GENERAL

PSYCHOLOGY

Garrett
PRESENTED TO
COUNSELING AND GUIDANCE CENTER
IN MEMORY OF
Justin E. Harlow, Jr.

BY HIS FAMILY

UNIVERSITY
OF FLORIDA
LIBRARIES

COLLEGE LIBRARY
American Psychology Series

Psychology       HENRY E. GARRETT
Psychology in Use, Second Edition  J. STANLEY GRAY AND OTHERS
The Organism     KURT GOLDSTEIN
A Laboratory Manual for Social Psychology  WILBERT S. RAY
Social Psychology, An Interdisciplinary Approach  HUBERT BONNER
Dynamic and Abnormal Psychology  W. S. TAYLOR
General Psychology  HENRY E. GARRETT
general psychology

HENRY E. GARRETT
Columbia University

AMERICAN BOOK COMPANY  New York
General Psychology is intended primarily for the student who is taking the first course in psychology as part of a liberal education. At the same time, the book will provide an adequate introduction for those who plan to do advanced work in this field.

The history of the introductory course in psychology parallels closely that of introductory courses in biology and the natural sciences. Until quite recently, the first course in psychology was designed chiefly to prepare students for advanced work in the subject, although this objective was not always clearly defined nor rigidly followed. Professional preparation was the goal of the first course in the other sciences also: chemistry, for example, was taught as though all beginning students were planning to become chemists, rather than as part of a comprehensive training program in science.

While there is by no means unanimity among teachers as to what should go into the first course, there are some areas, at least, about which there is agreement. Most psychologists would agree that the introductory course should survey the field; that it should emphasize "live" topics; that it should be selective, that is, need not
cover every subject which at some time was important in the development of psychology; that it should not be built around the instructor's hobby; and that it should not be a sermon (at least not all the time!). Many experienced teachers believe also that the first course should give the student a new vocabulary, greater precision in description, and a better understanding of the important as distinguished from the marginally valuable issues.

If we accept the idea that the beginning course should be a survey of psychology, we must, I think, take an eclectic rather than a systematic approach. I suspect that the systematist, who wants to fit every topic into a snug theoretical frame, ends by satisfying his urge for rigor rather than his students' need for understanding. In a biologically oriented course, we cannot safely ignore the role of the nervous system in mental life. At the same time, we must not overdo anatomy and sensory physiology, lest the student never get beyond the structure to the behaving organism.

It seems to me that an elementary text—or any text for that matter—should represent an author's mature organization and interpretation of available knowledge rather than being simply a heavily annotated collection of excerpts from the literature. In keeping with this view, I have omitted lists of names and detailed references. Brief footnotes (names and dates) are primarily for the instructor. Following each chapter are suggestions for reading which should lie well within the comprehension level of the beginning student. Undergraduates are not prepared to read technical papers, and copious references break the continuity of a text without contributing to understanding.

Many of my colleagues have greatly aided with suggestions and criticisms. To all of these I owe my thanks. I am especially indebted to Professors Clarence H. Graham, Conrad G. Mueller, Carney Landis, Joseph Zubin, and Robert J. Williams.

The diagrams in this book were prepared by Graphic Presentation Services, Inc. Credits for pictures at chapter openings are as follows: page 38, The Ape and the Child, W. N. Kellogg; pages 76, 200, 244, and 285, Courtesy Standard Oil (N.J.); page 110, Courtesy General Electric; page 155, Metropolitan Museum of Art; pages 342 and 601, Toy Manufacturers of the U.S.A.; page 380, Wide World; page 414, Life Magazine; page 449, Black Star; page 499, Courtesy Purdue University; page 543, Foldes from Monk-meyer.

Henry E. Garrett
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What Psychology is about</td>
<td>1</td>
</tr>
<tr>
<td>2. Heredity and Environment</td>
<td>38</td>
</tr>
<tr>
<td>3. Growth and Maturation</td>
<td>76</td>
</tr>
<tr>
<td>4. The Physiological Bases of Behavior</td>
<td>110</td>
</tr>
<tr>
<td>5. Perception and Attention</td>
<td>155</td>
</tr>
<tr>
<td>6. Feelings and Emotions</td>
<td>200</td>
</tr>
<tr>
<td>7. Motivation and Adjustment</td>
<td>244</td>
</tr>
<tr>
<td>8. Learning: Principles and Methods</td>
<td>285</td>
</tr>
<tr>
<td>9. Learning and Studying Effectively</td>
<td>342</td>
</tr>
<tr>
<td>10. Remembering and Forgetting</td>
<td>380</td>
</tr>
<tr>
<td>11. Thinking and Reasoning</td>
<td>414</td>
</tr>
<tr>
<td>12. Intelligence</td>
<td>449</td>
</tr>
<tr>
<td>13. Individual Differences and Aptitudes</td>
<td>499</td>
</tr>
<tr>
<td>14. Personality</td>
<td>543</td>
</tr>
<tr>
<td>15. Applications of Psychology</td>
<td>601</td>
</tr>
<tr>
<td>Glossary</td>
<td>643</td>
</tr>
<tr>
<td>Name Index</td>
<td>655</td>
</tr>
<tr>
<td>Subject Index</td>
<td>657</td>
</tr>
</tbody>
</table>
The psychologist is interested in behavior in a wide variety of situations. He may be concerned with the youthful offender or the child in his normal development.

The vocational counselor needs to know the skills required for various occupations.

Even the study of our perception of speed and distance may become a field of inquiry.
THE BEGINNING STUDENT CAN BEST DISCOVER WHAT PSYCHOLOGY is about by finding out what psychologists are interested in, what they have done, and what they are doing. The student need examine only a few books to realize that psychologists have studied, often quite extensively, many aspects of behavior. Some psychologists are interested in theoretical problems of learning, as well as in such practical questions as how a child learns to read, why one forgets what he was taught in school, and what the best ways are of acquiring skills, learning a new language, and breaking bad habits. Other psychologists are concerned with somewhat different problems. The specialist in perception wants to know how we judge such things as the distance of a mountain, the speed of a moving object, and the depth of a ditch. The applied psychologist seeks to discover to what extent people differ in intelligence, aptitude, and personality. The clinical psychologist investigates the life history and the abilities of a child so that he may
improve the youngster's emotional and social adjustment. The social psychologist attempts to uncover the antecedents of delinquency, to discover why crowds become mobs, and why nations go to war. In summary, psychology is the study of human behavior, and its subject matter is what people do and how and why they do it.

A DEFINITION OF PSYCHOLOGY

The word psychology, which is derived from two Greek words, means the science of the psyche, or soul. The science of the soul may seem to be a far cry from psychology thought of as the study of behavior. But if we take soul out of its religious context and translate it to mean "mind" or "self," then the study of the soul or mind and the study of the behavior of the individual are not so far apart as might appear at first glance.

PSYCHOLOGY AS THE STUDY OF THE "MIND"

If the reader should ask the first half dozen people whom he meets to define psychology, the chances are that most of them would answer that psychology is the study of the "mind," or is concerned primarily with "mental" activities. The accuracy of this definition hinges upon the meaning attached to the terms mind and mental activity. Perhaps the most widely held "commonsense" view regards mind as concerned primarily with intellectual functions (mind is what we "think with") and as being located (though this is somewhat vague) in the brain. To many—perhaps to most—people, therefore, perceiving, learning, remembering, imagining, reasoning, and the like are essentially "mental," while washing dishes, boxing, driving a nail, and operating a bus are "physical." Mental arithmetic is often thought of as being somehow different from ordinary arithmetic because in the one case the work is done "in your head," whereas in the other the figuring and calculation are done on paper. The first activity is considered mental because it is private and inside, the second as physical because it is observable and outside.
But this is really an artificial and arbitrary distinction. Mental arithmetic often involves counting on the fingers, talking to oneself, chewing a pencil, frowning, and the like. Hence it draws upon as many muscles—is as physical—as paper-and-pencil arithmetic, which is, of course, also mental. Learning to play a musical instrument, to kick a football, to saw along a straight line, or to control one’s temper—all these are mental as well as physical. We think with our fingers and hands as well as with our brains, and we learn with our muscles as well as with our nervous systems. Some activities, to be sure, involve more muscles (are more “physical”) than others, but all behavior is dependent upon an active brain and nervous system, and there is no point at which the physical leaves off and the mental takes over. In short, whenever a person is reacting to or interacting with people and things in the world around him, his behavior falls within the province of psychology, whether it be described as “mental” or “physical.”
If we call psychology the *science* of human behavior, we are obliged almost immediately to defend our use of the term *science*. The natural sciences—physics, chemistry, and biology—have been building for a long time, have many achievements to their credit, and have acquired great prestige in modern society. The word *science*, therefore, is one to conjure with, and as a consequence *science* and *scientific* have often been misused and frequently abused, especially in the realm of human and social relations. It has been said that “patriotism is the last refuge of the scoundrel.” For the same reason, but with a reversal in time relations, the psychological quack or charlatan is quick to describe his cure-all as “scientific.” “Scientific tests” are continually being cited in the newspapers and on the radio to “prove” almost anything for which the advertiser is able to pay, and the weaker the case, the more fervently the term *science* is invoked.

What, then, is science; and is psychology scientific? Science is a body of knowledge held together and made meaningful through common principles and laws. Science is not simply a collection of facts but is knowledge gathered and organized through the application of what is called *scientific method*. The mail-order catalogue contains hundreds of facts organized under various headings, but no one considers such “knowledge” to be science. The procedures of science as applied to psychology will be described later, on pages 7–30. Suffice it for the present to say that scientific knowledge is obtained largely but not entirely through experiment; that scientific observations are reproducible, repeatable, and verifiable; that such data can be fitted into larger and more inclusive generalizations called *laws*, and that such laws (in the form of mathematical equations) can be used in making predictions of future events.

To take an example from physics, the *law of falling bodies* is a principle or generalization which states that under specified conditions rocks, people, airplanes will behave in the same
way (namely, fall to the ground), and that this will occur in the United States, Patagonia, or Siam. Psychology, dealing as it does with complex and highly variable phenomena (that is, behavior), has not as yet formulated such precise principles as the law of falling bodies, the laws of motion, or the laws of electrical resistance. Although not an exact science in the sense that physics is, psychology has developed valid generalizations concerning behavior which either (1) approach the status of general principles or (2) seem likely to do so in the future. In the first class are the Weber-Fechner Law (page 182) and the laws of color mixture (page 117). In the second is the principle of reinforcement or the law of effect. The law of effect is hardly on a par with the law of falling bodies. But it is a valid principle, nonetheless, which states that the consequences of what a person does in learning to speak French, to operate a machine, or to acquire correct social manners makes a vast difference in his subsequent behavior (page 294), and that the change can often be measured.

POPULAR PSYCHOLOGY AND SCIENTIFIC PSYCHOLOGY

The difference between scientific psychology and popular, or commonsense, psychology is the difference between knowledge gained through the scientific method and "knowledge" based upon uncontrolled experiences, hunches, intuition, shrewd guesses, and superstitious beliefs. Popular psychology believes that the shape of a man's head gives evidence of his intelligence; that blondes are fickle, redheads temperamental, and shifty-eyed people untrustworthy; that bright children die young and are likely to be "odd"; that palmistry and astrology are authentic sciences. None of these doctrines has a basis in scientific fact, of course, though many of them are accepted by otherwise intelligent people.

Common-sense psychology confuses the scientific knowledge of behavior with the art of controlling people. All of us are acquainted with stratagems for influencing and controlling
behavior. The mother distracts the attention of her four-year-old from a bump on his knee by offering him a lollipop; the salesman flatters his elderly customer into the purchase of a resplendent tie by stressing its contribution to a youthful appearance; and the football coach spurs his charges to greater effort by reminding them in tearful tones of their duty to Alma Mater. Hitler, the great German dictator, was a master “psychologist” in the popular sense of the word, because he was an effective rabble-rouser; and the boxer is a clever “psychologist” if he wins his bout by tricking or confusing his opponent. In each of these illustrations, to be sure, someone is attempting to change the behavior of others—and often succeeding. But the person who controls or manipulates other people successfully is not necessarily a psychologist any more than the prosperous farmer is necessarily a botanist, the good mechanic a physicist, or the animal trainer a zoologist. The achievement of practical results requires keen observation and long experience in dealing with people under a variety of circum-

![Figure 2: Adolph Hitler represented an extreme example of controlling behavior through an appeal to the emotions of his audience.](image)
stances. Science often begins with common-sense observations, hunches, and everyday methods for achieving results. But until these techniques are studied under carefully controlled conditions, the exact nature of the principles which may be formulated from them and the range of their application must remain uncertain. Knowledge of facts alone, without knowledge of the principles which operate in organizing these facts or of the methods of discovering principles, does not make one a scientist. And knowledge of how to influence other people, gained through long experience or clever insights, does not make one a psychologist.

**scientific method in psychology**

The scientific investigator differs from the casual student or the dilettante in (a) expert knowledge and in (b) attitude and training. First of all, the scientist knows his subject and is acquainted with the “tools of the trade”—precision instruments,
laboratory apparatus, various psychological tests, statistical and mathematical techniques. (See Figure 3, on page 7.) In addition, the scientific worker is trained to be impersonal and objective. He does not discard observations or select his data arbitrarily; he reports his findings in such form that they can be checked, verified, and repeated; he does not warp or slant his conclusions to fit a pet theory or his own preconceptions. In short, the trained scientist allows the data and only the data to determine the final conclusions. Psychology deserves to be called scientific so long as psychologists follow the methods of science. By far the most rigorous of these is the experimental method.

THE EXPERIMENTAL METHOD

An experiment has been aptly described as a “question put to nature.” Such questions, however, are by no means casual and off-hand; they grow out of a background of established facts. Specifically, an experiment is set up to confirm or refute some hypothesis. An hypothesis is the investigator’s hunch or shrewd guess that some observed or apparent relationship between events or happenings holds generally, or that some proposition or belief is true or is not true (page 10). Hypotheses have a rational basis, or they emerge from a larger framework of theory or from preliminary experimentation. Illustrations of psychological hypotheses—set up as propositions—are the following: Incentives have a measurable effect upon learning. The average automobile driver will react more quickly to light than to sound signals. Boys are better than girls in arithmetic. Good students possess more “introverted” personalities than poor students. What we “see” depends more upon past experience than upon present sensory impression.

In a typical experiment, there are at least two groups, an experimental group and a control group. The function of the control group is to check the effects of some experimental factor (EF) which is applied only to the experimental group. The control group is as nearly like the experimental group as
possible, ideally differing only in being exposed to the EF. A single group may serve as both experimental and control group, provided the experimental factor does not induce changes which carry over and influence the control performance. This usually happens when the EF produces physiological changes which rapidly die out—for example, changes in pulse or breathing. When the EF involves practice or learning methods or attitude changes, two groups are usually needed. This may not be necessary, however, if the practice effects are temporary, as they may be when long periods intervene between trials, or if the experiment is so designed that practice is a constant factor (one that does not change) spread over the experiment. An experimental factor is called an independent variable, meaning that it is under the control of the experimenter and hence can be withheld or applied in different strengths. Dependent variables in an experiment are the scores or other measures of performance or attitude which are affected (raised or lowered) by the EF.

The student will get perhaps the clearest notion of experimental method and of the meaning of independent and dependent variables by examining the psychological experiments described below.

(1) does smoking lower mental and physical efficiency?
Claims have often been made concerning the dire effects of nicotine upon mental, physical, and physiological efficiency. It has been found that students who smoke usually receive lower grades in college than non-smokers, and this difference in achievement has been attributed to the deleterious effects of tobacco. Contrariwise, it has been argued that smokers are more sociable and more easygoing than nonsmokers and that the personality traits of the smoker, not the effects of tobacco, lead to poor scholarship.

The nicotine contained in an ordinary cigar, if given hypodermically, would suffice to kill a man. But the nicotine in smoking tobacco is decomposed in burning, leaving pyridine—a substance which is only about one twentieth as powerful as nicotine. It is pyridine which affects the mucous membrane of the smoker’s throat,
nose, and lungs; and the problem, therefore, is to determine the
effects of pyridine (not nicotine) upon mental and physical func-
tions.

To test the hypothesis that smoking lowers mental and physical
efficiency, a careful study was made of the effects of pipe smoking.*
Nineteen college men, nine of them nonsmokers and ten habitual
smokers, took part in the experiment. Each man was measured in
certain physical functions (for example, heart rate and muscular
steadiness) and was given a battery of mental tests covering such
abilities as speed of adding numbers, of reading aloud, of simple
associative learning. Records taken under smoking and nonsmoking
conditions were compared in order to determine the actual effects
of tobacco.

A subject might expect tobacco to exert some effect and hence
be very suggestible; or he might want to prove that tobacco does or
does not affect his efficiency and so be influenced in his report by
this attitude. To offset such factors and to render the tobacco and
no-tobacco sessions as comparable as possible in other respects, the
following precautions were taken: (a) all subjects were blindfolded
throughout the experiment; (b) there were two similar pipes, one
with ordinary smoking tobacco, the other fitted with a capsule con-
taining an electric coil and packed with damp asbestos plaster
through which a small hole led into the stem of the pipe; the pad-
ding of the capsule offered the needed resistance, and the bite of the
tobacco was duplicated by added heat, giving a warm, slightly
moistened flow of air; (c) during all the experimental sessions
noises incidental to smoking—scratching of matches, knocking the
pipe, etc.—were made, and ashes and matches were on view
to be seen by the subject at the end of the experiment; (d)
the two pipes were placed in the subject’s mouth by the ex-
perimenter and were taken out by him, so that the subject did not
handle the pipes at any time; (e) during the no-tobacco sessions
the experimenter smoked a pipe, so that the odor of tobacco was
present; (f) the sessions (tobacco and no-tobacco) followed one
another in random order, to avoid any cues which might arise from
regularity of presentation. These experimental controls were so
successful that none of the subjects suspected that half the experi-

* Hull, 1924.
FIGURE 4
The effects of tobacco smoking. To prevent detection by the subject, the electric wire is wound around the arm of the experimenter.

mental sessions were “blanks.” For a period of eighteen days the blindfolded subjects smoked either the tobacco pipe or the electrically heated pipe in alternate sessions.

Comparison of the records taken in the tobacco and no-tobacco sessions showed remarkably little difference in the accomplishments under the two conditions. There was a small increase in heart rate and a decrease in steadiness (increase in hand tremor) on the tobacco days, and this was more marked in the nonsmokers than in the smokers. But the functions measured by the mental tests were not significantly affected by the tobacco.

In the present experiment, it should be noted that there was no separate control group; each subject served as his own control—smoked the tobacco pipe half the time and the no-tobacco pipe half the time. The two sessions were then compared, in order to determine changes in the dependent variables (that is, the test scores) which might indicate the effects of the tobacco.

This experiment was outlined primarily to illustrate experi-
mental methodology, and hence for our purposes the effects of tobacco are of secondary interest. It may be said, however, that the fact that tobacco had little influence upon the given tests over the eighteen-day period covered in this experiment reveals little concerning the effects of long-time smoking. Some medical authorities consider the net effect of tobacco smoking to be harmful. On the other hand, many highly competent people—scientists, writers, business executives—are convinced that their efficiency is increased by tobacco, that their thinking is speeded up and their imagination stimulated. Such opinions, of course, are important as determiners of behavior, but they can hardly be regarded as experimental evidence. Most people use tobacco because they enjoy smoking, find comfort and relaxation in tobacco, are miserable (and hence inefficient) when deprived of it. A comparison of mental and physical output over long periods (several years) during which in some cases one is smoking and in other cases not smoking would provide much better comparative data as to the long range effects of tobacco.

(2) which is better for retention—concentrated or spaced study?

Most teachers believe that study spaced over regular periods of time is more effective (that is, more conducive to retention) than is the same amount of study concentrated into one effort. The two experiments given below confirm this belief.

In the first study,* eighteen college students were given the task of learning lists of paired nonsense syllables† presented visually. There were nine pairs of syllables in each list and the subject was instructed to learn the pairs so that he could respond with the second member of a pair when the first appeared. Nonsense syllables were used so that the task would offer approximately the same difficulty to all the subjects. The criterion for learning was two per-

* Hovland, 1949.
† These are three- or four-letter combinations consisting of several consonants and one vowel and having little if any associative value: for example, JUK, VEB.
fect recitations of a given list. In one experiment, each syllable pair was shown for one second; in another experiment the presentation time was two seconds. Trials in the concentrated series followed each other without break. In spaced learning, the presentation times were the same as those above, but two minutes intervened between trials. Colors were shown which had to be named by the subjects during these intervals. This was done to prevent recitation and review of the syllables. The results, shown in Table 1, reveal that spaced learning was on the average superior to concentrated learning in both experiments. While small, the differences are statistically reliable.

1 **Trials required to learn lists of paired nonsense syllables**

<table>
<thead>
<tr>
<th></th>
<th>rate = 1 second</th>
<th>rate = 2 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONC.</td>
<td>SPACED</td>
</tr>
<tr>
<td>Average number of Trials</td>
<td>30.2</td>
<td>20.8</td>
</tr>
</tbody>
</table>

In this experiment, it should be noted, the method of study (concentrated or spaced) is the independent variable, and the two EF's serve as controls for each other. In order to equalize practice and familiarity with the material, all of the eighteen subjects were given preliminary practice in both methods before the main experiments. Moreover, the methods were alternated so that practice would be spread over the entire experiment.

In another experiment,* which is somewhat closer to the learning done in school, five highly trained persons read carefully through difficult technical prose (history, economics, science, mathematics) under two conditions. In the first instance the material was read through five times in the same day; in the second, it was read once daily for five consecutive days. Retention in terms of the percentage of total number of ideas recalled was measured after one month. As shown in Table 2, 11–22 per cent of the total was remembered when the

* Austin, 1921.
reading was concentrated (five times per day), and 31–42 per cent remembered when the reading was spaced over five days.

2 Retention of ideas after reading difficult prose

<table>
<thead>
<tr>
<th>learning method</th>
<th>tested for recall after</th>
<th>average recall (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 times in one day (concentrated)</td>
<td>1 month</td>
<td>11–22</td>
</tr>
<tr>
<td>Once daily for 5 days (spaced)</td>
<td>1 month</td>
<td>31–42</td>
</tr>
</tbody>
</table>

Observe that here again each method serves as a control or comparison for the other. The character of the material, the experience of the subjects, and the time which elapsed between experiments make it unlikely that practice effect favored either group. The degree to which concentrated learning is superior to spaced learning depends upon a number of factors, among the more important of which are the length and difficulty of the task, the efficiency of one's study habits, and the maturity of the learner. In general, spaced learning is less affected by fatigue, boredom, confusions among materials, and negative attitude resulting from the apparent size of the learning task.

(3) will encouragement and discouragement affect our judgments of comparative distances?

This experiment* undertook to compare the relative efficiency of judgment under five conditions: punishment, reward, punishment plus guessing, punishment plus information, and knowledge of results. The task was to measure off by eye a distance equal to twice a standard distance set off on the Galton bar (Figure 5), an instrument much used in studies of visual space perception. By means of a flexible rod, the subject was able to move out or bring in the black sleeve on the bar until he was satisfied that he had set off a distance twice that laid off by the experimenter. Contacts on the reverse side of the bar caused a bell to ring when the subject's setting was within

* Hamilton, 1929.
FIGURE 5 The Galton bar, used in the study of the perception of small distances.

(or greater than) a given range of error. Sixty undergraduate women were given preliminary practice in making settings on the bar. On the basis of these preliminary records six groups of ten each were formed, all groups being approximately equal in performance.

These six groups (five experimental and one control) worked under the following incentive conditions:

1. The control group received no incentive. Members of this group were instructed simply to set off distances equal to twice that of the standard.

2. Subjects in the punishment group were told that a bell would ring as “punishment” if their adjustment was in error. Members of this group tried to prevent the ringing of the bell by a correct setting and were noticeably disappointed when they failed.

3. Members of the reward group were told that a bell would ring as “reward” if their settings were correct. In this case the subjects wanted the bell to ring and were pleased when it did so.

4. The punishment-with-guessing group were given the same instructions as in (2), and in addition were told to guess the direction of error—whether the setting was too long or too short. They were not told when they guessed correctly.

5. The punishment-plus-information group received the same instructions as (2), but were told the direction of their error.

6. The knowledge-of-results subjects were told at once whether a setting was right or wrong.
Results of this experiment appear in Table 3. The error score of each group in the last five trials is expressed as a percentage of the error made in fifty preliminary practice trials on the first day. The smaller the per cent of error, the greater is the improvement.

3 Errors in judgment of distance with the Galton bar

<table>
<thead>
<tr>
<th>group</th>
<th>per cent of initial error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>127</td>
</tr>
<tr>
<td>2. Punishment</td>
<td>24</td>
</tr>
<tr>
<td>3. Reward</td>
<td>26</td>
</tr>
<tr>
<td>4. Punishment plus guessing</td>
<td>15</td>
</tr>
<tr>
<td>5. Punishment plus information</td>
<td>20</td>
</tr>
<tr>
<td>6. Knowledge of results</td>
<td>45</td>
</tr>
</tbody>
</table>

It is clear that the control group, working without incentive, slumped badly. Both punishment and reward were effective to about the same degree. But the difference between these two situations is quite small—a not unexpected result, since neither incentive was very strong. The incentives offered by guessing at the result and being told were best for error reduction, apparently because they set up an active attitude and kept up interest. Knowledge-of-results was better than control, but not as good as punishment-with-information.

This experiment shows how differences in attention, interest, attitude, and motivation can affect even a relatively simple and non-emotional task. The procedure is a good illustration of the methodology used in the isolation, control, and measurement of various degrees of motivation.

(4) do children who are frustrated or thwarted tend to exhibit “regressive” behavior?

This experiment* was designed to test the thesis that young children, when baffled or frustrated in what they want to do, revert to

* Barker, and others, 1943.
an earlier and less mature behavior level. Such “regressive” behavior is marked by inadequate and childish reactions, often by weeping, screaming, and temper tantrums, and may be observed in adults as well as in children. In the present study the free play

**FIGURE 6** *Frustrating situation which led to “regressive behavior.”* The child first plays in room A (right) without knowing about room B (below).

After playing with the more attractive toys in room B the child is returned to room A but can still see the toys in the other room.

All photos courtesy University of Iowa
of thirty preschool children (on the average four years old) was carefully observed and recorded before and after a frustrating experience, and regressive changes in the constructiveness and creativeness of their play were noted. A “score” for constructiveness of play was assigned each child on a scale of “play units” which varied from two to eight.

The experimental situation was as follows. Each child was first allowed to play in room A (foreground of Figure 6). The partition to room B (the farther room) was then removed and the child allowed to play for fifteen minutes with toys far more attractive than those in room A. These toys included a highly decorated doll house with furniture and rugs, a table set with dishes, forks and spoons, a truck, a trailer, a toy lake, and so on. After this “attractive play period” the child was brought back to room A. The toys in B were still in sight through the screen but were no longer accessible to the child. During both sessions (in room A and room B), each child was observed by two psychologists and his play activities recorded in detail and later scored on the scale of constructiveness. Before the frustrating situation, the play of the thirty children was scored at about five on the average. During the later period in room A (when the child could see the toys in room B but could not play with them) the constructiveness score dropped to about four—a small but significant change. Twenty-two of the thirty children were recorded as having regressed to a less constructive (more childish) level, three did not change, and five showed greater constructiveness.

Note again that the children served as their own controls; that the recorded character of their “free play” was the dependent variable; and that the frustrating experience was the independent variable—the EF.

Experiments carried out with young children in relatively “natural” surroundings can rarely be as rigidly controlled as are experiments performed in the psychological laboratory. Systematic observation, however, yields more reliable information than is obtained from the casual accounts (often limited and unchecked) of parents and teachers. The child psychologist knows what to look for, what to ignore, and how to record what he sees objectively.
The primary objective of the experimental method is to control all factors likely to affect the dependent variable except one, the EF. An experimenter carefully arranges conditions so that the experimental factor will have a chance to exert any power it may have. Failure to set up a control group is one of the most frequent causes of false conclusions. We cannot tell, for example, whether three additional hours of study a week will improve scholarship unless we can compare this procedure with instances in which no additional time has been so employed. Because a number of students who are elected to Phi Beta Kappa have studied mathematics and Latin, the claim is often made that it is the training effect of these subjects which "causes" high scholarship. But this conclusion is not valid unless we take account of the rigid selection of students who undertake "hard" subjects. Compared with non-PBK's, the PBK's may have been more intelligent to begin with. An intelligent student is not intelligent because he studies Latin, but he may study Latin because he is intelligent (page 374).

The effects of smoking (page 9) upon scholarship cannot be assessed properly unless smokers and nonsmokers have first been equated for such factors as age, intelligence, extracurricular activities, secondary-school records, smoking history, and the like, since any one of these factors may outweigh the effects of smoking. So many claims had been made for the value of vitamins in reducing or preventing colds that an experiment to test the proposition was set up as follows. One large group of students (the experimental) received every day during the winter session a pill containing vitamin concentrates. A second equally large group (the control) was given a harmless pill which contained no medication. The groups were matched for health history and number of colds reported during the winter months; and neither group knew which was receiving the vitamin therapy. At the end of the experiment, the incidence of colds in the two groups was about the same, indicating that in young, relatively healthy adults, at least,
vitamins are not markedly effective in reducing colds. Many of the glowing testimonials for patent medicines and various new therapies illustrate the failure to set up controls. If the patient is not very ill, he will usually get better after a few days anyway. But it is likely that he will attribute this happy outcome uncritically to the medicine rather than to the curative power of nature.

Often it is possible to evaluate the effects of a number of independent variables, singly and conjointly, within the same experiment. This greatly enhances the value of the results obtained. To illustrate, suppose that a laboratory scientist concludes that wheat A grows better than wheat B when the amount of sunshine received by A is the same as that received by B. To the practical farmer this result may have very limited value and may even seem highly artificial. He wants to know not only the effect of sunshine but the separate and joint effects of rainfall, fertilizer, and sunshine upon wheat production. Or, to take an illustration from psychology, an investigator may want to know the individual and joint effects upon performance of differences in the length and difficulty of the task, as well as of differences in motivation. In many experiments the control of all factors except those under study is well-nigh impossible. Furthermore, it is often more meaningful to evaluate the cumulative and separate effects of several factors as they normally operate than to study the effect of each singly. It is fortunate, therefore, that experimental designs are available in which hypotheses involving several independent variables can be tested at the same time.

Observational Methods

While observation is often preliminary to more exact procedures, sometimes it is the only method available to the child psychologist, the animal psychologist, and the anthropologist. In many instances with young children or with animals, it is not feasible to set up a controlled experiment which is not restrictive and artificial. Moreover, it is often desirable to ob-
serve the behavior of animals in a natural setting. The social activities of monkeys for example, their tendencies to imitate one another and to engage in free play have been carefully recorded. Observational studies have been made, too, of the order of dominance, or what has been called the "pecking order," in domestic fowls. If several hens are placed together within a small enclosure, considerable pecking of one hen by another will occur in attempts to get at the food first. Gradually a pecking order emerges. The dominant hen pecks all the rest, the second hen in the hierarchy pecks all those beneath her, and so on down to the last hen, who is pecked by all. It is interesting to note that while the dominant hen will not tolerate hen number two close by, she will permit the lowest ranking hen to search for food near her. A good deal of observation suggests that an order of dominance is found in most animal social groups. When the dominant male in a herd becomes too old to maintain his leadership, he is driven off or killed by a younger, more energetic animal.
For several reasons, anecdotes, or stories of the exceptional performances of animals or children, must usually be heavily discounted. Parents who report the bright sayings of their offspring and pet lovers who relate the remarkable achievement of their dogs or cats are in most cases biased observers. Anecdotes are faulty because of large memory errors, an understandable pride which leads to exaggeration, and failure to check the behavior by subsequent observations. There is a strong tendency, too, to remember positive and to forget negative instances. One remembers the cleverness of his dog in opening a door or gate and forgets the many times when the dog failed because the latch did not happen to be loose. A small sample of behavior unchecked by further observation is always suspect. Repetition of the behavior under a variety of controlled conditions is necessary before we can be sure that the performance was more than accidental.

Figure 8 shows an observation dome used in the Yale Clinic of Child Development. The child to be studied is placed in a crib in the center of the dome. The dome itself is covered by wire mesh, is painted white, and is illuminated from within by soft, well diffused lights. Since the laboratory in which the dome is situated is dark, the walls of the dome constitute a con-

*Courtesy Arnold Gesell, M.D.*

**Figure 8**
The Gesell observation dome, used in the study of children.
FIGURE 9 Another type of observation room. The one way vision glass enables the observers to remain invisible to the child they are studying. Two of the observers are seen reflected in the glass.

Convenient one-way vision screen. Hence the observers sitting in the room outside the dome can see the child clearly as he plays and reaches for and manipulates objects, but the child cannot see the observers.

Infants from several weeks to about five years of age have been observed over varying periods of time. Written and motion picture records are taken systematically to show the child's sequences of development with respect to erect posture, reaching, walking, manipulation of toys and blocks, and exploratory and adaptive behavior.

Many observational studies have been made of the social relations exhibited by children in nursery school and in free play situations. An experiment in the reaction of preschool children to frustration was described on page 16. The results of other experiments will be found on pages 91–97. In play situations one child often assumes leadership, and his counsel and approval are sought by other members of the group.
When extreme timidity or backwardness appear, the “causes” for such behavior can be sought and the situation oftentimes remedied.

Considerable training is necessary before an observer is qualified to capture and record significant behavior in an animal or human group. Careful and controlled observation is not always easy, since the experimenter must have a clear idea of what he is looking for and must know how to record his findings with brevity, precision, and the degree of completeness allowed by the hypothesis being tested. If there is some definite behavior for which he is seeking, a printed form or check list may be used to systematize observations. Trained observers avoid superficial accounts which leave out important facts or ignore misleading and confusing factors, and they watch out for personal preferences and biases. Greater reliability of observation is usually obtained by having two or more observers make independent notes of the behavior under study and later compare what they have found. Agreement of independent observations adds weight and conviction to the accuracy of the description.

**GENETIC METHODS**

What is called the *genetic* or *developmental* method is an observational technique employed over the period of growth. In this method, careful note is made of the child’s mental and physical growth, as well as of his relations to other children.

*FIGURE 10* The timid child may hold back from joining a group until a greater development of muscular control and balance gives him more self-confidence.
and adults—that is, of his social development. When the same children are observed over the age cycle from kindergarten, say, to college, and their behavior in a variety of tests and free situations recorded, the method is called *longitudinal*. Since such research must extend over a number of years and hence is very costly, a compromise method, called the *cross-sectional*, is often employed. Instead of following the same children over several years, in this method sample groups are selected to represent a cross-section of child behavior at each age level. Changes in development are then measured by comparing the typical performances of children from one age level to the next.

**FIGURE 11** Aggressiveness in childhood may result in the kind of leadership exemplified by Mussolini.

In a different culture, the leader is more likely to be a person like Eisenhower.
For several reasons, the longitudinal method of studying growth changes is preferred to the cross-sectional. For one thing, it is hard to get groups which are comparable from year to year. High school students, for instance, are more highly selected than are elementary school pupils, since the less able youngsters tend to drop out as the work becomes more difficult. Again, the social, economic and experiential background of groups of children of different ages often varies widely, a fact which makes comparisons of mental and physical traits a dubious undertaking.

The Harvard growth study* is a good illustration of the longitudinal method. In this study, a number of physical, psychological, and educational measurements were taken of some 3500 school children in three mass studies. Children were re-measured annually over a twelve-year period beginning with the first grade. Figure 12 shows the changes in intelligence test score with age for 522 children who were retested each year

* Dearborn and Rothney, 1941.
from age eight to fifteen. The result at each age is based upon
the average of two or more test scores. In all, nine different
intelligence tests were employed over the age range. It will be
noted that the curve rises rapidly—is almost a straight line—
from age nine to thirteen; and that after thirteen it begins to
fall off. This type of growth curve is characteristic of the
changes in mental ability with age which have been obtained
in cross-sectional studies (page 346).

DIFFERENTIAL AND TEST METHODS

In a number of studies, major interest centers upon differences
between individuals or among groups in various aptitudes
and personality traits. We may want to know, for example,
whether preschool boys are more aggressive than preschool
girls, whether children from poor homes score lower on group
intelligence tests than children from good homes, whether
Negroes excel whites in sense of rhythm. When independent
variables (or experimental factors) are introduced and their
effects noted along with individual or group differences, we
have a combination of experimental and differential methods.

The Hartshorne and May studies of deceit or cheating
among school children (1929) are illustrative of investigations
in which a combination of experimental and differential meth-
ods have been utilized. In a series of studies, elementary school
children were given a wide range of paper-and-pencil and
performance tests, in some of which cheating was possible (in
fact, almost invited), in others virtually impossible. The tests
were administered in (a) the school room, (b) the home, and
(c) on the playgrounds. In each case “cheating” scores were
compared with non-cheating scores—that is, willingness to
cheat was the EF, while enforced honesty was the control. In
addition, however, to the experimental feature of the study,
the effect upon cheating of socio-economic status (good versus
poor homes), intelligence score, school grades, age, and other
variables was studied by comparing groups selected to pro-
vide a contrast.
Although our interest here is in methodology, several suggestive results may be quoted. The more intelligent children cheated less than the normal and low grade; children of good socio-economic status cheated less than children of poor socio-economic status. Sunday school attendance and religious instruction had little effect upon honesty if the socio-economic level was low. The morale of the classroom was of considerable importance. Under some teachers nearly all of the children cheated; under other teachers scarcely any children cheated.

Many correlational studies should be classified under the head of differential methods. Correlation is a mathematical device (page 514) for measuring the relationship among variables. In psychology these are most often physical and mental tests as against measures of social behavior, likes and dislikes, attitudes, interests. Studies of the correlations among the results of tests of various abilities tell us how physical and mental traits are related and how they are organized within the individual. Batteries of tests have been used to aid in the selection of factory workers; students in law, medicine, and engineering; and candidates for training programs in the armed forces (see Chapter 13).

**THE CASE HISTORY OR CLINICAL METHOD**

The case history or clinical method ordinarily is used for a single person, and its aim usually is diagnosis and treatment. For example, Ambrose L. is referred to a psychologist as a behavior problem. The mother reports that Ambrose is unruly, rude, and belligerent, is defiant of punishment or threats, and has several times run away from home. Or, perhaps a young veteran seeks advice from a vocational counselor as to the occupation he should follow, or he wants to know the kind of work for which he is best fitted, so that he may undertake special training. The case history, in such instances, usually begins with an interview in which relevant biographical data are obtained. When such information is supplemented by aptitude, intelligence, and personality tests, the counselor is better able
to evaluate the subject’s assets, to understand the reasons for his behavior in the light of his past performances, and hence to offer advice or treatment.

While the case history is concerned primarily with a single person, it is necessary for the counselor to have data on other people (that is, norms, as discussed on page 537) in terms of which he can assess the performances of the examinee. Is the client above the average for his age in intelligence? What are his dominant interests? What aptitudes does he possess? Does his work history reveal a persistent record of failure? In order to answer such questions, the adviser must know a great deal about the examinee; and he must know a great deal about other people in order properly to judge and evaluate the aptitudes.

**FIGURE 13** The speed and accuracy which the child displays in putting together a puzzle picture is an important index to his intelligence.
and achievements of the examinee. Experience and training are necessary before the psychologist or counselor knows what to look for, what to discard as irrelevant, and how to interpret what he finds. The clinical method has contributed chiefly, perhaps, to our knowledge of personality traits and to a better understanding of motivation.

aims and purposes of psychology

UNDERSTANDING

The first aim of scientific psychology is the establishment of facts and principles through which behavior can be better understood. Knowledge of behavior as determined from observation and experiment will enable us better to evaluate ourselves. Furthermore, the art of controlling others is put upon a firm foundation once we understand the basic principles underlying the observed activity.

Black Star

FIGURE 14 Jealous behavior often grows out of a feeling of inadequacy.
As we shall see in Chapter 7, an important application of psychology to a better understanding of oneself is found in the distinction between real and apparent motives. Jealousy, for example, is often a reflection of basic insecurity growing out of distrust of one’s capabilities. It is futile to label unpleasant behavior as “jealous” and think we have explained it. Often the person of whom one is jealous is considered to be superior to oneself in some way—better looking, more intelligent, socially more presentable. To deal adequately with jealous behavior, the underlying causes must be sought. Again, negativism (saying no to almost every suggestion) in children often arises from the growing child’s rebellion against real or imagined restraints on the part of parents or school. Punishment for behavior arising from such feelings will serve only to intensify the resentment, not to remove the cause. The adolescent who is neither child nor quite adult violently resents treatment which a few years before he would have accepted as entirely appropriate. Extreme stubbornness or arrogance may grow out of fear of loss of self-respect, hurt pride, or a feeling that one is being dominated by others or is being treated as a person of little worth. A knowledge of one’s abilities, dominant personality traits, and aptitudes for such things as mechanics, art, or music will make the planning of one’s life far more intelligent than it would otherwise be (page 277). If we may paraphrase quotations from Socrates and the Scriptures, to “know thyself” may not make us free, but it will give us better insight into our own motives and into the motives of other people.

An understanding of the principles of psychology is valuable as the basis for a keener appreciation of social and national problems. Many religious cults and strange movements dedicated to ill-defined purposes can be understood best as a means of satisfying basic needs which are otherwise thwarted or restricted. The childish and often irresponsible behavior of the staid middle-aged businessman who once a year attends a reunion may be in part, at least, a protest against the regularity
and unexciting routine of his daily life. Participation in a "crusade" sometimes supplies an emotional outlet for the lonely, the disappointed, the unhappy, and those who have developed few resources within themselves.

PREDICTION AND CONTROL OF BEHAVIOR

Understanding leads logically to better prediction and control of behavior. Psychologists have sometimes attempted to arrange behavior into levels of predictability, ranging from the simple reflex, which has high likelihood (page 151), to complex social behavior, which is affected by many factors and is often difficult, if not impossible, to predict. Successful prediction must be based upon a thorough knowledge of the stimuli which provoke the behavior. In a relatively simple situation we can control the antecedent causes to a far greater degree than in complex situations; and the resulting prediction is the more certain and more precise because of this control.

As an example of good prediction, we may consider a "reaction time" experiment. The subject is instructed to hold down two telegraph keys which he must release on signal—the first to the sound of a buzzer, the second to a flash of light. Under such rigid conditions, behavior is highly predictable, though even here the subject will occasionally react prematurely (before the signal) or may give a delayed reaction (because his attention is momentarily distracted).

An illustration of the clever manipulation of complex social behavior is offered by the salesman who uses the "yes" technique. A busy housewife on answering the doorbell is faced by a salesman who inquires whether she would like to purchase a set of books useful in aiding her children prepare their homework. If the prospective customer, somewhat irritated by the interruption, answers no emphatically, it is very likely that the sale is lost. In any event, the salesman is at a distinct disadvantage, since he must overcome a strongly negative attitude in order to make the sale. If, however, the salesman had first inquired whether the housewife has children in school, whether
their preparation of homework is not often a chore, and whether the housewife would not welcome help, the answer is likely to be yes to all three questions. (The salesman, of course, will have acquainted himself with the number of children and their ages.) Having established a train of yesses, or attitude of acquiescence, the salesman should then find it easier to present the case for his books. The appeal to self-interest, relief from unpleasant duty, and mild gratification at the salesman’s solicitude may provide sufficient impetus to close the sale. The salesman’s technique has been based upon a sound understanding of behavior, whether or not he is able to formulate his procedure with the precision required of a scientific hypothesis.

For many reasons, the prediction and control of group and of national behavior are exceedingly difficult. Often we do not know what motives are impelling the members of the group. Again, assuming that we can be reasonably sure of the major

*FIGURE 15* A good salesman develops techniques of approach which bring affirmative replies.
motives, it may be impossible to arrange conditions so as to control present motives or to invoke others. In general, self-interest, desire for prestige or for security, and strong emotional needs (for affection, appreciation, and the like) are dependable social motives, upon which the social psychologist can rely (page 251). Unfortunately, in the case of much complex behavior, prediction and control are beyond our grasp, as psychology is a long way from knowing all the principles of behavior. But of one thing we can be sure. There are no short cuts to an understanding of human nature—no tricks or procedures by which we can get a valid assessment of personality or character by rule-of-thumb methods, by consulting dream books or soothsayers. Progress in understanding as well as in predicting and controlling behavior will come—as it always has come—not through divination or intuition, but through careful researches in which the methods of science are employed.

what psychologists do

Few college students are so naive as to believe that psychologists can "read your mind" or forecast the future by means of a crystal ball, but many have little knowledge of just what the psychologist who is not a teacher actually does. Since World War II, increasingly large numbers of psychologists have been active in applying psychological techniques in business and other fields. A survey of the membership (more than 10,000) of the American Psychological Association in 1948 showed that about 50 per cent of psychologists are primarily teachers and research workers in colleges and universities. The next largest group (25–30 per cent) are clinical psychologists. These men and women work in mental hospitals, prisons, courts (especially with children and delinquents), behavior clinics, and social service agencies. Clinical psychologists take case histories, apply mental and personality tests, and make diagnoses
of mental deficiency and emotional maladjustment if these conditions are indicated. In conjunction with the psychiatrist (a physician who specializes in mental diseases) and the social worker, the clinical psychologist recommends treatment and aids in psychotherapy.

A third large group of psychologists are engaged in educational and vocational guidance, often including, as part of their work, advising on problems of social and personal adjustment. Still another active and rapidly increasing group are interested in applying to business and industry such psychological techniques as interviewing, screening and selecting personnel, incentive plans, and training programs (Chapter 15). As a result of the widespread use of psychologists by the armed forces and government agencies, it seems likely that many more will engage in applied work in the future.

**Summary**

The word *psychology* means the science of the soul, but modern psychology is better described as the scientific study of human behavior: of what men do and why they do it. For a science of behavior, the distinction between mental and physical is an artificial one, a difference of degree rather than of kind. Whether the activity is inner (mental) or outer (physical), the whole organism—muscles and glands—is engaged to a greater or lesser degree.

The distinction between scientific and popular psychology is the difference between knowledge gained through careful and precise method, and "knowledge" based upon hunches, intuitions, and superstitious beliefs. Popular psychology confuses the scientific study of behavior with the art of controlling people. Many individuals are quite skillful in applying stratagems of control, but such people are not necessarily psychologists. They may have no understanding of the principles (if any) upon which they operate, depending entirely upon tricks and clever insights.

The scientific psychologist possesses a high degree of training in the subject, as well as an intimate acquaintance with the tools
of the trade, both laboratory and statistical. The most valid scientific procedure is the experimental method. In a carefully designed experiment, the effects of several factors upon behavior may be measured. Experimental factors constitute the independent variables, and are under the control of the experimenter. Observed and measured changes in behavior are the dependent variables. In a good experiment, the effects of each experimental factor are checked against the effects obtained in a group wherein the experimental factor is absent. The latter is called the control group. Other scientific techniques are the observational, genetic, differential and case history, all of which require a planned attack, controlled observation, and careful recording of events.

The aims of psychology are (1) to understand behavior with a view toward (2) prediction and control. Both these goals are the more readily achieved when we deal with simple rather than complex behavior. A beginning, however, has been made toward the control of even complex behavior.

At present, the majority of trained psychologists are engaged in teaching and research. At least 25–30 per cent, however, are working full time as clinical psychologists in mental hospitals, institutions for the feeble-minded, orphanages, schools, and courts. Increasingly, psychologists are being sought by business and industry.

questions and topics for discussion

1. A critic (and perhaps a humorist also) is responsible for the following: “First psychology lost its soul, then its mind, then consciousness; it still has behavior—of a sort.” Do you agree?

2. It has been claimed that psychology can be reduced to chemistry and physics. Do you believe this true?

3. When can the judge, minister, the business executive, the teacher, and the physician rightly be called “psychologists”?

4. When you solve a problem “in your head,” where is the activity going on?
5. How would you design an experiment to determine whether attendance in kindergarten improves the work of the first grade?

6. Cite several incidents of false conclusions which resulted from failure to use controls.

7. Suppose you were to keep a detailed account of a child's physical, mental, and social growth from birth to age eighteen. How would your study be aided by cross-sectional data?

8. Cite several economic and social problems in which knowledge of psychology might be of aid in providing better understanding, prediction, and control of the observed behavior.

9. Cite cases from your own experience to show how the charlatan psychologist has misused the application of psychological principles.

suggested readings


2. L. R. Steiner’s *Where do people take their troubles?* (Boston: Houghton Mifflin Co., 1945) is an interesting account of how psychology is being exploited by the quack.

3. W. Dennis’ *Readings in general psychology* (New York: Prentice-Hall, 1949) is a good introduction to a variety of topics.

PROBABLY AT ONE TIME OR ANOTHER EVERY TEACHER HAS faced the unpleasant task of trying to instill a modicum of arithmetic or grammar into the head of a youngster who apparently refuses to learn. If asked to give a reason for the failure, the teacher may state flatly that the child is hopelessly stupid and incapable of learning anything difficult. Or she may answer that he is bright enough but too lazy or uninterested or too poorly trained in applying himself. The first of these explanations emphasizes native equipment—or the lack of it—as the cause of failure; the second puts the burden upon poor parental or public school training or both, lack of incentives, and the like. Neither explanation, to be sure, excludes the other, for the child may be bright and lazy, or dull and persevering. But the distinction between native capacity, on the one hand, and the development of one’s inborn abilities, on the other, serves to define concretely what is meant by heredity and environment.
The relative influence of heredity and environment, or what have been called *nature* and *nurture*, in determining achievement is an old and much-discussed question. Is what we inherit the major factor in deciding whether we achieve rags or riches, or is opportunity the reason why some succeed and others fail? Was Thomas A. Edison an inventive genius because of the inheritance of high intellect and special talent, or was it hard work and late hours which made him an "electrical wizard"? One thing is certain: the gifted individual is not the

*Figur 16 Both heredity and environment enter into behavior in a family situation.*
best person to answer this question. Edison is said to have remarked that “genius is a matter of perspiration and not inspiration,” and other men of high achievement have echoed this sentiment. We must heavily discount these “expert” judgments. The able man’s desire not to appear boastful leads him to attribute his success to hard work rather than to superior ability. Such an explanation is all the more acceptable because in our society both modesty and burning the midnight oil are praiseworthy and highly esteemed virtues.

Opinion has veered from full confidence in the importance of heredity to insistence upon the greater potency of environment. The staunch hereditarian reminds us that men do not gather grapes from thorns nor figs from thistles. And the oft-heard expression that some friend or acquaintance is a “born” teacher, or lawyer, or baseball player reflects a belief in the dominance of inherited traits and structures. The ardent environmentalist, on the other hand, insists just as strongly that if
we begin early enough, a baby can be trained to become an acrobat or an architect, a poet or a financier. Not many, perhaps, are as extreme as this in their beliefs, but the view is widely held today that we can expect more of training than was formerly thought possible.

Fortunately, we need not champion either extreme of this time-worn controversy. Nothing is more certain than that heredity and environment are co-acting influences and that both are essential to achievement. The color of a child's hair and eyes, his physique, and his strength are primarily inherited, while his "mother tongue" for example, English or Spanish, clearly depends upon the country in which he was born and reared, and hence is environmentally determined. But even here the distinction is not clean-cut. Eye and hair color, height, weight, and strength are affected by climate, diet, and disease (the environment), and spoken language of any kind is impossible unless one possesses the inborn structures of the throat

**Figure 18** The culture patterns of different periods may also be reflected in the environment of a family group or the isolated family.
and vocal cords. In neither case, therefore, is nature or nurture exclusively responsible. Every young animal or human being is born with certain muscular and skeletal structures, as well as with a repertory of movements which are inherited from his forebears. But this native equipment would be of little value unless shaped and molded by learning and experience. If behavior were arranged on a scale of complexity, from the simplest reflex to the most abstract literary or scientific achievement, there would be no point at which heredity would leave off completely and environment would begin. In any given act, whether it consists of spelling a word, throwing a baseball, or building a bridge, both native constitution and environmental influences enter.

To ask, therefore, whether heredity or environment is the more important to success is really meaningless—like asking, in fact, whether food or drink is the more important to life. But it is legitimate to inquire whether observed differences in behavior—as between John and Jim, say—depend upon differences in hereditary background to a greater extent than upon differences in environment. Unfortunately, we cannot answer this question as precisely as we would like. We cannot say, for instance, that self-confidence is 80 per cent environmental and artistic ability 90 per cent hereditary. Enough scientific knowledge has been accumulated, however, to make possible an "educated guess" as to the relative contributions of nature and nurture in a number of physical traits, mental abilities, and personality characteristics. Some of the evidence will be given in this chapter.

how heredity works

TWO GENERAL PRINCIPLES OF HEREDITY

It is a matter of common knowledge that cats have kittens, dogs have puppies, and human beings have babies; or, to state this fact in the form of a principle, that like begets like. More-
over, it is well known that children usually resemble their parents and relatives more closely than they resemble unrelated persons. A boy’s eye and hair coloring, for instance, may be that of his father or his father’s people, while in height and mental and emotional characteristics he may more nearly resemble his mother or her side of the family. In other words, a child is like both his parents but exactly like neither. He rarely duplicates the physique of his father or has the precise hair coloring of his mother. This brings us to a second principle: namely, that of variability in inheritance. Though all the members of a family group will resemble one another in some degree, they will also differ, sometimes considerably, from one another. Hence we must amend our first principle of heredity to read like begets almost (or nearly) like. Some of the reasons for consistency as well as for variability appear when we study the mechanism of inheritance.

**HE REDITY AND THE GERM CELLS**

The acorn carries within itself all the elements from which there will emerge later on a full-grown oak tree. In the same way every normal person (man or woman) carries within his germ cells* the hereditary determiners received from his par-

* The specialized reproductive function of the germ cells differentiates them from muscle, bone, skin, and other cells of the body.

**FIGURE 19** The son resembles both his father and his mother but is not exactly like either.

Courtesy Standard Oil (N.J.)
ents; these constitute his biological heredity. Since the parents have in turn received their determiners from their parents, a child is in reality the product of all of his ancestors—not merely his immediate forebears. A word should be said regarding the phrase “social heredity,” which is sometimes contrasted with biological heredity. This term refers to the cultural setting in which the individual grows and develops and is environmental, not biological.

The hereditary factors in the germ cell which shape the constitution and behavior of the developing individual are called genes. Genes are minute but definite particles located in what are called chromosomes. These latter are small bodies found within the nuclei of the germ cell. Chromosomes get their name (chroma = color and soma = body) from the fact that they can readily be stained or dyed and thus made visible. Chromosomes occur in pairs, the two members of each pair being similar in appearance. In general, the number of chromosomes in a cell is constant for a given species but varies widely

FIGURE 20 The reproductive cells divide many times in the normal manner (here represented only in the male cells) until finally a reduction division occurs in which the number of chromosomes is halved. Each cell then divides again, and in the case of the male cells, four sperm cells are formed. The division of the female cell, other than the nucleus, is unequal, so that only one functional egg results. After the sperm enters the egg, the number of chromosomes characteristic of the species is restored. Further cell division leads to the development of a new individual.
from one species to another. In each cell of a mouse, for example, there are thirty-six chromosomes; in the fruit fly, eight chromosomes; and in each human cell, forty-eight chromosomes, or twenty-four pairs. Chromosomes can be seen under the microscope, but genes are too small actually to be observed visually, although recent studies with the electron microscope indicate that we may be on the threshold of some quite revealing discoveries.

Recent work by geneticists has placed the number of genes in man as somewhere between 20,000 and 40,000. Figure 20 shows the position of the chromosomes in a germ cell just before cell division. The original fertilized germ cell divides into two, each of these again into two, and so on. In this way the organism grows and develops.

When the egg of the female parent is fertilized by a sperm cell from the male parent, the life of the new individual begins. Each person receives twenty-four chromosomes from the mother and twenty-four from the father, so that half his genes comes from one parent and half from the other. There is no way of predicting, however, which genes from any given pair of chromosomes will enter into the fertilized egg and thus become part of the inheritance of the new individual. In a general way we may say that one half our biological inheritance derives from each parent, one fourth from each grandparent, one eighth from each great-grandparent, and so on. (Figure 21.) But the almost infinite number of combinations and arrangements of genes causes even members of the same family to differ in hereditary constitution, so that in a real sense each person is unique. Brothers and sisters, for instance, will not have exactly the same hair color, eye color, features, or physique, though they will probably resemble one another more than they will persons not related to them. There are still further possibilities for variations in heredity within the same family.

Geneticists have discovered that a recessive trait may remain latent and fail to appear when suppressed by a dominant
trait. A good illustration is eye color. The genes for brown eyes are dominant over those for blue eyes (recessive), so that dark-eyed parents will probably have only dark-eyed offspring. If, however, both dark-eyed parents carry one recessive blue-eye gene, these two blue-eye genes may escape the dominance of the brown-eye genes and unite to give the offspring blue eyes.* Again, genes may be sex-linked and move together,

* See further, Scheinfeld, 1950, pages 68 ff.
or unpredictable mutations or changes in gene combinations leading to new characteristics may appear suddenly.

THE INHERITANCE OF ACQUIRED CHARACTERISTICS

The belief is still held by some persons that accomplishments and skills acquired by parents may be transmitted directly to offspring. The evidence, however, completely discredits this notion. To be sure, heredity shapes the body structures directly, the vocal cords, the muscular system, visual apparatus, the glandular makeup, and the nervous system. But biologists have been unable to unearth any mechanism whereby learned (that is, acquired) characteristics, skills, special knowledge, or effective social behaviors can be transmitted intact from parent to offspring. Heredity may influence a given skill or learned activity insofar as these depend upon body structures. Thus heredity can prevent the appearance of a function through failure to provide the necessary parts—that is, it may impose a limit upon the development of a skill. But biological heredity does not control the activity directly. The son of the highly skilled engineer is not born with a ready-made stock of mathematical formulas, though he may, to be sure, learn mathematics more quickly than the son of a less-gifted parent. Children of athletes, poets, musicians, or statesmen do not exhibit, without training, the highly complex skills of their parents. It is true that disease, alcoholism, malnutrition, and other noxious factors, if they harm the germ cells of either parent (this is unlikely), will affect the hereditary constitution of the offspring. But injuries to the body cells of the parent organism—muscles, bone structure, or sense organs—are not inherited. In one oft-quoted experiment it was found that cutting off the tails of successive generations of mice did not noticeably affect the length of tail in the species. And we all know that the offspring of a man who has lost a leg or an eye in an accident is not born with one leg or one eye. Someone has facetiously re-
marked that while we do not inherit an ancestor's wooden leg we may perchance inherit his "wooden head."

Another common misconception about inheritance is the widespread notion that the experiences and activities of an expectant mother may directly influence the personality and accomplishments of her unborn child. If the mother is badly frightened by a cross-eyed man, so the story goes, the baby may be born cross-eyed; if she reads scholarly books, the baby may be precocious; if she experiences an emotional shock, the baby may have a birthmark or some other blemish. These weird stories of prenatal influence have no foundation in fact. The hereditary constitution of a child is fixed at conception, not at birth. During prenatal life the mother is little more than a source of nourishment for her unborn child. (See Figure 22.) If she is ill, alcoholic, or fatigued through overwork, worry or emotional strain, the baby may suffer from malnutrition or indirectly from the effects of maternal infection. But these are general effects upon the organism, and there is no evidence that the specific experiences, thoughts, ideas, or nervous fears of the mother can influence directly the unborn child's personality traits and abilities.
The object of experimental studies carried on in this field has been to disentangle the effects of heredity from those of environment so that each may be separately assessed. In general, two variations of the experimental method are followed. In the first we attempt to hold the hereditary component constant, so that individual differences in behavior can be attributed to the environment. Conversely, we try to equalize the environmental factors, so that observed differences can be assigned to heredity. Controlled experiments of either sort are difficult to carry through, but a considerable restriction on one of the variable factors is often possible. We shall first consider the case in which heredity is controlled while environment is allowed to vary.

**HEREDITY CONSTANT: ENVIRONMENT VARIED**

(1) **the study of identical twins**

Studies in which heredity is a constant factor usually begin with twins. There are two sorts of twins, *identical* and *fraternal*. Identical twins develop from the *same* fertilized egg and have exactly the same set of hereditary genes. Identical twins resemble each other closely in appearance and are always of the same sex (see Figure 23, on page 50). Fraternal twins develop from *two* fertilized eggs, do not have the same allotment of genes, and are really just brothers or sisters born at the same time. Unlike IDENTICALS, fraternals are not necessarily of the same sex. Siblings are ordinary brothers and sisters who, of course, differ in age: they have a similar, but not the same, heredity. We thus have a gradation in kinship and common heredity from identical twins through fraternal twins and siblings to unrelated persons.

A comparison of identical twins reared *together* with IDENTICALS reared apart enables us to estimate the strength of the environmental factor in making for differences. Table 4 shows...
FIGURE 23 Identical twins. The pictures show the same pair of identical twins, photographed in childhood, early manhood, middle age, and old age.
Average differences between identical twins reared together and identical twins reared apart in height, weight, and IQ

<table>
<thead>
<tr>
<th>average difference</th>
<th>REARED TOGETHER ((n = 50))</th>
<th>REARED APART ((n = 19))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>.63 in.</td>
<td>.70 in.</td>
</tr>
<tr>
<td>Weight</td>
<td>4.0 lb.</td>
<td>9.0 lb.</td>
</tr>
<tr>
<td>Intelligence</td>
<td>5.4</td>
<td>8.2</td>
</tr>
</tbody>
</table>

(Stanford-Binet IQ)


the average differences in height, weight, and intelligence (IQ) between fifty pairs of identical twins reared together and nineteen pairs of identical twins reared apart. The figures in Table 4 are taken from one of the most careful and thorough twin studies, and considerable confidence can be placed in them, even though the number of children in each group is small. Note first that the fifty identical twins who were brought up together differ on the average by less than one inch in height, by four pounds in weight, and by about five points of IQ. The detailed tables of data from which our figures are taken show that twenty-four of these fifty twin pairs differed by less than five points of IQ, and that forty-two (84 per cent) differed by less than ten points. The error of measurement present in the determination of an IQ by the Stanford-Binet Test (see page 456) is approximately five points. This means that retests of the same child after short periods of time may show a shift of as much as five IQ points up or down—a shift due solely to inadequacies in the scale. Thus a child whose original IQ is 100, may, upon retest, measure 95 or 105—close to, but not exactly at his original measurement. Since our fifty twin pairs differ on the average by five points, if we allow for the known measurement error there is really no certainty that children of the same heredity and same environment (that is,
reared together) differ at all in intelligence. It is significant, too, that these twins differ negligibly in height and weight.

The nineteen pairs of identical twins reared apart show little if any greater difference in height but differ somewhat more in weight than do identicals reared together. The extra five pounds in average weight differences between co-twins is not large when one considers the often drastic effects of a rich diet (sweets, fats, etc.) upon the weights of children. The average difference in IQ of unrelated children paired at random is approximately fifteen points; and this amount may reasonably be thought of as the effect brought about by free action of both heredity and environment. In children of the same heredity reared apart, environmental differences produce an average change of only 8.2 IQ points (see Table 4). Hence, if we again correct for the measurement error of five points, the specific effect of environment upon IQ becomes roughly three IQ points (8.2-5). It appears, therefore, that only three points—a negligible amount—is the net IQ change which we can expect environment acting alone to produce in children of the same heredity.

**Figure 24** The two girls are mirror twins. One is right-handed, the other left; their hair whorls grow in opposite directions. The boys on the outside are also “one-egg” twins, but not mirror. Their physical features, abilities and interests are remarkably similar. The other two boys are twins but may not be identical. They show much greater differences in many respects.
It would be unwise to take these figures as anything more than rough numerical expressions of the *relative* contributions of nature and nurture to IQ differences. As noted above, our samples are small and the measurements are subject to considerable error. Moreover, the environment had operated for different lengths of time upon the nineteen twins who were reared apart. At the same time it should be said that this finding agrees quite well with the results of other investigations. Kelley (1926) and Burks (1928), for example, in careful statistical studies of large groups of school children, found native ability to be far more important than training in making for achievement differences in arithmetic, reading, science, and history.

It is of interest to examine the IQ discrepancies in those twin pairs for whom the environment is drastically different. A follow-up study has been made of the nineteen pairs of identical twins whose average difference in IQ of 8.2 is given in Table 4. These children were reared in different homes and were separated at ages of from one month to six years (on the average, at fifteen months). Of these nineteen sets of twins, five pairs differed considerably in formal education (from four to fifteen years). The better-educated twin of the pair showed an average superiority of sixteen points in IQ, whereas twins of the same or nearly the same education differed on the average by only three IQ points. The greatest difference in education occurred with two girls, one of whom was reared in a good home, was graduated from college, and became a teacher, while the other grew up in a backwoods region and received only two years of formal schooling. The IQ of the second girl was ninety-two, that of her better-educated twin, 116. This difference of twenty-four IQ points was the largest found. It seems clear that environment in the form of education certainly does improve performance on a test of intelligence, but that rather large educational differences are needed in order to produce *significant* differences in intelligence-test scores.
A recent study of adult identical twins* confirms this conclusion. Table 5 gives the average difference in vocabulary score achieved by adult identical twins of closely similar and of quite dissimilar education. The vocabulary test is regarded by psychologists as providing the best single measure of "abstract intelligence" (page 450). Two facts stand out in the table. First, adult identicals of the same education differ very little in absolute score on the vocabulary test. Second, differences in education have in general a negligible effect upon vocabulary. The largest difference in vocabulary score (seven points) appeared in the records of a pair of male identicals, one of whom had only one year of high school while the other had graduated from a first-class engineering school.

5 Average differences in vocabulary score of adult identical twins of the same and of different education

<table>
<thead>
<tr>
<th>Description</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 pairs of identical male twins (same</td>
<td>2.62</td>
</tr>
<tr>
<td>education)</td>
<td></td>
</tr>
<tr>
<td>8 pairs of identical male twins (different education)</td>
<td>1.88</td>
</tr>
<tr>
<td>33 pairs of identical female twins (same</td>
<td>2.10</td>
</tr>
<tr>
<td>education)</td>
<td></td>
</tr>
<tr>
<td>8 pairs of identical female twins (different education)</td>
<td>2.88</td>
</tr>
</tbody>
</table>

To summarize this section, experimental studies of identical twins have shown the action of environmental factors to be (1) slight and often negligible as far as appearance, physique, and other physical traits are concerned; (2) slight, on the average upon intelligence as revealed by tests, but considerable in individual cases. A good deal of evidence based upon interviews and visits to the home, indicates that environmental

* Feingold, 1950.
influences are greatest on personality characteristics and on social behavior. (See also page 66).

6 The resemblance of identical and fraternal older twins

<table>
<thead>
<tr>
<th></th>
<th>average intra-pair differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IDENTICALS (n = 46)</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>2.0</td>
</tr>
<tr>
<td>Kohs blocks</td>
<td>1.6</td>
</tr>
<tr>
<td>Memory for digits</td>
<td>1.2</td>
</tr>
<tr>
<td>Digit-symbol learning</td>
<td>4.4</td>
</tr>
<tr>
<td>Controlled association</td>
<td>2.5</td>
</tr>
<tr>
<td>Motor coordination</td>
<td>12.4</td>
</tr>
</tbody>
</table>

(2) a further comparison of identical and fraternal twins

Table 6 gives the intra-pair differences for forty-six identical and thirty-one fraternal twins in six tests. These twins, all female, ranged in age from sixty to eighty-seven years (Kallmann and Sander, 1949). Except in motor coordination, the fraternal twins differed twice as much, on the average, as did the identicals. Moreover, in this group the average difference in life-span for the identical twin pairs was three years, for the fraternal twin pairs six and one-half years—an indication of the dependence of longevity upon heredity.

(3) resemblance as a function of kinship

Heredity should be at a maximum as a source of likeness in the case of identical twins. It is of interest, therefore, to compare the resemblances shown by persons of lesser degrees of kinship—and hence of lesser degrees of common heredity—in physical, mental, and personal characteristics. Table 7 shows the correlations for a variety of traits of persons of different degrees of kinship.* Similarity is indicated by the size of the

* The data for this table have been assembled from various sources. See especially Wingfield (1928), McNemar (1933, 1942), Newman, and others (1937), Carter (1935).
correlation coefficient, a mathematical ratio which shows the
closeness of agreement between paired scores or other meas-
ures (page 514). Correlation coefficients vary from 1.00, which
denotes perfect relationship, to .00, which indicates no rela-
tionship. The correlation coefficients in Table 7 bear out what
was said in the last section. Identical twins are more closely
alike in intelligence, physique, and motor skills than are
fraternal twins or siblings. Identicals are not quite so similar in
personality traits* or in vocational interests but are still more
nearly alike than are less highly related groups. Cousins and
unrelated children show a negligible to zero relationship in
intelligence.

7 Correlation coefficients showing family resemblances in a
variety of traits

<table>
<thead>
<tr>
<th>kinship</th>
<th>intelligence</th>
<th>height</th>
<th>motor skills</th>
<th>personality traits</th>
<th>vocational interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identical twins</td>
<td>.90</td>
<td>.95</td>
<td>.80</td>
<td>.60</td>
<td>.50</td>
</tr>
<tr>
<td>Fraternal twins</td>
<td>.70</td>
<td>.60</td>
<td>.45</td>
<td>.50</td>
<td>.30</td>
</tr>
<tr>
<td>(both sexes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siblings</td>
<td>.55</td>
<td>.50</td>
<td></td>
<td>.50</td>
<td></td>
</tr>
<tr>
<td>Cousins</td>
<td>.25</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrelated children</td>
<td>.00</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ENVIRONMENT CONSTANT: HEREDITY VARIED

If environmental factors can be ruled out or held constant,
differences in behavior must be attributed to heredity. It is, of
course, by no means an easy matter to control or standardize
the environment in order to meet this experimental require-
ment. Environment as a general term covers all the outside
influences which affect the growing child. The socio-economic
status of the family and of the neighborhood, the school, the
recreations, the church, whether the community is rural or
urban—all these are important environmental factors. In addi-

* As found from ratings and questionnaires (page 567).
tion to these observable and material conditions, we must also consider the child's inner environment—his attitudes, beliefs, hopes, fears. These latter determine how much an individual child will be stimulated by his surroundings and to what things he will respond. For children living in the same town, attend-

**Figure 25** Inheritance of maze learning in rats. In running the maze nineteen times the brightest of 142 rats in the parental generation made seven errors; the dullest made 214. Interbreeding of the best and the poorest learners showed steadily separating learning curves in later generations. $F_3$ & $F_7$ are the third and seventh generations.

ing the same school, seeing the same movies, and playing the same games, the environment might seem to be a constant factor. Consider, however, the case of a brother and his twin sister, aged six, who are taken on an outing by their mother. The surroundings seem to be the same for the two children: the park is the same, the animals, the lake, the trees, and the people. But even at age six differences in interests, intelligence, and personality lead one child to "see" many things which the other ignores. The boy twin, for instance, plays and shouts noisily with his companions, counts the automobiles which pass, is absorbed in a low-flying airplane. The girl twin sits quietly with her mother on a park bench, takes care that her new shoes are not scuffed, and devotes herself to her doll and its carriage. To a large extent the child selects his own environment in the sense that he responds to those things which his age, sex, intelligence, and interests dictate. While environment may be objectively constant to the observer, therefore, it may be quite different to the persons who are exposed to it.

TWO EXPERIMENTS WITH ANIMALS IN WHICH HEREDITY IS SYSTEMATICALLY VARIED

As a consequence of the difficulties encountered in controlling complex environmental factors, psychologists have often resorted to the use of animals in studying the effects of environment. The physical surroundings of a rat, for example, can be controlled much more rigidly than can the environment of a man. In one experiment* with animals, the heredity of a group of rats was systematically varied over several generations, while the environment was held substantially constant throughout. Preliminary to the main experiment, 142 rats were given nineteen trials each in running a maze, and the total number of errors was recorded for each animal. The rats showed wide differences in maze-learning ability, the number of blind-alley entrances (errors) ranging from seven to 214.

* Tryon, 1940.
On the basis of these “scores” two groups of rats were selected, a group of the very brightest rats (those making the lowest error scores) and a group of the very dullest rats (those making the highest error scores). Bright rats were then mated with bright rats and dull rats with dull rats. This procedure was followed through twenty-two generations: in each successive generation the brightest rats were selected and interbred, and the dullest selected and interbred. Throughout the experiment, it must be remembered, the environment—living conditions, food, lighting, and temperature—was kept constant for all the rats. Figure 25 shows in graphical form the maze-learning scores for the original (unselected) group and for the third and seventh generations. After the seventh generation the effects of selective breeding were negligible, the two groups maintaining their separation in stable fashion but not increasing it.

At the conclusion of this experiment the bright and the dull rats were allowed to mate freely. The offspring of these bright-dull unions gave a performance curve (see Figure 26) much like that which appeared at the beginning of the experiment. There were very few bright and very few dull rats, most of them showing intermediate ability. It seems quite clear that the bright and the dull strains had blended into a single “average” strain.

This experiment demonstrates the tremendous role which hereditary factors can play in producing differences in the maze-learning of rats. By selective breeding one can apparently set up two groups of rats which—with respect to maze-learning at least—constitute practically new breeds. While we may well doubt that talent for maze-learning as such was inherited, it seems clear that such factors as physical vigor, energy, activity, and perhaps “intelligence”—all of which must contribute to maze-learning—were inherited.

A second experiment, dealing this time with the inheritance of emotionality in the white rat,* points to the same conclu-

---

* Hall, 1941.
sion as that found above for maze learning. When rats were placed in a brightly lighted enclosure, some were quite fearful and others, bold and aggressive. Two groups of rats, one group judged to be highly emotional, the other quite stable, could therefore be separated from the larger group. The criteria of emotionality, besides observed behavior, were frequency of urination and defecation—found to a marked degree in the timid and fearful rats. The emotional and the non-emotional rats were allowed to breed freely, each within its own group, but not to mate from one group to the other. In this way were

**FIGURE 26** Effect of mating bright and dull rats. When the bright rats (good learners) were bred to the dull ones (poor learners), their offspring spread over the scale. Most showed intermediate ability, with few very bright and few very dull. The curves are drawn on a normalized scale.

_ ibid., p. 115._
bred successive generations of fearful rats and successive generations of bold and aggressive rats. As shown in Figure 27, the timid rats continued with some variation to show fearfulness, while the bold animals became increasingly more aggressive. It is interesting to note that of the forty offspring of the emo-

![Figure 27](image-url)

**FIGURE 27** Inheritance of emotionality in rats. For twelve generations, the more emotional rats were interbred to produce an emotional strain, while the less emotional were also interbred. The increase in emotionality demonstrates the power of heredity.

...tional rats in the first mating, eighty-eight per cent were judged to be emotional, whereas of the thirty-five offspring of the stable rats, only 12 per cent were emotional according to the established criteria. It seems clear that emotional disposition is, at least in part, native, and is inherited in much the same way as physical structure.  

62 TWO heredity and environment
FURTHER STUDIES OF HEREDITY AND ENVIRONMENT

(1) family histories

Controlled experiments like those described on page 60 cannot, of course, be carried out with human beings. The nearest approach we have is through family histories. Such histories provide ready-made experiments in selective breeding, and enable us to study the occurrence of conspicuously high or conspicuously low ability over several generations. One of the earliest studies of the inheritance of high-level ability was made by Sir Francis Galton.* Among the close relatives (fathers, brothers, sons) of 977 eminent British men, Galton tabulated the names of 332 men who were likewise distinguished. Among the relatives of a group of 977 average men, we would expect to find by chance one distinguished person, not 332. The famous Wedgwood-Galton-Darwin family, which included Francis Galton and Charles Darwin, contributed a number of eminent scientists to Britain, five Darwins being elected Fellows of the Royal Society. Among the descendants of Jonathan Edwards, early New England scholar and divine, are scientists, clergymen, statesmen, professors—many of them distinguished. Musical talent also seems to run in families. Thus, of the fifty-seven male members of the Bach family who have been traced through four generations, forty-one, or 70 per cent, were musicians, including Johann Sebastian Bach (1685–1750), the most distinguished member of the family.

On the other side of the picture, we find a number of families which have exhibited a conspicuous lack of achievement—which have been, in fact, distinct social liabilities. In one such family, called the “Hominy family,”† the mother was feebleminded and sexually promiscuous, the father physically handicapped and probably of low-grade intelligence, and the home

* Galton, 1869.
† McPherson, 1936.
filthy and badly kept. Of the seven children in this family five were definitely feeble-minded and all were ne’er-do-well, or petty criminals, or sex offenders. The best known of the early investigations of a “bad” family tree is that of the Kallikaks, published by Goddard in 1914. The Kallikak family (the name is fictitious) is especially interesting genetically because there were two different lines from a common male ancestor, Martin Kallikak. Martin, a soldier in the American Revolution, was the father of an illegitimate boy by a feeble-minded mother. From this boy there have been traced 480 descendants, of whom 143 were almost certainly feeble-minded, 291 barely normal, and only forty-six of normal intelligence. The history of these “bad” Kallikaks presents a dreary picture of shiftlessness, depravity, crime, and social worthlessness. Shortly after the revolution, Martin married a girl of good Quaker stock, and from this union 496 descendants have been traced. All of these but two are believed to have been normal or above normal in intelligence. Among the “good” Kallikaks are found governors, college presidents, lawyers, physicians, teachers, and business men. (See Figure 28.)

While genealogical charts (family trees) are interesting and often instructive, they cannot provide precise information regarding the relative importance of nature and nurture, since the task of separating the two is virtually impossible. The Kallikak family shows, to be sure, the devastating effects of bad heredity in a bad environment. But this study would be a more convincing argument for heredity if the “good” Kallikaks had turned out well in bad environment and the “bad” Kallikaks had proved to be worthless in good environment. It is a familiar finding that capable people and good surroundings go hand in hand, and that dissolute families of low ability tend to come from poor and depressed areas. It is impossible, of course, to say which is cause and which effect in every case. At the same time, it seems highly improbable that inheritance plays only a minor role in the achievement record of a family. Thus, it is conceivable but quite unlikely that of fifty-seven persons
He dallied with a feeble-minded tavern girl. He married a worthy Quakeress. She bore a son known as "Old Horror" who had ten children. From "Old Horror's" ten children came hundreds of the lowest types of human beings. She bore seven upright worthy children. From these seven worthy children came hundreds of the highest types of human beings.

**Figure 28** The influence of heredity is demonstrated by the "good" and the "bad" Kallikaks.

*experimental studies of heredity and environment*  TWO  65
selected at random and reared in a musical environment, 70 per cent would have become, like the Bachs, accomplished musicians. And it seems equally unlikely that the Kallikaks are products simply of circumstance. In one island community there has been a systematic and continuing migration of the more ambitious in the population. Interbreeding among those less able folk who are left behind is apparently the chief cause for a steady deterioration in the social and economic life of this community.

(2) inheritance of emotional characteristics

While the effect of environment upon personality characteristics is generally admitted (page 55), there has always been a strong feeling that heredity plays a considerable part in shaping human personality. This does not mean that heredity directly affects such personality characteristics as friendliness, cruelty, or dependability, but only that there are inherited nervous structures which predispose a person toward certain behaviors rather than others. Various experimental lines bear this out. Thus upon inventories (page 556) and self-reports dealing with personal and emotional behavior, identical twins have been found to be markedly more alike than fraternal twins in their expressed anxieties, fears, feelings of self-confidence, and the like. Identical twins are more alike than siblings in such physiological indices of emotionality as the PGR,† and in various indices of brain function as well. (See page 229.) Every person's brain gives off continuously a series of rhythmic electrical beats. These so-called "brain waves"‡ exhibit definite patterns, which can be recorded by delicate electrical ap-

* Carter, 1935.
† When electrodes are attached to different points on the skin and are connected with a sensitive galvanometer, the skin offers resistance to an electric current flowing between two points. The amount of current passing through the galvanometer increases markedly during emotional states and is often taken to be an index of emotion. The galvanic deflection is called the psychogalvanic reflex (PGR).
‡ Also called electroencephalograms, or EEG.
paratus. In identical twins, only 4 per cent of the brain wave patterns are unlike, whereas in fraternal twins and siblings, 95 per cent are unlike.

There is good evidence that personality disorders as revealed in atypical and unusual behavior are in part hereditary. The milder forms of disturbed personal and social behavior are called neuroses. The neurotic person tends to be overly anxious, fearful, besieged by feelings of guilt, and full of compulsions (obsessive feelings that certain things must be done). At the same time, he possesses “insight”—that is, he is not insane, and he knows that his behavior is strange and abnormal. In a study of the inheritance of neuroticism, 100 normal twin pairs, identical and fraternal, and twenty-one unstable twin pairs, diagnosed as neurotic, were measured upon seventeen scales carefully designed to detect anxiety, timidity, over-aggressiveness, and so on. Through a statistical procedure known as factor analysis, a single scale or dimension of “neuroticism” was constructed, which separated sharply the normal from the neurotic twins. According to this index of emotionality, the identical twins were much more alike than the fraternal twins. In fact, this “emotional factor” accounted for 70 per cent of the score differences among the identicals and only 5 per cent of the score differences among the fraternals. In this analysis it was assumed that environmental influences were the same for all twins and that differences due to nature and nurture are independent. It would be hard, of course, to prove that these conditions hold and it seems likely that neither was strictly fulfilled. At the same time, the study suggests strongly that emotional stability (or instability) is to a high degree influenced by hereditary equipment.

There is considerable evidence that the constitutional predisposition for certain forms of mental disease (insanities) is inherited. The condition known as schizophrenia* is found in

---

* Schizophrenia is a mental disease marked by extreme introversion (page 596), shyness, timidity, withdrawal from society, lack of interest in surround-
about 1 per cent of the general population. Statistics on hospital admissions indicate that when both parents are schizophrenic, the chances are two out of three that their child will become schizophrenic; and this expectation is nineteen times as great as that for the general population. Should one member of a pair of identical twins (Kallmann, 1946) develop schizophrenia, the chances that the co-twin will also develop the disease are six times as great as are the chances that a sibling will become schizophrenic if his brother or sister does.

The evidence is certainly strong that constitutional predisposition to emotional instability and mental difficulty are inherited. At the same time, the fact that in 15 per cent of the cases one identical twin does not develop schizophrenia when his co-twin does shows that heredity is not the sole cause. Apparently environmental pressures must reach a certain breaking point before the personality defect appears. But this breaking point is lower for those whose heredity renders them more vulnerable than it is for others better fortified by nature.

(3) the ape and the child

What would happen if the general environmental opportunities and training of a young ape were made as nearly identical as possible to those of a child: how nearly “human” would the animal become? Such a test is not really comparable to the experiments already quoted since heredity is radically different in ape and child. It is suggestive, however, of the limits to which the environment can go. One well known case is the following:*

At the age of seven and one-half months, Gua, a baby chimpanzee, was brought into the home of a psychologist and his wife, and became the playmate of their child, Donald, aged

---

* Kellogg and Kellogg, 1933.
ten months. The chimpanzee and the boy lived together as brother and sister over a period of nine months (see Figure 29), Gua learned to walk, eat with a spoon, drink from a glass, use the toilet, skip rope, and obey commands. By the end of the experiment she understood ninety-five words. But she could not learn to talk, since the ape does not possess the hereditary equipment necessary for spoken language. Since an ape grows more rapidly and matures earlier than a child, at first Gua surpassed Donald in almost every way. By the time he was fifteen months old, however, Donald had caught up with and excelled Gua in everything except physical strength. Though this experiment shows what exceptional training can do in making an animal “almost human,” it also shows that heredity and early maturity set limits to Gua’s learning capacity so that after her initial superiority she fell rapidly behind the more slowly maturing but natively better equipped human being. In a more recent study, a chimpanzee raised in a home has been taught to “say” three words, cup, mamma, papa. (See Figure 30, on page 70.)

* Hayes, 1951.
(4) the interpretation of studies of heredity and environment

Certain broad principles emerge from our survey in the last two sections which should be useful in better understanding nature-nurture studies.

1. Heredity does not completely determine any trait. This fact is important and is worth keeping in mind. Even when heredity is exactly the same and environment ostensibly the same, as in the case of identical twins reared together, there is still considerable variability in both structure and behavior. Put differently, training and way of life may have some effect upon any trait.

2. Heredity influences some traits more than others. In-
Heritance is apparently more potent in determining level of intelligence, physique, and motor and sensory equipment. Environment, or more generally culture, has greater influence in shaping specific habits, personality characteristics, beliefs, and values. Such traits as honesty, dependability, and cheerfulness are strongly affected by training. Recent evidence, however (see page 67 also), indicates that many personality traits, if not basically inherited, are at least not as susceptible to training as many have believed. Follow-up studies of young adults, for instance, have shown that at age eighteen young people exhibit many of the same traits (aggressiveness, timidity, amiability) shown when they were babies (two–three years old). Even in the chimpanzee, distinctive personality traits appearing in infancy persist into adulthood.

3. Bad environment can suppress or even nullify good inheritance; but good environment is, unfortunately, not a substitute for good heredity. Residence in a slum or in a delinquency area and inadequate or even vicious training withhold opportunity, build up bad habits, and thus limit or even suppress the achievement of a potentially able youngster. The best environment, however, cannot make a bright adult out of a feeble-minded child nor a talented person out of one without talent, though good training will undoubtedly improve performance and cause the recipient to become a more acceptable member of society. The famous case of the Wild Boy of Aveyron is a case in point. In 1799 a boy of eleven or twelve was found by some hunters in a forest in France. The boy was wild, unkempt, unable to talk, and seemed almost to be an animal. He was taken into the home of a French physician named Itard and was carefully trained over a period of five years. Though he did not learn to talk, the Wild Boy was able to acquire many of the routine behavior activities of a civilized community. Thus he learned to dress himself, to eat with table utensils, and to care for his personal needs. Itard's careful training undoubtedly improved the Wild Boy's behavior, but it
was unable to bring this apparently feeble-minded child to normal.

In summary, it appears to be true that heredity determines what a man can do, environment what he does do—within the limits imposed by heredity. If a good automobile is neglected, it will run poorly; if well cared for, it will give a good performance. On the other hand, a cheap automobile,

**Figure 31** The "Gazelle Boy," found in the Syrian desert. He could utter only animal sounds, and lived on roots, grass, and water. It is thought that he was a Bedouin boy who had been abandoned by his mother in the desert.
even with the best of care, cannot be made to operate like a well-constructed car. With care, however, it will run better and last longer than otherwise.

The question of the relative importance of heredity and environment in determining individual differences in physique, intelligence, aptitudes, and social behavior is an old and much discussed problem. It is impossible to say precisely how much of any specific act is shaped by inheritance and how much by training. But a good deal of evidence has accumulated which enables us to judge the relative strengths of nature and nurture within broad areas of behavior.

Our biological inheritance is derived from genes—minute particles located in the chromosomes. The chromosomes, in turn, are found within the germ cells of the body. In the human species there are forty-eight chromosomes. A child gets twenty-four chromosomes from each parent, but the large number of possible arrangements and combinations of the genes causes members of even the same family to differ sharply in hereditary constitution. In a real sense, therefore, each person is unique.

Experiments with rats show that when variations in heredity are produced in the same environment, there are marked differences in ability to learn. This finding suggests that wide gaps in ability are to be attributed to heredity. Studies of the resemblance of identical twins and of other members of the same family provide a fairly clear notion of the effectiveness of common inheritance. Histories of “good” and “bad” families are also revealing. Experiments in which an ape has been reared along with a child in a human family show that training in the early years is amazingly effective in making the ape “almost human.” The animal, however, soon reaches the limits set by its heredity, and training is no longer able to produce improvements.

In general, it appears that differences in physique, intelligence, and aptitude are more affected by inheritance than are social behavior and personality traits. It may be said, in short, that heredity
determines what a man can do, environment what he does do within the limits set by heredity.

questions and topics for discussion

1. Are criminals "born" or "made"? How could heredity predispose to criminal behavior? How could environment?

2. Although the famous Dionne quintuplets were born with identical heredity, they seemed to develop quite different personality traits. Can you give an explanation?

3. Many delinquent children have low-grade intelligence. Does this mean that heredity is the "cause" of delinquency?

4. In what ways is the home not the same environment to all the children in a family?

5. If striving to overcome felt inadequacies is the "cause" of superior achievement, why are there so few outstanding people in view of the fact that many people feel inadequate?

6. How can we explain the presence of one bright child in an otherwise average or even dull family? Of a dull child in a superior family?

7. Comment upon the following statements: (a) "My child's timidity is owing to the fact that I was dreadfully frightened two months before he was born." (b) "I am sure that Mary (now aged two) will be artistic because for months before her birth I devoted my time to art and music."

8. "My child would be as smart as the next one in school if he would only apply himself." Do you agree?

9. What difference would it make to education if growth in a trait were known to be determined chiefly by heredity?


3. A. Scheinfeld's *The new you and heredity* (New York: J. P. Lippincott & Co., 1950) is an interesting non-technical account which somewhat over-stresses environmental factors.

4. Readable, but fairly technical, discussions of heredity in man will be found in E. G. Boring, H. S. Langfeld, and H. P. Weld's *Foundations of psychology* (New York: John Wiley & Sons, 1948), Chapters 4 and 19.
THE TOPICS “GROWTH AND MATURATION” FOLLOW LOGICALLY a discussion of heredity and environment. Psychologists study the child’s development because they are interested in discovering the repertory of activities with which he begins life and the ways in which his behavior changes and matures with age. Is it “human nature” for young children to be cruel to animals? Do kindness and consideration develop as a result of training? Does mental development proceed regularly, without ups and downs, or does it show considerable variability? Do girls grow up, mentally and socially, earlier than boys? Is the adolescent period marked by special stresses and strains? All these questions concern the developmental period in a child’s life, and specifically the development of his physical, mental, and personality traits.

The term maturation is used to denote a state of development, as well as the process of development. Thus a young man is said to be mature when he has attained his full growth:
FIGURE 32 As children grow in size they also develop in motor skills.
and a child is said to be maturing when he approaches these growth limits. General maturation of the organism results in increased activity and greater learning power; specific matura-
tion of the various sense organs, nerves, and muscles enables us to make responses not previously possible. New behavior patterns are undoubtedly a joint product of maturation and of learning. It seems clear that an organism cannot learn (or cannot learn efficiently) until it has reached a developmental level sufficient to “carry” the given behavior.
An experiment with young chicks illustrates this point nicely. Newly hatched chicks will immediately peck at wheat grains, seize, and swallow them. At first their aim is poor and their pecking movements clumsy and awkward. But improvement comes quickly, and we may ask whether the increased accuracy and co-ordination are the result of practice or whether they are attributable to maturation. In an experiment designed to answer this question, newly hatched chicks were kept for several days in the dark so that visual stimuli which might lead to pecking were absent. Four groups of approximately fifty chicks each were then formed. After one day of confinement, Group I was taken into the light and given a “pecking test” of twenty-five grains of wheat. Groups II, III, and IV were also given pecking tests of twenty-five grains after two, three, and four days respectively. The last three groups were fed by hand and were allowed no practice in pecking up to the day of the test. Table 8 gives the “scores” of all four groups—a score being the number of successful pecks, seizures, and swallows of grain in twenty-five trials.

The importance of practice in pecking is clearly seen as we look down the columns. The first three groups all show gains from the first to the second day—2.2, 3.0, 1.4 respectively. But the effects of maturation are also evident. Each group after the first began at a higher level than the group before it

### Table 8

<table>
<thead>
<tr>
<th>days after hatching</th>
<th>groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
</tr>
<tr>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>3</td>
<td>8.7</td>
</tr>
<tr>
<td>4</td>
<td>13.3</td>
</tr>
</tbody>
</table>

* C. Bird, “Maturation and practice: their effects upon the feeding reactions of chicks,” *Jour. of Comparative Psychology*, 1933, 16, 343–366.
(namely, at .7, 2.6, 3.6, and 4.6) owing to greater maturity, improved general co-ordination, and better muscular control. When the experiment was continued until the twentieth day, all the chicks in the four groups were seizing and swallowing from fifteen to twenty of the twenty-five grains.

Other experiments with animals demonstrate the need for a minimum level of maturity, or readiness, in order for practice to become profitable. Canaries, for example, have been raised from birth in sound-proof cages, where they could not hear and thus practice the songs of other canaries. Nevertheless, these isolated birds began to sing their typical songs at the time when canaries ordinarily begin to sing. It seems clear that the song of the canary, although determined by heredity, does not appear until a certain level of maturation is attained. In another experiment, tadpoles were placed in a solution which held them anesthetized and in a completely motionless state, but in which they were able to grow normally, since the water contained the necessary food materials. When the tadpole was removed from the deadening solution before the time at which it normally swims, it remained quiet. But when the immobilized animals were transferred to fresh water at the time when

![Figure 34](image)

*Most children are not “ready” to swim as early as this youngster, even though they may receive careful training.*
tadpoles which have developed normally usually begin to swim, swimming movements appeared. This experiment indicates that maturation involves changes in the nervous system and muscular apparatus as well as increases in body size—that the tadpole must reach a certain maturity level before swimming movements are possible.

MATURATION IN THE HUMAN INFANT

The course of maturation in the human infant proceeds from one of general or mass activity to one of more specific and directed responses. This is well illustrated in Figure 35 which shows the stages by which a child “learns” to walk. Walking alone, which appears on the average at fifteen months, is the end result of a fairly long developmental process. Maturation is certainly important, since it leads to steadily increasing bodily and muscular control. But practice in the activity itself, stimulated and encouraged by parents and other adults, serves to hasten the process along. Talking, reading, writing, and drawing are also the result of learning which operates at higher levels of maturity (page 289).

Children can be forced to learn before they are “ready,” but such learning is not efficient, and its effects ordinarily are transient and fleeting. Experiments have shown that youngsters can be taught to carry out rapid and co-ordinated movements, climb, jump, and memorize numbers at ages earlier than those at which these activities “normally” appear. But such “forcing” apparently has little permanent effect. Often the performance is quickly lost once practice is discontinued, or the practiced group is equaled or overtaken by nonpracticed children who have matured sufficiently to be ready for the activity. Probably there is a “most favorable” age at which each of the various school subjects—reading, speaking a foreign language, algebra, science—should be undertaken. Algebra, for instance, is learned more easily and with greater understanding at fifteen or sixteen than at eleven or twelve. On the other hand, a foreign language may often be acquired more readily and with
0 MONTH
Fetal Posture

1 MONTH
Chin Up

2 MONTHS
Chest Up

3 MONTHS
Reach and Miss

4 MONTHS
Sit with Support

5 MONTHS
Sit on Lap Grasp Object

6 MONTHS
Sit on High Chair Grasp Dangling Object

7 MONTHS
Sit Alone

8 MONTHS
Sit on High Chair
Grasp Dangling Object

9 MONTHS
Reach and Miss

10 MONTHS
Creep

11 MONTHS
Walk when Led

12 MONTHS
Pull to Stand by Furniture

13 MONTHS
Climb Stair Steps

14 MONTHS
Stand Alone

15 MONTHS
Walk Alone


FIGURE 35 Motor development in the young child. The pictures show a typical sequence based upon the observation of twenty-five children. Ages shown on the chart are approximations and are designed to show the general order rather than the exact time of development.
less self-consciousness at seven or eight years. Age limits of readiness are fairly wide and depend upon a number of factors. Bright children are ready to read much earlier than normal or dull, and children well-grown and physically mature are ready to engage in games and competitive sports earlier than less well-developed children of the same chronological age.

Teachers and parents are interested in a child’s physical and mental development for several reasons. They want to know the ages at which characteristic behavior patterns, attitudes, and interests are typically present. They wish to know also whether the child’s rate of progress (degree of matura-
tion) in physical, mental, and social activities is in accord with normal expectation. Some of the typical developmental changes with age will be discussed in the following paragraphs.

physical growth

BODY CHANGES

Figure 36 shows the changes in body proportions from the newborn infant to the mature individual. With increase in age, the head and the upper parts of the body becomes proportionally smaller, whereas the extremities become larger and

![Figure 36 Changes in bodily proportions with age before and after birth.](From: Morris’ Human anatomy, 8th Ed., P. Blakiston’s Son & Co., 1925, p. 17, Fig. 16.)
The various body systems have their typical rates of growth, maturing at different times. For instance, as Figure 37 shows, the brain and nervous system develop rapidly over the early years, reaching maturity at about sixteen years of age. By age six the brain has reached 90 per cent of adult size; hence it is rare for a child who had developed normally to age six to become feeble-minded thereafter. The body as a whole grows rapidly up to age five and somewhat less rapidly to age twelve. Then, after puberty, there is a final spurt, which reaches its culmination at about age twenty. The onset of puberty, as shown by the development of the sex organs, begins at age twelve or earlier, but the body does not reach full maturity until the end of the adolescent period.
Figure 38 shows the curves for height for four brothers from birth to early maturity. It is interesting to note that while the general form of these curves is the same, A, the tallest boy at birth, maintains his superior position in the group. Boy D, the shortest at birth, remains the shortest up to age twenty. The two intermediate boys in general maintain their positions. The persistence of these physical differences over the entire period of growth up to maturity is strong evidence of the importance of native constitution in determining physique.

**Changes in Performance with Age**

Activities involving muscular speed and accuracy follow characteristic progress curves with age. Figure 39 shows the changes with age in certain physiological and motor capacities. Scores at each age have been expressed as per cents of the eighteen-year score, which is taken as 100 per cent in each
case. Strength of grip, vital (lung) capacity, and “perception” speed (as measured by the rate at which letters on a page can be canceled out) follow the same general course of development. Sensitivity to pain reaches 50 per cent of the eighteen-year level at about age seven. Speed of voluntary movement (tapping) and steadiness of hand-eye control reach 80 per cent of their eighteen-year-old efficiency by ten years. Fine coordinations necessary for skilled performances however, are, relatively slow in developing. At age four the child has enough
control of wrist, hand, and finger movements to copy a small square with a pencil; he is seven years old before he can copy a diamond-shaped figure with a pen. Straight up-and-down movements such as are used in printing and in simple line drawings are easier for the young child than are the ordinary writing movements. In most modern schools, therefore, children are taught manuscript writing (a form of printing) before ordinary writing is attempted.

The development of muscular and motor control in running, walking, writing, and playing games is in part a matter of exercise and in part a matter of maturation. The nervous and muscular systems must have reached a certain stage of development before modifications and reorganizations can be effected through learning. Learning, therefore, follows upon and is directly conditioned by maturation.

**SEX DIFFERENCES IN MATURITY**

Growth in height is usually completed by age twenty. Except for the years from ten to about fourteen, boys in general are taller than girls. However, girls grow more rapidly and mature earlier than boys. Girls reach puberty earlier than boys, and during this period are somewhat taller and more mature. After puberty the boys forge ahead of the girls in height and are, on the average, taller at maturity. (See Figure 40.) Growth in weight follows the curve for height except that weight changes are somewhat greater during adolescence. On the average, girls are heavier than boys during the prepuberty period but

---

**Figure 40** The rapid growth at the time of adolescence occurs earlier in girls than in boys.
are lighter during puberty and adolescence. Tables which give expected (that is, average) weights for given heights are available for children as well as for adults. These norms or standards must be interpreted with caution. A girl of ten may deviate considerably from the average height or weight for her age and still be well within the normal range. Slim children with small bodies are often taller and lighter than average-sized children, whereas thick-set and large-boned children tend to be shorter and heavier. Type of build must be carefully considered in determining whether a child or adult is overweight or underweight for his age.

The earlier maturity of girls is not only muscular and motor but also mental and social. At age six the boy lags about six months behind the girl of the same age, and at puberty the average boy is about two years behind the average girl in relative maturity. Over the elementary-school years, girls at a given age level generally have better muscular control than boys: they are more adept with their hands, write better, and read better. In making comparisons between boys and girls in the same elementary grade, we should remember that boys are less mature physiologically—and also emotionally and intellectually—than are girls of the same age. It is a matter of common observation that the boy of fourteen is often an awkward, overgrown child, while the girl of fourteen may be a self-possessed young woman. The advantage of the girl over the boy in greater relative maturity is gradually lost after puberty. (See Figure 40, on page 87.)

**mental development**

Mental abilities mature in much the same way as do physical and muscular functions. Growth in vocabulary (page 55), for example, is quite regular. At one year the baby may be able to say two or three “words,” at two years to repeat a simple sentence or use words in combinations. At eight years of age
the child’s vocabulary is roughly 25 per cent of what it will be at age eighteen; by twelve it is slightly over 50 per cent. Simple associational learning develops somewhat more rapidly than vocabulary, and by age fourteen the child has reached 90 per cent of his eighteen-year level. Memory for disconnected words has reached roughly 65 per cent of the eighteen-year level by age eight.

Errors made by a child in reading are often indicative of the developmental level which he has reached. At six years there is much substitution and considerable confusion of words which look alike. “Cat” for “can,” and “look” for “took” are common, as are also “same,” for “some,” and “ever” for “even.” The child frequently must be taught words which he does not know or does not recognize. The child of eight or nine must still be helped with hard words. He is more willing, however, to guess at unknown words than at six and will often substitute words in approximately the same category—for example, “dog” for “puppy” or “house” for “room.” At this stage, also, he may read “his brother” as “he” or “his mother” as “she,” showing that he has knowledge of the meaning involved.

General mental ability in the normal child increases rapidly from birth to five or six years of age. This rapid growth paral-
lels the development of the human brain and spinal cord, as well as body growth as a whole (see Figure 37, on page 84). From six years on to fourteen or fifteen (during adolescence), the increase in mental ability is upward, but at a slower rate. As shown in Figure 177 (page 346), the curve for age changes in intelligence test scores reaches a peak by about age twenty. This curve is an expression of average development. In general, bright children grow at a somewhat faster rate than average children and continue to develop longer. Dull children, on the other hand, develop more slowly and reach their maturity at an earlier age level. Changes in learning ability with age will be discussed further on page 346.

Growth in comprehension and understanding follows in general the growth curve for intelligence. By age five the normal child can define objects by use: a chair is something to sit upon, a pencil something to write with, and so on. By age eight the child is able to classify objects according to a general concept: a tiger, for example, is an animal which . . . ; a soldier is a man who. . . . At various age levels the child's ability to profit from past experience, to form generalizations, and to use principles has been tested by ingenious methods. By age four the child is expected to answer sensibly the question, What must you do when you are hungry? By age ten a child should be able to detect the fallacy in the statement "A man said 'I know a road from my house to the city which is downhill all the way to the city and downhill all the way back home.'" In order to see the "moral" expressed in a proverb or fable, the child must be able to generalize from simple concrete situations. This ability does not appear in the normal child much before age twelve. A ten-year-old sticks closely to description and enumeration when asked to tell what he sees in a picture. But the twelve-year-old will give some interpretation or discussion of what is happening. The everyday vocabulary of the average public school child of ten is between 5000 and 6000 words; of the average public school child of twelve between 7000 and 8000 words. Estimates of "total" vocabulary will vary
depending upon whether it is spoken or written, and whether all parts of speech are counted or only nouns, verbs, and so on.

social development

SOCIAL GROWTH IN THE PRESCHOOL CHILD

As children grow in physical size and mental ability, they normally develop in degree of emotional control and social participation. The term social growth covers such observed behaviors as increasing sense of responsibility, development of self-confidence, and expanding interest in the adult world. Social maturity, often identified with "manliness" in boys and "poise" or "self-possession" in girls, expresses itself in wider and more adult social relations. Social development, accordingly, parallels closely the acquisition of desirable character and personality traits.

HOW THE HOME INFLUENCED THE PERSONALITY OF A FIVE-YEAR-OLD

Tommy was a top member of his class in nursery school—normal, healthy, intelligent. At age five his records flattened out: he lost weight, stopped growing in height, and his mental test rating fell off. Tommy appeared to be unhappy, tense, over-anxious and uncertain. In studying Tommy's case the child psychologist tried out the technique of "doll play." Three dolls, a man, a woman and a small boy, were placed before the child, together with home furnishings and other accessories. When Tommy was invited to "play house" he sent the mother doll off to the office, put the father doll in the kitchen, and pondered whether the boy doll would ever grow up to be a man. He speculated that he might even grow up to be a woman and work like mama. This doll drama revealed Tommy's home situation and the reason for his anxiety and loss of appetite. Tommy's mother had a job which kept her away from home all day. Frequently she came home exhausted, and since the father's

business hours were not exacting he did many of the household chores, often caring for Tommy and putting him to bed. Tommy’s anxiety grew out of the fact that he wanted to identify himself with his father but the family setup was so confusing that he didn’t know whether he should be father at home or mother at work. When the situation was explained to the parents they took immediate steps to correct it. A readjustment in the mother’s work hours made it possible for her to take over home duties performed by the father. Increased attention and affection by both parents soon led to a marked change in Tommy’s behavior. He ate better, was happier, and was more friendly in school. He began to increase again in weight and height, and his mental test scores went back to their previous levels.

The psychologist and the teacher, especially in the large cities, find many children in the first or even second grade who have never played with children of their own age. These children are often isolated by their schoolmates because they have not learned to co-operate in group activities. Little children are not “by nature” socially minded. Toys, candy, dolls, and picture books—all of these are thought of by the child as belonging to himself alone and not to be shared with others. A major task of

Courtesy Teachers College, Columbia University

FIGURE 42
A psychologist studies the social development of a child from his arrangement of the dolls as a family group.
Children may enjoy being with other children even though each one appears to play by himself.

The home, as of the kindergarten, is to build up habits of respect for the rights of others and a willingness to share one's things with other children. When there are several children not very far apart in age within the same family, the social spirit of give-and-take is usually acquired at an earlier age than when the family is small or the children widely separated in age. When children from two to four years old are observed daily during their free play hours, it is found that the two-year-olds are much less socialized than the three- or four-year-olds. They play "beside each other rather than with each other." There is little conversation, and little attention to the play of other children. Figure 43 illustrates what is called parallel play—that is, social play in which there is little or no interaction. A year or two later the effects of social influences clearly appear in the play of these children: they imitate one another, borrow and lend toys, and make suggestions to one another.
Organized play rarely appears before the age of four years. Thereafter children play school or house or train, each taking a part as teacher, father, mother, or conductor. Capacity for leadership makes its appearance at this time, the leader usually directing much of the play activity. The child leader is characterized by initiative, organizing ability, and willingness to conform to the wishes of others. Children who insist upon having their own way at all times quickly lose their following. The increasing influence of social pressures upon the child is seen in the gradual decrease in obstinate or willful behavior after age four or five. The years from two to four are usually the period of greatest obstinancy, the period in which the child reacts strongly against any coercion and adult control.

Little children often tend to ascribe consciousness to inani-
mate objects—to think of them as alive. The French psychologist Piaget held that children’s conceptions of living things develop through several stages. At four, Piaget found that children regard almost anything active as alive, even when it is stationary; at six or seven years, consciousness is ascribed only to things that move around; by nine, distinction is made between things that move and those that are moved; at eleven or twelve, consciousness is almost always restricted to animals. While these concepts vary from child to child and depend heavily upon mental age (page 458), they tend to follow a regular growth pattern.

The period of four to six years has been called the “questioning age.” Children at these ages are veritable question marks. Their conversation bristles with a why for this and a reason for that. Boys ask more questions involving “reasons,”
girls more questions regarding social relations. Most of these questions fall into two groups, the motives for which differ greatly. In the first category are questions which grow out of genuine curiosity and a wish to know. These questions are motivated by desire on the child’s part to verify or to extend his inadequate knowledge. In the second category are questions which are not genuine—in the sense of being information-seeking—but are chiefly a means of getting and holding the attention of some adult. Children ask questions because they are more compelling than statements and hence more likely to gain attention. It is important that we try to discover why the child feels it necessary to gain attention by asking questions. And it requires patience and wisdom growing out of experience, as well as knowledge of the child’s training and background, to enable the teacher or parent to sift out questions which should be answered and those which should be ignored. If the questions grow out of a sense of insecurity, it is better to remove the insecurity than stifle the questions. The child has a right to be answered when he genuinely seeks knowledge. But it is a mistake to allow a child to fall into the habit of asking irrelevant questions in order to make himself the center of interest.

Courtesy Laboratory School, University of Chicago

FIGURE 46
An outlet for creative expression in the young often prevents behavior problems as the child grows older.
Boastfulness in relation to age

<table>
<thead>
<tr>
<th>Age groups</th>
<th>The following percentages were boastful</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>14</td>
</tr>
<tr>
<td>8-10</td>
<td>19</td>
</tr>
<tr>
<td>10-12</td>
<td>25</td>
</tr>
<tr>
<td>12-14</td>
<td>12</td>
</tr>
</tbody>
</table>

Social changes in the elementary school

During the elementary-school period, boys (and often girls) indulge in boisterous and rough-and-tumble play which often resembles the antics of puppies and other active young animals. This period has been picturesquely called the "big Injun" age. Boastfulness then reaches its peak, in part because the child is beginning to perceive and copy adult standards without having acquired adult judgment or tact. In a group of 170 children whose social behavior was carefully studied, the percentage shown in Table 9 within each age group from six to fourteen were regarded as boastful. It appears that boastfulness reaches its peak during the ages ten to twelve and declines slightly thereafter.

From six to twelve the child is still more child than adult, though knowledge of social conventions and of the rules of adult behavior is increasing rapidly. Questions at various age levels in the Stanford-Binet Intelligence Examination (page 457) reveal the child's growing perception of social requirements. At age eight, for instance, he is asked what he should do if a playmate hits him without meaning to do so; at age ten, "why should we judge a person more by his actions than by his words." Answers to such questions may not be strictly true and yet reflect a change in social attitude.

The changing pattern of social relationships is shown in the kind of friendships which children form over this age period. The six-year-old makes friends with boys and girls without
much distinction. By age nine to eleven, boys and girls separate sharply not only in their friendships but in their games and interests as well. If a ten-year-old is asked to name his best friend or the child by whom he would rather sit, boys select boys and girls select girls. Preference for members of one’s own sex continues to the period of puberty, at which time marked interest begins to develop in the opposite sex.

SOCIAL DEVELOPMENT DURING ADOLESCENCE

Daydreaming and imaginative and often greatly exaggerated distortions of fact are common during early adolescence. These creations cannot be passed over brusquely as lies, since adult standards of truth and falsehood do not strictly apply. Often the child’s fantasies reflect his feelings of insecurity and unhappiness. They may express a rather pathetic desire to be important or an attempt to bolster up self-confidence or to elicit interest and praise. Many behavior activities essentially antisocial from the adult viewpoint may be regarded as typical (that is, normal) for children at certain age levels. In a study of public-school boys, for instance, occasional stealing (taking books, candy, pencils, and the like) was so common at age nine as to be fairly “normal” behavior. By twelve or thirteen, however, deliberate or planned stealing is significant of poor training or serious character defect.

STEALING AS AN EMOTIONAL OUTLET

Tony was an eleven-year-old in the sixth grade of a private school. In this school the boys customarily leave their clothes and personal belongings in open lockers in the basement during afternoon periods on the play field. After several thefts of money were reported, a quiet investigation led without much difficulty to Tony. Brought into the principal’s office and faced with his wrongdoing, Tony quickly confessed, explaining that he had only “borrowed” the money and expected to return it. Inquiry revealed the following facts. Tony’s family was relatively poor in a wealthy community,
and his parents were able to give him only a small allowance for spending money. The boy was not popular among his classmates, since he had no special talents with which to appeal for favor; he was small in stature, intellectually mediocre, and not athletic. Tony had bought soft drinks and candy with the stolen money; apparently all of it had been spent in treating his more popular classmates and none of it was kept for himself. The school psychologist, after consultation with teachers and parents, decided that Tony's need for popularity was so great that he was willing to steal to get it. The boy was not dropped from school, since fundamentally he did not seem to be a "bad" boy. The situation was explained to Tony and he was required to pay back the stolen money from his own funds (he worked three afternoons a week) and was put on probation for the rest of the year. Teachers were asked to use every stratagem to get Tony into the social life of his group, and the parents were urged to allow more youngsters to visit in his home. Later on, the father was persuaded to raise Tony's allowance. After several years there have been no further thefts on Tony's part.

Dishonesty in the form of deception or lying is common. Most adolescents learn how to avoid unpleasant tasks, to talk their way out of trouble, and to cheat if cheating seems to make something easier. The adolescent will often rebel vigorously against time-honored customs if they are identified with his parents or with the school. On the other hand, the moral code of the adolescent is rigidly determined by his group, and his standards may be quite conservative. In a Midwestern college it was found that two-thirds of the freshmen believed that "honesty is the best policy," "it is one's duty to lead a clean personal life," and that "sexual promiscuity is wrong." Self-condemnation, feelings of guilt, moodiness, and depression result when the young person is convinced that he is not living up to the standards of his culture.

During adolescence the developing boy and girl are perhaps most in need of sympathy and understanding. Though it seems probable that the "storm and stress" of adolescence have been somewhat exaggerated, it is true that profound
physiological changes are taking place within the adolescent and that he is disturbed by turbulent emotions the significance of which he does not comprehend. A major problem of adjustment during adolescence is acceptance of a new attitude towards the opposite sex. Girls who have shown little interest in boys, and boys who have regarded girls with indifference or disfavor, find that they must revise and reconcile their opinions. Another problem of adolescence is that of breaking “nest habits” and home ties. Resentment at family treatment, extreme self-assertion, and defiance are often characteristic of the adolescent boy and girl.

Examples of “adolescent protest” are easy to find, and some of them would be ludicrous if they were not tragic. Louise, a
girl of fifteen, violently resented her mother’s advice on clothes and “got back at her” by wearing outlandish outfits. Hugh, a college freshman who felt that his father was too strict and old fashioned, was chronically rude to people in authority, especially teachers and policemen. This boy painted his car in loud colors and parked it conspicuously in front of his family’s rather pretentious home. One adolescent girl in continual conflict with the austerity of her parents became deeply religious. Still rebuffed by her parents she finally, in desperation, committed suicide. Elsie, a girl of sixteen, moved from a small town and entered a large city high school. She had grown up in a highly protected household, had made few friends, and did not know how to get along with those of her own age. When her unsophisticated efforts at friendliness were rebuffed by her classmates, she became an object of ridicule. Hurt and bewildered, Elsie allowed her work to slump badly and gradually withdrew more and more into herself. Finally she dropped out of school.

Hero-worship is characteristic of the period of puberty, and participation in social groups, clubs, gangs, secret societies, and the like is common. At one moment the adolescent boy sees himself as a hero or martyr, at the next a bandit or outlaw ready to destroy in fancy those from whom he has endured

*Figure 48* The high school basketball player is a hero to girls of the same age.

Tharpe from Monkmeyer
real or imagined affronts. The gang or social group expresses the needs of the adolescent during a transitional period in which he is gradually being weaned from the family but has not yet taken a responsible place in society. Diaries kept by boys and girls from the ages of thirteen to eighteen show clearly the emotional and discordant motives of the adolescent.

SOCIAL MATURITY AS RELATED TO MENTAL AND PHYSICAL GROWTH

The relation of social behavior to mental and physical growth has been carefully investigated. In one study, a scale was developed for estimating social maturity, or what may be called “developmental age.” Developmental age denotes degree of social participation as measured by the child’s activities, atti-
attitudes, and play interests. It is related to physical growth and maturity and to mental ability, but the relationship is not perfect. A bright child, for example, may be babyish in his social behavior, while a child small in stature but well developed may be socially more mature than a large and clumsy child of the same age. This implies that the most effective grouping of children for schoolwork does not necessarily demand a like classification for athletic, social, or play activities. Children from several school classes, for instance, may group together naturally on the playground. (Figure 49.) In placing a child within a grade, advising promotion, or suggesting outside activities, the psychologist considers social maturity, as well as physical and mental development.

Backward children develop social difficulties more often than the average child, and the duller the child, the greater the probability of maladjustment. The dull child often fails to understand instructions and is slow in reacting to play situations. As a consequence, he is neglected by his playmates or treated as a nuisance. (See Figure 50.) Inability to fit into his age group may create a strong feeling of inferiority in the slow child and this, in turn, may lead to unhappiness and even to feelings of hopelessness and desperation. The slow, overaged
child is a real problem in the classroom. His defiance of authority, rowdiness, and disruptive behavior are often compensations growing out of the fact that he can secure attention in no other way.

SOCIAL DIFFICULTIES OF A BOY IN THE FIFTH GRADE

Harold was a twelve-year-old in the fifth grade—two years over-age for grade. His comprehension was very poor in reading, and he was slow and inaccurate in arithmetic. Often ignored by his classmates, Harold resorted to boisterous and often childish behavior—loud laughter, noisy shuffling of feet, dropping of books, foolish answers. Since there was no special class to which the child could be sent, the teacher invented for him semi-authoritative jobs, such as acting as monitor, passing out books and papers, cleaning the blackboard, and the like. Being especially chosen for this work caused Harold to feel that he was a person of some importance, and his behavior improved markedly.

The slow pupil in a private school in which the majority of children are bright can often be helped by transfer to a public school. When standards are not so high and selection is less

FIGURE 51
Not only are the younger children protected, but taking responsibility may avoid expression of aggressiveness in the older boy.
stringent, the slow-learning youngster finds for the first time that he is no longer regularly at the bottom of the class. He may be average or even above average. Increase in morale and self-confidence often results.

Contrary to popular notions, bright children are less boastful, more trustworthy, better controlled emotionally, and more socialized than the average child. Exceptionally bright children play alone more often than the average child and tend to select companions older than themselves. Unfortunately, classroom teachers sometimes describe bright children as “queer” or “different,” a common reason being that these children “know too much,” ask too many questions, and do not fit well into the orderly routine of the classroom. Bright children are as well or better adjusted than average children, but very bright children from homes in which parental understanding is lacking often tend to become “problems.”

CHILDREN’S READING INTERESTS AND PLAY ACTIVITIES

Evidence of the growth of interest in adult activities is clearly seen when one studies the changes in reading preferences with age. Children of six to seven are interested chiefly in picture books and in imaginative stories dealing with fairies, animals, and adventures. Studies of reading interests show that more than 50 per cent of elementary-school boys prefer adventure stories, animal stories, series dealing with boys’ adventures, and popular historical novels. Popular also are stories dealing with inventions, mechanics, radio, and aviation. Elementary-school girls select books with a strong element of excitement, activity, and adventure; from nine to twelve they prefer fiction and stories of love and other “dramatic” emotions. During adolescence, boys begin to read adult fiction, but adventure stories still have a strong interest. The average boy or girl does not read much poetry, history, or science beyond the assigned readings in school. Boys read popular scientific magazines to a much greater extent than do girls.
FIGURE 52 With added maturity, play as well as work becomes more complex.
Bright children from seven to fourteen show a wider range of reading interests and a tendency to seek out "adult" books, reading, for instance, science, history, biography, and travel books. Gifted boys read three times as many adventure stories as do gifted girls. Gifted girls, on the other hand, read five times as much emotional fiction as gifted boys. An interesting observation is that girls frequently read boys' books but that boys rarely read books about home and school life written especially for girls.

As children grow older, shifts in play interests reveal an increasing concern with the adult world. The play of young boys or girls does not differ greatly. Boys of five are interested in active play—wagons, running games, hunting, and the like; girls of the same age play dolls, draw pictures, and jump rope. By ten years of age, the play of boys is more active and competitive: baseball, bicycle riding, wrestling, and other games are popular. At the same age, girls roller skate, read, and attend movies. During adolescence, sex differences in interests and in the strenuousness of recreational activities become fairly well marked. The adolescent boy is just as interested in competitive games as before, while the girl is likely to be more interested in dancing, dates, and parties. The play of country children tends to be more out-of-doors and somewhat less mature and less sophisticated than that of the city child.

The wise athletic director or parent can accomplish much in developing and improving social participation on the playground. Children who are physically backward or who are timid and bashful should be encouraged to try games at which they can succeed and thus gradually gain confidence. The hurdle should be set high enough, but not too high. On the other hand, aggressive and dominating children should be prevented from imposing their will upon other children and yet should not be drastically repressed. Achieving this mean is not always easy, but it should be recognized as a real problem and not as a situation simply to be ignored.
summary

Together with heredity and environment, the topics of growth and maturation are especially important in any study of the course of a child’s development. The term *maturation* denotes a state of development as well as a process. A young man is mature when he has attained his full growth; a teenager is maturing as he approaches the growth limits. Experiments have shown that a certain level of maturation is necessary before a given behavior can appear.

Growth changes in physique, in physical and mental performance, and in personality traits have been studied carefully, and age-progress curves are available for many activities. A knowledge of the stages of development and of what to expect at each stage is of importance to the teacher and parent. It is in relation to such norms that a child is judged to be accelerated or retarded.

questions and topics for discussion

1. Modern children are allowed much greater freedom than were children of a generation ago. What do you think are some of the good and bad outcomes of the “new” treatment?
2. How does aggressive behavior differ typically at ages four, fourteen, and twenty-four?
3. What is the psychological basis for the statement, “A soft answer turneth away wrath”?
4. John is quite bright and William is quite dull; both are nine years old. What situations do you think might provoke fear in John but not in William?
5. A boy of sixteen wears outlandish clothes and uses all the latest slang expressions. His family is conservative and wealthy. Analyze the boy’s motives.
6. Under what conditions might “comic” books be harmful? When might they be helpful?

7. Are daydreaming and fantasy ever useful?

8. A girl of seventeen is forbidden by her mother to read certain books. Can you predict her behavior regarding “naughty” books?

suggested readings

1. An interesting longitudinal and also cross-sectional study of growth changes with age is H. E. Jones’ *Development in adolescence* (New York: Appleton-Century-Crofts, 1943).


WE COME TO KNOW OBJECTS IN THE OUTSIDE WORLD through our receptors, or sense organs. Sometimes one sensory receptor and sometimes another is dominant, but most often impressions are gained through more than one sense avenue. The expert looking at a picture in an art gallery, the music lover listening to a symphony over the radio, the connoisseur sipping a rare old wine, the athlete flexing a sore muscle—each of these is utilizing one sense predominantly. But the housewife shopping for fruit in a market is experiencing a variety of sensory impressions. She looks at the melons and oranges, listens to the comments of the salesman, tastes and smells the fruit, and perhaps even squeezes an orange or thumps a melon to judge its ripeness.

While the words, lights, sounds, touches, and so on, which act upon our sensory receptors constitute the real stimuli, it is customary to refer to the source of energy as the stimulus.
FIGURE 53 A prism's analysis of a composite beam of light into different vibration frequencies. Red is at the long- and violet at the short-wave end of the spectrum. The infrared waves are longer than the red, and the ultra-violet waves shorter than the violet.
Thus a stimulus may be a football game (visual), a radio program (auditory), an ice cream soda (visual and gustatory), or a question posed by a friend (verbal). When the sensitivity of one receptor is lost or greatly diminished (as in partial or total blindness, for example), other receptors are called upon to perform double duty. As a consequence of increased practice and greater concentration of attention, the sensitivity of the remaining receptors may seem to be greatly enhanced.

An organism (man or other animal) responds or reacts to a multiplicity of stimuli. The organs of response, muscles and glands, are called effectors. Between the receptor and the effector and within the body itself, the brain and central nervous system serve as highly selective connecting mechanisms. Because of this three-fold division into receptor, connector, and effector, human behavior is often likened to the action of a telephone exchange, incoming calls (stimuli) being switched over (through the brain and nervous system) and sent out over appropriate outgoing lines to their destination (muscles and glands). This analogy is an oversimplification, to be sure, but it serves to indicate the importance of the central station and to illustrate the point that the response which follows a stimulus is determined as much by the organism as by the stimulus—perhaps even more so.

the sensory receptors

Traditionally, man is said to possess five senses: seeing, hearing, tasting, smelling, and feeling (touch). This is correct as far as it goes, but actually we possess additional sensitive structures through which we come in contact with the environment. There are, for example, the organic or body sense, the kinesthetic or muscle sense, and the equilibrium or posture sense. More will be said about these later (page 139). Furthermore, the skin is not a single sense organ. On the contrary, it
contains four separate sensory receptors: for touch or pressure, for warmth, for cold, and for pain.

Of the different senses, sight and hearing are often called the "higher senses" because of their transcendent importance in everyday life. By far the greater part of what we learn in school, in business, and in social relationships comes to us by way of the eye and the ear. The person with impaired sense of touch or taste is handicapped, to be sure, but by no means so drastically as is the person who is blind or deaf.

The purpose of this section is to show how through our receptors we gain knowledge of ourselves and of the wide variety of things in the world around us. Sense perception is of crucial importance in human behavior, since without the basic data which it brings life would lose most if not all of its richness and meaning.

THE EYE

Light rays entering the eye through the circular opening, called the pupil, are focused by the lens, which lies just behind the

*FIGURE 54* Light rays from near and far objects of the same size enter the eye through the pupil. The retinal image, which is larger for near than for far objects, is upside down on the retinal surface. This is not disturbing as far as visual perception is concerned since we see objects, not the retinal image which is simply a way station in seeing.

seeing
pupil, upon the sensitive inner surface of the eye, called the retina. From the retina nervous impulses reach the brain over the optic nerve and are translated into visual perceptions. The mechanism of the eye may be compared roughly to that of a camera. In expanding or contracting to admit more or less light, the pupil corresponds to the camera’s adjustable diaphragm, with its circular opening. In the camera we adjust for distance by moving the lens farther away from or closer to the sensitive plate. In the eye this adjustment is made by a thinning or thickening of the lens, the distance of the lens from the retina remaining constant. Figure 54 shows how light rays which enter the eye from near and far objects are focused by the lens upon the sensitive surface of the retina.

Courtesy C. H. Stoelting Co.

Figure 55 A color mixer. Two, or more, colors may be mixed in any proportions. As the disks are rotated rapidly, only one color is seen.
Some Important Facts in Visual Perception

Objects differ in color, size, and form, and they lie at varying distances from us. The eye, supplemented by the other senses, enables us to become acquainted with the characteristic qualities of people and things.

(1) how we see color

Visual experiences of color may be classified according to hue, brightness, and saturation. The hues are the reds, greens, oranges, purples, and other familiar colors. Brightness is a matter of the intensity of the visual experience. Brightness ranges from pitch darkness to blinding glare. A given color, blue for instance, may be very bright or very dull—that is, it may vary in brightness over a wide range. Artists sometimes use the terms tint and shade to refer to colors that are somewhat lighter or somewhat darker than the color as ordinarily seen. Saturation is a matter of the richness or amount of color present in the hue. The larger the amount of white present, the lower the saturation. A blue may be a deep-navy blue—may have much saturation—or it may be a washed-out or faded sky-blue and have little saturation.
The psychological attributes of color, hue, brightness, and saturation are related to known physical properties of light. Figure 53 shows how a beam of light from the sun when scattered by a prism separates into light waves of different lengths. This phenomenon is seen in nature when the rays of the sun shining through the rain are refracted or broken up by raindrops to give the rainbow. Hue or color quality depends upon wave length. As seen in Figure 53, red has the longest wave length (about 700 millimicrons* ) and violet the shortest wave length (about 400 millimicrons), with the other colors falling in between. Waves of shorter length than violet (ultraviolet) are not visible, but their effects are often painfully evident, as when one develops a burn from overexposure to the sun’s rays. Waves of greater length than red (the infrared) are perceived as heat, not light.

Brightness depends upon the energy or intensity of the light waves per unit area. Brightnesses ranging from white through gray to black constitute what is called the achromatic series, while the chromatic series is made up of colors, as shown in Figure 53. Saturation depends upon the amount of mixture in, or complexity of, the light waves. Pink, for example, has less saturation than a deep rose red.

Psychologically there are four primary colors: red, green, yellow, and blue. The artist usually thinks of green as a blend because it is a mixture of yellow and blue pigments, but as a visual experience green is a unitary or pure color. We readily perceive orange, for instance, as being more or less reddish or yellowish, and purple as being both red and blue. But we see green as a single color, just as we do red and blue. The colors of the spectrum—red, orange, yellow, green, blue, indigo, and violet—are produced as shown in Figure 53 when a beam of light from the sun is refracted by a prism. This designation of seven visible colors is somewhat arbitrary, but it is traditional. It is clear that red, green, yellow, and blue shade into

* A millimicron = .000001 millimeter.
the various blends—orange, yellow-green, green-blue, and purple. Many of the colors observed in nature are mixtures, as are also the colors seen in clothes and in manufactured articles. Commercial colors (blends) often bear picturesque labels: fuschia, beige, cerise, aquamarine, maize, and orchid.

(2) color mixture

A good deal of the information concerning color vision has been gleaned from experiments in which colored lights were mixed on a color wheel (see Figure 55, on page 114). Cardboard disks of different colors (for example, red and green) are fitted together on the color wheel to form a circle. The sector or degree of red (or green) can be varied from one-half to any fraction of the total circle. When the color wheel is rotated, the sensitive cells of the retina are stimulated rapidly and in succession, first by one color and then by the other. If rotation is slow, a marked alternation of color, called flicker, occurs; as the speed of the wheel increases, flicker is replaced by a steady and uniform hue. Three laws of color mixture have been formulated from color-wheel experiments.

1. For every color, another can be found which, when mixed with the first in the right proportion, yields white or a neutral gray. For example, yellow and blue sectors can be so adjusted as to give gray, as can red and blue-green sectors. Such pairs of colors are called complementary.

2. The mixing of two colors which are not complementary results in a color of intermediate hue. Red and yellow give orange; blue and green give a blue-green.

3. If, when mixed on the wheel, two separate disk combinations give the same color sensation, these disks will in turn give the same color sensation when all four are mixed together. Thus, if a certain yellow and blue mixture yields a neutral gray, and a certain red and green mixture gives the same gray, these four, when mixed together, will give the gray obtained in the separate mixtures.
The first of these laws is perhaps the most useful to artists, painters, and dressmakers (see page 186).

The laws of color mixing apply to lights, not to pigments. It is a well-known fact that the artist regularly mixes yellow and blue pigments to get green. When yellow and blue pigments are mixed, the yellow pigment absorbs all wave lengths that would be reflected by the blue pigment except those for green, while the blue pigment absorbs all wave lengths that would be reflected by the yellow except those for green. Mixing the two pigments, therefore, gives only green. This is called “mixing by subtraction.” On the other hand, lights mixed on the retina, are additive. When two complementary colors—for example, yellow and blue—are mixed in right proportions on the retina, we get a sensation not of green but of a neutral gray or grayish white.

(3) color-blindness

People who do not possess the normal ability to distinguish colors or hues are said to be color-blind. Color-blindness results

**FIGURE 57**
The gray circle takes on the color of the negative afterimage of the large square.
from a lack of certain retinal cells, or from a lack of certain light-sensitive substances in the retinal cells. Night-prowling animals such as the cat are totally color-blind. The bee, and perhaps other insects, can see two colors, yellow and blue, while birds and most mammals, apparently, see all colors. Color-blindness or color-weakness occurs infrequently in women but it is found in varying degrees in 6 to 7 per cent of men. Total lack of color vision is very rare in man, the most common form of color-blindness being the inability to distinguish red from green. Figure 56 shows in an interesting way how the world looks to the totally color-blind, to the red-green color-blind, and to the normal human eye.

A color-blind man tells a dark-red tie from a light-green tie mostly by brightness and saturation differences. The red tie will be matched for hue against a muddy yellow-brown, the green against a light-gray or dull-blue. When red and green traffic lights are mixtures, the red a yellow-red and the green a bluish-green, the color-blind driver can tell one from the other by hue, without having to rely upon brightness and saturation. Color-blindness is an occupational hazard for railroad engineers and for pilots, and it is a distinct handicap to the dry-goods salesman and others who must work with colored materials in their business or profession.

A general loss of visual sensitivity arising from a deficiency of vitamin A is found in "night-blindness," a condition in which the eye's adaptation to low illumination is so poor that objects in a dim light can barely be distinguished. Night-blindness is sometimes relieved by the addition of vitamin A to the diet; but it does not appear that color-blindness can be alleviated to any considerable extent by the administration of vitamins.

(4) adaptation and contrast

Many factors in brightness and color vision contribute to visual perception. One is the phenomenon of adaptation to brightness. If we go out into the bright sunlight from a dimly lighted theater, at first we do not see things clearly, but in a short time
our eyes become adapted to the increased illumination, and objects appear as they normally do.

Color vision is not as good under lowered illumination as it is in ordinary daylight. In twilight, for example, reds appear somewhat darker and blues somewhat brighter, while green is brighter even than yellow—ordinarily the brightest color. Knowledge gained through experience keeps us from making many errors when perceiving colors under twilight illumination. A red coat looks brighter in sunshine than it does in shade, but it is still unmistakably red. Our ability to identify colors correctly, in spite of illumination changes, is called “color constancy.” Color constancy demonstrates the fact that our perceptions are not determined solely by sensory experiences.

According to the first law of color mixing, certain colored lights when mixed in proper proportions give a neutral, white-gray sensation. Such color-pairs are called complementary (page 117). Red and green (more accurately a green-blue) and yellow and blue are complementary colors, while black and white are complementary brightnesses. Complementary colors possess interesting reversible qualities. If we gaze intently at a bright red circle (a picture with a circular red frame will suffice) for ten seconds and then shift the focus to a blank wall (white or gray), a greenish blue circle will appear—the so-called negative afterimage of red. Nearly everyone has had the experience of coming in from the bright sunshine (mostly yellow light) out-of-doors and finding that objects in a room take on a bluish tint. The negative afterimage for yellow is blue, for green it is purple, and for orange it is a blue-green. The negative afterimage of any color is always its complementary, as one can easily verify by looking steadily at some colored object and shifting the eyes quickly to a white or gray surface. This effect is obtained in Figure 57: the gray circle seems greenish against the red background, since the afterimage (green) of the red tints the neutral gray.

Complementary colors play an important role in visual contrast. The negative afterimage of a color intensifies its comple-
FIGURE 58 We get to know the world through a number of sensations at the same time, whether in an esthetic experience or in selecting the day's groceries.
mentary and vice versa, so that the vividness of both is increased. Color contrast is observed, for example, in combinations of a red coat and green-blue scarf or a green tie and a tan suit. Brightness contrast causes black print to stand out sharply against a dead-white sheet. Because of brightness contrast, a girl's skin looks whiter when she wears a black dress and browner when she wears white.

(5) physiological factors in distance and depth

Objects are perceived as far or near because of various factors, some physiological and some psychological. Figure 54 showed how the lens adjusts, by thickening or lengthening, to light rays from objects which are nearby or far away. Cues to distance are derived from strain in converging the eyes, from the pull of the muscles which alter the lens, and probably from changes in pupil size. Nerve impulses incited by the action of these muscles go to the brain, where they become distance cues.

A physiological cue to distance is provided by the size of the retinal image. A man a block away casts upon the retina an image much smaller than that of a man in the same room. Since we know from past experiences how large men are relatively, we interpret the "small man" not as a dwarf but as a man far away. Young children, however, often confuse size and distance.

Another important physiological cue to distance, as well as to depth perception (three-dimensional space), is the fact that images of objects cast upon the retinas of the two eyes

Courtesy Keystone View Company

FIGURE 59
Many public libraries are equipped with stereoscopes and large collections of pictures.
The prisms deflect the light rays from the two pictures so that they fall upon corresponding points in the two retinas, as they would if a single object were straight ahead (at $P$). The partition limits the vision of each eye to its own picture.

When a card is held between the two drawings, they merge into a single tunnel in three dimensions. The space between the two eyes—called the interocular distance—is approximately three inches, so that the right and the left eye see objects from slightly different angles. The fusion of these retinal pictures gives us a perception of three-dimensional space. This can readily be demonstrated by looking through a stereoscope (Figure 59).
Figure 62 With the left eye closed, hold a mirror so that you look at the mirror image of the right hand picture; then open the left eye. After a time, the figures will suddenly appear in three dimensions.

Lenses or prisms in a stereoscope fuse the image in the right eye and the image in the left eye into a single picture. The result is a perception in which distance and depth appear. Pictures viewed through the stereoscope are taken from points separated by the interocular distance, so that objects are seen in correct proportions. Amusing results are obtained when pic-
tures taken from positions several feet apart are fused by means of a stereoscope. We now get the effect of looking around corners, and objects are badly distorted. A man sitting in a chair, for instance, will have his feet and legs drawn out toward the observer, so that he seems to be a giant, at least as regards his extremities.

A familiar example of how binocular fusion of the right- and the left-eye images gives a perception of depth can be observed when one looks at the hands on a large clock first with the right eye covered and then with the left. The hands will appear to jump from one position to another as first one and then the other eye is used. When we look with both eyes, however, we get a single picture in which the hands stand out clearly from the face of the clock. It was thought at one time that in flying an airplane, physiological cues given by the two eyes were absolutely necessary for perception of distance and depth. A famous one-eyed aviator demonstrated clearly that these cues were certainly not crucial in flying, however important they may be in ordinary perception.

(6) psychological factors in distance and depth

Psychological cues to distance and depth are just as important as are physiological factors, perhaps even more so. Among psychological factors may be mentioned superposition; perspective; variations in lighting, shadows, shade and color; and relative size. Two of these, perspective and relative size, can also be classified as physiological—or partially so.

(a) superposition If a parked automobile obscures the side of a house, we immediately infer that the automobile stands between us and the house which it partly covers. The superposition of people against buildings, of one building against another, and of trees and houses against a mountain range provide valuable cues to distance perception.

* This is called binocular parallax.
(b) perspective  Small objects are usually interpreted as far away, larger objects as nearer by. All of us have seen that as we look down a railroad track, the rails seem to converge at a point far away. The space between the rails appears to be much smaller at a distance than it is at our feet, but we interpret this convergence to mean distance, not an actual meeting of the rails. The decrease in the size of objects as they move away and their increase in size as they come nearer are employed by artists to represent relative distance.

Courtesy American Automobile Association
(c) variations in lighting, shadows, shade and color
Artists and stage directors depend to a considerable extent upon lighting and shade to represent distance and depth. (See Figure 65, below.) Near objects are placed “down” in the foreground and are in general brightly lighted. Far objects are placed “up” in the picture or on the stage and are less brightly lighted. Perspective is given by shadows, as for instance shadows cast by trees, people, and houses.

In general, cool colors (greens and blues) appear distant, whereas warm colors, such as reds, seem near. The artist represents distant mountains as bluish or having a purple tinge.

(Figure 65) Perspective may also be a matter of lights and shading.

(d) relative size
While the relative size of objects has usually been considered a physiological cue because of its dependence upon the retinal image, it is also a psychological factor. A small dog playing in the room is not judged to be as large as the horse some distance away, although the two animals may be represented by retinal images of the same size. The fact that objects retain their size despite differences in sensory

seeing FOUR 127
cues is an important psychological fact, called "size constancy." It shows the extent to which understanding and experience determine what we observe.

hearing

THE EAR

Sound waves entering the ear through the external opening pass through a series of interlocking bones to the inner ear, where sensory receptor cells pick up the vibrations. When the nerve impulses from these cells are carried over the auditory nerve to the brain center, we hear sounds. Sound waves ordinarily are vibrations of the air, but sound can be carried by...
various other media. For instance, in the open country the approach of a train may be detected by “listening” to the vibration of the rails long before any other sounds, except the whistle or horn, can be heard through the air. When the normal process of hearing is interfered with, one can often hear through the bones of the head (called bone conduction).

(1) attributes of sounds

The sounds which we hear in everyday life can be classified roughly into tones (smooth, harmonious sounds) and noises (discordant medleys of sounds). Sound waves move out in increasing circles from the vibrating body—a bell, a radio, or a squeaky door. As shown in Figure 68, sound waves can be compared to the increasing circles which we observe when a rock is tossed into a quiet pool. Tones—and sometimes noises—possess distinctive characteristics: pitch, loudness or intensity, and timbre.

A tone is described as of high, low, or medium pitch; a tenor voice is high-pitched, a bass voice low-pitched, and a baritone voice of medium pitch. The pitch of a tone depends upon the vibration rate of the sounding body. A slow vibration

![Figure 67](image)

*Figure 67* Sounds may be heard through bone conduction as well as through the ear.
rate, or vibration frequency, produces a low rumbling tone; a rapid vibration rate, a high tone. The lowest tone which a person can hear distinctly is from about sixteen to twenty vibrations per second: such a tone is heard as a low hum. The upper limit for tones in man is 20,000 to 25,000 vibrations per second. These very high tones are heard as a shrill or sharp whistle or screech. Vibration frequencies above 25,000 can still be heard as tones by some of the animals, but in man they produce, instead of a tone, a tickling sensation—often annoying and sometimes painful—upon the eardrum. Sensitivity to high tones wanes as we grow older, even when sensitivity over the middle range (for voices, music, common noises) is unimpaired. By means of the audiometer, an instrument for testing the acuity of hearing, the extent and degree of hearing loss can be determined.
Piano strings must be in regular order from the lowest pitched to the highest, but the arrangement of the instruments of an orchestra may be varied at will in order to achieve balance and harmony.

The loudness or intensity of a tone depends upon the amplitude or width of the vibrations given off by the sounding body. A string on a guitar, for instance, has a fixed pitch (vibration frequency), which can be made softer by giving the string a weak pluck. A vigorous twang causes the string to vibrate at the same pitch but with greater amplitude.

Timbre is characteristic tone quality. The difference between the same note on a piccolo (high and shrill) and on a violin (rich and full) is a matter of timbre. Timbre depends upon the number of overtones present, and upon their frequencies and intensities relative to the fundamental tone.
(2) overtones, beats, and different tones

A vibrating body—a string, for instance—in addition to the vibration along its whole length which gives the pitch of the fundamental tone, also vibrates in parts, the new tones having frequency rates which are multiples of the rate given off by the whole string. These additional tones, which add uniqueness and character to the fundamental tone, are called overtones. The vibration rate of half the string—called the first overtone—will bear the ratio of 2:1 to the vibration rate of the whole string. Other overtones have frequency rates three or four times that of the fundamental; and all of the overtones obviously have higher pitches than the primary tone.

Another common phenomenon of hearing occurs when two tones of slightly different pitch (vibration frequency) are sounded together. Fluctuations in loudness, called beats, result. What happens is, first, an interference or blocking when the crest of the one sound wave strikes the trough of the other (giving approximate silence or a dampening of sound); and second, a reinforcement or strengthening, resulting in increasing loudness, when the crests or troughs of two waves coincide (see Figure 70, below). The number of beats per second depends upon the difference in vibration rate of the two tones: thus, two tones of 512 and 520 vibrations sounded together will produce eight beats per second. As the difference in vibration rate between the two sounding bodies increases,
beats are first heard as a roughness or unpleasantness in tone quality. Gradually the beats disappear and a new tone, called a difference tone, can be heard, its vibration frequency equalling the difference between the two primary tones. In listening to the hum of his motors, an airplane pilot may use the presence or absence of beats as an indication of whether the two motors are running at the same speed.

(3) resonance

In addition to giving off overtones, musical instruments also have distinctive resonating qualities. Resonance is caused by sympathetic vibrations in the surrounding media which have the same frequency rate as that of the note sounded. If, for example, standing close to a piano we strike a bell which has

**Figure 71** Studio 8-H as it was originally built, redesigned for improved acoustics, and after conversion for TV.
the same vibration rate as that of one of the piano strings, the
string will give off a distinct sound. It is said that a singer with
a powerful voice can shatter a fragile goblet by singing a note
of the same vibration rate as the goblet. In fact, the famous
tenor Caruso is reported to have done just this.

We are all familiar with the difference in resonance quali-
ties between a soft wood-wind instrument and a blaring brass
instrument—the clarinet and trumpet are examples. A radio
with a large resonance chamber gives off a richer tone than
a radio with no supporting resonance equipment. Timbre or
tone quality of a musical instrument, then, depends primarily
upon the number and quality of the overtones and upon
resonance quality. There are other factors which help deter-
mine timbre, but these are the most important.

Voices differ in pitch, loudness, and timbre. Ordinarily we
do not recognize these as separate elements when we hear a
friend's familiar voice. The intonation, pronunciation, char-
acteristic expressions and ways of speaking, nasal twang, or
slow drawl all furnish cues. Sometimes we rely upon one of
these, sometimes upon several. Experts can identify the part
of the country from which a man comes by having him pro-
nounce certain words or phrases.

AUDITORY PERCEPTION OF SOUND
AND SPEECH

The perception and identification of the various sounds—
music, noises, speech—depend upon a variety of cues in addi-
tion to the factors of pitch, loudness, and timbre. Often we
place a sound by vision, as for example when we identify a
hum as coming from an airplane instead of from a passing
motor truck. Set or predisposition is a strong factor in deter-
mining what we shall hear and not hear. If we are listening for
the telephone, almost any tinkling sound will be immediately
interpreted as the telephone ringing. On the other hand, we
may become so absorbed in an interesting story that the music
of the radio is no longer "heard." If the music suddenly stops,
however, the listener is usually aware of the fact, indicating that the sound of the music was being temporarily inhibited or blocked out (page 328).

When listening to a speech or to a lecture, ordinarily we get only a few key words and phrases and fill in the rest from the context. Such listening is akin to skimming through a newspaper, hitting a few phrases here and there and inferring the rest. A common difficulty with beginners who are learning a foreign language is that they listen intently for every word instead of trying to get the general impression conveyed by key words and phrases. Listening for every word, as in reading
every word, often causes a person to lose the sense of what he is perceiving. In fact, we may say of such a person that he does not see the woods for the trees nor hear the melody for the notes.

**FIGURE 73**
In the pseudo-phone, each trumpet is connected with the opposite ear by a tube running over the head.

**PERCEIVING THE DISTANCE AND DIRECTION OF SOUND**

The distance away of a tone or noise is first judged (somewhat tentatively, to be sure) by its loudness: loud tones are likely to be close by, faint tones far away. Since faint tones may also be close by, however, we generally supplement our auditory impressions by visual and other information. Sounds are located directly ahead, to the right or the left, or above our heads, partly at least by the relative strength with which the sound waves strike the two ears. This has often been demonstrated in the laboratory in studies of sound localization. For
instance, a person may be seated in what is called a sound cage. (See Figure 72, on page 135). If the subject is blindfolded and clicking sounds are made at different points of the sound cage, perception becomes almost entirely dependent upon auditory cues. Under these conditions it has been found that sounds are best localized when they are to the left or right—that is, when the sound vibrations reaching the two ears differ most sharply. When the clicking sound is presented directly in front of the subject, he localizes it with fair accuracy by reason of the equal stimulation received by both ears. The poorest localization is that of sounds directly overhead; this is especially true when sounds are too far away for the difference in stimulation of the two ears to be of much help. Most of us have had the experience of hearing the sound of an airplane motor and having to look vaguely over the sky in order to locate the plane.

Echoes are often important in enabling us to locate the source of sound. The echo of a foghorn, for instance, from a boat which we cannot see will enable us to locate it approximately. Blind people who are forced to rely largely upon hearing are able to locate walls and other obstacles by the sounds (made by a tapping cane, perhaps) reflected from them. When a blind person's ears are plugged, he loses the ability to tell how far away he is from a wall or chair.

Interesting effects are obtained when the sound which normally enters the left ear is conveyed to the right, and when that which enters the right ear is carried to the left. Studies with the pseudophone (Figure 73), an instrument which accomplishes this reversal, give amusing evidence of our reliance for localization upon the comparative strengths of the stimuli received by the two ears. For example, a subject equipped with a pseudophone will at first see a horse trotting on the right and hear the sounds of the trot coming from the left. It is significant, however, that in experiments with the pseudophone visual and other cues prove to be so strong that after a time sounds seem to come from the object which is actually
producing them. Apparently our general dependence upon vision in everyday life is so firmly rooted that the discrepant impressions received from the two ears are forced into a perception which we "know" to be correct.

**other sensory receptors**

**Skin Senses**

The skin (page 112) contains four kinds of sensory receptors: for pressure or touch, for warmth, for cold, and for pain. The *epidermis* or outer layer of the skin is thin and non-sensitive; it is the *dermis* or inner layer which contains the cutaneous receptors. The sensory end-organs in the skin for pressure (and perhaps for warmth and cold) are small cones or corpuscles in which the sensory nerves terminate. The so-called free nerve endings in the dermis constitute the principal sensory receptors for pain.

Most sensations received from the skin are compounds of nerve impulses from several receptors. Thus *wetness* is usually touch and cold; *stinging* or *pricking*, touch and pain. Tickling, which may be pleasant or quite unpleasant, is mostly touch or pressure, sometimes with pain and other sensations added. The skin senses show the same contrast and adaptation phenomena found in vision (page 119). Suppose that the right hand is put into a vessel of hot water and the left hand into a vessel of cold water. If both hands are then withdrawn and placed simultaneously in a lukewarm solution, the water will feel quite cool to the right hand and quite warm to the left. What happens is that in the right hand the warmth receptors are adapted (or "satiated") so that the sensitivity of the cold receptors is increased, whereas in the left hand the cold receptors are adapted or satiated and the warmth receptors oversensitized. As a result, we have both adaptation and contrast effects.
Special sensory receptors, or “taste buds,” located upon the tongue and within the surface of the mouth area enable us to taste substances placed in the mouth. It will come as a surprise to many to learn that there are only four elementary taste sensations: sweet, sour, salty, and bitter. The great variety of tastes which we all experience are in reality blends—mixtures of two or more elementary tastes plus contributions of smell, temperature, touch, and even pain. The taste of orangeade, for example, is a compound of sweet, bitter, and cold plus a characteristic “orangey” odor. So well blended is the combination, however, that ordinarily we never analyze it, although we have no difficulty in identifying it immediately.

The sensory receptors for smell are located high up in the nasal cavity. As is true of taste, the number of distinct odors is few. In fact, there are probably not more than six elementary odors, in spite of the multiplicity of smells which daily assail our nostrils. These primary odors are described as (1) spicy (cloves), (2) fragrant (violet or rose), (3) ethereal or fruity (orange or lemon), (4) resinous (turpentine or pine needles), (5) putrid (rotten eggs or decaying fish), (6) burned (tarry substances or scorched coffee grounds).

Most of the odors which we perceive in everyday life are combinations in various strengths of these six primary odors. Furthermore, just as most odors and tastes are blends, so flavor is a compound of smell and taste. If the nose is tightly plugged, so that the receptors for smell are cut off, a blindfolded person cannot tell whether the substance placed on his tongue is a slice of potato, onion, or apple. Most of us have experienced the loss of “taste” which results from a severe head cold.

**Organic and kinesthetic senses**

Organic sensations cover a variety of impressions from the internal organs of the body, of which hunger, thirst, and nausea are examples. Sensations from the muscles, tendons, and joints constitute the kinesthetic sense, the word “kinesthetic” coming
from two Greek words which mean "movement sense." If it were not for the sensory receptors in the muscles and tendons, we would not know the positions of our arms, legs, and other body parts unless we could see them or touch them. This is shown quite dramatically in tabes, a disease of the central nervous system in which the sensory receptors in the spinal cord are affected. A person suffering from tabes walks in a jerky, uncoordinated manner. He can move his legs well enough—the muscles are intact—but he gets no returning sensation from the muscles and joints, so that he does not know where his feet have been placed unless he can see them. If blindfolded, such a person finds it almost impossible to walk, because he can no longer control his movements visually.

**EQUILIBRIUM OR POSITION SENSE**

Certain sensory receptors in the inner ear provide the data enabling us to maintain our upright posture and in general our sense of steadiness and direction in movement. The position sense organs consist of fine hair cells which are bent one way or another by the movement of fluid in the canals of the inner ear. When the head is moved from side to side or up or down, the push upon the hair cells gives us a cue to the movement. Perhaps we have all experienced the sensation of continued movement when the car in which we were riding stopped suddenly. The position or equilibrium sense enables a cat to fall on its feet and fish to stay right side up in the water.

The receptors for position are strongly stimulated when we whirl around vigorously, turn somersaults, or are halted suddenly in an elevator. The dizziness which results from too much spinning or turning or even swinging is, in part at least, a result of strong and persistent stimulation of the sensory cells in the inner ear. Psychologists have used the rotating chair to study ability to judge position and direction of movement. If a person is blindfolded and then rotated smoothly, he can tell when he starts, and he perceives the direction of rotation. With continued turning, however, he soon loses any sense of move-
ment and, if suddenly stopped, thinks he is turning in the opposite direction. What happens is that the hair cells have been stimulated in the forward direction (giving a perception of forward movement), and their swing-back to equilibrium gives an illusion of movement in the opposite direction.

Knowledge of position and movement is greatly aided by vision and by the kinesthetic and the skin senses. In an airplane the pull on the seat belt is a cue to direction of movement. If the plane flies upside down and is too high for us to see the ground, the position and visual senses are of little value, and we are reduced to muscular and organic cues which are often very disturbing.

Sensory impressions from the receptors are carried over the nerve pathways to the central nervous system, whence they go out to the effectors—the muscles and glands. The central nervous system is, therefore, a carrier of messages; but more important it is an organizer and regulator of behavior. For both of these reasons it is of interest to psychologists.

**THE CENTRAL NERVOUS SYSTEM**

The central nervous system consists of the brain, the spinal cord, and various nerve connections.* A general view of the central nervous system (see Figure 74, on page 142) shows the nerve pathways radiating from the nerve centers to the various parts of the body. A complete nervous unit, called a neuron, consists of a cell body and the fibers which radiate from it. Neurons are mainly of two sorts: sensory, which bring in impulses from the receptors; and motor, which carry messages from the brain and spinal cord to the effectors. A third variety of neuron, the associative, acts as an intermediary connector between the sensory and motor centers.

* For autonomic nervous system see page 232.
The Cerebrum (right hemisphere)
12 Cranial Nerves

8 Cervical Nerves

12 Thoracic Nerves
Innervate the Torso

5 Lumbar Nerves

5 Sacral Nerves in conjunction with the Five Lumbar Nerves, Innervate the Lower Torso and Legs

Olfactory Bulb
Hypophysis (pituitary body)
Pons
Medulla Oblongata
Cerebellum
Spinal Cord

Brachial Plexus to the Arm

Chain of Vertebral Ganglia, the Basic Nerve “Skeleton” of the Autonomic System

Lumbosacral Plexus to the Pelvis and Leg

FRONTAL VIEW

FIGURE 74 Diagram of the nervous system showing the relationship of the cranial nerves, the spinal nerves, and the autonomic ganglia.
nerve impulses and the all-or-none principle

Research has shown that the nerve impulse is an electrochemical disturbance—an intermittent series of tiny explosions which travel along the nerve fiber at a speed of 200–300 feet per second. Nerve impulses are far slower than the speed of light and considerably slower than the speed of sound, but are still fast enough to provide for very quick responses. A normal adult, for example, will react to the sudden blast of a horn in about one-fifth of a second. And even pain impulses, which travel more slowly than visual and auditory, are “felt” in half a second or less.

An early view of nerve energy held that nerve fibers from the eye carry impulses different in kind from those originating in the ear or skin. It is now known, however, that nerve impulses are qualitatively the same wherever they originate and whether they traverse sensory or motor neurons. Our sensory experiences depend upon the place in the brain where the incoming fibers terminate, and there is no specificity in the nerve impulses themselves. If the visual and auditory nerves could by some miracle be interchanged so that the visual led to the auditory area in the brain, and the auditory to the visual, we could, perhaps, “hear lightning” and “see thunder.”

If a nerve responds at all to a stimulus, it responds to the best of its ability. This is called the all-or-none principle and is analogous to what happens when we press the trigger of a gun: either the gun fires or it does not; it cannot go off halfway. On the all-or-none principle it might appear that nerve impulses would never vary in strength, since the nerve would either respond to the stimulus or fail to respond. But this is incorrect for two reasons. A strong stimulus arouses more nerve fibers than a weak stimulus—as witness the difference between a touch on the skin and a blow. A strong stimulus also provokes more nerve impulses per second (crowds more into a given time) than a weak stimulus. In both cases the motor responses is likely to increase with the strength of the stimulus.
the synapse

The great variety of behavior activities which we see in everyday life is made possible by the multiplicity of connections within the nervous system. The point where the fibers of a sensory neuron make contact with those of a motor neuron is called a synapse. There is no structural continuity between two neurons at the synapse, contact being established in much the same way as when one runner in a relay race passes the baton to another runner or when the limbs of adjacent trees interlace and touch each other. Neurons are not tied together chain-fashion. One neuron may make synapses with several associative neurons and thus transmit the impulse in a variety of directions (see Figure 75, above). In reflexive and highly automatic behavior (see Habits, page 333), the synaptic connections are firmly established and the activity runs off smoothly. Synapses are affected by drugs, by fatigue, and by other factors. Hence the passage of a nerve impulse may be
slowed up or even blocked entirely at the synapse; or it may be facilitated and hurried along.

**THE CEREBRUM**

The relation of the parts of the brain to the brain stem and the spinal cord is shown in Figure 76. The "higher centers"—that is, the cerebrum and cerebellum—are connected by way of the brain stem with the "lower centers" in the spinal cord. The cerebrum consists of two hemispheres, the right and the left, and occupies most of the skull cavity. The cerebrum appears as a large sponge-like mass, its surface marked by deep indentations or wrinkles called fissures. Nerve cells and their entering and leaving fibers constitute the so-called gray matter which lies on the surface of the cerebrum and makes up the cerebral cortex (or bark). The white matter of the brain lies beneath the cortex and is composed mainly of connecting fibers and supporting tissue. (See Figure 77, on page 146.)

**FIGURE 76** Diagram showing the location of the parts of the brain and the spinal cord.
In the human species the cerebrum or “new brain” completely overlies the old or primitive brain and the brain stem. Study of the evolution of the human brain reveals a progressive increase in the size of the cerebrum in proportion to the nervous system, and a progressive dominance of the cerebrum over the lower centers. It is in the possession of a much larger cerebrum that man’s nervous structure differs most markedly from that of other vertebrates. Man does not possess the largest brain in the animal kingdom in absolute size, the brains of the elephant and the whale being larger. But in relation to body weight, man’s brain is heavier than that of either the elephant or the whale. In the animal closest to man, the gorilla, the ratio of brain-weight to body-weight is 1/225, whereas in man it is 1/50—that is, man’s brain capacity is four and one-half times that of the gorilla’s in terms of the brain/body ratio.
The *cerebellum* is located toward the back of the skull cavity and is almost covered by the cerebrum (see Figure 76, on page 145). The psychologist's interest in the cerebellum lies chiefly in its function as a motor coordinating station between the cerebrum and the spinal cord. Centers for body balance and muscle tone lies in the cerebellum. The *medulla*, the bulbous part of the brain stem (see Figure 76, on page 145), is the center of control of several vital functions: breathing, swallowing, heart beat, digestion.

**THE THALAMUS**

The *thalamus* consists of two egg-shaped masses lying almost in the center of the brain. The thalamus receives sensory impulses from the receptors and distributes these to the cerebrum; it thus acts as a receiving as well as a relaying station. The lower part of the thalamus is concerned with motor impulses which control the vital functions of the body: metabolism, body temperature, sleep. The thalamus is sometimes called the "seat of the emotions" (page 234). When the cerebral cortex of an animal has been removed by operation, the animal exhibits vigorous and easily aroused emotional behavior. This accentuated activity which is initiated by the thalamus arises in part from the absence of the inhibiting and controlling function exercised by the cortex.

**LOCALIZATION OF BRAIN FUNCTION**

A great deal of research has shown that certain areas of the cerebral cortex have fairly specific functions. The *motor* area of the brain lies in the frontal lobes (see Figure 77, on page 146), just in front of the central fissure. Here are located the large motor cells from which impulses go out to the muscles and glands. Injuries in this area lead to paralysis and loss of voluntary movement. The *somesthetic* area lies just behind the central fissure in the parietal lobe. Stimuli from the sense organs in the skin and within the body eventually reach this...
center by a system of relays or intermediate stages through the lower centers of the brain and the spinal cord. Injury to the sensory area results in a loss of sensation in the arms, legs, skin, and other parts of the body. Other specific sensory areas have been localized for speech, vision, audition, taste, and smell. Roughly three-fourths of the remaining cortex is made up of associative neurons, the function of which is to connect and organize the sensory-motor relations.

**speech center**

For a long time brain physiologists thought that the center for articulate speech lay in the lower part of the frontal lobe (left hemisphere). Here a speech area was demarcated, called Broca’s area, after the early physiologist who first located it. Recent studies have shown that articulate speech cannot be definitely limited to one area. While Broca’s area is one important speech center, other centers for speech are located in the parietal and temporal lobes (see Figure 77, on page 146). In fact, a large part of the associative areas of the cortex probably is concerned with speech.

**visual center**

The visual center lies in the occipital lobe (Figure 77) in the back of the skull cavity. Injury to the primary visual area leads to partial or total blindness. Injuries to the surrounding associative areas often result in what is called word-blindness or object-blindness (page 398). The individual so afflicted is not blind, but he is unable to understand what he hears or reads, or to recognize familiar objects.

**auditory center**

The auditory area is located in the temporal lobe just below the fissure of Sylvius (Figure 77). Injury to the surrounding associative areas may lead to various impairments, one of which is called aphasia. In motor aphasia the patient is not deaf and knows what he wants to say but has difficulty in
speaking connected sentences or finding the right word (page 383). A mild degree of aphasia is experienced by many people when they are greatly fatigued or excited.

senses for taste and smell

The areas for taste and smell lie in the lower part of the temporal lobe, and in that part of the brain between the two hemispheres. These areas are part of the old or primitive brain and are more highly developed in many animals than in man.

higher organizing functions of the brain

No centers or compartments in the brain are localized for such psychological functions as perception, memory, or learning. The perception of an object or the performance of a learned act is a cooperative activity in which many parts of the brain and the nervous system take part. In learning the words of a new language, for example, there must of necessity be organization among visual, auditory, and verbal receptive centers and the various motor responses operative in speaking. Sensations from the eye and ear reach their primary receptive centers in the cerebrum, are elaborated through adjacent associative areas, and are then carried to the motor areas, to emerge eventually as spoken words. It is the task of the associative neurones to carry out these complicated interactions within the nervous system. Anatomists estimate that in the human cerebral cortex there are approximately twelve to fourteen million neurones—enough to allow for exceedingly complex behavior.

The frontal lobes are much larger in the human than in the animal brain. For a long time these regions were regarded as the centers for thought, reasoning, and the "higher mental processes" such as intelligent understanding (page 450). But there is no good evidence for the existence of specific centers of this sort in the frontal lobes. In fact, it has been found that
even after extensive damage to the frontal lobes an individual may function almost normally, with little or no loss of memory, learning ability, and so on. This has led to the view that much of the cortex is "equipotential"—that it has the potential capacity for taking over the functions of areas which have been damaged or destroyed. The ability of the rat and the monkey to recover from operations involving brain tissue removal and later to demonstrate normal or almost normal behavior shows the degree to which restitution of function or transfer of function is possible.

In recent years brain surgery has been used in an effort to relieve patients suffering from mental illness. In psychosurgery, as it is called, various parts of the frontal lobe are removed or the connections of certain parts with the rest of the brain are severed, the parts themselves being left in the skull cavity. Even extensive operational damage to the brain has been found to result in little loss in mental ability as revealed by standard tests. But the patient is often relieved of anxiety, becomes tractable and good tempered, and behaves rationally. After brain surgery, however, there is often a lack of concern for and interest in business or other activities, and an unwillingness to carry on sustained effort.

**effectors**

The effectors (page 112) consist of the muscles and glands. There are two sorts of muscle tissue—the *striped* and the *smooth*. Striped or skeletal muscles move the arms, legs, and body generally. Striped muscle responses vary in complexity from the simple flip of a finger to the careful articulation of a sentence in a foreign tongue. Smooth muscles carry on automatic and semiautomatic responses such as breathing, blinking the eyes, swallowing, and weeping.

The glandular effectors are also of two sorts: *duct* and *ductless*. The duct glands—for example, the sweat or the sal-
ivary glands—pour their secretions directly upon the skin or mucous membrane. In contrast, the ductless glands (the endocrines) empty their secretions directly into the blood stream. The endocrine glands play an important role in personality (Chapter 14).

Responses to stimuli are often described as occurring on three reaction levels: (a) the reflexive, (b) the spinal, including the lower brain centers, and (c) the cerebral. This is a useful and convenient classification, but it must be understood that these levels overlap and are not in any true sense independent.

(a) The simplest reaction unit is the reflex arc, which may involve only two neurons (see Figure 78, below) but probably requires three or more. A reflex is an unlearned response to a sensory stimulus. It is the fastest human response, the latent time* of the knee-jerk or patellar tendon reflex being only .03 second. While the reflex is in general a dependable bit of behavior, it can be altered, modified, and even blocked by fatigue, distraction, and emotional tension.

(b) Second-level responses involve those old brain structures below the cerebrum. In an evolutionary sense, these

* Latent time = period elapsing between stimulus and response.
structures are more primitive than are those of the cerebrum, and in the lower animals may serve as the closest equivalent of the new brain. Reactions on the second level include vegetative responses which regulate, control, and protect body functions.

(c) Conscious behavior requiring a high degree of coordination and integration, as in learning, intelligent planning, thinking, and reasoning, is carried on at the cortical level. Loss of the cerebral cortex is far more serious in man than in the lower animals. In the absence of a cortex a fish, for example, exhibits little or no loss in learning ability, and a dog can still learn simple tricks. But the baby born without a cerebral cortex gives little evidence of learning ability equal even to that of a feeble-minded child.

**summary**

Our impressions of the world around us are gained by way of the senses, sometimes one and sometimes several sense organs being involved. Sense organs are affected by *stimuli*, which are energy changes in the environment. Stimuli received by the receptors (sense organs) are communicated by way of the nervous system to the effectors (muscles and glands).

A classification of the sense organs reveals many more than the traditional five senses. Seeing and hearing are often referred to as the "higher" senses because of their importance in everyday life. A great deal of information has been gathered on the physiology of the senses and the characteristic ways in which they function.

Impressions from the receptors are carried to the effectors through pathways in the connecting mechanism called the central nervous system. The most important part of the nervous system is the brain, a mass of tissue consisting of cells and connecting fibers. Functions like movement, speech, sight, hearing, taste, and smell have been located in specific areas of the brain. However, complex functions, such as perception, memory, and learning, involve the entire brain and are not localized.
1. Classify the senses according to whether they are responsive to stimuli (a) arising inside of the body, (b) directly affecting the body surface, and (c) coming from a distance.

2. Compare the taste of coffee when the nostrils are held closed with the taste of coffee when the nostrils are open.

3. See if you can localize the sensations in your joints or muscles when you (a) lift a book from the desk, (b) bend over to pick up a pin, (c) turn your head from side to side.

4. Look steadily for fifteen seconds at the red background of Figure 57 and then direct the eyes to a gray wall and note the color of the afterimage.

5. Look steadily for fifteen seconds at a black cross upon a white surface. Then direct the eyes to a plain gray surface and describe the afterimage.

6. Overtones can be heard by striking lightly the rim of a glass goblet. Try it.

7. With the eyes closed, try to distinguish objects of different shape by letting them rest upon the skin and then by handling them actively. What senses cooperate in supplying data for "active touch"?

8. Give some instances of color and of form constancy.

9. Hold a pencil about eighteen inches before the face and look at it first with one eye closed and then the other. Note how it shifts from side to side. Fixate on the wall and note how the pencil doubles. Can you explain?

10. Have someone read several lines of print while you stand in front of him and observe his eye movements. Do the eyes move smoothly across the page or do they seem to progress by short jerks?
11. Give examples of illusions due (a) to physical causes and (b) to "mental set" or expectation.
12. What advantages in depth perception does a person with two eyes have over a person who is blind in one eye? What "psychological" cues are used by the one-eyed person in determining the distance of objects?
13. If you send a red-green color-blind person out to buy a brown suitcase, what mistakes might he make in color, and what mistakes would he almost certainly not make?
14. How would the loss of the kinesthetic sense be a handicap to a tennis player?
15. What sensations enter into the flavor of foods?
16. How does one distinguish between sounds of the same pitch coming from different musical instruments?
17. List some of the cues which in your experience are used in locating the source of a sound.

suggested readings

1. For a thorough survey of what is known about the senses, read F. A. Geldard's *The human senses* (New York: John Wiley & Sons, 1953). This book will be somewhat difficult for the beginner.

2. For an elementary and well-illustrated treatment of the senses, see N. L. Munn's *Psychology*, 2nd edition (Boston: Houghton Mifflin Co., 1951), Part VII.


4. For a more elementary account of the physical bases of behavior than that given in (3) above, consult E. G. Boring, H. S. Langfeld, and H. P. Weld's *Foundations of psychology* (New York: John Wiley & Sons, 1948), Chapters 11–16.
Perception is that organizing process by which we come to know objects in their appropriate identity, as trees, men, buildings, machines, and so on. Perception does not operate like an adding machine: impressions are not cumulative; instead, the mind interprets and integrates what it receives. Artists do not see the same thing in a picture, and witnesses will report the same accident very differently, depending upon their age, sex, intelligence, and background of experience. A difference is often made between sensation and perception on the ground that sensation is the primary response of the sense organ, whereas perception is the meaningful apprehension of the stimulus-object. This distinction is of theoretical importance but is of very little practical value, since the two processes—sensation and perception—are not separated in experience. Except perhaps through a deliberate process of abstraction, we never have "pure" sensations of color or form or sound apart from associations with objects and other experiences.
If someone mentions in conversation the phrase “Capitol at Washington,” our nod of recognition will probably include a visual image of the building supplemented by verbally expressed memories of things seen and even of the fatigue felt in walking up many steps. A characteristic medical odor instantly reminds many people of a hospital ward, while the taste of lobster may call to mind interesting experiences during a seaside vacation. In response to the term “swimming,” many people report feeling as though they were gliding through water. Such a “kinesthetic image” probably arises from slight muscular tensions which pantomime the act of swimming. Perception in these cases differs little from imagination. In fact, imagination is really perception in which there is a minimum of sensory experiences. Hence we find in imagination greater play of fancy and less stimulus control than when the observer is faced by specific situations—an old friend, a football game, or a towering mountain range.

What we perceive, then, depends in part upon the nature of the stimulus and to an even greater degree upon ourselves,

---

**Figure 79** A meteor crater which becomes a mountain when the picture is turned upside down.

American Museum of Natural History
so that perception becomes the comprehension of a present situation in the light of past experience. Some of the important factors which determine the character of our perceptions will be treated in the following sections.

**attention and perception**

Attention is active behavior, a process of give-and-take with the environment. We are said to be attentive or to be giving attention when our sense-organ activity is focused upon some defined stimulus: sounds in the street, the conversation of our friends, changes in the weather, a bitter medicine, a lecture, or a tennis match.

Attention often shifts rapidly and may be of relatively short duration. Speeches which are tedious or dull do not hold our interest for long. Attention does not simply evaporate but instead shifts to something else: other people in the audience, the decorations in the lecture room, the noises made by people coming and going—almost anything but the lecture. In general, attention is captured and held by (a) demanding factors in the outside world, and (b) motives or other conditions within the observer. This is, to be sure, a somewhat arbitrary and overlapping distinction, but it serves as a useful starting point.

**attention-getting factors in the stimulus**

While attention is selective in the sense of our being able to shift our focus of activity from one situation to another, sometimes the direction of attention is not completely under our control. We may be faced, for instance, by stimuli which force themselves upon us—loud noises, bright lights, intense odors, and the like. Other characteristics of the stimulus which direct and control the flow of attention may be enumerated as follows.
Objects which fall into natural groups or in orderly arrangement more readily gain attention than do jumbles of odds and ends. Noises, to be sure, are often demanding, but they do not hold the attention and are less well perceived than are tunes and melodies which have order and form. The number of things which we perceive in any flow of attention will depend upon the time allowed for observations, as well as upon the number of separate objects presented. As we look out upon an active scene in a busy street, it will seem as though we are perceiving a very large number of activities. Actually, however, the number of separate and distinct impressions which an observer can grasp in an instant of attention is relatively small. *Perception span* (often called *attention span*) has been studied in the psychological laboratory by exposing pictures of objects upon a screen for short periods of time—say $1/20$ to $1/100$ of a second. These exposure intervals are too short to allow for eye movements, so that the observer gets only a glimpse of the stimuli. Under such strictly controlled conditions, the perception span is not large: approximately five or six separate objects or letters. It is interesting to note that when letters are organized into words and sentences, the number of letters perceived in these short exposure times increases to twenty-five or more, a clear indication that we perceive words as meaningful units and not as collections of symbols. Visual perception span is somewhat larger than auditory, for when stimuli are presented simultaneously, groupings and other logical arrangements can be made. When somewhat longer time intervals (up to five or ten seconds) are allowed, so that the observer can move his eyes readily over the objects presented, the number which he can grasp and report upon is called the *apprehension span*. Apprehension span is larger than perception span but is still not more than six to ten separate objects in five or six seconds. To verify this fact, try glancing in the crowded window of a store for five seconds, and then turn your back to the window and
see how many separate objects you can name. In everyday life, apprehension span is usually what is meant when one refers to the number of things perceived in a single movement of attention.

**Intensity and Contrast**

The *intensity* of the stimulus is a potent factor in determining what we shall attend to and hence perceive. Flashing neon lights, the blaring noises from a loud speaker, intense changes in temperature—all of these fasten upon our sense organs; they demand and usually get our attention. *Contrast* effects are also attention getting: a bright light in the darkness, a red-haired girl in a green dress, a tall woman dancing with a short man, a disreputable character in an expensive fur coat, an ignorant person who affects a broad-A accent are examples.

**Change and Movement**

Things in movement—a sign flashing on and off or a fire engine dashing along the street—tend to attract attention. *Repetition*, if loud and intense, as when someone calls for help or shouts our name or when a bell rings insistently, are stimulus factors.

![Figure 80](image)

*Figure 80* The groups of dots show the influence of proximity, similarity, and continuity; the dots combine by twos or are seen as a pattern or as an angle.
which demand notice. If continued, however, until they become monotonous, repeated stimuli tend to be ignored (page 328).

**STRUCTURES AND PATTERNS**

There is considerable experimental evidence to show that natural groupings or patterns in the world around us are immediately perceived as *organized wholes*. (See Figure 80, on page 159.) A blind man who suddenly regains his sight sees the world spread out before him as an orderly structure and not as a jumbled hodge-podge of form and color. Experiments with the "blind spot" reveal that experience has a "wholeness" quality about it. The point where the optic nerve leaves the retina of the eye is called the blind spot; and it is a well-established fact that the images of objects cast upon this area are not seen. Figure 81 illustrates this phenomenon. Close your left eye and fixate upon the X with the right eye, and the face will disappear when the book is held about ten inches away. It is important that the focus be held. The book will have to be moved tentatively out and in to find the appropriate distance.

We perceive objects in continuous arrangement, and not as full of holes, because the structure inherent in the landscape (and in ourselves) fills in the gap made by the blind spot. In a well-known experiment, glasses which invert objects were worn continuously by an observer. At first the world was turned topsy-turvy, but eventually knowledge, habits, and past experience proved too strong, and the observer "saw" things right side up. This same reorganization of the world according to experience occurs also with the pseudophone, as we have already seen (page 136).
We attach meaning to what we perceive, whenever possible, by assimilating the present into the past (page 170). In Figure 82, for example, the broken lines are perceived by most observers as a “word,” that is, as a whole, not as a collection of broken pieces. In skimming through a newspaper or magazine we often fail to detect misspelled words, or omitted letters in words, since we are reading words and not letters. The professional proofreader is often annoyed because in reading a book or magazine he is continually finding misprints and misspellings.

attention-getting factors within the observer; inner determinants of perception

A hungry man looks for restaurant signs, a woman shopper seeks eagerly for bargains in hats or shoes, an adolescent boy is “all ears” for a favorite television program. Factors within the observer which govern what he attends to and hence perceives include among others interests and attitudes, sets and expectations, suggestion, and needs and values.

**INTERESTS AND ATTITUDES**

It is a common experience that inattentive pupils may have their flagging interest restored by the introduction of some-

---

**Figure 82** It is easy to see the complete word and the dog; the knight on horseback is more difficult to see.
thing novel or different, or by the interruption of the class routine for a recreation or recess period. Advertisements, costumes, magazines, people, almost anything in which we have developed an interest, may serve to draw our attention. The pulling power which music and games or social and political events have for us depends upon the interests, attitudes, and habits which we have built up around them. The inattention or fleeting attention of young children and of old people is oftentimes a result of shifting or transitory interests. In very young children strong interests have not been developed, while in older people many interests have waned in strength.

SET AND EXPECTATION

Our attention is directed toward those things which we are "set" to receive. The individual waiting anxiously for a message interprets any sound as a knock on the door. The man eager to buy a late edition responds immediately to a newsstand which ordinarily he would pass by with hardly a glance. The automobile driver is alert to respond to traffic lights to which his passengers may give little heed.

In all these cases, the individual is prepared to react much as a runner is ready to leap forward at the crack of the starting pistol. When a person's behavior is dominated by a set or expectation, the actual stimulus may be little more than the signal for some already predetermined action. The effect of set on the reading of misspelled words is shown clearly in the following experiment. *

Ten cards (each containing a printed word) were exposed briefly in a tachistoscope,† and adult subjects were asked to write down what they saw on each card. Some of the letter combinations shown were real words (like "horse"), whereas

* Siipola, 1935.
† A tachistoscope is an instrument for presenting visual stimuli, such as pictures, words, or other symbols, for short periods of time. The exposure is often controlled by a falling screen, sometimes by a spring shutter or other device.
others were ambiguous and artificial for example, "dack," "sael." Subjects in the first group were told that the words had to do with animals and birds; those in the second group with travel and transportation. Table 10 shows the different ways in which the ambiguous items were interpreted when the persons reading them were expecting a certain kind of word.

10 Influence of mental set upon ambiguous items

<table>
<thead>
<tr>
<th>actual stimulus on card</th>
<th>words most often seen by those set for ANIMALS OR BIRDS</th>
<th>words most often seen by those set for TRAVEL OR BOATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>sael</td>
<td>seal</td>
<td>sail</td>
</tr>
<tr>
<td>wharl</td>
<td>whale</td>
<td>wharf</td>
</tr>
<tr>
<td>pasport</td>
<td>parrot</td>
<td>passport</td>
</tr>
<tr>
<td>dack</td>
<td>duck</td>
<td>deck</td>
</tr>
<tr>
<td>chack</td>
<td>chick</td>
<td>check</td>
</tr>
</tbody>
</table>

In another experiment designed to show the effect of set,* subjects were shown ordinary and trick playing cards. The trick cards were printed with reverse colors—for example, a black 3 of hearts, a red 6 of clubs. A measure of recognition time was taken—that is, the time which the subject needed to perceive the card correctly. It took much longer to "recognize" the trick cards than it did to recognize the normal cards. Four perceptual reactions to the incorrect cards were reported by the twenty-eight persons who took part in the experiment. They noted (1) compromise: colors were incorrectly reported—for example, the red 6 of spades was reported as a purple 6 of hearts. There was (2) dominance: either color or form determining the perception. The red 6 of spades, for example, was reported as a 6 of spades or a 6 of hearts. Finally, there were (3) disruption and (4) recognition of incongruity. Subjects

* Bruner and Postman, 1949.
were either confused and unable to answer, or else they recognized the incongruity on the card.

**Suggestion**

What one perceives is often determined by suggestion, sometimes direct and sometimes subtle. Children are more suggestible than adults, the degree to which they are influenced depending upon maturity and intelligence. Leading questions may be answered in the way the questioner wishes if he possesses authority or is very self-confident and assertive. The following well-known quotation from Shakespeare's Hamlet (Act III, Scene 2) is an illustration of prestige suggestion (either real or feigned).

*Hamlet.* Do you see yonder cloud that's almost in the shape of a camel?
*Polonius.* By the mass, and 'tis like a camel, indeed.
*Hamlet.* Methinks it is like a weasel.
*Polonius.* It is backed like a weasel.
*Hamlet.* Or like a whale?
*Polonius.* Very like a whale.

If an observer is placed in a dark room, a point of light which is in fact stationary will appear to move, sometimes as much as twenty degrees or more. This phenomenon is known as the *autokinetic* illusion: the movement is initiated by stimuli arising from within the organism itself. It has been found that the extent of movement which a single observer sees will change when two or more persons view the phenomenon together. A younger or more naive observer is likely to change his report to agree with that of his partner, if for some reason the partner possesses authority or prestige which he recognizes. In political gatherings one is often struck by the degree to which a magnetic speaker can control the ideas and expressed beliefs of the audience. Frequently a forceful and persuasive person will completely change the meaning which a situation has for a large number of people.
In a familiar experiment in the psychological laboratory, the subject is required to hold in his hand a wire coil attached to a black box upon which are several large light bulbs. When the experimenter ostentatiously turns on the battery of lamps with a loud click, many observers report heat against the palms of the hand, although no current whatever is passing through the coil.

Another laboratory experiment illustrates how suggestion can influence a simple sensory experience. Subjects in a darkened room* listened to a tone which increased in intensity from a point so low that it could not be heard to a point where it was clearly audible. During the time that the tone was on, the subject faced a clear glass plate lighted by a bulb from behind. After tone and light had been experienced together, the light might come on, and fifteen to thirty seconds later be followed by the tone. Subjects were instructed to press a key when they heard the tone and hold it down as long as they heard it. Thirty-two of the forty persons who took part in the experiment reported hearing the tone when the light only was present. Apparently, since the subjects expected the tone along

* Ellson, 1941.

Figure 83 In this illusion from a book for children, the rabbit is seen to enter the cage. Hold a card on edge on the white center line and keep both eyes open.

Child Life
with the light, the suggestion effect of the light was so strong that they reported hearing the tone when the light appeared. Everyday examples of the same phenomenon are "hearing" the telephone when a call is expected, or smelling an unpleasant odor before it is actually experienced.

NEEDS AND VALUES

A number of studies have corroborated the rather general belief that an individual's perceptions can be slanted and conditioned by such inner states as hunger, emotion, and ideas of value. In a series of experiments, the effects of different degrees of hunger upon perception were investigated. Deprivation from food varied from one to sixteen hours and the subjects, 108 sailors in the submarine service, were told that the experiments dealt with visual acuity—an important possession in their work. Pictures too vague in outline to be clearly identified were thrown on a screen and the subjects were instructed to write down what they "saw." In some experiments verbal suggestions were given, such as "three objects on a table; what are they?" In others, hints were loaded in the direction of food and eating. Thus subjects were asked to tell which of two vaguely suggested objects was larger—an ash tray or a hamburger, a plate (of food) or a picture. Results showed that the number of food responses increased with hours of abstinence from eating. The number of instrumental food responses (for example, knife, spoon, dish) also increased with the number of hours of deprivation from food. An interesting finding was that food objects tended to be reported as larger than non-food objects by the group deprived of food for sixteen hours.

A more nearly life-like study of the effects of hunger upon perception was carried out upon thirty-six young men who were subjected to a semi-starvation diet over a period of twenty-four weeks. These subjects had volunteered for the

* McClelland, and others, 1948.
† Brozek, and others, 1951.
experiment, and while the deprivation hardly matched the food loss of starving people, nevertheless the situation was more realistic than that found in most laboratory set-ups. When these men were shown the Rorschach ink blots (page 569), the number of food objects which they “saw” in the blots rose markedly during the first week but dropped off by the end of three weeks. Feelings of depression, as indicated by symptoms reported in personality inventories (page 556), increased significantly from the beginning to the end of the starvation period.

Tension and anxiety may also affect the character of one’s perceptions. In one experiment, a group of adults* was given the task of matching—that is, adjusting—the size of a circular patch of light thrown on a screen to equal that of a bright pink disk one inch in diameter. Four experimental conditions were imposed: (a) a simple matching experiment; (b) matching in which a mild electric shock had to be endured in order to get the disk from a charged grid; (c) matching as in (b) except that the shock was as strong as the subject was willing to bear; (d) matching finally with no shock as in (a). Results showed that the group made matches which were significantly larger in the final test period than in the first: that is, the standard disk appeared to be greater in size. This is taken to mean that relief from tension and anxiety induced by the shock sessions accentuated the subject’s estimation of size. Other experiments have borne out this finding—have shown, in fact, that anxiety and stress can affect even the speed with which subjects learn a simple association.†

A familiar and oft-quoted study‡ showed that poor children overestimate the size of coins to a greater degree than do wealthy children. Groups of ten-year-olds from rich and poor homes were asked to match variable cardboard disks against

* Bruner and Postman, 1946-47.
† Taylor, 1951.
‡ Bruner and Goodman, 1947.
a penny, a nickel, a dime, a quarter, a half dollar. Comparison of these matches showed that the poor children overestimated the coins to a greater extent than the rich children—the quarter having the largest overestimation error. This study may indicate that wealthy children have less need for money and hence underestimate its size, and that the greater the social need or value the more the perceived object is inflated. While this conclusion has been partially verified in other experiments, results often prove to be inconclusive. In another laboratory experiment* dealing with value as an inner determinant, forty subjects were instructed to place two stimuli at equal distances from the eyes. One of the stimuli, a light green cardboard rectangle, was placed at a fixed distance of 360 centimeters from the observer. A movable comparison rectangle of the same color and dimensions was then placed at a point from twenty to thirty centimeters nearer to or farther away from the observer than the standard. The observer’s task was to move the comparison rectangle back or forth until it was at the same distance as the standard. In the second part of the experiment, the light green cardboard rectangles were replaced by twenty-dollar bills, other conditions remaining the same. The average error made in judging distance was greater for the rectangle

* Bevan and Dukes, 1951.

**Figure 84** Illusion induced by after image: gray spots appear at the intersections of the white lines.
than for the twenty-dollar bill. The experimenters conclude that two principles explain this finding: (a) greater alertness for the value object and hence greater sensitivity, and (b) greater apparent size of the value object, which thus "reduces" the distance and so increases the accuracy of judgment. There have been a number of experiments dealing with the influence of value upon perception, and the consensus is that need and value are important in determining the object-character of the perception.

*FIGURE 85 How much larger is the center circle of the left group than the center of the right group?*

In addition to those already mentioned, various other factors in the environment, as well as in the experiencing person, give organization and meaning to perception. In many instances these "organizing factors" are crucial in determining the kind of world we live in.

**FORM, COLOR AND SHAPE CONSTANCY**

It is a striking and significant fact that objects retain their shape, size, and color when the physical impressions which we receive from them change markedly. This is the phenomenon of object-constancy. When we say that an object is "constant"
we imply that it is unchanging insofar as its “real” character is concerned (page 128). It is common experience, for example, that a table remains rectangular, even though the position from which we observe it makes the near corner appear to be an acute angle and the whole table distorted in shape (see Figure 86). Our automobile appears shiny in bright sunlight and dull in shade: but we are not fooled—it is still our car and it still needs a coat of paint (see page 120). Men, animals, and inanimate objects retain their known size and proportions when seen from various distances and under different conditions of illumination (see Figure 87, on page 171).

Constancy phenomena disprove what has been called the “copy theory” of perception. This is the naive assumption that perception of the world consists in a kind of passive registration of those stimuli which strike the sense organs so that our perceptions in effect mirror the world around us. Evidence against the “copy theory” is found in the fact that shape, color, and size constancy become more pronounced with age, at least up to adolescence. Most modern empirical theories* of perception stress the factors of learning and experience. A perception is conceived to be the end-product of a variety of sensory contacts. Because of this backlog of experience, we are able to “make sense” out of a perception even when our sensory ex-

* Empirical = based on observation.
experiences are experimentally distorted. In Figure 88, for example, the cleverly distorted room appears normal when viewed with one eye from a predetermined position; and the two men seem to be of about equal height. In the room as seen with normal vision (both eyes), the two men appear to be very different in height. However, we interpret the difference in size as a matter of distance: in other words, the man on the left is not taken to be a midget nor the man on the right a giant. Since perception depends upon inferences from past experience, in a real sense a perception can be thought of as a kind of *average* response—that is, as the "most probable" response in the light of what we know. The man on a high building sees automobiles in the street, not toys, whereas a child of four may "see" the "small automobiles" as toys and not as normal-sized cars.

*FIGURE 87* When we have nothing else to go by, we judge the size of objects in relation to their context. The fish appears much smaller when seen as the same length as the cigar than when the cigar is covered up.
FIGURE 88 A monocular distorted room as it appears in its surroundings. In a room somewhat similar to the one above, having the two men change places makes it apparent that it is the room which is distorted, not the men.
Soldiers in battle are camouflaged, but nature has anticipated them by many centuries.
FIGURE AND GROUND RELATIONSHIP

In everyday observation, objects are perceived against some background: mountains stand out against the sky, apple blossoms against the green leaves of the tree, actors against the background of the chorus or the stage properties. In a painting, the subject or main theme is presented against a background: a battlefield, perhaps, or a peaceful landscape. The melody carried by a prima donna stands out against a background of orchestral accompaniment. When figure and ground are not clearly defined, shifts in perception may result, because of a lack of reference or anchorage. Figures 90 and 91 show two well-known ambiguous figures, the staircase and the cube illusions. Figure 90 will at one instant appear to be a staircase
and at the next a piece of overhanging masonry, and the cubes shift in or out—toward or away from us—with equal ease. In figures of this sort there is no clear distinction between figure and ground. The sensory stimulus remains the same, but perception changes with the meaning which the object has for the observer.

Camouflage is the deliberate confusion of figure and ground. A battleship is painted to resemble the waves of the sea; a soldier is dressed so that he blends readily with the jungle through which he is passing (see Figure 89). The protective coloration of many animals is an instance of camouflage in nature. The squirrel, for example, lying against the limb of a tree or the rabbit crouching in a brown field is often indistinguishable from the background. Many kinds of birds and insects have developed colors which blend readily with the environment in which they live.

**FIGURE 91**
The cube illusion. The cubes shift in and out—toward and away from—the observer. How many cubes do you count?
The setting or context serves to give form and meaning to perceptions. In moving pictures a series of still shots are thrown in rapid succession upon a screen. We do not see a succession of separate pictures, however, but movement and activity of the sort we are accustomed to observe when objects pass rapidly before our eyes. Figure 92 illustrates the importance of context, namely, of anchoring factors in the environment which enable us to correct and adjust our perceptions. The height of each airplane is gauged by the size of the trees and houses on the ground. The moon on the horizon appears to be much larger than usual because of context—the trees and houses with which it is compared. On a moving train, near objects speed by, whereas houses and trees in the distance appear to drift along with the train. Since we know that we are moving, we have no difficulty in interpreting the apparent movement in the shifting scenery. But if the reference or anchoring point is vague or obscure, we may have difficulty in knowing whether it is we who are moving or the world around us. If one stands on a bridge, for instance, and looks at the broad river flowing

**FIGURE 92**
The heights of the airplanes are judged in terms of the tree and the house in the environment.
beneath, it will appear as though the bridge is moving upriver. Since movement is relative, it is easy for us to interpret the small bridge upon which we stand as moving against the background of the river. If we direct our attention to the floor of the bridge or to the shore we can immediately correct this illusion. The bridge is stationary with reference to the shore line, which provides a stable reference point.

EQUIVOCAL PERCEPTIONS

*Illusions* are confused or misinterpreted perceptions, whereas *hallucinations* are truly false perceptions. Looking through a fog, we may decide that a moving animal, which turns out later to be a sheep, is a large dog. This perception is an illusion, since most other people would also be misled under the same circumstances. On the other hand, a person who hears voices others cannot hear or sees mystic signs in the sky is suffering from hallucinations.

Figures which create illusory perceptions have been much studied in the psychological laboratory, since they reveal, sometimes dramatically, how perceptions are determined by the observer rather than by the objective stimulus. Figure 93 shows several of these confusing figures. The first (A) is the famous Müllер-Lyer illusion. The two parallel lines seem to differ in length, the confusion arising from the arrows placed at the ends of the lines. A reasonable explanation of the Müller-Lyer illusion is that in glancing along the lines the eyes do not move as far when the arrows turn in as they do when the arrows turn out. This causes us to underestimate the one line and to “overshoot” the other. In the hat illusion (B), the explanation is the same. A horizontal eye movement is easier to make than a vertical movement of the same length. For this reason the hat seems taller—in relation to its width—than it actually is. (C) is an illusion which results from the confusing or distracting lines introduced in the background. Our eyes tend to follow these distracting lines and thus to pull the parallel lines along with them. (D) is an amusing illusion brought
about by our inability to separate the men's legs from the confusing checkerboard in which they are embedded. If the page of the book is held horizontally and on a level with the eyes, these distractors no longer operate, and the legs appear straight.

Illusions may result from a confusion or blending of several stimuli. Thus we are often fooled by the echo of a shout which comes from the direction opposite to where the voice is. Many people have experienced the illusions of direction and movement created by the system of mirrors often found in amusement parks. (See Figure 94.) These misleading perceptions are brought about by the presentation of stimuli which are contrary to and not readily identified with customary experience.

Illusions arise, too, from set and expectation (page 162). If one is reading a hair-raising detective story late at night, every creak of a window will be interpreted momentarily as the attempted entrance of a bandit. A friend whom we are seeking in a crowd will often be "recognized" several times before he is finally identified.

PERCEPTION AND LEARNING

Learning and perception are sometimes considered to be virtually equivalent processes. A young child will at first call almost anything which he sits upon a "stool"—a generalization from use. Gradually he learns that stools, chairs, and benches are separate "things." Finally, to the adult the concept "chair" embodies the essential features common to chairs which he has seen and used, everything from a rough kitchen chair to a fragile antique. The tendency to generalize sensory experiences is observed in animals as well as in human beings; it precedes and is a first step to discrimination. One author has written* that "once a sensory organization has been achieved, it seems to be retained very efficiently over considerable periods of time, thus justifying the term 'habits of sensory organi-

* Leeper, 1935.
FIGURE 93 A. Müller-Lyer illusion. The two horizontal lines are the same length. B. Height-width illusion. The height of the silk hat equals the width of the brim.

C. Zoellner illusion. The four horizontal lines are parallel. D. The legs are straight if observed without reference to the checkerboard. Raise the book to a level with the eyes and sight along the legs.
FIGURE 94 Distortion produced by concave and convex mirrors.
The botanist in walking through a garden “sees” details that the untrained person readily passes over. The astronomer notices differences among the constellations which most of us never recognize. Discrimination consists, then, in learning to select and use cues to which others are not equally sensitive. The untrained person is either inattentive to these sharp distinctions of the expert or, if he notices them, is unable to make use of the data which they provide.

Learning by discrimination enables us to assimilate new sensory experiences in familiar terms. Monkeys, for example, have been trained to respond actively to a card containing a printed square and to remain quiet when the card contains a circle. This discrimination was established by rewarding the animal with food when it responded to the square, never when it responded to the circle (page 296). When the experimenter substituted pictures for geometrical forms—a square-shaped house for the square or a round fat bird for the circle—the monkeys were able to grasp the equivalence in form. They responded to the house and not to the bird as they had to the square and not to the circle. The new stimuli were thus assimilated in accordance with the previously learned discrimination. When we “read things” into a perception, we are illustrating assimilation in accordance with the principle of probability discussed on page 171. Ambiguity in perception occurs when we are ignorant of object-properties or when the stimuli are themselves so equivocal that they cannot be assimilated readily (page 178). When this happens, we do the best we can to resolve the new perception in terms of the old, and familiar.

THE PERCEPTION OF DIFFERENCES AND OF CHANGE

An inch added to a man’s finger or to his nose is more readily apparent than an inch added to his height; the automobile headlight which is dim in the late afternoon is noticeably organizing factors in perception
brighter at night; a forty-pound weight is perceptibly heavier when its weight is increased by one pound whereas a 100-pound weight must be increased by three pounds for the change to be clearly perceived. All these illustrations point to the same conclusion: our perception of change depends upon the thing changed.

This general principle of relativity in the perception of differences has been studied in the psychological laboratory over a long period. Ratios (called Weber fractions*) denoting change/thing-changed have been set up for various sense experiences. Weber fractions are approximately constant for a given sense. Thus for visual perception of brightness the Weber fraction is approximately 1/100. This means that a light of 100 candle-power must be increased one candle-power for the increased brightness to be perceived, a light of 200 c.p. must be increased two c.p., a light of 500 c.p., five c.p., etc. The Weber fraction varies with the different sense modalities. For taste it is approximately 1/3, for the visual comparison of lines, 1/50, for the muscle sense (as in lifting weights), 1/30-1/40. A saline solution must be strengthened 1/3 for the change to be perceptible, two linear magnitudes (for example, 100 mm. lines) will be judged to be different if the first is longer by 1/50 than the second, and a box weighing thirty pounds will be judged heavier if increased by almost one pound.

Weber's principle was later elaborated into a general law by G. T. Fechner (1801-1887), professor of physics at the University of Leipzig for many years. Fechner developed the famous Weber-Fechner law to express the relationship between changes in the stimulus and our sensory perception of these changes. In mathematical terms the Weber-Fechner Law is expressed as

\[ S = k \log R \]

in which \( S = \) the sensation (really the perception of change);

* After E. H. Weber (1795-1878), professor of anatomy at the University of Leipzig who first announced the principle.
\[ R = \text{the stimulus (Reiz is the German word for stimulus)}; \text{ and} \]
k is a constant multiplier. The Weber-Fechner law holds approximately over the middle range of stimulus intensities. It breaks down when the stimulus is very weak or very strong. The Weber-Fechner law has been used practically by psychologists in the grading of perfumes and tobacco, by lighting engineers in determining the effects of increase and decrease in illumination, and by audition specialists in deriving curves to show the loss in acuity of hearing with age.

**perception and esthetics**

Common observation tells us that certain colors, tastes, odors, sounds, and touches are judged to be more agreeable than others. Furthermore, various combinations of color and form as in architecture, in design, and in decoration; of sounds as found in music; and of tastes and odors as experienced in a well-cooked dinner are pleasing, whereas others are not. Experimental esthetics is concerned with discovering what forms, shapes, colors, and other sensory impressions are generally preferred in perception, and what factors govern our choices.

**METHODS IN EXPERIMENTAL ESTHETICS**

The two basic methods employed in experimental studies in esthetics are order of merit and paired comparisons. In order of merit, the objects to be judged—pictures, advertisements, musical selections—are arranged in one, two, three order from the most to the least attractive. Order of merit is simple in practice, although data obtained from arrangements for preference may be treated by fairly technical statistical procedures. We can determine, for instance, the average position assigned each specimen or item by a group of judges; and we can discover also the extent of agreement about each specimen. If jokes are arranged in order of merit for “funniness,” all the judges may agree that the two or three jokes placed first are
very funny and that the jokes placed last are exceedingly banal. But there may be very little agreement about the jokes placed at intermediate positions. In fact, a considerable divergence of opinion is usual. It is often as important to know how well judges agree in reference to an item's merits or demerits as it is to know the mean position assigned to the item on a scale of esthetic value.

In the method of paired comparisons, objects or things are compared two at a time, the judge being instructed to report whether the second specimen is "better" or "worse" than the first. Each item is thus compared with each other item twice: first as a standard against which all the others are judged, and second as one of a series to be evaluated according to another
standard (that is, another one of the items in the series). The average position of each item upon some preference scale, as well as the consensus of the judges, can be computed as in the case of order of merit. Political, social, and religious attitudes and beliefs—for example, the degree of liberalism expressed by a series of statements, or the extent to which a statement is favorable to some institution such as the church—may also be evaluated by the method of paired comparisons. One real advantage of this method over order of merit is that the time of judgment can be controlled by the experimenter. Thus we can decide whether a person’s judgments differ significantly when

**FIGURE 96** In modern music the popular jazz may be combined with more conventional forms.

Courtesy Columbia Records
in the first instance he is allowed five seconds to make his decisions and in the second instance is forced to make up his mind in perhaps one second. A metronome or other time-measuring device can be used to present the stimuli at a regular rate.

**Color**

Experimental studies have shown that most people prefer reds to other colors. A dark purple is the least preferred color for both sexes. According to report, red is well liked because of its bright and stimulating qualities, whereas purple is disliked because it is dull and depressing. Furthermore, purple for many people has unpleasant associations with mourning and with old age. After red, blue is preferred by both sexes. Since blue and green are usually regarded as soothing and quieting colors, bedrooms and hospital rooms are often painted a light green or a pale blue-green. Perhaps the restfulness of blue and green is due to associations of these colors with the familiar blue of the sky and green of the foliage.

In nature the male bird wears the brilliant plumage, whereas the female’s coat is colorless and often drab; and the same sex difference in coloring is observed in many animal species. In interesting contrast, men’s clothes in our civilization are plain and subdued in color as compared with women’s. But this has not always been the case. In colonial times and during the Middle Ages, when life was more leisurely than it is today, men’s clothes were much more colorful. The sameness and lack of variety in the clothes worn by farm people in America is to a large degree, perhaps, a matter of economy and the character of their work. Moreover, fine clothes do not have the prestige and social value for country people which they have for city dwellers.

When colors are viewed in various combinations, complementary colors are usually judged to be more pleasing, probably because of contrast effects (page 119). That is, complementary colors contain the elements of a complete spectrum, a balance of warm and cool, exciting and restful. Nature offers
Various kinds of symmetry: A and B, running; C, bilateral which is also radial; and D, radial.

FIGURE 97
Running symmetry in Guatemalan Indian tapestry.
**FIGURE 99** The rose window of the Notre Dame of Paris: a beautiful example of radial symmetry.

**FIGURE 100** Radial symmetry in prehistoric Indian pottery.
many illustrations of contrast: red-yellow sunlight against green foliage, evergreens against a background of red sandstone, autumn leaves against a dark-blue sky.

TONES

Tones which are rich and full are considered to be more pleasing than tones which are high and shrill. Timbre rather than pitch or intensity is the important factor in the esthetics of musical tone. In judgments of tonal fusion, those tones which combine readily to yield a smooth effect are judged to be more pleasing than tones which are discordant and unharmonious. Noises, because of their sudden and jarring quality and lack of harmony, are put at the bottom of the esthetic scale. Much popular music—jazz, for example—is judged to be esthetically unpleasing by some musicians. In this form of music, disharmonies are deliberately introduced by the various instruments. No matter how dissonant and unharmonious the musical effects may be, however, time and rhythm (usually carried by the piano or drums) are always maintained.

FORMS AND OBJECTS

Symmetry in forms and objects results from regularity or balance in the arrangement of parts. Equality of parts is usually judged to be pleasing and is an important factor in esthetic judgment. Lines, for example, divided into equal segments are usually preferred to lines in which the parts are unequal or unbalanced. Forms and designs which are repetitive and regular are usually judged to be more satisfying than those which are irregular and unpredictable. Horizontal or running symmetry is present when designs exhibit similar elements repeated from left to right—that is, arranged in regular sequence. Figure 97 presents examples of running symmetry. Symmetry may also be bilateral, in which case the right and left sides of an object are counterparts of each other, or it may be radial, with similar parts regularly arranged about a central axis.

Experiments in the esthetics of form have revealed a prefer-
ence in many people for proportion over symmetry. Figure 102 illustrates a second principle of esthetics, that of proportion. When symmetry becomes monotonous, it yields in esthetic value to proportion or balance in which there is a pleasing *inequality* of parts. Decorations which combine symmetry and proportion are usually regarded as most pleasing if well balanced.

Many people prefer lines and areas which can be divided roughly in the ratio of 3:5. Studies of rectangles of various shapes, for instance, show that a figure in which the height is approximately 3/5 of the width is judged to be most pleasing. This relationship has been known for a long time and is called the "golden section" or the "golden cut." A rectangle which illustrates the golden section is shown in Figure 101. This figure is not so regular as to be unexciting, and is neither too thin nor too stretched-out to be displeasing. Among curved figures, an ellipse the ratio of whose axes is about 3:5 is regarded as more stable and better balanced than a thinner or thicker figure. Figure 101 shows such an ellipse.

The preference for the "golden section" is well established, but the modern art student is apt to consider this preference a result of our deep rooting in Greek and Renaissance culture rather than a basic human need as are balance and symmetry. The young artist of today often reacts strongly against Greek "S" curves and "golden sections" as elements to be avoided. Perhaps as a result of this attitude, another generation may not really prefer the golden section as an ideal proportion.

**Figure 101** The principle of the "golden section" as illustrated by a rectangle and an ellipse.
FIGURE 102. The principle of proportion. The cross was originally T shaped, as shown in A. After the Fourth Century, the cross bar was dropped down, as in B, giving proportion in the vertical direction as well as bilateral symmetry.

Statues and other architectural designs which conform to the principles of symmetry and proportion are generally preferred. In balanced objects the distribution of weight is around the figure’s center of gravity. An interesting explanation of our esthetic appreciation of balance is offered by the concept of empathy. According to the notion of empathy, the observer “feels himself” into the objects perceived and thus experiences those muscular tensions which the figure arouses in him (see Figure 104). Ill-balanced or uncertain objects, since they occasion in us a feeling of strain and tension, are regarded as unpleasing. On the other hand, works of art and natural objects which possess stability give us a feeling of ease and confidence. Empathy may thus be defined as the emotional identification of one’s self with the perceived objects.
The interest aroused by natural formations—for example, a large rock mass balanced precariously on a point—seems at first glance to contradict the principle of empathy. This is probably not the case. The attraction which these objects have for us is perhaps akin to the pleasant uncertainty which we experience in games and contests when the result is by no means a foregone conclusion. Interest is active as long as there is still a good chance to win but no certainty of it. Balanced rock masses such as those found in the Garden of the Gods are of interest to most people, although many would prefer to remain at a distance where they can admire the delicate balance and feel safe at the same time. The thrill which youngsters get from riding a roller coaster is probably a mixture of mild uncertainty and a sense of adventurousness overlaid by a reassuring conviction that nothing tragic will happen. Most people enjoy a tragedy in the theater, where to sympathy for the unfortunate characters is added the comforting thought that, after all, it is only a play.

**PERCEPTION IN WORKS OF ART**

Studies of eye movements have shown that in examining a picture or other object, the eyes do not move regularly and smoothly over the surface. On the contrary, they progress in a series of quick jerks, with frequent backward movements. In reading, the eyes move in a series of short hops along the line of print from left to right, the number of pauses depending upon the character of the reading material and the maturity and skill of the reader. In speeding up reading an attempt is made to have the slow reader eliminate excess stops and backward movements. These result in part from bad reading habits and in part from poor comprehension.

When one looks at a work of art such as that shown in Figure 105, perception is immediately directed towards a point with reference to which the picture is “sized up” and evaluated. Artists determine this point of orientation by various devices, the most obvious being that of giving the important figure a conspicuous position. From the center of orientation, the eyes
Figure 103  The cross is one of the oldest art forms. In the Medieval Era it became the floor plan of the churches. St. Patrick's Cathedral in New York City is modeled after the traditional Gothic plan.

Figure 104  The top heavy appearance of the Archaic Temple at Paestrum (right) was gradually replaced by more graceful proportions. The Parthenon, pictured above, represents the highest development.
FIGURE 105  The Sistine Madonna. The artist controls the center of orientation and the direction of exploitation.
explore the artistic theme in directions largely controlled by the artist. Sometimes the eyes move out from the central figure to the auxiliary figures and decorations. Again the direction of exploration may be circular, or it may be horizontal and vertical, depending upon the subject or theme. In Figure 105, the direct gaze of the key figures, the Virgin and Child, immediately draws attention to the central section of the picture. Typically the eyes then move left and right over the other figures, eventually examining the decorations in the background. The artist has the male figure on the left look upward into the face of the Madonna, while the female figure on the right looks downward toward the cherubs. If we follow her downward gaze, it is almost impossible to keep the eyes from retracing the upward gaze of the cherubs and thus moving again towards the central figures. Note how the two kneeling figures provide balance and proportion. Most famous works of art direct and control the orientation and exploration of the theme by the observer.

What we find pleasing and enjoyable in a work of art is to some extent a product of associations built up around the subject in the past. If some of the now famous pictures and statues were suddenly lost, to be rediscovered at a much later date, their value as art objects of high quality might be considerably diminished, if not lost entirely. Tradition and a wealth of associated values, rather than intrinsic merit, may account for much of the esthetic appeal of a recognized art object. There is the further fact that the artist provides a well ordered world within his picture or sculpture. A sense of design and form goes back to prehistoric times when man designed his tools and pottery with a sense of ordered pattern. The composition of the Sistine Madonna by Raphael, just discussed, is a more complicated design than the simple patterns produced by the cave dwellers. Contemporary artists often sacrifice photographic realism to create what they believe to be a better design and the resulting distortions and abstract patterns are sometimes disturbing to the uninitiated observer.

perception and esthetics
In this landscape, Stuart Davis sacrifices realism in favor of design.

summary

Perception has been defined as that organizing process through which we come to know ourselves and the objects in our environment. Perception differs from sensation in that sensations are believed to be dependent entirely upon the activating stimulus whereas perceptions include the meaningful apprehension of the stimulus in the light of past experience. When the activity of our sense organs is focused upon some particular stimulus-situation, we are said to be giving attention.

A number of factors in the stimulus influence attention: number and arrangement, intensity and contrast, change and movement,
FIGURE 107 Prehistoric Indian tools show symmetry and balance.

American Museum of Natural History

Structures and patterns. Factors within the observer which affect perception are attitudes and interests, sets and expectations, and suggestions.

Many of the determinants of perception have been carefully explored. Objects stand out against some background and are perceived as fairly constant in form, color, and shape over broad changes in illumination and distance. The study of illusions has increased our knowledge of perception. An illusion is a confused perception resulting from the introduction of elements able to break up the usual pattern of experience.

Experimental esthetics is concerned with determining those colors, shapes, forms, tastes, and so on, which are generally preferred or regarded as most pleasant. Works of art may be studied to discover the devices employed to attract and direct attention and to provide clear perception.
questions and topics for discussion

1. Prepare a column of two-place numbers, twenty or so in all. Try to add this column and at the same time recite a familiar poem or sing a well-known song. How well can you do it? Can you do it at all? Does your attention encompass both activities, or does it shift rapidly from one to the other? If one activity is highly mechanized, does it make the doing of two things at once easier?

2. List some ways by which you might secure sustained attention to a job from which your mind is apt to wander.

3. In the following situations which do you think to be more important in attracting attention, the nature of the stimulus or the conditions within the observer?

   a police siren
   a symphony
   a detective story
   an unpleasant odor
   temperature of the room

4. On one occasion an orchestra furnishes a soft accompaniment above which the singer’s voice is clearly heard; on another, the accompaniment is so loud that the singer can scarcely be heard. Relate these two perceptions to the figure-ground distinction discussed in this chapter.

5. Is the shifting which appears in ambiguous figures the same as the shifting observed in swings of attention?

6. It has been said that “the picture size of an object is an ambiguous sign analogous to an ambiguous word, but both get definite meaning from their context.” Explain this statement.

7. Analyze some art object, monument, or well-known building for symmetry and proportion.
8. Examine the decorations in iron grillwork or patterns in tapestry for running and for radiating symmetry.

9. Examine some famous painting. Try to locate the center of orientation and the direction of exploitation. To what extent has the artist controlled the way in which the picture is perceived?

suggested readings


2. Students interested in the growth and formation of social perceptions will find Chapter 19 in G. W. Allport's Personality (New York: Henry Holt & Co., 1937) valuable; also, Chapter 3 in H. Cantril's The psychology of social movements (New York: John Wiley & Sons, 1941).


In everyday language, feeling is usually identified with touching, but in a broader sense affectivities or feelings accompany complexes of sensation (tactile, organic, and even visual) which are judged to be more or less pleasant or unpleasant. A crackling grate fire on a cold night, dim lights, soft music, a gentle tickle, and a full stomach induce feelings which are pleasant, whereas seasickness or nausea, tight shoes, high temperature accompanied by high humidity, glaring lights, and uncomfortable clothes are definitely unpleasant. Sensations differ from feelings in that they vary along a scale of intensity from strong to weak, whereas feelings vary along a scale from pleasantness to unpleasantness through an indifference point. Unlike sensations, most affectivities involve the whole organism and are rarely restricted to a single sense organ. But sometimes the feeling seems to be localized as when we have “no stomach” for a job to be done.
Psychologists, and people generally, use the word *feeling* to refer to the emotional coloring of many daily activities. Most if not all of our experiences possess a feeling-tone which is more or less pleasant. When a person says, for instance, “I feel bitter about this” or “I am happy for your success,” he is expressing the emotional value which the situation has for him. Many emotional experiences are called feelings, and feelings are often described as emotions; in fact, the distinction between the two is often a matter largely of the words used in describing the response.

**JUDGING THE PLEASANTNESS-UNPLEASANTNESS OF FEELINGS**

The hedonic tone* of a feeling is often judged along a rating scale such as that in Figure 108. Other methods of estimating feeling-tone are *order of merit* and *paired comparisons* (see page 183). In *order of merit*, the observer ranks a number of people or objects in one, two, three order, according to his impressions of them, whereas in *paired comparisons*, each person or thing is set off against each other person or thing and a judgment of preference is made. Pleasantness-unpleasantness varies with the *intensity* of the stimulus, a very bright light or a very dim light, for example, being judged as less pleasant than one of intermediate strength. A 9 per cent concentration of cane sugar has been found experimentally to give a sweet taste which is judged to be more pleasant than stronger or weaker

*Hedonism is the philosophy that all of life’s activities are directed toward the end of gaining pleasure.

---

**FIGURE 108**

A rating scale for judging pleasantness.
solutions; similarly, a 2 per cent concentration of common salt gives the most pleasant or the least unpleasant salty taste.

The contrast effects which we found in vision (page 119) are present in judgments of feeling-tone. A tooth may still ache, but it is pleasant when the dentist stops drilling; and the joy of a child in a ten-cent toy is probably as great as that of the wealthy man in his yacht. The general principle of relativity in feeling-tone can be observed in a variety of social experiences. Thus in a strange city we are pleased to meet someone we know, even though ordinarily we would be quite indifferent to the person.

THE DEVELOPMENT OF FEELING-TONES OR AFFECTIVITIES

(1) the origin of feelings

The question is often asked whether some situations are not innately more pleasant than others, or whether the pleasantness-unpleasantness which one experiences is largely the result of training. Certain stimuli, sweet tastes, bright colors, harmonious tones, appear to be inherited “likes,” and bitter tastes, dull colors, and jarring noises to be inherited “dislikes.” E. L. Thorndike,* in constructing a scale designed to measure intel-

* The Measurement of Intelligence, 1927.

Courtesy Standard Oil (N.J.)

FIGURE 109 Is there anyone who doesn’t remember the pleasure he derived from eating spun sugar candy?
FIGURE 110 Attendance at a recent showing of the artist Cezanne illustrates intellectual pleasure.

ligence over a wide range, asked child and animal psychologists to list activities which in their experience were typical of the very lowest degree of intellect. Among the responses suggested for this "minimum intellect" category were the following: "having an object of bitter, nasty taste in his mouth, will spit it out more often than hold it there," and "having an object of sweet, pleasant taste in his mouth, will keep it there more often than spit it out." In the opinion of the psychologists who made the ratings, these elementary likes and dislikes are probably inborn.

There is a good deal of variability in the feeling-tone of colors, which seems to change somewhat with age. On page 186 some of the color preferences which appear in experiments in esthetics were noted, as were some of the common preferences for tones and artistic forms. Young children and primitive people generally prefer warm colors—reds, yellows, oranges—
whereas adults usually prefer cold greens, blues, gray-greens. Sweet is regularly preferred by children to sour, salt, or bitter. Both children and adults consider fragrant and spicy odors more pleasant than burned and putrid ones. Pain is usually rated as intensely unpleasant, but mild pains are often described as pleasant through the principle or relativity. Although some psychologists believe that familiar experiences are natively pleasant to the young child, and unfamiliar experiences natively disagreeable, it seems likely that learning plays the dominant role in these situations.

(2) common annoyances

In one experiment, a long list was compiled of things, situations, and events regarded by many people as annoying or disagreeable. The responses to many of these stimuli are clearly learned, but some involve feelings which are, in part at least, native. By far the largest number (57%) of everyday annoyances were related to offensive behavior of others: coughing in one’s face, bragging about one’s self, interrupting, belching, spitting, nagging, bullying children, chewing gum loudly, acting in a superior or supercilious fashion. Physical characteristics of people (general appearance, deformities, and the like) which they cannot change were ranked lowest on the scale of annoyances. Most people hotly resent being treated as inferiors or being “pushed around.” Conceited people, for example, are rated by college students as being the most unpleasant. Apparently the moral to be drawn from these studies is that tactful and considerate behavior is more likely than its opposite to win friends and influence people.

(3) acquired likes and dislikes

The law of effect (page 294) holds that the satisfaction following a successful action makes this response more probable, whereas the annoyance of dissatisfaction following an unsuccessful response makes this behavior less probable. According to this thesis, pleasantness-unpleasantness represents the real rea-
son why we learn. Many likes and dislikes are clearly learned, some inadvertently (page 302) and some by design, but it is not established that pleasantness-unpleasantness operates of necessity in all learning. Dislikes for certain foods, for cats, for roller coasters, and for red-headed people probably represent conditioned avoidance responses (page 296) in which feeling-tone is almost certainly an important factor. But adult preferences for such things as olives, sharp cheese, bitter wine, and unconventional art or music forms are learned or cultivated "likes" in which the feeling-tone has often swung from one extreme to the other—from unpleasant to pleasant. The violent preferences which many people develop for certain social, political, and economic theories and practices undoubtedly represent attitudes involving satisfactions acquired often through elaborate processes of association (page 290). Fortunately, pleasant experiences generally predominate over unpleasant. One experiment found that 50 per cent or more of one's daily experiences are rated as pleasant, the remainder being rated as unpleasant or indifferent in about equal amounts. Pleasant events and those completed with satisfying results are more often remembered than are unpleasant happenings and those left "hanging fire." This phenomenon has been described somewhat picturesquely as the "obliviscence of the disagreeable."

(4) social preferences
Several studies have shown that in our American culture certain racial and national groups are generally preferred to others. Persons have been given lists of national groups (English, Italian, Greek, etc.) and told to indicate their likes and dislikes upon a sliding scale of acceptability, from "would admit to close kinship by marriage" to "would exclude from my country." In one experiment of this sort, English, Scotch, and French ranked high in acceptability, whereas persons of other nationalities ranked low. In another study, college students were asked to select from among eighty-four descriptive terms
those which best fitted various nationality groups. Table 11 gives the group, the trait most often selected as characteristic, and the percentage choosing it.

These typical descriptions or stereotypes represent feeling-tones which are undoubtedly acquired, some being more firmly held than others.

**Traits associated with various nationality groups**

<table>
<thead>
<tr>
<th>group</th>
<th>trait most often selected</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germans</td>
<td>scientifically minded</td>
<td>84</td>
</tr>
<tr>
<td>Italians</td>
<td>artistic</td>
<td>53</td>
</tr>
<tr>
<td>English</td>
<td>sportsmanlike</td>
<td>53</td>
</tr>
<tr>
<td>Jews</td>
<td>shrewd</td>
<td>79</td>
</tr>
<tr>
<td>Negroes</td>
<td>superstitious</td>
<td>84</td>
</tr>
<tr>
<td>Irish</td>
<td>pugnacious</td>
<td>45</td>
</tr>
<tr>
<td>Turks</td>
<td>cruel</td>
<td>54</td>
</tr>
</tbody>
</table>

**Theories of Feeling**

Various theories have been proposed to explain the feeling-tone (pleasantness-unpleasantness) which accompanies or is part of so many of our experiences. The oldest theory (Wundt's tri-dimensional, 1896) held that feeling-tone not only varies along the dimension pleasantness-unpleasantness but moves also in two other affective dimensions, between the poles excitement-relief, and tension-calm. According to this theory, in witnessing a football game one might be in a pleasant, tense, excited state; when a touchdown is scored, in a pleasant, relieved, calm state. Seeing an auto accident would arouse unpleasantness, excitement, and tension. Wundt's theory has been criticized on the grounds that excitement-relief and tension-calm are really contrasting complexes of bodily sensations, which are themselves pleasant or unpleasant, and that pleasantness-unpleasantness is the only really affective dimension. Another theory begins with the premise that an organism normally acts to maintain, enhance, and repeat certain responses,
and to minimize and avoid others. When responses are positive and approaching, the feeling-tone is pleasant; when they are negative and avoiding, unpleasant. Other theories identify feeling-tone with emotion and “explain” both as arising in the activity of the thalamus or interbrain, the intermediate sensory-receptive center lying below the cerebral cortex (page 147).

**emotions**

Anger, grief, and joy describe experiences which we have all encountered in ourselves and observed in others, so that it would seem unnecessary to do more than name the experience in order to communicate what we mean. Poets, artists, and imaginative writers have used many adjectives to describe shades of emotional experience (awe, disdain, pity, hope, rapture, contempt, and suspicion are a few), the variety of de-
scriptions testifying to the predominant role played by emotion in our daily life. In patients suffering from certain mental diseases, the capacity for emotional experience may be weakened or even lost altogether. These people show dramatically how dull and drab life can be without its dynamic, intensifying, and often upsetting emotional accompaniments.

Psychologists, psychiatrists, and other students of human nature have attempted to go beyond verbal description to a deeper understanding of emotions. They have tried to trace the origin and course of an emotion such as fear in a man's behavior and to devise ways of harnessing and controlling its effects. Why do children have temper tantrums? Can we do anything to eliminate them? What is the role of emotion in mental and physical disturbances, for example, in anxiety or indigestion? Are emotions always disruptive, or are they sometimes useful? Can the various emotions be recognized from their physiological manifestations?

In general, emotions have been studied from three points of view:

(1) conscious awareness:
What is an emotion from the standpoint of the experiencing person?

(2) observable behavior:
What cues do we use in identifying emotions in others? Are some emotions more primary than others? Are there patterns of emotional behavior?

(3) physiology of the emotions:
What happens to the body in emotional states? What is the role of the nervous system in emotions?

All these aspects of emotional experience have been studied experimentally; the task of this section is to outline relevant findings.
THE INTROSPECTIVE STUDY OF EMOTIONAL EXPERIENCE

One is seldom in a position to observe an emotion while he is undergoing it, so that of necessity introspective analysis must give way to retrospection or recall. Emotions have been described as "stirred up" states of consciousness, a description undoubtedly often accurate. The expressions "up in the air" "to lose one's head," "out of control," "go to pieces," express

FIGURE 112 Charles Munch uses a display of emotion to develop effects during a rehearsal of the Boston Symphony Orchestra.

Filbert Friedberg
the confusion often involved in emotional states. The great psychologist William James held that the perception of one’s bodily state constitutes emotion—that emotion is the way the body feels. This is the famous James-Lange theory of the emotions. James wrote “we feel sorry because we cry, angry because we strike, flee because we tremble.” When the body is stirred up, our conscious awareness of these changes is also stirred up or confused.

Emotions are not always disruptive, however. Feats of strength and endurance performed under strong emotional

* Formulated independently by William James and C. G. Lange about 1885.
stress, though tales of them are often exaggerated, do happen, and they show clearly the facilitating and bolstering effects which an emotion may have. Students report that they do better on examinations when excited but not unduly apprehensive. Musicians, speakers, and actors use emotion to reinforce and enliven their performances. In one experiment, ten students pledged to a fraternity were led to believe that the amount of work done on a series of arithmetic problems would influence their acceptance. Under this strong emotional urge, these students, though already fatigued, maintained for two hours an average score more than 25 per cent higher than that of a control group which worked under less harried conditions. Emotions do not appear to be genuinely disruptive unless they are very strong and are initiated suddenly and without warning, and even then their disruptive effect is mostly at the outset. After the first shock, a strong emotion may be a help rather than a hindrance. (See Figure 123, page 226.)

This “first-aid” view has been called the emergency theory of the emotions. The eminent physiologist W. B. Cannon held that strong emotions such as fear and anger have an emergency character in that they prepare the organism to fight or flee (see also page 235). Among animals and primitive people such defensive preparation often means the difference between survival and death. In modern life strong, unpleasant emotions may well be of service in the same way, but they ordinarily begin and end without physical exertion. We are often angry but are seldom forced to fight, often fearful but seldom forced to run.

observable behavior in emotions

GENETIC STUDY OF EMOTIONAL RESPONSE
The study of overt or openly expressed emotional behavior usually begins with young children, before training and social
pressures have had time greatly to modify response patterns. The behavior of the baby is at first largely in the nature of mass activity—a general excitement (threshing with the arms and legs, cooing and gurgling), from which specific elements of behavior later become detached. Early experimental studies led child psychologists to conclude that there are three primary emotions: (1) fear, brought on by loud noises, hurtful stimuli (pinches, burns), and loss of support; (2) affectionate or love responses, initiated by petting, fondling, and stroking the sensitive zones of the body; and (3) rage or anger, arising when the child's activities are interfered with or restrained. These “primary” emotions were believed to be native and inherited.

Later studies of young children have demonstrated that, though these three emotions may be basically innate, their response patterns are by no means regular and invariable. Trained observers were shown motion pictures of babies reacting to hunger, a sudden dropping, physical restraint, being pricked with a needle, and so on. The stimuli themselves were not seen by the observers, only the responses of the child. Under these conditions, hunger was often called anger, and anger, fear. It was clear to the observer that the child's experience was decidedly unpleasant, but it was not at all clear just what emotion was being expressed. When these observers were shown the situations or occasions which led to the responses, their judgment was much improved. This means that we infer a child's (or an adult's) emotional state from what we anticipate will happen under the circumstances rather than from actual observed behavior.

One quite stable and persistent emotional response—called the “startle pattern”—has been found as a result of careful measurement. (See Figure 114, opposite.) In response to an unexpected and sudden stimulus, such as a revolver shot or sudden flash of light, a person will blink his eyes, flinch, and shrink away. This surprise response can be caught by high speed motion picture photography. It takes less than half a second, is repeatable, and highly dependable.
FIGURE 114 A startle pattern may result either from a pleasant or an unpleasant situation. The girl in the upper picture seems to be expressing fear as well as surprise.

Ewing Galloway

FIGURE 115 This picture was taken at a birthday party where the surprise, though startling, was pleasant.

Courtesy Rosen Studio and Vicki Bernstein
Many young children react fearfully to situations which previously had no emotional value, a fact indicating that the response has been learned. (See Figure 116, below.) In the pioneer study of emotional learning, a loud noise was made whenever a baby (eleven months old) reached toward a white rat in its playpen. After several associations of reaching-for-rat plus loud-noise, the baby showed fear of the rat and no longer reached for it. The "native" fear of the noise transferred not only to the rat but generalized or spread to a rabbit, a dog, and a fur coat. This is an example of learning by conditioned response; several illustrations will be found on page 302. The experiment is important in showing how a fear response may be learned, but practically it is of more importance to remove or "uncondition" fears already acquired. An attempt was made to accomplish this, to uncondition or retrain a boy of three who had developed a fear of rabbits. The method used was to associate a toy rabbit with food—a positive and very de-
The animal trainer gets results through the use of pleasant and unpleasant associations.

sirable stimulus. Each day the rabbit (fear stimulus) was moved closer to the child's plate as he ate his meals, being removed only when the child cried or asked that the rabbit be taken away. After more than a hundred associations of rabbit and food, the child lost his fear to the extent of petting and even playing with the toy rabbit. This method of unlearning, while effective, must be used with care. If it had been hurried, the child might have developed aversion to food rather than tolerance of the rabbit.

COMMON EMOTIONAL RESPONSES

Beginning with a general restlessness, crying, and struggling, which are present at birth, the child's emotional responses take on more definite and specific form as time goes on. Common
emotions experienced by children and adults alike are fear, anger, jealousy, joy, affection, grief, and curiosity. What are some of the sources of these emotions, and what, if any, are the typical response patterns?

(1) fear
Dark rooms, animals (snakes, dogs), high places, strange people, and loud noises have been found to arouse fear in from 20 to 50 per cent of children in the age range two to six years.

FIGURE 118  Fear inducing stimuli with the percentage of children exhibiting the fears at different age levels.
After Jersild and Holmes, 1935.
Figure 118 shows how fears drop off or change with age. Fear of animals increases up to about four and then declines, though fear of snakes is present at age six; fears of the dark, of being alone, of strange people, increase and then decrease. In older children there is a marked upturn in imaginative fears (fanciful, supernatural, remote dangers), as well as more practical fears of accidents, fires, death, and the like. Adolescents fear ridicule and being made to feel inferior. Adults also fear ridicule, economic and professional failure, and loss of social prestige.

The characteristic or typical response to fear is shrinking and withdrawal, often climax ed by flight or escape. The primary response of running away is often elaborated in strange ways, its pattern being quite variable. Afraid for her social acceptability, a woman may avoid social functions, become reclusive, withdrawn, and depressed. Fear of failure in business or profession may cause a man to "flee into illness" or take refuge in daydreaming or fantasy (for example, the ne'er-do-well and visionary). Under great stress, combat soldiers have become blind or paralyzed or unable to talk. These strange responses are acquired—are ways hit upon by accident or by design to avoid unpleasant situations. Ordinarily they are retained as long as they have utility.

(2) anger and jealousy

Anger is more common in young children than fear, because there are usually more anger-than fear-producing situations in the child's life. A child soon learns, too, that anger not only removes restraints but is attention-getting and rewarding—it gets him what he wants. The causes of angry responses in young children are many. In a study of children sixteen months to three years old, the following instigators were commonly reported: having toys taken away, having face washed, being made to sit on the toilet, being neglected by parents and other children, being bathed or dressed, being left alone. Among adults, anger is aroused by physical threats as well as by more
subtle menace to security and prestige: fault-finding, teasing, punishment, unfavorable comparisons with others. College students report thwarting and interference as a common cause of anger.

The anger response of the young child is immediate and often violent: stamping, screaming, hitting, kicking. Temper tantrums reach their peak at between three and four years. In older children and adults, sulkeness, negativism, quarrelsomeness, and scolding replace more overt responses. Anger, like fear, may find expression in various ways. The hostility of young people toward authority, as represented by parents or school, often takes the form of espousing radical and unpopular causes, wearing outlandish clothes, joining strange groups—all these in order to embarrass the source of their resentment. An adolescent reproved by his superiors works out his resentment on his family, or assumes a martyr-like role. Within a family, many frictions and jealousies develop when brothers and sisters vie for their parents’ or each other’s favor.

Jealousy is anger or resentment aroused when a person feels neglected, abused, or disregarded. Jealousy grows out of a social setting and is always directed towards a person. Young children are jealous of a new baby, of an older brother or sister, and often of a parent (see Figure 119). Students are jealous of classmates who excel in class work or athletics, and girls are often exceedingly jealous in boy-girl romances.

Jealousy is expressed by the young child in bodily attacks, refusing to eat, thumb-sucking, bed-wetting, or general sulkeness. In older children and adults, jealousy is shown directly in quarreling, gossiping, teasing, belittling, and indirectly in day dreaming, sarcasm, moodiness, and martyr-like conduct.

(3) joy and mirth

Joy (roughly synonymous with pleasure, delight, happiness) is an undifferentiated or generalized excitement response called out by many situations. Babies smile at about two months and laugh a month or so later. Among the situations which elicit
laughter or joy in young children are the following: being played with by parents, running, romping, playing with toys, singing, pounding. Figure 120 shows the uninhibited joy of a deprived youngster over a new pair of shoes. Laughter as an expression of humor is aroused in the child by active, rough-and-ready situations in which, for example, someone is falling down or being made ridiculous. Practical jokes and queer speech or gait (often in imitation of others) arouse laughter. In older people, laughter as an expression of pleasant emotion is evoked.

**Figure 119** The older child shows clearly her resentment of the new sister!

Hibbs from Monkmeyer
FIGURE 120 The pleasure of a deprived youngster in a new pair of shoes.
by a wide variety of social situations. The appreciation of subtle humor depends to a high degree upon age, sex, intelligence, and educational level. In responses to joyous emotion (for example, by laughter or excited behavior), efforts are made to prolong or continue the situation, and usually no effort is made to avoid or end it. Pleasurable responses may also be passive and relaxed, a kind of general euphoria (a sense of well-being), as after a full meal.

(4) love and sex excitement
People, animals, toys, all bring out expressions of affectionate behavior in young children. Childish affection is exhibited by hugging, kissing, or patting; later, overt responses tend to be replaced by verbal expressions of endearment. Among adolescents and adults, sexual excitement plays a major role in inducing affectionate behavior. The freest and most frequent expressions of affection are found in the lower social and economic groups, where social pressures to conform to conventional restraints are relatively weak or are lacking.

(5) wonder and curiosity
Anything novel, strange, or unusual may arouse the emotion of wonder or curiosity and lead to active exploration in the young child. Curiosity is not instinctive (page 261) in the sense that one is impelled to examine anything new or strange. But curiosity represents a strong tendency to discover, manipulate, explore, and control one’s surroundings. Babies will pull, suck, or shake any attractively colored movable object. The older child substitutes questions for active exploration, many children from three to six becoming veritable question marks. Curiosity in adults, especially in older women, often reveals a lack in their own lives which is met by an increased interest in the personal affairs of others. The curiosity instinct so generally attributed to monkeys is better explained as a native tendency to explore and usually put in the mouth anything small and movable.
(6) grief or distress

Grief or distress in the young child—expressed by crying and weeping—arises from deprivation, restraint, and punishment and is closely related to anger. Responses similar to grief appear by the first month of life, and probably express helplessness or sheer bewilderment in the face of difficulty. Grief and sympathy (self-identification with the grieving person) involves some understanding at least of the situation. It seems likely that true grief rarely occurs in the child before two years of age.

FACTORS INFLUENCING EMOTIONAL RESPONSES

Emotional responses are enhanced by fatigue and by hunger. The tired, over-excited child is predisposed to irritability and temper tantrums. In babies and young children, excessive emotional behavior is likely to appear just before regular eating and sleeping periods. College students report a tendency to greater irritation in the late afternoon before dinner time. The eldest child and the youngest child in a family are perhaps more likely to develop “spoiled” behavior than are intermediate children. The first born is jealous of his prerogatives, and the youngest is likely to be “babied” by parents and older brothers and sisters.

Poor health and an unhealthful environment also make for excessive emotionality. Poor health leads to lowered resistance and self-pity; an environment marked by tension and constant bickering between parents or within the family circle makes for irritability, timidity, fear, and anxiety.

OVERT EXPRESSIONS OF EMOTION

(1) facial expressions

The extent to which emotion is revealed by facial expression has been studied from photographs (stills) and from motion pictures. Facial expressions intended to depict pleasant or un-
pleasant emotion are judged quite accurately. But there is considerable disagreement about the more subtle or sophisticated emotions such as disdain, contempt, religious awe, and romantic love. In one study of the judgment of emotion from still photographs, fear and disgust were most often correctly identified. Motion picture studies have shown (page 212) that even the emotions of the baby are not accurately judged unless the stimulus situation is known, and this is even more true of adults. Adults soon learn to mask their true feelings by smiling pleasantly, even when annoyed. Figure 122 shows poses intended to portray various emotions. Most of these poses can be identified as pleasant or unpleasant, and their descriptions, as given by the originator, will seem reasonable. This is true, even though the situation producing the emotion is lacking, as well

\[\text{FIGURE 121 Small animals may excite curiosity rather than fear.}\]
FIGURE 122 Each of the facial expressions is intended to depict a different emotion.
Some of them, joy and curiosity for example, seem obvious. Can you identify the others?
as the usual cues received from facial coloring and movement. Many patterns of facial expression are acquired under social pressure, with the native dispositions suppressed or controlled. Thus smiling, frowning, laughing, or scowling may indicate almost any (or no) emotion.

(2) other expressive signs of emotion

Charles Darwin believed that many emotional expressions represent innate behavior patterns which have contributed to the survival of the species. When the cat spits and shows its claws, when the dog bares its teeth and growls, and when a fighting cock ruffles its feathers, these responses are intended to frighten the enemy and to prepare the animal for ready defense. Although most of these primitive responses have lost much of their utility in man, in whom they are heavily overlaid by social practices, many expressive signs persist. The mouth, the brow, the voice, and the speech, for example, are important cues to the emotional consciousness. A fairly regular pattern is the upturning of the corners of the mouth in pleasure and the dropping down in displeasure. (See Figure 124, opposite.) Arched or contracted brows may also be indicative of emotional tone. In adults who are highly self-controlled, the voice is often the best index of emotional state. Speakers and actors use change of pitch, intensity, dramatic pauses, and sudden inflections to portray an emotion. Figure 123 shows the marked

![Figure 123](image-url)

The range of the voice is over an octave in just this short passage. After Merry
change in the pitch of the voice during a rendition of Portia’s speech in the Merchant of Venice. Sorrow, dismay, anger, and remorse are expressed by the voice. The disturbing effects of strong emotion are revealed in one’s speech by stuttering, stammering, and blocking.
Many facial and movement cues expressive of emotion are culturally determined and so differ from place to place and from time to time. The American-born Italian is not as volatile or as overtly expressive of emotional states as is his kinsman in the “old country.” Americans attending a Chinese theater are often at a loss to understand what emotions the actor is trying to convey. Modern youngsters, upon viewing an old silent movie, often are convulsed with laughter at the exaggerated facial expressions and bodily contortions used by actors to depict grief, anger, or romantic love.

physiology of the emotions

GENERAL ORGANIC RESPONSES IN EMOTION

The conscious awareness of an emotion is marked by disturbance and confusion (page 209), and at the same time the body is also upset or agitated. Common physical manifestations of emotion are trembling, tingling of the skin, tension in muscles of body and face, dilation of the pupils, and increased pulse.

Figure 125 In many of the old silent films, emotions were greatly exaggerated.

Collection Museum of Modern Art
and breathing rate. The skin turns pale or fiery red and may break out in a "cold sweat." Are there regular and measurable physiological patterns of body response which are characteristic of a given emotion? Or is the organic response much like the observable behavior—namely, one of general agitation, the specific emotion not being readily identified? In studying bodily upset, the psychologist uses the methods of expression to reveal and measure physiological changes. The main purpose of such measurement is to relate organic responses to the conscious reports of emotion.

In many laboratory studies delicate instruments have been utilized to record the physiological upset caused by emotion-inducing stimuli. Records of breathing, pulse, blood pressure, and skin sensitivity during emotional stimulation may be obtained by means of the pneumograph, sphygmograph, sphygmomanometer, and galvanometer. The pneumograph consists of a coiled spring within a sealed rubber tube which can be strapped about the subject's chest. Rhythmic contractions of
the chest in breathing cause the tube to stretch and relax. These changes are transmitted through a small rubber tube to a writing point or are electrically recorded.

The sphygmograph consists of a rubber diaphragm which is fastened tightly over an artery. Pulse beats are transmitted to a writing point to give a graphic record. The sphygmomanometer consists of a rubber bag first bound around the upper arm and then inflated. The bag is ordinarily connected by an air tube to a mercury manometer. When the bag is inflated to the point where its pressure just overcomes the pressure in the artery, the reading on the manometer is a measure of the blood pressure.

A variety of situations, some decidedly unpleasant, have been set up in an effort to call out genuine emotional states. Stimuli include sudden electrical shocks, loud noises, being told sexy stories or viewing sexy motion pictures, being thrown backward in a specially devised chair, being forced to cut up frogs, decapitate rats, or go without food, and being angrily denounced by the experimenter. Under these conditions, the subject presents a picture of general body upset—but no pattern of response which regularly characterizes a reported emotional state. When the emotion is strong and unpleasant, as in anger or fear, pulse and breathing increase in rate and ampli-

**Body symptoms associated with fear**

<table>
<thead>
<tr>
<th>symptom</th>
<th>per cent reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violent pounding of the heart</td>
<td>86</td>
</tr>
<tr>
<td>Sinking feeling in the stomach</td>
<td>75</td>
</tr>
<tr>
<td>Feeling sick in the stomach</td>
<td>59</td>
</tr>
<tr>
<td>Trembling and shaking</td>
<td>56</td>
</tr>
<tr>
<td>Cold sweat</td>
<td>55</td>
</tr>
<tr>
<td>Tense feeling in stomach</td>
<td>53</td>
</tr>
<tr>
<td>Feeling of weakness and faintness</td>
<td>51</td>
</tr>
<tr>
<td>Vomiting</td>
<td>24</td>
</tr>
<tr>
<td>Involuntary defecation</td>
<td>10</td>
</tr>
<tr>
<td>Involuntary urination</td>
<td>10</td>
</tr>
</tbody>
</table>
tude and both become irregular, the blood pressure goes up, stomach contractions (of digestion) decrease or stop entirely, the mouth goes dry, and there is muscular tremor. Soldiers who have experienced fear in combat give a report of general body agitation but no invariable response. The percentage of men reporting various physical manifestations are shown in Table 12.

When the reported emotion is pleasant as in love or joy the body upset is less drastic and there is greater individual variation from person to person. But again there is no fixed bodily response pattern.

THE LIE DETECTOR

A combination of several recording instruments employed with some variation by psychologists to measure physiological upset has become known as the lie detector, because of its use in criminal detection. Ordinarily a lie detector, as used at present, records simultaneously the subject's breathing, blood pressure, and the electrical resistance of the skin. Sometimes other records are included. The distinctive feature of the lie detector is the measurement of the electrical resistance of the skin. Under emotional stress, the amount of resistance offered to the passage of an electric current by the skin is reduced in part because of increased perspiration. By means of electrodes placed on the skin, changes in electrical conductance can be measured by a galvanometer. Such changes constitute the psychogalvanic reflex (page 66). Figure 126 shows one form of lie detector; Figure 127 shows the PGR (psychogalvanic reflex) following a sudden scream.

**Figure 127**
The change in electrical conductance of the skin following a scream.

*Scream*
In lie detection, the subject is instructed to reply to a series of questions with the first answer that comes to mind. Continuous readings of breathing rate, blood pressure, and PGR may be taken. The assumption is that a criminal’s hidden knowledge will induce an emotion (feeling of guilt or fear) and that this emotion will show up in the physiological records, especially in the PGR, even though the suspect lies or refuses to answer the question. Usually, irrelevant questions are interspersed in the interrogatory with those relating to the crime. A lie detector uncovers lies by revealing the emotional guilt feelings which presumably accompany deception. The method is, therefore, by no means infallible. We cannot from the records alone distinguish between guilty and innocent knowledge of a crime; in fact, an innocent man may react more emotionally to a key question than a criminal. Furthermore, fatigue, deep breathing, and muscular tension all give PGR’s quite similar to those present in emotional stress. In general, the lie detector has proved to be useful as a supplementary device for discovering guilt. Sometimes its principal value is in frightening the suspect into a confession.

**role of the autonomic nervous system in emotion**

**The Structure of the Autonomic Nervous System**

The organic and physiological responses of the body are controlled by that branch of the central nervous system called the autonomic nervous system. The autonomic lies outside of the central nervous system and is connected with the cord and the brain through intermediate ganglia (nerve centers consisting of clusters of nerve cells). Figure 128 shows the relationship of the autonomic nervous system to the central nervous system and to the vital organs of the body.

The autonomic nervous system is not independent of the central nervous system. At the same time, many glandular and
role of the autonomic nervous system in emotion
smooth muscle responses are carried on by the autonomic without specific stimuli from the central nervous system. Such activities as digestion, for example, the rhythmic movements of the intestines, heart beat, breathing, sweating, and the circulation of the blood have a considerable degree of independence. They go along without conscious control.

The autonomic nervous system may be divided functionally into three main parts: (1) the cranial division, connected with the upper part of the spinal cord and mid-brain; (2) the sacral division, connected with the lower part of the cord; and (3) the sympathetic division, connected with intermediate parts of the cord. These three branches are shown in Figure 128. Nearly all the body organs are supplied with neurons from the sympathetic or from either the cranial or the sacral. The cranial and sacral divisions are distinct anatomically, but they have a similar function, which is antagonistic to that of the sympathetic. The sympathetic intensifies certain activities; for

Black Star

Figure 129
Situations which might lead to quarrels should be avoided at mealtime.
example, it increases the heart rate, raises the blood pressure, and increases breathing rate. The cranio-sacral, on the other hand, maintains the glandular and muscular activities of digestion, inhibits rapid heart beat, and controls the smooth muscle activity of the eliminative organs. In general, if the cranial or sacral accelerates, the sympathetic depresses. If the cranial-sacral reduces an activity, the sympathetic increases it.

A second feature of the autonomic nervous system is that while organic activities may go on to a large degree independent of control by the central nervous system, they may nevertheless be drastically affected by impulses from the brain and cord. Some impulses from the central nervous system accelerate the sympathetic, others the cranial-sacral. Situations inducing fear and anger, for example, increase the activities of the sympathetic, whereas situations inducing pleasure and joy increase the activity of the cranio-sacral.

CANNON'S EMERGENCY THEORY OF THE EMOTIONS

The emergency theory (page 211) conceives of strong emotion (anger, fear) as a preparation for action—a means of preparing the organism for fight or flight. Cannon’s emergency theory is based upon the antagonism between the sympathetic and the cranial-sacral branches of the autonomic nervous system. The theory is illustrated dramatically in the most quoted of Cannon’s experiments. A cat was fed a meal containing barium, a substance opaque to X-ray. Some time later, when viewed under the fluoroscope, the cat’s stomach showed normal rhythmic digestive movements. When the cat was barked at by a dog which had been brought into the laboratory, it demonstrated all of the behavior associated with fear or anger: arched back, erect fur, spitting, and so on. After this experience, when the cat’s stomach was again viewed under the fluoroscope, it was found that digestion had ceased and did not resume for fifteen minutes. Inhibition of the normal activity of the cranio-sacral by the sympathetic led to a stoppage of digestion in favor of
increased physical preparedness. The moral of this experiment for the human being is not to become angry during or after a full meal, unless he wishes to risk indigestion.

The sympathetic, in Cannon's theory, is thought of as an elaborate check-and-drive mechanism thrown into gear whenever immediate and energetic action is demanded. Thus, the sympathetic prepares the body for emergencies, while the cranial-sacral carries on the vegetative and restorative activities of the body—digestion, regular heart and breathing rate, as well as sexual functions and elimination. In an evolutionary sense it is important when danger threatens that the organism give up its calm, pleasurable state and mobilize for action. If the animal is to meet an emergency successfully, digestion must be inhibited so that the heart and lungs can work harder.

THE DIFFERENTIATING FACTOR IN EMOTION

The body upset exhibited in anger and fear presents no characteristic pattern of responses (page 230) which might serve to differentiate one emotion from the other. Unless one is acquainted with the instigating stimulus and other determining factors in the situation (page 212), he cannot tell from the physiological records alone whether the person is angry or fearful.

Anger and fear do differ, however, in the motive which determines the response. Suppose that a cat is being pursued by a dog and is running away, apparently in a high state of fear. Now suppose further that the cat, being cornered by the dog, turns swiftly and attacks vigorously, so that the dog becomes the pursued instead of the pursuer. One must infer that the cat's emotion has changed suddenly from fear to rage. And since there is little if any time for change in physiological state, the difference between the two emotions must depend upon the motivation (in the one case to flee, in the other to fight). In other words, it is the intention of the subject—what he is trying to do—that determines the character of the emotion. The same thing must be true of sorrow and joy. The mean-
ing which the situation has for the individual determines whether the emotion is one of sorrow or happiness—not the organic changes in the body. One may laugh when sorrowful and cry when happy.

**controlling the emotions**

The term *emotional control* usually implies that the emotion is unruly and unpleasant, and it is here that control is most needed. Techniques for controlling emotions are usually the same whether one is concerned with self-control or with the control of emotional expression in others. The most profitable methods of controlling unpleasant emotions are those based upon gaining an understanding of why the emotion occurred.

---

**Figure 130** Expression of emotion is often immediate and unrestrained in children. The temper tantrum is repeated if it enables the child to get its way.

Rapho-Guillumette
in the first place and how it might have been prevented. The following principles will be helpful.

1. **Avoid situations likely to arouse unpleasant emotion**

Poor health and family quarrels (page 210) predispose to irritation, while in children and youngsters especially, hunger and interference with rest and sleep habits are generally provocative of anger and fretfulness. A good way to control temper outbursts, then, is to prevent their occurrence by so arranging the situation that the irritating stimuli do not appear. This is not always easy, and “avoidance” is essentially negative advice. Often an unpleasant situation develops and must be faced—the child, for instance, who wins his way with a temper tantrum is likely to repeat. However, the adages “let sleeping dogs lie” and “an ounce of prevention is worth a pound of cure” attest to the success of avoidance tactics in preventing the onset of an unpleasant emotion. Most highly socialized adults develop a variety of techniques for avoiding emotional topics (religious, political, social) by using distractors to keep a situation emotionally neutral.

2. **Remember that counterattack often intensifies emotion**

The admonition “to fight fire with fire” may be useful as a military principle or for guidance in combatting forest fires, but usually it is not a safe rule in human relations. The teacher who disciplines an angry child severely before his classmates is more likely to arouse open hostility or silent resentment than feelings of remorse and pious resolution to do better. The officer who disciplines a soldier under battle stress for refusal to obey an order is a poor leader. Scolding and verbal whipping rarely accomplish what they are intended to do. A quiet talk when emotions have subsided and chagrin and loss of face are not involved is more likely to have good effects. “Counting to ten” before one speaks is a good rule, since the de-
FIGURE 131 Misunderstandings rarely occur in an atmosphere of friendliness. Rebuke does not necessarily have to take the form of scolding.

Monkmeyer
lay is likely to dull the first explosion of temper; and it is still true that it takes two to make a quarrel. It is a paradox that the unsatisfactory effects of emotional counterattack are almost universally known and yet are almost universally neglected. If a tongue lashing made people "good," certainly the world would long since have reached the millennium.

3. PROVIDE OPPORTUNITIES FOR PLEASANT EMOTIONS TO APPEAR

Preschool and kindergarten teachers know that little children are less likely to develop fits of temper or unreasoning fears if they are kept busy at interesting and emotionally satisfying tasks. Social workers and directors of playgrounds have shown that social gatherings, dances, and parties provide an outlet for the healthy display of emotion and are perhaps the best deterrent to sex delinquency, malicious mischief, fighting, and
thievery. Instead of punishing children for inattention and noise (thus making it more attractive), the understanding teacher rewards pupils for good attention and quiet behavior. Most parents will find it impossible to resort to the method of positive conditioning (page 334) to remove their children’s fears. Fortunately, many fears are lost with increased maturity, and others are better handled through social pressure and persuasion than through scolding and punishment. The child who attends a summer camp away from home often loses his fears, as well as his poor food and sleep habits, the corrective pressure of his companions being far more effective than the admonitions of well-meaning adults.

4. DEVELOP SKILLS, HOBBIES, AND INTERESTS

The young person who possesses social skills such as music, dancing, photography, or sports, and the adult with many interests and hobbies are far less likely to become morose, crochety, and irritable than persons not so fortified. Clubs and other social groups are well-known ways of providing healthy outlets for emotions.
Feelings are complexes of sensation judged to be pleasant or unpleasant. Some feelings appear to be inborn, but there is considerable variation from person to person, and many preferences are known to depend upon such factors as age, sex, and training.

Emotions are feelings which involve considerable force and tension. Emotions have been studied from three points of view: (1) conscious experience, (2) observable behavior, and (3) accompanying physiological state. The best-known theory of the emotions, the James-Lange Theory, holds that emotions result from bodily upset. Another widely held theory asserts that emotions have emergency value—that they prepare the body for action.

In the psychological laboratory, studies have attempted to identify the physiological bases of the emotions and to identify body responses with subjective reports. A number of experimental studies of emotion have also been carried out with infants and young children. Ability to control emotion is often desirable. Perhaps the best over-all advice is to attempt control of the emotions by manipulating the stimuli which instigate them.

questions and topics for discussion

1. Do you think a particular physical stimulus will arouse the same feelings in all persons?
2. How does the training of a medical student affect the emotional value of such “unpleasant stimuli” as dead bodies and profuse bleeding?
3. How might the fact that young children prefer red, yellow, and orange be explained without using the concept of feeling-tone?
4. Some persons who have never had direct contact with certain national groups rate them low in terms of preference. How can this be explained?
5. Why is it difficult to label an emotional expression when the arousing stimuli are not known?
6. Why is it that the same situation may be funny to some persons but disgusting to others?
7. How could you beat the lie detector?
8. How would you go about developing an interest in stamp collecting?
9. Why might a woman have different "feelings" about a live fox and a fur coat?
10. How would your feelings while watching a football game from a stadium seat differ from those you experience while watching it on TV? Why do you suppose that television viewers less frequently cheer, shout, or stamp their feet than people in the stadium.

**suggested readings**


ORGANIC NEEDS, ATTITUDES, INTERESTS—ALL THESE ARE motives which spur the individual to action and direct activity by making one course of behavior more likely than another. Motives operate from within the individual. A hungry man actively searches for food; a wealthy landowner regularly votes for all the conservative candidates on the ticket; a boy interested in mechanics eagerly reads the popular-science magazines. In the reaction sequence

\[ S - \text{Org} - R \]

in which \( S \) represents the stimulus, \( \text{Org} \) the organism being stimulated, and \( R \) the response, the motive is a drive or directing tendency within the organism. This “inner set” is often so much stronger than the immediate stimulus that the response seems to be out of all proportion to the stimulus. In fact, the stimulus which we “see” may sometimes be merely the spark which sets off the explosion. A hungry dog, for ex-
ample, seizes a piece of meat and devours it ravenously. Meat is the *incentive* or stimulus to which the hungry animal reacts, but hunger pangs constitute the original drive or urge towards food.

Motives vary from unlearned physiological needs to highly organized systems of ideas. At the one extreme are persistent bodily tensions, which initiate responses basically native and unlearned. At the other are attitudes, goals, purposes, ambitions, and various complex habits, which express themselves in responses acquired by the individual in a social setting. The social motive may be as powerful a determinant of behavior as the organic need. The politician obsessed with ambition for public office or the missionary infused with religious zeal is no less strongly motivated than is the angry man or “boy-crazy” girl.

The purpose of this chapter is to analyze the more important motives and to show what happens when these powerful drives are blocked or when they come in conflict with one another.

**physiological motives**

**Organic Needs**

Organic needs—or cravings, as they are often called—constitute the most regular and dependable human drives. Those physiological tensions which form the roots of much of our social behavior may be briefly described as follows:

1. **Hunger and thirst**

Hunger and thirst originate in disturbed states (usually stomach contractions, dryness of throat and mouth) within the organism. Figure 134 shows the relationship between hunger pangs and stomach contraction in a human being. In order to measure the contractions of the stomach, a small balloon is swallowed by the subject and is then inflated. Pressures upon
this balloon are transmitted to a writing point or tambour and are recorded upon smoked paper placed on a revolving drum (a kymograph). Hunger pangs as reported by the subject (see Figure 134) correspond closely to stomach contractions recorded on the upper line. The bottom curve is the breathing record.

A hungry or thirsty animal is strongly motivated to seek food or water, and its behavior is directed towards this goal. In experiments with animals in the psychological laboratory, when the purpose of the experiment is to have the animal learn to run a maze or to escape from a problem box, hunger has proved to be one of the most dependable prods to action. If an animal (a white rat, for example) is given the choice of two foods, his preference will be in general agreement with his body needs. Rats select food in accordance with palatability and previous diet, but there is much uniformity and stability in their food preferences.
In human society, food-needs early become conditioned to responses associated with eating. Among the first coordinations which the infant makes are those in connection with getting food into the mouth. Sucking is followed by eating with a spoon, and finally with a knife and fork. The baby quickly learns to respond eagerly to the sight of food and learns, too, that the sound of its mother’s footsteps, the rattle of dishes, and various odors “mean” food. Later on, the adult’s need to “make a living” (provide food and shelter) is one of the strongest incentives to learning. And the years spent in preparation for a trade or profession represent, at least in part, an investment in security—growing out of the need to assure an adequate food supply. In like manner, food hoarding—often observed in animals and sometimes in man—is probably an anticipatory food response motivated by the hunger urge. (See also page 261.)

In modern communities, food often loses its biological and urgency value. The possession of food in overabundance or the wasting of food then becomes a demonstration of the owner’s wealth, power, and prestige.

(2) sex

The initial drive to sexual activity, when puberty is reached, comes from nervous tensions within the body, set up primarily by the sex glands. The importance of these glands in sexual behavior is shown by the fact that their injury or removal at an early age radically reduces, or eliminates, the primary sex urge. In later life, however, many habits built around sexual activity may be retained when the primary drive is weakened or even absent. The urge to sex activity is physiological and organic. But the sex object—the kind of man or woman to whom one is attracted—is determined largely by environmental factors: social, cultural, economic, and even accidental.

The relative strengths of the drives of hunger, thirst, and sex have been studied experimentally in the white rat by what is called the obstruction method. This procedure is based upon
the principle that the more resolute the animal's behavior (as shown by a willingness to cross an electrically charged grid), the stronger the motivation. Placed in one end of an experimental box, the animal is forced to cross a charged grid or floor in order to reach food (or other objective) at the other end of the apparatus. When rats are deprived of water, food, and a sexual partner for varying periods of time, the number of times the animal is willing to cross the grid becomes a measure of drive strength. Figure 135 shows thirst to be the strongest drive, followed by hunger and sex. This order may be accepted with certain reservations. It is clear that hunger and thirst cannot be kept strictly independent, that the intensity of hunger does not increase regularly with time, and that after long deprivation from food, the animal's physical condition is weakened, as are its will and aggressiveness. At the same time, it may be noted that the relative strength of these three drives is in accordance with expectation.

After hunger, the sex drive is probably the strongest human urge. Unlike eating, sexual activity is not, of course, essential.

**Figure 135** The thirst drive is most intense at first, with the hunger drive approaching the maximum on the second day. The sex drive is less intense at first but continues for a greater length of time if food and water are supplied.
to the life of the individual. But because of the many restrictions placed upon its free expression, the sex drive is likely to be more insistent than hunger and is often forced to express itself in devious ways. No human urge is so hemmed in by society with taboos and controls or is invested with so much social significance. Before marriage the young man is expected to conform to various standards of courtship, to established customs and rules; and marriage itself is usually a religious as well as a civil rite. In our society, the observance of conventions governing sexual behavior may be even more important for the young women than for the young man. In fact, "immoral behavior" in women generally refers to conventionally improper sex conduct. A number of activities—dancing, parties, petting, reading romantic novels, theater and movie-going, and artistic and even religious enthusiasm—are recognized as socially acceptable ways of reducing the tensions arising from the primary sex drive (page 276).

(3) rest and sleep

The need to rest or sleep when fatigued appears early and remains a strong determinant of behavior throughout life. It is interesting to note that the primary need for sleep often becomes closely associated with such accompanying factors as darkness, quiet, a certain kind of bed, and other situations. These conditioned stimuli (page 299) may assume so much importance as to obscure the original drive. In many cases, in fact, a person cannot readily sleep, even when tired, except under specific circumstances.

(4) other bodily needs

A variety of physiological states leads to responses which are extremely important to the survival and comfort of the organism. When falling, a person seeks to right himself and maintain balance. In the same way the body, when disturbed physiologically, seeks to adjust itself and restore equilibrium. Hence when we are too hot or too cold or are fatigued, there
is an active search to find a more equable state—a better balance. The need to eliminate waste products from the body, to breathe, and to find relief from pain constitute fundamental organic drives which lead to fairly regular and predictable responses.

**instincts as motives**

There are a number of urges, partly native and partly learned, which are strong drives to action. In the past, behavior for which an inherited basis was known or could be assumed, and which appeared without prior training or learning, was ordinarily described as an "instinct." The term instinct, however, is no longer used generally to describe *human* behavior. In the first place, we find in man no such regular or stereotyped pattern of responses as appears, for instance, in the elaborate behavior rituals of ants, bees, and other animals. (See Figure 136, below.) Moreover, behavior which has been called in-

**Figure 136** Often-repeated and apparently unlearned patterns of behavior in animals are called instinctive.

Ewing Galloway
Distinctive varies greatly from person to person and varies, too, within the same individual upon different occasions. In the second place, the term instinct has often been confused with habit or learned responses. Thus a sports writer recently described a football player temporarily knocked out in the first half as playing “instinctively” for the remainder of the game. A lawyer wrote that the criminal should be “instinctively” afraid of a blue uniform. Playing football and fear of a policeman’s uniform are obviously learned, not inborn, responses. Finally, instincts furnish a circular explanation of behavior: an explanation which “explains” behavior by naming it. Whenever the same activity pattern is observed in a number of people, someone is almost certain to invent an instinct to account for it. So because children build things, we have the “instinct of workmanship”; because many people are restless and like to travel, an instinct of “wanderlust”; because small children actively explore any new and attractive object with eyes, fingers, and mouth, an instinct of “curiosity.” Many such responses are better thought of as ways of behaving acquired by people who have been subjected to the same social and cultural influences. In this chapter, therefore, instead of instinct we shall use the term psychological motive when referring to human beings, implying thereby a drive with some basis in inherited structure or organic need but determined so far as its expression goes by environmental factors.

**psychological motives**

Psychological motives are less fixed and dependable than are the organic needs, but they are no less important in daily living.

**EMOTIONS AS MOTIVES**

Emotions, as we have seen (page 211), act as powerful drives in directing human behavior. Unpleasant emotions have an emergency character (page 235): not only do they stir up the
organism and increase the physiological tempo, but they mobilize the body's resources for fighting or fleeing. Anger and fear belong in this category. Both these intense psychological states reinforce the primitive, unlearned bodily responses, which later are elaborated into complex learned behavior. Love, grief, and joy are also both physiological and psychological. These emotions do not usually possess the emergency character of fear and anger, but they are potent drives to behavior nonetheless.

(1) anger (rage) $\rightarrow$ struggle

In the young animal or human infant, restraint of movement (holding the arms or legs, for instance) leads to struggle reactions accompanied by screaming, biting, kicking, and other manifestations of anger. The native response of struggling against restraint acts as a stimulus to arouse anger or rage, which in turn serves to reinforce the struggle reaction. Rage is thus both a response to restraint and a stimulus to further struggle. In the civilized adult, struggle against physical
The emotion of fear may at the outset be mainly startle (page 212) or surprise accompanied by excitement. Fear is aroused in the young child by sudden intense and painful stimuli—injuries, pricks, bruises, and the like (page 212). The child's immediate responses to these stimuli are crying, whimpering.
withdrawal, and escape movements. As fear develops, these responses become intensified and reinforced by the emotion. Like anger, therefore, fear is both a response and a stimulus to further responses. In general, fear is a negative motive—that is, fear reinforces or strengthens escape movements designed to take the individual away from the fearsome stimulus. Through learning, the range of fear-producing stimuli is greatly increased (page 216). In modern society, fear as a motive runs the gamut of responses from putting on an “angry front” to cover one’s misgivings (loud talk, bluster, and the like) to cringing obsequiousness.

(3) grief or sorrow → weeping

It seems likely that the emotion of grief or sorrow derives originally from feelings of deprivation or discomfort or from fears of reprisal or of punishment. In the adult the motive for weeping or sad behavior may vary greatly from an intense sense of loss or a feeling of helplessness and frustration, to conventional ideas of propriety having little or no emotional content. In patients suffering from severe depression there is often little or no weeping. On the other hand, the shedding of tears is not an infallible index of sorrow or grief—one may cry from happiness.

(4) love → affectionate responses

Love or tender emotion leads to affectionate responses. The animal or human infant responds to petting and fondling first with quiescent behavior and later with active expressions of pleasure. The affectionate responses of the young child are readily extended from mother or nurse to anyone who ministers to its needs. Among adults, rewards, flattery, and praise from friends or community evoke responses of pleasure and gratification. This behavior, to be sure, is far more sophisticated than are the responses made by a child to those who care for his physical comforts. But psychologically it is an elaboration and extension of the early affectionate behavior.
When the emotion of joy is strong it tends to express itself in a release of energy, excitement, movement, and activity. Milder states of happiness (euphoria) lead to a sense of well being and relaxation. The physically healthy baby, well nourished and well cared for, enjoys its own activity of threshing with its arms and kicking.

A number of psychological urges are best described as common social motives. This designation emphasizes the large variability of response, as well as the important role of learning and social conditioning in the behavior initiated by the motive.

**SELF-ASSERTION, OR THE “MASTERY MOTIVE”**

This picturesquely described motive exhibits itself in the desire to dominate people and things. Self-assertion represents a somewhat more sophisticated development of behavior which originated in the primitive rage-struggle sequence. The urge to dominate is a strong determiner of behavior. It has been claimed, in fact, that a person's characteristic performance or “style of life” depends primarily upon the extent to which his “will to power” is able to find expression.
The frustration or blocking of the self-assertion motive often leads to aggressive action against the person or situation blocking the individual's desires. Crying, screaming, and struggling express the "fighting" child's protest against restrictions placed upon his movements. Temper tantrums, negativism, and the often violent revolts of adolescence exhibit the urge to self-assertion. As the child grows older, he often learns to anticipate restraint and thus to attack first—struggle in advance. Attack behavior may even become an established habit system, as shown in a boy's willingness "to fight at the drop of a hat." (See Figure 139, on page 255.) In many adults we find a tendency to bristle and argue vehemently at any suggestion of criticism (thought of as personal restraint). In adult society, furthermore, aggression as a response to frustration may express itself directly in swearing, loud complaints against real or imaginary grievances, protests, strikes, demonstrations, even revolution. Or the aggressive behavior may be more indirect and subtle, revealing itself in sneering remarks, belittling and captious comments, surliness, unfriendliness, and even neurotic illness (page 271).

Studies of the factors which cause workers to like or dislike their jobs have shown that the pay is not the only—nor always the most important—factor in worker satisfaction. In one factory (page 630) a group of girls was studied intensively to discover the effects upon production of such influences as rest pauses, length of work periods, bonuses, etc. It was found that these girls increased their output under a wide variety of conditions. Interviews revealed that the prestige and sense of well-being derived from being consulted and from being made to feel important and responsible (self-assertion motive) were the crucial factors in building morale and so increasing production.

The habit of attack growing out of the struggle response is probably the origin of the so-called "instinct of pugnacity." Pugnacity or aggressiveness develops, then, out of the attempt to defeat in advance those people, things, or institutions which
might conceivably restrict one's activity—physically, economically, socially, or politically. That the origin of self-assertive behavior is not generally understood is shown by the fact that the treatment usually prescribed for aggressiveness is punishment. Punishment, to be sure, may be deserved and may act as a deterrent. But punishment, even when drastic, is often ineffective: it does not remove the cause of the untoward behavior (the frustrating situation) and often serves to heap fuel on the flames and to intensify the emotional response (page 327). Consider, for example, the insecure and overanxious boy

![Figure 149 Friendliness, a sense of responsibility, and a feeling of belonging are even more important in a work situation than a recreational program.](image)

Monkmeyer

Courtesy Sperry Gyroscope
who asserts himself vigorously and is severely punished by a stern father; or the adult, restrained by lack of intelligence or money or social position from achieving some cherished ambition, who steals from his employer and is sent to jail; or even the defeated nation upon which harsh terms of peace are imposed and which awaits its chance to strike back. In these and many similar cases, punishment is likely to provoke counteraggression rather than suppression of the undesired behavior. When the aggressive behavior is out of all proportion to the situation setting it off—is, for example, senseless and ineffective—one should look for the origin in frustration. Patience and understanding rather than punishment and aggression become the most effective methods of handling such hostile and belligerent behavior.

Self-assertion expresses itself in a number of interesting ways. Most children of four would rather pound with a hammer, climb the stairs, or wipe their own noses alone and unaided than accept help from an adult. The adolescent protests against the authority of his parents and the school by wearing outlandish clothes, driving ancient cars, and indulging in queer dances. Attempts to dominate people and things, to attain

FIGURE 141 Adolescent humor is often more direct than commendable.
business or professional success, or to achieve political or social prestige are in part expressions of the self-assertion urge. The same motive appears in the scholar’s willingness to burn the midnight oil or to spend years cooped up in his laboratory; in the sportsman’s willingness to undergo long training or even hardships in order to win a race or a golf match or to climb a mountain.

**SOCIAL APPROVAL**

The desire to gain prestige with one’s fellows, family, friends, club, or community, or to be praised, appreciated, or rewarded in some way constitutes one of the most powerful social motives. Prizes, titles, diplomas, and testimonial dinners show to
Pleasure in owning things takes various forms depending upon age and financial circumstances.
what extent we recognize the strength of this motive. The urge for personal appreciation is probably a development and elaborated expression of the motive which leads the young child to seek petting and fondling. On the positive side, kind words, flattery, and material rewards enhance one’s sense of security and self-esteem. To illustrate, nearly everyone has a personal investment in his own name. No matter how appealing an advertising letter may be, it makes a negative impression if the name of the person to whom it is sent is incorrectly spelled. One popular magazine always gives the full name, including the first and the middle name spelled out, of those personages mentioned in its pages—a subtle compliment and an effective one.

The audience to whom an individual appeals depends in large measure upon his age, sex, and condition in life. The child seeks the approval of his family and often of strange adults by exhibiting his repertory of tricks—climbing, jumping, reciting poetry and rhymes. The adolescent displays his strength and daring, and advertises his sophistication through knowledge of currently popular slang and fads. The adult appeals for approval in many ways: by presenting a well-groomed appearance, by displaying his wealth, intellectual gifts, or generosity, or by his achievements in sports, business, politics, or a profession. In lieu of positive achievement, a person may fall back upon boasting, arrogance, bad manners, and even upon antisocial and criminal acts. Any attention, even adverse, is considered better than no attention at all. Thus the hoodlum and the gangster’s “moll” read avidly the lurid accounts of their exploits in the tabloids. The intense eagerness with which one enters into competition—provided the hurdle is not too high and there is a chance to win—is rooted in self-assertion and in the approval which success brings. Interest in collecting, though allied to food hoarding (page 247), also represents a method of satisfying one’s need for social approval. Boys and girls collect colored stones, marbles, campaign buttons, pictures of popular actors and actresses, and other trinkets;
wealthy men collect stamps, vases, or fabulously priced art objects. At different levels of sophistication, the motive is the same—pride of possession plus prestige gained within one's group from having a larger or more expensive display than someone else. Many times even submission is a technique for gaining social approval and approbation through humility and self-abnegation.

**Gregariousness**

What is called gregarious behavior expresses itself in the desire to be with one's own kind. Animals live in flocks, herds, or other groups. Children prefer children, adolescents prefer the company of other young people, and visitors in a foreign country seek out fellow countrymen. City people are often oppressed by the loneliness of the country, and country people appalled by the unfriendliness of the city. This “consciousness of kind” is a well-recognized and often-observed phenomenon; and it is a strong social motive. Though it is often described as an instinct, gregariousness probably is not a basically unlearned urge—it arises from a complex of needs. Sheep flock together, for example, for protection and warmth. Animals
live and travel in groups because habits of group behavior are built up early in life. The need for security, sympathy, and understanding is certainly important in human gregariousness, as well as the need for the approval of the group to which one belongs.

Gregariousness is not a universal phenomenon. The need shown by some individuals for conversation and social relationships is not exhibited by others. Many people, for example, prefer their own company and are well content when alone; and the hermit possesses the “instinct” of gregariousness to a negligible degree.

**SYMPATHY AND PROTECTION; THE SO-CALLED PARENTAL AND FILIAL “INSTINCTS”**

There is a good deal of evidence that sympathy for those in need (the deprived, ill, poverty-stricken) is a common social motive. Sympathy and tender feeling probably grow out of the unlearned love-affection responses which appear in early childhood. Hospitals, asylums, and homes for orphans and aged folk are monuments to this motive. The mutual affection of parents for children and of children for parents is sometimes described as rooted in parental and filial instincts. But such
behavior is probably not basically unlearned. A foster-parent may be just as affectionate and sympathetic as an own parent. On the other hand, the attitude of a parent toward his own children may be anything but affectionate, and the spontaneous responses toward her offspring of an unwed mother (from

**FIGURE 146** Love of offspring may come from many motives in the parent but the important part for the child is the sense of security he feels.

Courtesy Standard Oil (N.J.)
whom conventional expressions of praise and approbation are withheld) may be those of distaste and even loathing. The parental urge is best described as a common social motive made up of sympathy for the small and helpless plus pride of possession, social approval, and self-assertion.

**SELF-PRESERVATION**

The desire to protect oneself from danger is undoubtedly a strong and impelling motive. This has been long recognized in the common saying that “self-preservation is the first law of nature.” It is true that when faced by danger one’s first impulse usually is to withdraw or to escape. A man alone in the woods who suddenly comes upon a strange animal or a large snake will retreat as rapidly as possible and often call for help as his fears mount. Such a person’s behavior is obviously designed to protect himself, and the motive is basically that of fear-escape. But self-preservation is certainly not an instinct in the sense that an individual will—without prior learning—act always in such a way as to save his own life. What a person does “instinctively” in the face of danger may, in fact, result in his own destruction. Thus a drowning man who “instinctively” thrashes with his arms and legs or clings tenaciously to another swimmer who seeks to aid him may drown himself quite effectively. The child invites serious injury if, having set himself on fire, he runs around frantically screaming for help. Horses in a stable will burn to death rather than risk the loss of security which the stall has always meant. If their heads are covered, however, so that the fire is not visible to them, horses can be led from a burning building.

Use of the term *instinct* as applied to self-perservation substitutes logic for psychology. Everyone—except possibly the suicide—undoubtedly wants to preserve his own life. But what he does “instinctively” may accomplish the reverse of what he intends. Self-preservation, therefore, is best thought of as a complex motive rooted in the fear-escape urge.
UNRECOGNIZED MOTIVES

In many instances it seems clear that we do not fully understand—or are unaware of—the motives which determine our behavior. Strong evidence of the existence of such concealed motives come from several sources.

(1) Perhaps the most striking instances of the operation of unrecognized motives may be seen in cases of posthypnotic suggestion. A hypnotic state is a condition resembling sleep in which the person is only partly conscious and is highly suggestible. If under hypnosis a man is told that at ten o'clock on the next day he must read a certain book, the act will be performed as instructed. But our subject's explanation of his behavior, although entirely reasonable, may bear little relation to the real motive for his act. In fact, he will have completely "forgotten" the suggestion made earlier. Posthypnotic suggestions are dramatic instances of ordinary waking suggestions which are later carried out. To illustrate, suppose you have told a woman friend that a certain style of hat is very becoming to her, and shortly thereafter she purchases a hat of this type. While your remark may have been the determining factor in her purchase, your friend may be honestly convinced that the choice was entirely her own. In fact, she may even deny any memory of your suggestion.

(2) Often we may infer the "real" motive, as distinguished from the expressed motive, from slips of speech, from dreams, and from involuntary acts and gestures. The toastmaster who introduced the principal speaker as "our dissolute friend" instead of "our distinguished friend" probably meant what he said. Dreams, particularly recurrent dreams, often dramatically reveal motives of which the subject is unaware or which he is unwilling to admit. The highly religious man who regularly dreams of fatal accidents which befall his wife would probably not be overwhelmed with grief if such occurred, no matter how much horror he might profess at the idea. Frequently "actions speak louder than words." The Roman soldier who stumbled
on his doorstep when leaving for a new campaign interpreted his awkwardness to mean that “in his heart” he didn’t want to go. A late guest says that he really must go and the host, while protesting politely, quickly rises from his chair. In incidents like these, the evidence is suggestive rather than conclusive; but the implication seems clear that people are not always completely aware of the motives that determine their behavior.

(3) Various psychological techniques have been developed for the avowed purpose of uncovering unrecognized or unadmitted motives. In free association, the subject responds to a stimulus word by giving the first association (word or phrase) that comes to mind. Responses to certain emotionally toned words (for example, father, mother, love, cruel, guilt, sex) often reveal attitudes and trends of thought of which the subject is only dimly aware. The projective techniques (page 569) represent other devices for getting at motivation by indirection. For example, a person is asked to interpret pictures or to tell what he sees in various diagrams, ink blots, and designs. The assumption made here is that the subject will inadvertently read his own motives into his interpretation, and that strong, persistent, and often unrecognized drives will appear in what he “sees.” Finally, from interviews and from analyses a skilled counselor can infer much regarding a person’s dominant interests and attitudes when these motives are only vaguely understood by the examinee.

Sometimes the term unconscious motive is used instead of unrecognized motive to denote those drives which we perceive dimly, if at all. The phrase “unconscious motivation” is perhaps a bad choice, however, as it is easy to slip over from it uncritically into acceptance of the nebulous concept “unconscious mind.” As used in popular psychology, the notion of an unconscious or subconscious mind (the meaning is roughly the same) often carries with it the old demonological idea of the struggle between forces of good and evil for control of a man's soul. Conscious motives (ideals, precepts, social obligations, conscientious scruples), which the person may have been
forced to accept against his will by the culture in which he lives, are represented as being pitted against the (sometimes) illicit and primitive urges which have been repressed into the "unconscious." This is picturesque analogy, to be sure, but it is fiction, not science. There is no valid evidence for the existence of an unconscious mind, at least in the sense of a repository of dynamic urges (usually selfish, antisocial, or aggressive) which control behavior unrecognized by and almost in defiance of the consciously acting person.

What are usually labeled unconscious motives can be more adequately explained in terms of the unglamorous but more objective principles of habit formation (page 333). Unconscious motives fall into several classes. First are those motives which are really understood by the subject and will be admitted if the confession does not hurt the self-esteem too greatly. A young man, for example, may really know (though he may vehemently deny it at first) that his belittling of a rival stems from jealousy and fear of competition rather than from a high-minded ethical attitude. Second, motives are unconscious in a real sense when they have not been put into words or expressly formulated as part of the subject's system of ideas. Thus an attitude of hostility towards his father may cause a teen-ager to react violently against all adult authority—without clearly knowing why. Or a girl may be unable to find an acceptable suitor because her affection for and admiration of her father lead her to look in vain for the same maturity and wisdom in the young men whom she meets. Third, and fortunately only in extreme cases, unconscious motives may operate in instances of what are called split personality. The disassociation of one group of ideas and motives from the main stream of personality is not usually so dramatic as in the famous case of Dr. Jekyll and Mr. Hyde, but such splitting of the personality does occur. Cases are on record in which a person is at one time dominated by one set of motives and at another by a different set, the two personalities being virtually unaware of
each other. Under skillful treatment the two distinct personalities can often be fused into an integrated whole.

**INTERESTS**

Our interests in people and in things depend primarily upon two factors. In the first place, we are interested in what we as persons are able to do well. The boy who is athletic finds satisfaction in playing football, and the bookish youngster finds satisfaction (perhaps reluctantly at first) in the A’s which he receives in his studies. In the second place, we are interested in those things which are regarded as valuable by our social group. College students, for instance, regularly rank the vocations of physician, clergyman, lawyer, professor, and banker as high in social prestige, whereas those of barber, factory worker, and chauffeur are rated low. Once developed, interests motivate and often dominate our everyday activities. We all know the ardent baseball fan who reads only the sports page, knows the names of all the players, and can even quote their batting averages to three figures. Or the teen-age girl who is enamoured of some currently popular radio singer, who buys all his records, listens to all his broadcasts regardless of her parents’ scolding, and embellishes her daily conversation with stories of his talents, his clothes, his likes and dislikes. In these not unusual cases, a dominating and emotionally toned interest crops up time and again in a person’s behavior. Because of their importance in directing behavior, systematic attempts have been made to measure vocational interests by means of questionnaires or inventories, and to relate these interest “scores” to occupational success (page 518). Scores made upon an inventory help to identify a person’s dominant interests. The editor or journalist probably will like language and people and dislike science and business. Ministers and social workers will prove to be more interested in people than in business, merchants more interested in business and in people than in science, and scientists more interested in science than in people.
conflicts among motives

For a variety of reasons, motives are frequently unable to find free or adequate expression. Interference or blocking of a motive may come from several sources: (a) from competing and antagonistic motives; (b) from religious or ethical principles, moral scruples, ideals, and contrary habits; (c) from stumbling blocks imposed by circumstances: physical and personal liabilities, restraining laws and customs, social taboos, lack of money or education. A child wants a piece of candy but is deterred by his mother's warning that no more candy is to be eaten before dinner. An adolescent wants to dance but hangs back because of his awkwardness and fear of ridicule. A businessman is restrained by habits of caution from taking a flyer in the market, but is sorely tempted nonetheless.

When a strong drive is blocked by equally strong motives or circumstances, a sense of frustration often leading to conflict develops. A diagram of what happens in the conflict, expressed in behavior, is shown in Figure 147.

![Figure 147](image)

A stimulus situation encounters conflicting motives in the organism, so that the final response becomes uncertain. Or a given response, say R₂, is blocked by the environment, forcing the decision back to the organism and thus renewing (and perhaps even intensifying) the conflict. It appears clear that the term frustration can have two meanings. It may refer to tensions arising from conflict among motives within the individual,
or it may refer to the blocking of a response by people or obstacles in the environment.

Conflicts are marked by irritability, tension, anxiety, surli-ness, and often by aggressive behavior. We have already seen (page 255) how an individual may resort to aggressive tactics when blocked in carrying out what he wants. But aggressiv-ness and protest are not the only ways of meeting conflicts or of resolving the dilemmas presented by competing courses of action.

**ways of meeting conflicts**

**ADJUSTMENT TO CONFLICT BY DIRECT ACTION OR BY COMPROMISE**

A person may attempt to solve a conflict by direct action. He may examine the reasons for his indecision objectively and make a choice between contrary responses. Or he may adopt a compromise course in order to ease the dissatisfaction and anxiety set up by the conflict. A young man is undecided whether to enter law school and delay marriage or to find a job and get married immediately. Several possible courses present themselves: he may go to school and work part-time while his wife continues in her job; he may borrow money for full-time study and delay marriage; his parents may finance his schooling and allow him to marry at once. The “best” decision will depend upon the people involved and the attendant circum-stances. Almost any positive action is better for one’s men-tal health than continued worry and indecision. But unless the final choice really settles the conflict, indecision will re-occur and persist as a problem. When this happens, a person is likely to fall back upon one or more of the stratagems described later in this section.

In a general way, a decision reached by compromise is probably better for mental and physical health than is im-mediate and direct action. Unless carefully thought out,
weighed pro and con, and finally settled upon, direct solution of a conflict may be indecisive. An immediate decision, in fact, sometimes has a desperate quality about it, as when a boy, frustrated by his father’s sternness, runs away from home, or when a girl marries an attractive but worthless scamp rather than give him up. Conflicts resolved by compromises are analogous to those disputes between labor and management or between nations which are settled by conciliation and arbitration. Each side gives a little until the deadlock is broken, an agreement reached, and action is possible. Decisions reached by successful leaders are rarely of the “all or none” variety. Most of them are compromises designed to reconcile—if not completely to satisfy—the conflicting parties.

ADJUSTMENT TO CONFLICT BY INDIRECTION AND SUBTERFUGE

Unfortunately, many conflicts are not settled by direct action nor by compromise. The reasons for the conflict may not be fully comprehended. The individual may not have the intelligence or training or the emotional maturity or the courage to face his difficulty and work out a solution. It is possible, too, that there is no direct solution, as when a wife cannot live with her drunken husband but cannot divorce him for religious reasons. Various indirect methods are resorted to in order to avoid, or to ease, or to gloss over a conflict. At the same time, these devices often serve to protect the individual and to maintain “face” and prestige. Some of the well-recognized “mechanisms” or stratagems of adjustment by indirection or subterfuge will be described in the following paragraphs.

(1) responses to conflicts by withdrawal or surrender

A child refused something which he wants very much falls back upon pouting, petulance, or exaggerated indifference. A student realizing that he is going to lose a foot race or fail an examination quits and refuses to try. A woman unable to buy a new hat or dress for a social occasion goes to bed with a “headache.” These are instances of response to a conflict by
withdrawal or surrender. Instead of accepting refusal graciously, or trying harder, or revising one's set of values, the individual gives up and retreats. Surrender is a poor method of meeting a conflict. It may be temporarily effective, but it settles nothing and if persisted in becomes definitely a personality liability. Established habits of quitting, of protesting incompetence, or of exhibiting poor sportsmanship often build up feelings of inferiority, worthlessness, and guilt. Such behavior, if continued, inevitably colors the individual's decisions and conduct generally. The attitude that nothing can be done, that it is God's will, or that one is a miserable sinner is essentially unhealthy, since it substitutes surrender for positive action. Surrender and self-abnegation are perhaps most successful in the "suffering hero" role, in which a person for a time actually gains prestige and social approval by exaggerated humility. Eventually, however, the martyr or the disciple of "sweetness and light" becomes boring, if not repellent, to many people.

Persons who refuse to face their conflicts often resort to fantasy and daydreaming as a substitute for decision. The sensitive child may find temporary satisfaction in imaginative flights. A boy pictures himself as a great adventurer performing daring deeds; a girl becomes in fancy, according to her mood, a princess or a glamorous actress or a sainted missionary. Reading "escape" fiction, attending the movies, and going off by oneself for long periods are relatively mild ways of avoiding the hard decisions of everyday life.

(2) responses to conflicts through rationalization and other protective devices

In many conflicts a person is forced into a compromise which is not satisfactory and which he does not fully accept. Often he feels that he must justify his action by elaborate excuses or rationalizations, sometimes difficult to penetrate but often quite apparent. A student buys a watch which he can ill afford, or fails a course through laziness or inattention, or jilts a girl for someone else. The "good" reasons which he offers for his
behavior may be quite different from the “real” reasons. Thus he may say that he needed the watch in order to get to class on time; the failed course was uninteresting or badly taught or came at an inconvenient hour; the girl was unintelligent or a snob. The “real” reasons may have been that he wanted to show off (self-assertion, social approval), that he neglected studying for the final examination, and that the girl actually jilted him because she could not tolerate his rudeness or lack of consideration.

An excuse or rationalization in which one deprecates or minimizes the value of some objective which he is unable to achieve has been called the “sour grapes” response. The fable tells how the fox, unable to reach a bunch of grapes after much effort, saved “face” by declaring the grapes to be sour and unripe anyway. This response is extremely common and is a well-known protective device. A man is fired from a job, not for inefficiency but—to hear him tell it—because the boss was “down on him,” and the job was no good anyway. Student X gets a better grade than Student Y because X is a “grind,” not because he is more intelligent or more industrious. If John shows no talent in music or art, then artists are really a queer lot and are usually poor. In many social situations, rationalizations serve to save one’s pride and to bolster one’s self-respect. As such, they may be relatively harmless unless they become habitual. It is a good idea for everyone occasionally to examine his “reasons” critically. Even if he retains some as practically useful, he may at least understand his “pet” justifications for what they are—excuses, not reasons.

Use of protective devices, excuses, elaborate explanations, and the like is common in social living. In fact, many well-known beliefs are clearly examples of wishful thinking and reflect a reliance upon compensation—namely, that a person good in one thing is necessarily poor in another. So it is a matter of “common knowledge” that pretty girls are stupid; that the good die young; that bright children are nervous and irritable. * Called by a wit “sour grapes of wrath.”
These opinions often reflect the wishful thinking of those who are not pretty, not very good, and not overly intelligent. Overcompensations—that is, highly elaborated explanations—are illustrations of rationalizations designed to protect one’s pride and self-assurance by parading one’s own good points and belittling qualities which one does not possess. Thus the A student who is not athletic (but would like to be) sneers at athletic contests as puerile and silly. By the same token, the athlete who is slow in learning may poke fun at the owner of a Phi Beta Kappa key, especially if he wears heavy eyeglasses and is small in stature. By protesting too much, we often reveal an unsettled conflict rather than our own complete satisfaction with our lot.

Still another common mechanism of response by indirection has been called projection. A man stumbles over a chair in the dark and kicks or swears at the chair as though it, not his awkwardness or inattention, were the “cause” of his barked shin. An unattractive woman accuses men in general of flirting with her. Wanting masculine attention herself, she “projects” her desires on men. Thus she meets a conflict by shifting the blame, and at the same time remains both circumspect and desirable.

All these protective responses—rationalization, compensation, projection—can be classified as “defense mechanisms.” This term emphasizes the fact that all these schemes are ways, often subtle, of protecting oneself: of preserving pride and self-conceit in the face of an unsatisfactory compromise which has not completely resolved one’s conflicts.

(3) responses to conflicts through substitution or redirection

It sometimes happens that a person meets a problem which is not susceptible of direct solution. A young man wants to marry but must support a widowed mother and several small brothers and sisters. The girl refuses to marry unless he can leave home and set up a separate establishment. Torn between a normal desire to have a home of his own and a deep sense of filial
obligation to his dependents, this young man may decide to delay or even to reject marriage. In place of marriage he substitutes work with boys' clubs or charitable organizations; or he may resort to antisocial activities, such as gambling or drinking. A woman's only child dies. Unable to have another child or to reconcile herself to the loss, she works in an orphanage; or she may deteriorate physically and mentally into a whining, complaining woman taking out her grievances on her husband or her friends.

Activities which substitute for a desired—and usually a socially unacceptable—response, thus alleviating the tension of a conflict, are called sublimations. To use a physical analogy, the pent-up energy is sublimated or drained off into substitute activity. Substitutions may be socially undesirable or socially useful. Drinking, self-pity, and drug addiction are examples of the first. Devotion to art, music, science, or philanthropy may to a greater or lesser degree be socially useful sublimations of unresolved conflicts. Many outstanding achievements by men who already possess unusual talent represent, in part at least, sublimations in which unusual energy is concentrated. Intense application lessens and may in time remove the pain of the conflict. Furthermore, as interest grows with achievement, and rewards increasingly satisfy the need for self-assertion, the activity (art, science, or what not) becomes itself a secondary drive or motive to action.

(4) responses to conflicts by "repression"

We have seen how conflicts between behavior which is conventionally ethical but unexciting and behavior which is attractive but socially taboo may be relieved in various indirect ways: by fantasy, rationalization, sublimation. According to some psychologists, repression is still another important device for defending one's pride or saving face. Sex impulses, as well as illicit and cruel desires are conceived of as pushed down or repressed into the "unconscious." Such repressed thoughts do not remain hidden or permanently inhibited, however. They
crop up in fear-dreams, anxiety, stuttering, and other nervous manifestations, even in silly behavior, incessant giggling, and the like. Though such an explanation is picturesque and interesting, many psychologists do not accept repression as an explanatory concept because they do not accept the notion of an “unconscious mind” as a repository. A more naturalistic explanation holds that the motives indirectly revealed by such symptoms as those described are unconscious in the sense of being unrecognized for what they are by the person exhibiting them. They may never have been completely formulated as part of the personality or put into words (page 266), though their meaning is often fairly well understood. In certain cases, to be sure, a motive may actually be split off from the main personality, which is “unconscious” or unaware of its activity. But most stratagems for defending the “ego” or self-esteem can be better accounted for by the principles of learning than by resort to the alleged operation of mysterious repressing forces within the “unconscious mind.” Excuses, “good” reasons, substitute reactions, compensations, and daydreams are acquired responses, originally hit upon accidentally or resorted to deliberately, which have proved to be at least temporarily successful. These responses tend to be repeated through the law of effect (page 294) and after much repetition eventually to become habitual ways of behaving.

**treatment conflicts through psychotherapy**

**INDIVIDUAL COUNSELING**

Psychological methods have been proposed for resolving persistent conflicts which render a person unhappy, overanxious and in general maladjusted and ineffectual. Systems of psychotherapy which deal with psychiatric and medical procedures in the treatment of mental disease will be found described in textbooks of abnormal psychology, references to which are
given at the end of this chapter. When the individual is seriously ill and the conflict is intense, crippling, and of long duration, medical advice should be sought. For many people, however, this is unnecessary, as the problem is likely to be one of re-training, that is, of the substitution of new habits for old, or one which is alleviated by a better understanding of personal assets and liabilities. In such cases, the clinical psychologist or counselor is well qualified to assist. Counseling procedures attempt to substitute a positive program for ineffective and essentially negative behavior. In general, counseling therapy works better with children and young people than with adults. Young people are more flexible, their habits are less well established, and they are more willing to take suggestions and to confess motives not ordinarily approved by society. Counseling procedure in general runs somewhat as follows:

(1) The counselor goes carefully into the history of the current trouble before offering suggestions for improvement. The subject is told that he should not expect too much too quickly, that there are no magic formulas or drugs or books which will instantly resolve his difficulty, and that new attitudes and a new outlook are necessary. Undesirable and anti-social behavior often has a long history. Nothing is worse, therefore, than casual advice or snap-judgment based upon surface indications; in fact, such “therapy” often intensifies the difficulty. Intelligence tests and measures of aptitude, of interest, and of personality traits provide useful information upon which constructive advice can be based. If a young man’s aspirations run ahead of his abilities, he can often be “readjusted” by steering him into a vocation better suited to his ability.

(2) The main object of psychological counseling is to enable the subject to gain insight into his difficulties and to understand the reasons for his present plight. A schoolboy reported by his teacher as overbearing and self-assertive will admit to a sympathetic and tactful adult that his behavior is
causing him to lose friends and to be unhappy himself. If the counselor proposes a new program, the boy is often quite ready to co-operate. Many conferences are sometimes necessary, however, before an adult will give up his protective devices (page 273) and become convinced that a different approach is necessary and feasible.

(3) Suggestions as to new interests and hobbies often aid in alleviating conflicts. An elderly retired man, torn between his desire to continue his work and the realization that he is no longer wanted, may find a hobby a source of personal satisfaction and social approval. A timid pupil is much happier if allowed to run errands for the teacher, and a bully in the role of monitor may turn his self-assertive tendencies to good use. These are illustrations of the “expulsive power of a new affection”—of the renewed interest and zest which may result when a person forgets his troubles by throwing himself wholeheartedly into a new enterprise.

The two case histories which follow will illustrate some of the possibilities of counseling when the therapist is well trained, sympathetic, and patient.

Case 1

A young woman, apparently in considerable distress, came to a counselor for help. She stated that she had a serious problem, one which she could not solve by herself; that she needed someone's opinion and advice. Her story was that she had to choose between two men who wanted to marry her. The one was poor and without prospects; the other, somewhat older, could offer her a great deal of security. The counselor said very little, since he realized that the girl wanted to "talk herself out." He simply sat back, nodding and agreeing at appropriate intervals. As the young woman talked, she became more and more definite about being in love with the first man rather than the second. After an hour she arrived at her final decision. She was much relieved, thanked the counselor profusely for his help, said she could not have reached a decision without the aid of a psychologist, and left. This girl had really solved her own problem: she had brought all the facts she had to bear on the
subject and had marshalled her arguments pro and con. The counselor had scarcely said a word throughout.*

This is an example of what is called “non-directive” counseling. Essentially, the client works out his problem himself. The counselor’s role is to guide and focus the interview. The success of the method depends largely upon how skillfully and unobtrusively this is done.

Case 2

John W., a seventeen-year old high-school senior, was referred to the counselor for vocational guidance at the insistence of his father. John was a healthy, nice-appearing boy, quiet in manner. He was a good student but not outstanding, and was a fair athlete. According to the father, while John was bright enough, he was lazy and uninterested in his school work. In the first interview, it developed that John considered his father to be a domineering man, too much concerned with money and success. The father—a successful lawyer—often upbraided and sometimes punished his son (by withholding favors) for neglecting his studies by loafing and for lack of ambition. John appeared to be quite hostile toward his father, saying that his “ideal man” was a sociable, kindly person interested in sports and out-door activities. At the same time, John showed intense admiration for his father, boasting of his important cases, his popularity, and the like. The boy revealed considerable emotional tension, stammering frequently and twisting in his chair. The counselor decided that John’s was an emotional problem, growing out of his desire to fulfill his father’s ambitions for him and his own anxiety and fear of failure. This conflict led to indecision, lack of drive, and a tendency to waste time.

After a friendly understanding had been established, the counselor administered a battery of tests. There were tests of general intelligence (verbal and performance), of manual dexterity, of mechanical aptitude, and of interests. John ranked quite high in general intelligence and in mechanical aptitude. He was especially good in problems in mathematics and in visualizing in three dimensions. His manual dexterity was excellent, and he showed a

strong interest in science. As a result of the tests and interviews, John was advised to consider engineering as a life’s work. It was also suggested that, in view of his interest in music, he take up the playing of an instrument as an avocation.

In separate interviews, the counselor explained John’s conflict of motives to the father. The father was told of the boy’s good ability and was advised to give him more encouragement and friendly understanding. Fortunately, the father agreed with the counselor’s recommendations and promised to take a different attitude. Apparently the plan was successful since John is now a senior in engineering school and is doing excellent work.

GROUP THERAPY

The members of a group can often be induced to talk over their personal problems under the guidance of a sympathetic counselor or therapist. This mutual give-and-take often relieves tensions, allays anxieties, and makes for better personal relations. Persons at first slow to participate soon lose their self-consciousness. They express themselves more freely and with greater confidence once they realize that others have the same difficulties, worries, and feelings of inadequacy as themselves.

Social difficulties, timidities, and feelings of insecurity have been successfully relieved by group therapy. Results are best when the members of the group are of the same sex and about the same age, of average intelligence, and have problems in common and therefore common interests.*

Motives are drives or directing tendencies within the organism—“inner sets” which make one course of action more probable than another. Motives range from inborn organic tensions to complex acquired needs. Among the physiological or organic needs, hunger

* Case studies illustrative of group therapy are too long for reproduction in a general textbook, and excerpts from such studies are not very instructive. The following books which treat methods in detail will be helpful: S. R. Slavson’s Analytic Group Therapy, N. Y.: Columbia Univ. Press, 1951; and G. R. Bach’s Intensive Group Therapy, N. Y.: Ronald Press, 1954.
and thirst, sex, rest, and sleep are probably the most important. In animals, instincts act as motives, but it is doubtful whether instincts—in the sense of stereotyped and repetitive behavior—are operative in man.

In addition to organic and physiological motives, there are psychological and social needs. The desire for social approval, the wish to dominate, and the need for self-preservation illustrate these complex drives. Many motives go unrecognized and are sometimes described as “unconscious.”

When motives come into competition or are contradictory, conflict often develops. Conflicts can be settled by direct action, and they can be relieved temporarily by such devices as compromise, withdrawal, and rationalization. When conflicts are severe and persist over a long time, one may need the help of a counsellor to resolve his difficulty.

questions and topics for discussion

1. Which of the following satisfy the definition of a motive as described in this chapter: (a) the desire to sneeze; (b) a headache; (c) the impulse to tell clever stories; (d) ambition to become a great artist? Which kind of motive is concerned in each case?

2. Did you ever collect anything? At what age did the activity begin, and how do you think it started? When did the interest die out, and can you explain why?

3. How would you plan a study to determine whether pugnacity is an unlearned motive?

4. Why do some people like to tease? Why is it that the reputation of being a “great tease” is not likely to increase one's circle of friends?

5. Why do many boys like to hang on the back of buses, steal fruit, torment janitors? How would you treat such behavior?

6. If the desire to hoard is a strong urge, why is it that so few people accumulate enough money to support themselves in old age?
7. Would a night watchman have much interest in personal adornment? What are the main motives involved in adornment? Is there a sex difference?

8. Give several instances in which even a suspicion of disapproval has brought you great unhappiness. Does disapproval have to be expressed in words in order to be effective?

9. Negativism is defined as an attitude characterized by strong resistance to suggestions from others, so that the person goes to the extent of carrying out the opposite of what is suggested. Can you think of instances from your own experience where refusal to wear certain clothes, to read a book, to hear what was said, or to see what someone pointed out to you were instances of negativism? Why is negativism frequent in children at early ages?

10. Why is the adolescent often self-assertive? What is meant by stubbornness, and how would you deal with it?

11. What motives are probably gratified most readily in the life of the physician, the prize fighter, the minister, the scientist, the elevator operator?

12. What motives are likely to be operative in the following activities: (a) love of adventure; (b) dancing; (c) a mother’s pride in her children; (d) stealing; (e) playing football?

13. Laughter at practical jokes on others has been explained as arising from a feeling of one’s own superiority. Do you think this is true?

14. What are the signs by which you can infer that an individual is dodging a conflict or is meeting it by one of the subterfuges mentioned in the chapter?

15. When is rationalization useful in social relationships? What social usages almost demand “polite” excuses?

16. Can you think of several instances of eminent people who compensated in a useful way for the blocking of strong motives?
17. Cite instances when you have used the "sour grapes" response or when you have made adjustments through projection.

18. Several writers have argued that many reformers are motivated by the urge to protect themselves from temptation and that many violent critics are so because of inferiority feelings. Do you think this is true?

19. Note down some of the excuses which students give typically for failing to pass an examination. Are many of these rationalizations?

suggested readings

1. E. R. Guthrie's *The psychology of human conflict* (New York: Harper & Brothers, 1938), provides a readable and convincing explanation of many deviant forms of behavior as the product of learning and habit formation.

2. Read C. Landis and M. Bolles' *Textbook of abnormal psychology*, revised edition (New York: The Macmillan Co., 1950), Sections 4 and 5, for an authoritative account of modern psychotherapy and mental hygiene; also see N. Cameron's *The psychology of behavior disorders* (Boston: Houghton Mifflin Co., 1947), Chapters 5, 6, and 18.

3. Students who wish to know something about psychoanalysis will find Sigmund Freud's *New introductory lectures on psychoanalysis* (New York: W. W. Norton & Co., 1933) a good place to start.

4. For more intensive reading on psychoanalysis, two books which are quite valuable are Frieda Fromm-Reichmann's *Principles of intensive psychotherapy* (Chicago: Univ. of Chicago Press, 1950), and Harry Stack Sullivan's *Interpersonal theory of psychiatry* (New York: W. W. Norton & Co., 1953).

LEARNING IS A UNIVERSAL HUMAN EXPERIENCE. The infant must learn to feed and dress himself, to talk, and in general to regulate his behavior toward other people and things. For a span of from ten to fifteen years, the youngster's chief concern is to learn what is taught in the schools. During the school years, too, he must begin to acquire social habits and customs acceptable to the community. After the formal school period, the typical young person is busy learning how to do his job, how to deal with many kinds of people, and how to meet the responsibilities of family life. New situations demanding new learning continually arise in the middle years: new habits and attitudes must be acquired and old ones modified or discarded. Even in old age many people continue to learn. In fact, if one finds it hard to “teach an old dog new tricks,” probably it is because the oldster is unwilling to try, not because he is unable to learn (page 346). The demand for changes and...
modifications in behavior and the ability to make such changes continue, then, throughout the life cycle.

A DEFINITION OF LEARNING

Learning is most frequently thought of as that process which, as a result of training and experience, leads to new or changed responses. This general description is true enough as far as it goes, but it would be more accurate to define learning as that process by which we organize our responses into new behaviors. Emphasis upon the word organize implies that the capacity for carrying out the new act already exists potentially within the organism, so that what the learner does is to fit the pieces together. This means, of course, that the learner must already possess the pieces. In the young child, nervous, motor, and mental development are not sufficiently advanced to provide for the fine co-ordinations demanded in writing. So, while a three-year-old can mark with a crayon, attempts at writing will often lead to destruction of the pen. A child will learn to read when he is "ready"—that is, when he is mature enough to organize the necessary language, motor, and muscular responses. And a boy will ride a bicycle when his

Courtesy Yale Laboratories of Primate Biology

FIGURE 14S The ape learns to stand and to walk just as a child does.
Coordination involves learning, whether in the child's use of toys or the judgment of distance and motion necessary for driving a car.

First attempts at learning may be fumbling and hesitant; later, when the learner has successfully organized the appropriate parts, the performance is smooth and sure. So different is the final behavior from the preliminary and tentative trials that in a real sense a well-learned response is a new act.

strength, size, sense of balance, and co-ordination are able to "carry" the new activity. In short, we must be able to perform (at least by piecemeal) the various responses which will constitute a new activity before we can master the new act itself.
Carefully guided instruction speeds up the acquisition of new behavior patterns.
Learning demands the formation of associations or linkages between stimuli and responses. We see a friend and call his name; smell coffee brewing and feel our mouths water; enter a darkened room and push a light button; respond with "good morning" when someone greets us; pull the car over to the curb at the sound of a fire siren; answer $\pi r^2$ when asked the area of a circle. In all these instances a pattern of stimuli has been linked with a pattern of responses which, under certain conditions, are evoked by the stimuli.

Stimuli are prods to action—often to fairly specific action. Stimuli may come from within the body: aches, feelings, ideas, and thoughts are examples. Or stimuli may come from the environment in the form of words, lights, sounds, objects, people, social situations. When the stimulus is a complex setting—for example, football teams in action or the stage of a theater—it is often called a "stimulus situation."

Responses to stimuli may be verbal, muscular and postural, or glandular (for example, flow of saliva or tears). Responses are called "overt" when they are readily observable: when, for example, we say something or do something. Responses are "covert" when there is no clearly observable activity. A person may listen to a concert, for instance, or read silently with little if any appearance of activity. But physical responses are present nonetheless, though often in a much abbreviated form. Sometimes the response is merely a slight nod of the head, a lifted eyebrow, or altered breathing rate. Instruments have recorded muscular and glandular responses when none was observably present. In silent reading, for instance, movements of the larynx (subvocal talking to oneself) have been detected by instrumental methods, and in young children and poorly trained adults, movements of the lips and even a mumbling of words can often be clearly detected. It seems certain that any stimulus able to register upon the brain and the nervous sys-
tem is responded to physically in some way, however slight. Only the dead organism does not respond to any stimuli whatever.

From Aristotle down through the ages to the present time, psychologists have explained learning as a process of association. The time-honored "laws of association" describe four principles in learning: (1) similarity, (2) contrast, (3) contiguity (closeness of relationship) in space and (4) contiguity in time. A red-headed stranger reminds us of a friend who has red hair (similarity); day is associated with night (contrast); the name Miami brings to mind a vacation in Florida last winter (contiguity of association in space and time). In all of these examples, the essential fact is that events have somehow become linked or related, so that the one tends to reinstate the other. Similarity and contrast (the opposite of similarity) are really aspects of the same process. Both describe facts more or less contiguous to one another along a scale of resemblance. The four laws of association, therefore, can be usefully fused into a single principle, that of contiguity or closeness in common experience.

Contiguity or relatedness in experience serves to describe quite neatly associations as we find them. But the principle of contiguity does not explain why certain associations "take hold" and others do not, nor does contiguity explain the mechanics (the how) of learning. Experimental psychologists have not been content to stop with descriptions of learning. They look rather for active or dynamic processes which underlie association-forming; and the task of this chapter is to show how successful they have been in finding such principles.

**basic principles in learning**

It is standard procedure for the industrial psychologist to "break down" or analyze a job into those factors which in his judgment are crucial to success in the given activity. In much
FIGURE 151 Learning how to read and how to tie shoes involve the same processes.

Courtesy Greenwich House
the same way, experimental psychologists have conducted numerous job analyses in the form of experiments and controlled observations to discover how animals and human beings learn. Differences in technique, in terminology, and in points of view abound. But certain basic explanatory principles have emerged which apply generally, whether one is concerned with how the rat learns to run a maze, how the nursery-school child learns to lace his shoes, how the apprentice learns to operate a new lathe, or how a high-school student acquires a speaking knowledge of French. Our general principles may be summarized under four heads as follows: (1) initial motivation, or readiness; (2) multiple response, or trial-and-error; (3) reinforcement, or the law of effect; and (4) repetition, or the law of exercise. The first explains why the learner tries to learn; the second, how he gets the right responses; the third, why he retains and repeats the right responses; and the fourth, how he acquires habits and develops skill.

INITIAL MOTIVATION, OR READINESS

Some initial push or urge to activity (a need, wish, ambition, or goal) is necessary if one is to learn at all. To distort an adage, you can lead a prospective learner to a task, but you can’t make him learn unless and until he wants to learn—and is willing to try. A tame and docile cat, if well fed and not frightened, will lie quietly and even contentedly within the confines of a cage. But a hungry cat will try desperately to escape, especially if there is food outside the cage. Hunger is the motive or drive which starts the activity, and food is the incentive which furnishes the immediate spur. Motives start and maintain behavior and thus make learning possible; but the learning itself must be done by the learner. Hence getting out of the cage results not from hunger but from the organization of movements which enables the cat to open the cage door and escape.

The motive which is effective in a given instance depends upon the age, sex, and intelligence of the learner, as well as upon his interests, his personality traits, and various situational
factors. An active boy of ten learns the names of the different automobiles more readily than he learns the formal rules of grammar. Once he has a "girl," the adolescent youth quickly acquires manners and social usages which he had ignored up to that time. A socially ambitious woman will strive hard to learn to play bridge if this accomplishment aids her in joining an exclusive club; and a busy merchant will spend hours practicing golf shots if he is convinced that the game will improve his health or is good business.

The motive which leads to activity and finally to learning is not always as obvious as in the cases cited above. Motives are often complex, are not always recognized or understood by the learner, and are subject to change from time to time. But we may be certain, nonetheless, that some push or "will to learn" is there—at least in the beginning. Once learning has begun, pride in accomplishment may carry the activity along and even render the original motive of little consequence. Instances of such derived motives are quite common. A boy begins study of the piano reluctantly in order to please his mother; later, having made distinct progress, his growing interest furnishes sufficient drive to carry him on. Social motives (ambitions, pride, desire for prestige, ideals) are derived motives of major importance in maintaining activities which lead eventually to learning.

MULTIPLE RESPONSE, OR RESPONSE BY TRIAL-AND-ERROR

Unless behavior is rigidly circumscribed, the learner will ordinarily vary the responses under his control until he hits upon the successful sequence of acts. The correct associations may be learned in a single trial; on the other hand, they may come only after many hours spent in apparently fruitless endeavor. The length of the provisional trial-and-error period will depend upon the difficulty of the task, the maturity of the learner, and the skill, understanding, and experience which he brings to the task. The little child is very inefficient in his learning, and even older children and adults engage in much superfluous
activity. A major concern of education is to reduce the trial-and-error period and to aid the learner in organizing his available responses more quickly and effectively.

A college student is assigned the task of writing a theme on the topic “The industrial development of the Pacific coast since World War II.” Assuming that the student has some information on the subject, his behavior will be somewhat as follows. He will look through any books which he possesses on the subject; make a survey of relevant references in the library; arrange, perhaps, for a conference with his instructor; engage in discussions in seminar or informal gatherings with fellow students. As our student assembles his notes, certain materials will be selected and used; others selected tentatively will later be added or discarded. The organization of his paper will thus be changed and rearranged until the continuity is satisfactory. Multiple response in such learning situations is goal-directed—it does not imply haphazard movement in all directions. But unless the problem is very simple or very well known to the learner, there will always be some cutting-and-fitting (often a great deal) before the final product is deemed satisfactory.

SeleCion of responses through reinforcement: the law of effect

The provisional trial period ends when the correct or “right” responses occur. The right responses are those which close the deal—end the search or solve the problem. How are these right responses selected? According to the classical law of effect, the satisfaction attendant upon a successful outcome vivifies, strengthens, and reinforces the success-getting responses, thereby increasing the chances of their subsequent selection and repetition. The unreinforced responses, on the other hand, sometimes quickly and sometimes slowly (but always inevitably if the task is learned) drop out, yielding the field to the acts reinforced by success.

Although reinforcement and effect describe essentially the same phenomena, some psychologists prefer the principle of reinforcement to the law of effect as a primary determiner in
Having a goal provides an incentive; success in reaching tentative goals speeds learning.

Response selection. They argue that reinforcement is broader and more objective than effect: broader in that consequences need not always be satisfying or pleasing to be effective in response selection provided they are vivid, novel, or striking; more objective in that no inference need be made concerning the learner’s conscious state of satisfaction or annoyance (a deduction obviously difficult to make in animals). These psychologists add that in most cases the reinforcement or effect can better be determined from the learning curve than from the report of the learner. Controversies like these have merit when they lead to greater precision in the use of terms. But they are of greater interest, perhaps, to the theorist than to the practical student of learning.

The dropping out of unreinforced responses or their marked reduction has been called extinction. Extinction is the disappearance of responses once strengthened through reinforcement but now no longer made, whereas forgetting is the gradual disappearance of responses which have not recently been
exercised (page 329). Extinction bears somewhat the same relationship to reinforcement that forgetting does to frequent recall. Like forgetting extinction appears to be a temporary rather than a permanent loss of response (page 398). This is shown, for one thing, by the occasional occurrence of responses long unreinforced. An immature adult, for example, if denied his way may resort to a tantrum or other exhibition of childish temper. What happens, apparently, is that under emotional stress a response suddenly appears which was reinforced in childhood, but which has been extinguished for a long time.

Two further concepts—those of generalization and discrimination—help us to understand better the process of response selection. In generalization, the same (or nearly the same) response is evoked by various stimuli which are or have become equivalent in some way. Generalization or stimulus equivalence may come about through real or pseudo resemblances of a physical sort; or equivalence may be functional or symbolic in terms of use, meaning, attitude, needs, or beliefs. To a little child, any small furry animal is a "bunny"; to the professional politician, any Republican (or Democrat) is a rascal; to the mother of the slightly frayed debutante, every eligible male is a possible husband and every attractive girl a potential enemy.

When we reach for a good apple and discard a rotten one, we have discriminated between the two on the basis of soundness. Discrimination does not necessarily involve positive and negative behavior—acceptance or rejection—but it does demand a perception of difference and the selection of one response rather than another (page 304). Discrimination is of great importance in our everyday habitual responses. We are constantly making judgments which involve comparisons of things according to size, color, and the like. And we make daily decisions concerning people and events in terms of more complex and less easily defined characteristics.

THE LAW OF EXERCISE IN HABIT FORMATION

Once the correct sequence of acts has been established as a result of reinforcement, smoothness and skill are gained through
repetition or exercise. Repetition, in the main, does two things. First, it gives reinforcement a chance to operate, thus aiding the learner in making stimulus generalizations and discriminations among stimuli. And second, repetition strengthens the selected responses until they become well-established habits—relatively permanent parts of the learner’s equipment.

Two qualifications must be noted at once to a full acceptance of the law of exercise as a primary principle in learning. In the first place, repetition alone, if performed mechanically and without interest, is of little value; in fact, such lifeless exercise may even cause the learner to lose motivation—that is, “go stale.” In the second place, certain methods of exercising have proved to be more efficient than others (see Chapter 9). Spaced practice periods, for instance, are usually more effective than continuous, uninterrupted sessions (page 350). Even a brief period of no exercise at all may advance learning if the learner returns to the task with renewed zest, for during this period competing and interfering responses may have dropped out.

methods of learning

Several ways in which reorganizations of behavior take place have been identified and defined. These methods of learning are treated separately below for simplicity in presentation. But they are not to be thought of as operating in isolation since, indeed, all of them usually are active in any but the very simplest learning situation.

SUBSTITUTION LEARNING

(1) the conditioned reflex

The conditioned-reflex experiment furnishes the most precise example of substitution learning. The conditioned reflex is usually associated with the great Russian physiologist Ivan Pavlov. Pavlov observed the familiar fact that when a dog
is given a bit of food, saliva begins to flow freely. The flow of saliva is reflexive—that is, it is a native or unlearned reaction of the salivary glands to the presence of food in the mouth. Reflexes (page 151) may be defined most simply, perhaps, as immediate and unlearned responses of a muscle or gland to a sensory stimulus. By an ingenious and relatively painless operation, Pavlov was able to turn the salivary duct outward through an opening in the dog's cheek and to collect the drops of saliva in a test tube. The amount of saliva secreted is an objective and convenient measure of the strength of the gland's response.

By means of a restraining harness the dog was held loosely but firmly on a table in the laboratory facing the stimuli, which were automatically presented. (See Figure 153, above.) Pavlov presented a sound (for example, a bell or buzzer) at the same time that food was given to the dog. After from twenty to forty simultaneous presentations of food and bell, it was
found that saliva would flow at the sound of the bell alone. What happens in this interesting experiment is a substitution of the sound of the bell for the originally effective stimulus (food), so that the bell is able to set off the flow of saliva “on its own,” in the absence of food. A diagram of what takes place is shown in Figure 154.

The essential steps in the formation of a conditioned reflex are as follows. Along with a stimulus which elicits a reflex “naturally,” there is presented time after time another stimulus which does not ordinarily call out the reflexive response. The first stimulus is called the natural or unconditioned stimulus; the second, the substitute or conditioned stimulus. When the conditioned stimulus alone is able to elicit the reflexive response, it serves as a substitute or surrogate for the natural stimulus, and the reflex is said to have become “conditioned” to the new stimulus.

How do the principles of learning outlined on page 290 fare as explanations of Pavlov’s conditioned-reflex experiment? There is certainly adequate motivation or readiness to react: the dog is hungry and there is food in sight. To be sure, because of the rigidity of the experimental conditions, there is very little multiple activity or trial-and-error, but the principles of reinforcement, stimulus generalization, and exercise
are clearly operative. Food normally means eating and its resultant satisfactions. So the dog's salivary flow has been frequently exercised and strongly reinforced and is now immediate and predictable. Through the principle of generalization (page 296), the bell comes, after a time, to stand for or "mean" food, and in consequence the response to food becomes attached to the bell. Repetition is necessary, however, for the establishment of the conditioned reflex, the bell and the food becoming more and more closely identified as a result of repeated experiences.

Once the conditioned reflex has been established, the next logical step is to present the substitute stimulus alone (bell without food) again and again. When Pavlov did this, the dog at first salivated to the bell alone, but soon the flow of saliva fell off sharply and eventually ceased altogether—as though the dog were tired of being fooled. This experiment is a demonstration of the phenomenon of extinction, or of the dying out of an unreinforced response (page 295). That the conditioned reflex is not completely lost through extinction is shown by its quick re-establishment when the bell is again bolstered up by the addition of food, and by an occasional spontaneous occurrence of the response, as though the dog were making a test case to see what happened.

A great deal of animal—and much human—learning is of the simple conditioned-reflex form. Everyday observation confirms the laboratory finding, namely, that when a substitute stimulus is presented along with the natural stimulus, the substitute is often able, through stimulus generalization, to evoke the reflex. Learning is often quick and is sometimes dramatic. A child touches a hot radiator and withdraws his hand quickly (flexion reflex). Because of the strong reinforcement (burn-withdrawal), the child will thereafter inhibit the forward motion of his hand when he approaches a radiator. He has learned in one intense trial that a sizzling radiator "means" burn. A loud noise such as thunder often produces a spontaneous and apparently unlearned fear reaction in a young child. Since thunder is often
preceded by lightning, many children develop a fear of lightning as a conditioned reflex which persists throughout life (Figure 155). The eyes blink involuntarily (reflexly) when dust blows in them, and they soon “learn” to blink automatically when an object moves suddenly toward them. It is a well-known fact that the pupil of the eye reacts reflexly (and involuntarily) to light, becoming larger when the light is dimmed and smaller when the light is brightened. Through condition-

**Figure 155**

*Fear of loud noises is an unlearned response in a child. It is not surprising therefore, that lightning should build up the same fear.*

ing, the pupillary reaction can be taught to respond to the ringing of a bell. In one experiment, for example, after 400 paired stimulations of sound and light, the pupil “learned” to enlarge or to contract (in another experiment) to the sound alone: that is, with continual reinforcement of sound by light, the originally ineffective stimulus (sound) became generalized with the biologically adequate stimulus (light). This experiment may seem, at first glance, to be little more than a clever laboratory stunt. Its importance for learning theory lies in the fact that it demonstrates how even behavior which is usually considered to be well-nigh inflexible can be modified or “taught” through intensive training. Furthermore, the stimulus-response connection, once formed, is direct and immediate. No thinking or remembering *consciously* that “sound means light” is necessary to elicit the conditioned reflex.
The **conditioned response** represents an extension of substitution learning to include a wider range of stimuli and a greater variety of responses than are present in reflexive behavior. The conditioned response is more flexible and more **voluntary** than the conditioned reflex, but otherwise there is little difference between the two. The conditioned response is the method frequently employed by animal trainers. In teaching a bear to dance to music, for example, the trainer may at first have the animal stand upon a heated grill. As the bear lifts its paws alternately to relieve the heat on its feet (a strongly reinforced response), a hand organ is played. Later the bear will lift its feet, that is, will “dance,” to the music of the organ alone. The music substitutes for “heat on the feet,” the originally effective stimulus, and initiates the now reinforced response of dancing. Dogs can be taught to sit up and beg by reinforcing a command “Sit up” with a piece of bread, and horses to stop at the word “Whoa” by associating the command with a stiff pull on the reins. A hunting dog must be taught to retrieve birds without crushing or mangling them in its mouth. One method of accomplishing this is to have the dog during the training period retrieve a stuffed bird in which small pins or spikes have been placed. If the dog chews or mangles the “bird,” its mouth is pricked. The dog quickly learns that a chewed bird means pain (negative reinforce-
Animals can be taught many tricks through conditioned responses.

Courtesy Standard Oil (N.J.)

ment) and a carefully handled bird petting and food (positive reinforcement); hence later it handles real birds gently. In each of these examples, there is first of all a stimulus-response connection which in the past has been strongly reinforced. Next, through stimulus generalization or spread (association of substitute stimulus with effective stimulus), the reinforced response becomes attached to the substitute stimulus.

It is clear that many instances of human learning are conditioned responses. The learning of language and of motor activities can often be so described, as can also the acquisition of fears, likes and dislikes, and unreasoned attitudes. In many cases, conditioned responses seem to be forced upon the learner, who acquires them almost involuntarily. As a consequence, conditioned-response learning is sometimes definitely maladaptive and from the social point of view hampering and even stupid. A child who has been given cod-liver oil in orange juice, for example, may develop a dislike for orange and other fruit juices, although he may not be able to explain his dislike. Fear of dogs, of bugs, and of other relatively harmless objects can often be traced to some intense experience with
The child learns word associations through conditioning, Coaching and praise from the parents speeds up the process.

The child learns word associations through conditioning. Coaching and praise from the parents speeds up the process.

these stimuli. Later on, the mere sight of a dog or bug may be sufficient to elicit the fear response. If a dentist hurts a child, the child later may scream when he sees a man in a white coat or even the sign on the dentist’s office.

The conditioned-response technique may be used to demonstrate how stimulus discrimination is a development of or sequel to stimulus generalization. Babies have been taught, for example, to distinguish between middle C and the tone one octave above middle C (C') when these notes are sounded on a pipe organ. In such experiments, food was always given when the lower note was sounded, and no food when the higher note was sounded. At first the babies responded with food-seeking responses to either tone (stimulus generalization). By the end of the training period, however (C-food, C'-no food), the babies responded selectively to the lower note. These children had learned to discriminate or distinguish between two tones as a result of differential reinforcement.

Children learn to associate words with specific objects through the same conditioning process. A parent points to an animal and says, “cat.” The child says something which sounds vaguely like “cat” and is rewarded with praise and petting. When the baby’s vocal apparatus is sufficiently well developed for him actually to say the word “cat,” the sight of the animal—often through stimulus generalization of any small furry animal—may be sufficient to evoke the rewarded response.
“cat.” Later on, since only the word “cat” and no other is rewarded when an actual cat is presented, the child learns to discriminate cat from dog, from rabbit, and from other animals. See Figure 158 for a diagram of this learning.

What is called secondary conditioning occurs when a second and originally neutral stimulus is associated with and is able to substitute for the now effective stimulus. A student learns that his name called by the teacher is a signal for him to recite. Often a nod in his direction may serve as a cue for recitation-behavior. Indeed, through the operation of stimulus generalization, a whole string of signals (a glance, raising of eyebrows, and so on) may serve as effective substitute stimuli for reaction-behavior. The operation of cues, often far removed from the originally effective stimuli, are illustrations of what may be called secondary or higher-order conditioning.

Many everyday activities demonstrate secondary conditioning. A motorist stops “automatically” at a red light because a red light is associated with policeman, accident, arrest, or danger. A man steps off the curb and recoils quickly at the sound of an auto horn or a shouted warning. The horn or

**Figure 159** The mother and the nurse are conditioned to the sight of the needle.

Courtesy Standard Oil (N.J.)
warning substitutes for approaching car and danger. In learning to write the phrase “yours very truly” or to dance the tango, each letter or each step serves as a stimulus or cue for the next response in a kind of chain-reaction sequence. In chain conditioning of this sort, the discriminative responses must be successively reinforced if the signals or cues are to operate. The typist is pleased when she gets the right sequence of letters and annoyed when she strikes the wrong keys. Selective reinforcement leads eventually to correctly discriminated stimuli. If a wallet ordinarily carried in the righthand pocket is shifted to the left, the owner will make many false moves (wrong discriminations) toward the right-hand pocket because right-hand pocket has hitherto “meant” wallet. Many co-ordinated muscular activities in games and sports represent strongly reinforced discriminative responses, for which often only a word or sign is sufficient cue.

Through differential reinforcement, conditioned responses of higher orders can be demonstrated in the laboratory. The
response need have no essential relationship to the stimulus. A rat, for example, presses a bar in its living cage “by chance,” thereby releasing a pellet of food. Quickly the bar comes to mean food, and the rat will press the bar (now a strongly reinforced response) until it is satiated or until food is no longer forthcoming. If, then, a light is added, so that pressing the bar yields food when the light is on, the rat will soon press the bar only when the light is present. The light now serves as a secondary cue for bar pressing and initiates the response “on its own.”

**EXPERIMENTAL (TRIAL-AND-ERROR) LEARNING**

When faced by a difficult problem, the learner, even when strongly motivated, must perforce resort to tentative and experimental attempts to find an adequate answer. The solution—if it comes at all—is the result of a search among various alternatives and the final selection of those responses which are reinforced by success and the rejection of others which do not work out. Experimental attack during the learning process is called learning by trial-and-error, or learning by trial-and-success.

Trial-and-error presupposes a large variety of potentially appropriate responses. A schoolboy is assigned a problem in arithmetic. Not understanding clearly what is to be done, he tries out all the arithmetic processes which he knows, in the hope that one of them will fit—that is, give the answer in the book. If he finally hits upon the correct result, his search is

**FIGURE 161**

A standard animal maze used in learning experiments. At unit distances the path divides, one route leading to a blind alley, the other farther along in the maze.

After Warden, 1929.
ended, at least temporarily, and he has "learned" by way of trial-and-error. A good deal of the learning of intelligent adults (perhaps more than we would like to admit) involves tentative experimentation of this sort. Faced by a novel or relatively unfamiliar task, even the highly trained learner may for a time at least, be forced to resort to hit-or-miss methods in his attempts to perform it successfully.

(1) trial-and-error in animal learning

Animals provide illustrations of trial-and-error learning in its simplest and least complicated aspects. In consequence, psychologists have devoted much time to the laboratory study of trial-and-error learning in rats, cats, monkeys, and other animals. Two pieces of apparatus much used in the laboratory are the puzzle box and the maze. Figure 161 shows a maze which an animal (ordinarily a white rat) must learn to traverse in order to reach the food box, and Figure 162 shows a typical puzzle box used in learning experiments with cats. In puzzle-box experiments, the cat is usually placed in the box when hungry, so that there will be a real motive to escape. Release from the box is accomplished in one of several ways: by pressing a button, pulling a wire loop, pushing against a bar, and so on. At first the cat's behavior appears to the observer

**Figure 162**
The animal can escape from the puzzle box by operating a simple mechanism which opens a door. After Thorndike
to be random and planless. Not comprehending the situation and wishing to get out and eat the food (placed outside the box), the cat makes use of a wide repertory of acts. It will scratch at the door or bars of the box, or push against any movable object. Eventually the animal will hit upon the right combination of movements and escape. When returned to the box, the cat will gradually sift out and repeat the reinforced (successful) movements, finally learning to get out almost immediately. A typical learning curve of a cat escaping from a puzzle box is shown in Figure 163. This curve gives also what can be described as the rate at which the cat is able to organize appropriate discriminatory responses.

In running a maze, the hungry rat will at first enter the blind alleys about as often as the right runways until "by
chance" it finally hits upon the right sequence of pathways and reaches the food box. In subsequent trials the animal tends to select the reinforced or open pathways, so that its behavior is less and less "random" and more and more direct. After a few trials, a white rat will run a simple maze in a smooth and machine-like manner.

Figure 164 shows in an interesting and striking fashion the effect upon maze-learning of feeding or rewarding the rat according to different schedules. In A, the rats were given food after each trial; in B, they were given food only after ten trials; and in C, they were given food for the first ten trials and none thereafter. As shown by the drop in errors in succeeding trials (an error is the entering of a blind alley), the rats learned the maze under all three conditions. But the strongly reinforced (well-fed) rats in A learned most efficiently. The rats in B eliminated their errors quickly as soon as the runs were reinforced—that is, as soon as food was forthcoming—while the rats in C showed a marked upturn in errors after food was withheld. It is doubtful if the learning ability of the C rats actually deteriorated in any real sense after trial number 10. It is more likely that they simply ceased trying once the incentive to learn (food) was no longer available.

(2) latent learning in animals

The learning curve in Figure 164B illustrates the interesting phenomenon of latent learning. We have noted above that the unreinforced (unfed) rats quickly followed the correct pathways (eliminated their errors) once food was found at the end of trial number 11. This fact suggests strongly that the animals must have learned a good deal about the maze simply by wandering through it. Learning, to be sure, was slow during the first ten trials, but there was some learning nonetheless, as is shown by the gradual drop in the error curve. It has been claimed that the appearance of hidden or latent learning contradicts the principle of reinforcement in that learning takes place without reinforcement during the
unrewarded periods. But it is hardly correct to say that there is no reinforcement simply because we do not provide it. During their unrewarded runs, the rats must have become more and more familiar with the runways, better acquainted with the lengths of the runs and with the positions of the blind alleys, walls, and corners. Knowledge and familiarity are definitely reinforcing when they relieve tensions, allay uneasiness, and make for increased confidence. Latent learning, therefore, does not necessarily contradict the principle of reinforcement or the law of effect.

(3) trial-and-error in human learning

Trial-and-error appears early in human learning. The baby acquires spoken language by way of trial-and-error, as well as through substitution learning. The process is one first of stimulus generalization, and then of stimulus discrimination. To a very young child any color is “red” and any rumbling
After Ruger

**Figure 165** After he had gained considerable mastery, the subject attempted to work out some new phase of the puzzle. This greatly increased his time for one trial but subsequently lowered it.

noise "car." With increasing maturity, he attaches right names to objects and people as a result of differential reinforcement. In studies of experimental learning with preschool children, a toy is sometimes placed outside the playpen beyond the reach of the child, and his method of getting the desired object is observed. One child will spend a great deal of time trying to reach the toy by hand from various angles; another will narrow his activity after a few futile trials; and still another will quickly rake in the toy with the stick which has been placed in plain sight. In general, children do better than animals in solving problems through experimentation: trials are less numerous, errors are not so repetitive, and the reinforced or successful responses are more quickly selected and repeated.

An analysis of the ways in which elementary-school children learn arithmetic reveals a good deal of hit-or-miss behavior. Let us suppose that a group of third-grade children has been assigned the problem $6 \times 2$. Among the answers received we shall almost certainly get 8, 4, 12, and 3; that is, each of the four fundamental operations will be tried by some
child, and perhaps all four by the same child. The children understand clearly enough that something is to be done, but just what may be but dimly comprehended. Hence a few children will add, a few subtract or divide, and many (we hope) multiply correctly. Reinforcement of the correct response through explanation and illustration increases the probability of its subsequent selection and repetition.

If an adult is faced by an unfamiliar task, such as the solution of a wire puzzle or putting together the pieces in a jigsaw puzzle, a great deal of repetitive trial-and-error will appear. Figure 165 presents the record of an adult when solving a wire puzzle. Note that the learning curve is much like that of the animal shown in Figure 163. Studies of typewriting, telegraphy, code learning, or almost any other skill show acquisition curves which reveal tentative trial-and-error before the right responses (those reinforced by success) are selected and sufficiently strengthened by exercise to crowd out the error-responses.

For human beings as well as for animals, various rewards (gifts, praise, and the like) act as incentives to learning when they provide reinforcement and are direct indicators of success.

Courtesy St. Louis Board of Education

Figure 166: The exhibit provides an incentive both for the youngster and for his classmates.
Figure 167 shows the effects of graded rewards upon the rate at which sixty boys learned to trace an elevated finger maze. In order to trace a finger maze successfully, the subject must move his finger along a raised pathway and at each choice point select the right turn and avoid the blind alley. Three groups (twenty in each) of the same chronological age and general mental ability traced the maze. The first group had no tangible reward other than their own satisfaction at having done the job; the second group received a penny at the end of each trial; the third group was verbally rewarded, the experimenter remarking "good," "very good." "See if you can do even better next time." As shown by the falling curves in Figure 167, all three of the groups learned—that is, eliminated errors in succeeding trials. But the boys who received the material reward (the penny) were doing best at the end, the verbally rewarded boys next best, and the no-reward group worst. It is interesting to note that for the first fifteen trials or so the no-

**Figure 167** Group A received no reward; group B, a money reward; and group C, a verbal reward.

After Abel, 1936.
reward group kept pace with the rewarded groups. Diminishing reinforcement (through gradual loss of interest in the novelty of the task) probably accounts for the slowing-down of their learning in the latter half of the experiment, while the rewards maintained the learning in the other two groups.

In another experiment with the finger maze, a reward of twenty-five cents was offered for each errorless trial. There were few perfect runs and hence few quarters awarded, but this incentive led to the fastest learning. Learning is not increased, however, in direct proportion to the amount of the reward. A gift of ten pennies is not twice as effective as a gift of five pennies, and saying “very good” may be little better, if any, than saying “good.” The learner’s evaluation of the reward is extremely important. For example, a timid child lacking in self-confidence is bolstered up to a far greater degree by a word of praise than is a self-sufficient or self-assured child.

The latent learning which we observed in animal experiments (page 310) is also displayed in human learning. Learning a foreign language or learning to play the piano is an example. Often the acquisition of a coherent series of responses is so slow and halting that little if any progress is made, and the learner seems to be getting nowhere. However, if the learner persists in trying, finally—and often suddenly—the reinforced responses fall into their proper sequence, and the learner finds that he can actually speak a connected sentence in French or play a simple piece on the piano. It seems clear that learning was going on throughout the trial-and-error period, but that the separate responses were not strongly enough entrenched to function as a sequence. When the individual stimulus-response associations have reached a certain degree of strength through reinforcement and repetition, they suddenly reveal themselves in organized activity.

PLANNED OR PURPOSEFUL LEARNING

We have seen that one stimulus can substitute for another originally effective one; and we have explored the possibilities
of new acts being acquired through the process of trial-and-error when responses are differentially reinforced. Some of us, perhaps, would like to think of human learning (especially our own learning) as planned and purposeful rather than mechanical and uncomprehending. Many readers, therefore, may feel that our account of learning so far has been oversimplified in that it has failed to stress the more intelligent—and purposive—aspects.

Learning may in truth vary from a conditioned reflex acquired almost involuntarily to intelligent and selective effort in which the learner himself plans and directs his activity. But planned learning is not to be thought of as exclusively intelligent and substitution and trial-and-error learning as exclusively stupid and mechanical. All forms of learning are aspects of the same organizing process. To be sure, the preliminary trial-and-error period may be short-circuited or narrowed by the subject’s planned attack upon the problem; and the more intelligence, understanding, and experience the learner brings to the task, the greater the reduction in trial-and-error. But some degree of trial-and-error and some attempt at organizing are present in all types of learning.

(1) learning by imitation and demonstration

The meaning of imitation is expressed in the directions “I’ll do it and then you do it after me.” Reproduction of the right responses leads directly to satisfaction and greatly reduced trial-and-error. But imitation requires careful observation as well as careful instruction if the learner is to follow the model provided him.

Animals are often said to learn by imitation, though the evidence offered is usually anecdotal and is difficult to evaluate. Imitation in monkeys has been investigated in the laboratory by means of the apparatus shown in Figure 168. Two cages are placed side by side, and in the same position in each cage are identical puzzle boxes. One animal is trained to open the puzzle box quickly and easily. In imitation tests, the
untrained monkey is allowed to watch the trained monkey manipulate the puzzle and is then given an opportunity to solve the problem with a duplicate puzzle. In one group of fifteen monkeys, several showed definite signs of imitation.

But copy behavior did not occur in more than 50 per cent of the tests. This is a far less striking result than popular belief or the claims of pet lovers would lead us to expect. To be sure, the evidence for imitation is strong enough to suggest that monkeys do observe and sometimes copy the performances of other monkeys; but apparently “to ape” in the sense of “to imitate” is not characteristic of monkeys and there is no really
valid evidence of true imitation in animals below the monkey (dogs and cats, for example).

In human imitation the essential task also is to follow the model as exactly as possible. We observe carefully in order to reproduce the golf pro’s drive; to pronounce Monsieur as our French teacher does; to follow the steps observed in a new dance. While it is true that we learn by doing and not by simply observing, yet the teacher’s instructions may greatly limit the period of trial-and-error fumbling. A demonstration shows the best combination of movements at the outset, hastens selection of the reinforced responses, and enables the learner more quickly to eliminate false and useless moves. Moreover, the skillful teacher aids in the formation of relevant associations and provides immediate reinforcement by making practical application within the field of the pupil’s interest, pointing out associations likely to be missed by the pupil, correcting errors before they have become “set,” and stimulating further learning through reading and/or discussion.

**Figure 169** How many hidden figures can you locate in this famous old print by Currier and Ives?
Life
Magazine

FIGURE 170  Hard work and concentrated study precede what may appear to come by insight and inspiration.

(2) learning by "insight"

Insight occurs when the learner suddenly "sees" the relations (relevant associations) involved in a task and is able immediately to solve the problem. To illustrate, in working with a jigsaw puzzle one may suddenly see that a given block will complete the picture; or the meaning of a sentence in a foreign language will suddenly "stand out" clearly. Insight is characteristically accompanied by such expression as "Now I've got it." In fact, it is sometimes called the "Aha!" experience.

Insight is accompanied by a sudden drop in the learning time, indicating a new relationship of the learner to the
Climbing on obstacles to get his food is a "natural" problem for the ape. The man is as good a "prop" as any.
problem. New attitudes or new insights often develop suddenly when there is already some familiarity with the problem gained as a result of previous experience. When the learner possesses a good deal of background knowledge to begin with, learning obviously does not start from zero. In such cases drops in the learning curve are likely to result from sudden discriminations based upon experience rather than from sudden unexplained flashes of insight. Intelligence, keen observation, and latent learning sometimes also explain sudden or insightful learning.

Whether or not insight will occur depends to a considerable degree upon the character of the task set. Many problems which animals are called upon to solve lie outside the animal’s normal experiences. Getting food, for example, by pressing a bar or stepping upon a disk in the floor to open the door to the food compartment involves behavior which in itself must be meaningless to the animal. Since the animal does not comprehend the task, it must resort to trial-and-error. When the acts to be performed fall within the orbit of the animal’s natural experiences, it is better able to learn planfully and insightfully. Getting food by passing through the tunnels of a maze is a natural situation for a night-living animal like the rat, just as getting a banana suspended by a string is a reasonably natural situation for a monkey.

When school children do not understand a process or a method (as in arithmetic or algebra) and see no relationship of the given problem to anything important or real, learning of necessity lags. The aim of modern education is to increase insight by taking the problem out of the schoolbook and relating it to experiences in the life of the child. Geography is made real through trips to fairs and museums; arithmetic through “store projects” in which the child actually buys and sells things; history through trips, movies, and historical pictures. In such an approach, learning may well be insightful, since many relevant reinforcements not present in routine schoolbook instruction have a chance to come into operation.
(3) the role of instruction in learning

Psychologists have often tried the experiment of showing lists of short words or numbers one at a time in an exposure apparatus. Those observers who are told to learn the lists in one, two, three order have little trouble in doing so after several successive exposures. But observers who are given no precise instructions demonstrate little if any learning, even when they have seen the lists as often as those who learned readily. When asked why, the nonlearning observers answer that they were not told to learn, and so they simply looked.

Another experiment which shows the effect of careful and precise instructions is the following. Pairs of words (for example, sky-book, tree-chair, and the like) were exposed in order and the observers told to learn the word-pairs so that the second could be given when the first was shown. In one experiment, twenty unrelated word-pairs of this sort were read three times to a group of adults who were then tested for recall. The second word of a pair (for example, book or chair) was recalled in 74 per cent of the cases. The observers were then told to anticipate (and name) the first word of the next pair when the second word of the preceding pair was shown; for example, say “tree” when “book” was shown, and so on. The score was now only 7 per cent recalled. The contiguity or closeness of association was almost as marked in the second pairing as in the first. But the observers learned the pairs only as instructed; they were not set to learn the association from the second word of a pair to the first word of the next pair.

These simple experiments demonstrate the importance of definite instructions in learning. Precise directions are necessary even when the learner is highly motivated. Most of us can call off our ABC’s at a good rate of speed. But few of us can begin at Z or at some intermediate position and recite the letters in the backward direction to A. At age eight, only about 65 per cent of normal children can count backward from 20 to 1, but 100 per cent can count forward from 1 to 20. Many daily
commuters cannot give the order or even the names of the stations through which they pass in coming to the city. A man goes up the same flight of stairs day after day and has no idea how many there are; sees the same building time and again and cannot say how many windows it has or how many pillars stand before it. We learn, so it seems, in accordance with the delineation of the task; facts are not gained by photographic impression when there is no felt need for learning them. Repetition without reinforcement does not automatically stamp associations on our "minds." Active participation by the learner is necessary.

(4) a comparison of animal and human learning

Psychologists, as we have seen, use animals in experiments in learning because animals demonstrate the formation of associations and the organization of responses in a relatively simple way, uncomplicated by language and by cultural and social factors. It will be of interest, perhaps, to summarize briefly the main differences between human and animal learning as found in the psychology laboratory.

1. Man is more readily motivated toward a specific task and responds to a wider range of incentives.

2. Man is a better observer, responds more quickly to instruction, and is more likely than the animal to see relevant associations and to form generalizations and discriminations.

3. In general, man has better control over his emotions, is less likely to become confused, and devotes more of his energy and time to the learning problem and to the selection of reinforcing responses.

4. Man has a very great advantage over the animal in that he is able to work with symbols—language, numbers, spatial diagrams, and the like. He is better equipped than the animal, therefore, to chart a course of attack, to deduce general principles, and to weigh alternatives verbally without having to go through the actual physical movements.
some factors in response selection

FREQUENCY, RECENCY, VIVIDNESS, AND BELONGINGNESS

Various stimulus conditions—all well known to the reader—contribute to the selection of certain responses rather than others. The frequency, recency, and vividness of a stimulus, as well as its inherent interest, all make for the establishment of stimulus-response associations. The more often the advertiser through newspaper, radio, and flashing neon sign can link the name “Perfecto” with the description “a good cigar,” the more likely it is that the strongly reinforced response to a “good cigar” will be transferred to “Perfecto”; or in everyday language, the more likely it is that the prospective customer will think of “Perfecto” when he wants a “good cigar.”

Another important factor in response selection has been called “belongingness,” or relevancy. Natural or relevant associations are those which fit into the learner’s experience and way of life. A rat, for example, learns to traverse the pathways of a maze more readily (with less hit-or-miss trial) than it acquires habits involving acts which normally are not in its repertory—swimming, jumping, tripping catches, and the like. And the same is true in human learning. For a great many students, geometry is little more than a set of not very interesting puzzles in a dry textbook. If by happy chance, however, the principles of geometry are applied to real-life situations—laying out a baseball field or building a summer cottage—angles, triangles, and diagonals become relevant and useful. The positive reinforcement of usefulness may, in fact, invest the study of geometry with an interest which will astound the learner—not to mention the teacher!

REWARD AND PUNISHMENT IN LEARNING

The question is often raised as to whether reward or punishment is the more effective in reinforcing or confirming a given
response. If the incentive to learn is strong enough, the learner may select and repeat a response which is unpleasant. In general, however, when punishment speeds up learning it does so by (1) forcing the learner quickly to discard responses the consequences of which are unpleasant, and by (2) leading him the more readily to accept responses the consequences of which may be more pleasant, or at least less unpleasant.

In Figure 164 we observed the strengthening effect upon maze-learning of feeding a white rat at the end of a run, and the weakening effect of not feeding it. It is clear from Figures 164A and 164B that the rats in the B situation quickly eliminated errors (false entries into blind alleys) as soon as food was forthcoming. In contrast, the errors made by the rats in the C situation rose markedly when food was withdrawn. Many experiments with animals have demonstrated, as in the present case, that the consequences of a response crucially affect its selection and repetition.

The strengthening effect of reward is constantly demonstrated in human learning. In one experiment, forty words, each paired arbitrarily with a number between one and ten, were read through once to adult subjects. The words were then presented in order and the subjects instructed to respond with the appropriately paired number. The experimenter said “Right” if the number was correct, “Wrong” if incorrect. The series word-number was run through several times to see whether the responses “rewarded” by saying “Right” were repeated more often than unrewarded or “punished” responses (saying “Wrong”). Tabulation of answers showed that rewarded responses were repeated 67 per cent of the time in a following trial, whereas unrewarded or punished responses were repeated only 21 per cent of the time. If they were next to (before or after) a rewarded response, the “punished” responses were repeated 27 per cent of the time. It appears that (1) reward or reinforcement in the form of mild encouragement is more effective than punishment in the form of mild discouragement, and that (2) the reinforcement of the re-
warded responses spreads over to strengthen even the adjacent "punished" responses.

Children learn more quickly when the right response is reinforced by a reward—a penny, a gumdrop, or a word of praise—than when the wrong response is followed by scolding or by some penalty. A schoolboy will attack with great eagerness the problem of building a radio set or of learning the rules in his scout manual because the correct responses are personally satisfying and the wrong ones very annoying.

Since in general the positive reinforcement of a right response is more effective than the negative reinforcement (punishment) of a wrong one, the advice is usually good that we should reward and thereby strengthen what the learner does correctly and ignore, and thus weaken, what he does incorrectly. Punishment, in fact, may retard learning rather than promote it. Scolding and the withdrawal of privileges often create a sense of frustration and resentment, which inevitably has bad effects upon learning. It is unwise, for example, to punish a child for making errors in arithmetic by having him

Courtesy Greenwich House

**FIGURE 172** A good performance provides an incentive, and a word of praise from those proficient in the field gives reinforcement.
perform a long set of arithmetic problems as a chore. The dissatisfaction and boredom occasioned by this discipline may easily become associated with the situation “doing arithmetic.” The distaste which many adults have for school subjects—arithmetic, formal grammar, Latin, poetry, for example—can often be traced to the fact that the learning of these subjects was followed by discouraging consequences.

Punishment may be effective in learning when it drastically inhibits or weakens an undesirable response. But punishment when administered should follow the response immediately; it should be adjusted to the offense, and it should be not so light as to be ineffective, nor so heavy as to be unfair. If a young child’s ill-mannered or antisocial behavior is punished immediately, it is often quickly inhibited. But stressing the “do’s” and overlooking (not reinforcing) the “don’t’s” is psychologically more effective and less disturbing emotionally. It would be better, for example, to put signs on the pathways in parks reading “Walk on the paths and save the flowers” than to put up signs “Do not walk on the grass.”

KNOWLEDGE OF RESULTS

Knowing how he is doing offers strong incentive to the learner to put forth additional effort. Just as a football team works to overcome its opponent’s lead, so school children will work eagerly to surpass the record of another class or their own past records. Factory workers will often strive to exceed last week’s record in order to win a bonus; a lawyer will strive to gain more decisions or to make a larger income than a competitor.

It is often more desirable to have the learner work against his own record than to vie with someone else. This is especially true when the student is timid and easily discouraged. A learner is not so likely to be disturbed emotionally by his failure to exceed his own learning rate as he is by his failure to challenge successfully the record of some competitor. It is important that the learning task be adjusted to the learner’s level of maturity, his abilities, and his interests. The problem should be
hard enough to challenge him but not so difficult as completely to confound him. Too easy a task leads to indifference, or even to distaste for the job; too difficult a task may lead to discouragement and even despair. Neither situation is conducive to efficient learning.

**NEGATIVE ADAPTATION**

The selection of certain useful responses and the inhibition of others which are disturbing is illustrated in an interesting fashion by what is called *negative adaptation*. A spider will drop suddenly from its web if a near-by gong is sounded. But after several responses of this sort, the spider remains quiet when the gong is struck. The spider is now said to have become *negatively* adapted to the sound; in human terms one might hazard the guess that the spider refuses to be fooled any longer. Negative adaptation or the inhibition of a maladaptive response is an important property of the brain and the nervous system. It is an example of conditioned-response learning. The spider may be said to have substituted the quiescent (and pleasant) response which it ordinarily makes to the security of its own web for the dropping (and unpleasant) response to the gong, which is now checked or inhibited.

In negative adaptation, certain sensory stimuli are kept out of consciousness by the selective and inhibitory action of the nervous system. Suppression of distractors usually comes gradually and often without the learner's awareness. A student preparing an assignment is much annoyed by the loud ticking of a clock or the music from the radio. Suddenly he discovers (often only when the music stops) that these distractions are no longer interfering with his work, that they are simply not being attended to. Workers in industrial plants often learn to operate under conditions which were very disturbing at the start. The heat of the room, the pressure of one's clothes, outside noises, and other distractions lose their potency as the worker becomes more and more deeply engrossed in the task at hand.
Distractions often actually increase the learner's efficiency temporarily by forcing him to put forth extra effort. The net result of such a distraction may be conducive to greater immediate production, but the speed-up of learning through distraction may be wasteful and could ultimately be injurious to the worker.

**THE PRINCIPLE OF EXERCISE**

We have used the principle of exercise or repetition to describe the means whereby the learner (1) gives reinforcement a chance to operate and gradually builds up stimulus generalizations and discriminations (page 296) and (2) acquires smoothness and skill once the reinforced responses have been selected. Suppose that a boy after many trials has discovered how to balance his weight on a bicycle or that an auto mechanic has learned by careful observation and trial how to adjust a carburetor or tune up a motor. Skill in these performances, as in any series of acts which must of necessity follow each other in a given sequence, is gained by repetition of the
operations in correct order. With practice, smoothness and efficiency appear whether we are learning a foreign pronunciation, the multiplication table, swimming, or playing a mandolin. Through exercise, errors die of disuse as the correct (reinforced) responses become more and more automatic. A well-practiced act often becomes a part of the learner's equipment that is almost as dependable as a reflex.

But sheer repetition, as said before, in and of itself is not ordinarily profitable. Unless the learner comprehends the relations of the part activities and understands their sequence in leading to the final act, blind repetition is of little avail. Two examples will serve to illustrate the importance of sequence in repetition.
A teacher had been looking for some way to correct a pupil who habitually used "them" as an adjective: "them books," "them children," etc. Finally the teacher hit upon the idea of having the child write "those" on several slips of paper and put the slips in conspicuous places (her books, desk, etc.), where she would be "reminded" of the correct form. At the end of the day, the child was instructed to gather up the slips and return them to the teacher. After this plan had been followed for several days, the child hurriedly returned to the classroom one day, remarking as she turned in her slips, "I almost went off with them those." Obviously, this child had not been exercising "those" as a speech habit, the writing of the slips being regarded as an entirely unrelated chore. Hence there had been no reinforcement of the specific stimulus-response connection which the teacher was trying to establish.

A little girl had formed the habit of strewing her books and clothing helter-skelter over the room when she came home from school. Time and again her mother had required her to pick up her things and put them in the right places, with little subsequent effect. Finally the mother was advised to have the child put her hat and coat on again, gather up her books, go out and reenter the room and *then* hang up the clothes and put away the books. When successful, this plan works because it exercises the acts in the order in which the mother wants them established.

**summary of basic principles of learning**

On page 290 certain basic or explanatory principles of learning were proposed as follows: initial motivation, or readiness; multiple activity, or trial-and-error; reinforcement, or the law of effect; and repetition, or the law of exercise. The main purpose of this chapter has been to demonstrate the utility of these principles in providing information on the questions of (1) *why* a learner tries to learn; (2) *how* he gets the right responses; (3) *why* he repeats and selects these "right" responses; and (4) *how* he acquires skill. By way of summary, let us review our answers to these four questions.
WHY DOES THE BEGINNER TRY TO LEARN IN THE FIRST PLACE?

Unless motivated, the learner will make little if any effort to reorganize his responses in such a way as to acquire new behavior. Body needs, as well as the more sophisticated motives (ambitions, desires, interests, and the like)—these start the learner off and keep him going. But even the strongest drive cannot show the learner how to learn. Motivation is a primary antecedent to learning, but it is not a fundamental organizer in the learning process.

HOW DOES THE LEARNER ACQUIRE THE PROPER SEQUENCE OR PATTERN OF RESPONSES WHICH COMPOSE THE LEARNED ACT?

Reorganization of the learner's responses is accomplished through substitution, through trial-and-error, and through observation, imitation, and planned attack. Explicit instructions also aid by narrowing the range of responses. When the problem or task is unfamiliar, tentative trial must be resorted to; but when the learner is highly skilled, intelligent, and observant, he may learn the required association in a single trial. Such short-circuiting of the learning process is probably what occurs in insightful learning.

WHY DOES THE LEARNER SELECT ONE RESPONSE RATHER THAN ANOTHER; AND WHY ARE SOME RESPONSES MORE LIKELY TO BE REPEATED THAN OTHERS?

The answer to this question lies in reinforcement, or the law of effect. Responses which are relevant, satisfying, or successful are eventually sifted out and repeated, whereas those which are maladaptive, unsuccessful, and unsatisfying tend to be eliminated. The speed with which the learned act is acquired will depend upon, among other things, the maturity and the native ability of the learner, upon whether the task
fits into his experiences and interests, and upon the instruction and incentives provided.

**HOW IS SKILL ACQUIRED, ONCE THE SUCCESSFUL RESPONSES HAVE BEEN MADE; WHEN IS PRACTICE EFFECTIVE AND WHEN INEFFECTIVE?**

When the learner has selected the proper responses (that is, the reinforced ones), practice will aid in the acquisition of skill. But mere repetition, when the task is not well understood or is not relevant to the learner's experiences or needs, is likely to be ineffective. Often such prefunctory exercise leads to boredom, frustration, and even to resentment, rather than to better learning.

*Habits and Habit Formation*

*Habit* is the name given to behavior so often repeated as to be automatic. Man is often said to be “a creature of habit,” and on the whole it is fortunate that he is. Dressing habits, eating habits, work habits, and many other everyday activities are so nearly ready-made that for most of us they unfold “without thinking.” It is only when an emergency or a new situation arises that a habit temporarily loses its utility—is interfered with or disrupted. Most automobile drivers acquire a set of driving habits—depress clutch, shift gears, release clutch, depress accelerator—to the point where these movements can be performed with little conscious attention. In fact, a skilled driver can carry on a conversation, listen to the radio, or look at the scenery and still be in full control of the car. If an emergency occurs, however—the traffic light suddenly changes, a child runs in front of the car, or a policeman blows his whistle—the habitual reactions at once become highly conscious. The driver now directs his attention specifically to the driving responses and is acutely aware of them, whereas before he had “turned them over to the nervous system.”
The word habit carries an unpleasant connotation for many people; in fact, the term more often implies bad or unpleasant than good or useful behavior. Most of us are more concerned with the elimination of bad habits (swearing, drinking, and the like) than in the formation of good habits (studying regularly, working by schedule). Perhaps one may overcome a bad habit by sheer determination or strong countermotivation; but by all odds the best plan is to replace the harmful habit by a more desirable one. Several stratagems have been proposed for accomplishing this substitution. No new principles are involved, since habits, after all, are simply well-learned acts. It will be advantageous, however, to summarize these techniques, since they are practically useful and serve as well to illustrate, often quite vividly, the principles of learning discussed throughout this chapter.

1. LAUNCH THE NEW HABIT WITH ALL THE INITIATIVE OF WHICH YOU ARE CAPABLE

A dramatic public announcement that a drinker does not intend to imbibe after a certain date often provides sufficient emotional reinforcement to prevent a return to the habitual response. William James tells of one man who posted a notice offering a reward to anyone who found him in a certain saloon. The effect of a declaration of this sort is to invest the stimulus (in this case, whisky) with new qualities, so that the response of drinking becomes a reflection on one's integrity rather than a pleasant and socially acceptable response.

2. PERMIT NO EXCEPTION, NO RETURN TO THE UNWANTED HABIT

The old story of the frog in the well illustrates what happens when a new habit is broken. Each time the frog jumped up two feet, he fell back one. In the same way, each lapse weakens a new habit and forces us to begin again at a lower starting point. Moreover, the old habit is strengthened through lack of competition.
3. Exercise the New Habit Voluntarily and As Often As Possible

The person who wishes to improve his social acceptability by saying “good morning” to acquaintances instead of nodding curtly, of responding in a pleasant way when addressed instead of rudely, of agreeing rather than flatly contradicting, should make it a point to practice the desired set of responses regularly and voluntarily. Repetition provides regular reinforcement and makes the nervous system our ally rather than our enemy. A habitual response which is not strengthened through reinforcement tends to drop out, through the process of extinction. Many habits die through our failure to keep them alive.

4. Try Breaking an Involuntary Habit by Voluntary Practice

Paradoxically enough, deliberate exercise may eliminate a habit. A typist, for example, can often correct the habit of writing “hte” instead of “the” by practicing “hte” (the wrong sequence) instead of “the.” Voluntary practice enables the learner to gain control of the “wrong” responses and thus often to inhibit them. Many involuntary motor habits, such as stammering on certain words, distorting one’s face when working, twisting one’s nose and so on, have been successfully eliminated by the method of voluntary practice. Responses of this sort are acts which at one time or another have possessed utility. When a person has a cold, twisting the nose or coughing, for instance, acts to relieve the itching and unpleasant congestion. Later on, when the cold is well, twisting the nose persists as an involuntary act or “habit residual.”

Involuntary acts of this sort are often conditioned responses in which the now effective stimulus is unknown to the victim himself. He cannot inhibit the activity because he does not know what initiated it. Through voluntary practice he may gain control of the response to such an extent that he is able to inhibit it “at will.”
5. SUBSTITUTE A NEW RESPONSE FOR THE OLD BY THE CONDITIONED-RESPONSE METHOD

Suppose a small child has been knocked down or frightened by an overplayful dog and as a result has acquired a fear of animals. We wish to eliminate this fear and to put in its place an affection for, or at least a tolerance of, animals. A child’s response to food is immediate and positive, and it involves approach behavior. His response to a barking dog may be negative and fearful, and it may involve running to his mother. Suppose a toy dog is placed on a table close to a bag of gumdrops. Response to the gumdrops may be a strong enough reinforcement to cause the child to approach the table in spite of the presence of the toy dog. Gradually the “dog” brings out a neutral, if not a positive, reaction, and this response may transfer to real dogs. This is clearly a case of stimulus generalization and of substitution learning by the conditioned-response technique. While often effective, it must be carefully handled, since the child’s negative response to the dog, if deeply rooted,

**Figure 175** Habits of cleanliness should be acquired early in life.

Courtesy University of Minnesota
may become transferred to the gumdrops, rather than the other way round. Reading books about dogs, having them play at a safe distance from the child, bringing in children who are not afraid of dogs may through positive conditioning and social pressure recondition the child if the fear is not a very strong one.

In breaking a habit, the response of withdrawal and distaste (owing to negative reinforcement) may be substituted for the response of approach and satisfaction. If, for example, liquor makes a man very ill he may (for a time at least) give up drinking. Whether the new response persists will probably depend upon how strong the original association was and to what degree the now distasteful response is reinforced (by illness, perhaps, or by social approval, religious convictions, and the like).

6. **SET UP DEFINITE SPECIFICATIONS FOR THE NEW HABIT**

New Year’s resolutions to “be a better man,” to study harder, or to be more charitable to one’s neighbors are usually ineffective because they are too vague and too general. Opportunities to exercise the new and desired responses seem somehow never to arise, or when they do they catch us unaware, or we are not quite sure whether the new resolve applies in this instance. The student who is dissatisfied with his study habits will have a much better chance of improving them if, instead of expressing a pious hope, he lays down a definite schedule of hours and subjects and sticks to it (page 342). A very busy man often accomplishes twice as much as a less busy one because he has carefully budgeted his time and has built up regular work habits.

Perhaps it is well to remind those who wish to establish a new habit that attack is the best defense. A bad habit should be thought of as something to be defeated by new and aggressive behavior and not something to be wrestled with rather desperately. Constant repetition of the resolution “I won’t do this again” is usually futile. Instead of suppressing the habit, this
statement (though strongly negative, to be sure) serves rather to keep the unwanted activity vividly in mind, and thus to strengthen it through overzealous attention. A better way is to analyze the bad habit, try to find the source of its appeal, and seek to replace it by other responses which will, in part at least, serve the same purpose. Suppose, for example, that a person wishes to break the habit of smoking. Smoking is not only personally satisfying to many, but it releases certain tensions, gives the smoker something to do, and provides a set of ready-made responses which are often useful in social situations. Instead of making a resolution to stop smoking, which is soon broken, one may substitute other activities—munching a cracker when the urge to smoke is strong, chewing gum, eating cough drops. These stimuli provide for some of the habitual and strongly reinforced activities in smoking and may thus give partial satisfaction. An analysis of a bad habit will often show that it is possible to substitute for it socially-approved behavior which serves much the same purpose.

**summary**

Learning is that process which, as result of directed physical and mental activity leads to new or changed responses. The usual antecedent condition for learning in man or animal is a state of need or of high motivation. Learning proceeds through a trial-and-error period (which may be brief or long) to a final selection of the appropriate responses. The satisfaction or reduction in need which follows the effective response is called reinforcement.

Many laboratory experiments have been directed toward discovering the principles of learning. The conditioned reflex, associated with Ivan Pavlov, is an example of a fundamental kind of mechanical association. An extension of conditioned reflex learning is found in the conditioned response. Through conditioned-response learning, many complex behaviors become associated with and instigated by previously inadequate stimuli. In human learning the goal or objective is especially important. Efficient learning in
school is aided by careful planning, instruction, and the providing of insights.

Habits are sequences of behavior so well learned as to be almost automatic. Many habits are maladaptive and hampering. A variety of devices are available for the elimination of "bad habits" and for the substitution of more useful responses.

questions and topics for discussion

1. Analyze the following learned acts in terms of the principles proposed in this chapter:
   a) Answering the doorbell
   b) Using logarithms in solving problems
   c) Speaking a foreign language
   d) Shining your shoes

2. List several of your own peculiar dislikes: for example, for certain foods, high places, redheads, escalators, tan shoes, and so on. See if you can explain these as conditioned responses. Draw diagrams of the probable course of the learning.

3. Analyze the following instances of learned behavior; what method was probably used; how was selection effected?
   a) An elderly retired soldier secured a job as a waiter. One day as he entered the dining room with a tray of dishes, a would-be joker suddenly called "Attention" in a loud voice. The soldier-waiter immediately brought his arms to his sides dropping the dishes on the floor.
   b) A man who knew French and Spanish quickly learned to speak Italian.
   c) Jimmy, aged five, copies everything which Johnny, his twelve-year-old brother does. If Johnny chases a cat, Jimmy does; if Johnny walks along the top of a fence, Jimmy tries it; and so on.
   d) In the problem, \( y = 3x + 7 \), values of \( y \) are to be found when \( x = 1, 2, 3 \). Although Mary gets the correct answers for \( y \), she cannot solve the...
problem \( m = 3n + 7 \) in which values of \( m \) are to be found when \( n = 1, 2, 3 \).

4. Comment on the adage "practice makes perfect." When is this true?

5. Why is it that handwriting though highly exercised usually gets no better with age and often gets worse?

6. List some of the ways in which the performance of an expert golfer or tennis player differs from that of a novice.

7. A simple experiment in rapid sensory-motor learning may be set up as follows: List the letters A to I in order across the top of a sheet and assign a number to each, not in order; for example, 3 to A, 8 to B, 2 to C, etc. Now on the page write down in random order 100 letters in four columns of twenty-five each.
   a) Go down first column, writing numbers opposite appropriate letters. Record time taken to complete.
   b) Compare your times in columns 1, 2, 3, 4 for practice effect.
   c) Compare your progress with that of other students.
   d) Practice on a second and third sheet. Plot a curve of your performance.

8. Apart from obvious effects like injury and pain, what determines whether a response is satisfying or annoying?

9. How would you apply the law of effect to the grading, return, and display of examination papers? Should papers be returned promptly? Should errors be underlined with a red pencil, say? Or should good points be emphasized and the comments "Good" and "Very Good" liberally used? Would it be better to list the names of the best students or of the poorest students, or of all students?

10. A child is required to stay after school and write
each misspelled word twenty times. What effect might this have on his spelling?

11. If certain connections were not strengthened or reinforced, that is, if there were no law of effect, would there be any learning?

12. Give a reasonably plausible account of how the following behavior might have developed: (a) a girl of ten refuses to sleep if the door of her room is closed; (b) a boy of six refused to eat certain foods; (c) a man coughs whenever he is embarrassed; (d) a boy of fifteen has a stomach upset and is unable to go to a New Year’s Eve dance.

13. How might you break (a) a child of answering “What” when spoken to; (b) a young man from saying “He don’t”; (c) a dog from jumping up on the bed?

**suggested readings**


9 learning and studying effectively

There is, to be sure, no royal road to learning. But some avenues are better paved and more direct than others, and the task of this chapter is to help students discover the better routes. What we know is, to a large degree, a result of our own voluntary efforts to learn and acquire. In this chapter, therefore, we shall be concerned mainly with those methods of study which have been shown to increase the speed and permanency of fixation and retention.

Techniques of study

Draw up a study schedule

A schedule is often useful in setting up regular habits of study and thus enabling the learner to make maximum use of his time and energy. A schedule acts as a challenge, as well as a guide.
and monitor. The following is the one day schedule of an undergraduate who supports himself in part by working three hours a day.

**Monday:**

- 7 a.m. - 8 a.m.: out of bed
- 8 a.m. - 9 a.m.: breakfast
- 9 a.m. - 12 a.m.: classes
- 12 a.m. - 1 p.m.: lunch
- 1 p.m. - 3 p.m.: laboratory
- 3 p.m. - 6 p.m.: job in store
- 6 p.m. - 7 p.m.: dinner
- 7 p.m. - 11 p.m.: study
- 11 p.m. - 7 a.m.: sleep

This is a general schedule and is somewhat austere, since it allows no time for leisure or for social activities. Nor does it specify when each subject (mathematics, history, and so on), is to be studied and how much time is to be devoted to each. While such a general schedule allows for flexibility, it is probably better at the beginning to draw up a more detailed plan. Students soon know which subjects require (for them) the greatest allotment of time and can adjust their work schedule accordingly. If a student has provided an hour, for instance, for biology, he should pass on to something else at the end of this time, even if the assignment is not completed. The student who is reported to have spent fourteen hours on one German

---

**Figure 175** The recall of learned material increased when a part of the learning time (up to 80 per cent) was spent in recitation.

After Gates, 1917.
Good study conditions are conducive to effective learning.

Courtesy Better Light Bureau

lesson was more persistent than wise. If an assignment takes that much time, it is either much too long, or too difficult, or the student is obviously not prepared to do work at this level.

ATTACK THE ASSIGNMENT VIGOROUSLY

Make contact with the material through as many sense avenues as possible. First read the assignment through (page 355), then review it aloud in order to organize your thoughts, and if time allows, write a summary of the essential points. The more numerous the associations formed, the better the chance that some will function later in recall. Learning is an active, effortful process. There is no more ineffective method of study than merely to read the words of a book passively, waiting for the
material somehow to register itself on the “mind.” Two factors of great importance in study are *participation* and *interest*. In general, interest grows with knowledge and accomplishment. A student may be motivated to study French because of his interest in French history, or because he has visited France, or because he has a friend who speaks French fluently. But as the student’s knowledge and fluency increase, his interest will become more and more in the language itself. It is often true of elementary-school children that interest in a school subject which at first is of no especial concern to the child will become intensive and self-supporting as the child’s participation in the activity grows. Nature study begun with no particular interest, for example, will often become exceedingly attractive as children make collections, take field trips, and become acquainted with the many varieties of trees and birds.

When reading is supplemented by self-recitation, retention is improved. In an experiment designed to test this point, when the subjects devoted all their time to reading, recall of the facts in five short biographies (totalling 170 words) averaged 16 per cent after four hours. When three-fifths to four-fifths of the learning time was devoted to self-recitation, recall after four hours was nearly twice as great. In neither case is the absolute amount retained striking, but the relative increase brought about by recitation is considerable. When the material consisted of nonsense syllables, the positive effects of recitation were greater for both immediate and delayed recall. (See Figure 175, on page 343.) This may have been due to the additional effort necessary to learn the nonsense syllables and to their novelty.

Self-recitation in this experiment consisted of attempts to recall when not looking at the material, and in prompting oneself by looking at the book when unable to proceed. The advantage of recitation over passive reading is that the student is forced to react to the subject matter rather than merely trying to absorb it. It is because of this active attitude that one may learn more in a discussion or quiz section than in a lecture.
In discussion, the student is obliged by the challenge of direct questions to try to formulate what he has already learned.

Though the older student is often tempted to offer age as the major excuse for his failure to learn, unwillingness to try very hard rather than inability to learn is probably the real reason. Older people often have more deeply ingrained habits to overcome than younger, are more inclined to procrastinate, and are more concerned about criticism, ridicule, and possible failure. It is a common belief that with age the brain and nervous system lose their plasticity and sensitiveness to new impressions, so that ability to learn declines noticeably. While there is undoubtedly some loss in learning ability in middle age and even more in old age, it is not so great as many people have thought. Extended and careful studies of various types of learning have shown, in fact, that general learning ability increases up to about the middle twenties, declines very slowly to about age forty-five, and somewhat more sharply thereafter. Figure 177 shows graphically how learning ability declines with age.

Two findings concerning the relationship of learning to age are of particular significance to the older student. First, the loss in learning ability with age is greater in those tasks calling for flexibility and speed than in those demanding judgment, experience, and background knowledge. And second, the loss in learning with age depends upon educational level and presumably upon intelligence. The highly intelligent man of sixty

![Figure 177](https://example.com/figure177.png)

*Figure 177* The ability to learn first increases rapidly, then decreases slightly as a person gets older.
FIGURE 178
Although the learning represented in curve B appears to be delayed at one point, it may eventually reach the same level as A.

may not learn as quickly as he did at age twenty, but he learns more readily than the twenty-year-old of average intelligence.

WATCH FOR STAGNATION PERIODS IN LEARNING

When one undertakes the study of a new subject, such as Spanish or chemistry, learning follows a fairly characteristic course. Since the material is apt to be relatively easy at first, progress is likely to be good so that the learning curve rises fairly rapidly. Moreover, the learner usually brings some knowledge to the new subject, often a considerable degree, so that he does not start from “scratch.” Later, as the subject matter becomes more difficult, a period of no progress is often encountered, and the student is apparently making no gain. Periods of dead-level performance in the learning curve are called plateaus. Figure 178 illustrates a curve with a plateau.

Plateaus arise from a number of causes. (1) They may result from discouragement, failing interest, or boredom. As new difficulties are met, the student finds himself unable to cope

techniques of study  NINE  347
with all of them. In algebra, for example, students sometimes have trouble with negative signs or with literal nomenclature (letting \( x \) stand for a given quantity, for instance) and are unable to make further progress until these "blind spots" are removed.

(2) Plateaus may be caused by habits which are effective for a while but later on are stumbling blocks to progress. Counting on one's fingers, reading word by word or partly aloud, improperly holding the pencil in writing—all these fall into the poor-habit category. It is often difficult to discard such habits once they have been formed.

(3) Plateaus arise also from difficulties encountered in organizing simple habits into larger and more inclusive wholes. In such cases plateaus often represent periods of latent learning (page 310). In studying a foreign language, for instance, the student must progress from words to phrases to sentences. In like manner, the typist must learn to organize words into phrases and phrases into sentences. While lower-level habits are being strengthened through exercise, the learning curve may remain at a dead level, indicating no apparent progress. If the student perseveres until the latent learning becomes functional, however, he can expect a rapid rise from the plateau. (See Figure 178.)
Plateaus, to be sure, cannot always be avoided, and in many instances they should be accepted as useful and perhaps inevitable steps in the learning process. At the same time, they should not be permitted to drag out indefinitely. A good general rule is to form the associations from the start as nearly as possible in the order in which they are to function later (page 331). This method may slow up learning at the beginning, but it pays off in the end. Speaking a foreign language haltingly, but actually speaking it, leaving rules and grammar until later; learning words as words rather than as combinations of ABC's (on the false theory that words are perceived as groups of letters rather than as units); writing words and phrases on the typewriter from the beginning instead of pecking out separate letters—these procedures will aid in avoiding overlong plateaus. It is inefficient learning to form one set of simple habits and then lay these aside and attempt to set up a new set of more complex habits. It is far better to have the complex habits develop naturally out of the simple.

**Figure 180** Informal discussion aids learning and strengthens retention.

Ewing Galloway
DISTRIBUTE YOUR STUDY PERIODS; DO NOT CROWD ALL OF YOUR LEARNING INTO ONE INTENSIVE SESSION

Many studies in the laboratory, as well as in the schools, have shown that study spaced over several periods is more effective than study concentrated into one grand effort. Figure 181 shows hypothetically how strategically spaced reviews might conceivably recoup some of the ground lost through forgetting. The frog in the well that jumps up two feet and falls back one is making slow progress, to be sure, but better progress than the frog that falls back two feet! The idea expressed by Figure 181 is that review at regular intervals refreshes or revivifies what has been learned, thus maintaining retention at a higher rate than would be the case without exercise. Instead of waiting until the end of a term to review an assignment, therefore, it is better if the student distributes his study over regular and frequent intervals. By this procedure, loss from forgetting is at least partially overcome, and a larger amount of material retained.

It is important to know what length of period should be allowed between learning and review sessions. If the wait is

**Figure 181** When there are periods of review, learned materials are retained much longer. Without review the drop in retention is especially great in the first few days.
too long, forgetting may proceed so far that the subject matter becomes virtually new material. On the other hand, if we review too quickly, boredom, fatigue, and disinterest are likely to develop. In one experiment the problem of review was attacked by having equated groups study a lesson four times with different spacings, as follows: all four readings in one session, four readings at three-hour intervals, four readings at one-day intervals, four readings at three-day intervals. Figure 182 shows that four study periods three hours apart gave the best results, though this spacing is not markedly better than the other three. It seems clear, however, that review periods, not too close nor too greatly separated, are likely to be more efficient than study done all at one time. Perhaps the most strategic review intervals for any given person can be found only by trial.

The evidence in favor of spacing our learning periods discredits the mass method of cramming used by many students. Cramming is an ineffective method of study, even though it may serve to get a student through an examination. Many
Informal discussion is vastly superior to cramming as a method of learning, although the instructor may have to "bone up" on certain details before each lesson.

Lecturers and public speakers must of necessity cram—that is, they must, for the occasion, learn facts and figures which they have no desire to retain or intention of retaining after the occasion. Cramming may be useful as a temporary expedient (page 351) but it is a poor method for long-time retention.

The use of crutches or mnemonic aids falls into the same category as cramming (page 409). Memory jingles demand the formation of associations which are in themselves extraneous and often meaningless, and which usually have no essential connection with the material under study. There is no objection to a memory aid if one can remember the aid; but in the end it is often more timesaving to learn the material itself in the first instance.
USE OVERLEARNING AND GUIDED QUESTIONS TO CHECK FORGETTING

Forgetting is checked by overlearning—that is, by learning beyond the point at which the material can just be reproduced. Studies of rote memory have shown that overlearning increases retention (recall scores) when the time devoted to study is one and one half to two or more times that needed for bare registration. Figure 188, on page 358, illustrates the fixating power of overlearning. It shows graphically the progress made by students in acquiring correct grammatical usages from third grade through college. Data were compiled from samples of written work of pupils in elementary- and high-school classes, as well as from papers written in college. All errors in capitalization and punctuation, grammar, and sentence structure were recorded. For each educational level the number of errors of each kind per 10,000 words was then calculated. It is clear that the error curves drop rapidly at first, and then more and more slowly, leveling out finally at about the seventh or eighth grade. Apparently nearly all of the progress in fundamental language habits is made in the elementary school, where they are greatly overlearned. Such slight improvement as appears in high school and college is to be attributed not to additional exercise, perhaps, but rather to the fact that poorer students have progressively dropped out of school. The fact that college students make more errors in punctuation than ninth- and tenth-graders can be attributed in part to the acquisition of careless habits which develop when greater attention is paid to subject matter than to form. Moreover, since college students must deal with more complicated materials, the opportunity for error is greater.

Figure 184 shows curves of retention for three sorts of materials. Note that while there is a marked decline in retention during the first few days in every case, the meaningful materials (poetry and prose) stand up considerably better than the meaningless. This is in part the result of overlearning of the meaningful tasks.
Retention is increased when students are given lists of questions which serve as a guide in their reading and study. In one experiment, study guided by questions was compared with study by reading alone. Figure 185 shows the gains of the "question" groups as compared with the "reading alone" groups for both immediate and delayed recall (after two weeks). The advantage of studying with the aid of questions is considerable both for immediate and for delayed recall.

FIRST READ AN ASSIGNMENT AS A WHOLE:
DO NOT BREAK IT INTO SEPARATE AND DETACHED PIECES

Suppose one has an assignment in American history or in inorganic chemistry. What is the best way to tackle the task of
learning this material? There is a good deal of evidence that the most profitable first approach is to read the assignment through completely from start to finish. Difficult sections not clearly understood should be skimmed over and temporarily left behind. After the student has obtained an overview of the material, he is ready to concentrate upon the more difficult parts. This method of first assessing the scope of the material has been called learning by wholes to distinguish it from the traditional method of learning by parts. Whole learning is superior to part learning because from the beginning associations are formed in the direction in which they should normally operate. Moreover, whole learning provides an opportunity to apprehend meanings and relations within the material. Sections which were not understood initially become clearer on a second reading, partly as a result of a better general comprehension of the material as a whole.

The whole method makes for efficiency in performing many motor tasks. In learning how to play golf or tennis or how to

**Figure 185** The superiority of reading plus questions, over reading plus rereading, expressed in critical ratios. For example, the first bar shows that the use of questions was better than rereading by an index of 3.2.

After Robinson, 1946.
FIGURE 186 The school can teach for transfer. As part of their training for citizenship, these school boys take over the state government for a day.
operate a motorboat, for instance, it is wise to go through the entire process several times first. Then, after practicing those operations which are particularly difficult and troublesome, one can return to the whole method. This plan, which has been called the "whole-part-whole" learning sequence, has definite advantages over either the whole or the part method used alone.

Experimental studies provide certain comparative data relative to the whole and part methods of learning:

![Figure 187](image-url)

*Directed play and community 4-H club activities aid in preparing for life.*

Courtesy U.S.D.A. Extension Service
FIGURE 188 Improvement (as shown by the elimination of errors) in grammatical usage from grade three to college. Note that errors drop sharply up to the seventh grade, less sharply or not at all afterward.

(1) Bright children use the whole method more effectively than average or normal children. This is probably a result of the quicker perception of the bright child and his greater ability to perceive relations.

(2) The whole method loses its advantages over the part method when the material is long and difficult. In learning a short poem or a condensed summary—where there is continuity of thought and logical structure—the whole method has a decided advantage. But if the materials to be learned are difficult or loosely related, the whole method loses its advantage, and it often becomes necessary to fall back upon the part method. It will be profitable even here, however, to scan the assignment from beginning to end before attacking it by parts.
(3) The whole method sometimes appears at a disadvantage because students are accustomed to part learning and the new method strikes them as difficult and strange. It is probably best at first for a student to try out the whole method somewhat tentatively, restricting himself to short assignments until he is convinced of the value of the “whole” approach.

USE ALL LEGITIMATE STUDY AIDS

There are various “tools of the trade” which a student should know about and learn to use as early as possible.

(1) the “dictionary habit”

A dictionary should always be handy for looking up words not fully understood. When going to the dictionary is a first, not a last, resort, the vocabulary grows continuously, so that the dictionary needs to be used less and less.

(2) tables and graphs

Students often skip tables and graphs, confining themselves to the text. But graphic and tabular materials are put in for a purpose and should not be omitted. In fact, a summary graph or table is often worth several pages of explanatory material. A good plan is to get a general idea of what the table or graph is attempting to convey on the first reading and later study the details more intensively when the assignment is read through a second time.

(3) summarizing

It is often profitable to outline a chapter or assignment as one reads it, jotting down the important points brought out and underlining those facts which one wishes especially to remember. Oral recitation of a summary aids in the initial fixation of the material, as well as in its retention over a period of time. The two outlines below illustrate a useful scheme for organizing material during study. The first is of Woodworth’s Psychology, the chapter on “Habit and the Breaking of Habit.”
The second is an outline of this present chapter. The general rules for outlining are followed insofar as designation of main topics and subheads is concerned. A strict distinction between topical and sentence outlining is not maintained.

**outline 1**

**TOPIC: Habit and the Breaking of Habits**

1. How Habits Are Broken
   A. Disuse leads to disappearance. Real problem is how to start the disuse. Habits we desire to break afford satisfaction, therefore
      1. we cannot rely upon principle of disuse
      2. nor upon "willing" or wishing to break them
   B. Must form positive and satisfying counter-habits
      1. to break nail-biting, manicure and polish nails; take an active pride in appearance of hands
      2. practice art of being good company to overcome grouchiness
         a. greater skill, at first, as a grouch than as a pleasant fellow
         b. but ambition plus practice of being good company breaks habits of grouchiness
   C. If annoyance accompanies the habit, then practice the habit intentionally
      1. illustration of the principle
         a. when "hte" is written on typewriter for "the," force yourself in practice to write "hte" but always with the intention not to repeat the error in future typing
         b. if one stammers, then stammer intentionally and as nearly as possible like involuntary stammering
c. nail-biting may be overcome by deliberate performance and with the thought that in future the act will be performed voluntarily

2. explanation of the principle
   a. extinction of conditioned reflex requires that the sound of a bell not be followed by feeding. Absence of feeding eliminates the habit of secreting saliva to sound of bell
   b. if you write "hte" for "the," then a check-up breaks the habit
   c. by intentional repetition the habit is not repeated exactly
      (1) difference in motivation
      (2) difference in outcome. The check-up deprives habit of its fascination

Outline 2

Topic: Learning and Studying Effectively

I. Techniques of Study
   A. Draw up a study schedule
      1. allow longer time for harder studies
   B. Attack assignment vigorously
      1. importance of direct attack
      2. participation and interest, factors of
      3. self-recitation improves retention
         a. experiment in, upon material read
      4. age and learning
         a. loss greater in speed
         b. higher the intelligence less the loss
   C. Watch for stagnation periods
      1. plateaus as periods of dead-level performance; arise from
         a. loss of interest
         b. interfering habits
c. need for organization
2. reduction of plateaus

D. Distribute study periods
1. review reinstates associations
2. need for experimental determination of best study periods
3. cramming as an ineffective method of study
   a. useful, however, when temporary retention is wanted
4. mnemonic aids not useful

E. Use overlearning and guided questions to check forgetting
1. value of overlearning fundamental skills
   a. difference between meaningful and meaningless materials
2. guided questions also slow up forgetting

F. Read assignment as whole before breaking it up into parts
1. whole versus part learning
2. whole learning more efficient because parts of task learned in correct order
3. comparison of whole and part learning
   a. bright children use whole better than normal and dull
   b. when task is difficult part method may be used
   c. whole method suffers because novel

G. Use all legitimate study aids
1. dictionary habit
   a. builds vocabulary
2. table and graphs
   a. necessary for understanding; should not be omitted
3. summarizing
   a. oral recitation of summary aids retention
   b. samples in text
4. note-taking
a. sample in text
5. formulas and rules
   a. best method is to let formula or rule develop from problem
H. Do not avoid exams
   1. exams often a prod or incentive
   2. exams tell student where his strengths and weaknesses are
   3. exams taken in school are good preparation for professional exams
   4. knowledge of results sustains interest, speeds learning
I. Remove handicaps to study whenever possible
   1. health, sensory and organic, personal and environmental factors
      a. slow reader
         1) eye glasses and illumination
         2) reading by wholes
         3) avoid lip movements
      b. fatigue and boredom
         1) psychological rather than physical
      c. warming up period
         1) begin with something easy or interesting
      d. poor intelligence, meager aptitudes
      e. emotional tensions, family problems
II. Characteristics of a Good Student
   A. Good students
      1. use the dictionary
      2. have a regular time and place for study
      3. avoid distractions and do not work when tired
      4. make frequent use of charts and diagrams, notes and summaries
      5. study alone, early in the evening or in the morning
      6. take courses in which they are interested and which they believe to be valuable
7. review frequently, and briefly review just before class
8. have a definite study plan and make regular preparation
9. read silently with a minimum of lip movements
10. skim through the assignment first, in general following the whole-part method

III. Transfer of Training
A. Doctrine of formal discipline as off-product of faculty psychology
   1. faculty psychology: mind divided into compartments or faculties
   2. exercise of faculties held to be useful no matter what the material
   3. Latin and mathematics as training subjects
B. Modern psychology has refuted faculty psychology and formal discipline
   1. transfer through common methods or materials not through exercise of faculties
C. Experimental findings in transfer
   1. school subjects differ in value—math high, cooking low
   2. transfer is usually specific not general
   3. transfer depends upon intelligence
   4. transfer best effected by teaching for transfer
   5. transfer depends upon applications made
   6. similar materials and methods lead to transfer

(4) note-taking

It is generally agreed that taking notes in class is an effective aid to learning. The technique of good note-taking is not an easy one. In one survey of study difficulties encountered by 115 freshmen, for example, 40 per cent reported that they could not take useful notes. Class notes should be brief, accurate,
Taking notes and outlining are effective aids in preparing for an examination.

Figure 189 Taking notes and outlining are effective aids in preparing for an examination.

They should summarize what the lecturer has said without quoting his words exactly. Students can often improve their note-taking by exchanging class notes, by criticizing each other’s accounts, and by experimenting in taking fewer and shorter notes. When a student writes a long or verbatim account of a lecture, there is a loss of valuable time, which might be put to better use in listening, in asking questions, and in discussion. Figure 190, on pages 366 and 367 shows a series of longhand notes which a student might take during a lecture in a chemistry class. The lecture is on the physical properties of water, and the notes follow the order of presentation in a leading textbook.

* Graduate students are notoriously voluminous note-takers. One story has it that when a professor enters the classroom and says “good morning” the undergraduate replies “good morning” but the graduate student writes it down!
Most important compound - 3/4 of earth covered -
  essential to life process -
  Changes in earth's crust - glaciers, rivers, even raindrops
  Heavy water later -

% composition by weight
  pass hydrogen over heated cypnic oxide
  calcium chloride tube - weigh before and after
  also weigh copper oxide
  \[ H_2 + CuO \rightarrow H_2O + Cu \]  hydrogen - oxygen
  \[ 1 : 7.94 \]
  \[ 1.008 : 8 \]

Composition by volume
  Eudiometer -
  fill with mercury to 2 vol. steam
  Gay-Lussac's Law of Combining volumes -
  volumes of gases in reactions - small whole numbers
  The volumes of the gases used and produced in a
c  chemical reaction can always be represented by
  the ratio of small whole numbers. (memorize)

Physical properties - water used as a basis of definition
  of many physical constants:
  at 760 mm: 0°C ← liquid → 100°C
  Calorie - unit quantity of heat -
  heat to raise 1 gram 1°C
  average 0°C to 100°C - (other ways to define)
Specific heat - ratio to water -
quantity of heat to raise 1 g. 1°
water is 1 (average) - slightly higher middle, 0-100°
highest of all common materials -
lakes heat and cool slowly
1 milliliter H₂O at 4° = 1 gram (by definition)
maximum density at 4°
1 kg. H₂O at 0° = 1000.10 ml. - unusual to expand
1 " 100° = 1043.2 ml.
Pure water poor conductor of electricity -
many solutions very good

As a solid
Heat of fusion -
1 g. ice 0° to 1 g. liquid 0° - 80 calories.
Normal freezing point - 0° at 760 mm. - equilibrium
Supercooling - inoculate at low temp. - crystallize out
1 kg. ice 0° = 1090.80 vs. 1000.10 for water

As a gas
Heat of vaporization -
1 g. H₂O 100° -1 g. steam 100° - 539 cal.
Expands 1700 times in volume - more energy
Colorless, invisible
Cloud or fog is water droplets - formed by condensation
Surfaces of drops reflect light

The occurrence and physical properties of water.
Rules, generalizations, mathematical formulas, and laws are often learned by heart in the hope that they can later be applied to the solution of specific problems. Many teachers, for example, have children memorize the statement “the base times the rate equals the percentage,” in the hope that examples can be solved immediately with the help of the rule. Going from a generalization to specific cases is good deductive method, but it does not make for as effective comprehension as does going from examples to generalization (the inductive approach) (page 428). Instead of learning a rule or formula by rote, therefore, with the idea of applying it to various examples, the student should try working out specific examples which illustrate the rule first and have the generalization grow out of a many-sided acquaintance with the procedures which the rule is intended to summarize. After children solve a number of problems in percentage, for instance, the rule given above becomes a reasonable summary of the processes common to many examples.

WELCOME THE OPPORTUNITY TO TAKE TESTS AND EXAMINATIONS

Many students make the mistake of assuming that examinations are given for one purpose only—to provide the instructor with a basis for assigning a grade. To be sure, examinations are often essential as a means of evaluating knowledge and present progress. But they are much more useful in self-diagnosis—that is, in aiding a student to discover his strengths and weaknesses. Examinations further learning in several ways:

(1) An examination is a prod or incentive to the student to assemble and review what he has learned, to put on paper facts or ideas presented up to that time.

(2) The examination tells the student quickly and effectively whether additional work is necessary and where the major emphasis should be placed.
Experience in taking examinations proves useful when tests for Civil Service, various licenses, state boards, and the like are required. Students who have never faced the task of answering specific questions, or of organizing and expressing what they know on paper, often find such examinations especially difficult.

A knowledge of results (page 327) sustains interest and provides an incentive which often speeds up learning. Standard tests are now available in the various school subjects. These will enable the student to discover and perhaps remedy deficiencies in his preparation. A student, for example, may be having trouble with French for one of several reasons: meager vocabulary, ignorance of grammar, or lack of faculty in translation owing to insufficient reading. Several of the standard language tests provide sections dealing specifically with these various aspects of the subject. Once frequently repeated errors, misunderstandings, and gaps in knowledge are clearly recognized, subsequent study is more intelligent and selective.

**REMOVE AS MANY HANDICAPS TO EFFECTIVE STUDY AS POSSIBLE**

Poor health, physical deformities, bad eyesight, financial difficulties, unfavorable home conditions—these are handicaps (among others) which the student may be able to do little about and may be forced to accept and live with. But fortunately a number of deterrents to effective work can be eliminated; and sometimes a good deal can be done to compensate even for permanent disabilities. A few suggestions concerning handicaps and their treatment follow:

(1) slow reading

Poor reading habits are a definite handicap to many students. Some college students read no better than the average seventh-grade pupil, and perhaps at least one third of college freshmen read too slowly to do their most effective work. If the student suspects that his reading is slow as compared with that of
others, his first step is to have his eyes examined, so that proper glasses can be fitted if necessary. A second obvious move is to insure good illumination.

Difficult, new material, such as an assignment in physics or economics must be read carefully. It is a waste of time and effort, however, to read every word of an assignment in which only the main ideas are wanted. Every student must learn to skim as a measure of economy (page 342). Many speed up their reading by practicing intensively with fairly easy material. A quickened tempo of reading is obtained also when one reads by wholes and avoids lip movements. If these simple measures fail to improve reading, the student should consult a reading specialist or a psychologist skilled in the treatment of reading disabilities. Various reading tests are available from which the student can learn the extent of his handicap. If his reading is much below the average for his age and educational level, he should take special training to overcome this very serious handicap to effective study.

(2) fatigue and boredom

Psychologists recognize two kinds of fatigue, physical and psychological. Efficient work is extremely difficult when the student is physically tired or overfatigued. Many students find it profitable to transfer working on difficult assignments from the late evening to the early morning, when they are fresh and when application is easier and distractions less numerous. The curve of mental performance has been found to go up steadily during the early morning, falling off slowly before lunch. After the lunch period—when the cobwebs have been temporarily dusted away—the curve of mental work rises again, gradually falling off in the late afternoon. The ebb point of the day is often somewhere between four and six. It is to the student's advantage, therefore, if he can put hard subjects in the morning, reserving the afternoon for recreation and social diversion.

Psychological fatigue or boredom, which is not true fatigue, ordinarily results from flagging interest in an assignment which
the student finds hard or uninteresting. Temporarily laying a subject aside and changing to something else will often relieve boredom; or a short period of rest or recreation may serve to bring efficiency back to its former level. A study schedule such as the one outlined on page 343 should be flexible enough to allow for periods of diminished interest. It is important too, that the student make a strong effort to do his studying in as quiet a place as possible, avoiding such distractions as radio, desultory conversation, and interruptions.

(3) warming-up period

Many students find it difficult to settle down to serious study, and so waste much time in false starts. It has been found that students who work in the library make better grades than students who work at home or in dormitories. This is probably because there are fewer distractions—less social conversation, dawdling, and daydreaming—in the library, where the atmosphere is more conducive to study. It is often advantageous to begin with a relatively easy assignment, perhaps one in which the student has a great deal of interest. A review of notes and a quick skimming-over of already familiar material may provide an effective transition, or warming-up period, to an attack upon new subject matter.

(4) meager intelligence and the lack of special aptitudes

Students often have difficulty in preparing assignments because they are not intellectually as able as other students. The probability that a student from the lowest 25 per cent of his high-school class will fall in the lowest 25 per cent of college students in scholastic achievement is almost thirty times as great as the probability that he will fall in the highest 25 per cent. Students who have had great difficulty in graduating from high school would be well advised to take special vocational training courses rather than to attempt the course of study prescribed in an arts college. It is far better to become a successful bookkeeper, salesman, or dental technician than to be a me-
diocre or inferior engineer or lawyer. There is a great need for guidance of marginal students, whose ability to profit from college is doubtful. Often an otherwise good learner finds difficulty with some particular subject—for example, mathematics or a foreign language. Again the need for careful guidance is indicated. The student may be steered into courses where his interests and aptitudes make success more probable; or perhaps, through special coaching, he may be given advance preparation for those courses which offer a hurdle to his academic progress.

(5) nervous and emotional tensions, worry over finances, emotional involvement with personal and family problems

All these interfere with efficiency and render study difficult. No matter how great his interest and ability, no student can do effective intellectual work when distracted by worry, fears, and recurrent emotional upsets. A good plan, when it can be followed, is to avoid people, places, and circumstances which lead to emotional distractions and tensions. If the student's difficulty is deeply rooted in feelings of inferiority, if he worries constantly over his health or over personal and family problems, it would be wise for him to consult a psychologist or a psychiatrist. Casual advice from well-meaning friends is often worse than useless, serving many times only to exaggerate a minor difficulty into a major problem. It is far better to seek the counsel of a person trained to view the problem objectively from a background of long experience with college students.

characteristics of the good student

Perhaps we may best summarize the points of the last section by tabulating the findings from several studies which have sought to discover the characteristic habits of and procedures followed by good students, as contrasted with those whose records are poor. The reader may perhaps correct his own study
faults by checking off those procedures which he does not observe and at least giving them a trial. In general, successful students

(1) Use the dictionary.
(2) Have a regular time and place for study.
(3) Avoid distractions and do not work when tired.
(4) Make frequent use of charts and diagrams, notes, and summaries.
(5) Study alone, early in the evening or in the morning.
(6) Take courses in which they are interested and which they believe to be valuable.
(7) Review frequently, and review briefly just before class.
(8) Have a definite study plan and make regular preparation.
(9) Read silently, with a minimum of lip movements.
(10) Skim through the assignment first, in general following the whole-part-whole method.

transfer of training

FACULTY PSYCHOLOGY AND FORMAL DISCIPLINE

One of the avowed purposes of education is to prepare young people for citizenship. It is important, therefore, that what one learns in school be effective and useful in a wide variety of life situations. When the learning in one situation is applicable in whole or part to other situations, there is said to be transfer of training. Historically, the theory of transfer of training is an offspring of the doctrine of formal discipline, which in turn grew out of the old faculty psychology. Faculty psychology held the "mind" to be divided into compartments or faculties such as observation, memory, reasoning, judgment. Formal discipline is the theory that a given faculty can be strengthened through use, much as a muscle is strengthened by exercise. Whether obtained in games and sports or in physical labor (as farmer, mechanic, or lumberjack), exercise is effective in build-
ing muscle. Hence, it was argued by analogy, that it made little difference what sort of material was utilized in an intellectual activity so long as it gave exercise to the logical thought processes. During the Middle Ages, Latin was an indispensable part of the intellectual equipment of an educated man. As Latin gradually lost its utility as a spoken language, it began to be regarded more and more favorably as a general “mind trainer.” Other reasons why studies like Latin, Greek, and mathematics were considered to possess special disciplinary value arose from the fact that these subjects are difficult for most people, demand close application, and require a systematic and logical arrangement of the facts learned. Latin and formal mathematics (plane geometry, for example) are still widely believed to be valuable in general mind training. In fact, many youngsters in high school laboriously read Caesar and solve geometric originals in the wishful belief of teacher and parents that they are thereby training their “reasoning powers.”

**Modern Psychology Has Rejected Faculty Psychology**

Faculty psychology and its contingent doctrine of formal discipline or general mind training have long been discarded by psychologists. Mind is exhibited in active behavior; it is not made up of a number of separate compartments each of which must be independently trained. We do not perceive, remember, and reason as separate “acts.” On the contrary, experimental research has shown that our “faculties” or abilities enter into all our responses to a greater or lesser extent. Instead of transfer through the exercise of this or that faculty, therefore, psychologists believe that improvement from training takes place when the same material or the same method can be utilized in the two situations. It is not power that transfers, as was once supposed, but specific knowledge or skills needed in the new situation. We all know that school training transfers into business and professional life. Biology and chemistry, for example, are necessary for the practice of medicine; mathematics and
physics for engineering; bookkeeping and accountancy for business. Not only do we confidently expect that arithmetic and grammar will be useful in almost any vocation, but we hope, at least, that civics, history, and other school subjects will aid in making us more intelligent and useful citizens.

**EXPERIMENTAL FINDINGS IN TRANSFER**

Our interest, therefore, is not in the *existence* of transfer of training, but rather in the *extent* of transfer and the *conditions* under which it operates. There have been a number of experiments designed to discover whether training in one activity carries over to other undertakings. A summary of the conclusions most important for the general student is given below:

(1) School subjects differ in transfer value. Careful and repeated studies reveal that high-school subjects differ in transfer value over a school year. No subject is pre-eminently a "mind trainer." But mathematics and science have an edge over

---

**Figure 191** Metal working may be either a hobby or an industry. Transfer value depends upon common elements in differing situations.

Courtesy Denver Public Schools
languages and the social sciences, while history and English literature have zero transfer value. Cooking, sewing, and dramatic arts have no positive carry-over and may even transfer negatively—that is, the student may be less able to do difficult problems as a result of having taken these subjects.

(2) Transfer is more likely to be specific than general. Training received in conventionally taught classes in Latin and mathematics, for example, is likely to be specific. High-school freshmen students of Latin show a slightly greater gain than non-Latin students in vocabulary tests containing words of Latin origin, but no greater gain in vocabulary tests made up of words of Anglo-Saxon origin. Intensive practice in addition has been found to improve the adding efficiency of elementary pupils about four times as much as it improves their performance in subtraction, multiplication, and division.

(3) Transfer of training depends heavily upon the intelligence and the educational achievement of the learner—upon native ability plus what has already been learned. The highest one per cent of high-school students in general intelligence show nearly twenty times as much ability to make use of their learning (that is, transfer) as the lowest one per cent in intelligence, irrespective of subjects studied. High-school freshmen who studied Latin one year gained twice as much in English vocabulary as non-Latin students. But the Latin students knew more words at the start, were brighter, and more highly selected.

(4) The best way to get transfer in school work or in business is to teach for transfer. Table 13 shows the gain over a school year in scores on an English vocabulary test made by (a) students in conventionally taught classes in Latin, and by (b) students in Latin classes in which stress was placed upon word study and word derivation. There were 118 pupils in each group, and the two groups were matched for general ability as indicated by an intelligence test. At the end of the year, the word-study classes knew a significantly greater number of words of Latin origin than the conventionally taught classes, but few if any more words of non-Latin origin. It seems
Gains upon an English vocabulary test made by students in classes in Latin with and without stress upon word study

<table>
<thead>
<tr>
<th></th>
<th>Latin origin</th>
<th>Non-Latin origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventionally taught Latin classes</td>
<td>4.05</td>
<td>2.77</td>
</tr>
<tr>
<td>Latin classes taught with emphasis upon word study</td>
<td>8.12</td>
<td>3.49</td>
</tr>
<tr>
<td>Difference</td>
<td>4.07</td>
<td>.72</td>
</tr>
</tbody>
</table>

clear that when Latin is taught as a basis for understanding English words, there is transfer to English words derived from Latin but little transfer to vocabulary in general. (See Table 13, above.)

(5) Transfer depends upon the applications made by the student. Habits of neatness, for instance, are more likely to transfer if their importance is stressed in a variety of everyday situations than if training is confined to teaching neatness in one class or in one situation. Moral habits of honesty and dependability as taught in home and school, and habits of good sportsmanship in games and sports do not automatically carry over into business and professional life unless applications are repeatedly made, and, more important, actual performance demanded. Internships, apprenticeships, and clerkships represent practical ways of expediting the transfer of school learning to actual tasks.

(6) Transfer takes place through similarities of material, similarities of method, or both. Among the methods or materials which may transfer are facts in history and geography, common arithmetical procedures, routine experimental methods, principles, laws, attitudes, and ideals (being neat, careful, open-minded, having good work habits). Mathematics transfers to accountancy, English grammar and theme writing to editorial work. Those experiences and personal qualities which make a man a good salesman or executive or technician in one situation may also operate in similar or somewhat similar situations.
summary

In school learning, as in the learning of everyday life, some motivation or drive is necessary. Anything which arouses curiosity or increases interest is likely to facilitate learning a school subject. Interest and curiosity are increased if the study is related to our own personal lives or has direct application to everyday life. A number of general principles which aid in efficient learning have been formulated. While some of these seem self-evident and obvious, many are often neglected. Periodic review, studying by the “whole” method so as to provide context and belongingness, self-recitation, and other techniques have been found to be generally profitable. Furthermore, the “good” student makes use of such study aids as outlines, notes, rules, tables, and graphs. He avoids studying when fatigued or bored and does not “cram” all of his study into one desperate effort.

questions and topics for discussion

1. Are knowledge of effective teaching methods and ability to learn highly related? Are eminent scholars often poor teachers? Why?
2. Which is the better practice for a baseball team, batting and fielding separately or batting and fielding while playing an actual game?
3. It has been said that “we learn to swim in the winter and to skate in the summer.” If true, does this contradict the principle of exercise?
4. How could you employ the whole-part-whole learning method to teach a child: (a) the capital cities of each of the states; (b) long division; (c) a poem?
5. Why is it that learning to read a foreign language does not enable one to speak it? Would it be a good plan to learn the language by one method or another according to whether one wishes to speak it or read it?
6. Why is it that an adult often has difficulty in understanding a passage when it is read aloud to a group?
7. In teaching spelling, would you give the common misspellings of the word along with the correct form? Would it be better, for example, to give the word "separate" and point out that the incorrect form is "seperate"? Or would it be better to omit all incorrect forms?

8. Would it make for better retention to take a few notes during the lecture and write a full account later, or take very full notes during the lecture itself?

9. Sometimes the first page or so of a chapter seems quite difficult, but when you have finished reading the chapter you find these first parts comprehensible. Can you explain this in the light of the principles given in this chapter?

10. Is it better to study in the same room in which you sleep or in a different room? Why?

11. Recall an occasion in which you were too tired to study an assignment but discovered you had plenty of energy for something else.

12. Why are interruptions during study far more wasteful than the few minutes which are actually lost?

suggested readings


3. H. L. Kingsley's *The nature and conditions of learning* (New York: Prentice-Hall, 1946) has readable chapters on forgetting, remembering, and transfer.

In everyday speech we use the term "to remember" in two somewhat different senses. We speak, on the one hand, of remembering names or dates (word memories); on the other, of remembering how to ice-skate after a summer vacation or how to drive a car after an interval of several years. While these two usages seem quite different (the first being verbal and the second muscular), functionally they cover essentially the same phenomenon. Both describe the revival or re-instatement of certain responses acquired at an earlier time. Whether verbal memories require more "brain traces" or utilize more nerve pathways than motor memories, we do not know. But we can be sure that both sorts of memory depend upon changes in neuromuscular organization, that these changes must be maintained over a variable period of time, and that they must be capable of rearousal under appropriate stimulation.

Memorizing is usually identified with ordinary learning except, perhaps, in the case of "rote memory." Learning "by
"heart" is often spoken of as though it were a special kind of learning. In rote memory there is, to be sure, little or no tentative search among possible responses, the task being chiefly one of simple repetition until certain associations are formed. Rote memorizing, therefore, is a relatively rigid process; but it is learning nonetheless, and is not some "new" sort of mechanical registration.

For convenience, the phenomena of memory may be classified under the four headings fixation, acquisition, retention, recall, and recognition. Fixation is the effortful act of memorizing, of getting the impression; retention is the maintenance of the impression over a variable period of time. Recall and recognition both involve the revival or reestablishment of learned responses under appropriate stimulation. Each of these four processes is a necessary part of memory, and none is to be thought of as distinct or separate from the others. A survey of some of the abnormalities of memory—memory distortions—will demonstrate this fact and, at the same time, will furnish insight into the mechanics of remembering and forgetting.

1. Fixation

Patients suffering from mental disease sometimes display a marked inability to give sustained attention, their minds wandering in a curious "flight of ideas" from one topic to another. Young children are often poor "fixators" because their attention moves rapidly from one thing to another. Old people, too, sometimes fail to fixate because of inattention or inability or unwillingness to look or listen. In very old people there may be a true loss of plasticity in brain and nervous system, but even in the old, preoccupation and lack of interest are very often the cause of failure to learn (page 346). When attention is poor, stimuli fail to register or are crowded out by competing stimuli.
or other demanding factors. Most people fail to remember happenings experienced under great excitement and emotional tension or under the influence of drugs or liquor. In chronic alcoholism there is often a gap in memory due to poor fixation, plus a tendency to “fill in”—to invent or exaggerate (so-called “cheerful lying”). Shock caused by accident or injury, such as a blow on the head, often leads to fixation-amnesia: the injured person is unable to remember the accident itself or the events just prior to or just after the accident.

FIGURE 192 The diver remembers highly trained skills over long periods; Sandburg, like all folk singers, remembers the words and melodies of hundreds of songs.
2. Retention

True loss in retentivity occurs in mental disease when there is degeneration of brain tissue, as in senile dementia. The loss of memory in such cases is fairly general, though earlier associations, formed when the brain was presumably more retentive, are more resistant to decay than are later associations. Old personal information is often retained, for example, when the happenings of the day before are lost. Specific disabilities in retentivity occur in brain damage arising from tumors, wounds, hemorrhages, and the like. For example, memory defects called aphasia (page 148), result from brain injury and involve disturbances in the sphere of language. In aphasia there may be inability to find the right word in speaking—in extreme cases, speech becomes largely a jargon or "word salad"—or there is inability to understand what one reads. One elderly man mystified his friends by saying he wanted to have his umbrella washed, until it was discovered that he wanted to have his hair cut. Most normal people experience mild aphasia when greatly fatigued.
3. **RECALL**

In some mental diseases (hysteria, for example), a person cannot recall certain episodes in his life, though his memory for other things may be unaffected. Again, in shocks, accidents, or injuries, especially if accompanied by strong emotion such as terror, a person may be unable to recall his own name, the names of his friends, or events in his past life. Recovery in cases like these (and it is not unusual) indicates that recall must have been temporarily blocked in some way, there having been no physiological loss—that is, no destruction of tissue.

4. **RECOGNITION**

Recognition differs from recall in that to recognize we need simply to react with a feeling of familiarity (“oh yes, I know it”) to a stimulus before us. There are two common disorders of recognition: (a) a feeling of strangeness when objects, per-

---

**Figure 194** Drawing from memory is a good exercise in recall; it also develops fixation and observation.

Courtesy Standard Oil (N.J.)
sons, or surroundings are really familiar, and (b) false recognition, in which places and events really new seem familiar and seem to have been previously experienced. A sense of strangeness when faced by familiar things is found in certain forms of insanity: this is probably a kind of amnesia which results from the emotional blocking of certain associations to recall. False recognition, called paramnesia or "deja vu" (already seen), occurs when we are fooled by similarities in the appearance, size, color, or form of the new things to the things we know. A mild example of deja vu is present when we "recognize" an old friend in a stranger of similar build, dress, or complexion.

**the experimental study of memorizing**

**MATERIALS USED IN MEMORY EXPERIMENTS**

Materials used in experiments in memorizing usually begin with nonsense syllables. Nonsense syllables were invented by Ebbinghaus* to provide materials free from ready-made associations. It is difficult to get a fair measure of how well people can memorize from meaningful materials, since individuals cannot readily be equated for familiarity with words, poems, prose, and so on. Differences in score for learning meaningful material, therefore, might well reflect training and past experience to a greater degree than ability to learn or acquire. A typical nonsense syllable consists of a single consonantal sound followed by a vowel or diphthong and then by another consonantal sound. The number of letters may vary from three to six, four being the most popular. Illustrations are GIX, TEX, JOID, ZIBE.

In many studies, especially in those of school learning, experimenters have used various sorts of meaningful material.

* H. Ebbinghaus was a pioneer student of memory. His famous work *On Memory* was published in 1885.
Illustrations are disconnected words, prose passages of different degrees of difficulty, pictures, colored forms, designs, and objects. These materials are generally better measures of memory when used with children than when used with adults. Meaningful materials may be employed to good advantage with adults, however, when subjects possess a common background of experience for the memory material, or when the material itself is novel and unfamiliar to all of them.

**Methods of Studying Memory**

The efficiency of fixation and retention cannot be determined directly, but must of necessity be measured as recall (both immediate and delayed*) and recognition. Various objective methods have been used in studies of memory, of which the following are the most common.

*(1) Memory span*

One of the simplest ways of determining the efficiency of immediate memory (fixation) is to test the memory span. This is the largest amount of material that can be correctly reproduced after a fixed number of presentations. Memory span material ordinarily consists of numbers (digit-span), words, figures, or objects. Of these, digits are the easiest to give and are the most popular. In auditory presentation, the experimenter begins with a short list of three or four digits, and reads it through at the rate of approximately one digit per second. The learner then tries to recite the list exactly as it was heard. In visual digit span, the experimenter exposes cards containing lists of numbers differing in length for varying time intervals. One second is allowed per digit, and the subject is required to write down immediately what he has seen. To guard against slips of attention and distractions, in auditory presentation a subject is usually allowed three trials on each list. A list of five digits, for example, is regarded as "passed" if one

* Delayed memory = recall after a time interval.
of the three is correctly reproduced. Typical digit span lists are as follows:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3719</td>
<td>6183</td>
<td>4257</td>
</tr>
<tr>
<td>85742</td>
<td>73582</td>
<td>59286</td>
</tr>
<tr>
<td>463859</td>
<td>586371</td>
<td>943752</td>
</tr>
<tr>
<td>2873946</td>
<td>3625948</td>
<td>6274853</td>
</tr>
</tbody>
</table>

![Figure 195](image)

**Figure 195** Taking part in their own book club develops the children's interest in books and helps them to remember what they read.

(2) *Savings method*

This is a learning-relearning method. The subject learns a lesson—perhaps a list of words or nonsense syllables—to the point where he can recite it just once (or twice) correctly. The time taken to learn and the number of complete readings are recorded. After a time interval, the subject relearns the list by the same method as before, and again the time and the number of readings necessary for one correct reproduction are noted. The saving is the difference between the original learning time and the relearning time, and the per cent saved is the absolute saving divided by the original learning time. Instead of time, number of complete readings necessary for one correct reproduction may be used in computing the saving. Thus if a subject requires ten readings to learn the list and only seven to relearn, he has saved three readings, or 30 per cent.
To prevent cautious subjects from “overlearning” the material (exceeding the criterion of one correct recitation), and to exercise greater control in the presentation of material, apparatus like the memory drum, shown in Figure 196, is often used.

(3) paired associates

In this method the material to be learned consists of pairs of words, nonsense syllables, pictures, forms, or colors. These pairs are to be learned together, so that later when the first member of the pair is shown the subject can answer with the second. In a typical experiment by visual presentation, the experimenter has two sets of cards, one containing pairs of words, the other only the first word of each pair. Illustrations are

<table>
<thead>
<tr>
<th>sky—shoe</th>
<th>sky—</th>
</tr>
</thead>
<tbody>
<tr>
<td>man—tree</td>
<td>man—</td>
</tr>
</tbody>
</table>

The subject is allowed to see each word pair for a set length of time—perhaps three seconds—sometimes more than once, depending upon the length of the series. After an interval, the cards of the second set are shown and the subject is instructed to speak out or write down the associated word. Instruction or “set” is important in paired-associate learning in determining the ease and the direction of association (page 322).

(4) learning method

This is a flexible method, one which can be used with nonsense syllables, lists of words, or prose passages. The subject’s memory score is the time it takes him to learn a list “by heart,” or the number of “ideas” he can recall after one or more readings.
of a prose passage. Both immediate and delayed recall can be measured by this method.

(5) recognition method

The subject is shown a set of twenty pictures—advertisements, photos, or other stimuli. These are then shuffled with an equal number of new stimuli and the subject is instructed to sort out those he has seen before. The learner is allowed to say Yes (have seen), No (have not seen), or Don't remember. Sometimes the subject is required to say either Yes or No but is permitted to put a question mark by those answers of which he is not sure.

fixation and retention

Good fixation is good registration, and for this reason all of the techniques for improving study given on pages 344-359 are
After Guilford, 1939.

Figure 197 The number of digits a person can remember increases as he grows older.

applicable. This means that for effective memorizing we should attack an assignment vigorously, distribute rather than concentrate our efforts, use the whole-part-whole rather than the piecemeal method, make use of available study aids, check progress by recitation, and set up as favorable an emotional and environmental climate as possible. Memory span is a test of fixation and retention through immediate recall. When lists of digits are read aloud and three trials are permitted on each list, the adult has a memory span of seven to eight digits. Changes in memory span over the early years are shown in Figure 197. These data are based upon the digit span test in the Stanford-Binet examination (page 457). Children were required to recite the digits correctly in one out of three trials in order to be credited with a list. When materials are presented visually, memory span is usually several digits longer,
because of the possibility of grouping (for example, 34, or 567).

Girls are slightly better than boys in memory span at each age level—in fact, women generally score better in all memory tests than men. Memory span is positively related to intelligence, only 5 per cent of feeble-minded children scoring as well as the average normal child. Older people acquire meaningful material as well as or better than children. In one study 765 people, ten to sixty years old, were shown three motion pictures and immediately after each picture were given a memory test covering what had been seen. The relation of recall scores to age is shown in Figure 198. There is a rapid rise from ten to twenty, a peak between twenty and thirty, and a slow drop thereafter to about forty-five, after which the drop is more rapid. Even with the loss, however, adults past fifty have better immediate recall (fixation) than children of ten.

**FACTORS IN RETENTION**

Retention depends upon good fixation, upon the difficulty and character of the material (page 385), upon how well it has

---

**FIGURE 198** The ability to remember events observed in motion pictures varies with the age of the person.

After Jones and Conrad, 1933.
been taught (page 322), and upon how much the memorized material is overlearned (page 353). Retention depends, also, upon age, intelligence (page 371), motivation, and interests. Many studies have shown that we tend to remember propositions or facts toward which we are favorably inclined, or which fit into our point of view. In one experiment two groups, the one favorably inclined toward the Negro and the other unfavorably inclined, were asked to read an article presenting data on Negro-white differences. Both groups then wrote down all they could remember of the article. The favorable group remembered many more favorable statements, whereas the unfavorable group remembered more of the unfavorable statements. Attitude and predisposition, rather than memory alone, seem to have been the crucial factors in this retention.

**Motivation and Retention**

Motivation toward the memory task will also influence retention. A group of students was instructed to memorize pairs of words by the method of paired associates (page 388). When told to learn for permanent retention, these subjects retained more than when told to learn for temporary retention—and this was true for both immediate and delayed recall. The rapidity with which material acquired through cramming fades out after the examination is evidence that the attitude of the learner favored temporary retention. While cramming in college study is generally unprofitable, this method is useful when only temporary retention is desired (page 352).

**The Improvement of Retention**

In and of itself, retentivity is a physiological affair—a matter of the maintenance of the newly acquired organizations or connections within the brain and the nervous system. Unfortunately we can do little to improve our inherited retentivity other than to maintain good physical, mental, and emotional health. But we can improve retention by improving fixation.
Recall and recognition measure fixation and retention by showing how well the memorized material has persisted over a period of time. Fixation is measured primarily by immediate recall, retention by delayed recall—that is, recall after various time intervals.

Both immediate and delayed recall of connected passages of prose exhibit certain characteristic changes, as well as a general fading-out with time. The normal child of ten, for example, should be able to read the following paragraph in thirty-five seconds and immediately thereafter reproduce at least ten of the twenty-four “memories” marked off by vertical lines:

MEMORY TEST

New York | September | 5th. | A fire | last night | burned | several houses | near the center | of the city. | It took some time | to put it out. | The loss | was fifty thousand | dollars, | and seventeen | families | lost their homes. | In saving | a girl | who was asleep | in bed, | a fireman | was burned | on his hands.

In immediate recall we find, typically, a simplification of detail, a number of omissions (for example, date, number of houses, location), and retention of facts which are striking or familiar or interesting to the child (fire; $50,000; girl asleep; fireman burned on hands). In delayed or long-distance recall, there is frequently some elaboration of interesting detail, a filling-in with materials which are not in the passage, and often fairly free invention by the learner.

The tendency for characteristic changes to take place in recall and recognition is shown nicely in experiments dealing with memory for visually presented forms—figures and line

* Bartlett, 1932.
drawings. Three categories of change have been noted: leveling, sharpening, assimilating. In leveling, there is a typical smoothing out in recall: greater symmetry and fewer irregularities. In sharpening (in contrast to leveling), certain high points or irregular details are recalled more clearly in successive reproductions; and in assimilating (page 190), unusual or unfamiliar figures tend to become absorbed into those conventional or "normal" objects known to the learner. A good demonstration of how assimilation (and suggestion) may influence recall is shown in Figure 199. When the stimulus figures were presented along with identifying names (bottle, moon, eye glasses), the figures as reproduced were distorted in the direction of these descriptions. When the figures were shown with other names (stirrup, letter C, dumbbell), recall was again distorted, but this time in the direction of the new descriptions. Some leveling appears also in all the reproductions.

In studies of early memory, it has been found that the first childhood event which adults can ordinarily recall is experienced at about three and a half years. Often the remembered incident—a death, perhaps, or an intensely exciting experience—has a strong emotional tone. Men tend to recall more pleasant

**FIGURE 199** The word is assimilated with the stimulus figure, causing a distortion in the reproduction toward the object named.

From: Hilgard, after Carmichael and others.
early incidents than women, but both sexes report more pleasant than unpleasant early childhood memories (page 402).

RETENTION AND RECALL OF SCHOOL SUBJECTS

Table 14 shows the retention (as measured by delayed recall) of certain elementary, high-school, and college subjects for periods of from one to two years after completion of the formal courses. While all subjects show forgetting—and none extremely strong fixation or immediate recall—the greatest loss after one year is in botany and psychology, the least in high-school algebra, high-school Latin, and eighth-grade history. Perhaps botany and psychology suffer because the formal content of these courses receives little if any refreshment after the end of the term. High-school algebra, Latin, and eighth-grade history, on the other hand, are probably reviewed and reinforced in subsequent courses in the same subjects. Unless this is true, algebra and Latin ordinarily get even less review than botany and psychology. Table 14 suggests that either the presentation, or the subject matter, or the student's learning methods (or all three) could stand considerable improvement.

14 Retention of various school subjects at the end of course and of same material after one or two years*

<table>
<thead>
<tr>
<th>Subject</th>
<th>End of Course</th>
<th>After Twelve Months</th>
<th>After Twenty-Four Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany (college)</td>
<td>68%</td>
<td>21%</td>
<td>16%</td>
</tr>
<tr>
<td>Zoology (college)</td>
<td>78</td>
<td>39</td>
<td>30</td>
</tr>
<tr>
<td>Psychology (college)</td>
<td>70</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>Algebra (high school)</td>
<td>87</td>
<td>56</td>
<td>—†</td>
</tr>
<tr>
<td>Latin (high school)</td>
<td>82</td>
<td>60</td>
<td>—†</td>
</tr>
<tr>
<td>Chemistry (high school)</td>
<td>63</td>
<td>47</td>
<td>33</td>
</tr>
<tr>
<td>History (8th grade)</td>
<td>71</td>
<td>56</td>
<td>—†</td>
</tr>
<tr>
<td></td>
<td>74</td>
<td>43</td>
<td>24</td>
</tr>
</tbody>
</table>

† No records.
RECOGNITION AND RECALL

We often recognize immediately dates, names, and facts when we see them in print or hear them spoken and identify songs when they are whistled or sung none of which we could recall by our own unaided effort. Recognition is easier than recall because only identification and familiarity are required, and not exact reproduction. Hence objective examinations of the multiple choice type are in general easier than essay (recall) examinations. All of the answers are written out in the first sort of test, and the student’s task is simply to select the correct (familiar) answers rather than to recall them.

Students do not always distinguish between those facts which should be learned for recall and those for which recognition memory is sufficient. And unfortunately teachers sometimes give the impression that everything taught in the classroom should be “on the tip of one’s tongue.” To be sure, correct grammatical usages, arithmetical operations, and certain key facts and general principles should be overlearned until they are ingrained and dependable habits. But much of the time and effort spent in verbatim learning of long summaries, statistical formulas, rules, and definitions is likely to be wasted. Handbooks, manuals, and dictionaries in which such facts can be found are readily available. For much factual material, a recognition or reference memory is all most students can or should reasonably aspire to.

INCIDENTAL MEMORY

Of the thousands of sights and sounds which daily assail our sense organs, only a fraction are directly dealt with or reacted to. The recall or recognition of passing experiences not specifically observed has been named “incidental memory.” Incidental memory is often notoriously inexact. In experiments carried on in the psychology laboratory, subjects have been asked whether the numerals on their watches were Roman or Arabic; or they are instructed to draw a rectangle the size of a dollar...
bill, or to tell the number of windows in or the number of columns before a familiar building, or the eye color of a close friend. Reports of these often experienced facts may be far from accurate, as the reader can verify by trying the experiment himself.

The vagueness of incidental memory accounts in part for the unreliability of testimony. Experience shows that even when given under oath, the testimony of a witness in court is often incorrect, distorted, and highly questionable. The unreliability of verbal report (testimony) has been demonstrated in various classroom experiments somewhat like the following.

Arrange to have two weirdly dressed men (assistants) suddenly rush in and interrupt the lecture; have one denounce the instructor while the other draws a pistol and fires at him (a blank, of course); then have both rush from the room. Reports on such an incident will vary widely, even when called for immediately after the episode: witnesses will differ in their testimony as to the number of assailants, how they were dressed, what they said and did. After two or three days the accounts will vary even more, being now embellished by “facts” picked up in gossip and conversation. Even the testimony of the most honest and trustworthy witness is often inexact, for the following reasons:

(1) poor fixation—no intent to remember

Witnesses to an accident, for instance, are often excited and greatly confused (angered or frightened), so that their perception of many details is exceedingly poor.

(2) recall elaboration

Accounts of what one “saw” or “heard” may be so interwoven with “facts” gained in conversation with others or in newspaper accounts which have been read subsequently that a witness is uncertain as to what he actually experienced. Much of this elaboration is “unconscious,” in the sense that the person does not recognize it as being distorted.
(3) meager intelligence

Many witnesses are mentally incapable of reporting accurately what they have seen or heard. Children and low-grade adults tend especially to be suggestible and readily confused.

Recognition memory is often measured in "tests of social intelligence" on the theory that the person who likes people will remember names and faces better than the person less sociably inclined. For example, a person may look at the names and faces in a group of about ten pictures for five minutes. He then tries to locate the names and faces of those whom he has seen when they are mixed in with an equal number of people of the same sort.

Forgetting, or memory failure, is a universal experience and is perhaps our most convenient excuse. One of the first questions asked by elderly people of a psychologist is how they can improve their memories. Often they will add, somewhat naively, that while their memory for faces is excellent, their memory for names is exceedingly poor. Poor memory for names is a standard complaint of practically everyone over forty, and is perhaps an inevitable result of living. When we consider how many persons named John, Henry, Mary, or Anne we have met in our lifetime, that except in the case of famous people names have no special significance, that there is probably no necessary connection between the name Katherine and a blonde girl aged nineteen—it is no wonder that names are so often confused or forgotten. Poor memory for names need have little to do with real loss of memory.

THEORIES OF FORGETTING

decay versus interference

Many people believe that forgetting results from a progressive decay of memory traces in the brain and nervous system, much
as footprints in the sand wash out with the passing of time. This common-sense view sounds reasonable and certainly accounts for some forgetting, especially that found in several diseases and in the senile condition of old age (page 381). It is probable, however, that most of our everyday forgetting is occasioned by the interference and confusion of old with new rather than by a gradual fading-out of memory traces. Some psychologists have claimed, in fact, that nothing once learned is ever really forgotten, though it may be difficult to revive. There is considerable experimental support for this viewpoint.

(1) In the first place, we have the spontaneous appearance* of many facts (some learned years ago), songs, poems, and the like which had been completely forgotten. Often these memories pop into one’s head with no apparent rhyme or reason: perhaps some chance associative cue sets them off. Again, (2) the parent in helping his youngsters with their lessons is often agreeably surprised to find that the algebra or

* Compare with the spontaneous revival of an extinguished response (page 300).

**Figure 200** Due to interfering activities, the rate of forgetting is greater if a person stays awake after learning.

After Jenkins and Dallenbach, 1924.
Latin which he thought was completely lost can be relearned fairly quickly (see page 350). Finally, (3) under hypnosis a subject will often recall facts not available (forgotten) in the waking state; or, given suggestions, a subject will later carry them out with no recollection of having received them. Under drugs, great excitement, and other emotional states, we often recall memories long hidden. Results like these suggest a blocking of memories rather than an obliteration of brain traces.

Further evidence in favor of the interference theory of forgetting is found in certain experiments in which two adults memorized comparable lists of ten nonsense syllables (1) before a period of normal daily activity and (2) before periods of sleep. Retention (delayed recall) was measured after one, two, four, and eight hours of waking activity and after the same periods of sleep. The percentages of syllables recalled after the four experimental periods were, for the waking state: 46, 31, 22, and 9; for sleep, 70, 54, 55, and 56. Figure 200 gives the average recall for two subjects. While forgetting was obviously present under both conditions, recall after the periods of sleep was con-
sistently higher than after waking activity. Furthermore, the loss after four and eight hours of sleep was no greater than after two hours. Under the waking state, on the other hand, forgetting was markedly and progressively greater with time. It seems likely that the interference and competition of other activities explain why forgetting was so much faster during waking than during sleep. But the fact of forgetting in both cases argues for some fading-out in addition to interference effects.

repression versus selective learning

Another theory of memory loss accounts for forgetting as repression (page 276). According to this view we actively repress or “forget” those memories which it would be embarrassing or emotionally upsetting to recall. Although repression is a picturesque concept, many psychologists find it hard to accept as the “cause” of forgetting: what “agent” does the repressing and where are the unwanted memories stored? A more
objective theory of motivated forgetting relates the phenomenon to learning. This is to the effect that we recall what was originally satisfying (or what is satisfying to relate now) and forget what was originally unpleasant or annoying.

Whatever the final explanation, there is good evidence that forgetting may often be selective and purposeful. There is, for example, the common experience that in normal people highly emotional episodes tend (fortunately) to lose their sharpness with time, as though nature had a way of protecting the individual from the disorganizing strain of continual fear or bitter grief. Selective forgetting can be demonstrated in the laboratory, as in the following experiment.

In the first part of the experiment, “critical words” were determined for each of thirty subjects by means of a word association test (page 388). In word association tests the experimenter reads a word aloud and the subject is instructed to reply with the first word that comes to mind. The word list in the present experiment contained 100 items, and a good many words were included which might conceivably have emotional value for the subject or which might induce some emotional conflict. Two criteria were set up for locating critical words: (a) long response time, and (b) change in response upon retest. In the second part of the experiment, each subject was instructed to memorize a list of six words, in which one critical word (located as described above) was included. Later, when the subject was asked to recall the list, the relatively innocuous words like paper or green were remembered, while critical words like death, wicked, nasty were often forgotten. Sometimes the subject recalled five words and realized that one was missing, but was unable to reinstate it.

The forgetting of unpleasant events (here the critical words) may be explained as (a) an active repressing “force” or (b) differential reinforcement. We have found (page 294)

* This has been called “the oblivescence of the disagreeable.”
† Keet, 1948.
that positive reinforcement makes a response more likely (strengthens it), while negative reinforcement makes the response less likely (weakens it). One would expect recall, therefore, to be sharper for those memories which were initially pleasant (or not unpleasant) than for those which were definitely unpleasant. Explaining “willful” forgetting as reinforcement seems more reasonable than explaining it as repression.

**the curve of forgetting**

The classical Ebbinghaus curve of forgetting is shown in Figure 203. This curve was obtained from the learning and relearning of lists of thirteen nonsense syllables by the savings method. Each list was learned up to the point where it could be recited twice without error. When relearned after a given interval, it was found that nearly 50 per cent of what had been learned was lost after the first twenty minutes, 66 per cent after one day, 75 per cent after six days, and almost 80 per cent after thirty-one days. This means that with material which has almost no associative value, we can count on remembering perhaps about 20 per cent or so after a month. The retention of meaningful material is better, but there is still considerable loss, indicating the need for frequent review (page 350).

![Figure 203 The Ebbinghaus curve of forgetting.](image-url)
FIGURE 204 Pleasant childhood memories: the drugstore soda, the boy and the pup growing up together, first-hand contact with nature.
FIGURE 205 Nostalgic memories of the "ole swimming hole" are often glamorized by sentiment.

Courtesy Greenwich House

FIGURE 206 The testimony of a witness to an accident may be unreliable because many distracting stimuli make fixation—and hence recall—of pertinent facts difficult.
FIGURE 207 Most of the material we learn is forgotten quite rapidly.

The continuity of learning-retention is shown graphically in Figure 207. The memorizing curve rises until the criterion is reached (100 per cent learning). Thereafter forgetting is sharp and rapid at first, gradually becoming stable at a low point. A certain residuum is retained almost indefinitely (see again Figure 207).

other factors in recall and recognition

PERSEVERATION

After we have memorized a poem or learned a song, it sometimes happens that snatches of it come back to consciousness ("run in the head") without any effort on our part, and with no apparent stimulus. Unintentional recall of this sort, when insistent and lasting, has been called perseveration. In perseveration it seems as though the material persists at the edge
of consciousness, popping out at the first opportunity. A strong new stimulus, an interesting novel, an absorbing topic of conversation or demanding music, may serve to break up the persisting response. There are, moreover, marked individual differences in susceptibility to perseveration.

Perseverating responses may arise from some overlooked stimulus cue—a word, a question, or an emotional tension associated with the response. Such subtle stimuli come from within one's own thoughts or from the outside world. Many people are so disturbed by persistent and unsettled problems reappearing over and over again that upon going to bed they cannot fall asleep. This fits in with experimental evidence to the effect that tasks interrupted and left incomplete are likely to be better remembered than are tasks which have been completed. In one experiment* dealing with this topic, subjects were interrupted while performing a number of simple tasks (solving riddles, doing mental arithmetic, and the like) before they could finish them or carry out instructions in full. In other instances subjects were allowed to finish the tasks begun. The completed tasks took more time than the interrupted, but subjects, when questioned several hours afterward, were more likely to recall the unfinished than the finished performances. Heightened attention and the additional emphasis given the interrupted tasks apparently made for perseveration and aided in immediate recall. The advantage of the interrupted tasks in recall faded out, however, after twenty-four hours.

Perseveration is favored when attention is relaxed rather than heavily concentrated upon some task. The tendency to perseverate is also increased in fatigue, as though the stimulus has set up an echoing response in the nervous system. Perseveration appears in some types of mental disease. In “free” association tests, it will be recalled, a series of words is presented one by one, and the subject is instructed to respond with the

* Zeigarnik, 1927.
first word suggested by the stimulus. Normal people respond with a variety of associations to such stimulus words as table, dark, music, and mountain. In the insane, however, we often find a mental immobility, a lack of the capacity to shift quickly from one stimulus word to another. Thus, to a series of stimulus words the insane may give only one response—illness or family, for example. It is as if the stimulus word served merely as a cue for a response which is determined by the patient's own thought trends.

RETOACTIVE INHIBITION

The interference or confusion of present learning by subsequent learning has been given the special name of retroactive inhibition. Retroactive inhibition is most noticeable when two learning situations involve associations which are similar and hence are readily confused. A student having carefully prepared for an examination in beginning French immediately thereafter applies himself diligently to an assignment in Spanish. Later, in the French examination he finds that his recent study of Spanish has worked backward or retroactively to confuse his none-too-secure hold upon French. Of course, the French study may also work forward proactively to make the learning of Spanish more difficult. To some extent retroactive inhibition can be avoided by following the study of a given subject by one of very different content: French by physics, for example, or history by mathematics. Or interference can be lessened by learning thoroughly one set of associations (in French, say) before taking up the study of a related activity (for example, another Romance language).

EIDETIC IMAGERY

Vivid and accurate memory images, called eidetic images, are found in approximately 50 per cent of children under fourteen. The eidetic individual has what is popularly called a "photographic mind." He reports a scene or a picture almost as clearly and accurately as though he could still see it. Sometimes the
objects in the scene may be changed and the color made more or less bright, but essentially the reproduction is amazingly exact. Eidetic imagery is rare in adults. It is thought by some authorities to be related to overactivity of the endocrine glands (page 573), particularly the thyroid.

**memory training**

Since good recall and good recognition depend upon adequate fixation, the various systems designed to train or improve memory are of necessity concerned primarily with fixation. Memory training depends essentially upon increasing and strengthening the associations between stimulus and response. When the additional associations are relevant and meaningful, a memory system has many advantages. But if many meaningless and complex associations are prescribed, it is often easier to memorize the material directly than to remember it by way of a system.*

The methods for improving learning already discussed on page 344 will be useful here. In addition, several techniques for aiding memory recall directly have proved to be helpful.

**MNEMONIC DEVICES**

Mnemonic devices have long been known to facilitate the recall of often-used and especially valuable everyday information. The well-known jingle “thirty days hath September, April, June, and November . . .” is helpful in remembering

* By way of illustration, consider the following “verse” alleged to facilitate memory for the names of the presidents of the United States.

“Washington and Jefferson made many a joke;
Van Buren had trouble plenty to find pure bank notes;
Let Johnson go home grieving and crying hard cash.”

The first letter of each word gives the name of a president in order up to Cleveland. Thus, Washington, A-for Adams, Jefferson, M-for Madison, M-for Monroe, A-for Adams again (John Quincy), J-for Jackson. And so on up to “cash”—C-for Cleveland.

**memory training**
the days of the month, provided one can remember the dog-gerel. Beginners in music learn that the spaces in the treble clef spell F-A-C-E, and that when a composition is written in four flats the four flatted notes spell B-E-A-D. The letters V-I-B-G-Y-O-R* are sometimes of aid in remembering the colors of the spectrum. When mnemonics or memory crutches work, it is because of their novelty rather than their inherent value.

GROUPING AND RHYTHM

Grouping is useful in memorizing telephone and street numbers, automobile licenses, and the like, especially when the material falls into groups like 25 or 375. Students often remember the value of \( \pi \) (ratio of the circumference of a circle to the diameter) as 3–14–16; and the square root of 2 as 1–414. In poetry and music, rhythm, as well as grouping, becomes a decided memory aid.

SECONDARY ASSOCIATIONS

Spatial cues are sometimes prescribed as associative aids. A speaker, for example, may locate the four points he wishes to make in the four corners of the hall; or a housewife with good visual imagery may remember the articles she wishes to purchase by locating them along the shelves of her pantry. A hint on how to improve fixation of names is given by salesmen, politicians, and others to whom it is important to connect names and faces. Upon introduction to a stranger, we are told to repeat the name with some emphasis and immediately find occasions to use it. Hearing the name, saying the name, and later writing it down will give a variety of associative links, one of which may facilitate reproduction of the name later on. Many people jot down facts concerning those people whose names they wish to remember: age, education, business, pe-

* Violet, indigo, blue, green, yellow, orange, red. Another mnemonic (in reverse) for the same list is Roy G. Biv.
culiarities of manner or appearance. When a variety of associations have been set up, there is increased likelihood that some will persist, thus increasing the possibility of later recall.

**Summary**

Remembering and forgetting refer to the effect which the passing of time has upon something learned earlier. We use the term “memory” in two ways. On the one hand, we remember names and faces; on the other, we remember *how* to play tennis or to bowl after a lay-off—for example, several years of no practice. The facts of memory may be classified under four heads: (1) fixation, or the act of learning itself; (2) retention, or the storing of the impression; and (3) recall and (4) recognition, both of which have to do with the reinstatement of the learned response. A study of the disorders of memory brings out clearly the distinctions among these four processes, as well as their essential unity.

A number of methods for the study of memory have been devised. Some of these are concerned primarily with immediate memory for facts just acquired, and others with delayed memory for things learned earlier. Retention itself is psychological and probably cannot be improved directly; but retentivity can be greatly aided by improving methods of fixation. Recall and recognition, especially after a long period, tend to show several characteristic changes which are revealed most clearly in pictures and line drawings. Three categories of change have been labeled *leveling*, *sharpening*, and *assimilating*. The recall of many school subjects has been shown to be quite poor after a lapse of one or two years.

Theories of forgetting have attributed memory loss (1) to passive decay and (2) to interference with the old by the new. While there may be some actual loss of “memory traces” with the passing of time, the experimental evidence favors the interference theory. The “curve of forgetting” for meaningless material shows a sharp drop soon after the learning period and a more gradual fall-off later on. The various schemes for improving one’s memory
all depend upon techniques for improving fixation, at the same time increasing motivation and interest.

questions and topics for discussion

1. William James wrote that "nothing we ever do is, in strict scientific literalness, wiped out." Since a good many experiences are apparently forgotten, what does James mean by this statement? What has become of memories if they cannot be recalled?

2. What facts do you believe you overlearned in elementary school? What information would you have liked to overlearn but didn't?

3. Is there a single typical curve of forgetting, or does forgetting proceed at different rates for different functions?

4. Does quick learning necessarily mean quick forgetting?

5. Why do manual skills show less rapid loss through disuse than do verbal habits?

6. Cite some ways not given in the text in which memory might be improved?

7. What suggestions might you have for a student who complains of poor memory, saying that he puts hours on a lesson and reads it many times but still cannot remember what he reads?

8. To what extent do you think our memory of early experience is distorted by the desire to embellish the episode, improve our role, gain attention or get a laugh?

9. Show how an emotional experience may interfere with (a) memorizing and (b) recall.

10. Why is the curve for recognition memory better than for recall?

11. Which is better adapted for meaningful material: the savings method, or the method of paired associates?
Classify the following disorders of memory under one of the four heads of fixation, retention, recall, and recognition.

a) Through brain injury a man's vocabulary is much reduced.
b) A very old person cannot remember what happened an hour ago but still remembers experiences of his youth.
c) You have a weird impression that what is happening now has happened in the same way before, just as if events were repeating themselves.
d) After a physical or emotional shock or after a severe fever certain happenings are forgotten which later can be recalled.

suggested readings

2. N. L. Munn's Chapter 9 in Psychology, 2nd edition (Boston: Houghton Mifflin Co., 1951), is an interesting summary of methods and results.
TRAINING YOUNG PEOPLE TO THINK IS OFTEN STATED TO BE one of the primary aims of education. And surely one of the most frequent pieces of advice offered students is the admonition to “think clearly” or “think things through.” It is important, therefore, to ask just what we do when we think and what distinguishes clear from unclear thinking.

THINKING

Thinking may be defined as behavior which is often implicit or inner, in the sense of not being readily observable (page 2). Such inner activity is carried on by means of symbols.* The most common symbols are those of communication—words and numbers, diagrams, maps. Other symbols used in thought

*Symbols replace, stand for, or substitute for objects, experience, and activities. Words and mathematical terms are symbols, as are badges, flags, songs, and slogans.
are *images* ("mental pictures") of sights, sounds, odors, movements; and *ideas*—that is, concepts and other verbal and mathematical formulations (for example, *government*, *mankind*, $x^n$, and $\sqrt{2}$). In "common-sense" psychology, the thinking of a man is often likened to the mechanical activity of a machine—a cuckoo clock, for instance. Both man and clock are thought of as being "wound up" by a stimulus (a problem, perhaps, in the case of the man), and eventually, after much turning of wheels in the clock's "works" or the man's head, the clock cuckoos and the man enunciates a decision. But thinking is not confined to activity in the head—that is, in the brain and nervous system; on the contrary, thinking may involve the whole organism (page 3). We think, for example, not only in verbal and mathematical symbols but in gestures of the arms, hands, and head; and in a wide variety of expressive movements—a shrug of the shoulders, lifted eyebrows, a scowl, or a smile.

*Reverie, daydreaming, imagination*—all of these terms describe thinking which is relatively aimless: thinking in which there is a succession or flight of ideas with no particular goal in mind. A student who is inattentive during a lecture and is apparently daydreaming is not completely quiescent—"thinking of nothing," as it were. On the contrary, his "mind" is on other things often quite remote from his present task. The mother who complains to the arithmetic teacher that Johnny has a

**Figure 208** The daydreamer may be thinking of something but not necessarily his job.
Squeak, a squirrel, has to use reason in getting his meal. If he pulls the string in the proper direction, he moves the box into position so that he can reach the nut; having done so, he seems quite pleased with himself.
"good mind" if he would only use it does not mean that Johnny's mind is totally inactive, but only that he is not "using it" (that is, thinking) with respect to arithmetic. When we are exhorted to think, we are actually being urged to give close attention to the problem at hand—that is, to arrange all of the relevant facts in logical order so as to arrive at a valid conclusion.

REASONING

Reasoning is thinking with a purpose or goal. Reasoning is present in complex learning (page 315), in which use is made of past experience and in which organization and logical arrangements of responses is demanded. We may identify the successive steps in the reasoning process by means of the following example. A student in downtown New York finds that he has only forty minutes in which to reach an important engagement in the uptown area. He considers various methods of transportation—taxi, bus, subway. The taxi is ruled out because, though fast, it is too expensive; the bus is ruled out as too slow; and the subway is selected—although the nearest station is at some distance—because it is both fast and inexpensive. If our student reaches his destination in time, his judgment has been vindicated. In any event, he has considered symbolically various alternate solutions to his problem and has settled upon a course of action. His behavior up to the actual setting out for the subway station, it should be noted, has been verbal and "inside the organism."

In the process of reasoning, the following steps may be identified: (1) a goal is to be reached or a problem to be solved, (2) hypotheses or inferences are set up looking toward the solution of the problem, and (3) certain responses are selected and a tryout or solution attempted. Often there is a fourth step, which consists of the final validation or check of the action chosen. With some variation and frequent short cuts, these stages appear in the solution of problems ranging from the question of which method to use in attacking a
theoretical problem in physics to the practical choice of a necktie or an automobile. Man possesses a tremendous advantage over the animal through his use of symbols in the process of reasoning (page 323).

REASONING IN ANIMALS

Some psychologists believe that reasoning can be inferred when animals solve problems which demand the ability to see relations, combine past experiences in new ways, and make generalizations from observations (pages 316-323). Figure 210 illustrates a maze used in the study of reasoning* in the white rat. There are three pathways from the starting point in the maze to the food box. Path 1 is the shortest and most direct, path 2 is somewhat longer than 1 (because of the detour), and path 3 is the longest. Note that paths 1 and 2 have a common section not traversed by path 3. In preliminary training, path 1 is blocked at A, and the rats must learn

* Tolman, 1932.
to retrace path 1 and take path 2. When 2 is also blocked at C, the rats must take path 3. In the final tests (after training), paths 1 and 2 are blocked at B, just below their common section. Nearly all of the rats, finding path 1 blocked in the final tests, retraced their course and took path 3, not path 2. This result led the experimenter to conclude that since path 2 had been preferred to path 3 previously, the rats had “inferred” that B blocked the common path. Expressed differently, the rats had “put two and two together” and come out with four; that is, had “figured out” the right answer.

Animals can learn many complex tasks which require the sensible organization of elements in such a way as to reach a correct solution (page 321). But since animals do not possess language, it seems unlikely that they employ verbal symbols or set up hypotheses in the way human beings do. Although reasoning does not always have to be carried on by means of symbols such as words, numbers, and maps, the solution of many problems, especially those in mathematics, is virtually impossible unless acceptance and rejection of alternatives can be expressed in symbols.
In human reasoning we customarily make use of concepts. A concept may be a word or mathematical symbol which embraces the common property or basic similarities of a variety of objects or events. The process of forming concepts passes through the stages of generalization and differentiation (page 296)—that is, it is essentially a process of learning. To a little child with a puppy, all small furry animals (kittens, squirrels, rabbits) fall under the concept “puppy.” Later the separate concepts “dog” and “cat” emerge (are differentiated) and finally the more inclusive concept “animal.” The concept “chair” includes a variety of experiences with chairs of all sorts (large, small, expensive, inexpensive, highly decorated, plain), all of which are included in the generalization “chair,” and this concept is differentiated from stools, boxes, and other things upon which people sit. Later we set up sub-concepts—chairs of a certain French period, of a certain style or decoration or a certain price. Concepts, nebulous and inaccurate at first, become more sharply defined with greater knowledge. The concept of redness or greenness, for example, grows out of experiences with red and green objects—clothing, furniture, flowers, houses. Finally the term red or green gathers meaning to itself.

Much of the misunderstanding of what is read and heard may grow out of the fact that the student does not fully comprehend the concepts presented. Consider the following definitions: “A fraction is a quantity less than a unit or one expressed as a sum of a number of aliquot parts”; “Gravity is the accelerative tendency of bodies toward the center of the earth”; “Instinct is an organized and relatively complex mode of response, characteristic of a given species, that has been phylogenetically adapted to a specific type of environmental situation”; “The earth is an oblate spheroid.” Such statements may convey almost nothing to a student except a sense of confusion heavily tinged with dismay. He does not under-
stand because he cannot employ these concepts as tools of thought.

The terms *fraction*, *gravity*, *instinct*, or *sphere* (earth) become meaningful when we have undergone a variety of experiences with fractions, falling objects, unlearned activities, and things more or less round. Understanding normally increases with age. A child of five should be able to define, in terms of use or better, *doll*, *pencil*, *table*; a child of ten, such abstract words as *pity*, *grief*, *curiosity*; a child of twelve, *courage*, *envy*, *charity*, *revenge*. The twelve-year-old who defined justice as "to do right" or "to have peace" had a vague but inadequate notion of the term; and the eleven-year-old whose idea of revenge was "like you hate someone" probably got his concept from the movies. It is easy to predict the kind of life a twelve-year-old boy has led who defines charity as "out of work" or "something for nothing." The remedy for inadequate concepts is enrichment of experience through reading, through study, and through daily living. The often-heard expressions "to see through a situation," "to abstract the essential elements," "to generalize," all refer to the ability to respond to a situation in the light of past experience in such a way as to separate or isolate the important parts.

**THE EXPERIMENTAL STUDY OF CONCEPT FORMATION IN MAN**

Experiments* have shown that a person who has suffered brain injury may lose the capacity to think in abstract terms, even when his ability to take a "concrete attitude"—one controlled by immediate sense impression—is unimpaired. Suppose that objects of different form, color, material, or use are presented to a subject who is told to "put together those things that belong together." The subject's method of classifying reveals whether he is employing concrete or abstract concepts. Grouping on the basis of form or color (using a gen-

*Goldstein, K., 1939.
eral category) is taken to indicate an abstract attitude—that is, the use of an abstract concept. If, on the other hand, the subject groups only identical or nearly identical objects, or those that belong together by virtue of some specific use, his attitude is "concrete." To illustrate, a subject takes the abstract attitude when, for example, he puts into the one category of “tools,” hammers, screw drivers, saws, and nails of different size and shape. The subject takes the concrete attitude if he selects one hammer and one nail, stating that one hammer is enough to drive one nail. Again, the attitude is abstract when pipe, cigar, matches, and ashtray are all classified under smoking materials; it is concrete when the subject selects one cigar and one match on the grounds that after dinner one match is enough to light one cigar.

The test blocks shown in Figure 212 have been widely used in the experimental study of concept formation. This test* consists of twenty-two blocks in five colors, six shapes, two heights (tall and flat), and two sizes (large and small). On

* E. Hanfmann and J. Kasanin, 1937.
the hidden underside of each block is printed a three-letter nonsense syllable which serves to define a block type. All lag blocks are tall and large; all mur blocks tall and small; all bik blocks flat and large; and all cev blocks flat and small. Color and shape are irrelevant as far as classification is concerned and are really distractors, size and height being the important variables. The examinee is told that there are four kinds of blocks and that he is to find the four kinds and put them together. As a starter he is given one block of a kind (a lag, for instance), and is told to sort out all of those blocks which belong with it. The subject is free to proceed as he pleases, except that he is not allowed to invert a block and read its name. After a sorting in which perhaps all blocks of the same color or shape have been grouped, the experimenter points out one wrongly selected block and tells the subject to try again. The test continues, with the same directions for the other three types, until all four classifications have been made correctly. The experimenter seeks to determine whether the subject has used a logical hypothesis (all lag blocks are tall) or has followed a trial-and-error or guessing procedure. Like the tasks described above, the object is to discover how quickly the subject is able to detect the basis of classification—that is, whether he can grasp an abstract concept. Young children and low-grade adults, as well as patients suffering from mental disease (for example, schizophrenia*) or brain injury, usually take the concrete attitude: each block is treated as a separate stimulus-object, and there is an inability to generalize or to group in terms of abstract quality.

ROLE OF THE BRAIN IN THINKING AND REASONING

Two main theories have been advanced to account for the part played by the brain in thinking and reasoning. The first,

* Mental disease in which ideas or experiences are split off or dissociated from the main personality. Schizophrenia is often marked by hallucinations and a disorganized emotional life (page 596).
Does thinking take place only in the brain?

Or is the whole body involved?

called the central theory, holds that thinking takes place in the brain itself. According to this view, a stimulus such as a question is received by the auditory receptors in the ear, and nerve impulses are carried by the sensory nerves from the receptor to the brain. Here they are elaborated through the association areas and then carried to the motor areas (page 147), from which they emerge finally as muscular responses in the form of a spoken word or sentence. This is the “common-sense” notion that we think with our brains. It is also roughly in accord with the famous statement of Thomas Carlyle (British philosopher and essayist, 1795-1881) that “as the liver secretes bile so the brain secretes thought.”
The second theory, the *peripheral* or *motor theory*, holds that the brain is only one part of the thinking process, and that actually we think with the whole body (page 3). According to this view, the stimulus is received by the auditory receptor and the impulse goes to the brain over the sensory nerves. Here, however, instead of scurrying around in the cortex, motor impulses go by way of the association areas to the muscles of the body, where they initiate new stimuli, which in turn come back to the cerebral cortex. Thus there is a continuous chain of S-R relations, from brain to body and body to brain, until the final response emerges.

Evidence for the motor theory comes from observation and experiment. We have all noticed that in silent reading children and poorly educated adults often move their lips and even mumble, as though each word-stimulus sets off the next. Again, after we have read silently for several hours, it is not unusual to feel definite fatigue in the throat and larynx. In one experiment, recording instruments attached to the tongue revealed fine movements when the subject was instructed to read silently or to "think" a phrase. In another study, electrodes were attached to the tongue and underlip. When the subject responded to instructions to count silently "one, two, three" or to recall a song, *action currents*† from the tongue and lip were revealed by a galvanometer. The electrical manifestations in the action currents closely resembled those obtained when the subject actually spoke the words. Experiments like these indicate that in thinking there is often real or subvocal speech; put more colloquially, the subject is, in effect, talking to himself.

* Peripheral: the outermost parts of the body, in contrast to the central.
† Action current: the electrical current which accompanies a wave of excitation or impulse in a nerve, muscle, or gland.

**Figure 214** Action currents obtained from the right biceps (A) and the left biceps (B) while the subject imagined he was lifting a weight with his right arm.

From: Munn, 1951, after Jacobson.
Other experiments have shown that when deaf mutes are instructed to multiply or divide mentally, in 80 per cent of the cases action currents appear in their hands, whereas such responses are found in only 30 per cent of normal subjects. Action currents appear, too, from the arm muscles when subjects are told to imagine that they are lifting a ten-pound weight with the right forearm.

The presence of muscular activity during thought is strong evidence for the view that—at least part of the time—we think with the throat, the larynx, and the body generally. Whether this is always or necessarily true, we do not know. It is possible that thinking may go on in the brain without motor accompaniments. But it is impossible to prove or disprove the central theory, since the only evidence of thinking which we possess appears in the end products of thought itself—that is, in the verbal or muscular behavior of the thinker. On logical
grounds, the motor theory seems more plausible than the central, since meaning emerges as the end product of verbal and bodily activity. A spoon, for example, has meaning to a child only as something to eat with, to scoop with, or to pound with. The necessity for responses in order to give meaning to an experience implies the need for a continuous interplay (check and recheck) between brain and body.

training in thinking and reasoning

A builder can improve the construction of a house by (1) providing more and better materials, and (2) exercising greater skill in construction. And a student can improve his thinking in the same manner. First, he can increase his grasp of the facts—that is, of the background and implications of the problem. Second, he can use accepted and proved methods in his reasoning, avoiding as far as possible pitfalls in logic along the way. Let us consider these two approaches to better thinking.

Laying the Foundation—that is, Providing the Facts

It is so obvious as to be almost trite that many opinions about religious, social, and political matters are well-nigh worthless because the speaker does not possess the necessary information and experience to justify a pronouncement. Lack of knowledge is a potent cause of bad thinking. Many intelligent people, for example, not educated in science believe that the stars guide our destiny, and that longevity can be predicted from lines in the hand. The remedy for belief in magic lies in fundamental training in mathematics, philosophy, logic, and natural science. If a student understands what is meant by a rational universe, cause and effect relationships, and the concept of mind as behavior, he is not liable to fall a prey to vague and mystical explanations.
Knowledge and information normally increase with study and experience. Hence, the first advice to be given the student who wishes to think effectively is to increase his understanding of a given subject through reading, study, discussion, and practical experience.

THINKING AND REASONING CORRECTLY

deductive thinking—that is, reasoning from premises

In deductive thinking, the process is from a general proposition to a specific conclusion. The classical form of deductive thinking is expressed by the syllogism, of which the following is a well-known example:

All men are mortal (major premise)  
Socrates is a man (minor premise)  
Therefore Socrates is mortal (conclusion)

The major premise in a syllogism may be a theory, a well-established principle, a common and apparently invariable experience. The minor premise is a specific observation. If the major premise is true and if our minor premise (that is, the observation) properly belongs under it, the conclusion follows of necessity. Thus, in the example above, if it is true that all men are mortal and if it is true that Socrates is a man, it follows of necessity that Socrates is mortal.

If the major premise is not true, the conclusion may or may not be true—is indeterminate. Consider, for example, the following:

All stealing is a crime  
John is a thief  
Therefore John is a criminal

While the conclusion in this syllogism follows logically from the premises, many would question the truth of the major premise. Thus it could be argued that it is not criminal for a man to steal because he is desperate or hungry, or because his family
is in dire need; or that a child may “take things,” an apple or a pencil, say, without stealing, in the adult sense. In short, a conclusion may be logical but not convincing when the major premise is not accepted.

When an opinion or judgment is stated with vigor by an authoritative writer or speaker or is printed in a textbook, we are inclined to accept it uncritically. However, the argument offered may be logically unsound. To illustrate, the conclusion of the following syllogistic argument* was marked “correct” by 50 per cent of a group of college students.

All Mongolians have slant eyes
Chinese have slant eyes
Therefore Chinese are Mongolians

If this syllogism is changed to read

All birds have wings
Bees have wings
Therefore bees are birds

the fallacy is at once apparent, perhaps because we know bees and birds better than we do Chinese and Mongolians. In both of these syllogisms, the major and minor premises are reasonable enough, taken alone, but the conclusion does not follow logically from these propositions. It does not matter, therefore, whether the conclusion is true, as indeed it is in the first syllogism according to some definitions of the term Mongolian. The trouble with the first syllogism is that while all Mongolians may be slant eyed, other people who are not Mongolians may also be slant eyed; it does not follow, therefore, that Chinese are of necessity Mongolians. If the major premise had been “all slant-eyed people are Mongolians,” then if it is true that all Chinese have slant eyes, it follows that Chinese are Mongolians. It is clear that the conclusion from a syllogism may be quite deceptive, but at the same time so persuasive (fit in so well

---

with "common sense") that we are easily misled. Putting the argument in more familiar terms will often reveal its fallacy.

Textbooks in logic lay down elaborate rules for determining the conditions under which a syllogism is valid—that is, when the conclusion can be drawn legitimately from the premises.

While it is true that logic is the "science of how we think when we think clearly," formal logic is not especially useful in scientific work. In attacking an experimental problem, we are rarely able to begin with a general principle from which by regular steps we may deduce a specific conclusion. Far more often we must gather our facts under some hypothesis and then attempt to organize these facts in some sensible way so as to arrive at a generalization (page 296). For this purpose the classical syllogism is usually too rigid or too artificial.

**the middle term in deductive reasoning**

In deductive reasoning the truth of a conclusion often depends upon the adequacy of the **middle term**. A middle term serves as a stepping stone or bridge between the two things being compared or evaluated. Suppose we know that John is as tall as Jim, and Jim is as tall as Sam. It then follows that John and Sam are of the same height—Jim is the measuring rod or middle term by means of which we relate the heights of the two boys John and Sam. Our conclusion is a demonstration of the general principle that "things equal to the same thing are equal to each other," the "same thing" being the middle term.

An argument is fallacious if the middle term is faulty. Consider, for example, the following: Mary has an IQ of 115; Sue has an IQ of 115; therefore Mary and Sue have the "same intelligence." While the conclusion follows logically from the data, it is debatable if not incorrect because of the ambiguous middle term. An IQ of 115 on an intelligence test can be earned in several ways: one child may scatter his right answers up and down the scale, while another shows little scatter in items passed successfully; or an IQ of 115 may be earned by one child because of superior verbal ability, and the same IQ by
another child who compensates for lack of verbal facility by greater aptitude in handling numerical and spatial problems. Again, if Mary is five, say, and Sue is ten, IQ's of 115 do not mean the same intelligence but only the same degree of brightness with reference to five- and ten-year-olds, respectively.

Sometimes a middle term is faulty because its relationship to the other terms is equivocal or vague. The following argument is an illustration: Ann resembles Louise, and Margaret resembles Louise; therefore, Ann and Margaret resemble each other. The relation "resemble" fails to pin down the middle term. Ann may resemble Louise, for instance, in hair color and complexion, while Margaret may resemble Louise in physique and temperament. It does not follow necessarily, therefore, that Ann and Margaret resemble each other.

**inductive reasoning**

In inductive thinking, the process is from particular facts to a general conclusion. Our best example of induction is the experimental method (page 8) which is both inductive and statistical—the conclusion being always based upon probability. Suppose, for example, we find that the difference between seven-year-old boys and girls on a rote memory test is statistically significant* and in favor of the girls. If this result is verified at other age levels and if our samples of boys and girls are strictly random† we may conclude with confidence that girls are in general better than boys on memory tests of this sort. This general finding does not mean that every girl is better than every boy, but that the probability is high that the average girl is better than the average boy. Note that this final conclusion is based upon evidence drawn from samples of boys and

* A result is statistically significant when it is improbable that its occurrence can be explained on the basis of chance.
† A sample is random when every person in the population has had the same chance of being selected for the sample and when one choice does not influence another. Random samples tend to be representative of the populations from which they are drawn.
girls and hence is essentially inductive. In guided or instructed learning (page 322), thinking is usually inductive, as it is also in trial and error learning—in this last being often haphazard and wasteful.

A child's concepts of living things, as well as his intelligence and understanding, increase normally with age (page 88). A child's mental maturity, therefore, and his "reasoning power" can be measured by his aptitude at solving reasoning problems which have been found experimentally to be appropriate for children of different chronological age levels. In a reasoning test designed for children* the following problems are found at the designated age levels. These represent an increasing order of difficulty.

Age 7  Kate is cleverer than May.
        May is cleverer than Jane.
        Who is cleverest, Jane, Kate, or May?

Age 10 The doctor thinks Violet has caught some illness.
        If she has a rash it is probably chicken pox, measles, or scarlet fever.
        If she has been ailing with a cold or cough she may develop whooping cough, measles, or mumps.
        She has been sneezing and coughing for some days, and now spots are appearing on her face and arms.
        What do you think is the matter with Violet?

Age 14 John said: "I heard my clock strike yesterday, ten minutes before the first gun fired. I did not count the strokes, but I am sure it struck more than once, and I think it struck an odd number."

* Burt, 1921.
John was out all the morning from the earliest hours, and his clock stopped at five minutes to five the same afternoon. When do you think the first gun fired?

All these problems can be solved by sorting out and arranging the known facts in a logical way. The problem assigned to age seven, for instance, can be readily solved by putting the things to be compared in a linear order. Thus, in one, two, three order of cleverness our three girls are Kate, May, Jane. The problem at age ten is solved by narrowing down the disease descriptions to those which best fit Violet’s symptoms; and the problem at age fourteen by deducing that the gun must have been fired in the afternoon and before 5 o’clock and after 3 o’clock.

In most reasoning it is wise to combine the inductive and deductive approaches (page 428). A good plan is to work out, first, a number of examples which will serve to illustrate the theorem, formula, or other generalization in which we are interested. When the principle is well understood, it can then be applied to new cases when they arise. The process is thus from concrete to abstract, from induction to deduction.

GROUP THINKING

So far we have discussed problem solving and reasoning as if they were almost exclusively an individual enterprise. As it happens, however, most decisions which govern our everyday behavior depend upon group rather than upon individual thinking. The husband and wife decide whether or not they can afford to buy new furniture; the Board of Directors of a large corporation sets the amount of the current dividend; the General Staff draws up joint plans for a military campaign; and the U.S. Congress debates a new farm program. In all these cases a group is engaged cooperatively in solving a problem; and this joint endeavor is the essential thing, whether the prob-
Cooperative activity in problem solving may involve two persons planning a home, a small group, or a town meeting where the final decision is made by formal ballot.
lem is simple or complex and whether the group consists of two individuals or two hundred.

In general, it appears that groups solve problems better than individuals. In a study of individual and group competition* it was found, for example, that school children solved more arithmetic problems and stuck at the task longer when working for the group (their own versus another) than when working as individuals, the boys exhibiting more “group spirit” than the girls. In another study,† 105 adults were given the task of solving problems, sometimes as individuals and sometimes as groups consisting of two to four persons. Problems were based upon the game of “Twenty Questions,” a parlor amusement popular on radio and television. The procedure is to have the subjects ask questions in an attempt to identify some unknown object described simply as animal, vegetable, or mineral. The number of questions asked determines the score, and considerable verbal and logical skill are required in order to follow up cues as economically as possible. Group performance was better than individual at this game in (a) number of questions required, (b) number of failures, and (c) total time required to solve the problem. The number of questions per problem on the third day of practice, for example, averaged fourteen for the group, nineteen for individuals. Groups of four succeeded in more than one half of their attempts with the first three problems, while persons working as individuals succeeded in only one in ten attempts on the same problems. Groups consisting of two to four members were about equally effective.

Group organization may vary from exceedingly autocratic to exceedingly democratic, the most effective organization being somewhere between. If the group leader is quite dictatorial, other members tend to be subservient—mere rubber stamps—or they may be docile, and at the same time resentful.

* Maller, 1929.
† Taylor and Faust, 1952.
and even sullen. But group decisions are often as unsatisfactory when there is little or no regimentation as they are when there is one autocratic leader. In the loosely organized or highly democratic group, there is likely to be little leadership, little discipline, and very little efficiency. The group is more efficient than the individual when there is mutual stimulation of one member by another, a variety of suggestions, and when the leader accepts suggestions, brings out other members, and organizes what has been said. It is hard to define a "good leader" in general, since leadership requirements vary greatly with the demands of the task, character of the problem, and so on. The magnetic leader in a face-to-face situation is not necessarily the best leader when control is at a distance and when technical skills and long experience are crucial. A good example is to be found in the military establishment. The captain who leads his men in the field does not necessarily have
to possess the same qualities as the highly trained general officer who plans the strategy of a campaign. As far as group planning is concerned, the good leader has been found to possess the following characteristics: he is intelligent, in general knowing more about the problem than the other members; he is sensitive to, and considerate of, the feelings and attitudes of other members; he is self-controlled and stable emotionally—not given to temper outbursts and sharp and critical remarks.

The success of a group discussion—that is, the degree of accord and unanimity in its decision—depends upon a number of factors and conditions. The following have been proposed as especially valuable. *

(1) physical setting

The chairman or group leader should sit with the other members of a discussion group, perhaps around a table. All chairs should be on the same physical level, and there should be no distinctive dress or "seats of honor." When the group is small (fifteen is perhaps the maximum), there is greater likelihood of free discussion. Many reserved people are timid or nervous when asked to speak before large groups, especially if there are impressive strangers present.

* Gibb, Platts and Miller, 1951.
(2) friendly, informal atmosphere
If smoking is permitted and perhaps light refreshments served, the group is more likely to engage in free conversation and to offer suggestions. The friendly, informal atmosphere of a small group is more conducive to free discussion than is the somewhat more formal atmosphere of a large group in which the level of prestige varies widely.

(3) sharing the leadership
Greater participation by group members and increased confidence and sense of responsibility are evident when the leader is careful to delegate authority to other group members, to seek opinions, and to share his leadership with others.

(4) definite plan for discussion
The more definite the question at issue and the more clearly it is formulated, the greater the chance of reaching a decision. This is especially true when the group has the power to make decisions and to see that they are carried out.

(5) flexibility of agenda
Unless the question to be discussed is predetermined by some fixed policy or authority, topics on the agenda should be flexible and subject to change. This avoids rigidity and allows for the divergent interests of group members.

(6) agreement in final decision
Discussion should continue until the decision reached is approved by a majority of the group. If members of the minority have had the opportunity of expressing dissenting opinions freely, they are more likely to accept the majority decision without resentment.

(7) free participation
The most satisfactory decisions are those in which everyone has had a chance to take part. People who are poor listeners, who
are not very tolerant of and are insensitive to others, make poor group members. Even the prima donna, however, often improves as a group member when exposed to free discussion in which other views than his own are expressed and opportunity is given to resolve clashes of opinion.

(8) satisfaction in final decision

The rigid and dominating leader may not know or care whether the group as a whole is satisfied with the final decision. A tolerant and sensitive leader, on the contrary, is likely to lead the group to a satisfactory conclusion which is truly a product of group thinking.

SOME COMMON ERRORS IN REASONING

(1) hunches

A hunch is a judgment for which there may be little tangible evidence but often great conviction. Thus we may hear a friend say with much emphasis "I had a hunch that John was dishonest"; "I knew he would lose his money in the stock market"; "I was sure the new neighbor meant no good"; "I had a feeling my horse would win." Inferences of this sort (sometimes dignified as intuitions) are often announced triumphantly after the event (fallacy of single case). When made as inferences or predictions of future happenings, hunches are more often incorrect than not and should always be viewed with suspicion. Hunches are troublesome when based upon observations too vaguely recognized to be fully formulated but real nonetheless. We may, for example, have suspected John of dishonesty because of many small but significant acts thought to be unimportant at the time. It is a fairly safe inference that money will often be lost in the stock market, and horses which are not favorites do occasionally win races. Again, a new neighbor's attitude or his remarks or appearance may have aroused some suspicion and uneasiness, so that his subsequent behavior was not wholly unexpected.
Hunches which imply belief in occult or supernatural cause-effect relationships are generally called superstitions. Common examples are the admonitions that a howling dog is a sign of death, that it is unlucky to walk under a ladder, break a mirror, light three cigarettes on the same match, and so on.

(2) wishful thinking and rationalization

It is a common observation that we believe what we want to believe, whether it be in politics, science, or everyday life. The extent of such wishful thinking has been investigated experimentally in a study designed to discover whether our belief in the truth of a proposition is related to our view of its desirability. A set of thirty propositions was drawn up dealing with topics in the fields of religion, ethics, politics, and science. The following are illustrations:

Should all men have equal political rights?
Does two plus two equal four?
Is slander wrong?
Do air vibrations constitute the stimulus for hearing?
Do only the good die young?

More than two hundred persons were asked, first, to indicate the strength of their belief in each proposition by checking on a scale which ran from −10 through 0 to +10. The negative side of the scale enabled the subject to express degree of disbelief, and the positive side permitted a graded expression of belief.

After each proposition had been rated for belief, subjects were asked to rate them for desirability on the same scale. Minus ratings meant undesirability, plus ratings desirability, and zero indifference. Figure 219 shows the close relationship between belief and desire. The coefficient of correlation (page 514) between the two attitudes was +.81. This indicates that a strong belief or disbelief in a proposition is accompanied by a desire of the same relative strength and direction.

Rationalized "good reasons" (page 273) are more flatter-
The desirability of a statement tends to follow our belief in it.

Wishful thinking is clearly illustrated in rationalization, as well as in the various propaganda devices: use of glittering generalities, appeals to emotion and self-interest, and the careful selection of evidence (stacking the cards) to “prove” a point. Like wishful thinking, a “closed mind” also distorts thinking by making it easy to reach a decision. Moreover, a “logic tight” belief predisposes its holder to certain inevitable conclusions, and makes opposing ideas untenable or even unworthy of examination. The distrust with which many people regard pressure groups and societies dedicated to a cause (no matter how worthy) arises from the suspicion, often well founded, that the goal determines the facts rather than the facts the goal.
(3) the ambiguous use of words

Emotionally-toned words distort thinking, as do words used so inclusively as to have no precise meaning. Politicians, for example, use the word "democracy" to cover a variety of conditions ranging from almost complete regimentation to a high degree of individual freedom. Use of the phrases "slave labor law," "Red baiter," "do-gooder," and the like make clear thinking extremely difficult. In psychology such terms as instinct, personality, or intelligence are often used so loosely that their meaning is uncertain from the context.

(4) fallacy of the single case

A prolific source of error in inductive reasoning is the fallacy of the single case. It is a temptation to generalize quickly from a single positive result, ignoring negative instances. A man takes a patent medicine, feels better, and forthwith writes a testimonial to the effect that Nostrum X cured his kidney trouble; a tourist is cheated by a French merchant and concludes that all Frenchmen are mercenary; the fact that father and son are drunkards is convincing evidence that drinking is inherited; a bonus given to factory workers and followed by increased production is proclaimed as the sole cause of greater output. The remedy for the fallacy of the single case is caution about "jumping to conclusions," further observation and checking, and the use of control groups (see page 19).

(5) reasoning by analogy

Another common error that may interfere with inductive thinking is reasoning by analogy. A shifty-eyed man (who looks like a fox) must be tricky and clever. A quiet, serious-looking man is intelligent because "still water runs deep." Hasty inferences of this sort—first impressions based upon analogy—are frequent sources of error. Even when the analogy is not false, the generalization may be an instance of the fallacy of the single case.
Titian and Hugo produced some of their best works at an advanced age; Mozart, a child prodigy like Marta Argerich, became an accomplished musician; whereas Gershwin followed the more usual pattern of producing his best work in his thirty's.
**AGE AND CREATIVE THINKING**

Masterpieces in art, literature, and science are sometimes thought of as constituting the end product of long and painstaking thought. It is not strange, therefore, that the common-sense view has it that great works are produced by elderly people. However, this is not always nor even usually the case. Figure 221 shows in graphic form the ages of greatest output for outstanding men in four fields (chemistry, mathematics, astronomy, poetry). The curves give the average number of contributions made at each chronological age level. Two features of these curves are noteworthy. First is the fact that, except for astronomy, the greatest productivity falls in the twenties and thirties; and second is the continued output up to and beyond eighty years of age. Apparently a man of active and vigorous intellect, though he may reach his peak in output relatively early, may continue to produce into old age. An illustration is Thomas A. Edison, the inventor of the incandes-
cent lamp and the phonograph. Edison took out the largest number of patents on inventions at the age thirty-five, but he continued to patent inventions until age eighty.

Figure 221 is concerned with quantity of intellectual output. Another study* has been made of the age at which an author's "best" work was produced—meaning by "best" a book which appeared in at least six out of a total of thirty-one lists of great works. According to this criterion, the best literary work is produced between the ages of forty and fifty, but masterpieces are written as early as twenty-five and as late as eighty. (See Figure 222.)

That the maximum output of great thinkers appears relatively early in life is not surprising when we remember that mental ability as measured by intelligence tests (page 346) reaches its peak in the early twenties and declines slowly thereafter. At the same time, certain qualifications must be noted to the thesis that youth is the period of greatest intellectual productivity. Many able men die young and it is impossible to say what they might have done had they lived longer. Again,

* Lehman, 1937.

**Figure 222** The age at which the best work was produced by one thousand authors.

After Lehman, 1937.
as said above, the age spread is great, many men producing masterpieces late in life as a culmination of long apprenticeship or ripe scholarship. Leonardo da Vinci painted "The Last Supper" at age forty-three and Einstein announced his complete theory of relativity at thirty-seven. But Victor Hugo wrote "Les Miserables" at sixty, Goethe wrote "Faust" when past eighty, and Bertrand Russell, great mathematician and philosopher, is active at eighty. While great intellects inevitably decline with the years, it appears that a highly gifted man of sixty-five or seventy is still far more competent than most ordinary men of thirty (page 346).

**Summary**

Thinking is behavior which is often implicit and hidden and in which symbols (images, ideas, concepts) are ordinarily employed. Thinking is not confined to the "head," but may involve the whole body. While the brain is undoubtedly primary in thinking and reasoning, muscular activity during thought indicates that many parts of the body cooperate with the brain. In reasoning, the thinking process is applied to the solution of problems. Man's possession of language (symbols) gives him a great advantage over the animal in problem solving.

Concepts are symbols used in reasoning; they stand for or represent the common properties of a variety of objects. Concept formation has been studied experimentally by means of tasks requiring that objects, blocks, or pictures be classified or sorted according to certain principles. Many errors in reasoning stem from hunches, from wishful thinking, and from the ambiguous use of terms and concepts.

There are, in general, two methods of solving problems. Deductive reasoning starts with a general fact or proposition under which various specific items can be placed or classified. Inductive reasoning starts with observations and proceeds step by step to a general conclusion. Both methods are employed in most learning situations. Group thinking in which a number of persons partici-
pate in the solution of a problem is usually more efficient than individual effort and is often more satisfactory. A number of factors have been found to influence the success of group discussions.

Creative thinking as revealed in contributions to art, literature and science seems to reach its peak in gifted persons somewhere between the ages of twenty and forty. Highly talented people, however, often exhibit far into old age creative ability which is superior to that of average people in youth.

questions and topics for discussion

1. How does the animal’s solution of a problem differ from that of a man’s?
2. How important is trial and error in reasoning?
3. What experiences and other factors tend to create belief and what ones tend to arouse doubt?
4. What is your reaction to the view that thinking consists of inner speech?
5. Why do you think the superstition that Friday is an unlucky day has persisted over the years? If this belief were set up as a hypothesis how could it be tested?
6. What is the importance for reasoning of the laws of association discussed on page 290?
7. When an individual is thinking about a situation, where is the activity taking place?
8. Are we ever justified in saying that a man thinks with his brain?
9. Cite evidence that thinking involves the entire organism.
10. Criticize the following statement: “Deductive logic is but a more complex way of saying that A is A.”
11. How does rationalization differ from reasoning?
12. Cite some of your beliefs which appear to be motivated by desire.
13. Do you think that training in logic or scientific method would increase efficiency in reasoning?
14. Comment upon the following statements: "Necessity is not the mother of invention. Knowledge of previous inventions is the mother; original ability is the father."

15. Give your opinion of the following: (a) our colleges and schools require too much learning by rote; (b) it is not too much that is memorized but too little; (c) it is not that too much is memorized but that unessential materials are learned.

16. Which is more likely to stimulate a high school boy to thinking—the study of logic or a serial detective story? Will either improve reasoning in general?

17. If you were trying to encourage students to think would you start with very easy, very hard, or moderately hard problems?

18. Show how a child’s concept of “goodness” changes as he grows older.

suggested readings

1. Chapter VII in W. Dennis' Readings in general psychology (New York: Prentice-Hall, 1949) has sections on thinking in animals and children, as well as a discussion of methods.

2. John Dewey’s How we think (Boston: D. C. Heath and Co., 1923) is a classic which many students will find enlightening.


5. For an interesting and well-written account dealing with the importance of words in thinking, read S. I. Hayakawa’s Language in thought and action (New York: Harcourt, Brace & Co., 1949).
WHAT WE CALL "INTELLIGENCE" MAY EXPRESS ITSELF in a number of ways. The elementary-school teacher describes a youngster as bright if he learns his lessons easily; the machine-shop foreman calls an apprentice “a promising young fellow” if he is apt and skillful with his hands and his tools; and the store manager regards a saleswoman as clever and smart if she can size up her customers quickly and is able to anticipate and meet their needs. The teacher, the foreman, and the store manager would all agree that what they are reporting is efficient—which is to say, intelligent—behavior. Efficiency in the solution of everyday problems is perhaps as useful a working definition of “general intelligence” as any. Intelligence in the solution of problems demands power as well as speed. To do a thing well, we must know how to do it; and we must not dawdle and blunder in the doing.
VARIOUS KINDS OF INTELLIGENCE

The concept of general intelligence is too broad to be of much practical value. For convenience in treatment, therefore, psychologists often distinguish three kinds or three areas of intelligence activity—the abstract, the mechanical, and the social. Abstract intelligence is exhibited in our handling of symbols—words, numbers, formulas, diagrams. This ability is conspicuously absent in animals. The abstractly intelligent person is able to discover relations among symbols and to solve problems with their aid. Lawyers, physicians, literary men—professional people generally—as well as businessmen, statesmen, and the like should possess abstract intelligence in high degree. Mechanical intelligence enables its possessor to deal readily with machines and mechanical contrivances. The engineer, the master mechanic, and the highly trained industrial worker must all be mechanically intelligent. It is especially useful to know whether an applicant has mechanical intelligence when we are selecting people for occupations which require not only abstract intelligence but the efficient use of manual skill and co-ordination. The third sort of intelligence is shown in personal and social affairs. The diplomat, the salesman, and the minister must be socially intelligent. And in many other occupations one's success will depend as much upon social sense as upon formal training. The socially intelligent person has the knack of getting along well with people. He makes friends easily and is tactful and understanding in human relationships.

Variations in these three aspects of intelligent behavior are large from person to person and are often considerable within the same person. Many of us have known the boy who cannot learn algebra but who is clever and even ingenious with tools, or the girl who finds physics and biology distasteful but shows marked talent in mastering a foreign language. But wide swings in ability are the exception rather than the rule. A student is rarely very good in one subject and poor in all the rest, though he may be—and often is—better in some sub-
Figure 223 Behavior may be intelligent (efficient) with respect to people, books or things.
jects than in others. It is not true, unfortunately, that everyone can do one thing very well. It is true, however, that even mediocre people do some things better than they do others.

Psychologists have found that abilities are positively related (page 516). That is to say, people tend more often to be above average or below average in all their achievements than far up in some and far down in others. The abstractly intelligent scientist may not be a skilled mechanic, but he is likely to be better than average in mechanical sense. And the successful salesman is not likely to have been dull in school, though he may not have won a Phi Beta Kappa key. The life histories of eminent men reveal that very able individuals can—and often do—show high accomplishment in many directions. At the other end of the scale, the low-grade and feeble-minded are

**FIGURE 224** In this intelligence test, the colored blocks are to be arranged to match the designs on the cards. Both abstract intelligence and manual dexterity are factors in the time required for completion.
generally deficient throughout in the quality of their performances.

MEASURING INTELLIGENCE

The general intelligence tests so widely used today are measures primarily of abstract intelligence—that is, of the intelligence shown in dealing with symbols in a meaningful way. Different kinds of general intelligence tests will be described later in this chapter. A number of tests requiring mechanical intelligence—that is, perceptual ability, motor skill, and ingenuity—have also been developed. These are frequently used in studies of special aptitudes. They will be discussed in Chapter 13.

Social intelligence is sometimes measured by tests but more often is estimated by rating scales, questionnaires, and other techniques. Measuring devices of this sort will be described in Chapter 14.

THE ABSTRACT OR "GENERAL" INTELLIGENCE TEST

The first general intelligence tests were designed by psychologists for use in the schools. These tests were intended to serve primarily as an aid in determining a child's ability to carry on schoolwork—to read with comprehension and to use numbers and other symbols quickly and accurately. Ability of this sort is undoubtedly important. For this reason, among others, tests designed to measure abstract abilities came to be known as general intelligence tests, although, as we have seen, such tests do not run the gamut of mental life.

General intelligence tests fall conveniently into three groups: individual, performance, and group. The individual intelligence examination is administered to one child or adult at a time. These examinations take from forty minutes to an hour, and a trained psychologist is required to give and to interpret them. Performance tests are planned to test problem-solving
FIGURE 225 The person's reaction to distracting stimuli during a test may seriously affect his score.

Object assembly tests are widely used in determining mechanical aptitudes.
ability by using things—objects, blocks, pictures, and the like—instead of words. Performance tests are especially useful with young children, the feeble-minded and the low-grade, illiterates, persons with speech defects, and persons who do not know English well.

Group intelligence tests are of two sorts—verbal and nonverbal. The verbal group test lays out problems which require for their solution the ability to read and write. The nonverbal group test presents the same kind of problems as the verbal, but does so by means of diagrams, pictures, puzzles, mazes, and the like. In the latter, the examinee does not have to read or write but must be able to mark with a pencil.

the development of intelligence tests

BINET'S EARLY TESTS

Credit for construction of the first individual intelligence scale belongs to Alfred Binet, professor of psychology at the Sorbonne, in Paris. In 1905, with the aid of the French physician Theodore Simon, Binet published the first edition of the now famous Binet-Simon Intelligence Scale. This scale was first used in the elementary schools of Paris to locate children who learned slowly and hence might be in need of special instruction. Binet's tests were twice revised, the final scale appearing in 1911.

Binet's scale represents a sharp departure from most of the mental tests current at the time. Instead of measuring simple and rather narrow functions, he attempted to discover a child's ability to solve problems expressed in words and numbers, to follow out a simple line of reasoning, and to show comprehension and good judgment in answering questions. Fairly complex tasks were thought to be better indicators of intelligence than simple and relatively easy problems. Tests were arranged
in groups suitable for children from three to fifteen years old; and a set of tests was added for use with adults.

Binet arranged his test in what is called an *Age Scale*. Test items were assembled for different year levels, and a child's intelligence was determined by the age level which he could attain. The child of eight who was able to do the tests placed at the eight-year level was said to be normal or average. If he could do the tests beyond his age level, his "mental age" was greater than his life or chronological age, and he was described as bright or accelerated. If he was unable to do the tests at his own age level, the child's mental age was lower than his life age, and he was classed as slow or retarded. Mental age is a simple and useful concept. A mental age of nine means that a child can do the tasks regarded as appropriate for children of nine years. If the same child can do the tests set at the twelve-year level, his mental age is twelve, regardless of his chronological age.

**THE STANFORD REVISIONS OF THE BINET SCALE**

There have been a number of revisions of Binet's original scale. By far the best-known are those carried out at Stanford University under the direction of Professor Lewis M. Terman. There have been two Stanford Revisions, the first in 1916 and the second in 1937.

The 1937 Stanford Revision represents a decided advance over the first revision and the original Binet scale. The best items in the old tests were retained, and many new and valuable items were added. The 1937 scale covers the years from two to fourteen, with tests for average and superior adults. Described below are the tests placed at Year IV, Year X, Year XIV, and Average Adult in the 1937 Stanford Revision, usually called the "new" Stanford-Binet. These samples will give some idea of the kind of tasks which children at different age levels are expected to perform.
illustrative tests from the Stanford-Binet Scale for years IV, X, XIV, and average adult

Note that the tasks presented cover a wide range of mental activities; that they call for ingenuity and alertness and depend very little upon routine school information.

Year IV
1. Picture vocabulary. Child must recognize and name everyday objects seen in pictures.
2. Naming objects from memory. Child is shown small toys representing common objects. These he names, or they are named for him. Later he must recall from memory the name of each object.
4. Pictorial identification. Pictures of objects on cards to be identified.
   Repetition of short sentences read aloud to child.

Year X
1. Vocabulary. The examinee must give definitions of eleven words in a standard vocabulary list.
2. Picture absurdities II. Must recognize what is "foolish" in a presented picture.
3. Reading and report. Reads a selection and reports from memory what is read.
5. Word naming. Names as many words as he can in one minute: a measure of word fluency.
6. Repeating six digits. The lists are read aloud at the rate of about one per second.
Year XIV

1. Vocabulary. Larger vocabulary required than at Year X.
2. Induction. Tests ability to grasp and apply a general rule.
3. Picture absurdities III. Must recognize what is "foolish" in a picture; more difficult than at Year X.
4. Ingenuity. Tests ability to solve problems mentally.
5. Orientation: Direction I. Examinee must be able to solve problems involving space relations by following fairly complex directions.
6. Abstract words II. Must define words like loyalty and justice.

Average Adult

1. Vocabulary. Larger vocabulary than at Year XIV.
2. Codes. Examinee must learn two codes and write messages in them.
3. Differences between abstract words. Tests ability to generalize; makes use of fairly difficult concepts.
5. Proverbs. Interpretation of proverbs or fables.
6. Ingenuity. Solution of problems requiring "mental manipulation."
7. Memory for sentences V. Tests ability to reproduce rather long and involved sentences heard once.
8. Reconciliation of opposites. Examinee must tell how words denoting opposite states are alike. Tests ability to grasp abstract relations.

THE MA AND THE IQ

The Stanford Revision followed the practice of Binet in assigning a mental age (MA) to a child in accordance with his ability to pass the tests in the age scale. MA is a measure of status; it tells us how a child compares with children of his age. Two children of the same life age can earn the same
mental age upon an intelligence test in different ways as is shown in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Tests Passed</th>
<th>MA (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII.</td>
<td>All</td>
<td>84</td>
</tr>
<tr>
<td>VIII.</td>
<td>Five</td>
<td>10</td>
</tr>
<tr>
<td>IX.</td>
<td>Four</td>
<td>8</td>
</tr>
<tr>
<td>X.</td>
<td>Three</td>
<td>6</td>
</tr>
<tr>
<td>XI.</td>
<td>Two</td>
<td>4</td>
</tr>
<tr>
<td>XII.</td>
<td>One</td>
<td>2</td>
</tr>
<tr>
<td>XIII.</td>
<td>All</td>
<td>0</td>
</tr>
</tbody>
</table>

114 months, or 9 years 6 months

\[
IQ = \frac{MA}{CA} \times 100 = \frac{114}{98} \times 100 = 116
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>Tests Passed</th>
<th>MA (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIII.</td>
<td>All</td>
<td>96</td>
</tr>
<tr>
<td>IX.</td>
<td>Five</td>
<td>10</td>
</tr>
<tr>
<td>X.</td>
<td>Four</td>
<td>8</td>
</tr>
<tr>
<td>XI.</td>
<td>All</td>
<td>0</td>
</tr>
</tbody>
</table>

114 months, or 9 years 6 months

\[
IQ = \frac{114}{98} \times 100 = 116
\]

The first child, whose life age is eight years two months (ninety-eight months), reveals a mental age of nine years six months (114 months) by scattering his answers up and down the scale to a greater degree than the second child of eight years two months, who also earns a MA of nine years six months. Children differ in the way in which they answer the test items, but by and large a child will come out with a MA which indicates his ability to perform tasks of this sort. Comparison with other children is obviously of doubtful value when the child tested is ill, malnourished, deformed, or emotionally upset, or if
he has been reared under restrictive and abnormal circumstances.

The intelligence quotient or IQ is the ratio of the child's mental age to his life or chronological age. IQ is a measure of brightness or dullness. The two children in the illustration above both earn IQ's of 116. The eight-year-old who shows a mental age of just eight has an IQ of 100 (the decimal is dropped) and is just normal. The child of eight who shows a mental age of ten has an IQ of ten-eighths or 125 and is described as bright. If another child achieves a mental age of only six, his IQ is six-eighths or 75. This child would be regarded as dull or below normal in intelligence.

**AN INDIVIDUAL INTELLIGENCE SCALE FOR ADULTS**

The Stanford-Binet Scale finds its greatest usefulness between the ages of six and fourteen, that is, over the range of the elementary school. These tests are sometimes used with dull adults and even with bright adults, but they are not well adapted to this purpose, since the test items were selected to appeal particularly to children. The Wechsler-Bellevue Scale is an individual intelligence examination designed primarily for use with adults. This test consists of two parts: a verbal section, and a performance section, which requires a minimum of language. What is called the full scale is a combination of the verbal and performance sections. The tests of the Wechsler-Bellevue Scale are described below.

**Illustrative items from the Wechsler-Bellevue intelligence scale**

This series of tests is intended primarily for adults. The first five tests comprise a verbal scale; the second five, a performance scale. The full scale is made up of both series.
1. Information
   Twenty-five information questions, graded in difficulty.

2. General comprehension.
   Ten questions (and two alternates) which require understanding of language and the ability to give a sensible answer.

3. Arithmetic reasoning.
   Ten oral problems in mental arithmetic.

4. Digits forward and backward.
   Memory span for series of digits of increasing length.

5. Similarities.
   Twelve word-pairs which are alike in some way.

   Alternate: Vocabulary.
   A list of forty-two words to be defined.

**Performance**

1. Picture completion.
   Fifteen cards each containing a picture from which some part is missing.

2. Picture arrangement.
   Six sets of pictures, each set containing from three to six separate parts. Examinee is to arrange the separate pictures in the right order so that they tell a story.

3. Object assembly.
   Three form boards—the manikin, the profile, and the hand. Parts of each test must be put together as quickly as possible.

4. Block design.
   Sixteen small cubes colored differently on their faces. Cubes to be arranged so as to reproduce seven designs presented on cards.

5. Digit-symbol.
   A well-known association learning test in which numbers are marked with symbols in accordance with a key.

This individual intelligence examination does not provide a mental age, because mental age, though useful in describing
Performance tests do not measure exactly the same abilities as the verbal intelligence tests just described, but the two sorts

the mental development of a child, is not suitable as a measure of adult intelligence. But the Wechsler-Bellevue does yield an IQ which is of value in comparing one adult with another. Scoring of the scale is so adjusted that the average IQ for each age level from ten to about seventy years is exactly 100. A man of forty-five who earns an IQ of 120 is as superior to forty-five-year-olds in general as the young man of twenty-five who earns an IQ of 120 is superior to twenty-five-year-olds in general. The Wechsler-Bellevue and Stanford-Binet scales are closely related—they measure much the same functions. But IQ's from the two tests cannot be compared directly. The Stanford-Binet IQ is a developmental ratio: it compares the child's mental status with his life age. The Wechsler-Bellevue IQ is in reality a test score. It tells how far above or below the average person of his own age level an examinee falls.

Performance tests of intelligence

Performance tests do not measure exactly the same abilities as the verbal intelligence tests just described, but the two sorts
of examination are highly related. Performance tests of intelligence are especially useful with preschool children and, as was said above, with illiterates, the lowgrade, those with language handicaps, and those who do not read or speak English well. One of the best-known standardized performance scales is the Pintner-Paterson series of performance tests. (See Figure 226 opposite.) This test battery contains fifteen separate tasks. Seven of the tests are form boards—that is, boards containing apertures in which blocks of different sizes and shapes must be fitted; three are picture-completion tests which, like the jigsaw puzzle, require that parts of a picture be fitted together to make a meaningful whole. Other tests call for the counting of blocks, construction of figures, and simple learning tasks. Block counting demands close attention and memory for movements made.

The Pintner-Paterson series can be used with children from about four to fourteen years of age. Some of the tests are not useful over this entire age range. The manikin test, which requires the child to fit arms, legs, and a head on a small wooden body to form a man, is useful only at the early ages. The feature-profile test, which requires that parts of the face be fitted together, is applicable only at the upper age levels. From the scores earned on the separate performance tests, a final mental age may be calculated. This MA shows how the child ranks in relation to other children of his own age level in performing tasks of this kind.

The Porteus mazes represent another type of standard performance examination. In the Maze Test, a series of diagrams are presented. These range from easy to hard and are suitable for children from three to fourteen years old. The subject (child or adult) begins at the maze entrance and with a pencil attempts to trace the pathway to be followed in order to complete the maze and avoid blind alleys. Maze tests have proved useful with the low-grade and the dull. They are valuable also in studies of primitive peoples, since the factors of language and previous training are reduced to a minimum.
There is evidence that maze-tracing provides a measure of prudence, as well as a measure of the ability to plan or look ahead. For this reason the test is often useful with mental defectives and delinquents. Figure 227 reproduces the Porteus mazes for several age levels. Note that the tasks become progressively harder with age.

Several other standard performance tests may be mentioned briefly. The Cornell-Coxe Performance Tests are more difficult than those of the Pintner-Paterson series and are useful up to age fifteen or sixteen. This battery includes block building, picture arrangement, form boards, and tests of simple associative learning. The Merrill-Palmer series of performance tests may be used with children from six months to six years of age. This battery includes both manipulative and verbal materials. A rather unique performance test is that in which the examinee is asked to "draw a man." Scoring is in accordance with how good a figure is drawn, and whether the arms, legs, nose, mouth, and so on are included. This test can be used with children from about three to twelve years.

All these performance tests yield "mental ages," and from many of them the IQ can be calculated. It must be remembered, however, that the MA's and IQ's obtained from these tests are not directly comparable with the MA and IQ from the Stanford-Binet. Performance tests tap many of the abilities
measured by the language tests (page 453), but the scales are not identical. Performance tests are a useful supplement to, rather than a substitute for, the Stanford-Binet.

GROUP TESTS

Individual tests like the Stanford-Binet and the Wechsler-Bellevue require the services of a trained examiner. When it is necessary to get an estimate of the abstract intelligence possessed by large numbers of people in a short time, standardized group tests must be employed. In World War I, group tests of intelligence were administered to more than one and a half million soldiers. Two tests were developed, Army Alpha and Army Beta. Army Alpha is a verbal or language test; it contains items much like those in the Stanford-Binet. Army Beta is a nonlanguage test. Items in Beta require counting, marking, and the ability to see relations expressed in pictures, numbers, and diagrams.

During World War II, a group test called the Army General Classification Test (AGCT) was administered to more than ten million men. The AGCT consists of three sorts of material: vocabulary, arithmetic, and block-counting problems. The scoring was so adjusted that the average soldier earned 100 points. To be accepted in officer candidate school,
a soldier had to score 110 or better. Inductees who earned less than 70 points were ordinarily given individual performance tests to determine whether they were simply illiterate or illiterate and feeble-minded. Items illustrative of the material found in representative group tests are given below.

**items illustrative of various group intelligence tests**

These items range from very easy to difficult. They are illustrative of items in both verbal and nonverbal tests and cover a considerable age range. Items 1, 2, 4, 5, 6, and 11 are in multiple-choice form. All require ingenuity in the use of words. Items 3, 9, and 10 present only two choices; verbal relation-finding and reasoning are important. Items 7, 8, 12, and 14 require the ability to see relations and follow through a line of thought. All items demand alertness, concentration of attention, comprehension, and judgment.

1. A pistol is a gun knife sword pencil
   Hat is to head as shoe is to: man leather foot clothes

2. Indict—charge:: induct—indulge prolong instinct initiate
deduct
   Granary—wheat:: library—desk books paper librarian

3. Premature—early same opposite
dilapidated—ruined same opposite
effeminate—virile same opposite
abjure—renounce same opposite

4. Write the two numbers that should come next:
   \[
   8 \; 1 \; 6 \; 1 \; 4 \; 1 \; \_ \; \_
   \]
   \[
   81 \; 27 \; 9 \; 3 \; 1 \; 1/3 \; \_ \; \_
   \]

5. osmosis—1 old 2 young 3 separating 4 proboscis
   5 diffusion

6. “All that glitters is not gold” means
   1. Gold does not glitter like diamonds
   2. Only little things shine
   3. You cannot judge a book by its cover
   4. Some glittering things are silver
   5. The best things are made of gold
7. Mark out the one word which does not belong with the others.
   dynamo force magnetism energy gravity
8. Bill has $18. This is twice as much as John has. How many dollars does John have?
   \[ \begin{array}{l}
   $2 \\
   $6 \\
   $9 \\
   $16 \\
   \end{array} \]
9. Does violent exercise always have therapeutic value? 
   Yes  No
10. A is taller than B and shorter than C, who is not quite so tall as D. Is D taller than A?
    Yes  No
11. How many blocks in each pile?

12. Mark the thing that does not belong with the rest.*

13. Trace the maze from left to right.

* From: Pintner-Cunningham Primary Test, Form A, Test 3, 1939, World Book Company. Reproduced by special permission.
14. Put the numbers in the square in right order to make the picture complete.

Standard group tests have been widely used in the schools as an aid in the selection and placement of students. They have also been employed for the selection and placement of personnel in business and industry. How valuable the group test of general intelligence is in a specific situation depends upon the examiner’s purpose. Group tests are useful in classifying workers who possess a common educational background. They are ordinarily much less valuable than specific aptitude tests in classifying manual workers, mechanics, or truck drivers (page 519).

**How Intelligence Tests are Made**

Those unfamiliar with intelligence tests often speak as though these examinations were hodgepodges of questions, problems, and puzzles thrown together helter-skelter by a self-appointed
mental tester.” Such a view is far from correct. The “standardized” mental test is constructed in accordance with definite principles. It is quite different from the “IQ tests” found in popular magazines and newspapers and heard over the radio. The IQ tests of newspapers are intended to be amusing and interesting parlor games. Usually they call for detached and unimportant bits of information, and often they consist of “trick” questions. Such “tests” have little validity as measures of intelligence and bear no real relationship to what the psychologist means by the IQ.

Some years ago a mental test was drawn up by an eminent scientist (not a psychologist) with a view to selecting promising young men to be trained as engineers. The test—a rather conglomerate affair—was given wide publicity. One question asked “Who was Cleopatra?” Some acquaintance with the exploits of the Sorceress of the Nile would certainly enliven one’s social conversation, but it is difficult to see how such information could be a valid index of the abilities demanded in scientific work.

Perhaps it will lead to a better understanding of the problems of intelligence measurement if we examine briefly some of the rules which psychologists observe in constructing and using intelligence tests.

(1) Test items must be valid indices of mental alertness. Validity checks are made against various criteria: school grades, judgments of intelligence by competent observers, demonstrated quickness or slowness shown in learning. Those known to be bright must perform better on the test items than those known to be dull; older children must do better than younger. Ordinarily no single check is sufficient evidence of an item’s value. Older children, for instance, are taller than younger. But height is not positively related to intelligence except insofar as physical size is indicative of health and energy. Height, therefore, is not a good index of mental ability, though it does increase with age. Vocabulary, like height, also
increases with age. The average ten-year-old, for example, can define correctly eleven words in a standard list of fifty, and the average twelve-year-old can define correctly fourteen words in the same list. But vocabulary, in contrast to heights, is highly related to other measures of mental ability and hence is a good index of intelligence.

(2) Test items are carefully selected to sample a wide range of mental activities (see the sample items on pages 466–468). Wide sampling takes account of individual differences in ability and interest and guarantees everyone a fair and equal chance. Test questions should possess variety and intrinsic appeal. They should not depend primarily upon rote memory or special training, nor draw directly upon routine school information.

(3) Test items are graded in difficulty so that they become harder and harder as one goes through the list. This increase in difficulty provides a measure of level or power. A mental test must be long enough and hard enough to yield a good measure of the examinee’s ability; but it must not be so long as to tire and bore him, nor so hard that he quickly gives up.
(4) Mental examinations must be tried out on large numbers of children or adults in order to provide stable norms or standards. Norms are typical scores, or averages. They describe specific groups such as school grades, ages, occupations, and the like. An examinee’s score is interpreted as good or poor in relation to the norm for his group.

(5) Instructions for giving a mental examination are carefully drawn up and must be followed explicitly by the examiner. Inaccurate and misleading conclusions are almost inevitable when a standard intelligence test is administered by a well-meaning but untrained amateur.

levels of intelligence

THE DISTRIBUTION OF INTELLIGENCE

People differ in the scores which they earn upon intelligence tests just as they differ in height, weight, and personality traits. Intelligence tests given to children provide the clearest picture of the variations in mental ability in the general population. Children are more readily available than adults, they are more easily tested, and their abilities and interests are more flexible. Figure 230 shows the range of IQ’s achieved on the 1937 Stanford-Binet by nearly three thousand children from two to eighteen years of age. These children were drawn from eleven states (from Vermont to California) and represent quite adequately the various social and economic levels in the USA. The diagram is read from left to right as follows. Very few children (as shown by the height of the curve) fall at the lower end of the scale, more and more are found in the middle range, and again very few are at the high end of the scale. The bulk of measured IQ’s falls in the middle of the score range—that is, between 85 and 115. Many more children achieve IQ’s of 100 and thereabouts than IQ’s above 130 or below 70. This means that very bright children and, fortu-
The percentage of children in the general population who can be expected to fall at different IQ levels

<table>
<thead>
<tr>
<th>IQ range</th>
<th>per cent of population</th>
<th>classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 and above</td>
<td>1.5</td>
<td>very superior</td>
</tr>
<tr>
<td>120–139</td>
<td>11</td>
<td>superior</td>
</tr>
<tr>
<td>110–119</td>
<td>18</td>
<td>high average</td>
</tr>
<tr>
<td>90–109</td>
<td>47</td>
<td>average</td>
</tr>
<tr>
<td>80–89</td>
<td>14</td>
<td>low average</td>
</tr>
<tr>
<td>70–79</td>
<td>6</td>
<td>borderline defective</td>
</tr>
<tr>
<td>below 70</td>
<td>2.5</td>
<td>mentally defective</td>
</tr>
</tbody>
</table>

nately, very dull children are relatively rare in the general population as compared with normal and near-normal. The facts shown in Figure 230 are given in Table 15. The percent-
age of children who fall in each division of the IQ range drops sharply as we go from the middle towards the extremes.

Results from the Army General Classification Test administration to more than ten million soldiers in World War II provide a good indication of the range of intelligence in the general adult population in the USA. Table 16 gives the percentage of inductees who were expected to fall in each of the five scoring divisions set up by the Army. The actual percentages differ slightly from those expected. Although the Army group is very large indeed, it is not as representative of the adult male population in the USA as the group in Table 15 is of the child population. Many specialists, scientific and technical workers, physicians, highly trained older men, executives, and the like did not take the AGCT. For this reason there are slightly fewer men in Grade I and slightly more in Grade V than was anticipated.

### Table 16 Percentage of men in the general population to be expected in each of five intelligence levels

<table>
<thead>
<tr>
<th>army grades</th>
<th>score ranges (not IQ's)</th>
<th>per cent expected</th>
<th>per cent found</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>130 and above</td>
<td>7</td>
<td>5.8</td>
</tr>
<tr>
<td>II</td>
<td>110-129</td>
<td>24</td>
<td>26.2</td>
</tr>
<tr>
<td>III</td>
<td>90-109</td>
<td>38</td>
<td>30.7</td>
</tr>
<tr>
<td>IV</td>
<td>70-89</td>
<td>24</td>
<td>28.5</td>
</tr>
<tr>
<td>V</td>
<td>below 70</td>
<td>7</td>
<td>8.8</td>
</tr>
</tbody>
</table>

#### FEEBLE-MINDEDNESS

There are various definitions of feeble-mindedness—social, economic, and psychological. In an economic and social sense, the person who cannot get along in his community and earn a living is “socially feeble-minded,” even though he is normally intelligent in terms of the tests. Psychologists are generally
agreed that an IQ below 70 implies such meager intellectual equipment that its possessor is at least potentially feeble-minded. Such a person may be able to get along in a simple and protected environment and to earn a living by doing menial and routine tasks. But he does not possess enough intelligence to profit greatly from schooling, and occupations which require reading and the use of calculation are firmly closed to him. Three grades of feeble-mindedness are usually distinguished: the idiot, the imbecile, and the moron.

The idiot brings up the rear of the intelligence parade. His IQ is usually below 25. The idiot must be cared for in an institution or protected within the home. The following terse description of an idiot* (IQ about 6 or 7) is fairly typical of the individuals in this group.

Female, age twenty. Has been in institution fourteen years. Has a mental age of about one year. When admitted (at the age of six) she could hardly walk, could not care for her own bodily needs, said only a few words, would play with her doll a little. Since, she has scarcely improved. Learned to string a few beads, and to say a few sentences. The attendants say she never sleeps; does not understand commands; eats garbage. Very little known of heredity or cause of her condition, which is congenital.

Imbeciles in general have IQ's from about 25 to 50. If healthy and strong, the imbecile can do chores about a farm and the simpler sorts of housework. But learning is slow and effortful, and there is little understanding or capacity for planning or foresight. Below is an account of an imbecile† whose IQ is approximately 40.

Man, age thirty-four. Has mental age of six years. At ten, when admitted, speech was defective, memory poor, could not dress himself, was unclean, dangerous with fire, brutal, vulgar, profane and dif-

---

† Ibid.
difficult to manage. Has improved under institutional discipline and is now strong and healthy and a good worker in the institution, driving coal teams. Has quarrelsome, cranky spells, is somewhat sober, willing and tries to help, and is usually obedient. But he is not truthful or honest, is quick-tempered and forgetful.

Father and two uncles feeble-minded. One of his mother's brothers was also feeble-minded and had several feeble-minded grandchildren. Grandmother was feeble-minded. Cousin is also feeble-minded and in the same institution.

The moron has an IQ of from 50 to about 70 or 75. Morons can do somewhat more complex tasks than imbeciles and are often found in such occupations as fishing, barbering, simple carpentry, and routine jobs in factories and stores. The moron is more often a social problem than is the imbecile. Too intelligent to be placed in an institution, he is not intelligent enough to exercise good judgment and to protect himself, especially in a complex urban environment. The following account* vividly illustrates the difficulties which the moron may meet.

Chuck was a barber at a salary of twenty dollars per week. His mental age was about twelve years and his IQ approximately 75. Chuck's wife, Flora, who gave up a job as dishwasher in a restaurant to marry, had a slightly lower IQ, about 65. Chuck and Flora were continually in trouble. Flora would buy a fur coat on the installment plan which she could not pay for; or a set of books (impressed and

* Adapted from Eleanor R. Wembridge's "People of Moronia" in *The American Mercury*, January, 1926.

**FIGURE 231**
The mentally retarded child can live a happy, if not entirely normal, life when parents and older children are considerate and helpful.
flattered by a clever agent) which she could neither read nor pay for. Chuck flirted with other girls and spent his money with little thought of the inevitable rent and grocery bill. From the answers which Chuck and Flora gave to questions on a standardized intelligence test, one can better understand the reason for many of their difficulties. To the problem: if two pencils cost five cents, how many can you get for fifty cents, Flora answered 25 because “2 into 50 is 25.” Chuck answered 10: “You get 2 for 5, and 2 times 5 is 10.” To the question: if you earn twenty dollars a week and spend fourteen dollars a week, how long will it take you to save 300 dollars, Flora (who had a sense of humor) answered “a life time” and then, after some cogitation, “300 times 14.” To Flora, a lecture means “getting hanged,” skill is “you do it,” insure is “you get it when you are dead,” “it’s the company like,” “it’s when you get hurt.” Again, to Flora, charity is “don’t be silly,” and faith means “you do it.” Flora is over twenty-one and a voter. Yet to the question what is the difference between a President and a King, she answered “they sit different on thrones, but a President wears regular clothes.”

Chuck, though not much brighter than Flora, had a curious facility for words sometimes found in mental defectives. After one of several separations from Flora, he wrote the following correctly spelled letter: “I have thought this thing out pretty thoroughly and I have done this according to the balanced method of applied logic. As a result I am convinced that you are wrong. Not only that, but I have analyzed you psychologically, and checked up on the results. You have heard of psychoanalysis, of course. The results upon synthesis tallied with the facts.” This amazing hodgepodge of nonsense effected a complete reconciliation, as well it might, for Flora was tremendously flattered. Unfortunately, Chuck had only the haziest knowledge of the meanings of words, and very little capacity for abstract thought. Asked to explain the fable about the girl who counted her chickens before they were hatched, he laughed and said “it pays to be broadminded.” Chuck sighed over the crow who was flattered into dropping her meat in order to sing, and said “that’s like Lucille. These flappers. It don’t pay to be led by flappery.”

If we analyze the thinking processes of Chuck and Flora as revealed in their answers, it is clear that in every case there is a vague notion of what the problem demands. But the thought
process itself is incomplete and usually incorrect, and the associations are ineffective or irrelevant. Attention is limited, and the ability to follow a line of reasoning is of extremely narrow scope. The suggestible moron boy is often a pawn in the hands of more intelligent older boys; is often, too, in difficulty with laws which he does not understand. Vandalism, stupid thefts, and nuisance behavior are characteristic of the badly trained and vicious moron.

HIGH-GRADE INTELLIGENCE

Children with IQ's above 120 are generally described as bright, and those with IQ's of 140 and above as very bright. Contrary to the opinion of many persons, bright children are as well developed physically and emotionally as are children of average intelligence; in fact, they tend to be superior in body as well as in mind. The following account describes the achievements of a boy whose intelligence quotient was 187.

At the age of eight, Edward was above the norm in height and weight. While average children of his age are in the third grade, Edward was in the sixth grade. At age twelve Edward entered college, his score on the freshman entrance test being the second highest of 483 boys who averaged six years older than himself. Edward graduated in four years and was elected to Phi Beta Kappa. He is reported to have had at least a working knowledge of twelve languages. Edward took the Ph.D. degree in his early twenties and embarked upon a career in the ministry.

Professor Lewis M. Terman and his associates have made the most thorough follow-up study of the later achievements of very bright children. In 1921–1922 more than a thousand children of IQ 140 and above were located in elementary and high schools. These children would rank in the top one per cent of the general population. Sixteen years later, the careers of these young people—now twenty-five to thirty-five—were examined and their progress assessed. Nearly 90 per cent of the boys and 85 per cent of the girls had gone to college; they had won many
more academic honors than their classmates, though nearly
two years younger on the average; more than half had gone
into graduate and professional work, and 12 per cent had re-
ceived the Ph.D. degree. About 50 per cent of the boys had
entered professional training, their choices being law, engineer-
ing, medicine, college teaching and research, and religious
and social work, in that order. In the group were novelists,
writers, poets, a gifted musical composer, and several already
recognized scientists. All in all, these bright children showed
an impressive record of accomplishment.

What of those who did not live up to expectation? At least
thirty of these very bright young people had failed or almost
failed in college, and about one fifth of them were in clerical
or minor business jobs or skilled trades. Among them, for in-
stance, were a seaman, a jazz-band player, a policeman, and a
streetcar motorman. Family troubles, personality and character
defects, and unfavorable environmental factors were in several
cases important if not crucial in the lack of success of these
very bright children. From his data, Dr. Terman believes the
following conclusion is justified: "Above the IQ level of 140
adult success is largely determined by such factors as social
adjustment, emotional stability, and drive to accomplish."

The life of the very bright child is not always smooth sail-
ing. Finding schoolwork easy and uninteresting, these children
often dawdle, learn bad habits, and receive marks far below the
level of their capacity. If the bright child is misunderstood by
his parents and teachers, he often tends to withdraw into him-
self and to find satisfaction in adult books and "grown-up" ac-
tivities. This was illustrated in the case of Bob, a nine-year-old
boy of IQ 150. Bob had read most of the Encyclopaedia Britan-
nica "for fun," and knew in detail the geography of South
America. He easily stood highest in his class. Bob's mother
complained to the school authorities that he was disobedient
and rude because on several occasions he had "forgotten" to
run errands as promised and paid little attention to her scold-
ing. It developed that the mother would interrupt the boy no
FIGURE 232 Many interesting jobs are open to persons of average intelligence. People are happiest when they choose occupations that do not overtax their capacities.
matter how engrossed he was in what he was doing and expect him immediately to accede to her wishes. She had no real understanding of the child and little pride in his self-reliance and intellectual interests. With good reason, he tended to ignore her. Many schools make special provision for the dull and low-grade, and there are numerous institutions for the feeble-minded. It is a great pity that we do not provide just as generously for the bright child whose potential value to society is so great.

**Average Intelligence**

The bulk of school children, perhaps 65 per cent, will be found to have IQ's between 85 and 115. If not kept back by illness or loss of schooling through other causes, these children should complete elementary school and many of them will complete high school. In many cases, however, they are not good college risks and should not be encouraged to seek general education beyond the high-school level. To complete successfully the work of a good college, a young person should posses an IQ of 120 or above. Children with IQ's below 90 have little chance of graduating from a really first-class high school; while children with IQ's in the low 80's will rarely get beyond the seventh grade, and then two or three years behind schedule.

What job opportunities are open to the young person of average intelligence? A great many, except those in which the training is highly technical and the level of abstract intelligence demanded quite high. In the group of nearly seven million men who ranked as average on the Army General Classification Test in World War II, nearly every occupation is represented. We have seen that bright children often disappoint because of poor personality traits or because of adverse environmental and social factors. On the other hand, the average boy or girl in a stimulating home environment may, through industry, superior personality traits, and good training, compensate at least in part for modest intellectual gifts.
The IQ, as we have seen, is a measure of brightness or dullness; it shows the degree of a child’s advancement or retardation as compared with others of his own age. Suppose we have three children: John, whose IQ is 80; Mary, whose IQ is 100; and William, whose IQ is 120. The first child is dull or slow in mental development. The second is normal, and the third bright. Suppose all these children are ten years of age: what assurance do we have that at age twelve John will not now be normal, Mary dull, and William a “genius,” that is, possess an IQ of 190, say. This problem, which calls into question the constancy of the IQ, has been much debated and is frequently misunderstood. Unless a child maintains his position relative to the average child of his age group as he grows older, it is apparent that the IQ is an unreliable—not to say whimsical—measure, and is of limited value. Research in the question of IQ constancy has been extensive, and only a brief summary will be offered here. Like every other score, the IQ is subject to a measurement error. In determining IQ’s, this error may vary from two to five points. Whether this variation is considered to be large or small will depend upon one’s point of view. To the physicist, accustomed to measuring in millimeters and thousandths of a second, psychological measurement will seem very crude. But to the teacher who sees the child as a complex and highly variable organism, it will seem amazing that the IQ remains as steady and consistent as it does. In general, we can expect a child, when retested, to stay within five points plus or minus of his original IQ score, provided the examination has been adequately given. In other words, the IQ is relatively constant, and a child rarely shifts from the classification in which he has been originally placed. The dull child will ordinarily remain dull, the normal child average, and the bright
child bright, although the IQ may vary somewhat from one year to another.

In one of the best studies of IQ stability, retests were made on 1183 children after intervals of from three months to six years. The largest changes occurred after the three months'
period—as was to be expected—since memory and practice undoubtedly operate. After a year or more there was very little change, not more than one or two points up or down on the average.

Many psychologists have found a tendency for children of high intelligence to gain in IQ and those of low intelligence to lose somewhat in IQ as they grow older. This is probably owing to the fact that the very bright child engages in intellectual activities beyond his years, and these enriching experiences inevitably affect his subsequent test scores. On the other hand, the environment of the dull child becomes increasingly restrictive as he grows older. A dull child of five may not be recognized as retarded if he is well-behaved and docile, since little is expected at this early age. By the time he is eight or ten, however, the dull child’s slowness in reading and his general inability to profit from the school become painfully apparent.

There are many factors which may affect the stability of a measured IQ. Obviously important are physical defects, disease, irregularities in physical growth, direct coaching upon the intelligence test, and many social influences, such as praise and the stimulation offered by new and unusual opportunities. Sometimes a child’s poor hearing or bad eyesight passes unnoticed, or the examiner fails to get the child’s co-operation, or the examination room is too noisy or is uncomfortably warm or cold. Kindergarten children, especially those who are timid and immature, often show an increase in IQ after they have become accustomed to the ways of the school. Considering all the influences which may affect an intelligence-test score, we are forced to the conclusion that the IQ is hard to change and is in fact a remarkably constant expression of performance level.

**STUDIES OF FOSTER CHILDREN**

The part played by the home and family in making for differences in IQ may be evaluated in an indirect fashion from tests administered to foster children reared in the home with
“own” children. Foster children usually come from orphanages or child-placement agencies. Their environment is often unfavorable, and their heredity is likely to be poorer than that of the children in whose homes they are placed. To the extent that intelligence and personality are affected by home environment, we should expect foster children to develop according to the level of the foster home. To some extent this is what we do find, especially when children are adopted early, before their usually meager environment has had a chance to operate. The status of the home does influence the IQ of an adopted child. Normal children (IQ's 100 or so, page 480) tested before and after placement in a good home may show a gain in IQ of five or more points. An exceptional home may lead to an increase of fifteen points, and a poor home to a drop in IQ of about the same amount.

These gains need not (and probably do not) represent “true” changes in the child’s intelligence level. For one thing, it is hard to get a reliable measure of the intelligence of a very
young child before placement, against which we can measure subsequent changes. Moreover, the recognized tendency of agencies to place the brighter children or those with the better heredity in superior homes may account for the improved showing of children adopted into such homes. The home environment can provide or withhold stimulation and opportunity, and thus markedly affect whatever natural advantages the individual possesses. The correlation between the IQ’s of foster children and the cultural level of their foster homes is quite low—about one half the correlation between the IQ’s of own children and the cultural level of own home. Also, the intelligence of foster children has little relation to the intelligence of the foster parents. When a child’s IQ shifts drastically, it is perhaps wise to regard the change as a challenge—something to be explained. It should not be accepted forthwith as evidence of a permanent alteration in intellectual capacity.

FIGURE 235 Substandard housing is not an exclusive feature either of rural or of urban communities.
THE EFFECTS OF ENVIRONMENTAL EXTREMES AND OF OTHER FACTORS

Dull and feeble-minded children admitted to orphanages from inadequate and often deplorable homes may show increases of as much as twenty points in IQ after several months of kindness, good food, and adequate care. Such abrupt changes probably reflect little more than the influence of improved conditions. Poor and inadequate environment may have little effect upon the IQ of the preschool child but an increasingly depressing effect as the child grows older. Studies of children reared under extremely unfavorable and restrictive conditions, for instance, show that the very young may test normal or nearly normal, while older children (ten to twelve) show much lower IQ's. This has been shown dramatically in the famous case of the "canal-boat" children. The seventy-six children in this study lived on boats anchored in the River Thames in England. They had little contact with other children. Their homes, though clean, were intellectually unstimulating and without books or pictures. The school attendance of the canal-boat children was about 5 per cent of that of other children of the same age. Although the average IQ of the group was about 70, the four- to six-year-olds averaged 90, while those twelve and over averaged only 60. Deprivation of books, schooling, and social contacts are far more serious in older than in younger children, so that by comparison with those of his own age level the older child appears to be more backward than the younger. The same progressive increase in dullness with age has been observed in isolated American Communities.

Children physically handicapped by poor eyesight, bad hearing, physical deformities, and the like often appear to be far duller than they really are. Special school programs, by providing individual instruction and liberal encouragement, reduce tensions, relieve feelings of insecurity, and often work wonders in raising the apparent intellectual levels of these

*Gordon, 1923.
It has been repeatedly shown that negative and extremely shy children, the ill, and the emotionally disturbed, may test far below their “real” ability.

MISUSES OF THE MA AND IQ

As pointed out above, the MA is a suitable measure for use with children as it gives the status of the child with reference to his own age group. The IQ tells us whether the child is developing at an accelerated, normal, or retarded rate. Neither the MA nor the IQ is ordinarily a useful measure in describing the intelligence of a normal adult. The Wechsler-Bellevue “IQ” is in reality a score which compares the adult with members of his own age group. It is not a developmental ratio nor a measure of mental growth. Hence, the IQ from the Wechsler-Bellevue scale is not strictly comparable to the Stanford-Binet IQ, and the two measures should not be treated as equivalent.

Certain conditions must be fulfilled before the IQ is an adequate or stable measure of performance upon an intelligence test. These conditions are not fulfilled by most group tests, and one should not take the IQ from a group test as being directly equivalent to the Stanford-Binet IQ. It would be very much safer if scores and not IQ’s were used with group tests. And it would certainly clarify the meaning of the IQ if we restricted it to age scales of the Stanford-Binet type.

It is often not clearly understood why the IQ’s of very bright children inevitably drop with age. This must happen because the MA ceases to increase after the middle teens, and the ratio MA/CA must therefore become smaller. The highest IQ which an adult can earn on the new Stanford-Binet is 152. Hence a child of eight with an IQ of 180 will show a reduction of almost thirty points in IQ when he grows up, even if he does every test in the scale correctly. As long as mental growth continues, the IQ is a useful and valid measure. When, as in the case of the very bright child, the “top” of the scale is reached, the MA no longer increases, and the IQ must fall.

Schmidt, 1949.
THE RELIABILITY OF PERFORMANCE AND GROUP TESTS

Scores on performance tests of intelligence are less accurate and less stable than are the scores obtained from the Stanford-Binet or the Wechsler-Bellevue scales. When carefully administered, performance tests provide a satisfactory indication of a child's ability to deal with concrete things: to solve problems expressed in pictures, puzzles, blocks, and diagrams. But a child should probably not be regarded as atypical (above or below normal) upon a performance test unless he deviates considerably from the norm for his age. There may be little if any difference between two children one of whom is six months advanced and the other six months retarded on a performance test. Both these children are best marked normal. There is, however, likely to be a significant difference between the child who is a year or more advanced and the child who is a year or more retarded.

Scores on the standard group tests of intelligence possess a high degree of reliability. In fact, it is hard for one to increase his score honestly, upon an adequate intelligence test, by more than a few points. At the same time, a test score may vary considerably from one time to another. Usually it is safer, therefore, to record a person simply as falling in the upper 25 per cent of the group or the lowest 10 per cent, for instance, than it is to give him a specific numerical rating, which may shift up or down in subsequent testing.

FACTORS IN GENERAL ABILITY

The use of an average or total score in an intelligence test assumes that the test items are measuring a unitary ability. One cannot add apples, desks, and radios and expect to get a total which is anything more than an aggregate—a number of different "things." By the same token, the total score on an intelligence test is a valid measure only if the test items are all
tapping the same ability—that is, if there is such a "thing" as intelligence.

Is the assumption of a general trait of intelligence justified? A good deal of research indicates that it is for children below the age of fourteen or fifteen. In the elementary school, abilities are not sharply differentiated, and performance depends to a very large degree upon how well a child can read and comprehend language relations. At high-school and college levels, various aptitudes begin to appear, and the use of an over-all total score is no longer desirable nor especially useful. Experimental studies indicate that older children and adults possess certain fairly definite "factors" or subabilities which are relatively independent. The best-established factors are (1) verbal or language ability, (2) mathematical or number ability, and (3) perceptual or visualizing ability. Other probable factors are word fluency, memory, reasoning, and mental speed. Various test items designed to measure several of these factors are shown in the following pages.*

* These items are reproduced by permission of Dr. L. L. Thurstone, Dr. T. G. Thurstone, and Science Research Associates.

---

PERCEPTION

An identical pair of objects is hidden in each of these boxes. File clerks and copyreaders will probably be able to spot them in less than the normal time since they exercise the faculty of perception constantly in their work.
A synonym for each word at the left can be found among the other words in the same line with it. Ability to pick out the synonym shows the extent of word understanding, which is a vital factor in the learning process. Most high-school graduates get fifteen right.

| 1. JUVENILE | AWKWARD | YOUTHFUL | DEPENDENT | BASHFUL |
| 2. FAMOUS | FLUVIAL | RENEWED | FAITHFUL | RENOWNED |
| 3. OVERT | RICH | OPEN | TRIFLING | QUIET |
| 4. WANTON | GAINFUL | UNREstrained | EXTENSIVE | SOFT |
| 5. REMOTE | INIMICAL | DISTENDED | SPARSE | FAR |
| 6. POTENT | GAY | THICK | TIRESOME | STRONG |
| 7. OPUlENT | WEALTHY | ELECTIVE | CONTRARY | HATEFUL |
| 8. SERE | WITHERED | CHEAP | HELPFUL | SINGLE |
| 9. ECCENTRIC | EMPHASIZED | WARY | AWFUL | STRANGE |
| 10. VOLUBLE | EDIBLE | ENLARGED | DREAMY | FLUENT |
| 11. ANONYMous | RECONDITIONED | DESTRUCTIVE | NAMELESS | SYNONYMOUS |
| 12. ACOUSTIC | MELODIous | AUDITORY | SELDOM | ECSTATIC |
| 13. INEBRIATE | KINGLY | WEARY | FRISKY | DRUNKEN |
| 14. SUPERB | GILT | MAGNIFICENT | IMMENSE | MINUTE |
| 15. FLAGRANT | NOTORIOUS | PATRIOTIC | INFLATED | SUITABLE |
| 16. CAPACIOUS | HUNGRY | SAVAGE | ROOMY | ODOROUS |
| 17. FETID | AMUSING | FEVERISH | PUTRID | CONTAGIOUS |
| 18. GROTESQUE | LIVELY | RECUMBENT | BIZARRE | TRAGIC |
| 19. MALIGnant | STOLID | HARMFUL | WORN | POOR |
| 20. INNATE | DRUNK | INHERENT | IMPERATIVE | PASSIVE |
| 21. PRODIGAL | LOST | BELOVED | EXTRAVAGANT | YOUNG |
| 22. FRANK | POPULAR | QUEER | BRUTAL | OPEN |

Ability to calculate, tested by this exercise, is one of the most specific of the primary mental functions. It is essential to clerks, cashiers, and accountants and is valuable in many other professions. This number code is based on the numerical system of the ancient Mayas.
To prepare for the test, study the Mayan numbers 0 to 19 on the opposite page. Numbers 20 and over are expressed by combining symbols one above the other, are deciphered by multiplying the top symbol by 20, the bottom symbol by 1, and adding (as shown in the examples above). To take the test, which should require five minutes, write the equivalents of the Mayan numbers in the boxes at the right.
WORD FLUENCY Naming pictures with words all of which begin with the same letter (in this case P) measures fluency of vocabulary. This quality is indispensable to writers, teachers, lecturers.

REASONING An unrelated object in each line is out of keeping with the rest. In the top line, for example, all but the fedora are party hats. Reasoning power is important in intellectual occupations.
FIGURE 236 This profile shows a student who was above average in all tests, with his highest score in quantitative reasoning.

By the time a boy or girl reaches college, interests and abilities are becoming focalized, and it is more profitable to measure these aptitudes separately than it is to administer a general intelligence test. Figure 236* is the profile of a freshman whose scores in the quantitative and perceptual tests are much higher than are his scores in the verbal and language tests. This young man later became an honor graduate in mathematics. Profiles like this are very useful when one wishes to advise a student where his best chances of success lie. Aptitude-test scores should be supplemented, of course, by interviews and other assessments in order to determine the examinee’s dominant personality traits, his physical stamina, and his interests and ambitions.

HEREDITY AND INTELLIGENCE

How much of a person's intelligence-test rating depends upon native and inherited powers, and how much can properly be attributed to opportunity and circumstances? Unfortunately, no exact answer can be given to this often-discussed question. Children do not have the same parents and do not grow up in a vacuum. Inborn factors, therefore, cannot be studied apart from those of environment (opportunity, training, and so on). Another difficulty is the fact that "water seeks its level," in the sense that intelligent people tend more often to be found in the upper—and dull people in the lower—social and economic brackets. In a large sample of very bright children, 81 per cent of those testing above 140 IQ were from families of good status—fathers in professional, semiprofessional, and business classes. Only .13 of 1 per cent of children above 140 IQ came from families in which the father was a day laborer. In general, children of professional parents average 116 IQ, those whose
parents are unskilled laborers, 98. Part of this difference may be attributed to opportunity, but most of it is probably a matter of superior inheritance. Evidence of the relative strength of nature and nurture, as found in careful statistical studies (page 38), indicates that approximately 75–80 per cent of measured differences in IQ among children can be attributed to heredity. The remaining 25 per cent must be credited to differences in the environment.

This conclusion is supported by many other data. No matter how good the environment is, it cannot overcome the handicap of defective inheritance. The feeble-minded child can be taught to feed and to care for himself and even be taught good manners—but he remains feeble-minded, regardless of how much time and effort are expended on his training. Moreover, a small but important group of children insist upon being very bright even though they come from homes lacking almost every opportunity for development. The failure of the IQ to change radically upon retest argues for the greater importance of native constitution. All in all, the best evidence supports the view that we "can't make a silk purse out of a sow's ear," though with care we may make a better purse. Unless the environment is exceptionally good or exceptionally poor, achievement is primarily dependent upon the quality of the organism.

Intelligent behavior may conveniently be classified as abstract, mechanical, and social. The first category concerns the ability to deal with symbols (book-learning); the second, skill in manipulating physical objects, tools, machines and the like; and the third, tactfulness in personal and social affairs. Most popular intelligence tests in use today, whether individual or group, measure abstract intelligence. Credit for constructing the first comprehensive intelligence examination goes to the French psychologists, Binet and
Simon. The Binet-Simon scale was revised in this country in 1916 and again in 1937 by L. M. Terman of Stanford University and his associates. The Stanford-Binet, as this test is known, is our most widely used intelligence test with children from about six to fourteen. Two scores are derived from the Stanford-Binet, the mental age (MA) and the intelligence quotient (IQ). The first measures status (position on the age scale), and the second measures brightness. The $IQ = MA/CA$.

Most intelligence tests rely primarily upon verbal materials, but some make use of non-verbal and performance tasks—blocks, picture puzzles, diagrams. Performance and non-verbal tests are especially valuable with young children and persons with language difficulties. Group tests have been widely used in schools, in industry, and in the Armed Forces. These examinations are carefully constructed, and considerable skill and experience is necessary to administer and interpret them.

People differ widely from one another in their scores upon individual and group tests. In the general population, approximately 2–3 per cent are described as feeble-minded and about the same proportion as very bright. The feeble-minded may be classified as idiots, who require custodial care; imbeciles, who can perform menial tasks; and morons, who can carry out simple routine jobs. The IQ from the Stanford-Binet remains fairly constant for a given individual, usually varying from time to time by not more than 5 points up or down. Increases in IQ as a result of special training or adoption into a superior home have been reported. Many of these gains are temporary and represent no true gain in mental ability.

The various mental abilities are not sharply differentiated in young children. In young people and adults, however, separate aptitudes or “factors” appear. The best established factors are verbal, numerical, and spatial-perceptual. Scores in these summary abilities are more useful in educational and vocational guidance than are total general intelligence scores.

questions and topics for discussion

1. List three or four occupations (not given in this chapter) for which abstract and mechanical in-
intelligence seem important. Abstract and social. Mechanical and social.

2. A boy of five has an IQ of 120. What is his MA? If his brother has a MA of fourteen and an IQ of 110, what is his chronological age?

3. Criticize the following definition of intelligence: "Intelligence is the ability to undertake activities that are characterized by (a) difficulty, (b) complexity, (c) abstractness, (d) economy, (e) adaptiveness, (f) social value, and (g) the emergence of originals and to maintain such activities under conditions that demand a concentration of energy and resistance to emotional forces."

4. A boy of ten has an IQ of 130 and a boy of thirteen an IQ of 100. In what ways would these boys resemble each other? How might they differ?

5. Many of us classify people into types, either as smart or dull, for instance, or good or bad. How would a distribution of intelligence into two types differ from that shown in Figure 230.

6. Debate the following proposals:

   a) To divide elementary-school classes into sections based on IQ.
   b) To excuse very bright students from some of the work of a class.
   c) To select as filing clerks in a large insurance office girls with highest IQ's.

7. How might intelligence tests be useful in (a) a juvenile court, (b) home for orphans, (c) public school, (d) department store?

8. Why might it be more important to discover and educate one highly gifted child than to train a hundred morons?

9. Write several items like those on page 467. How might you determine whether your items were valid measures of intelligence?
10. If a child's IQ is 125, why is it preferable to drop the numerical rating and call the child “bright” or “superior”?

11. Circle the right answer:
   Morons differ most from normal children in
   *physique* co-ordination *vocabulary* honesty

12. Why might an information test developed for city people be unfair to farmers?

13. A boy of nine, in the fourth grade, has an IQ of 130. He is mischievous and inattentive. How might you explain his behavior? What would you do?

14. A well-mannered docile girl of twelve is doing fairly well in the fourth grade. The teacher describes her as a “nice, fairly bright girl.” Why should we be doubtful of this estimate?

15. Can a man be too intelligent for his job?

**suggested readings**


4. An excellent discussion of the effects of age, race, and sex upon intelligence will be found in L. E. Tyler's *The psychology of human differences* (New York: Appleton-Century-Crofts, 1947).

5. For a systematic treatment of feeble-mindedness, see L. S. Penrose's *Mental defect* (New York: Rinehart and Co., 1934).
The American Declaration of Independence declared it to be “self-evident that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty, and the Pursuit of Happiness.” The signers of the Declaration were able men. It hardly seems likely that they meant to imply that all men are of equal ability as far as heredity is concerned and differ only in the training which they have received. Surely what the founding fathers really meant is that all men are—or should be—equal before the law and should be allowed to develop freely whatever abilities they possess.

Everyday observation forces us to the conclusion that men do not possess equal potentialities; that, in fact, people differ radically in physical, mental, and personality traits. The difference between the genius and the idiot in intellect or between Winston Churchill and a city boss, say, in statesmanship is obviously very great. Differences between individuals are in
part a matter of natural endowment and in part a matter of opportunity and training, sometimes the one and sometimes the other being the more important. The troublesome question of the relative contribution of nature and nurture to individual differences is considered elsewhere (page 40). In the present chapter, therefore, we shall be concerned mainly with the fact of human variations and with the importance of such differences in educational and vocational success.

DIFFERENCES AMONG PEOPLE

Diagrams showing the extent to which individuals possess various amounts of a characteristic or trait are called “frequency polygons.” Polygons are plotted from arrangements of scores called “frequency distributions.” Figure 238 is a frequency polygon which illustrates the range in head height, measured in millimeters, in a group of sixty-eight men. Head measurements are represented by equal distances laid off along the base line in the figure, and the number of men who fall within each measurement category is shown by the height of

**Figure 238**  Head heights of sixty-eight men. A graph is not always a smooth, symmetrical curve, especially when the number of cases is small.

After Pearl, 1930.
the diagram above the different points. Figure 239 represents the scores on a vocabulary test earned by a group of 549 thirteen-year old pupils; and Figure 240, the distribution of scores made by 400 college men on a test designed to measure the personality dimension of ascendance-submission (page 502). In this last diagram the most ascendant or dominant men are represented at the left side of the figure (by plus scores) and the most submissive at the right side (by minus scores). The distribution of IQ's achieved by approximately 3,000 children on the Stanford-Binet Intelligence Test is shown on page 472 (Figure 230).

These diagrams are all roughly alike in form: they start relatively low, rise to a peak, and fall off again to a final low point. It seems clear that the extremes of a trait—whether physical, mental, or personality—are possessed by comparatively few people, and that an intermediate degree of the trait is more frequently encountered.
Scores on the Allport A-S Test made by 400 college men. The positive scores mean extroversion; the negative, introversion.

The Normal Probability Curve

Figures 230, 238, 239, and 240 all resemble in contour the normal probability curve, which is shown in Figure 241. This curve has been useful in mental measurement because many biological and psychological facts have been found to follow it closely. The symmetrical shape of the normal curve is determined by the operation of a very large number of factors which are present (operate) or are absent (do not operate) in combinations determined by “chance.”

The normal probability curve is sometimes called the “curve of error,” since in firing at a target, say, chance errors or misses tend to be numerous close to the bull’s eye and less and less frequent as we move out from the target’s center to the rim—that is, the errors tend to follow the normal probability curve.

After Allport, 1928.
One of the best illustrations of chance distribution is furnished by the combinations of heads and tails which appear when coins are tossed. Six pennies, for instance, will when tossed show various arrangements of heads and tails, some of which are more likely to occur than others. The exact probabilities or expectations of different head-tail combinations can be determined mathematically by expanding the binomial \((p + q)^6\) in which \(p\) = the probability of a head, \(q\) = probability of a tail, and 6 is the number of coins. Expressed as a "probability ratio," both \(p\) and \(q = 1/2\), since there are only two ways in which the coin can fall (namely, head or tail), and both outcomes are equally probable. If we expand the binomial \((p + q)^6 = p^6 + 6 p^5q + 15 p^4q^2 + 20 p^3q^3 + 15 p^2q^4 + 6 pq^5 + q^6\), and add the coefficients \((1 + 6 + 15 + 20 + 15 + 6 + 1)\), we get 64 as the total number of com-

**Figure 241** The normal probability curve.
binations. Now, referring back to the expansion, we see that there is one chance in sixty-four that all coins will fall heads \( (p^6) \); six chances in 64 that five will be heads and one tail \( (6 \ p^5q) \); 15 chances in 64 that four will be heads and two tails \( (15 \ p^4q^2) \), and so on. The greatest probability is for three heads and three tails \( (20 \ p^3q^3) \), for which there are twenty chances in sixty-four.

A diagram showing graphically the relative probability of these various head-tail combinations may be seen in Figure 242. This plot, which is called a histogram,* represents the chance distribution which arises from the combinations of six coins or six independent "factors" when any single factor is as likely to occur as not to occur. If we suppose a certain human trait—size of foot, for example—to be determined by six genetic factors which combine in the same way as do coins, then the greatest expectation (namely, 20 chances in 64) is that a person will have three "foot" factors for large size and three for small size, and hence possess medium-sized feet. The most unlikely result (one chance in 64) is that a person will possess all six factors for large size or all six for small size—have very large or very small feet. Thus it seems clear that, assuming human traits to be determined by the chance combination of a large number of equally probable factors, an average

* Note that when the midpoints of the tops of the rectangles are joined (Figure 242), we get a frequency polygon.

**Figure 242** The frequency of head-tail combinations when six coins are tossed.
Two distribution curves may take the same shape but have different means.

degree of the trait is to be expected much more often than either a very large or a very small degree.

We do not know for sure that the degree to which we possess a given trait is governed by chance in the same way that combinations of coins are. But we do know that the normal curve represents in ideal form the range of differences among people found typically when measurement is applied to a large group. Use of the normal curve in mental measurement is warranted, therefore, on the grounds of practical utility, if for no other reason.

Differences Between Groups

One group may differ from another in mean or average achievement. Thus, Figure 243 shows the distribution of scores
In these two curves the mean has the same value for both groups but the range of scores is greater in group B than in group A.

on a test of arithmetic reasoning made by two groups of children, one group in Grade V and the other in Grade IV. Grade V has a higher average score than Grade IV, but not all the children in Grade V are better than all the children in Grade IV. There is considerable “overlapping” of the two distributions, about 20 per cent of Grade IV doing better than the average of Grade V. While most of the children in Grade V do better than those in Grade IV, the difference between the highest and lowest child in each grade is far greater than the difference between the two means.

Two groups which do not differ in mean score may differ considerably in variability, or range of score. In Figure 244 the two groups have the same mean, but their range of achievement (as shown by the spread of the curves) is quite different. To illustrate, a group of boys may make the same average
score on a reading test as a group of girls, but the boys may range both higher and lower (be more variable) than the girls, who thus are said to be more homogeneous (alike) than the boys. Two groups may differ, of course, both in mean (average) score and in variability.

**Trait Differences**

Psychologists recognize two sorts of individual differences: variations in a given trait from person to person and variations among the traits within an individual. The first are called inter-individual differences, the second, intra-individual differences. Figures 230 and 240 showed how people differ among themselves in some defined characteristic. In contrast, Figure 245 shows the variation among eight measures of performance taken upon the same individual. The eight scores represented on this test profile were earned by student WNS in the Graduate Record Examination—a test designed to measure achievement in a number of school projects. The horizontal line drawn through the middle of the diagram (at 500) represents the achievement of the average student. Performance better or

**Figure 245** Profile showing the scores made by student WNS on the graduate record examination. Five hundred is the mean or average score of a large number of persons who took the examination.
worse than average is represented by a point above or below this “mean” line. WNS is not far from the average or mean in any of his scores, but he still exhibits considerable variation in achievement. He is better, for instance, in the sciences (mathematics, physics, and biology) than in literature and fine arts, and is exactly average in the “verbal factor” (a measure of intelligence). Test profiles are especially useful in educational and vocational guidance. The counselor wants to know an examinee’s strong and weak points. He wishes to encourage a student to undertake those courses of study or to enter upon that vocation in which his chances of success are greatest. Educational and vocational advice given to the boy good in mathematics and science will ordinarily be quite different from that given the boy who ranks high in literary subjects and languages but relatively low in science.

**THE DISTINCTION BETWEEN APTITUDE AND ACHIEVEMENT**

The terms *aptitude*, *ability*, and *capacity* mean much the same thing and are often used interchangeably. When we say that a young man shows aptitude for languages, for mechanics, or for sports, we mean that he has given evidence of such aptitude through superior performance in these areas. Aptitude or capacity, then, is potential: it is revealed in performance or is inferred from performance. Aptitude has future reference, in that it sets the limits of what a person will achieve when given the opportunity and training. Achievement, on the other hand, is actual performance; it is what a person *does*, regardless of his capabilities. Aptitude often exceeds achievement. A boy may receive low grades in school when his intelligence-test scores and other evidence lead us to feel sure that he possesses ability of a high order. But achievement can never really exceed aptitude, though sometimes it may appear to do so. A dull child, for example, may receive school grades better than his capacity warrants because he is overage for his grade or is pleasant and docile, or because the teacher is
sympathetic and rewards him for trying. But the child is not bright, despite his passing grade, and his achievement does not actually surpass his ability, because it involves other factors.

In some instances we can feel fairly certain of the aptitudes which a person must possess in order to demonstrate achievement in a given task. Marked proficiency in languages, for example, clearly demands a high level of verbal ability; success in salesmanship requires good intelligence, tact, patience, and courtesy; achievement in sports demands good muscular equipment, stamina, and endurance. Even when a person possesses ability of a high order, ordinarily he can reveal his aptitude only through achievement, and such achievement may require a considerable amount of specialized training. When a group has undergone the same degree of training, achievement becomes a reasonable measure of aptitude. Let us suppose, for example, that twenty-five girls, all without previous training, enroll in a course in costume designing. At the end of the training period those girls who have made the most progress are likely to be the ones who possessed the highest aptitude at the start.

Aptitude, or potential ability, shows a fairly high degree of transference among related activities. A boy who plays baseball well is likely to be good in other sports—for example, football and track—though he may not be equally competent in all of these. The college student who has shown aptitude for mathematics is likely to be more than usually competent in physics or engineering. In cases like these, transfer of training (page 375) is brought about by the common demands of the different sports, studies, or other activities.

THE RANGE OF INDIVIDUAL DIFFERENCES

We are sometimes so impressed by the wide range of differences among people that we are tempted to conclude that a person who learns very quickly is fifty or a hundred times as able as one who learns very slowly. A school child of IQ 120, for instance, will “catch on” so much more rapidly than a child
of IQ 80 that the teacher is likely to exaggerate the patently large gap in intellectual ability between the two. The range of human abilities is undoubtedly large, but differences between low- and high-ranking people in a given trait are perhaps not so great as casual observation may lead us to believe. Most human differences are **quantitative** rather than **qualitative**. This means that the able individual possesses and draws upon a larger repertory of responses than the less able. But the able individual does not possess a different **kind** of ability, and his performances do not differ from that of the dull person in the same way that a man’s behavior differs, let us say, from that of an animal.

How do the very able and the very poor compare in performance? One method of answering this question is to compute the ratio between the **highest** and the **lowest** scores—if the highest score achieved, for example, 100, is twice the lowest, that is, 50, the ratio of highest to lowest will be 2:1. Table 17
difference ratios for a variety of traits

<table>
<thead>
<tr>
<th>trait</th>
<th>ratio of highest to lowest measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head length</td>
<td>1.2:1</td>
</tr>
<tr>
<td>Adult stature</td>
<td>1.3:1</td>
</tr>
<tr>
<td>Brain weight</td>
<td>1.6:1</td>
</tr>
<tr>
<td>Pulse rate</td>
<td>2.0:1</td>
</tr>
<tr>
<td>Reaction time</td>
<td>2.2:1</td>
</tr>
<tr>
<td>Memory span</td>
<td>2.5:1</td>
</tr>
<tr>
<td>Intelligence scores (group test)</td>
<td>2.9:1</td>
</tr>
<tr>
<td>Hard learning</td>
<td>3.9:1</td>
</tr>
</tbody>
</table>


gives “difference ratios” for a group of selected traits. Note the steady change in ratio as we go from measures of physical status and of physiological function, where the ratios are approximately 2 to 1 or less, to measures of mental ability, where the ratios may be 3 to 1 or greater. Apparently people differ more in their intellectual performances than in their physical or physiological measurements, a fact which accords with everyday observation.

Figure 247 Whether in science or in baseball, some persons are better than others.
The ratios of the best to poorest shown in Table 17 hold approximately for elementary school subjects. In Table 18, the average of the two best scores made by a group of children has been divided by the average of the two poorest scores to give difference ratios for reading, spelling, arithmetic, and writing. These ratios vary from approximately 2:1 (reading) to 3:1 (spelling, writing).

The average of the two best scores divided by the average of the two poorest scores

<table>
<thead>
<tr>
<th>school subject</th>
<th>ratios of best to poorest score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading, words per minute</td>
<td>1.9:1</td>
</tr>
<tr>
<td>Reading, value of hardest passage</td>
<td>2.5:1</td>
</tr>
<tr>
<td>comprehension</td>
<td></td>
</tr>
<tr>
<td>Word knowledge</td>
<td>2.5:1</td>
</tr>
<tr>
<td>Spelling, number words correct</td>
<td>2.9:1</td>
</tr>
<tr>
<td>Arithmetic, number of problems correct</td>
<td>2.4:1</td>
</tr>
<tr>
<td>Writing, letters per minute</td>
<td>2.7:1</td>
</tr>
</tbody>
</table>

* After Gates.

Table 19 presents still another set of efficiency ratios, this time of the best to the poorest worker in various occupations. These ratios are somewhat more convincing than are those of Tables 17 and 18, since they are concerned with actual production efficiency in gainful tasks. While the ratios range from 1.4:1 to 5.1:1, most of them hover around 2:1, indicating the best worker to be about twice as efficient as the poorest. The ratio of 2:1 is probably too low, however, since those below a certain production minimum have been eliminated. Moreover, the very inefficient are not employed at all, and the exceptionally able have often been promoted. Perhaps a ratio of 4:1 or 5:1 is a better guess of the relation of best to poorest worker in most tasks—that is, the most efficient will be four or five times as productive as the least efficient.
The ratios of the most efficient worker to the least efficient in several kinds of jobs*

<table>
<thead>
<tr>
<th>job</th>
<th>measure</th>
<th>ratio of best to poorest worker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel trimming (shoes)</td>
<td>Number pairs per day</td>
<td>1.4:1</td>
</tr>
<tr>
<td>Loom operation (silk)</td>
<td>Time loom in operation</td>
<td>1.5:1</td>
</tr>
<tr>
<td>Hosiery maters</td>
<td>Hourly piecework earning</td>
<td>1.9:1</td>
</tr>
<tr>
<td>Loom operation (fancy cotton)</td>
<td>Earnings</td>
<td>2.0:1</td>
</tr>
<tr>
<td>Button scoring (shoes)</td>
<td>Number pairs per day</td>
<td>2.0:1</td>
</tr>
<tr>
<td>Knitting machine operation</td>
<td>Pounds of women’s hose per hour</td>
<td>2.2:1</td>
</tr>
<tr>
<td>Office boys</td>
<td>Weekly salary</td>
<td>2.3:1</td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>Ratings of superiors</td>
<td>2.5:1</td>
</tr>
<tr>
<td>Polishing spoons</td>
<td>Time per 36 spoons</td>
<td>5.1:1</td>
</tr>
</tbody>
</table>


While difference ratios provide a rough comparison of the ranges of performance, these ratios—like many others—are open to mathematical as well as psychological objections. One is that the highest and the lowest scores will vary with the group tested; so that the exact values of the ratios computed are uncertain. Another is that the units of measurement in mental tests are often unstable and hence unsuitable for the calculation of ratios. Difference ratios, moreover, can hardly apply to exceptional individuals—either to those who rank very high or to those who rank very low. The mathematical genius, for example, is so far ahead of the idiot in his ability to employ abstract symbols that no real basis exists for comparing the two. Despite these drawbacks to the use of ratios, it is revealing and perhaps comforting to discover that within an ordinary group of workers the better people are not overwhelmingly superior to the poorer. In fact, personality traits and work habits are often of more importance in determining a worker’s success than the degree of aptitude which he possesses. One
survey has concluded after a study of 10,000 job holders that a major part of the difference between a good and a poor worker can be ascribed to personal characteristics, a relatively small part being assigned to aptitude. This conclusion, to be sure, must be sharply qualified, since all of these workers were “on the job” and hence possessed at least enough ability to be hired in the first place. Aptitude differences, accordingly, were greatly reduced and personality differences accentuated to a greater degree than would ordinarily have been the case. At the same time, the fact that differences in job success are so highly related to differences in personality is a significant finding.

RELATIONSHIPS AMONG TRAITS

A great deal of research has been devoted to a study of the relationships existing among mental and physical traits. A knowledge of trait relationships is of great theoretical importance to psychologists interested in mental organization—that is, in the patterns of relationship found among mental and physical abilities as well as among personality traits. On the practical side, a knowledge of trait relationships is important to the counselor or vocational adviser, who wishes to know, for example, whether proficiency in mathematics is related to mechanical ability, whether good vocabulary is an index of intelligence, whether interest and aptitude tests are indicative of educational and vocational success.

The relationship between two sets of scores or other measures can be determined by a mathematical method which yields an index of mutual association, or correlation. Correlation coefficients range from +1.00 through 0.00 to −1.00. A correlation coefficient of +1.00 means that the person who stands highest in the one trait also stands highest in the other, and that throughout the list the correspondence is exact and 1:1. In a group of ten boys, for example, if the boy who ranks highest in mechanical aptitude also ranks highest in mechanical interest, and if the correspondence between aptitude and interest score
is 1:1 throughout, the correlation is +1.00, or perfect. Perfect correlation is rarely if ever found in practice, though high coefficients (.70 to .85) are sometimes obtained. Most correlations among measures of achievement and special aptitude are lower than this. For instance, the relationship between first-year marks in college and intelligence as measured by an adequate test is expressed typically by a correlation coefficient of about +.45. Tests of memory, perception, learning, association, and other mental functions correlate positively, though the relationship is rarely higher than +.50 to +.60.

A correlation of .00 implies a complete lack of relationship between the two variables under study. The correlation between measures of abstract intelligence and the speed of arm and finger movements (as measured by the number of taps made with a pencil in the course of a minute) is close to zero. This means that bright people perform this simple activity no more efficiently than the less bright—a result probably to be expected. Many studies have shown that physical dimensions, height, weight, and head size correlate close to zero with such mental abilities as memory, learning, and intelligence.

A negative correlation means that a person who ranks high in one trait ranks low in the other. For instance, in a class of boys, achievement in Latin may correlate negatively with athletic prowess as demonstrated in sports. Negative correlation is rarely if ever found among mental tests, though measures of sensory efficiency and physical strength may correlate negatively with mental ability.

Table 20 presents some sample correlations drawn from various sources. Measures of physical size and strength are related to each other but bear little relationship to tests of school knowledge and intelligence. Grades in school and in college correlate highly (but not perfectly) with objective tests in specific school subjects, especially in English and mathematics. Aptitude tests—for example, those of clerical and mechanical ability—have definite prognostic value for jobs and vocations which require these abilities. There is little or no
relationship between reported neurotic symptoms (fears, worries, anxieties) and intelligence-test score. But the better students tend to be somewhat more “introverted,” or shut-in, than the poorer. Neuroticism as determined from questionnaires is negatively related to measures of dominance.

20 Sample correlations showing relationships among various attributes and traits

<table>
<thead>
<tr>
<th>Physical measure</th>
<th>Correlation coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height and weight (men)</td>
<td>.50 to .60</td>
</tr>
<tr>
<td>Head size and intelligence (men)</td>
<td>close to .00</td>
</tr>
<tr>
<td>Height and strength of grip</td>
<td>.40 to .50</td>
</tr>
<tr>
<td>Weight and intelligence (men)</td>
<td>.00 to -.10</td>
</tr>
<tr>
<td>Vocabulary and spelling</td>
<td>.50 to .60</td>
</tr>
<tr>
<td>Grades in college (1st year) and intelligence</td>
<td>.40 to .50</td>
</tr>
<tr>
<td>Intelligence and mechanical ability (adults)</td>
<td>.20 to .50</td>
</tr>
<tr>
<td>Grades and educational achievement tests</td>
<td>.60 to .70</td>
</tr>
<tr>
<td>Verbal and performance tests (children)</td>
<td>about .40</td>
</tr>
<tr>
<td>Memory and verbal learning</td>
<td>.60</td>
</tr>
<tr>
<td>School subjects (that is, history and mathematics)</td>
<td>.30 to .50</td>
</tr>
<tr>
<td>Personality-aptitudes</td>
<td></td>
</tr>
<tr>
<td>Cheating and intelligence (school children)</td>
<td>-.50 to -.60</td>
</tr>
<tr>
<td>Neurotic symptoms (questionnaire) and intelligence tests</td>
<td>close to .00</td>
</tr>
<tr>
<td>Job performance and clerical aptitude tests</td>
<td>.20 to .30</td>
</tr>
<tr>
<td>Introversion and college grades</td>
<td>.35</td>
</tr>
<tr>
<td>Job performance and mechanical aptitude tests</td>
<td>.25 to .65</td>
</tr>
<tr>
<td>Interest and grades (college)</td>
<td>.50 to .80</td>
</tr>
<tr>
<td>Self-sufficiency and dominance</td>
<td>.40 to .60</td>
</tr>
<tr>
<td>Neuroticism and dominance</td>
<td>-.50 to -.70</td>
</tr>
</tbody>
</table>

general and specific abilities

Abilities may be classified into those which are broad and general (cut across a number of activities) and those which are
narrow and relatively specific. This distinction is not a precise and mutually exclusive one, to be sure, but it is useful and convenient for practical purposes. By far the largest number of general-ability tests have been designed to measure intelligence and school achievement (in English, mathematics, history, and the like). These tests are good indicators of aptitude for schoolwork (page 480) and are useful in identifying and selecting individuals for occupations which require school training.

General test batteries have also been constructed for determining the aptitudes required in mechanical and clerical work. Mechanical aptitude is needed in jobs which demand a knowledge of machinery, the comprehension of mechanical relationships, and the use of tools. Clerical ability enters into a large group of office tasks, such as typing, bookkeeping, checking, and filing.

Specific abilities and special skills are measured by a variety of oral, written, and performance tests. Trade tests determine a candidate’s level of proficiency in a given job (carpentry, plumbing), and tests calling for special knowledge and skill aid in the selection of individuals likely to be successful in the professions—medicine, engineering, law. Tests have been constructed also for measuring achievement in art and music and for locating individuals who in advance of training show marked talent. When possessed in high degree, aptitude for art and music is often spoken of as talent.

tests of general abilities

GENERAL INTELLIGENCE AND SCHOOL PERFORMANCE

The correlations between intelligence-test scores and school performance are high (page 516) but are by no means perfect. This means that a child’s success in school depends upon many
factors other than intelligence, including health, work habits, and personality traits. But the score which a child earns on an adequate intelligence test is still the best indicator of probable school achievement. Students must possess a minimum of abstract ability in order to succeed in school, no matter how hard they work. The educational expectation of a schoolchild, therefore, can be predicted fairly accurately from his intelligence level (page 480).

Group tests of general intelligence have been used successfully to select promising college students. When intelligence tests are combined with high-school records, measures of educational achievement, estimates of personality traits, and work habits, the prediction of school success is much more reliable than prediction from intelligence-test scores alone.

GENERAL INTELLIGENCE AND OCCUPATIONAL SUCCESS

Intelligence tests are indicative of aptitude for various occupations. Table 21, on page 519 gives the mean score and the range of scores in the Army General Classification Test achieved by men in twenty selected occupations. This test requires the ability to deal with language relations, to do simple mathematics, and to solve problems expressed in geometric or spatial terms. Working time is approximately forty-five minutes.

Two facts in Table 21 are noteworthy. First is the steady rise in score as we go up the occupational ladder from unskilled labor to the professional levels. Second is the wide range of scores at each level. It is clear that while machinists are in general "more intelligent" than truck drivers, some truck drivers are more intelligent than most machinists. Part of the increase in AGCT score shown in Table 21 can undoubtedly be attributed to the more extensive training—and in consequence the more stringent selection—required in the professions. At the same time it must be remembered that the education which a man can absorb is in itself a good index of his in-
Mean general classification test standard scores, standard deviations and range of scores, for army air force white enlisted men by civilian occupation.

<table>
<thead>
<tr>
<th>Civilian Occupation</th>
<th>Number of Cases</th>
<th>Mean Score</th>
<th>Standard Deviation</th>
<th>Range of Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountant</td>
<td>172</td>
<td>128.1</td>
<td>11.7</td>
<td>94-157</td>
</tr>
<tr>
<td>Lawyer</td>
<td>94</td>
<td>127.6</td>
<td>10.9</td>
<td>96-157</td>
</tr>
<tr>
<td>Teacher</td>
<td>256</td>
<td>122.8</td>
<td>12.8</td>
<td>76-155</td>
</tr>
<tr>
<td>Stenographer</td>
<td>147</td>
<td>121.0</td>
<td>12.5</td>
<td>66-151</td>
</tr>
<tr>
<td>Bookkeeper</td>
<td>272</td>
<td>120.0</td>
<td>13.1</td>
<td>70-157</td>
</tr>
<tr>
<td>Clerk, General</td>
<td>496</td>
<td>117.5</td>
<td>13.0</td>
<td>68-155</td>
</tr>
<tr>
<td>Clerk-Typist</td>
<td>468</td>
<td>116.8</td>
<td>12.0</td>
<td>80-147</td>
</tr>
<tr>
<td>Salesman</td>
<td>494</td>
<td>115.1</td>
<td>15.7</td>
<td>60-153</td>
</tr>
<tr>
<td>Manager, Retail Store</td>
<td>420</td>
<td>114.0</td>
<td>15.7</td>
<td>52-151</td>
</tr>
<tr>
<td>Receiving and Shipping Clerk</td>
<td>486</td>
<td>111.3</td>
<td>16.4</td>
<td>58-155</td>
</tr>
<tr>
<td>Machinist</td>
<td>456</td>
<td>110.1</td>
<td>16.1</td>
<td>38-153</td>
</tr>
<tr>
<td>Sheet Metal Worker</td>
<td>498</td>
<td>107.5</td>
<td>15.3</td>
<td>62-153</td>
</tr>
<tr>
<td>Mechanic</td>
<td>421</td>
<td>106.3</td>
<td>16.0</td>
<td>60-155</td>
</tr>
<tr>
<td>Butcher</td>
<td>259</td>
<td>102.9</td>
<td>17.1</td>
<td>42-147</td>
</tr>
<tr>
<td>Carpenter, Construction</td>
<td>451</td>
<td>102.1</td>
<td>19.5</td>
<td>42-147</td>
</tr>
<tr>
<td>Cook and Baker</td>
<td>436</td>
<td>97.2</td>
<td>20.8</td>
<td>20-147</td>
</tr>
<tr>
<td>Truck Driver</td>
<td>817</td>
<td>96.2</td>
<td>19.7</td>
<td>16-149</td>
</tr>
<tr>
<td>Laborer</td>
<td>856</td>
<td>95.8</td>
<td>20.1</td>
<td>26-145</td>
</tr>
<tr>
<td>Farmer</td>
<td>700</td>
<td>92.7</td>
<td>21.8</td>
<td>24-147</td>
</tr>
<tr>
<td>Farmhand</td>
<td>817</td>
<td>91.4</td>
<td>20.7</td>
<td>24-141</td>
</tr>
</tbody>
</table>

* Data from T. W. Harrell and M. S. Harrell, “Army general classification test scores for civilian occupations,” Educational and psychological measurement, 1945, 5: 231–232.

Intelligence. Men capable of becoming engineers or lawyers will in general possess a substantially higher degree of “abstract intelligence” than men who become carpenters and clerks.

Mechanical Ability

The term mechanical ability covers so many activities that it is difficult to define it precisely. Aptitude for mechanical tasks draws upon a number of traits: in varying degree it demands the ability to deal with mechanical relationships, manipulative and motor skill, visual acuity, strength, dexterity, and hand-
eye co-ordination. Mechanical relations may be concrete and tangible when, for instance, one is working with the interacting parts of a complex machine. But mechanical relations may also be quite abstract, as for example when one works with diagrams, plans, and mathematical equations. The first ability is perhaps more useful to the skilled worker, the second to the engineer.

MECHANICAL ABILITY TESTS

Mechanical ability tests are less specialized than oral trade questions (page 526) but are often used for much the same purpose. These tests may be paper-and-pencil examinations containing questions and problems which involve mechanical knowledge and the ability to think in concrete terms. Mechanical ability tests also include a number of ingenious performance tests. These make use of form and assembly boards, mechanical gadgets to be manipulated in some way, and tests of manual
dexterity, of co-ordination, of speed, and of the ability to visualize and comprehend spatial relations. Printed tests of mechanical ability cover in general (a) basic information about tools and their uses; (b) the ability to solve problems in geometric terms; (c) comprehension of mechanical principles; and (d) interest in and knowledge of mechanical things (on the assumption that the examinee who likes and uses tools, who has built airplanes and machines, will probably possess mechanical ability). Figure 249 shows items which require knowledge of and interest in mechanical relations for their solution.

**FIGURE 249** Specimen items from tests of mechanical aptitude.

If a man were lifting a stone with this crowbar, at which point would the bar be most likely to break?

From: The Bennett test mechanical comprehension, Form AA, Psychological Corp.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From: Detroit mechanical aptitudes examination for boys, Test 6, Public School Publishing Co.

In A, in the first line, marks are drawn through the two pieces in the row which when put together will make the square in the first box. For B, the directions are to mark the two pieces (that is, 2 and 5) which when put together will make the rectangle in the box.

A. A jack-knife will cut 1 gold 2 iron 3 steel 4 wood ( )

Directions are to put in the ( ) at the end of the line the number of the word which tells what a jack-knife will do.
Figure 250 Tests of dexterity and coordination in the use of tweezers help to predict success in such occupations as watchmaking.

Figure 251 shows two specimen items from representative mechanical comprehension tests designed to measure the ability to solve problems which make use of tools and involve mechanical relations. A complex coordination apparatus was developed for testing candidates for commissions as pilots in the Air Force during World War II. The student's task was to work the rudder (with the feet) and the stick (with hand) in response to signals flashed on the board placed just before him. A period of instruction was first allowed in which the candidate worked with rudder and stick, singly and together. Time of response to a new signal pattern was measured in the
The test proper. The test had good prognostic value. Of those students with shortest reaction times, 74 per cent graduated as pilots; of those with longest reaction times, only 14 per cent graduated.

Figure 251
Upper: Minnesota spatial relations test.
Lower: Minnesota assembly test, Box B.

From: D. Paterson, R. M. Elliott, and others, Minnesota mechanical ability tests, Univ. of Minn. Press, 1932.
CLERICAL ABILITY

Clerical tests have in general been designed to measure the aptitudes of several classes of office worker: general clerk, typist, stenographer, and the operators of various sorts of machines and tabulating equipment. Tests for clerical workers are substantially related to supervisory ratings for job efficiency. Figures 252 and 253 present specimen items from two clerical aptitude tests. These examinations measure speed of reading, accuracy and quickness in checking errors, speed in computation, and the like. Clerical workers score higher on abstract intelligence tests than do manual workers, partly because of the fact that clerical work calls for operations demanded by the usual paper-and-pencil intelligence tests.

Samples done correctly of pairs of Numbers

79542    79524

5794367  √  5794367

Samples done correctly of pairs of Names

John C. Linder    John C. Lender

Investors Syndicate  √  Investors Syndicate

Now try the samples below.

66273894    66273984

527384578  527384578

New York World    New York World

Cargill Grain Co.    Cargil Grain Co.

This is a test for Speed and Accuracy. Work as fast as you can without making mistakes. Do not turn this page until you are told to begin.

From: Minnesota vocational test for clerical workers, Psychological Corp.

FIGURE 252  Specimen item from clerical aptitude test.
SAMPLES

Sample I. You are to file alphabetically in the file drawers shown at the right. Each drawer contains six folders. After each of the names listed below the third file drawer, you are to write the number of the folder in which that name should be filed.

The first name, "Appel," should be filed in the folder for names from Ap to Az. This folder is numbered 3, so 3 is written after the name "Appel." The second name, "Cecil," should be filed between Ca and Cg, which is folder No. 7, so 3 is written after it. "Denby" is written in folder "Da-Dh", so write 10 after "Denby." Next write the number of the folder in which "Earl" should be filed. The number of the correct folder is 13.

Sample II. Write a C after the name of each man in the list at the right who is a teacher, is between 25 and 40 years of age, and resides in either Indiana or Illinois.

Nothing is written after Mr. Beach's name, as his residence is neither Indiana nor Illinois. C is written after Mr. Mark's name, as he is a teacher, is between 25 and 40, and resides in Indiana. You should not write anything after Mr. Savoy's name, as he is not a teacher. Write C after Mr. Bard's name as he is a teacher, is 31 years old, and is from Illinois.

Sample III. If the name, the address, and the charge are not exactly the same in the copy as in the original, X is to be written on the line at the right. If the copy is the same as the original, write S.

<table>
<thead>
<tr>
<th>Original</th>
<th>Copy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Address</td>
</tr>
<tr>
<td>Harris, E. G.</td>
<td>33 Oak St.</td>
</tr>
<tr>
<td>Graves, L. R.</td>
<td>21 Rex Ave.</td>
</tr>
<tr>
<td>Overt, P. W.</td>
<td>15 End St.</td>
</tr>
</tbody>
</table>

The first is marked X because the address was copied incorrectly. S is written after the second, as the name, address, and charge were all copied exactly as in the original. In the third, a mistake was made in copying the charge, so write X on the line.


FIGURE 253 Specimen item from clerical aptitude tests.

Figure 254 shows graphically the predictive value of a clerical aptitude test used in the Army. Note that fifty-five out of every hundred men who achieve a score of 140 should succeed in later training courses, whereas only one out of every hundred men who achieve a score of 60 will probably succeed. Expectancy charts of this sort are especially useful in guidance.

INTERESTS AND APTITUDES

Achievement in a given vocation depends upon the possession of definite personality traits, as well as upon the requisite mental and physical ability. Sometimes a candidate is able to meet the requirements for several vocations. His choice, then, must

tests of general abilities   THIRTEEN  525
The diagram shows the chances in 100 that a man receiving one of the above scores on a clerical aptitude test will do average or better in training.

depend upon whether his interests and personality characteristics are such as to make his expectation of success greater for one sort of work than for another. Questionnaires designed to determine interests in people, in science, in business, and in the literary and artistic pursuits are treated in Chapter 14.

tests of special abilities

The tests described in this section are more specific and specialized in content than are the tests of general abilities just described.

oral trade questions

Oral trade questions have been widely used by the U.S. Employment Service in the identification and classification of various sorts of workers. Trade questions are drawn up after consultation with experts in the given vocation, and the value
of each question is determined by examining workers who are actually on the job. Only those questions (usually twelve to fifteen) are retained which separate the expert in a given job from apprentices and those in related occupations. (The related occupation group consists of those whose work is somewhat like but is not identical with the job under study.) In general a trade question is considered satisfactory when it is answered correctly by at least 80 per cent of the experts in the trade, by not more than 50 per cent of apprentices and helpers, and by less than 10 per cent of those in related occupations.

To illustrate the use of oral trade questions, of the fifteen questions set up for painters, 78 per cent of expert painters scored above a critical score of 8 on the test, whereas only 17 per cent of the apprentice group and none of the related workers scored above 8. Only 8 per cent of the experts scored in the lowest bracket (0 to 5), as compared with 43 per cent of the apprentices and 96 per cent of the related workers. Unless questions are simple, direct, and put in the language of the trade, they are likely to be of little value. A highly skilled welder or plasterer cannot always tell an interviewer how he does a certain job. He knows how, but he cannot put it into words. Nor can the interviewer usually judge the degree of expertness revealed by the answer. A specific question, on the other hand, which requires a definite answer, such as “What do you call the method of marking a board to fit into an irregular space?” (answer: scribing), or “What is the effect of too much flux on cast iron?” (answer: hardens it) can be evaluated by an interviewer. (The first of these questions is intended for carpenters, the second for welders.) Oral trade questions have been criticized because they measure knowledge about a trade rather than actual skill in the trade itself. But this objection is not very important: the correlation between knowledge and skill in a trade has been found to be very high. Furthermore, only those questions are retained which differentiate sharply between levels of expertness. A well-made oral trade test is useful in enabling an interviewer to determine in a short
time the degree of proficiency possessed by an applicant in one or more occupations. Specific trade questions have been formulated and validated for well over one hundred occupations, many of them requiring considerable mechanical skill.

other special ability tests

A number of aptitude tests were developed for various jobs during World War II. One of these, the Army Radio Code Aptitude Test, requires the learning and recognition of the code signals for specified letters of the alphabet. Stimuli (code signals) are presented by phonograph records. The test proper is preceded by a learning period, during which the code signals are sounded, accompanied by the equivalent letter. In the test itself the signals alone are presented in random order, and the examinee indicates which letter the signal represents. Table 22 shows the relationship between test scores and code-receiving speed in several classes after two months of training. The relationship is expressed as the percentage of men within certain score ranges of the test who later exceeded a code-receiving speed of twelve words per minute. It is clear that of the men scoring 130 or above on the test, 87 per cent reached or exceeded this rate after two months of training. Of those men

22 Performance in code-receiving speed after two months of training compared with scores on the ARC-1

<table>
<thead>
<tr>
<th>performance</th>
<th>score range</th>
<th>per cent receiving at the rate of twelve words per minute or better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>130 and above</td>
<td>87</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>110–129</td>
<td>70</td>
</tr>
<tr>
<td>Low</td>
<td>100–129</td>
<td>48</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>Below 100</td>
<td>32</td>
</tr>
</tbody>
</table>

who scored below 100, only 32 per cent reached the level of twelve words per minute.

Figure 255 is an interesting illustration of the relationship between scores on airplane-pilot selection tests and the percentage of men eliminated in primary pilot training. During World War II, 185,367 men were tested by aviation psychologists for pilot aptitude and were followed through their training in order to check the predictive value of the test. It is clear from Figure 255 that of those applicants who made a score of 9, the highest score, only 4 per cent were dropped, 96 per cent completing the training; while of those making a score of 1, the poorest score, 77 per cent were dropped, only 23 per cent completing primary pilot training. These results are both significant and valuable. By training only those most likely to succeed, the Army Air Force is enabled to cut training costs, save equipment and lives, and produce superior pilots.
aptitude in the professions

MEDICINE

Aptitude tests designed for use in medical schools attempt to predict probable success in medical courses of pre-medical and first-year medical students. In general such tests measure scientific vocabulary, premedical information, visual memory, memory for the content of difficult scientific prose, and the comprehension and retention of technical forms. These are the aptitudes which a job analysis of the medical curriculum indicated to be important and significant. The results of one application of a well-known aptitude test for medical schools are shown in Figure 256. There is considerable overlap in the school performance of those who ranked high, medium, and low on the test, but at the same time the test does sort out those most likely to succeed. In a study of students in thirty medical schools, those whose aptitude scores placed them in the highest 10 per cent of the group upon entrance had school records as follows: 10 per cent, 90 or above; 83 per cent, 80 to 89; and only 7 per cent, 75 to 79. In another study, 1,000 students in fourteen medical schools were followed through four years of training. Of those

Figure 256 The relation between medical aptitude rating and success in medical school. The bars show the per cent of failures among those who ranked high, low, and medium on the test. As the test score drops, the failures increase.

After Moss

<table>
<thead>
<tr>
<th>APTITUDE TEST RANK</th>
<th>PER CENT GRADUATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>86.3</td>
</tr>
<tr>
<td>Second</td>
<td>84.9</td>
</tr>
<tr>
<td>Third</td>
<td>84.9</td>
</tr>
<tr>
<td>Fourth</td>
<td>83.7</td>
</tr>
<tr>
<td>Fifth</td>
<td>83.4</td>
</tr>
<tr>
<td>Sixth</td>
<td>83.1</td>
</tr>
<tr>
<td>Seventh</td>
<td>82.4</td>
</tr>
<tr>
<td>Eighth</td>
<td>81.7</td>
</tr>
<tr>
<td>Ninth</td>
<td>81.6</td>
</tr>
<tr>
<td>Lowest</td>
<td>75.0</td>
</tr>
</tbody>
</table>

AVERAGE MEDICAL SCHOOL GRADE

[Graduates] [Failures]
scoring in the lowest 25 per cent on the test, 53 per cent failed to graduate, while 60 per cent in the lowest tenth of the class failed to graduate. All of the students in the highest tenth were graduated. Used in conjunction with previous school record, interest tests, and biographical and health data, aptitude tests of this sort are extremely valuable in prognosis.

Studies of the relative prestige of various professions have shown that college students rank medicine first, banking second, and law third. In view of the importance attached to the work of the physician by people in general, it is extremely important that a careful selection of candidates for medical school be made.

LAW

Tests of aptitude for the study of law demand of the student: comprehension of difficult reading material, accurate recall, ability to reason by analogy and by analysis, and skill in logic. Results from a law aptitude examination in eight law schools are shown in Table 23. It appears from the table that of those

<table>
<thead>
<tr>
<th>RANK IN LAW APTITUDE EXAMINATION</th>
<th>first semester marks in law school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Highest quarter</td>
<td>15%</td>
</tr>
<tr>
<td>Second quarter</td>
<td>18%</td>
</tr>
<tr>
<td>Third quarter</td>
<td>0%</td>
</tr>
<tr>
<td>Lowest quarter</td>
<td>0%</td>
</tr>
</tbody>
</table>


students who were in the highest quarter in the examination, 52 per cent (15 + 37) received marks of A or B. Only 9 per cent of the students whose marks were D had been in the
highest quarter. While school record is in general a better predictor of success in law school than is the aptitude test, the test and the school record considered together are better than either alone.

Since 1948, the Law School Admission Test of the Educational Testing Service has been administered to 36,000 candidates for admission to more than a hundred law schools. When combined with high-school marks, the correlation of this three and one-half hour aptitude test with three-year marks in law school is .54. This is a better prediction than that based on first year of law school alone (.50).

**SCIENCE AND ENGINEERING**

In addition to mathematics, tests of engineering aptitude usually include measures of the ability to solve problems demanding a high degree of abstraction and visualization. Tests of aptitude for science contain questions and problems designed to measure experimental interest, the ability to reason clearly and to detect fallacies, and accuracy of observation in selecting and interpreting data. On general achievement tests, candidates for science and engineering are expected to achieve higher scores in mathematics and science than in other subjects (page 507). Questionnaires are useful in narrowing down the area of science in which a candidate possesses especial interests.

**aptitude in music and art**

**MUSIC**

Tests of music are in general of two kinds. The first determines the “ear for music”—that is, aptitude in musical perception. The second measures general achievement and extent of musical education and technical knowledge of theory, harmony, and the like. The Seashore Test of Musical Talent is by all
odds the best-known measure of musical ear. This test may be used with children in the grades, as well as with adults. It consists of six double-disk records which can be played on any standard phonograph. These records measure pitch discrimination, judgment of intensity, of time, of rhythm, of timbre, and of tonal memory. A revision of these tests (1939) provides three difficulty levels. Series A is for unselected people and Series B is for musical groups. Series C is a more precise test for use with individuals. A keen ear for music, as revealed by these records, does not necessarily mean that a person is a musician or will become one. At the same time, good musical perception is certainly a prerequisite to a successful career in music. A profile showing the variations in performance of a subject on the Seashore Test is reproduced in Figure 257.
Tests of musical achievement measure ability in sight reading, musical information and appreciation, and the knowledge of technical terms. These tests are useful in schools of music as measures of aptitude for students who have had the same training.

ART

Aptitude tests in the field of art measure an examinee's appreciation and judgment against that of recognized experts. In one test, pictures printed in photochrome and resembling etchings are presented to the examinee. Pictures are arranged in pairs and are alike except in one important aspect. The examinee is told in what respect the pictures differ and must decide which is the more pleasing, the more artistic, the more satisfying. (See Figure 258, below.) In another test, four treatments of the same theme are presented, and the examinee indicates which in his judgment is the most artistic. In tests of this sort, artistic appreciation and "good taste" in art are determined by the degree to which the judgment of the examinee concurs with that of recognized experts.

Figure 258 The redrawing on the left is definitely inferior, in rhythm and balance, to the original Japanese print from which it was taken.

From: The Meier Art Tests, by Norman Charles Meier, University of Iowa.
An aptitude test is not a set of questions, miniature performances, puzzles, and other gadgets assembled in the pious hope that somehow it will measure proficiency for a job or vocation. On the contrary, the construction of an aptitude test follows certain definite procedures and demands considerable psychological and statistical skill. The general steps to be followed in devising an aptitude test are as follows:

(1) JOB ANALYSIS

The psychologist first makes an analysis of the job, vocation, or other activity in order to determine the probable abilities, fundamental skills, and personality traits required. For example, if the tests are to be used in the selection of factory workers, he observes carefully the actual operations, often learning them himself. During the war, psychologists underwent various courses of training, flew airplanes, and acquired technical skill in order to study traits for which aptitude tests were to be made. From his analysis the psychologist draws up a list of specifications covering the activities and operations which the tests are to gauge.

(2) TENTATIVE SELECTION OR CONSTRUCTION OF TESTS WHICH WILL PRESUMABLY MEASURE THE TRAITS REVEALED BY JOB ANALYSIS

Analysis of the duties performed by clerks in large business offices, for example, revealed certain skills which appeared to be highly important for success. Tests were then constructed to measure efficiency in the following operations: name checking, number checking, coding, vocabulary, and the checking of catalogue numbers. While these tests admittedly do not cover all the duties which a clerk must perform, they sample some of the more important. A job analysis of the mechanical
After tests have revealed the student’s aptitudes, it still remains for the college advisor to help him select his courses.

work performed by various special groups in the Army led to the construction of tests designed to measure ability to perform simple arithmetic, to apply mechanical principles to the solution of problems, to demonstrate the operation of gears and pulleys, and to know the uses of various tools.

(3) Experimental Tryout of the Test

An aptitude test is said to be valid when it measures what it is intended to measure. A tentative battery of clerical tests, for example, is validated by administering it to a large number of clerks and comparing the test scores with efficiency ratings on the job. Often the clerks will be divided into three groups: those who are very good, those who are reasonably satisfactory, and those who show little ability. Specific test items are then
examined to see whether the very good clerks solve an item correctly more often than the poor clerks, with the satisfactory group in between. This validation procedure is called *item-analysis*. It makes for *internal consistency* (closeness of relationship) within the test by enabling the person who is constructing the test to remove items which do not differentiate between good, medium, and poor performances.

An aptitude test must be *reliable* as well as valid. Reliability is a matter of the degree of confidence which we can place in a test score. If the scores achieved by the same person upon two administrations of the test battery (or upon two equivalent forms of the test) are closely similar, the correlation of the test scores on the two occasions will be quite high, and the test is consistent or reliable. Standard tests of aptitude and achievement possess satisfactory reliability.

(4) **Setting up directions for administration and scoring; the establishment of norms**

Careful directions for giving and scoring the test battery are worked out during the process of validation. *Norms*, or typical scores (means or medians) for people of different degrees of experience or competence, are tabulated. From these norms the aptitude of an examinee can be evaluated in relation to the achievement of those who have had the same training or fall into the same classification as he.

(5) **Follow-up studies to determine the predictive value of the test battery in selection and in vocational guidance**

The ultimate value of an aptitude test is determined by how well it works out in practice. When the scores earned by examinees are compared with their achievement later on, whether in a job or in medical or law school, the extent of agreement provides a final test of the predictive value of the battery.
correspondence between scores and achievement leads us to place confidence in the value of the test battery.

**vocational guidance**

Vocational guidance is a broad and complex field, one which can be touched on only briefly here. In the main, a counselor’s services consist in (a) evaluating the education, work history, interests, and personality characteristics of the examinee; (b) administering tests to determine aptitudes and level of achievement; and (c) suggesting those work areas within which the individual is most likely to succeed. Studies have shown that a person’s self-appraisal is likely to be poor, and that in many instances a young person does not know the precise requirements of the job to which he aspires. Elementary-school children, when asked to state what they “would like to be” when they grow up, often make choices which are unwise or are clearly impractical (if not impossible) of attainment. Many of the brighter students, for instance, select semiskilled trades and report no plans to go to college, while many slow and even dull pupils aspire to the professions. For a young person casting around for a vocation, the following list represents a minimum of what he should know about a job.

(1) What general education is required? What special training is needed, where can you get it, and what will it cost?

(2) What special abilities are demanded, and do you possess them? What are the physical demands: does the work require a high degree of physical strength and stamina, good eyesight, and good hearing?

(3) What are the interests and satisfactions to be derived from this job? What are the earnings and the possibilities of advancement?

(4) What security does this job give; how much prestige—social, economic, and so on—does it carry?

Let us illustrate the usefulness of this inventory by con-
sidering the case of a young man who is planning to study engineering. From teachers, bulletins, and catalogues he can readily determine educational requirements and the probable costs. His aptitude for science, strength and stamina, eyesight, and hearing can be measured by various sensory-motor and aptitude tests. His interest in engineering can be estimated from one of the vocational interest blanks described in Chapter 14. Statistics are readily available on the number of engineers and the income that a beginner can reasonably expect. A person's choice of a profession is more likely to lead to success and satisfaction when it is made with such full knowledge of probable fitness than when it is determined by family pressures, financial considerations, and social prestige.

The vocational counselor is rarely competent to tell an individual precisely what work he will do best. But in many cases he can help a person discover the "family" of vocations for which he shows the greatest promise, leaving the final choice to the person himself. To illustrate, suppose that a young man who has worked in an accountancy firm for several years with indifferent success becomes dissatisfied and decides to change. The problem is to find a vocation in which the promise of success will be greater. If our young man possesses good verbal facility and pleasing personality traits but only slight mathematical ability and average educational background, the counselor may suggest some kind of selling as offering a better opportunity than accountancy. Interviews, personality studies, and aptitude and achievement tests have proved to be of decided help in indicating to an examinee his relative strengths and weaknesses so that he will not waste time in attempting work for which he is ill fitted.

summary

It is a common observation that people differ from one another in physical, mental, and personal characteristics. The form of dis-
distribution which such differences take follows in general the normal probability curve: a great many people fall at the middle of the scale and relatively few at either the upper or the lower extreme. In general, the best workers are from two to three times as efficient as the poorest, instead of fifty to a hundred times, as is often imagined. There is considerable variation among the traits within an individual. Profiles or graphs showing the ups and downs of a person's abilities are useful in vocational and educational guidance.

The relationships among traits varies from relatively high to quite low. Physical traits (height, weight, strength) are substantially related; mental and educational achievement scores also show positive and often strong relationships. Measures of personality are in general indifferently related to general intelligence and to special aptitudes. Many tests have been constructed to measure special aptitudes, as well as general abilities. General ability tests (intelligence, mechanical, clerical) have proved useful in predicting occupational success as it involves performance in mechanical and clerical jobs. Special ability tests are widely employed to assay aptitude for the various trades, as well as for the professions—medicine, law, engineering. Aptitude examinations not only measure present competence but also give an estimate of potential ability. Tests in art and music are available as indexes of talent.

Aptitude tests are carefully made examinations. A job is analyzed into its basic requirements, tests are selected or designed to measure aptitudes presumed to meet these requirements, and an experimental tryout is undertaken. Follow-up studies, directions for administering, and norms for various groups are then set up. On the basis of standard tests, interviews, questionnaires, and vocational history, the psychological counselor is able to give a person valid information concerning the probability of his success in a given field.

questions and topics for discussion

1. What would be the consequences for society if all men were in fact created equal in intelligence and in aptitudes?
2. Would you expect a class of first-grade children
in a public school to differ more in mental than in physical abilities?

3. Why is it that two lawyers with the same training are not always equally successful?

4. Cite instances in which accomplishment seems to exceed aptitude. Can you explain them?

5. Would you rather differ widely in your aptitudes or possess good, but not exceptional, aptitude for a number of tasks?

6. Is it true that "a jack of all trades (is) master of none"?

7. Can a man possess too much aptitude for his job?

8. The correlation between intelligence and cheating is negative and fairly high but it is not perfect. Why should a very bright youngster cheat?

9. In some colleges and grades, A, B, C, D, and F are given; in others only two grades, P (passed) and F (failed). Which system do you prefer and why?

10. In which of the following is a high degree of intelligence probably necessary: driving a truck, taking shorthand dictation, selling insurance, plumbing, writing short stories? What other aptitudes are important?

11. What are some of the differences between an aptitude test and an ordinary school examination?

12. Which of the following practices are psychologically sound?

   a) On a long hike insisting that everyone keep in step.
   b) Organizing Boy Scout companies in which every boy is of the same height.
   c) Prescribing exactly the same curriculum for all students.
   d) Giving credit to every student who passes the examination in a course without regard to attendance.
e) Requiring every student to take a course in art or music.
f) Promoting good workers as rapidly as possible.

13. How does an aptitude test in art differ from an aptitude test for mechanical ability?

14. A person might possess musical aptitude and still not be a good musician. Is the reverse true?

15. Can an aptitude test be reliable but not valid?

suggested readings


2. For a general reference on individual applications of psychology, see J. Tiffin’s Industrial psychology, 2nd edition (New York: Prentice-Hall, 1947).

3. W. V. Bingham’s Aptitudes and aptitude testing (New York: Harper & Brothers, 1937) is a good source for techniques and results.

IN POPULAR OR EVERYDAY PSYCHOLOGY, WE USE THE
 term *personality* to describe those traits which make us at-
tractive or unattractive to other people. We like or admire the
individual who possesses “personality,” and describe him
variously as dynamic, forceful, friendly, or pleasant. And we
dislike or are indifferent to the man of “no personality” be-
cause, to us at least, he is irritating or disagreeable. Instead of
possessing no personality, of course, the unattractive person
may actually have very definite personality traits—but not
those which appeal to us.

Psychologists have used the term *personality* to denote con-
siderably more than social attractiveness. In fact, their defini-
tion of personality not only includes an individual’s charac-
teristic ways of conducting himself in everyday situations but
stresses as well such conditioning factors as physique, appear-
ance, intelligence, aptitudes, and character traits. All these
contribute, albeit in varying degree to a person's total quality—that is, to the impression which he makes upon other people.

Biographies, character sketches, and letters of recommendation are in reality personality evaluations, sometimes with the emphasis upon one aspect of behavior and sometimes upon another. By way of illustration, let us consider the letter of recommendation, given below, written in behalf of John White, age twenty-four, who has just graduated from a school of business following two years in an arts college. White has applied for a job in a large bank, giving his major professor as reference. In response to an inquiry from the bank's personnel officer, Professor Black writes as follows:

"John White has had two years of work in accountancy with me and I believe I know him quite well. He is a tall, athletic-looking chap, dresses neatly, and makes a good appearance. In intelligence I would rank White in the upper 25 per cent of my own students over the past five years. His general academic record is good, his grades being A's and B's with only two C's. White is a good typist and has some knowledge of stenography.

"John White is well-mannered, courteous, and friendly, and I have found him dependable, hard-working, and co-operative. He is well liked by students and instructors. White's disposition may be described as generally placid and easy-going. He is given to occasional moody spells which, however, do not last very long. My colleague Professor Green thinks that White lacks aggressiveness. I do not agree, as I think Professor Green is misled by White's even-tempered manner and his deference to older people."

This letter, while brief, is at the same time comprehensive enough to illustrate in a general way what the psychologist means by personality. Note in the first place that we get a picture of John White as an individual (a whole person)—his physique, appearance, record as a student, intelligence, emotional and social traits. The letter is not concerned solely with White's probable success as an accountant and prospective employee of the bank. Second, we are told something about
the organization of John White's behavior, instead of being given simply an enumeration of specific vices and virtues. This matter of organization is especially important since personality is not merely a collection of independent and unrelated habits. A man is not pleasant and cooperative, but pleasantly cooperative; not offensive and arrogant, but offensively arrogant. It is this structure of behavior which makes an individual unique. A good analogy is the human face. Every normal person possesses eyes, a nose, and a mouth, but no two faces are exactly alike. So it is with personality. All of us have many characteristics in common: to some extent we are energetic, friendly, stingy, and stubborn. But the degree to which we exhibit these traits and their interrelationships vary markedly from person to person. And it is the integration of our personality traits which constitutes our distinctive style and serves to set us off from other people.

In the third place, while our sketch includes a brief evaluation of John White's physical and mental abilities, observe that it has special reference to those social and emotional behaviors which determine White's acceptability as a person as well as an employee. Personality traits are not the same as abilities or capacities. An ability—to play the piano or read a blueprint—is what a person can do. His personality is revealed by the characteristic ways in which he does it. Personality traits become character traits when they describe behavior which can be classified as right or wrong according to some moral or ethical standard. Honesty, pride, generosity, and cruelty (all personality traits) are character traits too, since they describe behavior which is judged by society to be good or bad.

INTEREST IN PERSONALITY STUDY

To many people personality is the most exciting topic in psychology. Part of this excitement, no doubt, has been aroused by the stress placed upon personal acceptability in modern life. Interest in “personality” training is reflected in the newspapers, in popular books and magazines, and in lecture courses which
often purport to “improve” one’s acceptability almost overnight. No subject is so invested with pseudo-science and downright quackery. It should be said forthwith, therefore, that the scientific psychologist does not believe in “character readings” from lines in the hand, facial “signs,” bumps on the head, or stars in the sky. Claims that personality can be changed or improved by magic formulas are, in truth, psychological “gold bricks.” Students will be well advised to remember that ordinarily no system of training or advice or exhortation can affect a person’s character or personality unless he is willing to undergo a process (often long) of re-education under expert guidance. The “will” or desire to change is not enough.

The beginning student, when asked what he expects to get from a course in psychology, often expresses the hope that he will learn how to improve his own personality and how better to understand the motives of other people. These are entirely legitimate expectations, and psychology must attempt to satisfy them. A sounder knowledge of learning and of habit formation, of motives, especially of motives which are unrecognized or dimly understood (page 266), and a realization of the extent to which behavior is amenable to training—these are valid, if not very glamorous, ways in which psychology can help in the improvement of personality. Some general suggestions which also may be useful, will be found on pages 619–627.

theories of personality organization

In the main, personality has been studied from three points of view: of types, traits, and overall structure. Type theories portray an individual with respect to a relatively few broad classifications. Trait theories try first to discover the meaningful personality dimensions, and second to describe a person in accordance with the degree to which he exhibits these charac-
teristics. Finally, structure theories envisage the individual personality as an organized and dynamic whole rather than as a collection of its variable constituent parts or elements.

FIGURE 260 The extroverted circus "barker" and the introverted music lover may look alike yet have vastly different personalities.

Courtesy Standard Oil (N.J.)
Over the years, people have sought to find a short cut to personality description by setting up a few general categories into which they could pigeon-hole their friends and acquaintances. Most people, especially those untrained in science, believe firmly in personality types, and these inclusive descriptions have become ingrained in popular language. Thus we speak of “high brows” and “low brows,” of “level-headed” men and “flighty” women, of “regular fellows” and “sad-sacks.” Various caricatures of stage and screen—the hen-pecked husband, the absent-minded professor, the windy politician, the female gossip—are quickly recognized as depicting a personality “type.” The sloppily dressed teenage girls who a generation ago were known as “flappers” have now become “bobby-soxers,” and their male counterparts, the “cake-eaters,” are now “hep-cats.” Characterizations of this sort often stem from acute and subtle insights, but many depend upon superficial and surface observation. Such summary descriptions probably do little harm if they are taken humorously and are not regarded as authentic and inclusive personality pictures.

Various schemes for “typing” personality have been proposed by psychologists, the best-known being the two-fold classification into introvert and extrovert. These contrasting groups are discussed on page 556 as the extremes of a complex behavior dimension. Introversion and extroversion are beguiling categories, since we can readily find “reference people” who can be cataloged as “typically” introvert or extrovert. But the fact is that most of our acquaintances fall somewhere in between these two extremes (page 502). In another classification, personality type is made to depend upon what a man values most, what he is interested in and considers to be of maximal importance. In the Allport-Vernon Study of Values, six fundamental life areas are staked out, as follows: theoretical, economic, esthetic, social, political, and religious. The assumption underlying this scheme is that the dominant in-
terests of the theoretical man lie in determining truth, of the
economic man in what is useful, of the esthetic man in form
and beauty, of the social man in love of people, of the political
man in power over others, and of the religious man in the com-
prehension of human life in terms of religious and moral values.
The Allport-Vernon questionnaire consists of two parts and
demands 120 answers, twenty in each of the six areas. A
subject’s dominant value-system determines his score in each
category.

The following examples illustrate the kinds of questions
proposed in this inventory.

1. At an exposition do you chiefly like to go to the building
   where you can see
   (a) automobiles?
   (b) scientific apparatus or chemical products?
2. Do you think a good government should aim chiefly at
   (a) more aid for the poor, sick and old?
   (b) the development of manufacturing and trade?
   (c) introducing more ethical principles into its policies
      and diplomacy?
   (d) establishing a position of prestige and respect among
      nations?

Figure 261 represents the scores earned by a salesman in
each of the six categories. It is clear that this man’s interests
lie predominantly in the economic and political spheres, being

FIGURE 261 Test profile of a salesman on the Allport-Vernon study of values.
low in theoretical and esthetic values. Answers often cut across several areas, however, the same man sometimes having strong interests in one or two or even in all of the six categories.

The main criticism of personality types is that they tend to be all-or-none, asserting too much or too little about an individual. Thus, a person is rarely ascendant or submissive (page 559) under all circumstances, and few are always economically or always theoretically minded. In other words, most people belong in more than one “type.” As we shall see later (page 577), this criticism of all-or-none ness applies also to physical types, few men being very tall or very short—that is, varying widely from the “norm” in either direction. Another difficulty with types is that such descriptions make it easy to slip over into stereotypes,* which are often an excuse for careless observation or for unwillingness to think. We all know people who announce glibly that all Scotsmen are stingy, all Irishmen happy-go-lucky, and all Indians lazy, echoing these false generalizations as though they were original discoveries. Racial and religious stereotypes often express hate or aggression and are used to convey contempt.

PERSONALITY TRAITS

Differences among people appear not only in aptitude, intelligence, and physical attributes, but also in personality characteristics or traits. Personality traits are distinctive ways of behaving, more or less permanent for a given individual, and depending upon both native and environmental factors. If traits are regarded as the fundamental units of personality, then John’s personality may be thought of as essentially the pattern or organization of his traits. John’s pattern may resemble but be different in striking ways from that of William or Richard.

Personality traits are neat and succinct ways of describing the multifold aspects of behavior; in many respects they offer

* Stereotype = a characterization or generalization often strongly biased and derogatory—for example, the “terrible Turk.” This expression implies that all Turks are cruel and bloodthirsty.
the most useful approach to personality study. It would be a mistake, however, to think of trait dimensions as fixed entities which, like a child's building blocks, can be added or subtracted at will. Rather, personality traits must be thought of as bound together into distinctive patterns, in which sometimes one and sometimes several traits are dominant. Stubborn hard-headedness in one man may be dogged determination in another; the politician's ambitions may be strong enough to crowd out all ethical consideration; and the ardent reformer may find that the end justifies the means. A profile of traits (page 560) must always be evaluated with the subject as a person in mind. Otherwise, the profile represents a skeleton, not a living organism.

A distinction should be made at the outset between personality traits which are basic and real, and those which are apparent and specious. A man may be rude because he is embarrassed or timid, aggressive because he is afraid, friendly because you are a customer and he wishes to make a sale. Recognition of the difference between surface behavior or appearances and the basic underlying motives appears clearly in such common sayings as "appearances are deceptive," "the lady doth protest too much, methinks," "smile and be a villain," "the devil can cite Scripture for his purposes."

A major task of psychology is to define and measure the basic personality traits. It has been found that at least 18,000 adjectives in the English language have been used at one time or another to describe various aspects of behavior. Fortunately not all of these define distinct personality variables, and many of them refer to the same or almost the same behavior. Perhaps a basic personality trait may best be thought of as revealed in distinctive and relatively permanent behavior which varies along a dimension from one extreme to the other. For example, cheerful-gloomy and kind-cruel are trait dimensions which each of us exhibits in some degree.

Several systematic attempts have been made by psychologists to reduce the numerous personality descriptions to
FIGURE 262 Personality is as important as aptitudes in determining success on a job. Working alone requires personality traits that are different from those needed for outdoor work with others. Fear of high places would rule out steel construction work.
a small number of basic or fundamental traits. The twelve “primary” traits in Table 24 were isolated after considerable research with test, questionnaire, and rating-scale data. Several of these dimensions are tentative and will undoubtedly be refined and better described in subsequent work; but on the whole they represent the best established list of basic traits to date.

24 Primary traits or dimensions of personality

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easygoing, genial, amiable</td>
<td>Inflexible, cold, hostile</td>
</tr>
<tr>
<td>Intelligent, independent, reliable</td>
<td>Stupid, unreflective, frivolous</td>
</tr>
<tr>
<td>Emotionally stable, realistic, steady, fast</td>
<td>Evasive, emotionally changeable, excitable</td>
</tr>
<tr>
<td>Dominant, boastful, self-assertive</td>
<td>Submissive, self-effacing, modest</td>
</tr>
<tr>
<td>Cheerful, sociable, talkative</td>
<td>Unhappy, depressed, seclusive</td>
</tr>
<tr>
<td>Sensitive, tenderhearted, sympathetic</td>
<td>Hard-boiled, unemotional, cynical thetic</td>
</tr>
<tr>
<td>Thoughtful, cultured, esthetic</td>
<td>Boorish, uncultured, coarse</td>
</tr>
<tr>
<td>Conscientious, responsible, painstaking</td>
<td>Slipshod, impulsive, irresponsible</td>
</tr>
<tr>
<td>Cooperative, carefree, kind</td>
<td>Reserved, cautious, secretive</td>
</tr>
<tr>
<td>Vigorous, persistent, strong-willed</td>
<td>Languid, slack, ineffective</td>
</tr>
<tr>
<td>Hypersensitive, excitable, impatient</td>
<td>Phlegmatic, tolerant, calm</td>
</tr>
<tr>
<td>Friendly, trustful, enthusiastic</td>
<td>Suspicious, hostile, frustrated</td>
</tr>
</tbody>
</table>

* Adapted from R. B. Cattell, Description and measurement of personality (Yonkers: World Book Company, 1946), pp. 311-336.

Two steps are necessary in order to establish the existence of a primary or fundamental personality trait. First, we must demonstrate a common core of meaning among the several adjectives which describe the ends of the personality dimensions; and second, we must show that the given trait differs in some real way from other trait dimensions. Let us illustrate with the first two traits listed in Table 24. If people who are easygoing are usually genial, whereas those who are inflexible or rigid tend at the same time to be cold and hostile, we have defined a single trait dimension—at least tentatively. Moreover, if genial people are not necessarily intelligent, nor inflexible
people necessarily stupid, trait number 1 is a different dimension from trait number 2.

These two criteria of "traitship" hold reasonably well for the behavior dimensions listed in Table 24. The groups of adjectives which describe the extremes of each dimension possess much in common—that is, describe much the same behavior. Furthermore, these twelve traits define overlapping but not identical behavior dimensions. Once we have established the relative independence of any two traits, we must, of course, then demonstrate the relative independence of these traits from other postulated dimensions. A simple illustration is provided by the two physical traits, height and weight. People vary in height from tall to short, and in weight from fat to thin. Though these two traits are related—tall people tend to be heavier than short people—they constitute, nonetheless, two recognizable and distinct physical dimensions.

PERSONALITY AS UNIQUE STRUCTURE

The psychiatrist and clinical psychologist prefer to think of personality as a unity, as more than the sum of its parts. They contend that traits can be understood only in the light of the whole structure, and that a personality profile taken alone leaves out the essential organizational factors. Two narrative accounts which attempt to give personality pictures will illustrate the clinical point of view. The first, an interpretation of the Rorschach record (page 569) of an eighteen-year-old school boy, John, was written by a psychologist who had not seen the boy.*

This Rorschach record is not one of a well-adjusted young man. On the contrary, one may infer that John's emotional life is quite disturbed, strong, labile, and self-centered. The intelligence seems to be superior and is indirectly affected by the emotional tension. It may be expected that this will result in a somewhat uneven intellectual level, with performances which are sometimes very superior but are frequently unsystematic. The boy is probably irritable and

* Adapted from Jones, 1944, page 123.
has great difficulty in making an effortless and satisfactory emotional adjustment to his environment. His superior intelligence and his strong inner life (inner creativeness) serve to stabilize his labile affectivity. He seeks to get along with his environment but he does so less by trying conscientiously to control himself than by cautious cleverness and calculated behavior (including affectation).

The second is a personality picture based upon the TAT records (page 571) of a twenty-three-year-old unmarried man who came to an out-patient clinic for psychiatric treatment. He complained of nervousness, headaches, inability to concentrate. Patient states he is ill at ease in social groups and that if he attempts to go with girls he has acute physical symptoms, including nausea.

This is an individual depressed and anxious in outlook, who feels inferior and is still dependent upon his elders. Conflict with parents is evident. Patient is negative toward his mother and more or less hostile toward the father. Dependence grows out of patient's apparent insecurity, to which is added naive indulgence in adolescent fantasy centering around concern about masculine prowess. To the patient, sex in all its aspects appears dangerous and unhappy. This sexual maladjustment seems linked with parental dependence and with patient's relationship to his father . . .

It is clear from these accounts that the clinician's object is to provide a picture of a functioning individual as a living personality and not as a collection of traits (page 488). The two approaches—traits and structure—are not opposed, however, but are in reality complementary. An individual's personality cannot be described except in terms designating his dominant traits. And the traits themselves must be determined before the personality picture can be drawn. In measuring personality traits, tests, rating scales (page 563), and personality inventories (page 556) are perhaps most useful. For the overall picture of personality structure, projective techniques (page 569) are especially valuable.

* Adapted from Rosensweig, 1950, pages 141-150.
Perhaps the best-known trait dimension is that of introversion-extroversion. These terms have been so widely used that they have now become as much a part of our everyday vocabulary as the IQ and the inferiority complex. Typically, the extrovert (literally, a “turned-outward” person) is conceived to be one whose interests are directed towards the world around him,

<table>
<thead>
<tr>
<th>Yes No</th>
<th>1. Do you limit your acquaintances to a select few?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes No</td>
<td>2. Are your feelings readily hurt; are you sensitive about remarks or actions which have reference to you?</td>
</tr>
<tr>
<td>Yes No</td>
<td>3. Are you suspicious of the motives of others?</td>
</tr>
<tr>
<td>Yes No</td>
<td>4. Do you worry over possible misfortune?</td>
</tr>
<tr>
<td>Yes No</td>
<td>5. Do you indulge in self-pity when things go wrong?</td>
</tr>
<tr>
<td>Yes No</td>
<td>6. Do you get rattled easily, lose your head in moments of stress?</td>
</tr>
<tr>
<td>Yes No</td>
<td>7. Do you keep in the background on social occasions and avoid leadership in social affairs and entertainments?</td>
</tr>
<tr>
<td>Yes No</td>
<td>8. Are you critical of others?</td>
</tr>
<tr>
<td>Yes No</td>
<td>9. Do you prefer to work alone rather than with other people; do you prefer to work at tasks which do not bring you in contact with people?</td>
</tr>
<tr>
<td>Yes No</td>
<td>10. Do you have ups and downs in mood without apparent cause?</td>
</tr>
</tbody>
</table>

**FIGURE 263 Questions from an introversion-extroversion inventory.**

who likes people rather than books, and activity rather than repose, and who may often be a salesman or a politician. The introvert (a “turned-inward” person), on the other hand, is described as tending to be shy, as primarily interested in his own thoughts and feelings, as seeking solitude and quiet rather than crowds and people, and as being more often than not a solitary or self-sufficient worker.

Several questionnaires or behavior inventories have been designed to measure the introversion-extroversion variable. The
questions in Figure 263 cover behavior which is presumably characteristic of this personality dimension. "Yes" answers to these questions are taken to be indicative of introversion; "No" answers, of extroversion.

Two comments should be made concerning the introversion-extroversion personality dimension. In the first place, most people are neither introvert nor extrovert, but are ambivert—that is, possess both in-going and out-going qualities. Indeed, few people are so shut-in or so generally exuberant as to deserve the blanket description introvert or extrovert (Figure 264). In the second place, correlational analysis has indicated that introversion-extroversion is not a single personality dimension, but on the contrary is made up of perhaps as many as five relatively independent components. These subtraits have been denominated social introversion-extroversion (shyness versus sociability), thinking introversion-extroversion (self-analysis and meditation versus practical thinking) depression-happiness (gloom or pessimism versus cheerfulness and optimism), cycloid disposition (flightiness versus stability), and rhathymia (the happy-go-lucky versus the rigid attitude). It appears fairly certain, therefore, that introversion and extroversion are loose descriptions of a complex behavior dimension which includes intellectual and social as well as emotional components.

Figure 264 Forty-four medical students and an equal number of clinic patients showed no outstanding group differences in the scores made on an introversion-extroversion test.

After Neymann and Yacorzynski, 1942.
FIGURE 265 The performer and the technician of radio and television represent extremes in personality types.

Courtesy Westinghouse

A much-used personality inventory (the Bernreuter) consists of 125 questions designed to measure four hypothetical trait dimensions. These are described as:

- neuroticism—normality
- introversion—extroversion
- dominance—submission
- self-sufficiency—dependence
Scores in each of these postulated dimensions are obtained from the same set of questions by means of differently weighted scoring keys. A correlational analysis of this questionnaire has shown that these four trait dimensions can be reduced to two, neuroticism being virtually the same as introversion, and dominance the same as self-sufficiency. These two surviving and independent trait dimensions have been designated

self-confidence—sociability
insecurity—reclusiveness

A somewhat more specific personality dimension, called *ascendance-submission*, has been defined as the “disposition of an individual to dominate his fellows (or be dominated by them) in various face-to-face relationships of everyday life.” Items in the inventory* designed to study this trait present a list of common and everyday situations, to each of which the examinee is asked to react by selecting that one from among several responses which most nearly describes his typical behavior. The following are samples:

A salesman takes manifest trouble to show you a quantity of merchandise. You are not entirely suited. Do you find it difficult to say “No”?

*yes* ______

*no* ______

Someone tries to push in ahead of you in line. You have been waiting for some time and can’t wait much longer. Suppose the intruder is the same sex as yourself, do you usually

remonstrate with the intruder ______
call the attention of the man at the ticket window ______
“look daggers” at the intruder or make clearly audible
   comments to your neighbor ______
decide not to wait, and go away ______
do nothing ______

This questionnaire is most useful, perhaps, with young people, especially with those who have had college training.

* The A-S Reaction Study (G. W. & F. H. Allport, Boston: Houghton Mifflin Company, 1939 revision), of which there is a form for men and a form for women.
When answered honestly, it is a useful estimate of the extent to which the examinee believes that he dominates or is dominated by his fellows. Men with high dominance scores should do well in executive positions, in selling, and in politics; women with high submission scores are often happiest in nursing and in secretarial or library work. Other traits and abilities, of course, would have to be considered.

One of the most inclusive questionnaires, the Minnesota Multiphasic Personality Inventory, provides descriptions of nine aspects of personality based largely upon psychiatric categories. There are 495 statements in the test. These cover a wide range of conditions, including health, family and marital adjustments, personal and social attitudes, delusions, and masculine and feminine interests. Each statement is presented on a separate card, and the subject is instructed to sort the cards into three groups—True, False, Cannot Say. A statement is evaluated by the subject depending upon whether it applies to himself, does not apply, or is of doubtful application.

Typical items in the MMPI are as follows:

A windstorm terrifies me.
I daydream very little.
My hardest battles are with myself.
My father and mother often made me obey even when I thought it was unreasonable.

FIGURE 266 Profiles in the Minnesota Multiphasic Personality Inventory.

After Schmidt, 1945.
Items in the test were given to mentally ill patients and to normal subjects. Responses of these groups were compared and the answers given more often by patients in a certain psychiatric classification than by normal persons determined the scoring key for that classification. The nine categories are described below. Simple definitions of the psychiatric terms are provided, so that the reader will know in general what they mean.

*Categories in the Minnesota Multiphasic Personality Inventory*

1. Hypochondriasis (Hs)—exaggerated fear of illness
2. Depression (D)
3. Hysteria (Hy)—seizures, fits, palsies, anesthesias
4. Psychopathic deviation (Pd)—marked emotional instability
5. Masculinity (Mf)
6. Paranoia (Pa)—delusions, mostly of persecution and grandeur
7. Psychasthenia (Pt)—anxiety, obsession, tensions
8. Schizophrenia (Sc)—delusions, shut-in attitudes, fantasies
9. Hypomania (Ma)—excitement, elation

A profile of the scores in each of the nine categories can be plotted to show the subject's relative strengths and weaknesses. Figure 266 shows two such profiles. The first gives the average score in each of the nine categories for ninety-eight normal adults, the second the average score for ninety mental patients (psychoneurotics). The mean or average score for people in general is set at 50. It is clear from the profiles that the two groups are far apart in the extent to which they exhibit symptoms of mental disturbance. They are closest in the masculinity and the hypomanic categories. The MMPI has been widely used in mental hospitals.
judging personality

Various schemes have been devised for appraising and summarizing an individual's personality assets and liabilities. Methods vary from those which attempt to get an impression of personality as an organized whole to techniques planned to evaluate rather specific trait dimensions. Some of the most useful of these approaches will be treated in this section.

THE INTERVIEW

The interview may be either formal or informal, and these two approaches are often profitably combined. In the formal interview, the adviser tries to get definite information from the subject (usually an applicant) which he enters on a blank or question form. The individual's suitability for college, for professional training, or for a certain job is determined from his academic record, his work history, his character and personal references, and other pertinent information. If a vocation de-
mands good health, physical stamina, and a calm, even-tempered disposition, the adviser sizes up his candidate with these requirements in mind. The salesman who must meet customers in face-to-face situations needs to possess personality traits which the bookkeeper would not necessarily find useful. Success in a formal interview depends upon how readily the personality traits sought for can be identified, and upon the skill of the interviewer.

In the informal interview, the counselor or adviser lays aside his list of questions and engages the examinee in conversation, permitting him to do most of the talking. An experienced interviewer will gain many valuable insights into the individual's personality traits from his expressed interests and ambitions, his dress, his manner of expression, hesitations, emotional blockings, and confusions. The informal interview is often used as a means of aiding people with personality problems: those, for instance, who are anxious or worried about themselves, their schoolwork, their jobs, their social or personal relationships. In personal interviews of this sort, the subject is encouraged to "talk out" his problem and is gradually led to discover for himself where his difficulties lie. A certain amount of direction may be given by the interviewer, but the steering is subtle and unobtrusive and is often not detected by the interviewee.

**RATING SCALES**

The rating scale is a device for obtaining systematic judgments of the extent to which an individual possesses certain traits or exhibits certain kinds of behavior. One of the most useful of these devices is the graphic rating scale, several examples of which will be found in Figure 268.

In making graphic ratings, the judge indicates the degree to which, in the judge's opinion, the individual possesses the trait or behavior by placing a check mark at some point along a line taken to represent the personality dimension. Ratings may be expressed as numbers by dividing the rating line into perhaps five equal parts, labeling the sections 1, 2, 3, 4, and 5.
(From a Clerical Workers Scale)

Accuracy—Consider quality of work, freedom from error

<table>
<thead>
<tr>
<th>No errors</th>
<th>Very careful</th>
<th>Few errors</th>
<th>Careless</th>
<th>Many errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(From a Personality Rating Scale)

B. Does he need constant prodding or does he go ahead with his work without being told?

<table>
<thead>
<tr>
<th>Needs much prodding in doing ordinary assignments</th>
<th>Needs occasional prodding</th>
<th>Does ordinary assignments of his own accord</th>
<th>Completes suggested supplementary work</th>
<th>Seeks and sets for himself additional tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs much prodding in doing ordinary assignments</td>
<td>Needs occasional prodding</td>
<td>Does ordinary assignments of his own accord</td>
<td>Completes suggested supplementary work</td>
<td>Seeks and sets for himself additional tasks</td>
</tr>
</tbody>
</table>

(From a Leadership Rating Scale)

Steadiness and Self-control

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor self-control, often freezes</td>
<td>Fair self-control, blows up sometimes</td>
<td>Satisfactory self-control, sometimes nervous</td>
<td>Good self-control, competent and cool</td>
<td>Excellent self-control, welcomes difficult situations</td>
</tr>
</tbody>
</table>

**Figure 268 Personality rating scales.**

Rating scales provide useful estimates of personality traits when we observe certain precautions, among which the following may be mentioned.

(1) The behavior characteristics to be rated must be carefully defined. To illustrate, suppose that a foreman in a factory is asked to rate workers with respect to their "cooperation." His ratings will be greatly improved if the meaning of cooperation is made clear at the outset. The following definition of this term is taken from one rating scale.

**Cooperation:** Consider how well the man works with his supervisor and other workers. Does he readily assume duties which may be inconvenient, does he freely offer help, does he work at jobs requiring time work?
Objective definitions in terms of what one actually does are always preferable to more precise and formal dictionary definitions.

(2) The rater should be instructed to spread his ratings over the whole scale and not to enter them all in one division. Most of us have an inveterate tendency to label or classify people into fairly distinctive categories, and the notion of a personality dimension is novel to many raters. Illustration and careful instruction are needed to convince an untrained rater that behavior varies between extremes, that many more people are mediocre than are either very good or very poor (page 500).

(3) The halo effect must be guarded against. When a rater evaluates the same person on a number of traits, he is likely to rate him high or low on all of them if he regards the ratee as a generally superior or a generally inferior person. This has been called the “halo effect.” Halos can be diminished by having the judges mark all of the ratees upon a single trait, then upon a second, and so on, instead of marking each ratee on all of the traits at the same time.

The combined ratings of several judges will ordinarily be more dependable than a single record, provided the judges are equally good observers. The competence of a rater can be determined by comparing his records with the consensus of several other judges. When a judge is frequently out of step, it may be that he is overcautious, or biased, or is interpreting the traits in a manner different from the other raters.

THE QUESTIONNAIRE OR BEHAVIOR INVENTORY

The questionnaire presents a list of statements or queries which are to be answered by checking one of several possible answers. In general, the questionnaire has been employed by psychologists with three objectives in mind. The first has been to obtain systematic information concerning the individual’s worries, anxieties, feelings of inadequacy, and the like. These in-
A. PERSONAL DATA ITEMS

1. Are you afraid of high places? Yes No
2. Do people usually take advantage of you? “ “
3. Do people generally treat you right? “ “
4. Check one:
   Would you rather
   (a) Be an expert in some one line? ( )
   (b) Be pretty good at a number of things? ( )

B. ATTITUDE SCALES

(Check those statements with which you agree.)

1. Religion is necessary to a full life. ______
2. War often has a hygienic effect. ______
3. Races differ in intelligence. ______
4. The gangster moving picture contributes to juvenile delinquency. ______
5. The Germans as a race are very pleasant people. ______

C. INTEREST ITEMS

(Circle L, I, or D if you like, are indifferent to or dislike a given item.)

1. Playing poker L I D
2. Raising money for a good cause L I D
   (Indicate your choice by checking in the first space if you prefer the item to the left, in the second space if you like both equally well, and in the third space if you prefer the item on the right.)
3. Motorman ( ) ( ) ( ) ( ) Conductor
4. Actor ( ) ( ) ( ) ( ) Advertiser
5. Physics ( ) ( ) ( ) ( ) Poetry

FIGURE 269 The questionnaire.

ventories are called personal data sheets or sometimes “trouble sheets.” The Bernreuter Inventory (page 558) is an illustration of a trouble sheet. Second, questionnaires have been used to obtain information concerning attitudes toward and beliefs about social, economic, and religious issues. Third, questionnaires have proved to be valuable as a means of appraising a person’s interest in a variety of things—people, books, vocations, sports, and the like. One interest inventory (the Kuder Preference Record) enables us to measure an individual’s interests in each of the following nine areas: mechanical, com-
putational, scientific, persuasive, artistic, literary, musical, social service, clerical. From another vocational-interest inventory (the Strong Vocational Interest Blank), we can gauge the strength of a person's interest in fifty-odd occupations and professions, including law, medicine, teaching, engineering, salesmanship, and accountancy. Vocational advice is more likely to prove successful and satisfactory when, in addition to measurements of a client's intelligence and aptitudes, we have estimates of his interests in various fields.

Samples illustrating the three sorts of questionnaires are shown in Figure 269. The first four items are typical of those found in personal data sheets, the next five of those in attitude scales, and the last five of those in interest blanks.

There are two approaches which the personality inventory can take, the direct and the indirect. In the direct form, specific information is called for and no effort is made to conceal the meaning of the questions. An examinee, for instance, may be asked whether he is shy with the opposite sex, whether he is favorable to labor unions, whether he prefers detective stories to works on mathematics or philosophy. It is obvious that the examiner must count heavily upon the cooperation of the subject in answering these questions, since a clever or unscrupulous examinee may "see through" the questions and hence answer them in the conventionally correct way. In order to conceal its real purpose, the author of a questionnaire may take the indirect or disguised approach. One indirect technique that has proved useful is that of giving the subject a choice as between two occupations (butcher or florist), two activities (working with tools or reading a novel), two recreations (handball or fishing). The subject is instructed to select one of the two alternatives. When neither choice is one which the examinee would ordinarily make, or when he is undecided, instructions are to select the more desirable (or the less undesirable). Consistent traits and attitudes are often revealed by an examination of these choices. It is difficult for the subject to deceive in this type of questionnaire, since
neither choice may be acceptable or flattering, and he may not know, or cannot guess, what a choice means in terms of personality trends.

**PERFORMANCE AND SITUATIONAL TESTS**

Often the psychologist sets up situations in which an individual can act out and thus exhibit personality traits or characteristics. In a systematic study of honesty among school children, for example, honest performance was assessed from tests administered in the schoolroom and from test situations arranged in the home and on the playground. In all of these, cheating or deceptive behavior could be shown by the subject. Almost no relationship was found among these several measures of deceptive behavior, a fact which led the investigators to conclude that honesty is a cluster of fairly specific habits rather than a general personality dimension. This conclusion has been questioned on the score that many traits other than honesty were involved in the performances upon the tests. Competition, the desire to excel other children, the influence of the teacher, and the general atmosphere of the classroom probably play a major role in determining whether a child’s behavior will be labeled as conventionally honest or dishonest. If behavior on the tests were determined by many motives rather than by a single trait of honesty, there would be little consistency in the behavior shown from one situation to another.

The puppet show and various dramatic situations have been employed in studies of children who present behavior problems or personality difficulties (page 270). These performance tests allow the child, who controls the puppets, to reveal unwittingly those wishes, frustrations, and hostilities which often he cannot or will not report verbally. For instance, a child may demonstrate a strong, but unrecognized, hostility toward a parent by “punishing” the puppet representing the father. Or he may reveal feelings of inadequacy and insecurity in dealing with situations which involve social relations by
confining his play to one or two puppets, excluding most of the “children.” Performance tests of this sort are essentially projective techniques.

Tests of a performance nature have been used to obtain systematic evaluations of such traits as courage, leadership, and persistence. For example, a situation has been set up in which soldiers under full field equipment are ordered to climb over a barricade. The task may be well-nigh impossible, and the observers far more concerned with the way the soldier attacks the problem than with whether he solves it. Is his behavior clever and ingenious, or stubborn and stupid? Social and interpersonal situations have been arranged in which, unknown to the person being rated, his characteristic methods of dealing with others or of handling a problem are carefully and unobtrusively observed. Acute insights into a man’s personality structure may be obtained when several well-trained judges observe him “off guard” or under conditions of emotional stress.

**PROJECTIVE TECHNIQUES**

Many people experience anxiety and embarrassment when asked to discuss intimate personal affairs, and the desire to conceal behavior regarded as blame-worthy is especially characteristic of insecure and poorly adjusted individuals. In such cases, the so-called *projective* tests of personality are useful. The projective test presents an ambiguous situation into which the subject may “read” his own wishes, fears and fantasies—that is, “project” his strong personality trends. These procedures seem so impersonal and innocuous that the examinee often reveals unconventional and unrecognized motives with a minimum of emotional stress and without realizing that he is “giving himself away.”

Figure 270 shows an ink blot which resembles those of the well-known Rorschach Test. The Rorschach is the best-known of the projective techniques; it presents an unstructured situation with a minimum of “clues.” The examinee is shown ten
ink blots in succession and is asked to describe everything he “sees” in each blot. Responses recorded include how many things are seen, whether replies involve parts or wholes of the blot, whether they exhibit form, color or movement, and what kinds of objects are reported—animals, people, plants, and the like. Peculiarities in thinking, emotional blocks, fantasies, and unrecognized motives are inferred from the quality and quantity of the associations recorded. While informal test-interviews, like the Rorschach, are difficult to “score” and to interpret, they have been shown to give considerable insight into personality trends when administered by an expert.

In a second type of projective test, the examinee is shown a standard set of pictures and is asked to report what is happening in each picture. People often project their own feelings and experiences into the picture themes, so that their accounts
when analyzed reveal fundamental personality traits. A picture which resembles those in the Thematic Apperception Test is shown in Figure 271.

In another type of projective test, the subject is given a list of incomplete sentences, each of which is to be finished as he likes. The sentences are planned to evoke responses which will reveal such attitudes as feelings of self-esteem, personal and social relations, and conformity to social custom. The Air Force has found this test to be useful in screening out student pilots who are poor risks. Much work is being done at the present time in the field of projective testing, and these devices offer considerable promise for the study of personality organization.

* USAF School of Aviation Medicine, Report #3, 1953.

By permission of Harvard University Press

FIGURE 271  A picture from the Thematic Apperception Test.
The medical profession is one in which the personality traits of calmness, firmness, and stability are important in reassuring patients and relatives.

Our personality traits, like our habits and learned behavior generally, are shaped and fashioned by biological (that is, inherited) as well as by social (environmental) factors. Psychologists, recognizing this twofold origin, have sometimes for convenience described personality traits as being primarily biophysical or biosocial. Biophysical traits, which are observed in a variety of behaviors, are inherited and basically organic. Examples are aggressive activity, cruelty, passivity, and quick
temper. The characteristic aggressiveness of the terrier, the tranquility of the cow chewing its cud, and the cruelty of the tiger appear to be basically native and constitutional. And the same is true of people. On the other hand, biosocial traits are exhibited particularly in interpersonal relationships and are determined to a greater degree by environmental and social factors. Persistence, tact, rudeness, and sense of responsibility are perhaps primarily biosocial—that is, characteristic habit patterns built up within a social framework.

In this section we shall consider the influence of biological and social factors in shaping our personality traits. The action of biological factors is more general and less specific but no less important than is the action of social and psychological factors. Biological factors set the limits of personality developments, while social factors operate upon the raw materials provided by nature.

**BIOLOGICAL FACTORS IN PERSONALITY**

(1) the endocrine glands

The endocrine glands, or glands of "internal secretion," release chemical substances called *hormones* directly into the bloodstream, by means of which they are carried over the body. Hormones from the endocrine glands directly affect the growth and development of the organism. Also, in part, they regulate energy output, determine whether we are alert or drowsy, quick or slow-witted, self-controlled or emotionally disturbed. While it is more fiction than fact to say that we are "the playthings of our glands," the endocrine hormones undoubtedly influence strongly many of our personality traits. Perhaps their effects are seen most dramatically when one or more of the glands is disturbed in function. The names and locations within the body of the principal endocrine glands are shown in Figure 273, together with certain of the organs of the body.

The endocrines constitute an interlocking system, so that the malfunctioning of one gland will usually affect the others.
Figure 273 The endocrine system, showing the relative location of the glands.
At the same time, certain glands are known to affect particular personality traits directly. The most important hormone from the thyroid, for example, called thyroxin, is known to modify muscular and nervous activity and to influence our emotional ups-and-downs. An oversecretion of thyroxin whips up body activity and leads to nervous tension, irritability, restlessness, and emotional instability. Undersecretion of thyroxin, on the other hand, contributes to placidity, listlessness, chronic fatigue, and laziness. Malfunctioning of the thyroid may lead to various personality difficulties in otherwise normal children. The capricious behavior of the nervous and overactive child, for example, may arise from an overactive thyroid rather than from innate depravity, and the laziness of the slow and sleepy child may come from an underactive thyroid rather than from inborn shiftlessness. If the thyroid is severely underactive from birth or from early childhood, growth is badly stunted and intelligence is low, leading to a condition known as cretinism. Besides his dwarflike stature, the cretin typically has a rough and thickened skin, coarse hair, low intelligence, and a placid disposition. Early treatment may do much to relieve cretinism.

Hormones from the pituitary gland, sometimes picturesquely called the “gland of mastery,” are known to affect physical growth, as well as behavior. Marked overactivity of the pituitary in childhood may lead to gigantism (excessive height), precocious sexual development, and often to aggressive and dominating behavior. Underactivity may cause deficiencies in bony and muscular structure, resulting in a lack of stamina and a tendency to fatigue easily. In children, timidity, whimpering, frequent crying spells, and cowardice may result in part from an underactive pituitary.

The inner portion of the adrenal glands, the adrenal medulla, secretes a powerful hormone known as adrenalin (also called adrenin or epinephrine). When adrenalin is released into the blood stream, there is a speed-up of the heart rate and an increase in muscular energy. When released during strong
emotion, adrenalin delays the onset of fatigue, provides what is called “second wind,” and often enables us to perform feats of strength unusual if not impossible under normal conditions. The outer cortex of the adrenal glands secretes several hormones, including cortisone, which are essential for life. These
regulate the balance of sodium and potassium salts, influence the metabolism of proteins and carbohydrates, and affect muscular efficiency.

Secretions from the gonads, or sex glands, in conjunction with hormones from the adrenals and the pituitary, regulate normal development of the sex organs, as well as secondary sex characteristics. These latter include typically masculine or feminine body size and form, hair and fat distribution, pitch and quality of the voice, and the like. Aggressiveness and vitality or timidity and a calm and placid disposition depend, in part at least, upon the activity of the sex glands, and upon the relative amounts of the hormones, since both male and female hormones are normally present in both sexes. Men who lack a normal amount of the male sex hormone often present a "neutral" or even feminine appearance and may exhibit characteristic feminine traits, whereas an overabundance of the male sex hormone in women may lead to the development of masculine characteristics—deep voice, bearded face, and exaggerated masculine traits such as swagger and aggressiveness. The person described as over- or under-sexed, however, may exhibit various sexual aberrations because of rigid family training, strict religious background, and other environmental factors in the absence of marked irregularities in sex-gland secretion. But some disorder of gland function is usually present.

(2) physique

A person’s size and his physical strength and stamina determine in considerable degree the way in which he reacts to other people and the way in which they react to him. The St. Bernard is stolidly indifferent to the barking of the little terrier, and the large man usually ignores the noisy boasting of the pint-sized individual. There is a long-standing belief that physique is related to temperament. Temperament is the term used to describe a person’s characteristic emotional state or mood. A habitually cheerful man is said to have a hopeful or
optimistic temperament. Other often-described temperaments are happy, gloomy, fretful, and lethargic or indifferent. If a person reveals a rapid alternation of moods, such as changing swiftly from happy to sad, he may be described as being of unpredictable or unstable temperament. Several studies have attempted to correlate temperament with constitutional or physical factors. A common approach has been to separate people into three groups, the tall and thin at one extreme, the short and fat at the other extreme, and the more harmoniously proportioned in between. According to the work of the German scientist Kretschmer, the tall, thin person (called the leptosome) is typically shy and introverted; the short, fat person (called pyknic) is excitable and emotionally unstable; and the in-between person (called athletic) exhibits a more evenly balanced emotional and temperamental organization.
The most elaborate attempt to correlate physique and temperament (that of Sheldon and his co-workers) employs much the same physical types as Kretschmer but defines them more precisely, in terms of a system of measurement by which they can be more readily identified. Three basic types are proposed as follows: (1) the endomorph, a person of relatively large body and short arms and legs; (2) the mesomorph, harmoniously proportioned and mostly bone and muscle; and (3) the ectomorph, long arms and legs, often skinny, with relatively small body. An individual's body form, or somatotype, is expressed as the degree of endomorphy, mesomorphy, and ectomorphy which he shows. The strength of each component is indicated on a scale which extends from 1 to 7. One denotes the least and 7 the greatest amount of the component. A man who is tall and very skinny (ectomorph), for example, might be described as 1-1-7, thus indicating that he possesses endomorphy and mesomorphy to a minimal degree (that is, 1), and ectomorphy in the highest degree (that is, 7). A short tubby man (endomorph) might be 7-2-1 or 7-2-2, and a man who shows no marked identification with either of the two extreme groups (so-called balanced type) might be described as 3-3-3 or perhaps 4-3-3 or 3-4-3. A careful study* of the personality traits shown by a group of 200 men revealed a strong association between ectomorphy (tall-thin) and such introverted tempermental characteristics as caution, emotional restraint, and love of solitude; between endomorphy (thick-fat) and such extroverted traits as relaxation, amiability, and love of physical comforts. The intermediate type, the mesomorph, is associated with energetic action, dominance, physical courage, and a somewhat callous or "hard-boiled" attitude.

From present experimental work it seems clear that the glandular and biological constitution of an individual influences both his physique and his temperament. Hence a certain correspondence of physical and personality characteris-

* Sheldon & Stevens, 1942.
tics can be expected. At the same time, it must be emphasized that wide individual differences within each group make it hard to forecast a man's personality traits with any precision from his physical and muscular make-up. Moreover, other investigators have not found the close association between physique and temperament reported by Sheldon, and many do not believe that such a relationship exists.

SOCIAL FACTORS IN PERSONALITY

From the time of birth, the child's personality is shaped and molded by the community in which he lives. At first "the community" may consist only of the child's family; later on, school, church, teachers, friends, movies, and companions all exert their influence. An early responsibility of the home is to inculcate habits of personal cleanliness, regularity in eating and sleeping, and good toilet habits. Training in useful social behaviors should also begin early and should follow the
principles of learning outlined in Chapter 8. If a two-year-old reaches for a forbidden object, for example, a sharp rap on the fingers with a pencil, accompanied by a firm “No” and a shake of the head will build up a conditioned response (page 302) far more quickly than at a later time. Petulance, whining, finicky food habits, and other undesirable responses are most readily corrected by negative reinforcement (page 328) when training is undertaken early.

The treatment which a child receives in the home will determine to a large extent the kind of biosocial traits which he exhibits. A patient, sympathetic father or an understanding mother may inculcate socially acceptable and personally rewarding traits. By the same token, a domineering father or nagging mother may leave permanent scars on the child’s personality in the form of emotional instability, shyness, and hostility. Children from homes broken by death, illness, or
divorce often reveal a basic insecurity through their anxieties and fears. The overprotected and babied child develops habits of dependency which lead him to be teased and laughed at as a "sissy." The spoiled child is likely to become selfish and headstrong, to exaggerate his own importance, and to have little consideration for others. These traits bring him into conflict with the rules of the school and with other children. Negativism (that is, saying No to every suggestion), temper tantrums, stubbornness, teasing, and whining are personality traits which develop in the spoiled and untrained child. On the other hand, the rejected child or the child subjected to rigid discipline often shows social timidity and fear, withdrawal from responsibilities, lack of self-confidence, and insecurity. The unloved or rejected child may seek pathetically to win the favor of older children, of the teacher, and of other adults.

Birth order is considered by some psychologists to be an important factor in determining personality traits. The oldest child is said to be dominating and jealous of his position in the family and to identify himself with his parents. The youngest child, on the other hand, is described as spoiled and babied, and as tending to lean on his parents or friends for protection and help. Intermediate children are depicted as striving to supplant the older and suppress the younger, and the only child or the favorite child is selfish, egotistical, and "different." These personality descriptions fit many cases reasonably well, and the child's position in the family may be valuable in suggesting what difficulties to look for. At the same time, evidence as to the importance of birth order is conflicting, and there are many notable exceptions to the personality descriptions attributed to different positions in the family. Only children, for instance, if not overprotected, if allowed to have playmates of their own age, and if permitted to develop habits of independence, do not show the unfavorable traits often attributed to them.

The kind of sex instruction which the child receives may greatly affect his developing personality. Parents' attitudes
toward sex should strike a golden mean between silent disapproval and exaggerated nonchalance. Perhaps more harm comes from a policy of stern suppression of all discussion than from one of free and easy indifference, though neither is to be advocated. Children should not be shamed or led to believe that sex is “nasty.” But at the same time the child should not be given information which he is unready to receive and therefore does not understand, and which he may parade in garbled fashion before his companions. It is a well-established observation that many emotional difficulties in later life grow out of feelings of guilt and unworthiness resulting from sexual behavior which the child has been taught to regard as sinful or blameworthy.

In dealing with children we should guard against the “give a dog a bad name” attitude. Children, like animals, respond in the way in which they are treated. A “fighting” child will remain belligerent if the fact that he is a “problem case” is kept constantly before him. The unruly boy who has gained a reputation for being “difficult” in one grade will show the same behavior in the next grade if the new teacher expects it of him and treats him in such a way as to encourage it. Also, the teacher’s pet will show the same dependent attitude if the new teacher’s behavior makes it seem useful and rewarding. Knowledge of the principles of learning and of habit formation (Chapters 8 and 9) is useful in dealing with developing personality traits. Moreover, a large dose of patience is needed, as well as the realization that each child is an individual and must be understood in the light of his physical, mental, and personality traits, as well as in the light of his family and the community background.

The organization of an individual’s personality traits is what makes him a unique person. A painting, an oriental rug, or a
mural—all these possess a central or integrating theme, which serves to unify the parts despite variations in color, form, and design. In the same way, an individual is “a personality” rather than a collection of specific habits. For most of us, an individual’s personality is a fairly consistent and recognizable pattern of traits. We express our faith in personality integration when we say of a friend “Mary would never do that,” or when we are amazed at the behavior of an acquaintance whom we thought we “knew.” Sometimes a single personality trait is so outstanding that it sets the tone for one’s general behavior. The ambition of Hitler or Napoleon, the patience of Job, the humility of Saint Francis, the humanitarianism of Lincoln, the patriotism of Joan of Arc, the energy of Theodore Roosevelt, and the absent-mindedness attributed to some professors are instances in which a basic trait is so closely identified with the person as to provide an index to his general behavior.

Prediction of behavior is most successful for individuals whose personality traits show consistency from one time to the next; and prediction is least successful for those emotionally unstable, socially immature, or happy-go-lucky people whose behavior is markedly and typically erratic. The benevolent statesman, the wise philanthropist, and the modest, self-effacing scholar usually reveal a high degree of personality integration. And the recidivist or habitual offender repeatedly arrested for the same kind of crime, or the “professional” tramp or ne’er-do-well, may also show consistency of behavior, but at a low level of social approval.

Children frequently show marked inconsistencies in their behavior—are rude and considerate or sympathetic and cruel in quick succession. When adults exhibit the same lack of harmony in their behavior or a striking discordance between what they say and what they do, we describe them as emotionally immature or poorly integrated. In some instances a person’s responses may be consistent from his point of view, though not from that of his friends. The clerk who cheats
his customers during the week, for example, and piously goes to church on Sunday seems poorly integrated to the observer but not necessarily so to himself. In fact, he may argue indignantly that what we call cheating is clever salesmanship and is not inconsistent with a religious life. All of us exhibit such illogical behavior from time to time, though perhaps not so extreme as this. Marked and frequent inconsistencies in behavior, such as are observed in certain mental disorders, are indicative of personality disintegration.

Psychologists sometimes attempt to represent personality integration graphically by means of a chart or profile. The personality profile of a fifteen-year-old boy, JS, is shown in Figure 278. The line drawn through the middle of the chart represents the “normal” (that is, the average) degree of the trait possessed by other fifteen-year-olds. From his profile JS appears to be less good-natured and less cooperative than other members of the group, and to be slightly less calm, slightly less willing to take responsibility, and slightly less constant in mood. This boy ranks above the mean of his group in deliberativeness and resolution, but except for these two traits he is consistently below the mean. Estimates of JS’s personality traits were based upon independent observations.

**Figure 278** Personality profile of a fifteen-year-old boy.
After Jones, 1943.
made by three or more judges. It is according to this consensus that JS is compared with other children of his age group.

The personality profile is faulty if it is taken to represent traits as specific and independent behaviors. A boy who is persistent and intelligent may become a successful professional man, while a boy who is persistent and dull is doomed to be a plodder. It is the pattern of traits which counts. A profile, taken alone, does not show clearly the extent to which personality traits are related. At the same time, the profile does provide useful information regarding the strengths and weaknesses of an individual's personality. And it gives a helpful notion of the consistency to be expected in the behavior of the person whose trait measurements are depicted on the graph.

the abnormal personality

We have seen on page 472 that the feeble-minded do not constitute a separate species but are simply the low end of the intelligence distribution. The feeble-minded possess intelligence but not enough to bring them within the normal range. The same situation holds for those who exhibit unusual or highly disturbed behavior—whose personalities deviate to a greater or lesser degree from what we regard as “normal.” Mildly deviant and even insane people do not make up a species different from the normal. Rather—like that of the feeble-minded—their behavior can be regarded as representing extreme or exaggerated degrees of the same behavior observed in normal people. There is, in short, a continuity in personality from the sub-normal to the abnormal: a difference in amount, not in kind. To illustrate, consider the case of the person who is generally known to be very “sensitive.” All of us number among our friends some “tender-minded” person (a woman, perhaps) whose feelings are constantly being hurt, who is quickly and easily offended, who feels certain that people
Figure 279 The patient suffering from catatonic schizophrenia sits in a stiff, rigid manner. He is mute and apparently is oblivious to his surroundings.

Courtesy Dr. C. Landis

are laughing at or talking about her, and who may assert that every hand is raised against her. When such “touchiness” and suspicion are greatly exaggerated and become, moreover, fixed and permanent personality traits, we call the condition paranoia (page 597). The paranoid asserts firmly that “people” are plotting his destruction (delusions of persecution), and often, perhaps as compensation, feels sure that this persecution is owing to the fact that he is a great personage (delusions of grandeur) of whom “they” are jealous. Such a mentally ill person has no appreciation of the absurdity or groundlessness of his suspicions.

In order to understand clearly what is meant by deviation from the normal, we must, of course, define what is meant by the “normal” personality. Within our society a normal person may best be thought of, perhaps as one who is well adjusted to and happy in his station in life. Ordinarily, a normal man works steadily at his job, pays his bills, marries and rears a family, and is regarded as a responsible and trustworthy member of the community. Normality is, to be sure, conditioned by the culture in which one is born and reared. Habits and customs (of dress and of eating, for example) normal to the Australian aborigine or the Eskimo might be considered highly abnormal in a Midwestern American town.

The abnormal personality  Fourteen  587
Figure 280 shows graphically the unbroken relationship between normal and abnormal behavior. The curve represents behavior as ranging far to the right and to the left of the "normal" reference point. Approximately 80–85 per cent of the general population lies in the normal zone, about 15–20 per cent showing personality deviations of a more or less serious sort. On the fringe of the normal zone and shading over into it we find the neuroses. A neurosis may be defined as a relatively mild personality disturbance, marked by excessive fatigue, anxiety, lack of self-confidence, and feelings of inadequacy and inferiority. People do not die of neuroses (they are not physically diseased) and rarely need to be
hospitalized. Neurotics possess insight—realize that their behavior is unusual and unsatisfactory, and that it is disturbing to themselves and to others. Far out at the extremes of the behavior distribution are the psychoses.

The psychoses are the really serious mental illnesses; they affect about 1 per cent of the population and are of two sorts, organic and functional. The organic psychoses result from disease or other degenerative processes in the body. The functional psychoses have no known organic component, the name "functional" implying that the personality and not the organism itself is disordered.

Over the years, the insane have been objects of reverence and of fear. Sometimes regarded as holy or possessed of magical powers, the insane person has more often than not been punished as a witch or as a madman possessed by devils. Even as late as the eighteenth century, the insane were chained, closely confined in dungeons, treated as sinful outcasts. It is only in the last century that reforms, beginning in England and France, have led to better treatment of the mentally deranged. As mental disease became better understood, the demented person began to be recognized as a patient to be hospitalized and not as an evil-doer to be jailed and punished.

Mental illness constitutes a colossal national problem. There are today 1,000,000 or more people in the United States who have personality deviations of a serious nature. The mentally ill, in fact, occupy more hospital beds than are filled by all the medical and surgical cases taken together. While most psychotics are hospitalized, many are not found in institutions.

The psychotic does not necessarily present the same abnormal personality traits in a more distorted form than appears in the neurotic. Neurotics, in fact, rarely becomes psychotic. Hence the continuity from the neuroses to the psychoses is to be thought of as increasing severity of mental illness, not as a continuity in distortion of the same personality traits.

Even when no organic disease can be found, many experts in abnormal psychology and psychiatry believe that disease processes are present, but cannot be detected by methods available at present.
THE NEUROSES

A number of classifications have been proposed for the neuroses, of which none is entirely satisfactory. It must suffice here for us to give illustrations of some of the commonly met-with forms of neurosis; for more detailed descriptions the student should go to the standard textbooks on abnormal psychology. (See “Suggested Readings” at the end of this chapter.)

(1) nervous exhaustion—the fatigue syndrome

Nervous exhaustion has been called the “American disease” because of its prevalence in this country. The condition is marked typically by excessive fatigue, feelings of weakness and inadequacy, and vague aches and pains throughout the body. The following is an illustrative case.†

The patient, an unmarried woman of forty-two complained of feeling “weak and draggy,” of having no stamina, and of being obliged to conserve her strength in order to get through the day. The symptoms had been worse since her mother’s death, but had evidently been present as early as pubescence, and perhaps earlier. She complained also that for many years she had suffered from spells in which her head felt as though she were “on a Great Lakes steamer in rough weather.” Her sleep had been poor as far back as she could remember, apartment and street noises awakening her at least once every night. Sometimes she seemed to be half-awake throughout the night; occasionally, but not regularly, she resorted to a mild sedative and always slept heavily when she did . . .

She had a few close friends of many years’ standing who dropped in frequently for an afternoon visit. If more than two were present together, she found the talk confusing and felt “done up” when they left. By telephoning her orders for food she managed to restrict her trips out of the apartment to one or two a week. On her way out and on her way back, she paused at each landing until her

* The term syndrome includes the distinctive symptoms which serve to characterize a disease.
† Adapted from Cameron, 1947, pages 227–228.
heart-beat came down to normal. She was unable to attend church or go to the movies because of her fatigability. . . . In addition to her head symptoms, rapid heart beat on mild exertion, poor sleep and nocturnal sensitivity to sound, this patient complained of ringing in her ears, floating spots before her eyes, poor appetite, chronic constipation and backaches, as well as an inability to recall conversations and stories she had been listening to or reading.
(2) anxiety and compulsion

Anxiety is characterized subjectively by intense apprehension and dread, and is a common neurotic symptom. Physical symptoms accompanying anxiety are rapid and irregular breathing, intense sweating, heart palpitation, and feelings of pressure in the head and of sinking in the stomach. On the mental side, we find compulsions (irresistible impulses to carry out repeatedly some such act as washing the hands, setting fires, or stealing), phobias, torturing doubts and indecision. The following cases illustrate anxiety and compulsion.* \[1\]

A man of thirty-three had suffered an acute attack of anxiety one year before admission to the hospital, and had had repeated attacks of the same type since then. In the first attack, he complained of severe pains in the heart, great difficulty in breathing, and fear of death. His wife said that he was pale and trembling during an attack. These attacks occurred frequently during the night. Patient would awaken gasping for breath, belching and panic stricken. Patient reported that he knew of no specific factor that brought on his attacks, but that they seemed more severe when he was alone. During hospitalization, it was noted that his symptoms seemed more exaggerated when he had an audience. He talked at great length of his suffering to anyone who would listen. Patient was of superior intelligence, with excellent educational and cultural background. Throughout his school days he had been a trouble-maker. This same pattern continued in the hospital. He was extremely critical of the hospital and uncooperative with its routines. He complained that his family had always rejected him, a complaint not supported by any actual evidence. He was unable to adjust himself to his marriage with an intelligent, emotionally stable woman. He had always been hypercritical of others, although resistant and resentful of any criticism of himself. He was described by his family as thoughtless, selfish, and "touchy." He made many demands upon his family and wife but refused to accept any responsibility as far as they were concerned.

* Adapted from Landis and Bolles, 1950, case 5, page 98.
† Ibid., case 6, page 99.
A forty-year-old business man was admitted to a mental hospital for treatment of compulsive behavior. For the past six months he had washed his hands twenty to thirty times a day. He also felt it necessary to count steps leading to a door and to touch the door a certain number of times before passing through it. There was also a complicated ritual involving the number 3. These and other rituals that he felt forced to carry out interfered with his ability to function efficiently in his work and were both annoying and embarrassing to him. He had always been a scrupulously neat person, over-concerned with minor details, and fastidious in his personal habits. In the past six months he had shown increased irritability and agitation over his wife’s unwillingness to follow his rigid schedules in running the house, and felt she was at fault for failing to cooperate.

There was no history of mental disease in the family. His mother was described as extremely affectionate with him. She dressed and undressed him completely until he was eight years old . . . He recalled that his father had been partial to his older brother but accepted this with no conscious ill-will toward either one.

During psychotherapy, it became evident that he was basically very aggressive and hostile. These tendencies were usually controlled and concealed, so that he gave the impression of being very shy, timid and rather ineffective. With psychotherapy he gained some relief from his immediate symptoms, but continued to be rigid
and meticulous. His basic problem of inner hostility was not completely worked out.

(3) hysteria and disassociation

The term *hysteria* covers a variety of bizarre symptoms—sensory, motor and organic. Often there is mutism (loss of voice), twitching of arm or face muscles, body spasms, “hysterical” blindness and deafness, loss of skin sensitivity. Present also are forgetfulness, vagueness, inability to understand clearly, and loss of contact with reality. The hysterical personality picture is one of childishness and immaturity. Hysteria has nothing to do with the convulsive fits of laughing or crying commonly called “hysterics” and occurring under emotional stress in otherwise normal people. The following is a case history of hysteria.*

G. G., a merchant forty years of age, complained of a numb, “unnatural” feeling in the left leg and arm and the left side of the body, of a flushing sensation in the left side of the face, and of heaviness in the left arm and leg. The history was that one day, four months before coming to the office, his left arm and leg suddenly became numb and the limbs heavy. The condition gradually grew worse despite medical attention, and the fear of paralysis finally brought him to a neurologist. He had always been nervous and irritable, suffered for years from gastro-intestinal disturbance, and at one time from “renal colic,” neither of which conditions was ever confirmed by X-ray or other examination. G. G. is a married man who had to work hard to support not only his family, but some of his brothers and sisters and particularly his mother, to whom he is very much attached. A few months before the onset of his present difficulty, his mother sustained a hemorrhage of the brain which resulted in paralysis of the left side of the body, with total loss of sensation on that side. A complete neurological and general medical examination of G. G. failed to reveal any organic disease. The assurance that he was not paralyzed nor likely to be, coupled with the positive suggestion that the numbness and heaviness would disappear, and the explanation that he had identified himself with his

* Adapted from I. S. Wechsler’s *The Neuroses*, 1929, pages 183–184.
mother to such an extent as to beget symptoms on the same side as her paralysis, resulted in almost immediate recovery.

ORIGIN OF THE NEUROSES

The neuroses are initiated by a number of factors, many of which may have been present over a long period of time. It is probable that the "cause" of a neurosis can be revealed only by intensive psychiatric or psychological treatment. In a general way, however, it may be said that a neurosis develops from two sources. The potential neurotic inherits a body constitution and nervous system which are highly susceptible to emotional stimuli; or the environmental pressures are so intense and so long continued that they break down the individual's powers of resistance (page 271). Probably either the hereditary or the environmental factor is sufficient to initiate a neurosis; and more often than not, perhaps, both are present. Neuroses common in World Wars I and II were known as "shell shock" and "combat fatigue," respectively. These conditions developed most often in men with constitutional weaknesses or predispositions, men who were unable to withstand the fearful and often emotionally devastating conditions of modern warfare. The form a neurosis takes—its direction and character—probably depends at first partly upon accident. The harassed person "hits upon" some practice or activity which, temporarily, at least, relieves his difficulty. Thus he may "retreat" into drug addiction, alcoholism, or invalidism (page 272). Through repetition and reinforcement, this often anti-social and personally disrupting behavior tends to become habitual, and the neurotic response then becomes part of the personality pattern.

Many mild neuroses clear up without treatment: better physical health, improved finances, a change of marital or occupational status, a relief from emotional tensions—all these may bring about an alleviation of symptoms or even a cure. When the case is severe and long continued, treatment by a psychiatrist or clinical psychologist may be needed to enable the disturbed individual to regain his mental equilibrium.
THE PSYCHOSES

These conditions, it will be recalled, are the severe cases of mental illness. A true psychosis rarely develops from a neurosis, though there are usually symptoms in common. Behavior in a psychosis is often so strange and so deviant that its unusual character is recognized at once, but in other cases a psychosis may go undetected for a long time. Common organic psychoses are paresis, senile dementia, and alcoholic psychosis. The chief functional psychoses are schizophrenia, manic-depressive psychosis, and paranoia.

(1) the organic or structural psychoses

These personality disturbances are the result of disease or degenerative processes which lead to physical and physiological impairment. They are chiefly a medical and custodial problem and little need be said about them here. Paresis results from syphilitic infection of the brain and nervous system. Physically, there is uncoordinated gait, slurred speech, muscular weakness. Among the personality changes are boastfulness, euphoria (sense of well-being), grandiose ideas, fantastic exaggerations. With new and improved methods of treating syphilis, paresis is not so frequently encountered nor so dreaded as formerly. In senile dementia there is deterioration of brain and nervous tissue owing to extreme old age; in alcoholic psychosis there is deterioration due to the effects of overindulgence in alcohol. Victims of these psychoses are confused, forgetful, often boastful, and badly oriented—not clear as to what is going on around them. Alcoholic psychosis is often marked by delusions and hallucinations.

(2) functional psychoses

The psychosis known as schizophrenia takes at least four forms, all marked by disassociation (splitting of the personality). The schizophrenic is highly introverted and shut into himself, shows little real emotion, often experiences auditory hallucinations, and lives in a dream or fantasy world of his own making.
Movement is often jerky; other characteristics are giggling and grimacing, and sometimes stupor and catalepsy. Schizophrenia is the most prevalent form of insanity, patients suffering from this psychosis making up 50 per cent of the hospital population. The disease is commonly found in adolescence and early adulthood; in fact, it is often called dementia praecox or “youthful insanity.” Interest in the treatment of schizophrenia has been revived of late as a result of the introduction of various forms of shock therapy. When the schizophrenic patient is thrown into a shock or coma by means of electricity or drugs, in many cases marked improvement follows.

The manic-depressive psychosis is characterized by extreme fluctuations of emotional mood. At one time the patient is exhilarated and excited (manic phase), swears, shouts, and talks incessantly; at another he is gloomy and sad (depressed phase), cries, refuses to eat, and accuses himself of various sins. In paranoia, delusions of persecution and/or delusions of grandeur (page 177) are typical. Paranoia is often complicated by schizophrenia.

The causes of the functional psychoses are complex, and no simple explanation can cover all cases. Bad heredity (page 63), bad environment, or both are nearly always present. To these predisposing causes must be added the exciting or immediate causes found in individual cases. A long history of social inadequacy, of anxiety, of withdrawal from responsibility, and immaturity is usually found. (See Reference 6 at the end of this chapter.)

**summary**

The psychologist usually thinks of personality as including such attributes as physique, appearance, intelligence, and special aptitudes, as well as characteristic social behavior. Biographical “character” sketches and letters of recommendation often provide good indices of personality because they describe the individual as a person living in a social environment. Personality traits are not
the same as abilities. Rather, personality is revealed in the typical ways in which the individual reacts to his surroundings. Personality traits become character traits when given a moral or ethical interpretation.

Most students of psychology are primarily interested in the improvement of their personalities. Psychologists can provide help by giving a sounder knowledge of how certain traits are acquired, of motivations and of habit formation. But there are no quick or magical ways in which personality can be changed overnight. Personality has been studied from the points of view of (a) types, (b) traits, and (c) unique structure. In the present chapter the trait approach is adopted as being the most useful and defensible.

Basic personality traits must be distinguished from those which are obvious and specious. Psychologists have defined a number of basic personality dimensions, such as Introversion-Extroversion, and these have been related to other traits. Interviews, questionnaires, rating scales, and performance and “projective” tests are all useful in appraising personality. Among the important biological factors influencing personality are the endocrine glands. These glands of “internal secretion” release chemicals called hormones into the blood stream. Hormones affect the growth and development of the body as well as the personality. Attempts to relate physical type to temperament (characteristic emotional mood) have, however, met with varied success. Probably some relation exists, but there are wide individual differences within each physical type.

From birth to maturity, the personality is shaped by the social community, always within the limits imposed by the biological factors. Parents, the school, and friends are especially important. Consistency among one's personality traits is the rule rather than the exception. Most people behave in a predictable manner—and our society is based upon this expectation.

The abnormal personality is in reality an extension and exaggeration of maladjustive traits present in all normal people. In fact, normality is behavior which is tolerated by society. The neuroses or mild behavior deviations and the psychoses or severe mental illnesses are present in about 15-20 per cent of the general population. The psychoses constitute a serious health problem by imposing a heavy burden on hospital facilities.
1. Personality has been defined as the "effect a person has on other people." Do you agree?

2. Some psychologists believe that there are only a few basic personality traits; others that there are many personality traits. Based upon your own experience, which view are you inclined to favor?

3. Intelligence, honesty, and dependability might each make for consistency in behavior. Can you think of other traits which may serve to integrate a person's behavior?

4. How do personality dimensions differ from personality types?

5. Is persistence a general or a specific trait? Might it be both?

6. Is it possible for diverse forms of behavior to be expressions of the same basic trait? Illustrate.

7. Rate yourself upon a 5-point scale for the twelve traits listed in Table 24. Compare your own ratings with those made by several friends.

8. What do people mean when they speak of a "manly boy," a "feminine woman," a "typical German"? Do you know any such types?

9. Why is a consistent person often described as "dull" while an inconsistent person is called "colorful"? Which do you prefer, and why?

10. Are personality traits always socially determined? Does the hermit or recluse possess personality traits?

11. What personality traits seem to change most with age? Which appear to change least?

12. Select two acquaintances one of whom is endomorph and the other ectomorph. Do they differ in the personality dimensions of Table 24?

13. Average the ratings (self and friends) which you obtained in Question 7. On the assumption that 3 is the average or "normal" rating, construct a
profile like that of Figure 278 in the text. How well integrated are you in terms of the profile? Compare your chart with the others in your class.

14. Select two or three friends or acquaintances. List several of their traits, which in your opinion are maladaptive or hampering. How do you think the techniques described on page 619 might be helpful in improving your friends' "adjustment"? Now try your hand on some of your own less desirable traits.

**suggested readings**

1. Good summaries of present-day trends in personality study will be found in E. G. Boring, H. S. Langfeld, and H. P. Weld’s *Foundations of psychology* (New York: John Wiley & Sons, 1948), Chapters 21 and 22.


3. N. Cameron’s *The psychology of behavior disorders* (Boston: Houghton Mifflin Co., 1947), Chapters 4, 5 and 6, gives a readable description of how personality traits are shaped by the environment.


15 applications of psychology

This chapter deals with the applications of psychology to selected areas of life and work. Throughout preceding chapters we have regularly indicated ways in which psychological knowledge may be used practically, and this has been especially true of the last two chapters—13 and 14. In the present chapter, we shall draw together and summarize further materials on application.

getting a job that fits

Most young people eventually face the necessity of finding work which they can do efficiently and with satisfaction. To the applied psychologist there are at least three aspects to the problem of getting a job that fits. The first is concerned with the assessment of the individual—determining his abilities,
interests, personality traits. The second relates to the assembling of detailed knowledge covering the requirements for various vocations: training time, preparation needed, remuneration, and so on. The third aspect is concerned with fitting the person to the job. This last phase of the job problem is often treated under the head of "vocational guidance" or "vocational counseling."

THE PROBLEM OF PERSONAL ASSESSMENT

It was pointed out in Chapters 13 and 14 that psychological tests and other devices are useful in sizing up an individual’s capabilities. The following list classifies a variety of mental tests according to their objectives.

I. General ability
   general intelligence tests
   mechanical aptitude tests
   clerical aptitude tests

II. Special abilities
   sensory-motor tests (performance, dexterity, speed)
   specific vocational tests (trade tests)
   professional aptitude tests (medicine, law, engineering)
   talent tests (art and music)

III. Educational achievement
   standard tests in school subjects

IV. Inventories of personality, aptitudes, interests

V. Assessments of personality and temperament through ratings, interviews, projective techniques

A profile (page 605), which shows a person’s relative standing in a number of psychological tests, gives a useful picture of his capabilities: his ups and downs of ability. In addition, a survey of interests and attitudes will serve to identify a young man’s interests with those of successful people in one or more occupational groups.
We saw in Chapter 13 that psychological tests are related—sometimes quite closely—to performance in various kinds of work. Thus general-intelligence is linked to school achievement and to occupational level; tests of clerical aptitude, code

25 Extent to which selected psychological tests predict job proficiency for different occupational groups

<table>
<thead>
<tr>
<th>type of test</th>
<th>office workers</th>
<th>salesmen</th>
<th>sales clerks</th>
<th>general foremen</th>
<th>factory skilled</th>
<th>factory workers</th>
<th>unskilled workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence</td>
<td>.40</td>
<td>.30</td>
<td>-.10</td>
<td>.50</td>
<td>.35</td>
<td>.25</td>
<td>.10</td>
</tr>
<tr>
<td>Immediate Memory</td>
<td>.30</td>
<td></td>
<td>-.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substitution</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arithmetic</td>
<td>.30</td>
<td></td>
<td>-.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Comparison</td>
<td>.25</td>
<td>-.10</td>
<td></td>
<td>.20</td>
<td>.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name Comparison</td>
<td>.30</td>
<td>-.15</td>
<td></td>
<td>.20</td>
<td>.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancellation</td>
<td>.15</td>
<td>-.05</td>
<td></td>
<td>.40</td>
<td>.30</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>Spatial Relations</td>
<td>.10</td>
<td>.40</td>
<td>.45</td>
<td>.30</td>
<td>.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Principles</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>Finger Dexterity</td>
<td>.20</td>
<td></td>
<td></td>
<td>.20</td>
<td>.30</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>Hand Dexterity</td>
<td>.15</td>
<td></td>
<td></td>
<td>.35</td>
<td>.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Dexterity</td>
<td>.20</td>
<td></td>
<td></td>
<td>.15</td>
<td>.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality</td>
<td>.20</td>
<td>.40</td>
<td>.30</td>
<td>.25</td>
<td>.20</td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>.30</td>
<td></td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* After Ghiselli, 1949.

learning, and speed of reaction are prognostic of success in special fields; and aptitude tests in medicine, law, and engineering are important in the selection of applicants for training in these vocations. The extent to which commonly used tests are prognostic of job performance in a variety of vocations may be seen in Table 25.

Some of the correlation coefficients in Table 25 are of considerable interest. Only one validity coefficient (page
514) is as high as .50 (general intelligence and ratings as supervisors), most being .30 or below. It appears that in order to predict proficiency in even a simple job, we must combine several tests into a battery or team. This fact is well illustrated in the case of office workers. The best single index of office-worker efficiency is the general intelligence test. When tests of immediate memory, of substitution learning, of arithmetic, of number and name comparison are added to the general intelligence test (these tests are all found in batteries designed to measure clerical aptitude), the combination gives a better prediction of efficiency in office work than any single test. Motor and finger dexterity show little relationship to clerical proficiency, and neither does the personality test. Significantly, the personality test is the best predictor of sales aptitude, none of the performance tests being useful here. In skilled work (electrical and building trades, and the like) tests of spatial visualization and of mechanical and manual dexterity are important. These tests are also related to the job proficiency of factory workers. None of the tests listed is of much value in predicting the proficiency of unskilled workers.

There are now available several test batteries which provide score patterns for a range of occupations. The General Aptitude Test Battery of the U. S. Employment Service* includes ten separate tests: (1) general intelligence, (2) verbal aptitude, (3) numerical aptitude, (4) spatial visualization, (5) form perception, (6) clerical perception, (7) hand-eye coordination, (8) motor speed, (9) finger dexterity, and (10) manual dexterity. A battery intended for use primarily with high school students—the Differential Aptitude Tests—has been developed by the Psychological Corporation (1952). This battery includes separate tests of (1) verbal reasoning, (2) numerical reasoning, (3) abstract reasoning, (4) spatial relations, (5) mechanical reasoning, (6) clerical speed and accuracy, and (7) lan-

* Dvorak, 1947.
guage usage (spelling and sentences). Figure 283 shows how this battery may be used in educational and vocational guidance.

**PREDICTING SUCCESS ON THE JOB**

A person may possess the qualities to do a job and at the same time be unhappy because the work does not provide the satisfaction he is seeking. A number of studies bring out this fact. In one investigation, factory workers were asked whether, if they were fifteen years old and starting life again, they would choose the same occupation or trade. About one-third answered that they would choose the same trade, slightly more
than half said that they would not, and about one-sixth were not sure. A survey of college alumni in 1951 indicated that 75 per cent were satisfied with their present vocation. In another questionnaire survey of college graduates (1952), however, 25 per cent indicated a wish that they had majored in some other field than that chosen. The highest degree of satisfaction with the major was found among those who had been in the pre-med and pre-law programs (approximately 90 per cent being satisfied). Only about 65 per cent of the students who had majored in education, social science, history, or literature were satisfied with their choice. Most often the dissatisfied students wished they had majored in business administration, engineering, or medicine. It seems likely that the greater opportunity for jobs and higher salaries in these fields, and the greater prestige of the established professions, were factors in this dissatisfaction.

Studies like those quoted above show clearly that it is not sufficient to know simply that the worker possesses the requisite ability to do a job. When one offers vocational guidance, interests, personality traits, attitudes, physical health, and appearance must be taken into account as well as job opportunities, salary, chances for advancement, and such intangible factors as prestige. When administered by an expert, ratings, personality inventories, and projective techniques (page 569) are all undoubtedly useful. But these devices are often of limited value to the counselor pressed for time. Dependability, honesty, emotional stability, cooperation—all these are important, if not crucial, in most vocations. But such traits can rarely be evaluated quickly or precisely by a counselor in a single interview. Hence, work histories, school records, and letters of recommendation (the traditional estimates of personality) must still be relied upon in many situations.

One of the most satisfactory (and emotionally least disturbing) ways of estimating the probability of job satisfaction is through a systematic survey of interests. The Kuder Preference Record (page 566) supplies an estimate of interest in nine
vocational areas, and the Strong Vocational Interest Blank (page 567) identifies an individual's interests with those of successful men in fifty-odd vocations. Analysis of the Strong Interest Blank has revealed four interest families: science, business, language, and people. Physicians, chemists, and biologists are more interested in science than in people; ministers, social workers, and salesmen, are more interested in people than in science. Follow-up studies have been made of men whose dominant interests were first tested in college and then later when they had been out of school for nine or ten years. The following are general findings:

(1) Men who stayed in an occupation made a higher score for interest in that occupation while in college than in any other.
(2) Men who stayed in an occupation made higher interest scores in that occupation while in college than those who entered the occupation and then changed to another.
(3) Men who changed from one occupation to another scored as high in the second occupation while in college (before the change) as in the first occupation undertaken.

It seems clear that a systematic survey of a young person's interests has real predictive value for later satisfaction in an occupation.

Vocational counseling is admittedly not an exact science, but psychological tests and other devices provide a far sounder basis for guidance than hit-or-miss methods based upon casual and often unimportant criteria. From test data we may help a young person better relate his aptitudes to some vocation. We can with some assurance, for example, advise a young man of high general intelligence to undertake the study of law, provided he possesses the personal, social, and interest requirements. Also, we can advise a young man whose mathematical
FIGURE 284  Good health, mutual friends, and common interests are indications of probable future happiness in marriage.
ability is meager not to attempt engineering; a girl who ranks low to the Seashore Tests (page 532) to try some other career than music; a man who is clumsy and uncoordinated not to try dentistry. Advice of this sort must, of course, always be subject to qualification. No method or set of tests will provide an exact prescription nor insure complete success.

adjustment in marriage

After choosing a vocation, perhaps the next most pressing problem facing the young person is that of finding a mate and making a happy marriage. Studies carried out by sociologists and social psychologists have spot-lighted many of the factors which incline to a happy marriage, and in addition have identified those factors which predispose to marriage failure and divorce. Information of this sort is enlightening and often helpful to the young person contemplating matrimony.

WHY MARRIAGES SUCCEED

Among the antecedents making for marital happiness, the following have been shown to be important:

(1) happiness of parents and resulting happy childhood of their children
(2) early sex education
(3) common interests and mutual friends
(4) economic stability in the home
(5) healthy attitude toward sex and marriage

It seems reasonable to expect that being reared in a happy home will make for emotional stability and for friendly and congenial attitudes. In such a home, punishment is infrequent, and when administered is mild and firm. A rigid and puritanical attitude toward sex on the part of the parents increases a child's feeling of guilt and often leads to an abnormal interest in sexual matters. Early sex education (preferably given in
1. What is the attitude of your closest friend or friends to your fiancé(e)? approve highly........; approve with qualification........; are resigned........; disapprove mildly ........; disapprove seriously........

3. Do you confide in your fiancé(e)? about everything ........; about most things........; about some things ........; about a few things ........; about nothing ........

8. Is your fiancé(e) satisfied with the amount of demonstration of affection? yes........; [no: desires less........; desires more........]

10. State the present approximate agreement or disagreement with your fiancé(e) on the following items. Please place a check in the proper column opposite every item.

<table>
<thead>
<tr>
<th>Check one column for each item below</th>
<th>Always agree</th>
<th>Almost always agree</th>
<th>Occasionally disagree</th>
<th>Frequently disagree</th>
<th>Almost always disagree</th>
<th>Always disagree</th>
<th>Never discussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money matters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious matters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstrations of affection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philosophy of life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. How long have you been keeping company with your fiancé(e)? less than 3 months........; 3 to 5 months ........; 6 to 11 months........; 12 to 17 months ........; 18 to 23 months........; 24 to 35 months........; 36 months or more........


**FIGURE 285** Specimen items from Marriage-Prediction Schedule.
2. To what extent were you in love with your spouse before marriage? “head over heels” ; very much ; somewhat ; a little ; not at all.

4. How much conflict (arguments, etc.) was there between you before your marriage? none at all ; a little ; considerable ; very much.

5. To what extent do you think you knew your spouse’s faults and weak points before your marriage? not at all ; a little ; somewhat ; considerably ; very much.

9. What is your attitude to having children? desire children very much ; desire children a good deal ; desire children somewhat ; desire children a little ; desire no children.

10. If children have been born to you, what effect have they had on your happiness? added to it very much ; added to it considerably ; added to it somewhat ; have decreased it considerably ; have decreased it very much ; no children.

11. In leisure-time activities: we both prefer to stay at home ; we both prefer to be “on the go” ; one prefers to be “on the go” and the other to stay at home.

13. Do you kiss your spouse? every day ; almost every day ; quite frequently ; occasionally ; rarely ; almost never.

16. Are you satisfied with the amount of demonstration of affection in your marriage? yes ; no: (desire less ; desire more).

27. How many serious quarrels or arguments have you had with your spouse in the past twelve months: none ; one ; two ; three ; four or more.

30. If you had your life to live over, what do you think you would do? marry the same person: (certainly ; possibly) ; marry a different person ; not marry at all.

Reproduced by permission of Burgess, Cottrell, Wallin, and Locke.

**FIGURE 286** Specimen items from Marriage-Adjustment Schedule.
school, where it is likely to be more impersonal), when neither sentimental and mawkish nor exaggeratedly casual, encourages a healthy attitude and makes for happiness later. Financial security and common intellectual and social interests are frequently mentioned by experts as important in making for a successful marriage. Mutual friends and interests are perhaps best guaranteed by similar educational, social, and economic background.

The proper function of courtship is to provide opportunities for young persons to meet members of the opposite sex. Hence courtship is an important preliminary to marriage. In modern American society, “dating” constitutes a trial period in which boys and girls meet a number of members of the opposite sex before one is singled out for special attention. “Going steady” means that the preliminary period is over. The time at which any two people should enter into steady dating depends upon the maturity (physical, mental, social) of the boy and girl. It is unwise for this phase to be entered upon before the exploratory dating period has been fully experienced.

**WHY MARRIAGES FAIL**

The following factors are frequently present in marriage failure and divorce:

1. personality conflicts, often arising from wide differences in social and economic background
2. financial insecurity
3. carping criticism, lack of consideration, bad manners
4. unconventional behavior by one partner, especially toward sex, religion, drinking
5. hasty marriage
6. early marriage (before age twenty)

Quarrels, accusations, criticism, and frequent arguments—all are listed as important components of marriage failure. In recent years, disruption of family life by war has been an im-
FIGURE 287 The marriage counselor tries to give an unhappy couple some insight into the real causes of their difficulties.
FIGURE 288  Military service dislocates the lives of many young couples. The father may return a stranger, at first, to his children.

All photos Look Magazine
Important cause of divorce, the number of divorces in the U. S. having doubled from 1940 to 1946. Unrest and uncertainty, emotional tensions, shortness of engagement—all undoubtedly contribute to marriage failure.

The breakup of a marriage uproots the home and often leads to serious emotional disturbances in children. This is especially true of adolescents, who are unusually sensitive to social disapproval. It is impossible to generalize as to whether it is better for parents to maintain the pretense of a home for the sake of the children, or to avoid constant bickering and emotional outbursts by separation. The ages of the children, the degree of antagonism, and the socio-economic level of the home are all factors to be considered in a particular case.

Engagement-adjustment inventories have been drawn up covering a number of factors prognostic of marriage success. These "scales" have been satisfactorily employed in marriage counseling. Typical questions from one inventory are given in Figure 285, on page 610.

**the delinquent and criminal personality**

**PERSONALITY OF THE DELINQUENT**

Through study of the personality traits and environmental background of the delinquent, psychologists have sought to uncover the factors which predispose to offenses against society. Young delinquents often reveal a distorted sense of right and wrong. They are, however, quite sensitive to prestige suggestion (follow the leader), and regard disloyalty to the gang (being "chicken" or yellow) as the supreme offense.

Signs of delinquency may appear long before the child is actually in serious trouble. Among the forerunners of delinquency—many of which can be remedied if treated properly and in time—are constant irritability, chronic disobedience, defiance of parents and teachers, indifference to the outcome of
Gangs need not lead to delinquency when boys have good social outlets.

Hochman from Monkmeyer

One's acts, lack of humor and of insight into one's motives, and exaggerated interest in sex. These personality characteristics are often present in children who live in slums or delinquency areas—neighborhoods of extremely low socio-economic status and high crime rate. Not all delinquents are feeble-minded or even low grade, however; many are above average. In fact, general intelligence is not regarded by most experts as of crucial importance in juvenile delinquency. A significant exception is the low-grade child who is led into crime (usually thievery, vandalism, sex offenses) by an adult or by an older and more clever companion.

It is generally agreed by experts that there is no such thing as a "criminal personality." Delinquents report more worries.
than non-delinquents, reveal more neurotic symptoms (page 588), and are less mature socially. A reasonable view holds that the poor and inadequate personality may, when circumstances so incline, turn to antisocial acts as a means of gaining prestige and building up self-confidence. However, poorly organized personalities do not necessarily turn to crime as an outlet for their frustrations, or their real or imagined grievances.

**THE TREATMENT OF DELINQUENCY**

The main attack upon the problem of preventing delinquency has been through Child Guidance Clinics. These clinics, which are often attached to juvenile courts, employ a variety of methods in their efforts to aid the young offender. Punishment—at least severe punishment—is rarely advocated today and is seldom used. Rather, the modern behavior clinic offers a program of thorough medical service, education and training in social skills, and supervised recreation. Some of the methods commonly used in aiding children who are delinquent or potentially delinquent are outlined below. All of these should be administered by trained personnel.

**1) Release therapy**

Children, especially very young children, who are hostile and aggressive toward their parents and teachers (that is, toward authority) may be allowed to express, and perhaps dissipate, their pent-up emotions through such devices as puppet shows, dolls, finger painting, or drawing. The child is given a chance to “take it out” on the restricting adult in effigy, so to speak: he may smear the paint, tear up a drawing, punish a doll, arrange to have a child puppet “beat up” the older brother or father. Through such behavior, the child may release emotional tensions, and the therapist gain valuable insight into the child’s motives (page 266).

A little girl, aged five, the youngest of three children was referred to a therapist because she refused to be a girl, cut off her curls, insisted on being called by a boy’s name, and fought against wearing
girl's clothes. The difficulty started when she was about four, and seemed to be related to her jealousy of a boy of her age who showed off his strength and pooh-poohed girls. She was jealous also of her brother, aged thirteen, whom her governess distinctly favored.

It was possible to have only five sessions with this child. The therapist surmised that the little girl really favored girls and was hostile to boys whom she regarded as "oppressors"; that she had identified herself with the "superior" sex as a sort of self protection. This inference was borne out by the destructive attitude displayed by the girl in playing with boy dolls. By the fourth session, the little girl now somewhat tired of lambasting "boys" was inclined to think that girls were after all better than boys since they could wear pretty clothes. A week after the last session, the child stopped insisting that she be called by a boy's name and made no protest against wearing girl's clothes. A check-up interview six years later indicated normal feminine development.*

(2) environmental techniques

Recreation, dances, sports, "support" therapy (putting the delinquent under the care of a probation officer), reassurance, vocational guidance—all are used when the counselor thinks they may be helpful.

Peter, a boy of twelve, was referred to the counselor as a potential delinquent by Mr. R., the school principal. Mr. R. reported that Peter was frequently absent, did poor school work, was often in trouble for fighting and for annoying other pupils. Peter was suspected of vandalism—smearing paint on the school walls, breaking windows—and of petty thievery, but he had never been caught.

The counselor found Peter to be small for his age. His cocky and tough manner were believed to be a defense against feelings of insecurity and inferiority. Peter came from a bad neighborhood, his father was often out of work, his mother had been recently ill, and the family of four (all younger than Peter) was frequently hungry and neglected. Peter's IQ (Stanford-Binet) was 95—low normal. He did fairly well on manual dexterity tests, but poorly on tests of mechanical aptitude. After several interviews, Peter became more

* Adapted from Maslow and Mittelmann (Principles of Abnormal Psychology, 1951), page, 265.
friendly and was willing to discuss his future with the counselor. Mainly, he disliked school and wanted a “good” job with lots of money.

Therapy consisted first in trying to improve Peter’s home. The case was reported to the local social service agency, a job was found for Peter’s father and medical attention provided for his mother. Peter was persuaded to join a boys’ club where he could play games, use the gymnasium, and engage in sports under supervision. After two years, Peter is doing better school work, has had no trouble, and is much friendlier and more amenable to suggestions for improvement.

**Predicting the Outcome of Parole**

The appraisal of an offender by the prison psychologists furnishes the best available forecast of the offender’s future conduct on parole. In one study, the conduct of 193 men and women was reviewed six years after probation had been granted. The prediction of the clinical psychologist was confirmed by subsequent conduct in 70 per cent of the cases; in 25 per cent the forecast was in error, and in 5 per cent was not clear. In another study of 120 cases, the correlation between the prediction made by the psychologist and success on parole was .71 (page 514). Results like these are encouraging. They show the possibility that the outcome of parole may be forecast with considerable accuracy.

**Improving Personality**

In Chapter 14 it was pointed out that many students take up the study of psychology in the hope of discovering how to improve their own personalities. It was stated that psychology can best meet this expectation by providing a better understanding of motivation (especially of unrecognized motives), together with a sounder knowledge of the principles of learning and of habit formation.
Rules for improving personality, maxims, and "good advice" are often useless and may even be dangerous, since principles tailored to fit people in general may not meet the needs of someone in particular. Frankness, for example, is undoubtedly a virtue in the abstract. But the unobservant man, admonished to be frank, may deeply offend his friends by outspoken comments concerning their appearance, clothes, mannerisms, and social activities. Again, the timid and diffident child who is urged to be self-reliant, in trying to oblige may succeed only in being stubborn, unresponsive, and uncooperative. In such cases, the last state of the person may be worse than the first.

In spite of the many and obvious difficulties which arise when one tries to fit general rules to individual cases, there are techniques for improving social acceptability which have stood the test of time and which have a firm grounding in known principles of motivation. Several of these procedures will be outlined in the following paragraphs.

REMEMBER THAT YOU YOURSELF ARE A SOCIAL STIMULUS

People respond to you, and you respond to other people. This may seem trite—as indeed it is—but because of its very familiarity it is often neglected or overlooked. Appearance, speech, education, and culture as revealed in conversation, expressed opinions, and attitudes—all these markedly affect one's stimulus-value. Consider the child who is shy and withdrawn because he must wear thick eyeglasses or a brace on his teeth; or the youngster who is belligerent and aggressive because his parents treat him like a baby (he may indeed act like one); or the adolescent tormented by embarrassment because he has pimples on the face or a speech impediment which renders him unattractive to girls; or the young woman who declines an invitation to a formal dinner because she is not sure of her dress or of her table manners. In such cases as these, and they are many, real or fancied deficiencies serve to warp and to distort the personality and thus to affect the attitudes and behavior of
other people. The attitude of our associates is markedly affected by the opinion we have of ourselves.

While some of our defects cannot readily be remedied, nevertheless much can be done to improve our stimulus-value. A good book on etiquette will help, as will close observation of those who are admired because they are successful, wise, or self-assured. By wearing clothes of a different style, getting a new hair-do, or correcting indistinct enunciation, a young woman may greatly improve her social acceptability. A young man may accomplish a like result by keeping his hair cut and his shoes shined, by improving his social manners, and by refraining from expressing freely and positively opinions which may needlessly give offense to others.
CULTIVATE ACCEPTED SOCIAL SKILLS

People who can do things are more likely to be sought after than those who cannot or will not, or who continually offer excuses. The girl who can play the piano or a good game of bridge or tennis; the boy who can cook a meal or pitch a tent on a camping trip; the man who can tell a good yarn or sing tenor—each of these will find his accomplishment useful. Knowledge of and interest in art, music, or some other special subject (for example, folk dancing or photography) will oftentimes greatly enhance one's popularity within his own group.

Every young person (and many older ones) would do well to cultivate the art of being a good listener. Nothing is more satisfying nor more flattering to an individual than to have his conversational partner exhibit (or seem to exhibit) interest in his activities and accomplishments. All of us have met self-centered and often egotistical people who pause in their conservation, not to listen to what someone else has to say but merely to gain breath in order to resume the recital of their own exploits. The art of good listening is a useful social skill and one which is not frequently encountered. Its cultivation will often greatly improve one's acceptability.

The timid and insecure person would do well to be satisfied at first with small social successes—on the principle that one must crawl before he can walk. Self-confidence is gained when the hurdle is not too high for success to be achieved; and one success (a small party or minor social function) may so change

FIGURE 291 Even the soda fountain may become a "fountain of knowledge" in learning the social graces.
a person's attitude and strengthen his resolution that the next step is far easier than it would otherwise have been. Young people who develop social skills *early* have a great advantage over those who delay or refuse to acquire accomplishments highly valued by their associates.

**TRY TO PENETRATE THROUGH AND UNDERSTAND YOUR “REAL” MOTIVES**

It is important that we cut through the smoke screen of our rationalizations (page 273) and understand our behavior, opinions, and attitudes for what they are. A young man expressed great distaste for social dancing which, so he declared, was vulgar and immoral. Nevertheless, when an older woman friend offered to give him lessons privately, he accepted with alacrity. Later he became an enthusiastic champion of the modern dance. It seems clear that this man's attitude toward dancing was not at all what he pretended it to be. Perhaps it is necessary in modern society that we employ polite excuses and even subterfuges, that we sometimes tolerate and appear to condone practices of which we disapprove. The man who boasts
that he is a staunch individualist, that he never compromises, always says exactly what he thinks regardless of consequences, and despises the social climber and the “toady,” will often find himself ignored and avoided. It is not necessary, of course, that we defer to everyone’s opinions, but “grin and bear it” is often a better technique than a firm expression of disagreement. Furthermore, we should be ready to appraise our own motives and to revise and revalue them when new conditions so demand. It is quite probable that the hardy individualist is actu-
ally fooling himself with elaborate protective devices to explain away and justify his lack of friends.

**STRIVE TO DEVELOP POSITIVE PERSONALITY TRAITS**

In Table 24 (page 553) are listed twelve dimensions of personality, between the extremes of which behavior may range. Perhaps we cannot hope always to be intelligent, emotionally stable, co-operative, and friendly at the same time, but at least we can strive to develop the positive rather than the negative aspects of these trait dimensions. The rules for developing new habits, given on page 333, will be useful here: practice the desired behavior as often as possible; permit no exceptions; set up definite specifications as to the behavior wanted.

**FIGURE 294** The “show-off” may act from a basic feeling of insecurity, but whatever his motives he soon becomes socially unacceptable.

Foldes from Monkmeier
PERSONALITY TRAITS ARE MODIFIED MORE BY EXAMPLE AND BY INDIRECT METHODS THAN BY FRONTAL ATTACK

Suggestion, example, and counterappeals are the best devices for altering what we believe to be unsound or unwise opinions and attitudes of our friends and associates. A youngster’s views on politics, religion, or social issues, for example, will be influenced to a greater extent by what his parents and friends do than by what they say. Perhaps the worst possible way to modify in another person a trait which we judge to be hampering is to ridicule and condemn it. Statesmen, diplomats, lawyers, and salesmen know that a man is rarely convinced of the fallacy of his position by force of argument. Even when he suspects or even realizes that his assertions do not hold water, he is likely to continue to defend them vehemently, through stubborn pride, unwillingness to appear weak or silly, or irritation at his opponent and at his own discomfiture. If one values a friend’s good will and honestly wants to change his view, one will not offend and belittle him at the outset. By granting a point here and there, admitting one’s own fallibility, and avoiding irritation and a show of temper, one can often get another person first to yield a bit and then perhaps gradually to shift his position. Attitudes and opinions which are strongly held can best be influenced by suggesting a counterprogram, relying upon opposed and dependable motives to effect a change, and by avoiding the hostility and negativism which result from heated argument.

SOCIAL CONFORMITY AND “GOOD” PERSONALITY ARE NOT NECESSARILY THE SAME

The reader may have got the idea from our list of techniques for improving personality that psychologists believe everyone should cajole and palliate others, never assert oneself, and carefully observe and respect all of the conventions and accepted
social usages. Nothing could be further from the truth. Established social behaviors, to be sure, have a certain sanction insofar as they express the experience of many people. And social conformity provides for many a sense of security and "belongingness" which is both satisfying and reassuring. But an individual should certainly hold fast to and defend what he believes to be right and condemn what he believes to be wrong. At the same time, he should be quite sure that his motives are sincere and that he is prepared to take the consequences which may arise should he defy accepted practices. The techniques described above are practical methods for developing behavior which will enable an individual better to adapt himself to the group or to the social framework in which he lives. But they are in no sense immutable principles, and they should be discarded or changed when the occasion demands.

psychology in industry

The psychologist working in industry is interested in three problems: (1) analysis of job requirements; (2) development of more efficient work methods; and (3) better relations between labor and management, that is, improving morale.

THE ANALYSIS OF JOB REQUIREMENTS

The analysis of a job can be made in several ways. A young person may observe those who are successful in the job and make his own analysis—subject, of course, to considerable personal error. Again, an applicant may talk to people familiar with, or engaged in, the job. This is helpful provided the young person realizes that, for various reasons, many persons tend to belittle their own work. Finally, an applicant may seek the advice of a vocational counselor and at the same time consult sources of occupational information. This is probably the most objective attack. Information concerning many occupations will be found, for example, in C. L. Shartle's "Occupational
THE JOB OF THE MECHANICAL ENGINEER

• WHAT HE DOES
• HOW HE QUALIFIES
• WHAT HE EARS
• WHAT IS THE EMPLOYMENT OUTLOOK

1 September 1945 Occupational Brief No. 20

Information” (1952) and in G. Forrestor’s Occupational Pamphlets (rev. ed.) 1948. The United States Government has published a number of occupational briefs which supply relevant information regarding vocations. Occupational Brief #20, for instance, “The Job of the Mechanical Engineer” (see Figure 295, above) tells what a mechanical engineer does, how one qualifies for the job, what he may earn, and what (at the time of publication) the occupational outlook is.

The Dictionary of Occupational Titles (1949) lists 21,653 different kinds of work. Clearly, the number and variety of occupations makes it virtually impossible for the young person seeking a job in industry to know—without help—the opportu-
unities in and the training requirements for more than a very few vocations.

**The Development of More Efficient Methods of Work**

In studying the actual movements made routinely by a skilled workman, the industrial psychologist may break down the total act into its component parts. The analysis of work units into their elements, with a record of the relative duration of each element, is called *time and motion study*. The object of such study is to eliminate unnecessary and wasteful activity. Motion pictures of the movements performed by an expert worker, reduced to separate pictures or shown in slow motion, may be analyzed; or a system of symbols may be employed to denote such component movements as finding, selecting, assembling, inspecting, loading, and so on. Analytic studies have yielded valuable information relative to the necessary components of a job. Time and motion studies have, however, been criticized on the grounds that there is no *one* best method of carrying out an industrial task, that individual differences and preferences (that is, style) appear even in relatively simple activities. Furthermore, psychologists have argued that a total act is not merely the sum of a number of specific acts.

Many workers object to time and motion studies—in fact to any study of worker proficiency. They like to work at their own speed; they fear reduction in the number of jobs as a result of speed-up methods, and the possible effect upon wages, promotion, and health. Many skilled workmen in large plants deliberately restrict their output either on their own initiative or on orders from their union. This situation indicates the need for better management-labor relations.

**Worker Motivation**

Several surveys have made it clear that the morale of a workman depends on more than wages. The personal satisfaction which the worker gets from his job, the responsibility and
prestige which it carries, the working hours, and so forth may be more important than such things as rest periods, lighting, bonuses, or length of working day. In one factory (The Western Electric study in 1939), social and psychological factors were found to be highly important in productivity. It was believed that variations in lighting, temperature, rest periods, and wage rates would affect work output in a positive way, and this proved to be true. But an unexpected result was that the work-output of a group of girls engaged in assembling telephone relays increased for all of the factors, and for varying degrees of the same factor. Interviews revealed that the girls had developed a “team spirit,” that they felt honored to be chosen for the experiment, and were “set up” because of the greater freedom allowed. The morale factor overshadowed the more objective situational variables.
The objectives of worker and management are frequently in conflict, largely because of mutual lack of understanding. This fact was shown clearly in a study* in which thirty-three management representatives and forty-four union representatives were asked to answer twenty-four questions dealing with labor-management relations. Three sample questions from this list are given below:

4. Regardless of whether the employer prospers or not, a labor union should try to get more money for its members.

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>disagree</th>
<th>undecided</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
</table>

18. Intelligence, ability and hard work won’t get you very far nowadays unless you have group support.

<table>
<thead>
<tr>
<th>strongly disagree</th>
<th>disagree</th>
<th>undecided</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
</table>

23. ( ) Practically all. . . . . . Labor leaders are trying to take
( ) Many over the duties performed by
( ) Some management and run American
( ) Few industry themselves
( ) Practically no

The two groups—labor and management—took opposite sides on twenty-two of the twenty-four questions, thus demon-

* Libo, 1948.

Courtesy Standard Oil (N.J.)

**Figure 297** Many modern companies provide pleasant facilities for labor-management conferences.
strating a real difference in point of view. Each group was then asked to fill out the questionnaire as it thought the other group would answer: management for union, union for management. This time the management representatives showed more insight than the union representatives. On three questions, management thought labor would take a more extreme view, whereas on ten questions labor missed the management point of view, in whole or in part. Management expected the unions to take a more extreme position than they actually did regarding more money for workers, jurisdictional strikes, and attitude toward leaders. Of the ten “misses” by the labor representatives, on three questions the union representatives thought that management would favor workers not joining a union, would oppose increasing wages unless the cost of living went up, and would advocate a curtailment in the power of labor unions. On the remaining seven questions, the labor representatives thought that management would be less extreme on three and more extreme on four.

The Psychology of Customer Preference

Applied psychologists have carried out many studies of interest to business men who have the problem of advertising and selling their merchandise. The effectiveness of an advertisement is usually measured by the average number of readers for each dollar spent; and the relative effectiveness of a list of different appeals may be compared in terms of readers. Table 26, gives the ranks assigned by more than five million men and women readers to sixteen copy appeals in Sunday newspapers. News features and social advancement have the greatest appeal to men, scare appeals, such as fear of disease, and service with product, the least. For women, sex allure and news features are strongest, price and product alone, the weakest.

Experimental studies of customer preferences show that selections of merchandise are often based on cues of which the customer is unaware, or upon factors having little bearing on
The product. In one study, for example, 250 housewives were asked to select the best of four pairs of hose, identical except for differences in odor (introduced by the experimenter). Only six of the women mentioned the odor, although the results clearly indicated that odor determined the choice. All of the women thought they were deciding on the basis of texture, weave, quality, and weight. In a study of milk drinking habits in New York City, it was found that 36 per cent of the people interviewed stated that they drank no milk, and that the age level ten to fifteen years was the time when most of them stopped drinking milk. Comments to the interviewers indicated that during the 'teens, milk was often associated with

* Adapted from report made by Gallup Research Bureau, 1935.

---

The product alone, with no drama

---

* Laird, 1932.
babies and hence was considered "sissy." One dairy, as a result of this survey, began to direct its advertising toward building up the idea of milk as a food for athletes, stressing the "strength" features of milk drinking.

**psychological warfare and propaganda**

**Psychological Tests in the Military Establishment**

Chapters 12 and 13 described how psychological tests were used in the Armed Forces for selection and placement. In addition to the Army General Classification Test (AGCT), tests of clerical aptitude and mechanical ability were employed in the selection of men for special services (page 524). The tests of mechanical aptitude measure much the same thing as the AGCT, namely, abstract learning and the ability to deal with symbols. Hence, when the men scoring in the lowest bracket of AGCT were eliminated, the correlation between AGCT and the mechanical aptitude test was so high that, except for predicting success in the training of mechanics, the AGCT was as good as the mechanical aptitude test. Table 27 gives the mean AGCT scores achieved by selected military specialists in the Army Air Force. As in Table 21, on page 519, the higher the level of training demanded by the job, the higher the mean score in AGCT.

**Morale in War**

Morale, in a military sense refers to drive, spirit, willingness to fight. Military men have always regarded morale as of paramount importance. During World War II, sociologists and psychologists carried out several studies (by questionnaire) dealing with soldier morale. Among the areas covered were attitudes toward officers, toward the army, toward postwar conscription, and toward one's army job. In these surveys the army
### Army general classification test results for selected military occupational specialties of army air force enlisted men*

<table>
<thead>
<tr>
<th>title</th>
<th>median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather Forecaster</td>
<td>136.7</td>
</tr>
<tr>
<td>Oxygen &amp; Nitrogen Plant Operator</td>
<td>121.2</td>
</tr>
<tr>
<td>Geodetic Computer</td>
<td>119.8</td>
</tr>
<tr>
<td>Aerial Photographer</td>
<td>118.8</td>
</tr>
<tr>
<td>Radio Mechanic, AACS</td>
<td>117.8</td>
</tr>
<tr>
<td>Wire Repairman, VHF</td>
<td>116.4</td>
</tr>
<tr>
<td>Altitude Chamber Technician</td>
<td>115.2</td>
</tr>
<tr>
<td>Radio Operator Mechanic Gunner</td>
<td>114.4</td>
</tr>
<tr>
<td>Crew Chief</td>
<td>112.6</td>
</tr>
<tr>
<td>Office Machine Serviceman</td>
<td>111.0</td>
</tr>
<tr>
<td>Aerial Torpedo Mechanic</td>
<td>110.0</td>
</tr>
<tr>
<td>Meat &amp; Dairy Inspector</td>
<td>106.8</td>
</tr>
<tr>
<td>Duplicating Machine Operator</td>
<td>106.0</td>
</tr>
<tr>
<td>Diesel Mechanic</td>
<td>104.0</td>
</tr>
<tr>
<td>Sheet Metal Worker</td>
<td>101.6</td>
</tr>
<tr>
<td>Able Seaman</td>
<td>98.8</td>
</tr>
<tr>
<td>Painter, General</td>
<td>96.8</td>
</tr>
<tr>
<td>Baker</td>
<td>94.4</td>
</tr>
<tr>
<td>Heavy Auto Equipment Operator</td>
<td>92.2</td>
</tr>
<tr>
<td>Control Station Operator</td>
<td>87.9</td>
</tr>
<tr>
<td>Laundry Machine Operator</td>
<td>83.4</td>
</tr>
<tr>
<td>Airplane Handler</td>
<td>67.8</td>
</tr>
<tr>
<td>Average, 209 AAF (Occupational) Specialties</td>
<td>103.7</td>
</tr>
</tbody>
</table>

* After Harrell, 1949.

psychologists distinguished between the content of an attitude and its intensity. The difference between these two aspects of an attitude may be seen when two men express the same unfavorable attitude toward their officers, or toward an Army policy. The first man may have little conviction and may be readily susceptible to suggestion or argument, whereas the second may have strong feelings and be adamant to argument. An illustration of the relation of intensity of feelings to content is found in Figure 298, which shows the strength of the attitudes expressed by enlisted men toward their officers. Each
soldier received two scores: a content score, which depended upon the number of questions answered favorably or unfavorably concerning officers, and an intensity score, which expressed the strength of the attitude (favorable—unfavorable). Questions were concerned with such factors as officer efficiency, fairness, interest in and regard for the welfare of the enlisted man, personal qualities, respect in which held by men, and so on. The sample interviewed included 2827 enlisted men. From Figure 298 it appears that both favorable and unfavorable attitudes were held with greatest intensity, the weakest intensities of feeling being found with mildly favorable attitudes.

Table 28 shows that experienced combat veterans were less eager to fight than were men inexperienced in combat. Perhaps this is to be expected, since the experienced soldier knows what to expect far better than does the recruit who has never faced danger. Surveys of opinion among naval aviators* showed that in squadrons judged to have high morale, pilots preferred to fly with their squadron mates in combat. In squadrons having low morale, pilots preferred men in some other outfit as partners

* Jenkins, 1948.
Willingness for combat among enlisted veterans and inexperienced replacements in line infantry companies*

<table>
<thead>
<tr>
<th></th>
<th>Number of cases</th>
<th>Per cent making favorable responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CASES</td>
<td>Question 1</td>
</tr>
<tr>
<td><strong>noncoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veteran Division A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterans</td>
<td>178</td>
<td>17</td>
</tr>
<tr>
<td>Inexperienced Divisions</td>
<td>2,357</td>
<td>57</td>
</tr>
<tr>
<td><strong>private &amp; pfc's</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veteran Division A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterans</td>
<td>427</td>
<td>15</td>
</tr>
<tr>
<td>Replacements</td>
<td>406</td>
<td>28</td>
</tr>
<tr>
<td>Inexperienced Divisions</td>
<td>7,493</td>
<td>45</td>
</tr>
</tbody>
</table>

Question 1. "Which of the following best tells the way you feel about getting into actual combat zone?"

The answer categories were as follows:

- X I want very much to get into it just as soon as possible.
- X I'm ready to go any time.
- X I'd like to go before it's over, but I don't think I'm ready yet.
- __ I hope I won't have to go but if I do I think I'll do all right.
- __ I hope I won't have to go because I don't think I would do very well.

The categories marked X were considered favorable.

Question 2. "Which of the following best describes your own feeling about getting combat against the Germans?"

The answer categories were:

- X I'd like to get into the fight as soon as I can.
- X I'm ready to go when my turn comes.
- __ I'd just as soon stay out of combat if possible.
- __ I don't want to go into combat at all.

The categories marked X were considered favorable.

* After Harrell, 1949.

in combat. Contrary to legend, few soldiers in modern armies really like to fight. The American soldier expressed himself as more willing to fight when he believed in the cause, and less willing when he did not so believe, even though he was well
led, trusted his officers, and felt that other able-bodied men were doing their part.

Going absent without official leave (AWOL) has often been taken as objective evidence of low morale. In general, soldiers who went AWOL were younger and less well educated (and presumably less intelligent) than the more stable men. The AWOL men also tended to be immature and aggressive and to have a history of irresponsibility. They were likely to stay to themselves and to be unpopular with their fellows.

PROPAGANDA IN WARFARE

The object of propaganda and morale-building programs in wartime is to persuade people to think in definite (often different) ways. While propaganda may be directed against enemy soldiers as well as against enemy civilians, morale programs are primarily for home consumption. During war, propaganda is conducted by radio broadcasts, by leaflets dropped behind enemy lines and by word of mouth. Early in World War II, German propaganda was directed against French civilians in order to undermine their confidence in the allies (“England will fight to the last Frenchman”) and to convince the French of the invincibility of German arms. The American demand for unconditional surrender is believed by many to have stiffened the opposition as much as it frightened the enemy. Public opinion is very sensitive to events. There was, for example, a rapid loss in Japanese confidence with time and increasing sense of impending defeat.

War propaganda is often effective when it is vague, hinting at disasters without detail. Propaganda is also effective when it proclaims what people want to believe. Most people, for instance, fervently desire peace. Hence loud shouts for peace, the calling of peace congresses, and appeals to disarmament (no matter how false) always find a receptive audience. War propaganda is usually effective when it is directed toward prejudice, self-interests, relief of anxiety, and enhancement of prestige.
FIGURE 299 Other weapons than guns are used in a “cold war.” Balloons carrying propaganda leaflets may be sent into countries where the press is controlled.
summary

The techniques of modern psychology have proved useful in many problems involving human relations in business and industry, as well as in problems of personal and social adjustment. In helping a young man find a satisfactory job, the applied psychologist assesses the capacities of the applicant, analyses the requirements of the job, and seeks to fit the two together. Analysis of the movements made in industrial tasks have led to improved methods of work, and psychological appeals to prestige and self-satisfaction have proved to be as powerful incentives as bonuses and rest periods.

Light has been shed upon many problems of personal and social adjustment through studies by sociologists and psychologists. Thus, many factors which make for successful marriage have been examined, and those antecedents which lead to marriage failure and divorce have been scrutinized. Modern therapeutic methods have been directed toward the amelioration of delinquency and crime, and whenever feasible, toward its prevention. Common-sense techniques, soundly based upon psychology, have been developed for improving one's social acceptability.

The morale of the civilian is as important in modern warfare as is that of the combat soldier. During World War II, many surveys were made not only of the soldiers' attitudes but also of the effect of various kinds of propaganda upon a nation's willingness to continue fighting.

questions and topics for discussion

1. What traits do you think are important to success as a student? How could you test them?
2. Is success in a particular job a unitary thing? Do you think two people could be successful at the same job for different reasons?
3. Why would intelligence be a poor predictor of success in medical school?
4. Do you think that all people categorized as delinquents are similar in psychological make-up?
5. What kind of relationship exists between an ad-
advertisement's attractiveness and its selling power? Need it be a one to one relationship?

6. What problems can you see in using the worker interview method of job description?

7. Do you think there is one best personality? Could a good personality in one situation be a poor personality in another situation?

8. How would you measure the morale of our infantry company? Would the same measure work for a WAC company?

9. Do you feel that a person's aptitudes and interests need be identical?

10. What comments can you make concerning the statement, "For each man there is one mate"?

11. Is it possible for a re-marriage to succeed where the original marriage failed? Why?

12. Under what circumstances would you expect propaganda to be most successful?

suggested readings


ability: skill or aptitude shown in performance. Ability may be greater than that revealed by tests.

achievement: actual performance; often used in reference to scores on educational tests or to school grades.

adjustment: the relationship between one's wants and needs and the environment.

adolescence: period from the early 'teens to the early twenties.

adrenal glands: endocrine glands situated near the kidneys. They secrete adrenin a powerful hormone useful in combatting fatigue and increasing body stamina.

adrenin or adrenaline: hormone secreted by the adrenal glands.

affective experience: pleasant or unpleasant feeling-tone.

afterimage: prolongation or renewal of a sensory experience after the stimulus has ceased to affect the sense organ.

age norm: average score on some test made by children of the same age.
aggression: behavior characterized by hostile action toward some person or object.

ambiguous figure: an outline figure which may be seen in more than one way.

amnesia: partial or total inability to recall certain past experiences. Such memories are often regained.

anxiety: intense uneasiness, especially with reference to the future.

apprehension span: the number of objects correctly perceived during a short exposure long enough, however, to permit eye movements.

aptitude: native or potential capacity to learn, inferred from performance.

assimilating: distortion of memory in the direction of familiar objects or experiences.

association of ideas: the principle that things experienced together tend to be recalled together.

associative learning: the principle that in learning ideas or objects are tied together or associated.

attention: the process of focusing upon certain elements of experience so that they become relatively more vivid.

attitude: a more or less general tendency to react favorably, unfavorably, or with indifference to certain persons, objects, ideas.

attitude scale: a device for measuring the strength of an attitude.

autonomic nervous system: a system of nerve cells and fibers lying outside the central nervous system. The a.n.s. regulates the smooth muscles and glands. It has two main divisions the sympathetic and the parasympathetic (cranio-sacral) branches.

behavior: observable (and often inferred) activities of an organism.

bimodal: a distribution of scores or other measures which has two modes or peaks.

brightness: intensity of the visual experience (brilliance).
case history: interview and test materials used in studying an individual.

central nervous system: nervous structures including the brain and the spinal cord with their sensory and motor connections. The c.n.s. controls the striped muscles and is usually dominant over the autonomic nervous system.

cerebral cortex: surface layers of the two hemispheres of the cerebrum.

cerebrum: main division of the brain; active in thinking and learning.

chromosomes: small paired bodies in the germ cells; contain the genes.

chronological age: life age. (Written CA.)

clinical psychologist: a psychologist trained to administer tests, conduct interviews, make diagnoses, administer psychotherapy. Usually works in hospital or institution.

coefficient of correlation: an index (decimal fraction) which expresses the degree of correspondence or relationship between two sets of measures.

color constancy: tendency to see familiar objects as of the same color regardless of illumination and apparent changes in hue.

compulsion: repeated or stereotyped movements that a person feels obliged to make; often ritualistic.

concept: a name embracing a class of objects or properties common to a class of objects. “Cat” is a concept which includes a wide variety of animals, and “fraction” covers a number of common numerical relationships.

conditioned reflex: a reflex initially set off by a sensory stimulus A, and later aroused by stimulus B which has been associated with A.

conditioned response (CR): a response or responses made to a conditioned stimulus, namely, a stimulus which substituted for the originally effective stimulus.
conflict: the competition of two or more contradictory impulses; usually accompanied by emotional tension.

contour: outline or boundary of an object.

controlled association: association tests in which the subject is instructed to give a certain answer; for example, a word meaning the opposite of the stimulus word.

copy-theory: the notion that we perceive objects as they are.

correlation: see coefficient of correlation.

cretinism: retarded mental and physical development resulting from thyroid insufficiency.

culture: social organization, including language, customs and the like.

defense mechanism: behavior, often elaborately disguised, designed to "save face" or avoid loss of self-esteem.

dependent variable: behavior changes which can be attributed to some independent variable.

disassociation: a splitting or division of the personality.

discrimination: in learning, a differential response; reaction to a positive (reinforced) stimulus and not to a negative (non-reinforced) stimulus.

drive: a condition within the organism which predisposes to some action; for example, hunger, sexual feeling.

empathy: the feeling of oneself "into" a work of art or natural object.

endocrine glands: ductless glands of internal secretion. The hormones secreted by the endocrines regulate body activity, and are important in shaping personality traits.

endomorph: a person of relatively large body and short arms and legs. One of the three basic body types proposed by Sheldon.

experimental method: techniques in which conditions are controlled, sources of error eliminated, and the effects of independent variables upon dependent variables measured.
extinction: the gradual weakening of a conditioned response by repeated stimulations without reinforcement by primary unconditioned stimulus.

extrovert: personality “type” in which interests are directed toward the outer world and social life rather than toward oneself.

faculty psychology: early view of psychology which regarded the mind as composed of a number of separate faculties such as intellect, feeling, memory, volition or will.

fantasy: day-dreaming; fanciful and uncontrolled imagination.

feeble-minded: those judged to be of low intelligence in terms of various criteria.

feeling-tone: the pleasantness or unpleasantness of an experience.

figure-ground: term used in perception to denote an object or thing against a background.

forgetting: the loss, temporary or permanent, of something learned earlier.

formal discipline: the theory that the study of certain subjects (Latin or mathematics, for example) trains the general faculty of reasoning and judgment.

fraternal twins: twins developed from two eggs; brothers and/or sisters born at the same time.

free association: in word association tests, the giving in response to a stimulus word, of any word which occurs to the Subject.

frontal lobes: the forward parts of the cerebrum.

frustration: sense of defeat (annoyance, confusion, anger) when a motive is blocked as in a conflict.

gene: the unit of inheritance found in the germ cells.

generalization: in learning, the principle that once a CR has been established to a given stimulus, a number of other stimuli may call out the response. Hence the response is generalized.
goal: an incentive or objective which directs behavior—food or a good job.

graphic rating scale: a scale in which the rater makes his judgment by marking somewhere along a line, one end of which describes the high, the other end the low degree of the trait.

group tests: tests (intelligence, aptitude, educational) administered to a number of persons at the same time.

habit: a sequence of activities, well learned and highly automatic.

hallucination: false perception.

heredity: the biological transmission of traits from parent to offspring by way of germ plasm.

hormone: secretion of an endocrine gland.

hysteria: mental disorder characterized by disassociation and often accompanied by fits, palsies, or functional disorders.

identical twins: twins which have developed from a single egg; always of the same sex, and closely alike in appearance.

idiot: a person with the least amount of mental capacity.

illusion: a confused or misinterpreted perception.

imbecile: grade of mental deficiency just above the idiot and below the moron.

imitation: in learning, behavior which copies what the instructor does.

immediate memory span: number of items (numbers, words) reproduced immediately after a brief exposure.

incentive: an object or thing which directs and stimulates behavior; for example, food, praise, and so on.

independent variable: the variable controlled by the experimenter for the purpose of studying its influence upon behavior.

individual differences: variations in performance from person
to person, as, for example, on an intelligence test.

**individual test**: a standardized test, such as the Stanford-Binet, administered to one person at a time.

**insight**: in learning, the sudden perception of relationships hitherto not comprehended. In psychotherapy, the understanding of one’s own behavior as being normal or abnormal.

**instinct**: a form which describes patterned, often stereotyped, behavior, thought to be inborn in animals. Rarely used in reference to human beings.

**intelligence**: efficient behavior at the abstract, mechanical, or social levels.

**introvert**: personality “type” in which interest is directed toward oneself.

**IQ**: an index of intelligence, used with children primarily, and defined as \((\text{MA}/\text{CA}) \times 100\).

**item**: a single unit or test question.

**law of effect**: the principle that the satisfaction or annoyance following a response makes the response more or less probable at some later time.

**leveling**: the tendency in recall toward greater symmetry and smoothness in the perception.

**manic depressive psychosis**: mental illness in which behavior goes thru cycles from elation (manic phase) to depression and melancholia (depressive phase).

**maturation**: a state of growth or development, or the process of reaching a given state of development.

**maze**: a learning device consisting of runways with correct pathways and blind alleys.

**memory trace**: physiological changes which are believed to take place in the nervous system when something is learned, and to persist until recall.

**mental age** (**MA**): the score attained on an “age scale,” that is, a scale in which test items have been grouped by age levels.
mental deficiency: low mental ability as determined by various criteria, usually by test scores.

mesomorph: a person of relatively harmonious body and limb structure. The second of the three basic body types proposed by Sheldon.

moron: a mentally deficient person just below normal; above the imbecile.

motivation: a term which refers to inferred “sets” or drives within the organism which impel to action.

motive: a need, aspiration, ambition, or purpose. Motives initiate behavior.

negativism: defiant or stubborn behavior found in young children and often in older people. The negative attitude sometimes leads to behavior which is the opposite of that asked for.

nonsense syllables: artificial “words” usually consisting of a vowel and two or more consonants; for example, BIP, RONT.

norm: the average score of some defined group. For example, the norm on an educational achievement test for the Third Grade is the mean score earned by large unselected groups of children in this grade.

normal curve: a symmetrical bell-shaped distribution; is approached by distributions of scores in which a few are very high, few very low, and many intermediate.

object-constancy: the tendency to see objects as we know them (in shape, size, and color) under different conditions of illumination and distance from the Observer.

overcompensation: behavior in which exaggerated efforts are made to conceal weaknesses or real or felt inferiorities.

overlearning: continued practice over and above bare mastery.
paired associates: learning method in which items are learned in pairs; one item is the stimulus, the other the response to be given by the learner.

perception: the organizing process by which we become aware of things around us. The sensory stimulus is always influenced by the Observer’s experience and interests, so that perception becomes an interpretation of sense-organ data.

perception span: the number of objects correctly perceived in an exposure too short to permit eye movements.

performance scale: a scaled test (usually of intelligence) which does not depend upon language; suitable for young children and adult illiterates.

personality: organization of characteristic behavior traits which serves to describe an individual.

personality dimension: trait which varies from one extreme to the other, for example, vigorous-lazy.

personality inventory: a list of statements about personal characteristics; answers give insight into an individual’s personality when referred to norms obtained from groups having known characteristics.

personality structure: unity or organization ostensibly underlying a person’s traits as exhibited in behavior.

physiological motive: a bodily or organic need, as for example, the need for food or water.

pleasantness: the feeling-tone described as pleasant; the opposite of unpleasantness.

posthypnotic suggestion: a suggestion given under hypnosis and carried out by the person after he has come out of the hypnotic trance. Usually the person has no memory for the suggestion which caused the behavior.

projection: the attributing of one’s undesirable traits to some person or thing; a defense mechanism.

projective test: a test situation (often “unstructured” like an inkblot) into which a subject reads his own wishes and needs.
psychology: the systematic study of behavior.
punishment: negative incentive such as pain or electric shock; used in learning experiments to eliminate unnecessary or useless behavior.

rating scale: a marking device on which a rater can record judgments of himself or others.
recall: recollection of names, facts, and so on, often in response to a question or slight cue. See recognition.
receptor: the bodily sense organs, eye, ear, and so on.
recognition: response of familiarity to objects or things previously seen or heard. Persons may be recognized when their names cannot be recalled.
reinforcement: in learning experiments any device which increases the probability of a given response.
remembering: the recall of something learned at an earlier time.
repression: alleged process by which unpleasant memories or guilt feelings are excluded from consciousness.
resonance: the vibratory response of an object (a piano wire, for example) to a frequency imposed upon it.
response: an activity, a movement, an answer, or an unobserved glandular secretion which results from some stimulation.
retention curve: a curve which shows the loss in memory retention with the passing of time.
retroactive inhibition: the theory that what has been learned earlier is interfered with by something learned subsequently; confusion of the old with the new.
reward: a positive incentive designed to increase the rate or permanency of learning.
schizophrenia: mental illness in which there is a split in personality; marked by delusions and disordered emotions; a functional psychosis.
set: an adjustment or readiness for action. In many experiments the instructions furnish the set.
**shape-constancy**: tendency to perceive objects as of known shape regardless of lighting, distance, or angle of observation.

**sharpening**: distortion of memory so as to bring out certain marked characteristics.

**sibling**: brother or sister.

**size-constancy**: tendency to see familiar objects in their usual size regardless of distortions.

**skill**: highly trained and useful habits; for example, typing, reading.

**smooth muscles**: muscles under control of the autonomic nervous system; so-called involuntary muscles.

**social intelligence**: ability to get along well with others.

**stereotype**: a characterization which may disparage a group; for example, "square head" as applied to Germans. Also used to describe the endless repetition of certain responses found in some mental diseases.

**stimulus**: any source of energy which affects a sense organ.

**striped muscle**: skeletal muscles under the control of the central nervous system; often called voluntary muscles.

**sublimation**: a defense mechanism in which a person substitutes some approved behavior for socially unapproved forms.

**temperament**: characteristic emotional level; mood or tone.

**test**: a group of items (problems, questions, and so on) carefully selected and designed to measure some performance.

**trait**: a more or less permanent personality characteristic which persons possess in greater or lesser degree; for example, irritability, geniality.

**trait profile**: a chart on which ratings for a number of traits can be represented and compared.

**transfer of training**: the better learning of some task because of prior training of some faculty (reasoning, logical selection); for example, the idea that studying mathematics will aid one in making more logical
decisions in business or a profession. (See faculty psychology.)

**trial-and-error:** method of learning in which various responses are tentatively tried (and some discarded) until a solution is attained.

**type:** a group of persons who presumably have certain physical or mental characteristics in common; these characteristics serve to distinguish them from other groups.

**unconscious motives:** motives conceived to be operative without the subject's awareness.

**unpleasantness:** disagreeable feeling-tone; opposite of pleasantness.

**values:** certain behaviors or ways of life regarded as more desirable than others.

**variable:** any response or behavior which can take different degrees; for example, the effects of various amounts of study (independent variable) upon school performance (dependent variable) may be investigated.

**verbal intelligence:** ability to use words and verbal relations efficiently.

**Weber's Law:** law of relativity of judgment; the principle that a perceived change depends upon the thing changed. The change in illumination in a room, for example, depends upon the amount of light already present.

**Weber-Fechner Law:** mathematical formulation of Weber's Law to give an equation of relationship between changes in the stimulus and consequent changes in response.

**word-association tests:** tests in which the subject replies to a stimulus word in accordance with certain instructions.
Abel, L., 314  
Allport, F. H., 559  
Allport, C. W., 199, 559  
Anastasi, A., 498  
Andrews, T. G., 37, 448  
Austin, S. D., 13  
Bach, G. R., 281  
Barker, R. C., 16  
Bartlett, F. C., 393  
Bevan, W., 168  
Bingham, W. V., 542  
Bird, C., 79, 379  
Bird, D. N., 379  
Bolles, M., 284, 592, 600  
Boring, E. G., 75, 154, 243, 600  
Brozek, J., 166  
Bruner, J. S., 163, 167  
Burgess, E. W., 641  
Burnham, P. S., 493  
Burt, C., 432  
Cameron, N., 284, 590, 600  
Cantril, H., 199  
Carmichael, L., 109, 394  
Carter, H. D., 66  
Cattell, R. B., 553  
Challman, R. C., 379  
Cohen, M. R., 37  
Cottrell, L. S., 641  

Crawford, A. B., 493  
Cunningham, B., 467  
Dallenbach, K. M., 399  
Dashiell, J. F., 109  
Davis, R. A., 341  
Dearborn, W. F., 26  
Dennis, W., 37, 448  
Dewey, J., 448  
Dollard, J., 284  
Doob, L. W., 641  
Dukes, W. F., 168  
Dvorak, B. J., 604  
Ebbinghaus, H., 385, 403, 413  
Ellson, D. C., 165  
Faust, W. L., 435  
Fechner, G. T., 182  
Feingold, L., 51, 55  
Forrestor, G., 628  
Freeman, F. N., 52  
Freeman, F. S., 498  
Freud, S., 284  
Fromm-Reichmann, F., 284  
Galton, F., 63  
Garrett, H. E., 413, 600  
Gates, A. I., 379, 512  
Geldard, F. A., 154
Ghiselli, E. E., 603
Gibb, C. A., 437
Goddard, H. H., 474
Goldstein, K., 421
Goodenough, F. L., 75
Goodman, C. C., 167
Gordon, H., 486
Gray, G. W., 91
Gray, J. S., 542, 641
Guilford, J. P., 354, 390, 391
Guthrie, E. R., 284, 341
Hall, C. S., 60
Hamilton, H. C., 14
Hanfmann, E., 422
Harrell, T. W., 519, 635, 641
Hartshorne, H., 27
Hayakawa, S. I., 448
Hebb, D. O., 413
Heidbreder, E., 448
Hollingworth, L. S., 498
Holmes, F. B., 216
Holzinger, K. J., 52
Honzik, C. H., 311
Hovland, C. I., 12
Hull, C. L., 10, 513
Irion, A. I., 341
James, W., 341
Jenkins, J. G., 399, 636
Jersild, A. T., 75, 216, 243, 379
Jones, H. E., 109, 554
Kallman, F., 51, 56
Kasanin, J., 422
Katz, D., 199
Keet, C. D., 402
Kellogg, W. N., 68
Kingsley, H. L., 341, 379
Laird, D., 633
Landis, C., 284, 587, 592, 600
Langfeld, H. S., 75, 154, 243, 600
Leeper, R. W., 178
Lehman, H. C., 444, 445
Libo, L. M., 631
Maller, J. B., 435
Marquis, D. G., 199, 429
Maslow, A. H., 280, 618
May, M. A., 27
McClelland, D. C., 166, 600
McConnell, T. R., 379
McGeoch, J. A., 341
McNemar, Q., 56
McPherson, G. E., 63
Merrill, M., 498
Miles, C. C., 498
Mittelmann, B., 280, 618
Morgan, C. L., 154
Munn, N. L., 109, 154, 199, 413, 542
Nagel, E., 37
Newman, H. H., 52, 56
Penrose, L. S., 498
Pintner, R., 467
Postman, L. J., 163, 167
Prescott, D. A., 243
Pressy, S. L., 358, 395
Robinson, F. P., 351, 355
Rosensweig, S., 555
Rothney, J. W., 26
Ruch, F. L., 243, 379
Scheinfield, A., 46, 75
Schlosberg, H., 199, 341, 413, 448
Schmidt, B., 487
Shartle, C. L., 627
Sheldon, W. H., 579
Shirley, M. M., 82
Siipola, E. M., 162
Slavson, S. R., 281
Stagner, R., 641
Steiner, L. R., 37
Stellar, E., 154
Stevens, S. S., 579
Sullivan, H. S., 284
Super, D. E., 641
Taylor, H. C., 435
Taylor, J. A., 167
Terman, L. M., 456, 498, 641
Thurstone, L. L., 489
Thurstone, T. G., 489
Tiffin, J., 542
Tolman, E. C., 311
Tryon, R. C., 58
Tyler, L. E., 498
Warden, C. J., 307
Weber, E. H., 182
Wechsler, D., 460, 511
Wechsler, I. S., 594
Weld, H. P., 75, 154, 243, 600
Wembridge, E. R., 475
Wingfield, A. H., 56
Woodworth, R. S., 75, 199, 341, 359, 413, 429, 448
Zeigarnik, B., 407
<table>
<thead>
<tr>
<th>Subject</th>
<th>Page Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abilities, clerical</td>
<td>524-525</td>
</tr>
<tr>
<td>correlations among</td>
<td>452-453</td>
</tr>
<tr>
<td>definitions of</td>
<td>508</td>
</tr>
<tr>
<td>distributions of</td>
<td>500-506</td>
</tr>
<tr>
<td>factors in</td>
<td>488-489</td>
</tr>
<tr>
<td>general and specific</td>
<td>488-494, 516-517</td>
</tr>
<tr>
<td>mechanical</td>
<td>519-523</td>
</tr>
<tr>
<td>special</td>
<td>528-529</td>
</tr>
<tr>
<td>Achievement and aptitudes</td>
<td>508-509</td>
</tr>
<tr>
<td>Acquired characters, body and germ</td>
<td></td>
</tr>
<tr>
<td>cells</td>
<td>47-48</td>
</tr>
<tr>
<td>inheritance of</td>
<td>47-49</td>
</tr>
<tr>
<td>Adolescence, characteristics of</td>
<td>100-102</td>
</tr>
<tr>
<td>social development during</td>
<td>98</td>
</tr>
<tr>
<td>Afterimage, negative</td>
<td>120</td>
</tr>
<tr>
<td>Age, creative thinking and</td>
<td>444-446</td>
</tr>
<tr>
<td>curve of learning ability and</td>
<td>346</td>
</tr>
<tr>
<td>and intelligence</td>
<td>89-90</td>
</tr>
<tr>
<td>mental</td>
<td>458-460</td>
</tr>
<tr>
<td>and physical growth</td>
<td>85-87</td>
</tr>
<tr>
<td>Ambiguous figures in perception</td>
<td>177-178</td>
</tr>
<tr>
<td>Anger, as motive</td>
<td>252-253</td>
</tr>
<tr>
<td>as primary emotion</td>
<td>212</td>
</tr>
<tr>
<td>studies of</td>
<td>217-218</td>
</tr>
<tr>
<td>Animal learning</td>
<td>308-311</td>
</tr>
<tr>
<td>experiments in</td>
<td>297-300, 308-311</td>
</tr>
<tr>
<td>imitation in</td>
<td>316-317</td>
</tr>
<tr>
<td>insight in</td>
<td>319-321</td>
</tr>
<tr>
<td>reasoning in</td>
<td>418-419</td>
</tr>
<tr>
<td>Aphasia as memory defect</td>
<td>388</td>
</tr>
<tr>
<td>Apprehension, span of</td>
<td>158</td>
</tr>
<tr>
<td>Aptitudes, in art</td>
<td>534-535</td>
</tr>
<tr>
<td>clerical</td>
<td>524-525</td>
</tr>
<tr>
<td>definition of</td>
<td>508</td>
</tr>
<tr>
<td>interests and</td>
<td>525-526</td>
</tr>
<tr>
<td>law</td>
<td>531-532</td>
</tr>
<tr>
<td>mechanical</td>
<td>519-523</td>
</tr>
<tr>
<td>medicine</td>
<td>530-531</td>
</tr>
<tr>
<td>music</td>
<td>532-534</td>
</tr>
<tr>
<td>science and engineering</td>
<td>532</td>
</tr>
<tr>
<td>tests of</td>
<td>519-535</td>
</tr>
<tr>
<td>tests, construction of</td>
<td>535-538</td>
</tr>
<tr>
<td>Army General Classification Test,</td>
<td>465-466</td>
</tr>
<tr>
<td>and occupations</td>
<td>519</td>
</tr>
<tr>
<td>results from</td>
<td>473</td>
</tr>
<tr>
<td>Army tests, Alpha and Beta</td>
<td>465</td>
</tr>
<tr>
<td>Ascendance-submission, study of</td>
<td>559-560</td>
</tr>
<tr>
<td>Assessment, personal</td>
<td>602-608</td>
</tr>
<tr>
<td>tests in</td>
<td>604-605</td>
</tr>
</tbody>
</table>
Association, laws of, 290
in learning, 289-290
Attention, factors in, 157-160
perception and, 157
span of, 158

Belongingness as factor in learning, 324
Binet-Simon Scale, construction of, 455-456
Binocular vision, 123-125
Brain, development of, 84
role of, in thinking and reasoning, 423-427
Brightness in color vision, 115-116
Camouflage in perception, 173
Cannon emergency theory of emotions, 211, 235-236, 251-254
Case history or clinical method, 28-30
Cerebellum, description of, 145-146
Cerebrum, 145-146
frontal lobes, 149-150
psychosurgery in, 150
Character and personality, 544-545
Characteristics of good student, 372-373
Child, development of, 81-86
foster, 483-485
mental growth of, 88-91
physical growth of, 83-87
social growth of, 91-98
Chromosomes in genetics, 44-46
Color, adaptation to, 119-120
blindness, 118-119
complementary, 117
constancy, 120-121
mixing, 117-118
preferences, 186
primary, 116-117
Concepts, development of, 420-421
experimental study of, 421-423
Conditioned reflex, in learning theory, 297-301
Pavlov's experiment, 297-299
Conditioned response, definition of, 302-307
discrimination in, 304-305
establishment of, 302-307
extinction of, 300-301
generalization of, 296
Conditioned stimulus, 299
Conflicts, in adjustment, 270-271
methods of reeducation in, 277-282
reactions to, 271-277
Connectors, definitions of, 112
Constancy, meaning of, 120, 169, 177
Contrast, in color, 119-121
Control groups, function of, 19-20
Cornell-Coxe Performance Scale, 464
Correlation, meaning of, 514-515
in study of abilities, 514-517
Counseling, in guidance, 277-282
illustrations of, 279-281
in industry, 607-609
Cramming, 352
Customer preference, factors in, 632-634

Daydreaming, 415
Defense mechanisms, 272-277
Delinquency, personality factors in, 615-617
treatment of, 617-619
Development, of abilities, 83-87
of intelligence, 88-91
sequences of, in child, 82
Differences, between groups, 505-507
individual, among people, 500-505
range of, 509-514
among traits, 507-509
Differential Aptitude Tests, 604
Differential methods, illustrations of, 27-28
Discrimination in learning, 296
Distance and depth perception, 122-125
Distribution, curve of, 503
of effort in study, 350-352
of intelligence, 471-473
of personality traits, 502
Dominant traits, definition of, 46
Dreams, motives in, 266-267
Drives, classification of, 245-270

Economy in learning, 344-359
Effect, law of, 294-296
Effectors, definition of, 112
function of, 150-152
Emotionality, inheritance of, 60-62, 66-68
control of, 236–242
expressive signs of, 226–228
facial expression in, 222–226
and feelings, 200–201
genetic study of, 211–215
introspection in, 209–211
methods of studying, 207–208
in motivation, 251–255
physiology of, 228–236
Emotions, common, 215–222
Empathy in perception, 191–192
Endocrine glands in personality, 573–577
Environment, experimental studies of, 57–68
and heredity, 38–42
human, effect upon ape, 68–71
importance of, 70–72
study of family histories in, 63–66
Equilibrium or position sense, 140–141
Escape behavior, 253–254, 272–274
Esthetics, in art, 189–196
in color, 186
experimental results in, 186–196
in forms and objects, 182–192
methods of, 183–185
in perception, 183–196
Exercise, principle of, 296–297
Experimental factor, defined, 9
Experimental method, characteristics of, 8–9
control and experimental groups in, 8–9
illustrations of, 9–20
Extinction in conditioned response, 300–301
Introversion, 556–559
Eye-movements, in perception, 192–195
in reading, 369–370
Factors, in general ability, 488–493
verbal, numerical, spatial, 489
Fear, conditioned, 300–301
experimental studies of, 216–217
as motive, 253–254
as primary emotion, 212
Feeblemindedness, defined, 473–477
occurrence in population, 472
Feelings, development of, 202–206
and emotions, 200–201
methods of judging, 201–202
theories of, 206–207
Forgetting, curve of, 403–406
sleep and, 399
theories of, 398–402
Formal discipline in faculty psychology, 373–374
Foster children, studies of, 483–485
Frequency as factor in learning, 324
Frustration of motives, 270–271
Galton bar, description of, 14
Generalization in learning, 296
Genes in inheritance, 44–46
Genetic methods, illustrations of, 24–27
longitudinal and cross-sectional, 25–27
Golden section in esthetics, 190
Gregariousness as instinct, 262–263
Grief as emotion, 222
Group tests of intelligence, 465–468
illustrations of, 466–468
Group therapy in counseling, 281
Growth, mental, 88–91
physical, 83–87
social, 91–98
Guidance, vocational, 538–539
Habits, formation of, 333–334
methods of breaking undesirable, 334–338
Hallucinations, 177
Halo effect in ratings, 565
Hearing, role of the ear in, 128–129
Heredity, biological principles of, 42–46
experiments on, 49–57
function of the germ cells in, 43–46
Heredity and environment, 38–42
experiments on, 49–72
intelligence and, 494–495
relative importance of, 40–42
twin studies and, 49–56
Higher units in learning, 348–349
Hormones in personality, 575–577
Hunger as drive, 245–247
Hypotheses in science, 8

Identical twins, resemblances of, 49–56
Idiot, abilities of, 474
Illusions in perception, 177–178
Imagination, defined, 156
in thought, 415
Imbecile, abilities of, 474
Imitation in learning, 316–318
Incidental memory, 396–398
Industry, tests in, 518–528
place of psychology in, 627–629
Inhibition, in learning, 328–329
retroactive, 408–409
Inkblot tests, 569–570
Insight in learning, 319–321
Instincts, defined, 261–265
Intelligence, abstract, 450–453
average, 480
differences in, 518–519
distribution of, 471–473
of foster children, 483–485
heredity and environment in, 49–57,
486–487, 494–495
kinds of, 450–453
low grade, 473–477
mechanical, 450
occupational levels and, 519
range of, 472
social, 450
superior, 477–480
test of, 453–468
Intelligence quotient (IQ), 458–460
adult, 462
constancy of, 481–483
distribution of, 472
misuses of, 487
Intensity of tones, 129
Interests, measurement of, 566–567
vocational success and, 605–609
Interviewing in guidance, 562–563
Introversion, 556–559
Inventory, personality, 556–561, 565–567

James-Lange theory of emotions, 210–211

Judgment, effects of punishment and
reward upon, 14–16

Kallikak family, study of, 63–66
Knowledge of results in learning, 327–328

Learning, 285–287
animal, 308–311
curves of, 309, 311–312
human, 311–315
imitation in, 316–318
insight in, 319–322
instruction in, 322–323
language in, 323
latent, 310–311
maze in, 307–308
memorizing and, 380–381
methods of, 297–323
motivation in, 292–293
observation in, 316–323
plateaus in, 348–349
principles of, 290–297
purposeful, 315–323
puzzle, 312
reward and punishment in, 324–327
sequences in, 329–331
substitution and, 297–307
summary on, 331–333
trial-and-error in, 293–294
Lie detector, 231–232
Love as primary emotion, 212

Maladjustment and conflicts, 270–282
Marriage, counseling, 608–612
success and failure in, 612–615
Mastery motive, 255–259
Maturation and growth, 76–81
experimental studies of, 79–83
of nervous system, 84
physical changes in, 83–85
sex differences in, 87–88
of sex organs, 84
Maze learning in animals, 307–308
Mechanical aptitude, 519–523
Medical aptitude, 530–531
Medulla, location of, 147
Memory, economy in, 344–359
experimental study of, 385–389
four aspects of, 381–385

660 subject index
for names and faces, 398
recall and recognition in, 384, 396, 406–409
retention, 389–398
rote, 380
span of, 386–387
training in, 409–410
Mental age (MA), 458–460
Mental organization, 488–493
Merrill-Palmer Performance Tests, 464–465
Methods in psychology, case history, 28–30
differential, 27–28
experimental, 8–20
genetic, 24–27
observational, 20–24
Mind, psychology as a study of, 2–3
Minnesota Mechanical Ability Tests, 523
Minnesota Multiphasic Personality Inventory, 560–561
Mnemonic devices, 409–411
Morale, in war, 634–638
among workers, 629–632
Moron, abilities of, 475–476
Motivation, in learning, 292–293
in factory workers, 629–632
Motives, 244–245
classification of, 245–270
conflict of, 270–277
emergency, 251–254
escape, 253–254
interests, 269
mastery, 255–259
maternal, 263–265
physiological, 245–251
psychological, 251–270
sex, 247–249
social approval, 259–262
unlearned, 261–265
unrecognized, 266–269
Motor area, in brain, 147
speech center, 148
Mueller-Lyer Illusion, 177
Musical aptitude, 532–534
Nature and nurture, meaning of, 39–40
Needs (see Motives)
Negative adaptation, 328–329
Nerve fibers, character of, 141–145
Nervous system, central as connecting mechanism, 141–152
autonomic, role of, in emotions, 232–236
Neuroses, 588
origin of, 595
varieties of, 590–594
Night blindness, 119
Noise and tone, 129
Normal probability curve, in mental measurement, 502–505
Norms, 29, 537
Note taking, methods of, 359–367
Observation and perception, 155–161
errors in, 177–178
Observational methods, 20–24
apparatus used in, 22, 23
Occupation and intelligence, 518–519
tests and success in, 605–609
Odors, classification of, 139
Oral trade questions, 526–528
Orchestra, placement of instruments in, 133–135
Overlearning, 353–354
Overtones, 132
Part method, in learning, 354–359
Perception, accuracy of, 161–178
auditory, 134–137
constancy in, 120, 169, 177
defined, 155–157
differences and change in, 181–183
distance and depth in, 122–125
equivocal, 177–178
and esthetics, 183–196
factors in, 161–169
grouping in, 157–160
illusions in, 177–178
and learning, 178–181
of number, 158
visual, 122–128
Performance tests, 462–465
reliability of, 488
Personality, 543–545
abnormal, 587–590
basic traits of, 550–554
biological factors in, 573–580

subject index 661
Personality (continued)
difficulties in adjustment, 270–282
dimensions of, 556–562
endocrines in, 573–577
integration of, 583–586
judging, 562–572
performance tests of, 568–569
physique in, 577–580
profile of, 560
projective tests in study of, 569–572
questionnaires in study of, 557–567
rating scale and, 563–564
social factors in, 572, 580–583
split, 276–277
techniques for improving, 619–627
theories of organization in, 546–550
types of, 546–550
as unique structure, 554–555
Physique and temperament, 577–580
types, 579
Pintner-Paterson Scale of Performance Tests, 463–464
Pitch, defined, 128–129
Plateaus in learning, 347–349
Play in social growth, 105–108
Pleasantness and unpleasantness in feelings, 201–202
Porteus mazes, 464
Prenatal influences, belief in, 47–48
Primary colors, defined, 116–117
Projective tests, 569–572
Propaganda in war, 638–640
Proportion, principle of, in esthetics, 190
Pseudophone, 136–137
Psychological warfare, factors in, 634–640
Psychologists, what they do, 1–2
professional activities of, 34–35
Psychology, aims and purposes of, 30–32
definition of, 2
laws in, 5
prediction and control in, 32–34
as science, 4
scientific method in, 7–30
scientific and popular, 5–7
Psychoses, 589
organic and functional, 596–597
Pugnacity, instinct of, 256
Puzzle box, experiments with, 307–310
Questionnaire in personality studies, 557–561, 565–567
Ratings scales in personality study, 563–564
Rationalization, in motivations, 273–275
in reasoning, 440
Reading, children's interest in, 105–107
eye movements in, 369–370
importance of, for study, 369–370
Reasoning, in animals, 418–419
concepts in, 420–423
defined, 417–418
errors in, 439–443
role of the brain in, 423–425
training in, 427–433
Recall in memory, 384, 396
Recency as an aid to learning, 324
Recessive traits, definition of, 46
Recitation as factor in learning, 345
Recognition, 384, 396
Reflex, conditioned, in learning theory, 297–301
Pavlov's experiment, 297–299
Regressive behavior, experiment on, 16–18
Reinforcement as principle of learning, 294–296
Reliability of tests, 488, 537
Remembering, defined, 380–381
fixation in, 381–382
Repetition in learning, 353–354
Repression, in forgetting, 401–403
in motivation, 276–277
Response selection, factors in, 324–329
Retention, experiment upon, 12–14
in memory, 389–398
improvement in, 392–395
Reverie in thinking, 415
Rorschach test, 569–570
Salivary reflex, in conditioned reflex experiments, 298–299
Saturation in colors, 115–117

subject index
Schizophrenia, defined, 596
Science, meaning of, 4
   methods in, 7–8
Self-assertion as motive, 255–259
Self-preservation as motive, 265–266
Sensation, auditory, 128–131
   kinesthetic and organic, 139–141
   and perception, 155–157
   position, 140–141
   taste and smell, 139–140
   temperature and touch, 138–139
   visual, 115–122
Sensory receptors, 110, 112
Sensory or somesthetic areas, 147
   auditory, 148–149
   taste and smell, 149
   visual, 148
Set, instruction in, 322–323
   in learning, 322
   in perception, 162
Skill, how acquired, 329–331
Skin senses, receptors in, 138–139
Smell, sense of, 139
   primary odors, 139
Social cooperation, development of, 93–95
Social development, case histories of, 98–102
   influence of home upon, 91–92
   mental and physical growth in, 102–107
   play in, 93–94
   school, 97–98
Sound cage in experiments on localization, 135–136
Sounds, attributes of, 129–134
   waves, 130–132
Space perception, 122–128
Span, apprehension, 158
   memory, 386–387
Stanford-Binet test, construction of, 456–458
   items from, 457–458
   MA and IQ in, 458–460
   value of, 451–463
Stereo-scope, use of in visual perception, 122–124
Study, aids in, 359–368
   handicaps to effective, 369–372
   schedule for, 342–343
   techniques of, 342–359
Sublimation in motivation, 275–276
Suggestion in perception, 164
Symmetry in esthetics, 190
Synapse, defined, 144–145
Taste, elementary sensations of, 139
   sense of, 139
Techniques, in improving personality, 619–627
   of study, 344–359
Temperament, meaning of, 577
Tests, achievement, 508–509
   aptitude, 508–509, 519–535
   army, 465–466
   battery of, 537–538
   Binet, 455–456
   clerical, 524–525
   construction of, 468–471
   form-board, 463–464
   group, 453–454
   individual, 453–454
   in industry, 518–528
   intelligence, 453–468
   maze, 464
   mechanical, 519–523
   performance, 453–454
   projective, 569–572
   reliability of, 488, 537
   Rorschach, 569–570
   Stanford-Binet, 456–460
   validity of, 469–470, 535–538
   Wechsler-Bellevue Scale, 460–462
Thalamus, function of, 147
Thematic apperception test, 571
Thinking, 414–417
   deductive, 428–431
   group, 433–439
   inductive, 431–433
   training in, 427–439
Timbre, 129–131
Tobacco, experiment on effects of, 9–12
Tones, and noises, 129
   overtones, beats and difference tones, 132–133
   resonance, 133–134
Touch, sense of, 138–139
Traits, distribution of, 500–505
   individual differences in, 507–514
Traits (continued)
  primary, 488–493
  relations among, 514–516
Transfer of training, 375–378
Trial-and-error, 293–294
  experiments in, 307–315
Twilight vision, 120
Twins, identical, 49–56
  intelligence of, 49–57
Unconditioned stimulus, 299
Unconscious motives, 266–269
Validity of tests, 469–470, 535–538
Variable, independent and dependent, 4
Vision, binocular, 123–125
  color, 115–122
  role of eye in, 118–115
Visual perception, distance and depth
  in, 122–125
  physiological factors in, 122–125
  psychological factors in, 125–128
Vividness, as factor in learning, 324
Vocational guidance, 538–539
  factors making for success in, 605–609
Warfare, psychological, tests in, 634
Weber-Fechner law, 182–183
Wechsler-Bellevue Scale, 460–462
  IQ in, 462
  items from, 461
Whole method in learning, 354–359
Work methods in industry, 629
Zoellner illusion, 179
<table>
<thead>
<tr>
<th>Date</th>
<th>Due</th>
<th>Returned</th>
<th>Due</th>
<th>Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>