PSYCHOLOGY:

A First Course in Human Behavior

Under the Editorship of
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PSYCHOLOGY:
A First Course in Human Behavior

by

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PSYCHOLOGY: A FIRST COURSE IN HUMAN BEHAVIOR

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Preface

THERE are many textbooks of general psychology and there are also many good ones. As authors of this book in justifying to ourselves this undertaking, we allowed weight to a number of considerations. One of these is the present rate of change of emphasis and interest following the rapid extension of psychology into new applied fields, into clinical psychology, industrial psychology, school psychology, the psychology of public opinion. These new fields demand some consideration in introductory texts and they demand extensions of psychological theory particularly into the psychology of personality. Another consideration was of course certain forms of dissatisfaction with the texts now available. It has been traditional for textbooks of psychology to include a very considerable amount of material that is properly physiology and not psychology at all, and is much better treated in courses in physiology. The detailed structure of sense organs and nervous system concerns the physician and the physiologist, and although a qualified psychologist should know something of them, they are unnecessary in an elementary textbook.

We have tried to write an introductory text free from paragraphs and sections that have meaning only for the professional. We hope that there will be found in these pages no dried specimens of discarded theories. We have tried also to avoid the too facile eclecticism of some texts, which adopt two or three radically different theories and use them indiscriminately. We have made an earnest effort to be systematic, particularly in our treatment of purposive behavior and personal-

ity. Throughout we have tried to emphasize the basis of a scientific psychology in public fact.

We are quite aware that this book fails to take the current trend toward the handbook or one-volume encyclopedia which is a natural response to the crowded classes and inadequate library facilities now encountered in many institutions. Such books lend themselves more readily to the use of true-false examinations, since they are essentially collections of some thousands of rather discrete facts. Our desire was to write a book that would give the beginning student an adequate notion of the general principles of psychology and the basic methods and point of view of the science. Ideas and theory are harder to teach than are collections of discrete facts; but we believe that their teaching is well worth the effort.

Our collaboration as writers of this book consisted in the preparation of an elaborate and detailed outline by the younger author, some argument and discussion of this outline in which mutual understanding was facilitated by a history of eighteen months' companionship at adjoining desks in Washington, and an extension of the outline into a running text by the older author (in longhand); then a radical rearrangement and editing of this continuous text by the younger author, and a final reading and editing by the senior.

E. R. G.
A. L. E.

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I

Introduction

THERE are over half a million patients in mental hospitals who are there because they behaved in ways of which our society disapproves, or because their behavior was not sufficiently adaptable or was dangerous to the public.[1] There are hundreds of thousands of others in our prisons and penitentiaries because of behavior which violated accepted rules of conduct.[2] Behavior difficulties bring one out of every six marriages to a climax in a divorce court.[3]

Whether we have war or peace depends upon the behavior of men. Men fight, build cars, consume goods, get angry and excited, laugh, live happily or unhappily, become criminals or respected citizens, write books, compose music, study, play games. The whole organization of society is founded in the behavior of men and in the nature of human motives and satisfactions and needs.[4]

Psychology is the science that systematically studies behavior and tells us what to expect of those living organisms that can react to the

[1] N. Cameron, The functional psychoses, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, p. 873. Cameron estimates that the 500,000 patients in institutions could be matched with another 500,000 outside.

[2] Statistics on crime may be found in the quarterly bulletins of the Federal Bureau of Investigation, Department of Justice, Uniform crime reports, Washington: Government Printing Office, 1930 to date.

[3] A. Cahen, *Statistical analysis of American divorce*, New York: Columbia University Press, 1932, p. 15.

[4] M. Sherif, *The psychology of social norms*, New York: Harper, 1936.

world in ways that depend on experience. This book will be concerned with human psychology and an account of what to expect of people. But much of our knowledge of human psychology has been pioneered by experiments on animals. There are some profound similarities between human and animal behavior, similarities that reflect the resemblances between the basic structures that are concerned in behavior: the sense organs, nerves, and muscles.

Two benefits should follow from the study of psychology, the science of behavior. One is that we should be in a better position to understand the behavior of others. And if we know what to expect of others, this knowledge should have a profound effect on our own behavior. A mark of the real student of psychology should be not only a demonstrated ability to do better in predicting what others will do, but also a marked tolerance that comes from understanding. The psychologist should not react to his fellow men with impatience and anger, but should try to gain skill in heading off objectionable acts or, if the behavior cannot be avoided, he should adjust himself to it.

The teacher-psychologist will not get angry at pupils who do not learn, but will follow one of two other courses: If the learning is judged possible, he will find the conditions and methods for bringing it about; or if a pupil is discovered to be incapable of learning—and there are such pupils—the teacher will learn what disposition can be made of the case. This may be in the nature of a special class, an excuse from the task in this particular case, or, rarely, commitment to an institution. There, those who are known, by means of proved psychological examination methods, to be extremely defective in learning capacity can be looked after by the state with a minimum disturbance of the community and kept in the comfort we believe owing to any fellow human being.

Students in a course in general psychology are also people, and if psychology can tell what to expect of people it can tell us what to expect of ourselves. That should have the same two advantages that follow from understanding others. We should, if we know how behavior can be changed, have more control over ourselves. It may be

true that psychologists as a class do not exhibit this added control. Artists do not always beautify their own surroundings or make themselves beautiful. But psychology should make it possible to regulate our own habits and tempers with greater ease and, where our psychological insight leads us to recognize in ourselves the inevitable, to become reconciled to that rather than spend our efforts in vain struggles to change in improbable ways. The recognition of our own limitations is often a condition of happiness if not of sanity.

NONSCIENTIFIC APPROACHES TO BEHAVIOR

The question "What shall we expect of people?" has had many answers from nonscientific speakers.[5] Some of these answers have expanded into whole systems of doctrine, systems that have existed side by side with science because they professed to answer questions which still had no scientific answers or because their answers were easy and science is hard.

One of these systems of answers is called *phrenology*, and it professes to tell how men will behave by a study of the shape of the head. Phrenologists believe that the brain is divided into a number of compartments and that each compartment contains a specialized function related to some ability or trait. From this premise, the phrenologists argue by analogy that the brain is like a muscle. If you exercise a muscle it increases in size. If you exercise a faculty such as memory, the phrenologists say, the portion of the brain in which this function is supposed to be located should also become larger. This in turn should result in a bulge in the portion of the skull covering the faculty. So the phrenologists believe that if you just feel the bumps on a person's skull, you can tell whether he is generous, intelligent, brave, and so forth.

Of course the phrenologists ignore the fact that the brain is not divided into small specialized functions. They ignore the fact that the brain is not like a muscle. Nor do they make any objective checks on their statements. It would be possible to do so by dividing a large group

[5] D. M. Yates, *Psychological racketeers*, Boston: Bruce Humphries, 1932.

of individuals into those who were definitely known to be generous, as evidenced by their behavior, and those who were not. The section of the skull where generosity is supposed to be located could then be compared for these two groups to see whether there is any real difference. But such checks would disprove the claims of the phrenologists and as a result they are carefully avoided.

Another of the nonscientific systems is *astrology*. This pretends that behavior is somehow determined by the stars and that the position of the planets at the birth of an infant influences his future behavior. In spite of its wild and fantastic doctrine, many men follow the supposed advice of astrology and make decisions concerning investments, marriage, and even the policies of governments in accord with what "astrologers" have told of these planetary influences. There is, of course, no attempt whatever at evidence or scientific support. The "astrologer" relies solely on men's earnest desires to see into the future.

Numerology and palmistry are systems much like astrology and phrenology. *Numerology* pretends that the future can be predicted and men's traits and abilities known by giving letters number values and adding up names. If you don't like a numerologist's predictions, you can, of course, change your name so that the future will look better. *Palmistry*, which pretends to portray your future by reading the lines in your hand, offers less hope. They are your hands and they can't very well be changed. Numerology and palmistry, like other nonscientific systems, avoid objective checks on their statements. No palmist ever visits morgues or undertaking establishments to find out whether the length of men's "life lines" on their palms corresponded to the length of their lives. Holding dead men's hands would be less entertaining and less profitable than reading live men's palms.

All of these nonscientific systems are evidence of men's strong interest in human behavior and in its prediction.[6] All have the advantage of being easy explanations of a very difficult subject. They

[6] L. R. Steiner, *Where do people take their troubles?* Boston: Houghton Mifflin, 1945. This book indicates the current extent to which people are eager for advice on personal problems.

require no training save in their "patter" and they resist objective checks. The road to the scientific study of human behavior is not so easy. Some of its difficulties are outlined in the next section.

SOME DIFFICULTIES TO BE FACED

We often hear it remarked that a certain politician, or a certain salesman, is a great psychologist. Obviously the politician and the salesman must, if they are successful, make their behavior conform to certain psychological principles. But men get votes or sell goods without being psychologists and without any knowledge of science or scientific rules.

A man may be a good cook without knowing the organic chemistry of the changes that his cooking brings about. He may be a good farmer without knowing botany. A jack rabbit may rear two litters of a dozen each every year without being a child psychologist or even a physiologist. A man may be an excellent driver without knowing how gasoline makes his engine turn over. Kreisler could be ignorant of the physics of sound and still play the violin in a way that moves his fellow men very profoundly.

A man is a psychologist only to the extent to which he is aware of the rules and principles of behavior. But these rules are much more difficult to discover and to apply than the rules of physics or chemistry. One reason for this is that we find it extremely difficult to be objective about ourselves or our friends. We cannot take the detached view that science requires. Even a famous physicist, if he were falling from a plane without a parachute, would find it hard to think of the event as just another illustration of gravitation. A physiologist with a stomach ache is bound to look on it not just as another illustration of some rule of gastrointestinal reaction, but as an event of particular significance. It is hard to take a public and objective view of what happens to us or to our friends.

Another reason for the difficulty of scientific psychology is that we have learned ready reasons for most of the things that we do; and these reasons are learned in order to please other people, or to get us out

of trouble. When a mother asks a child who has made chalk marks on the living room wall, "Why did you do that?" the answer she receives is not detached and objective.

Ask any man why he married that particular girl. We may get from him a ready answer, but the chance that it will be in scientific terms is extremely remote. We ourselves are unaware of many of the determiners of our own behavior in the sense that we have had no practice in observing or describing them. They passed unnoticed. The early experiences that formed a man's taste in beauty went unrecorded in words. Our reasons for voting the Republican ticket or attending the Presbyterian church usually have no connection with the determiners of such behavior that an impartial and scientific observer would select. We give the reason that we have learned is acceptable. We speak in terms of the nobility of the candidate or the merits of his platform, rather than in terms of being reared in a Republican household.

One psychologist believes that Western cultures are peculiarly ready with acceptable reasons or verbalizations of action.[7] It is more probable that this tendency is evident in all cultures because all persons are exposed to the situations that demand reasons, justifications, explanations, excuses, by the very fact that they must learn to adjust themselves to a human community and that they share a common language. We learn early in life to avoid or lessen the penalties of surprising or annoying people by making excuses, using deceit, or by giving plausible reasons or promises. We learn to explain being late for an engagement by saying that the alarm did not ring, not by attempting to analyze the real causes which may have included a certain aversion to going or an inclination toward a rival event.

We are so habituated to these social explanations for what we do that psychological or scientific explanations are not part of our behavior. Such explanations would often be quite unacceptable. They would be embarrassing. For a young man or a young woman even to speculate on the biological significance of an invitation to a dance would be obviously a complication.

[7] J. G. Miller, *Unconsciousness*, New York: Wiley, 1942, p. 282.

A man dislikes fish. The fact is that the sight of fish on his plate fails to make his mouth water and it causes some slight movements of revulsion. He does not remember the occasion when this response was learned. The revulsion is not associated with a date, the name of a place, or of an occasion. We call it a revulsion of *unconscious* origin by which we mean that its origin is not verbalized, has not been put into words.

It is not only our common dislikes whose origins we forget. Who can remember learning to lace his shoes, which is a rather complicated skill? Few of us recall the early struggles we had in learning to button our garments. Few of us recall how or when we learned to spell most words. We do not recall when or how we acquired many of our mannerisms or our manners.

But parents and friends expect us to be able to give reasons or to explain our behavior.

Refusing to eat fish may make others uneasy and curious. The act may demand an explanation or perhaps start a long argument. We learn early in the game to save trouble by saying we are allergic to fish or by some other fashionable and socially acceptable excuse. How we come to learn our way out of such difficulties will be a subject for detailed discussion later in this book. At this point it can be said that we learn to make the answers that stop questions.

Two sources of difficulty in the scientific analysis of behavior have just been described. One was the trouble we have in taking an objective view of our own behavior and that of others. The second was our large repertoire of socially acceptable explanations and excuses. There is a third difficulty. Unfortunately early personal experiences produce in us personal beliefs and these form a large part of the equipment of all of us. Some people believe, for example, that they can tell an honest man by sight. They do not know how they can do this; they just believe that they can. It is in terms of such beliefs that we make many of our judgments, evaluations, interpretations.

Some of these beliefs are learned as children before we are able to examine them critically. This is true of many of our loyalties, likes and

dislikes. When we are older and are capable of more rational judgments, we cannot give up or correct these early beliefs without considerable unlearning. Sometimes childhood beliefs or attitudes are so interwoven in our associations that to give them up would require almost a complete mental reorganization.

Allport has shown that political party preference is closely related to whether we are born into a family of Democrats or a family of Republicans.[8] We may be reasonably sure that this is also true of our religion, our theories of government. But family influence is seldom given as a reason for our politics and religion, as has been noticed earlier in this chapter.

Not only political and religious beliefs are fixed in us through early example. All sorts of beliefs concerning human behavior we accept before we have the mental equipment for criticism or choice. Many persons think that bright children are physically weak. There is excellent evidence from many studies that bright children tend to be stronger and healthier than dull children of the same age.[9] The widespread belief to the contrary probably has its origin in the fact that bright children tend to be advanced in school and, therefore, are compared with older children. Many college students, and college teachers, for that matter, can be found who subscribe to the belief that redheads are more temperamental than other persons; that Negroes are lazy by nature; that a child is influenced *in utero* by its mother's experiences; that people who learn slowly retain more of what they learn than do fast learners; that the behavior of individuals from other cultures is "queer"; that Frenchmen are more excitable than Englishmen. Each of us has a large equipment of such unverified notions. These can seriously interfere with learning to take the psychological point of view.

Our standards of good and bad interfere with the cold detachment that science requires. We look at a motion picture of an ape or of

[8] G. W. Allport, The composition of political attitudes, *Amer. J. Sociol.*, 1929, 35, 220–238.

[9] L. M. Terman, *et al.*, Mental and physical traits of a thousand gifted children, in *Genetic studies of genius* (3 vols.), Stanford: Stanford University Press, 1925.

a child and are prevented from seeing it in psychological terms by our tendencies to see the creature as repulsive or cute. We see someone behaving in an immoral way and our distaste prevents us from trying to understand the basis of the act. We feel only horror and disgust that anyone could be so depraved. Observe, over a short period of time, how frequently you find yourself evaluating someone's behavior, judging it as "good" or "bad." Such evaluations are not part of psychology. They provide insight only into *your* standards of conduct. They do not help *you* in understanding the behavior of the individual judged.

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II

The Development of Modern Psychology

IT has been only a short generation since psychology was taught in colleges in departments of philosophy. Eighty years ago the course was often called "mental philosophy." This means that psychology is the last of the sciences to break away from the parent source, philosophy.

There is an easy way to tell when that break has taken place. When the new science no longer claims to be stating the ultimate nature of reality and begins to speak of its conclusions as hypotheses or theories, it is no longer philosophical. Science is tentative where philosophy is definite and final. The reason for this is that the methods of science have been worked out through close observation and the conclusions of science must be continually resubmitted to comparison with the facts. Scientific theories fit the facts better and better, but there is no reason to believe that the final, perfect fit can ever be reached. Psychology began to break with philosophy soon after psychological laboratories were started in the colleges and universities, because these laboratories began to collect the hard facts that show up the defects in theories.

Wundt's laboratory at the University of Leipzig dates from 1875. Titchener and other students of Wundt established laboratories in

the late eighties in the United States. A psychological laboratory is now taken for granted in American universities and the range of equipment and of the topics investigated has grown enormously. In its early days as a laboratory science, however, psychology was largely concerned with *psychophysics*, which is the study of the relations between the stimuli applied to sense organs and the resulting sensations. Many of the problems investigated, for example, centered around the ability of subjects to distinguish between differing intensities of stimulation. How much must the light in a room be increased in order for the change to be noticed? How much must two weights differ in order that a difference will be perceived by a person who lifts the two in succession? There are, of course, no ultimate and universal answers to these questions because so much will be found to depend on distraction, on individual differences between persons, and on our criterion of successful discrimination (whether we shall accept 75 successes in 100 trials or more or less than this).

When the question is taken into the laboratory for answer, when optimum conditions of freedom from distraction are established, and when trained subjects are used, it is found that the differential threshold is a constant fraction of the stimulus. Experiments have shown that this holds true over a surprising range of kinds of stimuli and a surprising range of strengths or intensities of these stimuli. For light, the fraction approximates 1 percent. This means that if a laboratory subject is looking at a lighted surface, an increase of 1 percent in its illumination will more often than not be noticed.

Very early it was suggested that the laboratory findings covering the differential threshold could be made the basis of a unit of measurement, the *just noticeable difference*. A just noticeable difference may be defined as the least amount by which a stimulus must be increased in order that the person stimulated will be able to judge correctly in a series of trials that the stimulus has been increased. By how much, for instance, does the noise of a certain city street at a certain time of day exceed the noise of a large office? By how much is the noise of the office reduced by using sound-deadening materials on the ceiling,

or by designing the walls so as to eliminate the standing echo waves which reverberate between parallel surfaces? The effectiveness of various deadening devices may be measured in terms of the just noticeable difference. A device which reduces noise by 65 just noticeable differences is obviously superior to one that reduces the noise by only 35 just noticeable differences.

Until well into the present century the chief interest of psychologists remained in the field of sensation and measurement in terms of just noticeable differences.[1] Sensations were classified into visual, auditory, tactile (touch), kinesthetic (originating in sense organs in muscles and glands), and many other modes or forms according to the groups of sense organs through which sensations are aroused. Sensations of vision were further analyzed into their color or hue (associated with the wave length of the stimulating light), their intensity (associated with the amplitude of the stimulating waves), and their saturation (associated with the extent to which one wave length predominates in a mixture). Attempts are still being made to classify smells into five or six basic kinds like "flowery," "fruity," "spicy," "resinous," "putrid," and "burned." This was a set of names proposed by a German in 1916. There is little probability that any short list of basic odors will find the general agreement in use which the four basic tastes secure. There has been very general agreement among psychologists that "salt," "sweet," "sour," and "bitter," or combinations of these, describe all the sensations resulting from the stimulation of the taste receptors in the tongue and throat. This agreement on the use of terms is essential to a scientific classification.

Psychologists during this period of interest in the forms of sensory experience learned much about the nature of the special senses and the variety of sensations, and learned much about the nature of the usual stimuli for the various forms of sensation. The association of sensations of thirst with dryness of the pharynx, and the association of sensations of hunger or hunger pangs with certain forms of stomach spasms appear well established. Many other forms of sensation, like nausea, remain obscure so far as their origin is concerned.

[1] E. G. Boring, *Sensation and perception in the history of experimental psychology*, New York: Appleton-Century, 1942.

DARWIN AND THE THEORY OF EVOLUTION

During the same half century from 1850 to 1900 in which modern psychology had its beginnings, another strain of ideas, the Darwinian theory of evolution, was altering profoundly the fundamental ideas in all the life sciences.[2] The new interest in the forms and processes of life which Darwin shared with many others of his generation led to a new conception of man's place in nature. The fact that man is an animal and that he shares with animals all his physical structures and physiological processes was foreign to the older studies of man. Man's liver operates just as do the livers of dogs, cats, and other mammals. His nervous system and his skeletal structure have close similarity to those of other mammals. His muscles contract and his glands secrete and his nerves conduct in much the same fashion as do those of other animals.

Before Darwin, practical men might act as if animals see, hear, and learn much as man does, but no practical man would hazard the saying of it. The new view of the continuity of nature threw as much light on the sciences of man as the rejection of the "earth at the center of the world" theory threw on the problems of astronomy and of physics. It was eventually responsible for the interest of psychologists in animal behavior and in their use of animals as subjects in experiments in learning. Darwinism also emphasized the importance of individual differences. The theory of natural selection bases evolution on individual variations.

TREATMENT OF THE INSANE AND DEVELOPMENT OF ABNORMAL PSYCHOLOGY

The growing interest of men in the humane treatment of the insane also had its influence upon psychology. For many thousands of years

[2] G. Murphy, *A historical introduction to modern psychology*, New York: Harcourt, Brace, 1939, p. 130.

men had explained abnormal behavior in terms of possession by evil spirits. There was a period of two centuries in which, according to one historian, over a million persons were condemned as witches and put to death after trials which were, according to the fashion of the day, fair and just. We are now beginning to realize that the judicial tortures inflicted on witches were the psychotherapy of that day, and that the witches were the patients.

The work of the French physician Pinel who at the end of the eighteenth century was beginning to persuade the public and the authorities to control the insane with routine and kindness instead of chains and torture, marked a change in the public temper and a time ripe for the introduction of scientific ideas. It was in France that this interest led in later years to the new insight of Charcot in the 1860's and later of his pupil, Janet, at the Clinic of Salpêtrière.[3] Charcot was responsible for the revival of a serious interest in hypnotism, which had been abandoned to quacks for many decades after Mesmer had excited men's imaginations with his "mesmeric" cures in Paris in the 1790's. Janet was Charcot's successor at Salpêtrière and published many studies on his clinical experience at that hospital for mental diseases. These studies covered areas which were neglected by the academic psychologists interested in the analysis of sensations.

Janet, working at a clinic for nervous and mental diseases, made observations and attempted explanations of the disorders of personality that appear in such a clinic, the *amnesias* or losses of memory, *anesthesias* or losses of response to stimuli of a certain kind, the *compulsions* in which patients apparently against their own will and interest tend to carry out some action, the *hysterias* in which disease symptoms may be simulated, *aboulia* or the inability to make decisions in a situation in which most persons would find no difficulty.

Freud also came under the influence of Charcot and spent the year 1885–1886 at the Salpêtrière and later worked out the main principles of his psychoanalytic theories which have had a profound effect on

[3] J. C. Flügel, *A hundred years of psychology*, New York: Macmillan, 1937, pp. 215–218.

scientific psychology by forcing it to attack practical problems that had been hitherto neglected.[4] The title of Freud's first book, *The Psychopathology of Everyday Life*, indicates one of the great services rendered by Freud. He broke down the distinction between sane and insane to help show that the same mental processes are going on in both.[5]

Between the psychotic who believes that he is president of the United States and the bore who believes that his conversation fascinates others, there is a difference largely in degree. The schizophrenic patient who is described as unable to take the point of view of others and thus finds himself talking in a manner which appeals to others as nonsense is an extreme case of something which we all occasionally illustrate. The amnesia victim who has no memory for the events of his past life which may identify him with some unwanted role has offered a striking and extreme illustration of the selectiveness of memory which leads any of us to forget more readily failures than triumphs.

From Pinel, Charcot, Janet, and Freud has thus come a whole tradition that has enriched our psychological equipment. By the new interest in the behavior of the insane and of the mentally ill this tradition has thrown much light on normal behavior.

FRANCIS GALTON

Another quite different tradition has been responsible for even more practical advance in modern psychology. The English psychologist Sir Francis Galton set out to discover whether or not genius and ability are inherited.[6] Influenced by his cousin Charles Darwin, he attempted to find whether or not intelligence is a matter of family or a matter of education and opportunity. This question he did not answer. But in his efforts to answer it he led the way toward objective and quantitative methods of studying individual differences. These new methods were the beginning of mental tests. Galton undertook to find whether or not genius was inherited. This required that he have some device for

[4] *Ibid.*, pp. 279–281.
[5] *Ibid.*, p. 283.
[6] G. Murphy, *op. cit.*, pp. 123–130.

measuring genius. Galton had then to find objective measures of genius. He began with measuring such things as the time required for making an association, or the intensity of visual or auditory imagery arranged on a scale of comparisons. People differ in the vividness of their visual imagery and their auditory imagery, their ability to picture a scene or to "hear" a voice or an instrument.

Galton's interest in the measurement of traits led him to an interest in the relationships between traits, and he was responsible for the development of the correlation coefficient as a statistical device for measuring the extent of association or connection between traits.

Galton's studies on the inheritance of genius were responsible for a great deal of argument over the question, "What is a genius?" There was never any great degree of agreement reached on this point, but Galton had made a real step forward. He had substituted more objective measures in a field that had been left entirely to opinion and subjective judgment. And he led men nearer to a realization that in genius we are not confronted with an "all-or-none" difference from the more ordinary ones of us. Galton's method made of genius something measurable. As soon as measure was applied to genius it became evident that the differences between men in abilities are not like the differences between chemical elements or some natural species, and so clear that we need never mistake one for another. The differences between men's abilities when actually measured on a scale show certain very interesting characteristics which they share with qualities like stature and weight. We find most men clustered about the middle range; fewer and fewer men represent abilities more remote from the average. At the extremes we find very few indeed. The fact that this so-called "normal curve" applies to men's abilities only began to be understood after Galton called such forceful attention to it.

Individual differences are now taken for granted in all human abilities and this is, in part, a point of view which we owe to the pioneer work of Galton. It was the recognition of the fact of such differences that made possible steps toward the measurement of differences between persons and the establishment of group standards.

ALFRED BINET

Through introducing more objective and scientific methods Galton had helped to break down the widespread but lazy public notion that geniuses are a class apart, different in kind from the rest of us. The French psychologist Binet did the same for feeble-mindedness. Binet had noticed that the judgments of feeble-mindedness were subjective and this meant that different persons would have different opinions. Whether or not a child was committed to an institution depended on who was making the decision. The judge's opinion often prevailed even though the judge had had little experience with children, normal or dull, and his opinion differed from the opinions of persons with more experience.

Like Galton, Binet solved his problem (problems like that, of course, never stay solved because we can always look for a better solution) by getting the judgment of feeble-mindedness on a *fact* basis, by using a series of tests adapted to different ages, so constructed that children of a particular age would pass a certain percentage of the test items.[7] That percentage having been arranged and verified through giving the test to many children, the test could now be used to determine the comparative advancement of individual children.

The use of such tests was a long advance toward a scientific understanding of the distribution of human ability. The items are public. Whether or not a child answers correctly an item can be a close approach to a fact. This means that it is the kind of described event that any observer would agree on. For instance if one of the early tests requires that a child point to his nose on being asked, "Where is your nose?" there can be little argument over whether he did so point or not. When two pennies are placed on the table and a child is asked, "How many pennies are there?" observers can agree that the pennies are present, that there are two pennies, that the child answered correctly or did not answer correctly. There may be occasional ambiguous cases,

[7] G. D. Stoddard, *The meaning of intelligence*, New York: Macmillan, 1943, pp. 94–99.

but in general the situation offers facts—events on which all observers would agree. When the judges at a state fair judge which is the best pumpkin pie or the best apple jelly, we are not in the realm of facts. Judges may decide in terms of friendships, prestige, private tastes. Not all judges accept the judgment. Tea tasting is an art, and the blenders of tea must employ such judges; but this has nothing to do with science. Only events so described that any observer must accept the description are facts. When we say, "Let's get down to facts," what we really mean is, "Let's get down to what we can all agree on." It is this interest that makes science the powerful instrument it has proved to be. Science is unbiased. By that we mean that it gets down to descriptions on which we all agree, whatever our nationality, or our religion, or our politics.

PSYCHOLOGICAL TESTING

The objective testing methods introduced by Galton and Binet had a powerful shove from World War I. Under the advice of many psychologists, the United States Army began the systematic testing of soldiers. For the first time tests were used on large numbers of men. The Army Alpha Test, designed to measure general mental capacity among those who could read and write, was given to almost two million soldiers.[8] Tests were designed for measuring the extent to which men had acquired skilled trades (trade tests). The short duration of this war (April, 1916, to November, 1918) did not allow much development of testing methods. Between the two wars the War Department and the Navy abandoned practically all psychological work and the development of tests was left to the schools and to industry.

A college aptitude test can predict (with an estimated degree of error) what will be the success of students in college courses. It is to be hoped that within a few years this prediction, which is now only a very general one and subject to a rather large error, will be made more specific, so that an entering student can be told that 40 percent

[8] R. M. Yerkes (ed.), Psychological examining in the United States Army, *Mem. Nat. Acad. Sci.*, 15. Washington: Government Printing Office, 1921.

of students with his test record successfully complete majors in chemistry while 80 percent making such scores successfully complete a major in literature. This is the kind of prediction offered by such tests.

In industry, the selection of workers and the assignment of the proper persons to the proper jobs may mean the saving of much time, much cost, and much distress.[9] This field is new and psychologists are still searching their way about in it. In the meantime American industry shows signs of attempting its own solution by breaking up jobs into simple operations that do not require elaborate skill or profound interest. The welder in a modern shipyard often learns, not his trade (which he may never learn) but a single operation and learns this in a few weeks' practice. He learns to weld only one kind of fixture always of the same metal, the same size. But even here, tests may be useful in determining when he has reached the proper competence on the one job. Such a test would, of course, consist in having him perform the job under standardized conditions and measuring the quality of the result on a standardized scale.

With the immediate prospect of World War II, the War Department set up in the Adjutant General's Office and in the Army Air Force strong organizations for developing and using tests.[10] The Air Force alone has published some thirty-nine volumes describing the new psychological methods developed by psychologists of that branch during the war. In all, thousands of psychologists were employed by the Army and by the Navy. The result has been to advance materially the application of psychology to problems of classification, assignment to duty, and training and the measurement of training results.

APPLIED PSYCHOLOGY

Of the many special fields of applied psychology at the present time, this book can give only a survey. Abnormal psychology deals with

[9] J. Tiffin, *Industrial psychology*, New York: Prentice-Hall, 1944. This recent text devotes a number of chapters to problems of psychological testing in industry.

[10] This work is reported in various issues of the *Psychological Bulletin* under the heading "Psychology and the War," beginning in March, 1942.

those persons who require special attention and treatment because they do not respond to the ordinary social controls of behavior, conversation, requests, directions, and the like.[11] We find in such persons disorders of belief and of perception, disorders of memory, of the ability to make decisions, and sexual abnormalities. From abnormal psychology we have gained much new insight into the behavior of everyday life and the nature of fantasy, the effects of disappointment and frustration, the direction and control of thinking. Many disorders of the body are being related to behavior through close observation of their causes. Stomach ulcers normally follow on prolonged anxieties and failures of decision. Some writers use the term "psychosomatic medicine" to denote that extensive range of medicine in which mental factors are involved in the cause or cure of a disorder.

Legal psychology covers the psychology of testimony and the laws of perception.[12] The extent to which the accounts of witnesses of an event can be trusted can be shown to depend on the training of the witness, on his own interests and desires, on the circumstances of the trial, and on other factors. Legal psychology should also cover the field of human motives and intentions. The psychology assumed in the courts is often as naïve or outmoded as would be expected when the personnel of the courtroom has had no acquaintance with modern psychology. Legal psychology could also include the study of the sentencing habits of judges, which one psychologist has shown to be full of idiosyncrasy but at the same time remarkably persistent over periods of years.[13]

Clinical psychology is an indefinite field that in current practice includes problems in marital adjustment, school adjustment, the functional mental disorders such as neurasthenia, hysteria, psychasthenia, anxiety states, the phobias, disturbances of sleep, the adjustment of bad habits, and addictions. It extends into the field of counseling and inter-

[11] C. Landis and M. M. Bolles, *Textbook of abnormal psychology*, New York: Macmillan, 1946.

[12] H. E. Burtt, *Legal psychology*, New York: Prentice-Hall, 1931.

[13] F. J. Gaudet, Individual differences in the sentencing tendencies of judges, *Arch. Psychol.*, N. Y., 1938, No. 230.

viewing in which recently developed psychological methods are proving themselves.[14]

During World War II social psychologists were in great demand in Washington. Propaganda and psychological warfare made use of the beginnings of a science of social psychology. The new field of measurement of public opinion and attitudes was important to the propagandist as well as to the politician and the advertising man.[15] The Army found psychological methods necessary for the classification and assignment of recruits and, though many enlisted soldiers may express a dim view of the army methods since they did not assign twelve million men all to jobs of their choice, it probably remains true that in the Army men were assigned to jobs consistent with their capacity and training to an extent far greater than prevails in civilian life.

The psychology of children is a special field and has, since the turn of the century, developed many children's clinics and an enormous body of information about what to expect of children.[16]

Other extending fields are advertising and public relations.[17] Here it is only necessary to contrast the carefully planned campaigns through which the public use of cigarettes and certain liquors has been multiplied many times with the primitive and crude advertising methods of political campaigns, the "Jones for Sheriff" posters, to realize that advertising as a field of applied psychology has both a past and a future.

The newest field of all, the field of industrial relations, is only beginning to be explored.[18] It should be the concern of psychologists to see that it is not developed as an instrument of exploiting labor as advertising has been developed as a tool for exploiting the public, but

[14] C. R. Rogers, *Counseling and psychotherapy*, Boston: Houghton Mifflin, 1942.

[15] A. B. Blankenship (ed.), *How to conduct consumer and opinion research*, New York: Harper, 1946. Part II of this book describes the use made of opinion surveys by the government.

[16] F. D. Brooks, *Child psychology*, Boston: Houghton Mifflin, 1937.

[17] H. E. Burtt, *Psychology of advertising*, Boston: Houghton Mifflin, 1938.

[18] Problems of industrial relations are discussed in F. J. Roethlisberger, *Management and morale*, Cambridge: Harvard University Press, 1941. See also N. R. F. Maier, *Psychology of industry*, Boston: Houghton Mifflin, 1946.

that this new branch of psychology is developed from the point of view of public interest and industrial peace.

The result of the advances of psychology into all these new fields has been to develop better and more objective techniques of measurement. The reader of psychological statistics will be somewhat overwhelmed with the detail of the methods of measurement in aptitudes, interests, achievement, and the other traits or qualities that psychologists undertake to measure, particularly if his acquaintance with such measurement is limited to the usual college grades, which are usually of unknown reliability, unknown validity, and unknown meaning. A second advance has been in the direction of greater reliance upon observation, an increased tendency to check theory with facts. When psychology was taught as "mental philosophy" it was far more dogmatic and opinionated than it could be when psychologists undertook to apply it to medicine, to industry, to education, to politics. The extension of psychology into these applied fields has put it on a sounder basis and has resulted in still greater insight into problems of human behavior.

SUGGESTED READINGS

The books by Tiffin, Landis, Burtt, Blankenship, Brooks, Roethlisberger, and Maier, cited previously, discuss applications of psychological principles within the fields indicated by the titles. The following books summarize, in one or two chapters, applications in all fields:

Berrien, F. K., *Practical psychology,* New York: Macmillan, 1944.
Griffith, C. R., *An introduction to applied psychology,* New York: Macmillan, 1934.
Guilford, J. P. (ed.), *Fields of psychology,* New York: Van Nostrand, 1940.
Husband, R. W., *Applied psychology,* New York: Harper, 1934.

III

Science and Psychology

SCIENCE is a way in which certain men behave and think and talk. It is the rules that scientists learn to follow. It is not a body of facts or a set of theories, or knowledge about anything in particular. It is just a certain way of exploring the world and agreeing on its nature.

The outstanding thing about a scientist is an interest in describing what is going on in the world, and in describing it in a way that must be accepted by anyone who observes the same events. One of Binet's real contributions to human knowledge was his use of objective measures of intelligence in a field which had been left to subjective opinion. These two words "objective" and "subjective" need some explanation. They are in a way roughly equivalent to "public" and "private." Binet used simple tests made up of problems and questions in order to determine how bright a child was. The child who could answer correctly more questions was assumed to be more intelligent. This is a "public" method in the sense that one can get public agreement on it. Certain special questions may turn out to be "private," in the sense that Binet alone would judge the answer and others might not agree, but Binet's method at least made possible public agreement on his facts. This is very different from a subjective or private opinion which is not open and shared. Parents are likely to misjudge the abilities of their own offspring. This is because their judgment is private. A mother could not be expected to take the public or general view of her

own child. A survey once showed that car owners as a class have strong subjective bias in favor of the make of car that they happen to own. They are convinced that it is the best for the money, or that it is the most dependable, or the most powerful for its size, and this, even when their own example of the make is in a deplorable condition as viewed by another observer.

THE NATURE OF SCIENTIFIC FACTS

The very essence of scientific method lies in "getting down to facts." Did you ever ask yourself: What is a fact? A chair is not a fact; a sunrise is not a fact. No object is a fact. It is an object. Facts have a kind of double life. They exist in two worlds, the world of things and the world of talk. A *fact* is an event so described that its description would be accepted by any competent observer.[1]

Binet got judgments down to a fact basis, which means a basis on which we must all agree. We can disagree about the intelligence of our acquaintances, but we tend strongly to agree that saying "six" in answer to the question "What is two times three?" is brighter than to say "seven."

We could prove to be wrong at that, and we might find eventually that very bright people indeed enjoy giving a perverse answer. But there is more agreement on "six" as a correct answer than on any other. We can also all agree on what a child writes or says more readily than we can agree on whether he looks bright or dull; his answers to test questions more nearly approach facts than do bright looks or dull looks.

When two scientists in the same field find themselves in disagreement they must go back to facts; they must retreat until they find descriptions on which they can agree, and attempt to build up again an account that will be accepted by both. This means that when their descriptions of the world go beyond the facts on which all agree, those descriptions must be recognized as tentative, on trial, not final. Scientists call such tentative descriptions *theories*. When they are even

[1] E. R. Guthrie, Psychological facts and psychological theories, *Psychol. Bull.*, 1946, 43, 1–20.

more tentative and farther removed from agreement, when they are viewed as temporary devices for understanding or for teaching, discussion, or research, they are called *hypotheses*. Theories and hypotheses mark the scientist as different from the theologian or the philosopher or the supporter of a political program. Debates in Congress include very few expressions of tentative judgments. But a scientist is willing to reserve final judgment until the description is found which must satisfy his fellow scientists. It is contrary to the scientific tradition to burn or shoot dissenters as is still being done in the field of politics. The scientist must try to find the description that the dissenter must accept. This operates strongly in favor of keeping descriptions as theories or as hypotheses long after men, if acting as religious or as political partisans, would have started to fight nonbelievers.

Science must be continuously checked against events in nature. Armchair theories may prove to be empty noise. Science works with facts, and facts are events so described that any observer must accept the description. The scientist tries to find such acceptable descriptions by conforming to the rules followed by scientists in making observations. His observations, for one thing, must be repeatable by others. To be repeatable, his descriptions must be made in clear and standard language.

THE GOAL OF SCIENCE

What the scientist is attempting to discover is a rule that will include many facts. He is interested in conveying to other men knowledge of what to expect of nature. The psychologist, for example, is looking for rules that will tell us what to expect of people in the various kinds of circumstances in which we are interested. These rules are not contained in the events themselves. Events do not describe themselves or make their own rules. Scientific rules pick out those features of the events to which men have given names because they were important to men; the rules themselves have been hit upon or discovered by some man intent on a concise description.

The rule is often suggested as an hypothesis. When scientists believe

they have discovered a rule, the next step is to find whether it holds in a new set of observations. If it does, it may be published, along with the data it purports to describe. This is the point at which other scientists have a chance to verify it, correct it, amend it, usually by a repetition of the observations and an examination of their results. If the rule survives this publicity and reëxamination it may be, for the time, accepted.

During this whole process the scientists involved exhibit suspended judgment—skepticism. Partisanship leads easily to desertion from the hard task of reducing the phenomenon to a factual basis, makes one ready to adopt conclusions that will turn out to be inacceptable because nature will not back them up, or because other scientists cannot agree with the description.

The hard road of science does not even promise to lead to any final goal of truth. Instead of truths, science stops with theories, and the fact that scientific theories have always been in a state of change promises continuing change in theories in the future. New facts are always being arrived at because what men observe and how they describe what they observe are both subject to change. The retarding effect of penicillin on the growth of bacterial cultures was written off by its discoverer as an odd fact with probably no useful application to human disease. After the discovery of the effects of the sulfa drugs, penicillin became a very different thing—its effects of tremendous importance. The phenomena of atomic physics are leading physicists to observe and record new facts.

SCIENCE, RELIGION, AND POLITICS

Science, religion, and politics are three kinds of tradition. There is no necessary conflict between or among them because they are devoted to different ends. Religion deals with the ultimate meanings of life and death, with the relation of the individual to his neighbor, to society, to the world, to what most men call God. Science, occupied with the description of what to expect from nature or man under one set of circumstances or under another, does not even pretend to offer

ultimate guides to duty or ultimate answers to the question, "What for?"

Politics also goes outside the field of science and makes choices concerning the relation of the individual to the state. The Nazi theory of the state is derived from Hegel and Hegel's doctrine that the individual is subordinate to the state and exists only for the success of the state. The American tradition holds the state to exist in order to further the happiness and well-being of individuals. Science will not choose between these doctrines; but a living man must make his choice and choose, in spite of himself, some doctrine of his relation to his fellow men and to the cosmos as well. Science will not determine these choices.

SCIENTIFIC DETERMINISM

Science is a game which must be played by the accepted rules.[2] No individual can revise these rules to suit himself. Refusal to accept the rules merely means refusal to be a scientist.

One of the assumptions that science must make is that all events are determined by antecedent conditions. This is not a belief of the scientist; it is an assumption. Since science is a search for the rules that events follow, it must assume that there are rules. The relation of this doctrine of *scientific determinism* to the problem of "free choice" is often confused.

A *free choice* is an act in accordance with an intention or decision. If I decide to give up tobacco and then do so, that is a free act. If I so decide, but am found smoking, I may be called a slave to a habit. But that my original decision to give up smoking had causes is reasonable to anyone. It was presumably influenced by my noticing that I had a cigarette cough, by reading Raymond Pearl's statistics[3] that incline to the hypothesis that heavy smoking shortens life considerably, by reading a report of a London hospital that heavy smokers complicate abdominal operations with pneumonia six times as often as nonsmokers.

[2] M. R. Cohen, Scientific method, in *Encyclopedia of the Social Sciences*, 1935, 10, 389–396. This article discusses the rules followed by the scientist.

[3] R. Pearl, Tobacco smoking and longevity, *Science*, 1938, 87, 216–217.

If my free decision is not influenced by determiners like these, it would be a senseless and wild attribute.

There are many kinds of determiners of behavior. Some of these give rise to long-range prediction. As soon as we know that a certain bird is a particular species of oriole we know what sort of nest it will build if it builds a nest. There are behaviors that attach to dogs. Any of us would be as surprised to see a cat behaving like a dog as we would to see it playing a flute.

There are forms of behavior that are predictable as soon as we know the culture in which a man was reared. We then know how he will react to many ideas, something of the nature of his relations to his brother or sister and to his parents, his language, many other things about him. The student of sociology and anthropology should know something of what to expect of members of many specific groups.[4]

The immediate occasion for behavior is agreed by psychologists to be sensory stimulation. *Stimulus* is the Latin word for goad—a pointed stick used to prod draft animals. We speak of it as the occasion for behavior rather than as the cause for the reason that behavior has many causes. The causes of behavior include the meals we have eaten (from which the energy for our muscular contractions and nerve impulses arises). They include those past actions responsible for associating stimuli with specific movements. They even include the possible quilting bee at which our great-grandparents met. Certainly without that meeting we would not be here.

Thus behavior has entirely too many causes. But movements are normally the close consequents of nervous impulses over motor nerves to muscles. And motor impulses are normally limited to close succession after impulses to motor centers from connecting nerves and these are in turn normally close followers of sensory impulses traveling from sense organs to central nervous system. And (we are reaching the end)

[4] W. I. Thomas, *Primitive behavior*, New York: McGraw-Hill, 1937. This book relates behavior patterns to cultural factors in primitive societies. See also A. Davis and J. Dollard, *Children of bondage*, Washington: American Council on Education, 1940. This study reports upon caste and class as factors related to personality development in Negro children.

sensory impulses normally are occasioned by or, if you prefer, follow immediately on sense organ activity that is the consequence of some physical change to which the sense organ is sensitive. Because of this chain of release in behavior, some brief account of our responding organs, muscles and glands, will be in order. Also, and also brief, some account of the sense organs and of the connecting system of nerves which makes muscles responsive to changes which stimulate sense organs will be necessary for a clear picture of the "causes" of behavior.

RESPONSE, ORGANISM, AND STIMULUS

What is meant by *behavior?* It is usual to limit that word to exclude purely physical reactions to changes in the world. The pugilist who takes a left to the chin finds his chin moved suddenly up and to one side. This is, however, something that happens to him, not something he did. We do not include it in behavior. That word is restricted to the responses we make as the result of nerve impulses activating muscles or glands. Falling downstairs may involve some behavior in the form of holding out our arms, but it is essentially merely an event for description in terms of mass and impact. We are not much better at falling downstairs than the bucket of paint we were carrying.

Our prime interest as psychologists is in response, which is action mediated through the nervous system. Suppose we write: $R = f\ (O, S)$. We can mean by that that R (or response) is a function of (or is to be predicted by examining) two things, the organism (O), and the situation in which the organism is placed (S). There is a restriction on this S. Since R (for response) is limited to those reactions brought about through the nervous system, S is by the same token limited to those features of the physical situation that act upon sense organs and so can affect the nervous system and eventuate in responses.

O (for organism) also takes some explaining. It includes such observable features of the organism as are known to affect response. These include the individual's heredity, since certain types of behavior can be predicted from knowing the parentage of an individual. If his parents are cockroaches he will not develop a tendency to crow. That is the

exclusive behavior of the offspring of chickens. Some human behavior must be predicated on the family, but we are only beginning to explore just what this is.[5] The children of some kinds of parents do better at various tasks than the children of other kinds of parents. Identical twins, who presumably have shared the same inheritance, behave alike in certain respects even if reared apart, much more alike than do fraternal twins or ordinary brothers, who do not represent identical inheritances.[6] In addition to heredity, various conditions of the organism are known to affect its behavior. It can be tired, hungry, excited, drugged, and these organic conditions have definite influences upon behavior.

Certain features of an organism's history are also of extreme importance in predicting its behavior. These include observations of its past experience and learning. Persons who have been through an earthquake behave differently from naïve persons at feeling an earth tremor. All schooling is an effort to influence future behavior by guiding present behavior into certain channels. We try to induce pupils to write, or say, or think "fifty" after seeing, or hearing, or thinking to themselves "five times ten." We try in school to call out in pupils certain attitudes of liking or of disliking, pleasure or disgust, approach or avoidance, indulging or abstaining in certain situations and then trust that in the future the situations themselves will evoke the behavior. We induce the child whose hands are dirty to wash them clean and hope that even fifty years later the sight of dirty hands will lead him to the wash basin.

The reason for stating above that $R = f(O, S)$ or that responses are a function of organism and of situation is only that this may be a reminder of where we are to look for the signs of action. This formula may help us to remember that a person may respond to the same stimulus situation differently at different times. The hungry man and the well-fed man, the excited man and the calm man, the depressed

[5] Work in this field is reported in *Journal of Experimental Education, American Journal of Orthopsychiatry, Psychiatry, Child Development, Journal of Genetic Psychology,* and various other journals.

[6] H. H. Newman, F. N. Freeman, and K. J. Holzinger, *Twins: A study of heredity and environment.* Chicago: University of Chicago Press, 1937.

man and the man with enthusiasm may be the same man at different times and may respond very differently indeed to our invitation to dinner or to our arguments or to our urging of a duty.

These differences are differences in O, the organism. They may be differences in learning experience; changed response to certain foods, for instance, may follow an ocean trip. Some modern dentists encourage parents to bring children in for a purely social call and lollipop refreshment on several occasions before the tooth is pulled. Such experiences may make the difference between enthusiasm and extreme reluctance over future visits. Indifference toward food may be the result of a full stomach (a present state of O) or of a confronting of this same food before when well fed. Packages of a certain dog biscuit once carried the wise psychological advice to remove all traces of the biscuit the instant the dog stopped enthusiastic eating. This advice was offered because a dog whose last sight of the biscuits was followed by turning away replete is very different from a dog who last saw the biscuits while enthusiastically attacking them.

Just as the same S (for situation) may arouse very different responses in a person at different times and under different organic conditions, so the same S may arouse very different responses in different individuals. Here also the difference is attributable to the O of the formula. A well-cooked snail appeals differently to a Frenchman and to an American. Orders that would only confuse the civilian may produce effective results among trained soldiers. The veteran responds differently from the new recruit to the sight of blood.

CONTROL AND PREDICTION OF BEHAVIOR

Sometimes the control of the behavior of others is managed through manipulating stimulus situations. Advertising is a good example. By placing the proper advertisement in a newspaper, in a magazine, or on a billboard, where it will stimulate the vision of readers or passers-by, or by putting the sound pattern on the air where it will be heard by those listening to the radio, the advertiser hopes to change the future behavior of at least a small proportion of his public. Some-

times his efforts may be repaid if one person in a thousand is led to think of or utter the name of the advertiser's product when making a purchase.

The propagandist also hopes through manipulating *S* to bring about certain behavior or certain attitudes in the future. He drops a leaflet over enemy lines which describes how enemy soldiers have given themselves up. The leaflet may have no immediate effect, but the soldier who has picked it up and read it attentively may, the next time he is discouraged or is cut off from his own forces, carry out its suggestion with great fidelity.[7]

The theatrical producer attains his successes often by using hackneyed situations: the dead baby's shoes, the waving flag, the company of cavalry on the gallop to the rescue, slang, profanity, can often be depended on with near certainty to produce tears or laughter or excitement. Novelists can make their readers angry, depressed, anxious, through the proper choice of words.

All education is an effort to control the behavior of individuals through exposing them to certain forms of stimulation in the hope that their future responses will be modified in the direction of good citizenship, skill, and the elimination of asocial behavior. The business of the teacher is to set up stimulus situations which will elicit desirable responses, and to trust to learning to ensure that these responses will become associated with other signals, and will no longer be dependent upon the presence of the teacher or the devices which she may have used in eliciting the responses.

It is worth noting how much more accurate prediction becomes when knowledge about *O* is increased. In the intimacy of the family where *O*'s have lived together for years, each learns how the others will respond. We learn how to tease, to please, to get assent to our use of the car, or to the purchase of new clothing, or to an increased

[7] A crude evaluation of the influence of such leaflets on German soldiers during World War I may be found in G. G. Bruntz, *Allied propaganda and the collapse of the German Empire in 1918*, Stanford: Stanford University Press, 1938.

allowance. We learn when to ask for things and when not to. Wives learn just how a husband may be expected to react to a good meal, or to burned toast, or to the suggestion of an evening out. All these knowledges are made possible by knowing the past of *O* in the formula.

Predictions in psychology become more accurate as the psychologist's knowledge of a given individual increases. Clinical psychologists find it to their advantage to develop many ways of recording more and more about *O*—case histories and biographical records, tests, all help contribute their bit. A college aptitude test gives some prediction of college success. Add the high school record, and the predictive accuracy is much increased. Add information that comes from close acquaintance, and sometimes specific predictions are possible.

The propagandist found it to his advantage to labor to increase his information about the peoples that he addressed. The propagandist who knew their history, particularly their recent history of disputes and divisions and their ambitions, was doubly armed for his job as propagandist. It was also essential to know the current state of mind of his audience—their fears, their discouragements, their jealousies, their hopes. These states of the *O* (organism) guided the propagandist's choices of *S* (his propaganda).

We know an astonishing lot about a man when we know the cultural group to which he belongs. We know something of the limits of his response capacity and can often give strong odds on the specific response to be expected of him. If he is born and reared in Petersburg, Virginia, we not only know what language he will speak but also his accent. If we further know that he was one of the white community in Petersburg and his age and family income, his religion, there is much more that can be predicted of him. We can lay heavy odds on his politics and his opinions.

AN EXERCISE IN PREDICTION

A student may carry out a short and simple experiment that will illustrate the nature of simple predictions. Below is a list of words

for a simple word association test.[8] Take a card and cover all but the first word. Take a pencil and write down the *first* word that you think of when you read the first stimulus word. Then move the card down to expose the second stimulus word and write down the first word you think of when you see this second word of the stimulus list. Do this for all the stimulus words.

WORD ASSOCIATION TEST

Stimulus Word	*Response*
1. Table	.....
2. Man	.....
3. Red	.....
4. Dark	.....
5. Hammer	.....
6. Butter	.....
7. King	.....
8. Salt	.....
9. Green	.....
10. Loud	.....
11. Long	.....
12. Foot	.....
13. Sweet	.....
14. Window	.....
15. Chair	.....
16. Black	.....

When you have finished, compare your response list with the predictions made on page 303. Also try the experiment with a friend. You read the stimulus word and record his first response; then see how many of his responses have been correctly predicted.

In the cases in which you have made an uncommon response it is often possible to account for this response in terms of your own recent experience. Think whether or not you recall something that has happened during the last twenty-four hours to establish this association in you. Or reflect whether the unusual response is associated with some troubled part of your past—some fear or dread, some jealousy, some dislike, some strong desire.

[8] G. H. Kent and A. J. Rosanoff, A study of association in insanity, *Amer. J. Insanity*, 1910, 67, 37–96.

The stimulus word "green" may evoke different responses for subjects depending on organic conditions. Just before mealtime while hunger is present there may be many more responses naming edibles like "beans, peas" than will appear among a group that is not hungry. Did you make any responses that depend on hunger, or being too warm or cold, or upon organic states?

There is an occasional instance of a student who, making none of the predicted responses, is on other evidence believed to have rejected the first words that occurred to him and sought for others that would mark him as different, or as an original. This state itself is less objective and simple than a state of hunger, but it is also a state of the organism that helps to determine the response.

Every test that you take in college is likewise an effort to get information about your response tendencies or response capacities which depend on your past experience. Your mid-term examination in chemistry tells a great deal about how you have been spending your time. It may not name the coffee shop, the motion-picture palace, or the small and select group of bridge players that did occupy your attention, but the test is eloquent about how you did not spend your time.

SUGGESTED READINGS

Freeman, E., *Principles of general psychology*, New York: Holt, 1939, chap. 13.

Shaffer, L. F., *et al.*, *Psychology*, New York: Harper, 1940, chap. 2.

IV

Heredity and Maturation

MAN is a machine. Man is not a machine. Both sentences are of course true, and argument over them is silly. Man is a machine in the sense that to him all the laws of physics apply as well as they do to a screwdriver or to a printing press. Man's sources of energy are measurable. We know within small limits what some jobs require in food and we know that no man lacking the necessary calories will do those jobs no matter how devoted or how determined he is.

Unlike most machines, however, a man can climb stairs; but when he climbs stairs he does not get rid of any of his weight. He is not defying gravity. He is just illustrating it in a rather complicated way. We cannot construct a man as we can construct a machine. Men require parents, and men grow in ways that are still beyond any very good scientific description. But this fact does not make man any less a physical object with all the physical properties that are possessed by an ice cube or a phonograph record. When a man talks, that is a physical event and it conforms to physical laws. But we do not ask a physicist many questions about behavior. Physicists know what to expect of physical objects under certain circumstances that are included by physics. They even know what to expect of a man when he falls from a given height, or strikes the instrument board of a car with a certain momentum, or what to expect of a floor when a given number of persons stand on it. But there are a lot of situations

that physics simply disregards. What will Mr. Jones do when presented with his bill? That is not in any physics text.

But man is just the same a physical object. Two people can fall in love. They remain physical objects. A man can get religion and he will remain a physical object even if physics has no language for telling what has happened to him and no rules that cover the conversion. The physics of human behavior can be left out of a psychology textbook. But the fact that it is left out means that it is taken for granted—not that it is not in effect.

The same is true of biology and physiology. Man is a living organism. He shares with the rest of all living things certain ways of acting. Parentage is one of these qualities. All the organisms we know including man are the results of a separation from a parent. A part of an organism has separated from the rest and become a new organism. In man, that is complicated by the elaborate process of sexual reproduction. He is dependent on the separating off of two extremely small parts of two parent organisms and the subsequent union of these two minute temporary forms, an ovum or egg cell from the mother and a spermatozoon from the father. The spermatozoa are so small that the cap of a toothpaste tube would hold over two billion, enough to father all living human beings.[1]

Like the principles of physics, the principles of biology and the principles of inheritance in particular must be taken for granted in a psychology textbook. All men are subject to these principles and all men conform to them. But, like the principles of physics and chemistry, the principles of biology do not tell us what we want to know as psychologists. Even a psychologist can get a certain amount of comfort out of the reflection that no one of his ancestors—even if we had succeeded in tracing our descent to one of those sea-water forms that began life on dry land—no one of the millions of his ancestors ever died in infancy. If there is anything in the theory of natural selection and adaptation, he is of a hardy species. Every ancestor of his has been of a constitution that enabled him to make his living, face the

[1] A. Scheinfeld, *You and heredity*, New York: Stokes, 1939, p. 4.

dangers of disease and storm, battle, murder, and sudden death, and survive at least to that point of maturity at which he enacted his part as ancestor or she, if it was a woman, gave birth to, and usually also reared successfully, her child.

It is not as psychologists that we find a certain interest in reflecting that we, like other animals, can be described as marine forms living in the leathern bag of our own hides but still living in sea water. The blood which bathes the cells of our bodies is the salty source of the food of each cell and the tide on which each cell deposits its waste products—its sewage. Each of us must collect the water that makes up most of the weight he carries about, and he must find and add to this the proper amount of salt that will give him a close approximation of his original medium, the ocean.

There is an elaborate body of knowledge worked out concerning heredity. These principles of heredity will also, like the principles of physics and the principles of physiology, be here taken for granted. By *heredity* we mean the transmission of characteristics from parents to offspring by means of the germ plasm. In the science of genetics certain physical traits like the color of Mendel's peas or the length of an animal's hair have been with high probability assigned to certain features of the germ cells, the chromosomes.

When human ovum or egg cell and sperm meet, the complicated process of sexual union follows in a manner very much the same in both plants and animals in sexual reproduction. The details of this process can well be left to textbooks in genetics because very few of these details can be related to the psychology of man.

HEREDITY AND ENVIRONMENT

The remarkable process of sexual reproduction ensures among other things that there will be a new deal or a reshuffle of inherited traits transmitted by mother and father in each instance. The chance that two brothers or brother and sister start life with the same ancestral "deal" is very remote indeed. Only in identical twins or identical multiple births do two persons begin life with the same inheritance.

The study of identical twins may someday throw much light on human inheritance. At present it does not. The difficulty of separating the factors contributed by parents from the factors contributed by environment has thus far not yielded much to attack. Prediction of a number of physical features like hair color, or build in animals, is possible through a knowledge of the parentage and of the principles of heredity.[2] But that holds true of few or no psychological traits.

A few men once believed, for example, that feeble-mindedness was inherited according to Mendelian laws, but that point of view has become increasingly untenable as a theory as knowledge of feeble-mindedness has increased.[3] We recognize that feeble-mindedness, like other psychological traits, has an indefinitely large number of determiners, just as poor performance in an automobile engine can have a multitude of causes. Personality also is so much the product of situation as well as of ancestry that personality cannot be said to be inherited. We inherit eye color, our nerves and the general character of the nervous system, our muscles, our glands; the structure of our bodies is also inherited in the sense that it is predictable when our ancestry is known, always assuming some typical or ordinary environment.

We inherit the general structure of the larynx, which is one of the things that makes human speech possible. But we do not inherit speech. There are probably other structures just as important as the larynx, for instance, the rich provision of nerve pathways in the brain which makes it possible to connect somehow the visual centers stimulated by many thousands of written words with the muscles that pronounce these words. But there has been no successful connection of capacity for making these connections with any recognizable or describable specific structure in the brain, or with any feature of any chromosome.

It is worth mentioning here that thus far there has been no demon-

[2] *Ibid.*, pp. 87–95.

[3] This early point of view is taken in H. H. Goddard, *The Kallikak family*, New York: Macmillan, 1913. Compare this with G. D. Stoddard, *The meaning of intelligence*, New York: Macmillan, 1943.

strated alteration of inheritance through acquired traits. The practice of circumcision on an indefinite succession of males has in a number of societies failed to affect the physical structure. The binding of the feet of many generations of Chinese ladies would not affect the size of the unbound feet of the generation in which this was for the first time not done. Cutting the tails of spaniels does not shorten or alter the tails of descendants. The fact that one's ancestors have for many generations spoken French or German gives one no provable advantage in American public schools when the French or German is not spoken at home.

Most of the arguments over the relative influence of inheritance and environment are false issues.[4] No person becomes anything without parents and heredity and no person becomes anything at all in an environmental vacuum. All that we can really mean by references to the effects of either environment or inheritance is that there is some prediction in these terms.

We predict that a man will speak English if he is reared in one of the English-speaking neighborhoods of New York. This does not mean, however, that those individuals born in the same neighborhood but handicapped by having mice or cockroaches for parents will therefore speak English.

We predict (and miss only once in a few thousand cases) that any human infant will speak some language. We can be equally sure that if the parents are cats, no speech will develop. We therefore say that speech is dependent chiefly on inheritance and the specific language on environment.

We can be fairly sure, judging from what we know of inheritance, that there will be family and group peculiarities in any trait we choose. Where a stock of shellfish lives for a long period isolated from other strains, a local type in the shape and markings of the shell appears to develop. This same effect of isolation probably is involved in many of the hereditary types of men with which we are familiar. The Eskimo and the African pigmy have lived in sufficient isolation to

[4] G. D. Stoddard, *op. cit.*, pp. 322–329.

establish recognizable physical traits, which may or may not be accompanied by characteristic differences in behavior type. Since behavior ultimately is a matter of structure we must admit the *possibility* of group and familial differences in mental as well as in physical traits.

From what has been said about heredity it is clear that heredity and environment are not two opposed forces. Heredity may be thought of in a sense as setting the limits within which an individual will develop. We can, for instance, think of an individual as being capable, in hereditary terms, of developing low to somewhat above average intelligence, depending on the presence or absence of certain environmental advantages. In a poor environment, his development is at a minimum and in a good environment at a maximum. It is highly probable that a child who makes extremely high scores in several tests of intelligence must have had the advantages of both favorable hereditary and favorable environmental factors. Such children practically never have parents of low intelligence.

The inheritance of certain fundamental structures makes the continuance of the species itself possible. We must resemble our parent stock in certain essential features or we shall not be capable of life. Offspring lacking these essential structures drop out of the continuum of the succession of living organisms and leave no descendants. Some of these hereditary characters essential to the maintenance of life itself are described in the following section.

CONSTANT STATES

An oak tree is very different from an acorn. A banker or a tavern operator is very different from the infant that a mother nursed and sang to forty-five years before. The infant may have borne the same name through this period but the very matter of which it is made as well as its size and form and habits have undergone thorough changes.

We say that the infant has developed into the banker. By that we mean a number of things, of which one is that the change by which the baby became a banker is a continuous one. It is continuous even from the original union of the two parent cells and, for that matter,

continuous with the whole ancestral history. Conception, birth, and death of the individual are outstanding landmarks in a continuous process of change.

The development or *maturation* of the individual following the fertilizing of the ovum is conspicuously the increase in size that we call growth. By the time of birth, muscles, glands, nervous system, and the other specialized organs are sufficiently developed to allow separate maintenance. At birth a baby is a living individual. The fact that an infant makes its living by what has been called the "nuisance technique," that is, by making loud noises when hungry or cold or in other discomfort, and thus prodding into activity its parents, does not diminish the fact that the infant is now a going concern.

By this is meant that the infant's body can now maintain itself. This self-maintenance is achieved in part through the maintenance of certain conditions necessary to life. It was mentioned before that the cells of the body are maintained through a fluid medium so that their environment is like the ocean water in which they originated. This fluid medium is subject to regular losses because of its use as a disposal medium for body wastes. Water is lost through the evaporation of sweat, through the breathing that gets rid of carbon dioxide and supplies oxygen, through the kidneys and bladder. To maintain life this water must be replaced.

Serving that replacement are a number of mechanisms. One of these operates through sense organs in the pharynx which are activated by dryness. These sense organs in turn activate sensory nerves and the resulting sensory (or ingoing or afferent) nerve impulses help produce a state of excitement in the body, an increase of tension or tonus in muscles—in general a condition in which the infant or the individual is restless and active. This activity is at first undirected except that it includes in the infant a tendency to cry and so enlist or compel the services of an adult. The chapter on learning will describe how generalized activity tends to be directed into channels that bring relief.

There are many similar states that are essential to continued life.

We are so made that we react to disturbances of these states by doing something that brings us back to normal. One other such *constant state* is the balance of oxygen and carbon dioxide in the blood stream.[5] Oxygen is necessary for any muscular activity and for glandular action. Life could not go on without it.

The activity of muscles produces among other things carbon dioxide. This must be eliminated if life is to go on. Since the two needs are closely connected, the production of carbon dioxide follows exactly the using up of oxygen; one mechanism can serve both needs, the need for getting more oxygen and the need for getting rid of carbon dioxide. The mechanism in question is breathing, and the rate of breathing is regulated by the balance of oxygen and carbon dioxide in the deep air of the lungs. It is specifically the presence of carbon dioxide in this deep air that spurs up the breathing rate.

Other constant states are the percentage of mineral salts in the blood stream, body temperature, certain metabolic states which govern food intake, freedom from certain waste products in the blood stream.[6]

There are, in addition to these relatively permanent constant states, certain *temporary self-maintaining states* like body posture. As you sit in a chair reading, minor unbalances or disturbances of your posture are promptly corrected and you return to balance. A practical movement when interfered with or disturbed tends to correct itself and resume normal or usual action. There are other *acquired states* such as habits which are self-maintaining. Habits also are resistant to interferences and disturbing conditions.

Some of this maintenance of constant states is covered by the science of physiology. But the temporary and acquired states are in our own field, psychology. How, for instance, habits tend to be self-maintaining is a question for psychologists.

Here it is sufficient to note that the maturing baby is at birth equipped with enough of these regulatory mechanisms to keep itself

[5] J. S. Haldane, *Organism and environment as illustrated by the physiology of breathing*. New Haven: Yale University Press, 1917.
[6] W. B. Cannon, *The wisdom of the body*. New York: Norton, 1932.

alive. Its muscles and sense organs and nerves are sufficiently developed to ensure its essential constant states.

This development, however, is not complete at birth. It is complete only in the adult individual. The process of maturation is actually completed only at death, not at so-called maturity since the bodily changes that result in an eventual old age and death appear to be as inevitable and as natural—as much "in the cards"—as the changes that bring about maturity itself. It is probable that the death of individuals has been a condition of the improvement and survival of species.

It is obvious from what has been said that this maturation of muscles, bone, nervous system is a gradual thing and that we cannot expect a one-day or a one-month-old infant to walk, because his muscles and bones are not sufficiently mature. On an average, children walk at the age of 64 weeks, some earlier and some later.

GENERAL ACTIVITY AND MATURATION

Maturation has been going on before birth. Our knowledge of the maturation of the human fetus is limited by the difficulty of observing behavior in this stage. Minkowski, a Swiss surgeon, observed a number of developing human organisms that had been removed from the mother by a Caesarean operation necessary to save the mother's life.[7] These fetuses were placed in a saline solution (our marine environment again) at about the body temperature and kept alive for a short time—long enough to make a few observations. With fetuses from two to three months of age, responses to stimuli such as a light pressure or the stroke of a soft brush were massive reactions of many muscle groups rather than limited local contractions of muscles. In the older fetuses, estimated to be from four to five months of age, some fairly specific reactions like sucking in response to stimulation of the cheek were observed.

[7] M. Minkowski, Überfrühezeitige Bewegungen, Reflexe, und muskulare Reactionen bei menschlichen Foetus, und ihre Beziehungen zum foetalen Nerven und Muskelsystem. *Schweiz. med. Woch.*, 1922, 3, 721–724, 751–755.

Pratt, Nelson, and Sun observed babies in their first day of life.[8] They had built a special cabinet in which the babies could be placed for observation. The baby lay on a platform suspended from springs in such a way that every movement of the platform was recorded. The observations of these babies extended into the first two weeks of life.

It was found that general activity was associated with hunger, bowel evacuation, and other general sources of discomfort. Local stimuli, such as lights and pressure, were applied in very limited intensities, and to these there tended to be a local response which spread from the area stimulated. Responses to light resulted in some general activity but the local responses of eye movements were more conspicuous.

Certain responses appeared to be determined more by the organism (*O*) than by the external situation (*S*). For instance one baby tended to respond to a great variety of stimuli, light, sound, touch, and so forth, by fanning his toes. It was just his day for toe fanning and into this activity most sensory pathways led.

Bridges' observations of emotional responses in young infants tend to confirm the principle that specific and definite patterns of response are later developments.[9] In very young infants she observed only states of general excitement. At six months, however, she believed that behavior identifiable as fear, disgust, distress, anger, excitement, or delight was in evidence.

MATURATION AND PRACTICE

One great problem in describing human maturation is to distinguish its results from the improvement that comes with practice. There appears to be no doubt that such activities as walking depend for their sudden full-blown appearance on a state of readiness in the nervous system which makes coördination possible. At 44 weeks almost no children walk. At 64 weeks about one half are walking. What has happened in the interval is maturation.

[8] K. C. Pratt, A. K. Nelson, and K. H. Sun, The behavior of the newborn infant, Columbus: *Ohio State Univ. Contr. Psychol.*, 1930, No. 10.

[9] K. M. B. Bridges, Emotional development in early infancy, *Child Develpm.*, 1932, 3, 324–341.

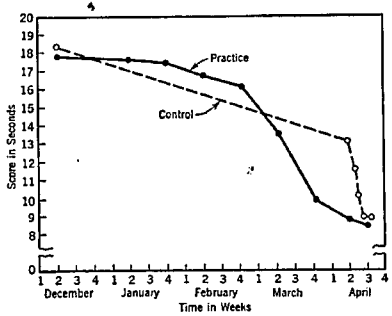

FIG. 1. Mean Learning Curves for Two Groups in Climbing. Each group consisted of 8 children between the ages of 24 and 36 months. The groups were equated in terms of CA, MA, sex, and initial climbing ability. The practice group was given 12 weeks of training from January to April. The control group was trained for one week only, between the second and third week in April. Note that one week of practice was sufficient to bring the scores of the control group and the practice group to similar levels. (From J. R. Hilgard. Learning and maturation in pre-school children, *J. Genet. Psychol.*, 1932, 41, 36–46.)

Two studies will serve to illustrate the psychologist's approach to this problem. Hilgard investigated ladder climbing with the question—maturation or improvement by practice?—in mind.[10] Two groups of eight two-year-old children were used. The children in the two groups were matched in mental age, sex, and their initial ability to climb the ladder. One group was given intensive practice for 12 weeks. Dur-

[10] J. R. Hilgard, Learning and maturation in pre-school children, *J. Genet. Psychol.*, 1932, 41, 36–46.

ing these 12 weeks the other group had no practice. At the end of the 12-week period the "trained" group was much superior. This we might have expected. But we would not all have expected that the untrained group would catch up with the trained group in one week of practice, which was actually the case. This looks seriously like the influence of maturation. The untrained group has benefited by being 13 weeks older.

Gesell and Thompson have studied the development of identical twins.[11] With identical heredity such twins should mature at equal rates assuming their diets and relevant environmental conditions are similar. One twin (T) was given training in stair climbing for 6 weeks at the age of 46 weeks. The other twin (C) was allowed no contact with stairs until its 53d week. At the age of 50 weeks Twin T was climbing stairs unaided and at the age of 53 weeks could climb the stairs in 26 seconds. At this time, Twin C was first tested and was found to require 45 seconds to climb the stairs. But by the time Twin C had been given only two weeks' practice, its stair climbing was as fast as T's.

It was once believed that many skills had a ripening period which represented the time they could be acquired with the least effort. Parents find often that they have purchased a tricycle too early for a child. Somehow the alternating pedal movements are not possible. Eight months later, the child may rediscover the vehicle and within a few weeks be touring the house at breakneck speed and avoiding collisions by inches. Or we may conclude from experience that children require less effort than adults in picking up a foreign language. In the first case we are probably dealing with maturation in the sense that strength and balance are more adequate now. In the second case it is probable that not maturation accounts for the ease with which a child learns French, but the absence of thousands of conflicting habits that handicap the grownup. These would also handicap the grownup who undertakes to learn the bicycle late in life.

[11] A. Gesell and H. Thompson, Learning and growth in identical twins, *Genet. Psychol. Monogr.*, 1929, No. 1.

viscera (or body cavity containing such organs as the stomach and liver). We become aware of these muscles in regurgitation or in control of the bladder. Sometimes in extreme stage fright or panic the victim notices great activity of these smooth muscles in his intestines. They are normally occupied in the progressive waves of contraction that send food along the alimentary tract.

Exercise may result in increased size and power of muscles. Learning may also establish very fine coördination of muscles, as in the activities of a watchmaker or a skilled tennis player or a swimmer.

Physiologists have not made much progress beyond the stage of speculation in explaining just how the contraction of muscle cells is brought about. The ability to contract is not limited to muscle cells but is found in many other types of cells. In muscle cells, however, contraction is the cells' special function and is more vigorous, more extensive, and more speedy than in other cells.

The normal occasion for the contraction of muscle is an impulse over a nerve, which, arriving at the ending of the nerve in the muscle in some way, starts the process of contraction in the muscle fiber. In the muscles which are attached to the skeleton these nerve endings are small platelike shapes and there is some evidence that the effect of a nerve impulse is to bring about the release of a chemical substance, acetylcholine, which probably plays a part in initiating the contraction.

The contraction of a muscle fiber, like any other physical change in this world, requires energy. This energy is derived from the oxidation of the blood sugar brought to the muscle in the blood stream. The oxidation leaves a number of chemical products, carbon dioxide and lactic acid among them; these are carried away by the blood stream, and the used-up sugar is restored. The presence of these waste products of contraction is the chief condition of muscular fatigue, or the state in which the muscle is ready to function only with diminished energy. In states of muscular fatigue, muscular action is painful, and this fact has far-reaching effects on our behavior and tends to direct conduct into channels of least exertion.

Fatigue has proved extremely hard to measure, because there are a

number of devices by which fatigue can be counteracted. There is some evidence that the adrenal glands, which are described in the next section, secrete a substance which, when carried to the fatigued muscle by the blood stream, in some part counteracts the effect of fatigue. In states of excitement the increased rate and power of the heartbeat bring blood at a greater rate, and the fatigue products are carried away more rapidly. The state of fatigue in a muscle is therefore not simply a question of how much contracting the muscle has done in a given time. We cannot assume that a subject in the laboratory who had done a standard amount of work with a set of muscles (for example, repeatedly pulling a weighted string a given distance with the finger) has accumulated a standard amount of fatigue. The fatigue products in his muscles will be influenced by his pulse rate and his adrenal secretions, which, in turn, will reflect his interest in the experiment, his anxiety to make a good record.

It is of passing interest to note that when a muscle contracts, part of the energy used up serves only to overcome the viscosity of the muscle itself. This is somewhat like the relation of the automobile engine to the motion of a car. At the higher speeds a large fraction of the energy used in the engine is required to drive the engine itself, and does not serve to drive the car directly.

It is also worth notice that muscular fatigue may be produced without actually performing any work at all. The fact that opposed sets of muscles may be tensed means that fatigue products are accumulating in the muscles but that the energy of contraction is wasted in a sort of self-opposition. In learning to drive a car, a large fraction of the energy used in the muscles is devoted to this tension of opposed sets of muscles. With practice we learn to drive with the muscles not engaged in steering in a fair state of relaxation, and with only so much tension of opposed muscle sets as will ensure control over the movements of steering.

Muscles are fully relaxed only in death. They maintain even when we are asleep some small degree of tension. We call this general maintained tension *muscle tonus*. You may readily observe, for example,

that your facial muscles have a certain amount of tension. You may also notice that falling asleep is usually accompanied by a series of stepped relaxations of many different muscle groups.

THE GLANDULAR SYSTEM

There is another group of effectors or response organs. They are called *glands* and they manufacture chemical substances or solutions. The major activity of the glands is the release of secretions. Secretions, for one thing, prepare our food for swallowing. It would be hard to get down a dry soda cracker without the help of saliva, which is released by the salivary glands. The glands also furnish the necessary chemical reagents for such purposes as digesting a turkey. They lubricate the surface of the eye for its occasional wiping by the lid. They lubricate and condition the skin. Some of the glands do not discharge through ducts but contribute their secretions to the blood stream as it passes through the capillaries traversing the gland. These ductless or *endocrine glands* secrete products called *hormones* which are carried by the blood stream to various parts of the body and there influence other processes. Normal growth and the control of growth depend on the presence of such hormones. Many disorders are attributed to the excess (*hyper*) or deficient (*hypo*) functioning of these glands.[1]

The *thyroid* gland, for instance, secretes thyroxin, which is carried by the blood stream from the neck, where the thyroid is situated, to the muscles and various organs of the body. When the thyroid is underactive (hypothyroidism) there is likely to be in evidence what in medicine is called a *syndrome*, a group of symptoms sufficiently stable and typical to be given a name and recognized as a disorder or disease. In extreme cases, the symptoms of hypoactivity of the thyroid gland include slowed mental processes, reduced bodily activity, sluggishness, excessive sleeping, a tendency to gain weight. These symptoms can be reduced by the administration of thyroxin pills.

Hyperactivity or overactivity of the gland occasions a very different

[1] R. G. Hoskins, *The tides of life*, New York: Norton, 1933.

syndrome. The symptoms are generally restlessness instead of sluggishness, overactivity, irritability, loss of weight, difficulty in sleeping.

There is a group of four small glands named the *parathyroids* because of their position near the thyroid. These glands are believed to participate in the control of the body's use of calcium.

The *pituitary* gland on the underside of the brain in almost the exact center of the skull has been shown to have two major parts with different secretions and different effects. The forward or anterior pituitary regulates body growth and many other functions. Hypofunction of this part in early life results in dwarfism. Excess secretion of the anterior pituitary results in excessive growth and retarded sexual development. When this excess function (often caused by the growth of a tumor in the gland) comes after maturity it results in *acromegaly* or excessive growth of the extremities, lengthened arms, enlarged chest, distorted and enlarged head and face.

The posterior section of the pituitary gland is different in function from the anterior section. Its secretion delivered into the blood stream appears to increase the ability of the body to burn fatty substances; hypofunction of the gland is associated with a tendency toward the deposit of increased fat.

The *adrenal glands* are located near the kidneys. They also are in effect compound glands. The outer layer, called the adrenal *cortex*, has been shown to be related to heightened general activity and to the accentuation of such male characteristics as growth of beard. Many women suffering from hyperactivity of the cortex of the adrenals develop masculine appearance. The diminished function of this gland in the male is associated with general weakness and depression.

Secretions from the *medulla*, or inner core of the adrenal gland, have been found to supplement the general bodily states that occur during exertion and muscular contraction. These states are believed to include an increase in rate and volume of the heartbeat, a readiness of the blood to clot (preparing us for the bloodshed that was the normal accompaniment of excitement in our animal days), the release of glycogen (a tasteless carbohydrate related to starch and dextrose)

from the liver into the blood stream, the inhibition of digestion, and the secretion of saliva and gastric juice, and numerous other physiological changes.[2]

The *gonads* or sex glands are the *testes* in men and the *ovaries* in women. On the secretion of these glands, along with that of the adrenal cortex, depends the development of secondary sexual characteristics of both behavior and physique. In rats, dogs, and various other animals, experiments have shown that sex behavior, being more fixed through maturation and less dependent on learning, can be radically altered through the extirpation or transplantation of sex glands or the injection of hormones from these glands. The grafting of ovarian tissue in the castrated male rat, for example, results in typically feminine behavior, such as nest building. Even such behavior as the style of micturition in dogs can be changed by interference with gonads.[3]

Another endocrine gland whose functions are less well understood is the *thymus*. It appears to be responsible for inhibiting the development of gonads and sex characteristics until puberty.

The understanding of the functions of a single endocrine gland is complicated by the fact that these glands profoundly influence each other. A disturbance of one of the endocrines is often accompanied by a disturbance of several others. In either sex, for example, hyperactivity of the thyroid gland tends to increase sexual drive.

The anterior pituitary is often referred to as the "pacemaker" gland for the reason that changes in it appear to influence the activity of the thyroid, of the adrenal cortex, and of the gonads. But these glands in turn interact with each other and with the pituitary. Removal of the gonads, for example, results in "a change in both the structure of the anterior pituitary and in its hormone content."[4] And "removal of the thyroid gland causes enlargement of the pituitary and, presumptively,

[2] W. B. Cannon, *Bodily changes in pain, hunger, fear and rage*, New York: Appleton-Century, 2nd ed., 1929.
[3] I. A. Berg, Development of behavior: The micturition pattern in the dog, *J. Exp. Psychol.*, 1944, 34, 343–368.
[4] R. G. Hoskins, *op. cit.*, p. 331.

increase of its secretions. Destruction of the pituitary in turn results in the depression of the thyroid."[5]

The muscles and glands whose general characteristics have just been described are the effectors of the body, the organs of response. Everything that we do, in so far as it can affect other persons or change the world about us or stimulate us to further activity, involves muscular contraction or glandular secretion.

RECEPTORS

The body has another group of specialized structures called sense organs or *receptors*. Through them we are stimulated by changes "inside our skins" and in the outer world. Through the eye, for example, we are responsive to the band of light waves ranging from about 400 to 800 ten millionths of a centimeter (millimicrons) in length. The ultraviolet waves which are somewhat shorter than 400 millimicrons are not visible to the eye nor are the infrared rays which are just somewhat longer than 800 millimicrons in length. Our ears are stimulated by the low notes of the pipe organ which are produced by sound waves of small frequencies and by the shrill of the train whistle which is produced by a sound wave of high frequency. But if we strike a tuning fork which vibrates with a frequency of 15 cycles per second or one which vibrates with a frequency of 20,000 cycles we hear nothing. The ears of the dog and of various other animals, on the other hand, are stimulated by sounds outside this range. Dogs can easily be trained to respond to very high-pitched "whistles" that we cannot hear.

Our noses, or rather the delicate membranes which line the nasal passages, are stimulated by chemicals in air-borne gases and through this stimulation we experience odors. The taste buds of the tongue and mouth are stimulated by four types of substances which give rise to salt, sweet, sour, and bitter tastes. It is, incidentally, highly appropriate that smell and taste be located at the food intake, because their

[5] *Ibid.*, p. 331.

chief use in man is in the selection of food. All sense organs are strategically located. By this is meant that they are placed where sensitivity of that particular sort is most likely to be an advantage to the animal.

Eyes, ears, and nose are called *distance receptors* because these three sense organs can be excited by disturbances which originate at a distance. Of these three, sight gives the most accurate orientation because light travels in approximately straight lines. Sound is useful but not so accurate in orienting the object source. Smell has no directive power except through learned associations with the direction of the wind.

The skin, when stimulated, gives rise to a number of experiences, grouped together by our ancestors as "feeling" or touch. We now distinguish touch proper, the sense that is activated by light skin contact, from the temperature senses which give rise to feelings of warmth and coolness, and other types of skin sensations such as "tickle."

In the muscles and tendons and joints are other receptors that are stimulated by the distortions and pressures that come with our movements. Through these sense organs we respond to our own position and movements even when we cannot see them. By means of signals from these "movement" sense organs we can learn to follow our own signals. These sense organs are called kinesthetic sense organs, and the movement sense is called *kinesthesis*. This word means "movement feeling."

There are highly specialized sense organs in the inner ear that are activated by changes in our motion as when we are rotated in an office chair or go up and down in a fast-running elevator. These are the so-called *static* organs. Through them we are able to keep our balance when it is disturbed, to walk with our eyes closed, to make quick movements of recovery when we stumble.

There are numerous other types of receptors within the body. The small intestine is stimulated by stretching (colic pains) but is not sensitive to temperature changes and can, like most muscles, be cut

without giving rise to pain. The brain is also insensitive in the sense that when the brain of a conscious person is exposed during the course of an operation, he does not "feel" local pain or touch or temperature.

THE NERVOUS SYSTEM

Besides depending on effectors and receptors, behavior depends on the connecting system, the wonderfully intricate nervous system. The *central nervous system* consists of the brain and spinal cord. It is in these central parts of the nervous system that the remarkable system of pathways and connections is found through which it is possible to route impulses from almost any receptor to any effector. Pavlov's learning experiments with dogs, which we shall have occasion to discuss in greater detail later, consisted in making a variety of signals like a pin prick (stimulating pain receptors in the skin) or a buzzer (stimulating the ear) or a light (stimulating the eye) effective signals for the secretion of saliva. Somehow each of these stimulus signals was made to activate the gland, and this fact implies that a conducting pathway existed or had been established and that over this a nervous impulse has traveled. From the receptor stimulated by the pin, a discharge of energy has traveled along a *sensory nerve* to the central nervous system, and from there has been conveyed to a series of connector nerve cells and from these to a motor nerve and eventually to the gland itself.

This system, the path from receptor to effector, is called the *neural arc*. It always includes a sensory or *afferent* nerve cell leading from receptor, at least one and sometimes many *connector* cells, and a motor or *efferent* cell to the effector.

Afferent and efferent nerves (sensory and motor) make up the *peripheral nervous system* which is not an independent system at all but just the outlying pathways of the nervous system as a whole. There is, however, another nerve system. This is the system of nerves that goes for the most part to viscera and glands. It is called the *autonomic nervous system*.

THE NERVE IMPULSE

The whole nervous system, fibers and all, is a system of nerve cells. These cells are specialized as conductors, just as muscle cells are specialized contractors and sensory cells are specialized receptors. Nerve discharges or nerve impulses travel along these cell fibers at rates as high as 400 feet per second in the peripheral nervous system and at slower rates in fibers of the autonomic system.

Every one of these nerve cells or *neurons* is an energy system that can be discharged as a firecracker is discharged by a faint spark. The receptor responds to stimulation by activating the nerve fiber and starting a nerve impulse traveling along the nerve.

The energy of the impulse does not come from the stimulus. Just as leaning hard on the button of a friend's doorbell does not ring it louder because the energy of the ring comes from the house current and not from the visitor's push, so the energy of the nerve has been stored in the nerve before it was released by the stimulus and the action of the adjoining part of the nerve. Just as when a wave crosses a lake, no material goes across, only a disturbance, so the nerve impulse is a traveling chemical and electrical disturbance of the neuron. Its most interesting feature is the fact that the impulse is an "all-or-nothing" affair, like the doorbell. If you push hard enough to ring it at all the ring is as loud as it will be for any push. The chief characteristics of the nerve impulse are these:

1. A galvanometer will show that the spot being traversed by an impulse is electrically negative with relation to the spot ahead and the spot behind.
2. Impulses travel in peripheral nerves at a speed of about 100 meters per second. In other nerves (in the autonomic system) the speed may be as slow as 1 meter per second. The speeds vary with temperature and with the diameter of the neuron.
3. Once an impulse has been sent along a nerve, another impulse will not be transmitted until the nerve cell has recovered. The sequence is something like this:

   a. Following stimulation there is an *absolute refractory period* during which the nerve will not conduct any impulse.The minimum duration of this period is about one thousandth of a second.
   b. The absolute refractory period is followed by a *relative refractory period*. During this period the nerve may be fired before it has completely recovered, if the intensity of stimulation is increased.
   c. After the relative refractory period, the nerve is ready to fire again at the level of intensity required by the original stimulus.
4. The point of junction where two neurons meet is called a *synapse*. At the synapse there is evidently some barrier to conduction, and there the impulse travels more slowly. Impulses can cross synapses in one direction only. At this point the impulse is more subject to interference from drugs and fatigue.

STUDYING NERVE ACTIVITY

The operation of the central nervous system has been studied by many methods. One of these is extirpation, the "rooting out" of some portion and observation of the effect on behavior. A number of such operations on animals have thrown much light on the functions of the nervous system. We have learned that certain areas of the brain are the areas where incoming impulses from sense organs are projected. The destruction of such areas produces blindness, deafness, loss of sensitivity to odors, according to the "projection area" destroyed.

Another method used by Loucks consists in burying a very tiny wire coil in the part of the central nervous system being studied.[6] This can usually be done with no noticeable aftereffect of the operation and then, in what is practically a normal animal, the area can be stimulated by induced current from a small primary coil taped to the head.

Still another method of investigation was introduced recently. This consists in placing electrodes at points which will enable the experimenter to record various of the electrical potential changes which are characteristic of the living brain. These action potentials are to some

[6] R. B. Loucks, A technique for faradic stimulation of tissues beneath the integument in the absence of conductors penetrating the skin, *J. Comp. Psychol.*, 1934, 18, 305–313.

extent characteristic of the individual. Analysis of the frequencies of these brain impulses is asserted to show three main rhythms, so-called *alpha* rhythms[7] with frequencies of about 10 per second and a range of 8 to 13; a *beta* frequency[8] of about 25 per second with a range of from 18 to 30, and a *gamma* wave,[9] which is not too often observed, with a frequency from 35 to 45. During relaxation alpha waves are typically found, while thinking and other forms of mental activity tend to break up the alpha rhythm into irregular patterns. Brain waves have also been used to detect brain tumors and to diagnose epilepsy.

THE BRAIN CENTERS

The outstanding parts of the brain include the expanded upper portion of the spinal cord called the *medulla oblongata*. This we know contains part of the mechanism essential to breathing and heartbeat. The central nervous system can be severed or removed from this point on and a vertebrate animal like a cat or a dog will continue sustained breathing. Above and behind the medulla is the *cerebellum*. Injuries here are accompanied by loss of the ability to maintain balance and smoothness of coördination. Above the medulla is the *midbrain*, which is associated with many reflexes, particularly reflexes involving vision and hearing. Beyond this are the *thalamus* and the *hypothalamus* through which are relayed many of the sensory pathways. There is some reason to believe that the hypothalamus functions as a motor center for the expression of emotions.[10] In human beings, lesions caused by tumors in the thalamus have apparently been associated with abnormal emotional states, forced laughter or tears.

The endbrain, the *cerebrum*, is judged to be the last part extensively

[7] D. B. Lindsley, Electoencephalography, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, p. 1039.

[8] *Ibid.*, p. 1040.

[9] *Ibid.*, p. 1040.

[10] K. S. Lashley, The thalamus and emotion, *Psychol. Rev.*, 1938, 45, 42–61. See also J. H. Masserman, *Behavior and neurosis*, Chicago: University of Chicago Press, 1943.

developed in the course of evolution. It is almost absent in fish. The brain of the higher apes is much more complex in its development than that of a dog or a cat, but not nearly as complex as that of man. In general, the cerebrum can be described as an outer cortex or rind of gray nerve cell bodies interspersed with fibers, and an inner white portion made up of millions of insulated nerve fibers connecting the various areas.

Like the other parts of the central nervous system, the functions of the cerebrum are only vaguely known.[11] The paths of the main groups of fibers are known and mapped. The chief areas that can be distinguished are the *sensory areas* and the *motor areas*. The remaining areas of the brain are believed to function largely as *integrating centers*.

Some indication of the nature of the sensory areas may be grasped by thinking of a point on the surface of the skin as being represented by a corresponding "point" (a circumscribed area or group of cells) in the brain. When the point on the skin is stimulated, a sensory nerve impulse is set up which in turn arouses neural activity in the corresponding "point" in the brain. The visual field also appears to be projected point for point in the brain. Minute injuries in the visual areas, located at the rear and basal portion of the cortex, have been shown to be associated with small blind spots in the field of vision. It is believed that other sensory areas have a similar point-for-point projection.

The chief motor area of the cerebrum lies atop and across the cortex. Electrical stimulation of the cells in these areas will produce movements in very specific regions of the body such as the feet, legs, trunk, arms, neck, and so on. Patients who were having brain operations performed under a local anesthetic and who consequently were fully conscious have been stimulated in this fashion.[12] The resulting

[11] S. G. Klebanoff, Psychological changes in organic brain lesions and ablations, *Psychol. Bull.*, 1945, 42, 585–623. This article summarizes the literature to date on brain area destructions and corresponding changes in psychological functions.

[12] W. G. Penfield and E. Boldrey, Somatic motor and sensory representation in the cerebral cortex of man as studied by electrical stimulation, *Brain*, 1937, 60, 389–443.

movements of the patient are identified by him as having been "forced" by the surgeon. It is as if he says: "I didn't move my leg; you made me do it."

CENTRAL CONTROL OF ACTIONS

Several features of the efferent peripheral nervous system must be mentioned. It appears to be the case that afferent impulses from sense organs must compete for the outgoing pathways to muscles. Many movements and actions represent the capture of an efferent pathway by impulses from one center rather than from another.

What is really captured is not the final efferent pathway but the brain or cord center from which motor nerves lead to this pathway. The capture of the center is an inferred event and not demonstrable. But its assumption makes very plausible the notion that many coördinations of action, involving complex patterns of muscle contraction and the inhibition of opposed movements, are represented by central controls.

Such a control would be well illustrated by Magnus's description of a bit of cat behavior.[13] If a cat is decerebrated, meaning that its cerebrum is disconnected with the rest of the nervous system, the cat loses much of its responsiveness to the world about it and practically all, but not all if we judge from some experiments, of its learned responses to the situations about it. One thing it will continue to respond to is the pull of gravity. The cat, placed on a table, will stand up and will maintain this antigravity posture, making the proper corrective movement whenever it leans too far toward one side and disturbs its equilibrium. This is a complicated response and occupies many of the cat's muscles.

If now you move the cat's head to the right, the right front leg will be stiffly extended and the left front slightly flexed. The cat takes a stance from which it could immediately take off to the right. This stance is the result of a posture forced on the cat. It is probable that brain centers rule such postures. If the proper stimuli and sensory

[13] R. Magnus, *Körperstellung*, Berlin: Springer, 1924.

impulses capture the center, the center dictates the movement, and centers for rival movements are thrown out or inhibited. If another center had been activated first it might have used the same muscles in some other response (readiness for taking off to the left instead of to the right or readiness for flight to the rear), and these same muscles would be otherwise occupied.

One of the writers recalls banging his desk while a laboratory kitten was very slowly and very tensely following a bug on the floor. In response to the slap the kitten jumped several inches and landed running to the rear. This jump away must have been there in readiness all the time, in the form of certain tensions in the kitten's muscles and certain activities in the centers which controlled the jump.

We know from watching other people or from observing ourselves that complicated action patterns like this jumping may be in evidence. At any given moment these patterns limit what we can be made to do. They allow only compatible movements to take place.

These action patterns can *facilitate* or they can *inhibit* other action patterns. When one action increases the vigor of another it is said to facilitate the other. If you strike the patellar tendon in the right spot just below the knee, its sudden stretching is a stimulus for a sudden contraction of the muscles that make the leg kick.

This so-called *knee jerk* will not occur (or is greatly diminished) during sleep, or during some strongly depressing general states. But if you strike the knee just as the subject pulls apart his clasped hands, the resulting knee jerk will be much exaggerated. It has been facilitated by the other action.

Some action patterns facilitate each other; some inhibit others. By inhibition is meant that one action pattern prevents another from appearing even when stimuli that would normally produce it are present.

There are other effects of this interaction of systems and centers. The result of the stimulation of two incompatible systems (like raising and lowering the arm, smiling and frowning, turning right or left) may be not conclusive action, nor inhibition of either system by the

other, but the activation of opposed muscles in a state of conflict.

Of such states of conflict a considerable part of the psychology of adjustment and maladjustment must take account.

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VI

Associative Learning

THE word "psychology" is a combination made by the Greeks from two words, *psyche* and *logos*. The second meant literally "word" but was used as an ending to mean "the science of." The first word originally meant "breath," and, like so many words for "breath" in other languages, it had come to mean "spirit" (*spiritus* was Latin for "breath") or "mind" or "soul," or in general, the inner cause for "animate" behavior (*anemos* was another Greek word for "breath" or "breeze"). Our word "ghost" is an old word for "breath."

There are two distinctions among things that men confront all their lives. One of these distinctions is that between living objects and nonliving objects. The other separates living objects into two classes: those that have "mind," and those that have not. Lima beans may be alive. Parsnips may be alive. But they are not material for psychologists. They have no minds.

How does common sense use that word "mind"? What are the qualities we mean when we attribute mind to a living creature? The distinction will probably be found to be, if we question many persons on this point, that mind is attributed to living things that are capable of changing their behavior as the result of experience.

As living things, plants make responses to physical changes in their environment. If we plant a radish in a room with one window, the growing plant will turn toward the source of light, and if we rotate

the pot in which the plant is growing, it will change its direction of growth to such good purpose that it still grows toward the window. Roots grow downward. These are responses to physical conditions in the environment. But we know of no case in which a plant will acquire new signals for its responses. The plant will "come" toward the light, but cannot be made to come toward a whistle instead of the light. The living being that can do this is said to have a mind.

The changes that give evidence of mind can be described in two very different ways. General usage employs the term "learning" to indicate both of these kinds of change in behavior. One description of change or learning is in terms of the results of action; the other is in terms of the movements themselves. The latter description is simpler than it sounds. We may notice that the baby has taken to pulling the kitten's tail. This is a case of description in terms of end effect. The baby could go through just the same series of motions, but if there were no kitten about, it would not be said to be "pulling the kitten's tail."

A serious difficulty in the psychological description of learning is that people in general are interested only in the first kind of description because they are interested in the results of movements, not in movements for their own sakes. But psychologists must be interested in how the results get accomplished, and must predict specific movements.

Most people use the word "learning" to mean the acquiring of an ability to bring about some desirable state of affairs, to reach some goal, to *make something*, or to *do something*.

Both making something and doing something are defined by the something made or done and not by the motions by which they were made or done. Neither one can be defined in terms of the body movements required to get the result. These movements could be duplicated, but unless they have their result, they are not a case of *doing* or *making*. A man could duplicate accurately all the movements he had previously used in frying a pancake, shoveling snow, eating a steak, going to the store, but unless the movements end up in a pan-

cake, in the removal of snow, in the presence of the one-time steak in a stomach, in his own presence in the store, the act has not occurred.

Acts are defined by their results, not by the movements that make them up. Practically all our descriptions of human behavior are in terms of acts. We tell what people get done, what they accomplish. We do not even have names for 99 percent of the movements by which the result is accomplished. We do not have names for the movements because it is only the results that are of importance to us. Just how the dinner guest gets to dinner is unimportant. It is the arrival we are interested in and the action is named by the arrival—"going to dinner." The dinner guest can walk, trot, take a taxi, hitchhike, cycle, drive. All of these are simply "going to dinner."

The movements used in an act are irrelevant. We can write a letter by making tapping movements on the keys of a typewriter, by moving a pen with fingers, wrist, and arm, by dictating to a stenographer. "Writing a letter" covers these indifferently.

The movements in an act may be irrelevant, but it is still true that every act must be carried out by some one series of particular movements. This is always and universally true. There is no possible way to go to dinner or shave without using some definite and specific series of movements. Shaving can be done with many styles of razor and by either hand, or, in the case of at least one man born without arms, by movements of a foot; but some definite movements are always necessary. One must needs shave *somehow*, even if the how is not important to the act. Shaving means cutting whiskers off *anyhow*, but shaving *consists* in cutting whiskers off *somehow*. There must be a *how*.

This is all of great importance to psychological theory because in any effort to understand what makes man tick—how a man works—it is the despised movements that must be investigated. Viewed as a machine, all behavior consists in the operation of muscles or glands. From the noblest oration or the most splendid writing to the ingestion of a piece of buttered toast or the tying of a shoelace, it is muscles and glands that are operating.

The occasions for muscular contraction or glandular secretion are in all normal cases the arrival of nervous impulses over a nerve at the muscle or gland. A muscle will contract on being struck or given an electric shock, but these are not part of ordinary behavior.

Muscles and glands react to the arrival of nerve impulses over the outgoing or *motor* pathways from the central nervous system. In their turn these nervous impulses are reactions to incoming nervous impulses over *sensory* pathways. Sensory impulses have their origin in the reaction of sense organs to certain types of change in the physical world.

All of this chain of cause and effect leads from changes in man's situation to responses in his muscles and glands. It is in these effectors that motor nerves have their endings.

Here is the psychologist's difficulty. Common sense describes behavior in terms of acts which name effects of behavior on the world—eating dinner, throwing a ball, writing a letter, going to town, welding a ship's plate. But no nerves lead to dinners, to baseballs, to letter paper, to town, or to the plates of a ship. Nerves lead to muscles. It is *only movements*, not acts, that can be directly explained by the psychologist. This difficulty of the psychologist is not insurmountable. Actually we can usually count on a movement to achieve a result in most instances. Therefore, if we have explained the movement (which means telling the circumstances under which it takes place) we have at the same time practically explained the act. We can, when we have spoken of a man's habit of biting his nails, his habit of smoking cigarettes, his habit of using taxis for getting about town, bear in mind that all habits so described in act terms, are, nevertheless, actually made up of very specific movements.

LEARNING AS CHANGE IN RESPONSE

When we describe behavior in terms of acts it is natural to use the word "learning" in its commonest sense. We define it as the improvement with practice in the performance of an act. By improvement we

mean the reduction in time required for producing the effect which defines the act, the reduction of errors and waste motion in the performance, and the increase in certainty of the end result.

When we describe behavior in terms of movements (not acts) it is necessary to use a very different meaning for the word "learning." We must mean by learning a change in response to stimuli, a change resulting from previous experience of the stimuli.

This chapter will be devoted to learning in this second sense, namely, the changes in behavior that result from use. In this sense of the word, learning may not consist in a desirable change or an improvement. We can learn bad ways as well as good. We shall try to describe the way in which behavior changes with experience.

THEORY OF ASSOCIATION

The only theory ever offered of learning in this sense is the theory of association. This has had a very long history and many illustrations of explanation in terms of association are to be found in writers of any period.[1] Association is familiar to each of us. "That reminds me" or "The sight of him recalled"—or innumerable other familiar phrases should make us aware that we rely on association for study, for training, for learning skills, and even for forgetting what is obnoxious.

But while association is so familiar to us, it is quite remarkable that men have never been very clear about what it is that gets associated. Our purposes will be served if we assume here that what gets associated is not ideas, mental states, sensations, but something definitely clearer than these vague entities—something that is definitely easier to treat scientifically. It will be remembered that science was said to be prejudiced in favor of public facts, and ideas are not easily demonstrated as public facts.

What gets associated is a *stimulus* and a *response*. We may stop to define these two words. A *stimulus* is a physical change that activates a sense organ, as light activitates the eye or sound the ear. It is

[1] E. S. Robinson, *Association theory today*. New York: Appleton-Century, 1931.

stimuli that prod us into activity. Stimuli are the occasions or origins for the activities of the nervous system that end in motor nerve impulses that activate muscles and glands. If we were by some miracle deprived of all incoming sensory nerve impulses, we should presumably be inert and inactive. A *response* is a contraction of muscles or a secretion of a gland. Responses are normally produced by motor impulses whose occasions eventually go back to the stimulation of sense organs.

It was said that what gets associated is a stimulus and a response. An example would be dodging at the sight of a threatened blow. We take dodging for granted, yet small babies do not exhibit it. And to a threatened blow of the hand that stops short of hitting, dogs reared in well-brought-up households respond by closing the eyes and possibly by moving the head nearer the on-coming hand. It is only after an association has taken place that a dog will "duck" such a blow.

PAVLOV'S STUDIES

At about the beginning of this century, a Russian physiologist Ivan Pavlov published a book on digestive secretions in which he reported his observations of something which he termed a "psychic" secretion.[2] The dogs which he used in his experiments would initially secrete saliva or gastric juice only when food was presented. But Pavlov observed that other stimuli which accompanied the presentation of food would, when presented by themselves later, also arouse salivary activity. The sound of a bell, for example, if presented along with food, would after a time result in the flow of saliva even when it was not accompanied by food. At first Pavlov regarded this psychic secretion as an annoying impediment to the study of gastric secretion. But eventually finding it of extreme interest in itself, Pavlov made the study of it his chief life work, and by that work became world famous.[3]

The theory which Pavlov advanced to account for the psychic secretion was that an association had been formed between the stimuli.[4] The new stimulus (bell) becomes effective in evoking the response (flow of saliva) because it (bell) has been associated with a stimulus (food) which was already effective in producing this response. Pavlov called the old stimulus the *unconditioned stimulus* and the new stimulus the *conditioned stimulus*. The term "conditioned" was introduced to modify the new stimulus because the response to it is *conditional upon the occurrence of the association between the stimuli*. The point of view which we have taken differs from Pavlov's theory in that we believe it is not the association between the old stimulus (food) and the new stimulus (bell) that is important but rather the *association between the new stimulus (bell) and the old response (flow of saliva)*.

What Pavlov's experiments consisted of was, in a typical instance, as follows:

A dog is brought a number of times into the laboratory room and fastened into a loose harness that holds him erect. At the same occasions the experimenter tries to reduce the dog's agitation and get him used to standing in the harness. When this has been accomplished, the dog is placed in the apparatus and some stimulus, such as a bell or a buzzer, a pin prick, a current of air, a light, is presented to the dog and shortly after (perhaps five seconds) food is deposited in a feeding dish. The dog promptly attacks the food and saliva flows through a small aperture in the dog's cheek into a tube which conducts the saliva to one of the several kinds of registering devices that will count the number of drops.

We may call this a "pairing," meaning that the unconditioned stimulus, food, which already causes saliva to flow, has been paired with the buzzer which did not. After a number of such pairings, the buzzer alone will elicit saliva. This is the *conditioned response*.

In his early experiments Pavlov found that it took some fifty or more pairings of the new signal and the unconditioned stimulus to

[2] I. Pavlov, *The work of the digestive glands* (Trans. by W. H. Thompson), London: Griffin, 1902.

[3] I. Pavlov, *Lectures on conditioned reflexes* (Trans. by W. H. Gantt), New York: International, 1928.

[4] A brief but fairly complete account of the work of Pavlov may be found in H. G. Wells, J. S. Huxley, and G. P. Wells, *The science of life*, New York: Literary Guild, 1934, pp. 1288–1317.

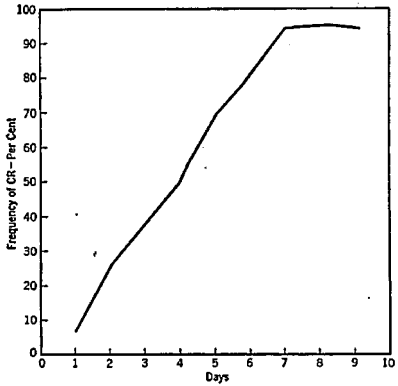


FIG. 2. Establishing a Conditioned Response (Cessation of Crying at the Sound of a Buzzer) in Infants. In this study the unconditioned stimulus was milk from a nursing bottle. The unconditioned response was the feeding reactions of the infant (sucking, mouth-opening, quieting). The conditioned stimulus was the sound of a buzzer. Just before feeding time, the infants were crying, active, and ready for food. When the bottle was presented, the crying stopped. The sound of the buzzer failed to evoke any such response; in some cases it simply increased the crying and general activity. The conditioned response (cessation of crying at the sound of the buzzer) was established by sounding the buzzer for five seconds before the nipple of the bottle was introduced into the infant's mouth and continuing to sound it for five seconds after the infant started nursing. At various times during the feeding interval, the sound of the buzzer was repeated. After a relatively short period of time, the sound of the buzzer results in a sudden stopping of crying. A conditioned response has been established. (From D. P. Marquis, Can conditioned responses be established in the newborn infant? *J. Genet. Psychol.*, 1931, 39, 479-492.)

make the operation of the new signal reasonably certain. When he had built a new laboratory with sound-resistant rooms and provisions for screening the experimenter from the dog—precautions which eliminated distractions—it was found that he now required as few as ten pairings to establish the response to the signal.

There is reason to believe that when still additional precautions are taken to avoid distraction, the required number of pairings is only one instead of ten or fifty. This is also more in accord with our observations of daily life. We do not ordinarily require to be told things ten or fifty times. Many things we associate in one pairing.

"TEMPORARY" EXTINCTION

Pavlov reported that the strength of a conditioned response is increased with the number of pairings. This strength can be stated in terms of the probability of the response's occurring when the stimulus is presented. (It is assumed that the general situation in most respects remains constant.) If on 65 out of 100 presentations of the conditioned stimulus the response follows, the strength could be estimated as 65 percent or .65. Responses with high probabilities are believed to be more resistant to extinction than responses with low probabilities. By the term "extinction," Pavlov referred to the fact that when a conditioned response had once been established with high certainty, he could, by repeating the signal frequently at short intervals, reduce the vigor or energy of the response (in his own work, the number of drops of saliva secreted) to zero. This he called experimental extinction or temporary extinction. It was called "temporary" extinction because by waiting a period and then giving the signal, the saliva would be found again to flow. The response had not stayed extinguished.

The reader may become acquainted with this temporary extinction in a very simple experiment. Roll a piece of paper eight or ten inches long and have a friend strike you repeatedly across the forehead, using rather uniform blows. With most subjects the response to the first blows is blinking. As the blows continue, however, an occasional

failure to blink occurs and the failures gradually take the place of blinking. Blinking has been extinguished.

Discontinue the experiment for some minutes and then resume. In most instances blinking will be found quite restored. But as the experiment continues it is again extinguished and this time more quickly.

Or, after the response has been extinguished to the point of only an occasional blink, if the experimenter suddenly slaps the subject on the back or makes any kind of diversion, the next blow of the paper will probably cause blinking. The diversion has, to use Pavlov's words, *disinhibited* the inhibition.

Extinction has been explained as the conditioning of an inhibiting response.[5] In the case of the blinking there is some evidence that what takes the place of the blink is a slight widening of the lid aperture. The temporary character of some extinction (not all extinction is temporary) is, on this theory, explained by conditioning on temporary signals or temporary features of a situation. The general attitude built up during the blink experiment is lost when a time interval brings a change of attention and stance or a blow on the back upsets posture and the stimulus pattern on which the resistance had been conditioned.

INHIBITORY CONDITIONING

There is another form of learning very like temporary extinction. The only difference is that it is not temporary. The response to a stimulus may be lost without automatic recovery. This can happen in three ways.[6] (1) The signal is given at a time when some new response incompatible with the old one is taking place. The signal then becomes a signal for the new response. Or (2), the signal is given when fatigue or exhaustion prevents the old response. The signal then loses its effectiveness. Or (3), the signal is given repeatedly at first with such slight strength that it will not produce a response. Since the intensity that a stimulus must have to produce a response is called its

[5] G. R. Wendt, An interpretation of inhibition of reflexes as competition between reaction systems, *Psychol. Rev.*, 1936, 43, 258–281.

[6] S. Smith and E. R. Guthrie, *General psychology in terms of behavior*, New York: Appleton-Century, 1924.

threshold, this third alternative may be spoken of as stimulating below the threshold. If now the stimulus is repeatedly given with slightly increasing strength, it can finally be given at a strength that would have produced a response but no response occurs.

Notice that all three cases can be stated in one rule. *When a stimulus is given and its response prevented, the stimulus loses its ability to call out that response.* The stimulus has become associated with a new inhibiting response. This has been called *inhibitory conditioning* or *conditioned inhibition*. A student may find innumerable examples from his own experience. Some homely illustrations may serve here.

A girl called at the psychology department's office at her mother's insistence that she find some method of rising in the morning. Her present response to an alarm clock was to reach for it, turn it off, and put it on the floor. Her response to her mother's call was to answer "yes" and turn over for return to sleep.

She was directed to practice a new routine. Her instructions were: Tonight when you go to bed set the alarm for fifteen minutes later. Go to bed and wait for it to ring. When it rings throw back the covers violently and get out of bed. Then set the alarm for the morning rising hour and go to sleep. As soon as you get to school, come and report what happened.

The result astonished the girl. She reported the next morning that she had gone faithfully through the routine and with energy. In the morning when the alarm rang she had repeated the routine and found herself standing beside the bed before she was thoroughly awake or realized what was going on.

In this instance, the established response to the alarm clock had been to turn it off and turn over to bury the head deeper in the pillow. One pairing of the alarm with the new routine was enough to establish a new association. Conditioned inhibition of the former response was achieved by conditioning of the new.

Another illustration: A girl of seven is in the habit of entering a living room by opening a door and always leaving the door open. In cold weather this produced a draft of cold air which made the others

in the room uncomfortable and there was, as the girl entered the room, loud and prolonged protest from the family.

This protest eventually was quieted by the girl's return to the door and closing it. The result was to establish what was almost a compulsion. The original stimulus for closing had been the family clamor. But the sight of the open door always accompanied the beginning of the act of closing. It thus became a cue for the act and the girl was noticed to close the door whenever it was left open by any member of the family, and to close it on days when mild weather meant there would be no possible discomfort from the open door. The sight of the open door was the signal for an act and resulted in tension and restlessness until the act was consummated.

Probably a much better result could have been obtained if, instead of insisting on her return to the door from the living room, which made the sight of the open door the new signal for going over to close it, the family had originally persuaded the girl to repeat her entrance, closing the door as she came in. In this case the movements of opening and entering become the cues for closing. There will be no awkward tendency to close the door whether that is necessary or not. She will close the door if she finds it closed, leave it open if she did not open it herself.

LEARNING REQUIRES ACTIVITY

If we accept the statement that learning is the result of an association between stimulus and response, there is an interesting consequence. It is not only true that all that is required for learning is activity in the presence of stimuli; it also follows that learning is restricted to this activity. In this sense, we learn only what we do.

To illustrate: It is the first business of a teacher to get the pupils to do what is required to be learned. This is where the art of teaching comes in. The teacher uses all his knowledge of inducement to try to produce the desired activity in the pupil. Once produced, it can later be commanded or produced by the appropriate signals that have been associated with it. We do not *learn what we see in a textbook*

or what we hear a teacher say. We are absolutely restricted to *learning what the textbook or the teacher incites us to do.*

The trainer of animals does not write his scenario and then teach the animal to perform the act. What he actually does is to watch his animals and pick out some one of the things he has seen them do, and try to induce its repetition under circumstances that the trainer can control. He is really only establishing new signals for old behavior. The original sea-lion performance in tossing a ball back and forth with the nose was not thought up by a trainer. The trainer, having seen sea lions doing this, sought its repetition under circumstances that would let him give the signal.

LLOYD MORGAN'S STUDIES

In 1900 the British psychologist C. Lloyd Morgan published a book in which he described some of the very first experiments on learning.[1] Morgan set out to discover just how "ideas" get associated. To test this he placed before newly hatched chicks either bits of orange peel or bits of egg yolk. The chicks peck at either one. This pecking is instinctive or inborn behavior in the sense that we can predict that any chick will do it. Behavior that we can predict of an animal just from knowing its species may be called *instinctive.*

But after the chick has pecked, then events depend on whether it was yellow orange peel (presumably bitter to the chick) or yellow egg yolk (not bitter). Chicks that have pecked orange peel will now peck at neither orange peel nor egg yolk. Chicks that have pecked at egg yolk only will continue to do so. How does this come about? Morgan believed that the bitter taste gets associated with the sight of the yellow bit and *somehow* inhibits pecking. Notice that Morgan does not really tell *how* the result of not-pecking-orange-peel is attained. He is really saying that *what* we learn is *what leads to pleasant results,* and that somehow *we unlearn what leads to unpleasant results.* "Somehow." This does not tell us *how.*

The English psychologist Hobhouse, the American Thorndike, and

[1] C. L. Morgan, *Animal behavior,* London: Arnold, 1900.

a long line of more recent theorists have followed Morgan in this approach to learning theory. Hull believes that what gets learned is action that results in "reinforcement" or reward.[8] Tolman believes that what gets learned are the signals which "mean" success and failure, and a conceptual map or schema which serves to guide later performance.[9]

The theory of associative learning alone does not tell what gets achieved; that requires further explanation. Association theory tells how behavior changes with experience. Its basic principle is: *Stimuli which accompany any response tend later to evoke that response.*[10] This is not made to depend on success or pleasant results or on anything but the mere fact of association. On this theory a stimulus-response connection that does not get learned fails because there was no association. One that gets unlearned, gets unlearned because some inhibiting response was associated with the stimulus and the old response is crowded out or replaced. The increased certainty of the response to a stimulus is explained not as the effect of reward or reinforcement but as the effect of the association of additional stimuli which produce the response in a *variety of situations.*

GENERALIZATION OF THE SIGNAL

The general principle of association as just stated appears open to a criticism. There are many obvious instances in which the signal for a response has obviously never accompanied the response in the past. A child is frightened by a dog, and the next day his terror reappears at the sound of a dog barking outside the house, though barking did not enter into the original terrifying experience. A student who has "felt faint" at the sight of blood on one occasion feels the same state coming on during a conversation in which blood is mentioned but certainly not seen. How can an experience become thus associated with stimuli which have never accompanied it?

The answer is probably that the actual signals for the behaviors are

[8] C. Hull, *Principles of behavior*, New York: Appleton-Century, 1943.

[9] E. C. Tolman, *Purposive behavior in animals and men*, New York: Appleton-Century, 1932.

[10] E. R. Guthrie, *The psychology of learning*, New York: Harper, 1935.

not just the obvious stimuli to exteroceptors, as, for instance, the sight of the approaching large dog, or the redness of the seen blood. The individual has had previous experience with dogs or with blood, and has already formed certain complex associations with these. Among those associations may be the tendency to name. If the word "dog" or the word "blood" has been aroused in connection with the original experience, other situations that arouse these words may serve to set off the train of the response.

The new signal may be effective because it arouses a response through its own past association, and this response entered into the conditioning experience. For instance, a housewife finds the traces of mice in the cupboard extremely disturbing. The original conditioning involved reaching into a bread box which contained a very active mouse and withdrawing her hand with enthusiasm. The surprise of the situation added to its effectiveness. But there is then talk of mice, and the talk is associated with components of the frightened response. When the housewife has later learned to identify the signs of the presence of mice, these signs carry a perceptual response given to mice. Mice are about. The response to mice being about is really a response to her own reaction to mice, which was present in the frightening experience and also in the discovery of the signs in the cupboard which had no intrinsic capacity to frighten.

CATS IN THE PUZZLE BOX

The associative theory of learning may be illustrated by reference to a series of observations made by Guthrie and Horton of cats making their escape from a puzzle box.[11] The puzzle box was so constructed that by touching a post the cat could open the door. The escape was made possible through an electrical contact and a solenoid magnet that released the door catch and allowed a spring to open the door.

On being admitted to the puzzle box all cats entered the area cautiously, wandered about, examined outstanding features, sniffed at various features of the box, clawed at the base of the door or at visible

[11] E. R. Guthrie and G. P. Horton, *Cats in the puzzle box*, New York: Rinehart, 1940.

cracks about the exit door or the entrance. Usually the cat avoided the pole in wandering about the box. The average cat spent about fifteen minutes in the box, actively exploring before it touched the post. When it did touch the post the manner of this differed with each cat. One clawed at the door and in backing away bumped the post. One stepped on the base of the post with its right rear foot in passing. One struck the post with its tail in turning before the door. One struck the post with its flank in walking by. One lay down and eventually, rolling slightly, struck the post. One jumped and clung to the top of the cage and then dropped, hitting the post. One bit the post. One stood beside the post and nudged it.

When the post was struck, the door opened, and the cat looked up and then walked out the open door.

When the cat was a second time caught, put in the starting box, and again admitted to the puzzle box, there was a remarkable tendency to duplicate its behavior of the first occasion. This extended to long series of movements performed in the same order as the first time. The cat would pause at the entrance, turn in the same direction, linger at the same points, and often (not always) repeat its past performances.

As trial succeeded trial there was a noticeable tendency for much of the movement in the box to be eliminated. But this was not true of the last movements which had resulted in opening the door. This last movement tended to be repeated in great detail.

Since the same touch of the pole that opened the door of the box actuated a camera, we had a picture record of the cat's position at the moment of success. A number of these pictures are shown on pages 82–83. The pictures are tracings made by projecting the original 35 mm. negative on a ground glass and tracing paper.

What the pictures show is that the cat in numerous escapes has reproduced its movements of previous escapes in remarkable detail so that the photographic cross section of its movements catches it in almost the identical posture.

Why do many of the cat's movements in the box disappear but the final movement that operates the release tends to remain? One explana-

tion is to be found in the view that when the cat enters the box and wanders about, each movement tends to become conditioned on the stimuli furnished by the last movement and so to form a serial response. What the cat does the first time in the box depends on many accidents. But on the second occasion it tends to repeat the whole series because even if the stimuli that guided the first entrance are now gone, the cat's own movements have come to be the signals for its next movements.

But how do movements get eliminated? This happens, we believe, when, being still in the box, the cat is made to change its behavior in the box. This can happen in many ways. When the cat claws at a door, eventually fatigue or pain may inhibit clawing. The cat is now confronting the door but backing away. Backing away may be a response that replaces clawing at the sight of the door.

Useless movements made in the puzzle box tend to be preserved merely because they were made and are conditioned on the stimuli from the preceding movement. But these same useless movements are also open to unlearning. If fatigue or accident inhibits them, the stimuli of the box no longer evoke them. They are eliminated. And in this way the cat's stay in the box tends to be shortened. Cats that average fifteen minutes the first time through reduce the average to as many seconds.

With the final movement or series of movements that ends in escape it is a different story. This series *takes the cat out of the box*. This has an important consequence. Being now out of the box the cat cannot unlearn any behavior that was conditioned on the box itself. To unlearn a response to a stimulus, the stimulus must be present and some other response compelled. The stimulus then becomes the signal for the new response. But when the cat is not in the box, no new responses can be attached to the stimuli of the box.

What is being said here is that we learn anything we do; but when an act or a series of acts leaves us in trouble, or exposed to the same annoying environment, new behavior is likely to supplant what we previously did. Behavior that gets us out of trouble, or takes us away

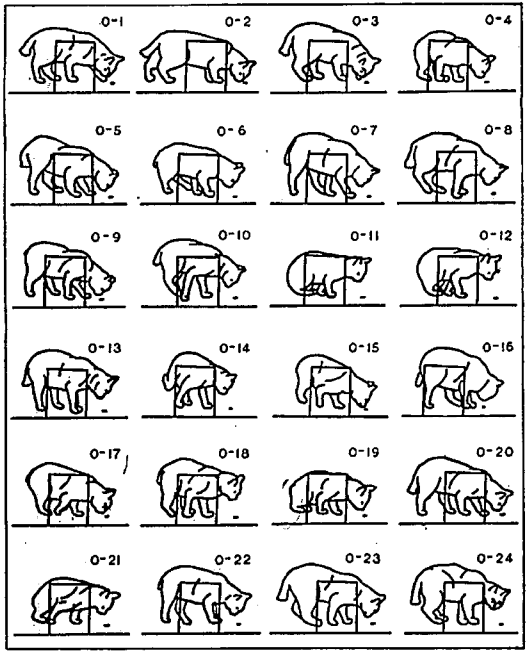
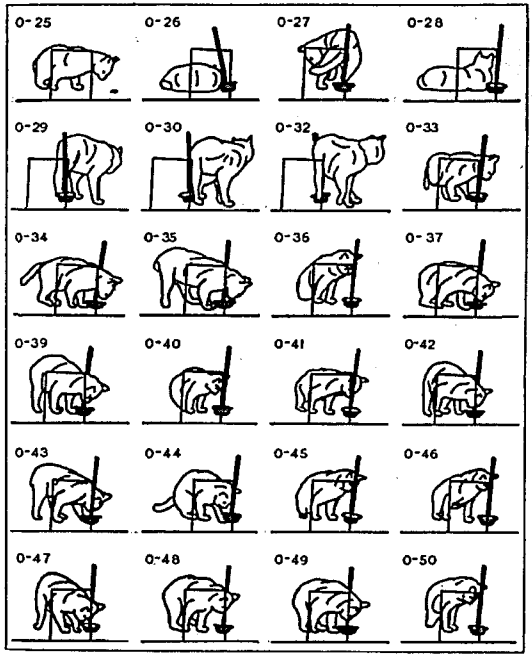


FIG. 3. Cats in the Puzzle Box. The pictures are tracings from the projection of the negatives of photographs. When a beam of light, which passed through the hole in the floor, was interrupted by a movement of the cat, this actuated a mechanism which opened the door of the box. The cat thus took its own picture when it made the successful movement which opened the door and allowed it to escape.

It will be noticed that the cat has, in the first 25 trials, approached the hole in the floor from the same direction and has very much the same



posture. On the 26th trial a post was substituted as the escape mechanism and the cat had to learn all over again a method of getting out of the box. On trial 27 the escape is somewhat different, but on trial 28 it again resembles trial 26. Trials 29 through 32 show much the same sequence of movements. Trial 33 shows the beginning of a different series of movements which again become more or less stereotyped for the succeeding trials. (From E. R. Guthrie and G. P. Horton, *Cats in the Puzzle Box*, New York: Rinehart, 1946, pp. 58–59.)

from the annoying situation remains our response to trouble or annoyance. It remains our response to trouble or annoyance because there is no chance to condition new behavior on the troubling situation when that has disappeared. Associative learning requires the presence of stimuli in order that they become signals for a response.

Consider some human illustrations of this same general principle that the behavior that gets us out of trouble tends to remain our response to trouble. A child placed in a frustrating situation, refused something that it wants, may have an access of exciting emotion that amounts to a temper tantrum. It lies on the floor and screams and kicks, or holds its breath. If this behavior solves the situation, frightens the mother into yielding what had been forbidden, gives the child his way, a temper tantrum is very likely to become a routine solution for similar situations in the future.

In the schoolroom, children are often annoyed and upset because their actions do not receive the attention to which they are accustomed. This annoyance frequently produces some entirely new behavior that solves the trouble by ensuring attention. A profane word, naughtiness in one form or another, is usually to be explained in terms of its effectiveness in getting attention for a child habituated to more attention than is being given him.

SUMMARY OF THE ARGUMENT

The description of the cat's behavior applies to human behavior as well. Placed in a situation that is painful, distressing, agitating, a person is made active. The occasion for such activity is sometimes a simple stimulus like an ache or a pain; or like cold, excessive warmth, hunger spasms of the stomach, prolonged loud noise. Babies win their livelihood by making such noises on practically any disturbing stimulus.

The disturbing forces are sometimes very complex. After a man has become an addict to cigarettes or an infant to thumb-sucking, interfering with the exercise of the habit is in itself upsetting. Both cigarettes and thumb-sucking are "escapes" which have been hit upon

by previous learning, but once established as habits, interference with them is as effective a disturber as a pain.

Driven by a goad (which is the English word for the Latin *stimulus*), a man or an animal becomes active. Excitement is produced, and excitement or *exciting emotion* may be described as a state of the organism that favors activity. *Depressing emotion* may be defined as a state of the organism depressing activity.

Excitement is self-sustaining. When muscles contract sharply, their own contraction stimulates receptor cells in muscles and tendons, and this stimulation adds to the contraction or results in other muscles being contracted. In excitement we are tense. This means literally that many muscles are actually under stress of contraction.

A maintained disturbing stimulus therefore tends to produce activity in the stimulated man or animal. This activity establishes many associations and movement sequences. These are learned with one pairing and tend to appear when their stimuli are repeated. But one association may replace another. Learning one thing always involves unlearning something else. A new *R* to an *S* always displaces the old *R* to that *S*. Hence, behavior is varied.

But there is one response series that does not get unlearned because it got the person out of trouble and can't be unlearned as a response to that trouble because the trouble is gone. All this is sometimes called learning by *trial and error*. That name is not particularly appropriate. It is much better called learning by *activity and success*.

In the chapters to come we shall see that personality traits are often the outcome of certain family or social conditions in which the person is reared. We can think of a family as being a complex set of puzzle boxes from which, or from many features of which, a person must learn escapes. And the type of escape learned will be determined by the nature of the family puzzle box.

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VII

Emotion

PSYCHOLOGICAL studies of emotion have had very different purposes. Some of them have attacked directly the problem of the nature and development of emotion. Just what goes on in a frightened person, or in an angry person, or in a person in love? Other studies have set out to find how accurate are our judgments of emotion in others. Can we tell fear from rage, or love from homesickness? Other studies have attempted to select the basic scientific facts involved in emotion. Blood pressure, heartbeat, the distension of surface blood vessels in blushing, muscle tremors, visceral activity, muscular tension are some of the suggested facts open to the public agreement that is necessary for scientific interpretation.

Still other studies have asked what conditions produce emotion. What produces fear, rage, shame, humiliation, love, elation? Finally, there have been studies that investigated the effects of emotion on problem solving, on learning, on reasoning, on memory. It is obvious that these effects exist and are important in understanding behavior.

CLASSIFYING EMOTIONS

Common speech has found use for a long list of terms to name emotions. To the ones named above—fear, rage, shame, and the rest—could be added dozens of other terms that name seemingly very dif-

ferent emotional states. People are said at times to be irritated, querulous, defiant, silly, or, to get down to a very basic description of emotional states, excited or depressed. The problem of classifying emotions and of agreeing on the basic meaning of emotion has long plagued the psychologist.

In 1650, René Descartes, in his *Treatise on the Passions of the Soul*, named six primary emotions. He believed all other emotions to be combinations of, or variants of, these. The six he suggested were wonder, love, hate, joy, desire, sadness.

In our own times John B. Watson led many psychologists to agree that there were three fairly distinct patterns of emotion recognizable in infants.[1] These were, he suggested, fear evoked by sudden intense noise or loss of support, love evoked by stroking, and rage evoked by the restraint of movement.

With the behavior of a frightened child nearly everyone believes himself familiar. He has seen and heard the effects of the ferry whistle on naïve children on the upper deck; he has seen children thrown into sudden loud weeping by an inexpert approach of an adult. He has seen the sudden rages of children from whose grasp a forbidden object has been wrenched by an adult, or from whom another child has seized a toy. But, actually, the identification of these emotions in children is very uncertain; and it includes interpretations of the situation and guesses about future conduct, as well as observed facts.

Sherman let observers see infants who had been exposed to stimuli which, according to Watson, would cause pain, fear, and rage.[2] The observers could not agree on the name for the emotion, nor could they tell which infant had been dropped a short distance to a soft mattress, and which had had its head held motionless for a short time, or which had suffered slight pain.

Emotional behavior was, according to Sherman, much the same in these three situations; and it consisted in very diffuse and undif-

[1] J. B. Watson, *Psychology from the standpoint of a behaviorist*, Philadelphia: Lippincott, 1919.

[2] M. Sherman, The differentiation of emotional responses in infants, *J. Comp. Psychol.*, 1927, 7, 265–284; 335–351.

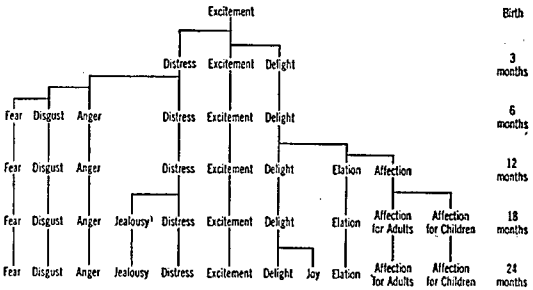

FIG. 4. The Approximate Ages of Differentiation of the Various Emotions During the First Two Years of Life. The age arrangements are tentative. They are based upon recordings of observations of the emotional behavior of 62 infants in the Montreal Foundling and Baby Hospital. The infants were isolated in separate wards according to age. (From K. M. B. Bridges, Emotional development in early infancy, *Child Develpm.*, 1932, 3, 324–341.)

ferentiated activity. Stratton expressed the same views in 1928.[3] According to him, the common feature of emotions like the pain, fear, and rage mentioned above lies in the excitement present. Bridges has some confirming observations on this point.[4] In very young infants there is only a condition of general excitement present, much the same response to pin pricks, restraint, or loud noises. At about the age of three months it becomes occasionally possible to distinguish between distressed excitement and delighted excitement. At about six months, Bridges believes it becomes occasionally possible to distinguish between angry excitement, disgust, and fear. At twelve months, delight can be further distinguished as elation or affection.

[3] G. M. Stratton, The function of emotion as shown particularly in excitement, *Psychol. Rev.*, 1928, 35, 351–366.

[4] K. M. B. Bridges, Emotional development in early infancy, *Child Develpm.*, 1932, 3, 324–341.

PHYSIOLOGICAL CHANGES IN EMOTION

The attempts to find internal physiological changes that are different for different emotions and that would serve as reliable signs of emotions have had results very like what Bridges found in attempting to distinguish one emotion from another by just observing general behavior.

In 1913, Cannon observed the presence of sugar in the urine of football players during a game.[5] The sugar was not occasioned by the activity alone, because it was present in some players not taking part in the game. Students were tested before and after a difficult examination, and a marked increase of sugar was confirmed in many instances.

Glycosuria, or marked increase in blood sugar, can result from activity of the adrenal glands. When a cat is stimulated by a barking dog, adrenin is released by the glands into the blood stream and there circulated. On reaching the liver, adrenin stimulates the liver to release glycogen (stored sugar) into the blood which carries it to the muscles.

Adrenin has other results. It reduces or inhibits the digestive secretions, including saliva. Most persons have experienced the dryness of the mouth that follows embarrassment or panic and accounts for the presence of a glass of water on the speaker's stand. Adrenin in the blood stream contracts visceral blood vessels and thereby drives blood to the skeletal muscles. The readiness of blood to coagulate is increased. An excited person is prepared for bloodshed.

These internal changes are much the same to frightening stimuli, painful stimuli, and to stimuli designed to produce rage. Internal physiological changes, therefore, do not give any basis for differentiating what we call emotions, rage, fear, pain, grief, and the like.

It is much more practical to follow the usage of the mental hospital, where descriptions of emotional states have prime importance. In such

[5] W. B. Cannon, *Bodily changes in pain, hunger, fear and rage*, New York: Appleton-Century, 1929, pp. 75–76.

hospitals, patients are described as excited or depressed. The important internal component of emotional states is the presence of the conditions favoring and intensifying action (excitement). The physiological causes for the depression of action are less well known, though states of depression are as familiar as states of excitement.

We are perfectly familiar with the behavior symptoms of tension and the absence of tension. We know that an angry man tends to slam doors, speak loudly, walk quickly, do whatever he does vigorously. In the relaxed states caused by fatigue or illness or mere lack of stimulation, our behavior does not show this vigor. Our voices are less loud, our step is slower, our efforts to push open the door or lift the heavy suitcase are not at once effective. They lack "punch." Relaxed eye muscles follow imperfectly the lines of the dull textbook, and turning its pages is an effort. Substitute a mystery and, if we are susceptible to mysteries, reading becomes effortless and page turning prompt and vigorous.

One characteristic of these physiological components of emotion is of great importance in understanding behavior. This is the fact that they are not readily dissipated, but tend to persist until they have been worked off through muscular exertion. Whether adrenin turns out to have the importance which Cannon attributed to it or not, the fact that the endocrine secretions in the blood stream are responsible for a number of the changes carries with it the consequence that these changes will persist so long as the hormone is in the blood stream, and its removal will require time.

The chief obstacle to the quick disappearance of rage or fright is possibly a very different one from the persistence of the hormone in the blood stream. The second obstacle is the tendency for muscular tensions to maintain themselves and to be responsible for the maintenance of other muscle groups. A contracting muscle is stimulating sense organs in the muscle itself, and the mass of nerve impulses entering the central nervous system when a muscle group is contracted tends to increase the tonus or tension of skeletal muscles over

the body. The effect can become circular because this increase in tonus is in its turn responsible for new sensory impulses into the central nervous system.

One of the components of the form of panic which most persons have experienced and called "stage fright" is probably a spread of tonus to visceral muscles. The sphincter muscles which close the entrance to the stomach from the esophagus and the exit to the duodenum may go into spasmodic contraction. There is a probable relation between this phenomenon and the gastric ulcers which tend to develop in overwrought or anxious persons.

It should be noted that the physiological changes that take place in excitement are changes that favor action. The changes in pulse and breathing rate serve to get oxygen to the muscles, to carry off muscular fatigue products like carbon dioxide and lactic acid, and to increase the rate at which this takes place.

The changes that take place in depression are less well catalogued and less well understood. Depression may include severe lowering of blood pressure, and the depressing effect of this on action can be well understood. The general decrease in the tonus of the muscles of the body in cases of depression has been little studied. The facial expressions that we associate with severe grief and severe depression are merely the result of the loss of tonus in facial muscles and are not usually distinguishable from the facial expression in extreme fatigue. Through the accumulation of fatigue products, fatigue depresses action in obvious ways by lessening the capacity of muscles for action.

INDICES OF INTERNAL CHANGE

Many techniques have been used for the factual observation of the internal components of excitement.[6] By means of the pneumograph, changes in breathing can be accurately followed. One *pneumograph* consists of a small metal drum with rubber ends. Each rubber diaphragm is connected with a tape which is passed about the chest under

[6] A description of the various techniques may be found in P. T. Young, *Emotion in man and animal*, New York: Wiley, 1943.

the arms. Inspiration expands the chest, pulls on the tape, reduces the air pressure in the drum; and this reduction is recorded by leading a tube from the drum to a recording instrument which translates change of air pressure into movement of a stylus on sensitized paper. It has been found that the relation of inspiration to expiration increases in excitement and decreases in depressed states.

By the use of a *sphygmomanometer*, which measures the pressure necessary to close an artery and make its pulse disappear, the blood pressure can be measured. Heightened blood pressure is a characteristic of all varieties of excitement, whether painful, frightening, enraging, or erotic stimuli are responsible.

Depression of action even to the point of fainting is signaled by a sudden fall in blood pressure.

In the *electrocardiograph*, which records the action currents of the heart muscle, the changes of the rhythm of the heartbeat can be recorded and these, as was remarked before, follow with extreme sensitivity the faintest stimuli for excitement. Many observations of blood pressure and heartbeat made for purposes of medical diagnosis are wrongly interpreted because exciting stimuli have affected them.

In some persons a conspicuous feature of excitement is sweating palms. In any person the sweat glands tend to be active in excitement, and this activity can be measured by a changed resistance in the skin to the passage of very small electric currents. Since changes in resistance can be measured with a very sensitive galvanometer, this has been one device used for recording excitement. The changed resistance has been called the *psychogalvanometric reflex*.

CONDITIONING OF EMOTION

The components of exciting emotion are subject to direct conditioning. Heartbeat is astonishingly responsive even to minor changes in our environment. The pulse of a man lying quietly in a room will show changes responding to passing footsteps, slight changes of position, to exciting components in a train of thought. One of the components

in excitement is a state of high tonus in skeletal muscle. When muscles are already tense, any action elicited from them is exaggerated. In a state of general relaxation in which the body muscles have very little tonus, stimuli have little effect. Reflexes like the knee jerk may almost cease to appear.

It is in terms of associative learning that we can understand the arousal of erotic excitement by perfumes, the prompt appearance of anger in response to a newspaper editorial, the emotional stir that we sometimes experience on hearing the doorbell or the telephone when other reminders are present. The sudden panics to which some persons give way on approaching an elevator or the edge of a cliff become intelligible to a psychologist when he sees their resemblance to the familiar case of the dog salivating at the sound of a bell. This is also a "strange" reaction. There is no reason why a bell should cause saliva to flow. It is possible that this signal had never been effective with any ancestor of this particular experimental dog. His wolfish ancestors were not exposed to bells. Salivation at the sound of a bell takes place only because the bell has on some previous occasion just preceded the activation of the salivary glands by some other cause.

LIE DETECTION

Emotional reactions associated with words are the basis of the *lie detector*. This makes use of several of the devices just described, particularly the blood-pressure and sweat-gland phenomena, to explore the emotional associations of a subject. The lie detector can be used in conjunction with a word association test or with the asking of significant questions. The theory is that the telling of a lie usually involves conflict and excitement.

The reaction time of the subject to various words is also used as an indicator of their emotional associations. It is assumed that the inhibition of a guilty response will account for a longer reaction time of the second and third association.

The Russian physiologist Luria used ingenious new methods for discovering emotional associations in human subjects.[7] He sat the

person to be examined in a chair and had him grasp a rubber bulb in each hand. Tambours or drum recorders registered changes in the subject's grip on the bulbs and a voice key registered the first vibrations from the subject's verbal response to the stimulus words of a word association test.

Luria, for a period, had the police bring in directly to the laboratory any persons arrested in Moscow for murder. Such an arrangement is possible in a dictatorship. Luria's subjects were instructed to respond to each stimulus word as quickly as possible with the first word that occurred and at the same time to squeeze the right-hand bulb.

Luria found that even when a man, who had a few hours before used a knife in a murder, was able to control himself to the extent of repressing revealing answers to the stimulus word "knife," there was a strong tendency for a "spill-over" of response in other channels. The subject would inhibit speech but squeeze the right-hand bulb vigorously or, when this also could be controlled, press the left-hand bulb.

CONDITIONED INHIBITION OF EMOTION

There is another far-reaching consequence of this knowledge that emotional reactions are conditionable. If they are subject to conditioning they are also subject to unconditioning. If they are learned they can be unlearned. If emotional reactions can be attached to new stimuli, they can be detached from these stimuli by the simple process of associating the stimuli with some other response.[8]

The person in whom acute excitement and distress have been attached to the near presence of a cat is sometimes said to have a phobia of cats. By a *phobia* is meant an acute emotional distress attached to some situation (being on a ladder, near a high window, near a snake, on a train, in a small, closed room, in the open) by association. The reason most phobias last for years is that they have

[7] A. R. Luria, *The nature of human conflicts* (Trans. by W. H. Gantt), New York: Liveright, 1932.

[8] M. C. Jones, The elimination of children's fears, *J. Exp. Psychol.*, 1924, 7, 382–390.

motivated behavior that avoids the disturbing stimulus, and so reconditioning could not take place. The woman with a "mouse fear" or a "cat fear" has been motivated to avoid mice or cats, and these cannot become signals for any new response without being present. New behavior toward mice requires the presence of (1) new behavior and (2) mice. If the fearful woman has learned to avoid mice, the fear can remain indefinitely.

The conditioned inhibition of emotion follows the rule of all conditioned inhibition. Present the stimulus and arrange (1) that the response be inhibited by some other response, (2) that the response be exhausted or fatigued, or (3) that the stimulus is at first so slight that it does not call out its response and is then gradually increased.

In the University of Washington laboratory some observations of learning in cats were being made one winter. In the large animal room were fourteen cats in two large cages.

The clinical psychologist entered the room with an attractive little girl of eight. They stood in the doorway and talked about the cats and then entered the room. The girl was asked if she would like to open the cages and let the cats out, which she did. When it was then suggested that she pick up a cat, she promptly did so and carried it downstairs to show her mother.

The girl had been brought to the psychological clinic because she had a paroxysm of terror and screaming when she encountered a cat. How may we explain her changed behavior?

The answer is that the clinical psychologist had tried a combination of the methods for inhibitory conditioning mentioned above. In his office he had insisted that the girl show him how she screamed when she saw a cat. He had insisted on repetition of this to a point where the girl flatly refused to scream. Fatigue was obviously present, though not the only cause for refusal. When he then suggested that they go to see the laboratory cats, screaming was distinctly in a state of high threshold and the sight of the cats failed to evoke it. The sight of cats becomes the signal for whatever behavior takes the place of screaming. In this case the new behavior is pleasant conversation about cats, unlocking the door, picking up a cat, fondling it.

STEREOTYPING OF EMOTIONAL EXPRESSION

Earlier in this chapter it was said that observers cannot recognize differentiated patterns of emotional response in infants from seeing the response alone. Sherman's observers could not tell pain, rage, and fear apart just by looking at the excited infant.

There is better agreement when we have knowledge of the exciting stimulus as well as of the response. We are then assisted in recognition by our own response to the exciting stimulus or its associations. We then perceive how we feel and read this into the other person's observed behavior. He looks as if he felt as we feel. This is, of course, an interpretation, not an observation.

At first, a child may respond to a gift, a toy, a trip, a game with much the same marks of delight. Or he may respond to a minor cut, a bump, a prohibition with much the same pattern of distress. In an adult the patterns of response to these situations have become highly differentiated. They include the adjustive habits that have been developed in each situation. The adult has learned in some situations to modify or control his expression of delight or of irritation, or to express it in some conventional manner.

The expression of an emotion in a conventional manner puts our behavior in a form which others have learned to accept and to react to. When others perceive our emotion correctly they adapt themselves to it, learn to take account of it, allow for it. We learn conventional ways of expressing surprise, sadness, joy. We also learn to conceal certain of these expressions. We express joy at another's good fortune, or at least conceal our own disappointment. We learn to express surprise when friends give us a surprise birthday dinner. If we are not obviously surprised, our friends are distressed and upset. When we are bearers of exciting news we are upset and uneasy if it is received calmly. We say people who lack proper conventional modes of expression are "cold," "unsympathetic," "without feeling," "hard as nails," "have no sense of humor."

Actors on stage and screen use these stereotyped forms of expression, and audiences learn to recognize them. On the stage can be shown the

stimulus situation as well as the conventional response, and our recognition is doubly guaranteed. The mother holds in her hand the dead child's possession. The lover gazes at his sweetheart's picture. The child's possession should be a doll or a child's shoe, rather than a streamlined toy auto or a Buck Rogers space gun. Convention lags behind cultural change. The lover should not convey his mood by fondling his sweetheart's portable radio, but her picture, her glove, her handkerchief.

The writer uses stereotyped forms of expression to portray his characters. By showing an individual weeping at slight occasions he paints a picture of an emotionally immature and childish individual. Heroes and villains are moved, heroes at the proper and villains at improper cues. Villains gloat at the heroine's misfortune; the hero moves energetically to her rescue. By showing calm but resolute behavior in situations that normally confuse, the author gives us an impression of maturity or of discipline.

AROUSAL OF EXCITEMENT

Excitement is produced in at least three different ways. Intense stimuli of almost any class will cause it. A sudden shrill of a police whistle would stir the pulses of the most bored and relaxed lecture audience. Screams, crying, shouts, all depend on their intensity for their activating effects. The brass of the symphony orchestra in loud passages rouses dozing husbands.

Less intense stimuli may still produce excitement. When a series of stimuli each adds its effect, an accumulation of exciting effects may occur. We can by a series of small annoyances be roused to a frenzy of rage, or a series of minor frights may add up to panic. Lovers' quarrels may serve to intensify the emotion of a reconciliation, or erotic excitement add to the intensity of cruel and hostile behavior.

But probably the commonest sources of excitement, and certainly the sources that the clinical psychologist most often encounters, are the interferences and conflicts set up by the presence of opposing or incompatible action systems. When we are stimulated to two different lines

of action which are mutually exclusive, excitement is the normal result. It is excitement that helps resolve the conflict by putting us into a condition of unstable equilibrium.[9] The addition of excitement when we are hung up between two courses of action so energizes all action that one course or the other wins out. When fatigue or exhaustion depress action, we may remain for long periods undecided. The tired man can't "make up his mind." This is an odd and very inaccurate phrase. What gets "made up" is a line of action.

The conflicts that cause excitement may be in the realm of words and word-attitudes. Indecision between two different names may profoundly motivate a botanist or a zoologist whose ruling interest is the classification of living forms. Indecision between two rival theories may prompt long investigations.

But most of the indecisions that move men to excitement have to do with attitudes or with emotional action. The frustration of a habit interest may account for a sudden flare-up of emotion. We find that Mr. X's sudden ill temper is based on an overheard remark that he cannot accept without a thorough revision of his role. Stage fright derives from the conflict of strong tendencies to walk on and play the part for which we have rehearsed and almost equally strong tendencies to avoid criticism and ridicule by keeping out of the limelight. The conflict of these two lines of action may reverberate in visceral muscles, as well as make itself evident in tremors of skeletal muscles.

Anxieties and worries may produce excitement that activates the pyloric sphincter of the stomach to a spasm which we refer to as "nervous indigestion."

EXCITEMENT AND BEHAVIOR

The presence of excitement has marked effects on behavior. The intensification of action causes new stimulation and therefore may explain new responses or changed response. Many new habits date from a period of excitement. The experienced public speaker sometimes exhibits a mannerism that was established on the occasion of his first

[9] E. R. Guthrie, *The psychology of human conflict*, New York: Harper, 1938.

embarrassed appearance in public. Initial experiences in erotic excitement set patterns of habit that are persistent in later life. The establishment of sex perversions often can be attributed to single critical events which left habit patterns very difficult to change.

Behavior in panic or extreme emotion may revert to older habits believed to be long ago lost. On the break up of recent habits, old associations have their chance. In extreme excitement, for example, soldiers may suddenly give way to behavior that seems to be completely irrational, nonadjustive, and at the same time new. The conditions under which this can happen deserve examination. Military panics take place usually in new troops, not among veterans. They occur when troops confront situations for which training has not prepared them. Men can be depended on to an astonishing extent to behave as they have behaved before in a situation. This is the whole reason for training. But when the situation is one for which there has been no training, men are subject to older and nonmilitary habits of response. When training has prepared men for fighting an enemy in only one direction, the appearance of paratroopers in their rear has been effective in introducing confusion and panic; and once these are present, old stray habits like the tendency to run when others run may seize a whole regiment. We tend to run when we see others running because we have in the past run with the others.

The part played by emotional responses in social behavior is infinitely varied. The propagandist studies the emotional habits of his audience and uses their angers and their fears to dictate their behavior. Hitler and Goebbels used old folk tales and folk hatreds together with new angers and frustrations to turn anger against the Jews, fear against the French, and scorn against the rest of Europe. We addressed propaganda to the Nazi soldier trying to rouse his anxiety about his family, jealousy of his wife, his hopelessness of victory, his suspicion of his officers.

Political campaigns in all countries depend far more on emotional appeals than on reason and inference. Ridicule, fear, hate, and suspicion are the tools of the politician. Florists reach our pocketbooks through

propaganda about Mother's Day. Insurance men make capital of our fears of death and poverty. The mortician takes advantage of our bewildered depression to "sell" us an expensive funeral.

It is also true that people may learn to use their own emotional responses as a means of controlling the behavior of others. When a child's temper tantrum has gotten him out of trouble, or given him what he wanted, it may become his fixed solution for many of his difficulties. Many wives have learned that tears will lessen their husbands' occasional outbursts of anger.

The general physiological states that move men to energetic action or depress the capacity for action—in short, men's emotions—have profound effects in determining what men learn to seek and to avoid. It is emotion that determines what will be to us important and what will be trivial. And the fact that emotions themselves are subject to change through associative learning is what offers the clinical psychologist his opportunity to interfere successfully with distressing behavior.

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VIII

Drives

CARL and John are both college sophomores of about the same age and, so far as one can judge from their college aptitude scores, the same capacity for college work. But Carl puts in long hours at study and comes through with a knowledge of what his course is about and an interest in the subject that remains throughout the rest of his life. John, by way of contrast, puts in little work and his time is obviously wasted. How shall we account for the differences in their behavior?

One man falls in love and marries and remains faithful to his wife for the rest of a long life. Another is a Don Juan who spends his middle age in a constant desperate pursuit of new loves. What accounts for the difference?

This chapter takes up the problem of motivation. It will be concerned with what many psychologists call the dynamics of behavior, how men behave in the circumstances in which they are placed, how men respond to the "forces" that move them.

NATURE OF PSYCHOLOGICAL EXPLANATIONS

In explaining men's behavior we shall use a new type of explanation, one that has for very good reasons no standing at all in the physical sciences. We shall ask the question why men behave as they do. In physics the question why objects behave as they do is never asked. The physicist tries only to understand *how* objects behave. The word

"why" is equivalent to the phrase "to what purpose" or the phrase "to what end." The answer to "why" usually names a condition still to come, something that does not yet exist. If you are asked, "Why did you come down town?" you might answer, "To buy a hat." This is very different from the question, "How did you come to go down town?" To answer this would require more insight than most people have.

The question "why?" calls for a *purposive explanation*. Purposive explanations are in general not scientific. They refer to events that have not yet happened and so are not factual in the sense that science must be factual. The reader will remember that a fact was defined as *an event so described that any observer must accept the description*. Future events are not facts. They cannot yet be observed. But similar events can be observed. And we can, on the basis of past experience, judge that a particular event will come out to a particular result. We are not talking facts, but we are talking about something that can be based on facts.

When we say that Carl works hard at his college courses *in order to* qualify as a graduate chemist *or in order to* gratify his restless curiosity about men's behavior we are using purposive explanations. We are explaining something here and now by appealing to an event that has not yet happened and could not possibly cause anything because it has not yet happened. But Carl's purpose corresponds to a present reality. In one sense it is something here and now. We mean by that phrase, "in order to," to imply that Carl has some present "idea," "wish," "intention," that operates to direct his conduct.

Some psychologists (behaviorists) assume that ideas, wishes, intentions are at bottom physical events. Saint Augustine believed that we betray our wishes and intentions to the devil by their physical expression. We all know that we have difficulty in hiding from others our impatience at the delay of our host's dinner, our annoyance at an attack on our political favorite, our boredom with the speaker, our profound lack of interest in an acquaintance's bright child. Other psychologists (nonbehaviorists) are willing to accept ideas and inten-

tions without any effort to relate them to the physical world or describe them as physical events. We all do this most of the time.

When we raise the question why people behave as they do we must recognize a certain danger and a certain incompleteness in the answer. Carl works hard to get "A" grades. He wants "A" grades in order to know he has mastered the subject and in order to make others know this too. He wants others to know it in order to be recognized as a competent chemist or as a qualified psychologist. He wants to be recognized as a competent specialist in order to be able to command a job or adequate fees. He wants fees for, well, for some of the myriads of purposes to which we apply money when we get it. When do we get to the end of this indefinite series of whys?

The answer is that we get to the end when the asker of the question and the answerer are both satisfied. Explanations are but word descriptions that *satisfy* a questioner. An explanation must do this for the questioner or it is no explanation. The explanations given by psychologists are answers to psychological questions and, the questions having been asked by psychologists, it is psychologists that have to be satisfied. It is not physiologists, physicists, anatomists, or engineers. We do not have to explain in terms of physiology or physics. We can use psychological terms. It is very true, however, that our psychological explanations must not be inconsistent with physiology or the other sciences.

There is no ultimate and final explanation in science. There are only psychological explanations, or physiological explanations which go beyond the psychological, or the physicist's explanations which in a sense go beyond or go deeper than the physiologist's.

We assume that all behavior is brought about through neural activity. But neurological explanations are of very little use in explaining most behavior. So far as we can observe, we do not as yet know just what neural events are concerned in learning to type, voting, being quarrelsome. In the simple reflex like the knee jerk, or like blinking in response to a blast of air on the cornea of the eye, or in the sudden contracting of the pupil of the eye to light, we can know something

of the neural reflex arc involved. But these are very elementary behaviors. So complicated an act as eating a steak goes far beyond our knowledge of the correlation of events in the nervous system with behavior.

So we do not speak in terms of the nervous system when we are explaining the actions of man. For similar reasons explanations in terms of heredity of genetics have been given up. These were once very popular indeed, and it will probably always be true that fathers account for the good traits of their offspring by paternal family traits, and for the faults, by the maternal. When men carried scientific method into this field of heredity and tried to state the rules and then verify them, most of the rules had to be given up. The actual prediction of horse thievery or of mathematical genius turned out to depend on certain other factors such as environmental facts.

We are, however, interested in certain physiological conditions of the organism because we can connect certain physiological states with the persistence or absence of behavior aimed at or directed toward certain ends. The state of hunger, for instance, alters our whole line of thought and action.

VARIETIES OF EXPLANATION

Young has described three varieties of explanation used by psychologists. He distinguishes developmental explanations, conditional explanations, and hypothetical explanations.[1] *Developmental explanations* explain behavior in terms of the past history of the individual or in terms of learning. One boy says "four" when he sees 2×2 written on the blackboard, while another just scratches his head. One has been in the past induced to say "four" in this situation and the other has not.

Conditional explanations are explanations in terms of internal or external conditions under which certain behavior patterns appear. We say that men will work harder when they know and approve the object of the work, or when their leaders exhibit an appreciation of what they are doing. A recent publication of a number of Yale psy-

[1] P. T. Young, *Motivation of behavior*, New York: Wiley, 1936, pp. 41–42.

chologists explains aggressive behavior as the normal result of frustration. The small boy slaps his baby sister because he has been deprived of the usual amount of attention given him before the baby appeared. Thefts of school lunches are traced to a boy who has been left out of things by his playmates.

Hypothetical explanations are what Young calls those explanations that attribute behavior to certain forces or drives. In physical explanations of the world, gravity and electricity cannot be seen. They are actually just classes of events. But they are spoken of as if they "did" things. It is legitimate to do this if we realize that we are really classifying acts rather than giving causes. Hunger and thirst and sex may thus be spoken of as drives or as forces that move men to eat or drink or make love. When we say a particular action is explained by hunger, we are putting the action into a familiar class of actions. That is what all scientific explanations really do. When a physicist speaks of gravity as a force causing movement he does not mean that something called gravity comes out and gets the object. He means only that this movement of the object is a familiar kind of movement called gravitation.

LISTS OF INSTINCTS AND NEEDS

Some early psychologists like William McDougall relied heavily on hypothetical explanations. McDougall assumed that all human behavior is the product of some twelve or fifteen human instincts which were inborn tendencies or forces more or less common to all members of a species.[2] When a man fights, this is the *result* of a fighting instinct. When he makes love, this is *caused* by a sex instinct.

There has always been trouble with explanations like McDougall's, which seek to explain behavior in terms of a list of instincts such as eating, drinking, mating, constructiveness, imitativeness, and so on. When we try to explain the extraordinary tenacity to life shown by human beings by saying that there is an instinct of self-preservation, this says remarkably little. If I look out of the window and say,

[2] W. McDougall, *Outline of psychology*, New York: Scribner, 1923.

"There is a man in the act of preserving himself," that leaves you rather ignorant of his conduct, and certainly tells you nothing profitable.

But the obvious inadequacies of such lists have not prevented theorists from making them. The sociologist W. I. Thomas, for example, proposes to explain all behavior in terms of four wishes: (1) the wish for new experience, (2) the wish for security, (3) the wish for response, and (4) the wish for recognition.[3] All behavior is supposed to be classifiable into one or more of these four classes.

Sigmund Freud interpreted behavior as the result of the interplay of two instincts, the life instinct and the death instinct.[4] How much does this tell you of your own future? You find the terms can be used only after the event, not for prediction because they are not factual.

The most recent list has been suggested by Murray, who proposes some thirty odd "needs" as basic to human behavior.[5]

In this book we shall make use of some *hypothetical constructs* in explaining behavior but we shall not set up any lists of instincts and needs which are assumed to be universal. These constructs will be of two kinds, one of them physiological and based on certain conditions of the organism like food deprivation, and the other based on certain modifications of the organism which constitute learning. The term "motive," which means that which induces or incites to action, will be used to designate both the physiological conditions and the learned modifications.

These modifications cannot be seen directly either in a living man or (thus far) at an autopsy. There is not yet described any difference between the brain of a man who plays slot machines and the brain of a man who does not. We assume there is a difference and we are on factual ground in that we can observe the behavior when the habit is being formed.

[3] W. I. Thomas, *The unadjusted girl*, Boston: Little, Brown, 1922.
[4] S. Freud, *Beyond the pleasure principle*, New York: Boni & Liveright, 1922.
[5] H. A. Murray, *et al.*, *Explorations in personality*, New York: Oxford University Press, 1938.

CONSTANT STATES

We shall consider first the physiological conditions which have been fairly well established as determiners of behavior. The most important of these physiological determiners are the constant states whose maintenance is provided for by inherited structures. By a *constant state* is meant a condition whose alteration results in a restoration of the original state. For example, when the room grows chilly, the temperature of the body is lowered, and this starts a number of processes like the reduction of sweat secretion, shivering, and the like, which tend to restore the disturbed state. This process of restoration is called *homeostasis*.[6]

Although Cannon coined the expression, the notion of such regulatory mechanisms was quite familiar in physiology. Haldane had described the maintenance of oxygen—carbon dioxide balance in the deep air of the lungs.[7] Stevenson Smith, in a paper in 1914, had pointed out the role of such mechanisms in sustaining life.[8] Raup offered a very similar doctrine in his theory that all action is the result of a disturbance and tends toward a restoration of a quiet state he calls *complacency*.[9]

HUNGER DRIVE

Let us examine the results of keeping man from food as our first illustration of homeostasis. The first effect of going for a time without food is certain changes in the blood which activate sense organs particularly in the stomach. As a result of this stimulation, the stomach muscles begin to contract and the general level of activity of the organism is increased. The major characteristic of this increased activity is that it is *directed* toward obtaining food; that is, the activity persists until food is eaten.

[6] W. B. Cannon, *The wisdom of the body*, New York: Norton, 1932, p. 24.
[7] J. S. Haldane, *Organism and environment as illustrated by the physiology of breathing*, New Haven: Yale University Press, 1917.
[8] S. Smith, Regulation in behavior, *J. Philos., Psychol., Sci. Meth.*, 1914, 11, 320–326.
[9] R. B. Raup, *Complacency*, New York: Macmillan, 1925.

An object (or situation) which reduces this activity we shall speak of as a *goal object* and the response which is made toward the goal object is called the *goal response*. Internal states which are primarily tissue conditions and which activate or energize the organism until they are removed are called *drives*. Hunger is thus a drive.

We may note here that the notion of hunger drive does not at all specify what kind of food shall be eaten or the method by which it will be obtained. Drive is, therefore, a purposive explanation in that it can be described as a tendency toward a certain outcome. The hunger drive predicts that some kind of food will be taken.

The manner of its taking and the kind of food differ from person to person and from culture to culture and are the result of learning which modifies the behavioral expression of the drive. Learning may even inhibit goal response. Men may starve to death rather than eat strange foods. In the Irish Famine, people starved in rooms adjoining the landlord's share of the potato crop because they had learned certain notions of property.

Not all eating is an expression of hunger drive. We may time our meals through routine habit so that we appear very hungry at twelve noon, but if kept busy until one we may "forget" our lunch and not notice we have not had it. There are also social signals for eating which may have little to do with real hunger. Desserts are usually made to appeal to habit after the hunger drive proper has been quieted.

The word "appetite" is often used to indicate strong food-directed activity not based on actual physiological hunger but on the presence of stimuli which have been in the past associated with eating. In that sense desserts may be said to appeal usually to appetite rather than to hunger. We may have been undisturbed by any hunger drive but be made distinctly restless and uncomfortable by the sight of another person eating. This is probably the reason for the development of conventions against eating in public except where others are also eating. At the mess table in a logging camp, hard physical labor has ensured strong hunger for most of the eaters, and a common game—the attempt to interfere with eating by mention of unappetizing things,

the attempted arousal of a sort of counterappetite in the form of disgust—is only very occasionally successful. The same stimuli at a table of polite and sedentary folk would often offend all present to the extent of driving them from their dinners.

THIRST DRIVE

Water loss results in chemical changes and activity which is directed toward restoration of water balance. This is the *thirst drive.* Drinking is the goal response and water the goal object. When wounds cause an extensive loss of blood, thirst becomes all-absorbing. But here again we notice that there are beer or coke drinkers who disdain water (at times) and also that drinking may occur without the presence of the thirst drive. Its occasion can be an invitation or the sight of the water fountain. Learning complicates the expression of the drive.

An interesting form of drive has been suggested in connection with the thumb-sucking of infants. It has been found that puppies nursing from bottles whose nipples had been pierced with a large hole allowing milk to flow freely were far more subject to continued sucking than puppies whose rubber nipples had small holes demanding hard and prolonged sucking to get a meal. Here we can assume that the sucking mechanism when not exercised has some tissue state favoring activity. This is relieved by exercise. Babies whose meals have been obtained too easily are perhaps also left with a certain dissatisfaction, a disturbing readiness for action, which finds its release in thumb-sucking.[10]

SEX DRIVE

The genitals in both sexes produce secretions that give rise to the *sex drive.* This drive, like hunger and thirst, is also not something directly observed but something inferred, and so it can be called a construct rather than a fact. We infer the drive from its symptoms. In a very strict sense there is no goal object nor goal response, but if

[10] D. M. Levy, Experiments on the sucking reflex and social behavior in dogs, *Amer. J. Orthopsychiat.*, 1934, 4, 203–224.

we do not speak strictly the goal object may be said to be an organism of the opposite sex and the goal response may be said to be copulation. But the nature of this goal object and goal response is modified by learning.

The particular type of beauty that appeals is a matter of experience that involves determination through both cultural environment and learning. The Hollywood starlet would not necessarily appeal to the African Bantu. The expression of the drive even within a given culture may have a wide range from the normal or usual outlets. When the sex drive has been aroused in connection with the inflicting of pain on another person, the infliction of pain may be an essential part of the goal response. Such a perversion of the sex drive is called *sadism.* When pain has been experienced along with the relief of sex drive, suffering may become an essential part of the goal response and this perversion is called *masochism.* When the goal response becomes directed toward a person of the same sex, which is often the case whenever men or women are long kept from the society of the opposite sex, this is called *homosexuality.*

Such cases are exactly analogous to the learning of a cat in the puzzle box. Whatever behavior has produced relief of the tension of the drive tends to remain associated with the drive because *no new associations can be established in the absence of the drive.* The drive stimulus remains faithful to the last associated response which is normally the response that brought relief.

This fact that the drive stimulus tends to remain faithful to the last associated response, which is normally the response that brought relief, has been made the occasion for a modified doctrine of learning by Gardner Murphy in his book on personality.[11] Murphy interprets the familiar fact that we modify the ways in which we seek goals more readily than we modify the nature of the goal objects themselves as an evidence that the precurrent behavior, the behavior leading up to the goal, is readily subject to new associations and change, while the

[11] G. Murphy, *Personality: A biosocial approach to origins and structure,* New York: Harper, 1947.

final behavior must be described as "channeled" and the channeling as relatively fixed.

There are many familiar illustrations of the facts. In the habit-forming use of drugs the addict readily learns new ways of getting the drug, but is so difficult to retrain so far as the eventual interest in the drug is concerned, that most of the farms or hospitals which attempt cures of drug addiction report that patients tend strongly to relapse after an interval. Alcohol addiction is equally difficult to cure. Cures have been attempted by a comparatively simple conditioned-response technique in which the habitual form of alcohol is administered to the patient under circumstances which ensure severe nausea as a prompt consequence. There appears evidence that these cures have some clear successes, but that the majority of cases, particularly of men below middle age, do not stay cured. Conditioned nausea may be so well established that a sudden encounter with a page of liquor advertising may cause vomiting. In spite of this, the addiction is rather easily reëstablished in younger men.

There is also evidence that when once homosexual practices have been overtly indulged in, there is extreme difficulty in retraining the perversion.

The theory being followed in this text differs from Murphy's. It holds that the strong tendency for goal behavior to be more fixed than preparatory or precurrent behavior leading up to the goal behavior is the fact that, just as in the case of the cat in the puzzle box, the final goal response *rids the organism of the drive stimulus.* With the drive stimulus gone, it is difficult or impossible to recondition the drive situation which has just disappeared. No new associations can be established when the signal is absent.

What appears to be a more effective approach to the cure of alcoholism than the straight conditioning technique is the work of an organization called "Alcoholics Anonymous." It may be suggested that the advantage of this organization lies in the fact that there is a strong social component in the cues which lead to drinking in most cases. Social pressure tends to goad the nondrinker until he conforms. Al-

coholics Anonymous succeeds in establishing an atmosphere in which the social pressure is in the opposite direction. Men learn to vie with each other in their record for abstaining. The so-called conditioned-response technique, which fails so often with younger men, has failed to utilize conditioning to its fullest. The patient has been reconditioned against the sight and smell of his favorite whisky, but not against the tense social situations which "drove him to drink." Drink has in one case brought effective relief from business worries or domestic difficulties, or from more deep-seated sources of conflict which involve sex perversions. Having brought relief by the simple effect of impairing conduction in the nervous system, "anesthetizing" the individual's pain, drinking remains effectively associated with the worries, the anxieties, the conflict state. In the so-called "conditioned-response" technique, only the superficial cues like the sight and smell of whisky are reconditioned, the superficial cues such as advertisers depend on for the effect of magazine advertising.

It should be noticed that the methods of Alcoholics Anonymous are fully as dependent on reconditioning procedures as are the other methods. But the inclusion of the reconditioning of social attitudes is an added weapon against the addiction.

PAIN AND SLEEP

Pain as a drive has certain attributes of its own. The drive strength of pain is, of course, useful in that it tends to keep us active until the painful states are relieved. Because such drugs as morphine relieve pain they readily become its goal object. In time after a number of doses of morphine, the absence of the drug itself constitutes a tissue state that activates the organism until the drug is taken and relieves the activity.

Sleep has all the earmarks of a drive, though we know little or nothing about the tissue conditions behind it. We do know that deprivation of sleep can lead to an overpowering tendency to sleep so that sleep can compete successfully with painful wounds or other drives. G. W. Crile describes visiting a first-aid station in World War I

during the British retreat from Mons where men had been unable to get continuous sleep for days.[12] As he approached the church in which the wounded lay he missed the groans and cries that usually characterized such places. There were only snores. Not until men had slept for hours did pain regain its preëminence as a drive and the sound of groaning fill the church-hospital.

GENERAL PRINCIPLES

It is evident that what appeared first to be rather simple physiological explanations of behavior turn out to be extremely complicated, and this is true of all drives. What general statements can be made about the tissue conditions that give rise to drives and represent the physical actuality behind these purposive concepts? All of these conditions represent a disturbed equilibrium in the organism and all follow the general principle of homeostasis. This principle may be stated as follows: In living organisms the maintenance of life is dependent on the maintenance of numerous constant states whose departure from the normal activates mechanisms that restore the norm.

Early activity is entirely determined by homeostasis, but there is a gradual supplementation of homeostasis by the effects of learning. Except for a few specific mechanisms like the increase in breathing rate with oxygen deficiency, homeostasis acts through the arousal of diffuse activity, and this activity becomes more and more specific as a result of learning. One illustration of this has been suggested by E. B. Holt.[13] When a hot object touches a baby's palm it stimulates grasping. Grasping is a reflex present even before birth. The heat does not cause immediate rejection of the grasped object. Probably the heat actually facilitates grasping, thus carrying a deeper burn. But the local disturbance of a temperature constant produces diffuse activity and excitement. The baby squirms and wriggles and cries. In the course of this activity new stimuli are encountered and new responses introduced. One of these is eventually (in a few seconds) letting go of

[12] G. W. Crile, *A mechanistic view of war and peace*, New York: Macmillan, 1916.
[13] E. B. Holt, *Animal drive and the learning process*, New York: Holt, 1931.

the hot object. This experience leaves the baby a changed person. Now its last association with hot-object-in-palm is letting go.

The first dependence of behavior on disturbances of constant states is gradually supplemented by dependence on symbols and other substitute stimuli. After experience the adjustive behavior is aroused by signs of the disturbed constant state. The sight of pain rather than its cold contact acts as a directing drive. The picture of a sandwich in the streetcar can disturb us in advance of actual hunger spasms of the stomach. Sex is no longer dependent on an inner state but can be aroused by overheard speech, the radio, the motion picture, the advertisement.

It is evident from the statement of these principles that the concept of drive is most important in describing the behavior of young babies, and that as age increases and the results of learning accumulate, drive becomes less and less important.

What is important for the understanding of the behavior of men is to know their interests rather than their drives. But a knowledge of interests requires that we have observed the individual we wish to understand. Interests may be defined as behavior patterns adjusted to particular goal objects through learning. To have developed an interest in playing bridge means that in one way or another we have been encouraged or pressed or enticed into that game until we have established habits that have power as motives, and we are, at the regular times at which we play, or on seeing some reminder of play, stirred to bridge behavior that interferes with other pursuits and makes us restless until we are sitting in a game. An interest in tobacco is established in much the same way. Our first indulgences may have been variously induced. National advertising campaigns have had more to do with our habit than most of us like to acknowledge. The pressure on men to smoke has many varied forms. Once the habit has been indulged in for a time it tends strongly to be initiated by a wide variety of reminders, the end of a meal, the offer of a cigarette, the sight of an ash tray, and many others that are obscure because they have no names and no description.

After the habit has prevailed for many years, it has become an integral part of the daily habit pattern of our life. It is part of the way in which we relax; it is an essential part of our conversational style; it is the regular accompaniment and so a necessary part of working habits; it is an essential in reading. If we suddenly give up tobacco we, in a sense, have to relearn all these activities. We have to learn to carry them on without tobacco. We find it difficult and disturbing.

A list of a man's interests comes near being a total description of the man himself. We know what to expect of him, how to appeal to him.

Obviously a psychology textbook cannot undertake to give this information about people. There are too many people. What the psychology textbook can do is to describe the ways in which interests are acquired through learning, the ways in which habits are established and the ways in which habits are altered.

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IX

Frustration and Conflict

IT has been mentioned that goals and goal objects are those situations or things toward which behavior becomes directed because they represent restorations of equilibrium and reduction of drive.

It has been also explained that the reason why situations associated with drive reduction tend to remain goal objects, and to remain the objects of goal activity, is that the act which reduced the drive or removed the drive stimuli must remain associated with the drive, because new associations can be established only in the presence of the stimulus. The drive or its signs thus remain a signal for the goal response by which the drive was removed.

The action patterns which result in the attainment of a goal object belong to the class of reactions we call habits. These particular habits are action patterns that originated as a goal activity by removing a drive and through conditioning as a serial response have become in part independent of the original circumstances which gave rise to them and in part resistant to external interference. This will take more explaining.

When any animal has gone through a series of movements, the principle of association states that each of those movements tends to become the signal for the next by virtue of the fact that it was followed by the next. The series when it first occurred was guided by many

chance stimuli. The cat's first experience in the puzzle box, a student's first day in a classroom depend on what is seen and heard. On the next occasion they depend to an astonishing extent *on what was done the first time.*

All series of movements therefore tend to be preserved as serial responses. But when movements fail to rid an animal of an annoyance, of a drive, the activity continues *in the presence of the annoyance or drive,* and so new behavior is associated with the drive situation and the unsuccessful behavior is unlearned. But the goal response is not unlearned. It cannot be unlearned because its stimulus is gone and unlearning requires the presence of the stimulus.

Habits may readily become independent of the original circumstances that gave rise to them. They may be started by signals that were chance accompaniments of the original drive. Once started, the habit may be self-maintaining. One movement leads to the next. Every person carries about with him hundreds of now meaningless habits that were once goal responses and thus meaningful. They are now a sort of mental debris of former activities and are often noticed only when they are embarrassing or lead to awkwardness. We notice in a college student a head toss that is a reminder of an earlier period of hair worn long. The head toss was the relieving response that took his hair out of his eyes. It is now signaled by some obscure feature of posture or action and takes place though it no longer is necessary for relief of the eyes. The immigrant who has lived in his new home for ten years still preserves certain food preferences and many ways that were established as habits in the old country and are useless in the new. But as habits they have a tenacity of their own.

Every person has many hundreds of such vestigial habits and in most cases would be at a loss to account for their first formation. We have tongue habits that were formed about a tooth cavity which has since been filled, hand habits which were formed in connection with clothing of design different from what we now wear. Our ways of following the melody and rhythm of the music to which we are listening are highly individualistic. As a result of a few lessons on

the violin as a boy, one person tends to follow melodies with movements of the fingers of the left hand appropriate to the fingering of the violinist. Another drums out tunes as one would on a piano. Another hums a tuneless accompaniment that follows the rhythm but reflects his failure to learn to sing in pitch.

There are more complex systems of habits harder to recognize. One person exhibits a strong tendency to oppose authority, which is in essence a set of habits formed in resistance to parental domination. Men who have had a year or more in a prison camp carry away habits of unreasoning and unreasonable deep opposition to authority which were originally formed in answer to the camp discipline and the behavior of camp guards and camp officials.

HABITS BECOME DRIVES

Woodworth was the first to lay great stress on this tendency of habits to become drives.[1] Interference with the execution of a habit is followed by the development of excitement. The interference with the habit may come either from obstacles to its execution (like a sticking door, a detour sign, a disapproving parent) or from the absence of something essential to the execution (like the lack of a cigarette, the absence of a fork, the absence of a mother on whose presence habits depend, the lack of praise when we are used to praise). Either positive obstacle or negative lack operates in the same fashion. It leaves us with a confusion in behavior, with conflicting impulses to continue or abstain. Conflict in the form of an excitation of action patterns that are incompatible or mutually exclusive is one of the primary causes of excitement.

Therefore, when something either blocks the carrying out of a habit or something is missing that would be necessary to its execution, *we are placed in the same condition as by a drive.* We are made restless and active. New behavior results. And we are likely to hit upon some modified action *that allows the habit to be resumed.* Once a habit is

[1] R. S. Woodworth, *Dynamic psychology,* New York: Columbia University Press, 1918.

established through learning, that habit becomes a dynamic guide to future conduct. Habits are self-conserving.

The term "homeostasis" should undoubtedly be reserved for the operation of biological mechanisms that restore "constant states." Allport has suggested a phrase for the tendency of established habit mechanisms to be resistant to change. He calls this *functional autonomy*.[2] This means that a habit can get along "on its own" once it is established.

We are all familiar with this conservative nature of habit. It is what makes an honest man remain honest in discouraging circumstances. It is what enables us to win bets with friends who believe they have quit smoking. It accounts for the astonishing versatility that is shown by the drug addict deprived of his drug or the alcoholic deprived of his alcohol. The deprivation acts like an original biological drive. It produces the acute restlessness, the new behavior, the eventual lucky hitting upon a way. We can bet on the drug addiction even when family, friends, neighbors, and police are unanimously and actively opposed.

Settled habit traits like dominance or dependence strongly influence behavior. They are self-preservative in that when having our own way or depending on a mother is interfered with there is aroused enough excitement and diffused activity to make probable the discovery of a way around the interference. The frustration of the habit leads to a slight modification of the habit that escapes the frustrating obstacle. The dominant person who moves to a new school may be upset by the failure of new companions to accept his leadership. But he is upset sufficiently to ensure that he will hit upon new ways of getting attention and respect.

ROLE AND EGO

We shall have occasion to refer frequently to one very important set of habits that is quite remote from biological drives. This is the role of an individual, what experience has led him to think of himself,

[2] G. W. Allport, *Personality*, New York: Holt, 1937.

the words and phrases he accepts as applying to himself. Roles are habit systems and in most cases very conservative, occasionally tragically so. The great actress, the great beauty, the man of wealth who becomes poor, the aging Don Juan all tend to exhibit strange devices for preserving their opinions of themselves against increasing evidence. We react to criticism first by distress and discursive response, but eventually we become skilled in discounting its value, in pointing out that the critic is stupid, ignorant, malevolent, mercenary, and the criticism therefore void.[3] Eventually we may learn not to associate with critics, not to hear or see criticism, not to expose ourselves to hostile judgments, to parade and emphasize our good points. We learn to do this because criticism is annoying and uncomfortable. That is how we learn to find food and warmth. That is how we learn everything.

The reader can roughly confirm this from his own experience with criticism. What is the usual reaction of himself and of his friends to adverse criticism? Obviously this depends on the point of attack of the criticism. If I do not at all fancy myself as a skier, I am not upset at hearing myself described as clumsy or awkward. If, however, I have formed habits of accepting such phrases as "graceful," "good skier," "fast man on skis" as applying to myself—in other words, if I have accepted the role of skier and think of myself as a good skier—criticism disturbs me.

At one state university, many members of the faculty take advantage of a service which will on request make a survey of student opinion of teaching. It is interesting to note that the teachers who request such a survey are in nearly all cases found to be in the upper half of the faculty in teaching effectiveness. In other words, college teachers in general know whether they are good teachers or not. For a certain very small group who have for years succeeded in avoiding thinking of themselves as bad teachers it is extremely frustrating to have the experience of a student survey and see the phrases describing faults and the rating at the bottom of the faculty scale.

[3] J. M. Fletcher, Homeostasis as an explanatory concept in psychology, *Psychol. Rev.*, 1942, 49, 80–87.

What do such persons do in response to this frustrating experience? Once in a very rare reaction a teacher has simply accepted the judgment and sought other employment. But this is extremely rare. The usual reaction is to take one of a number of now familiar lines of action. One of these is to explain that the quality of his students is so low that their judgments of teaching ability are valueless. Another is to explain that in this particular course a very special combination of circumstances has entered to befog student judgment. A third reaction is to make the claim (demonstrably false for the ratings as a whole) that students so resent severe grading that they take it out by recording adverse opinions of the instructor.

Notice that all of these reactions enable the teacher to continue thinking of himself as a good teacher. The habit role has survived its temporary peril.

Some writers use the word "ego" to describe what has here been called the role. This is a subject in which psychologists have not yet succeeded in working out a clear language, and we must accept the fact that this is the case.[4] We shall distinguish between these two concepts. By *role* will be meant the verbal phrases we consciously accept as applying to ourselves. By *ego* we shall include certain attitudes we hold toward our own bodies, our own names, our own memories, our own physical and mental traits, some of which may be at an unconscious level. Our concept of ourself is our role, because concepts are organized about word symbols. The role can be approached through the methods of interview. The observation or description of a person's ego remains an extremely difficult undertaking, whereas whether or not a person accepts certain words as applying to himself can often be agreed upon by all observers, making of it a fact.

Role and ego both tend to be protected. The strength of this defensive protection depends on the extent to which the role or ego has become involved in all features of our routines. With all of us many of our behavior patterns may be understood as *ego-defensive*

[4] G. W. Allport, The ego in contemporary psychology. *Psychol. Rev.*, 1943, 50, 451–478.

reactions or defense of role. We go to great lengths to preserve our opinions of ourselves.

The college boy who fancies himself as irresistible to the ladies dismisses the girls with whom he fails as stupid or without taste, beneath further notice. Even when the opinions are bad and we believe that we are stupid, awkward, homely, unlucky, depraved, they tend to be protected. When a first sergeant "riding" a victim succeeded in making him accept the notion that he was no soldier, the army had lost one man as an effective. But once adopted, the role of "coward" or "sinner" tends to resist argument and evidence that brings it in question.

FRUSTRATION

When we block the satisfaction of a drive in a laboratory rat, put obstacles in the way of quenching thirst, satisfying hunger or sex, we notice that the animal builds up a heightened state of activity. This heightened activity is also present when habits are blocked. The state of the organism resulting from such interference either with physiological drives or with habit drives is often called *frustration*. This view makes frustration an interpretive construct rather than a fact. But it is a construct that is not far removed from fact. We cannot see frustration directly but we can see and record the situations that presumably give rise to it and the immediate consequences of frustration in behavior itself.

We may push our interpretation farther and speak of frustration as being but one form of tension, *tension* being defined as a disturbance of the equilibrium of an organism including the disturbance of learned habits as well as of tissue conditions—the biological norms or constant states. A man who has learned to dominate undergoes frustration when this habit is interfered with. A man who has learned to sit in a certain chair undergoes frustration when another person preëmpts it. One who has learned to be dependent on others also undergoes frustration when this habit is interfered with.

Frustration is conspicuous when a change of scene or status finds the individual not prepared for the new situation. Nervous breakdowns

are commonest when radical changes are to be faced—a marriage entered upon by an ill-prepared boy or girl, a teaching job accepted by a timid person, the initial concert of a musical career approached by a person who has not faced his own known inadequacy. In marriage the person well habituated to being loved and cherished may suffer frustration when she must give as well as receive love.

One prominent psychiatrist has said that the majority of his dipsomaniac patients, meaning the patients who have occasional periods of heavy drinking with almost total abstaining in between, were homosexual men living in a society that effectively repressed this interest.[5] The homosexual interest in a hostile environment can, over a period of weeks, build up a state of frustration. On some occasion alcohol has produced relief of tension. It then becomes the associated solution of this frustrated state. A week's drinking leaves the patient sick, often seriously, and weak. But it leaves him also relaxed. His troubles are gone. When he is nursed back to health the process begins all over again.

The behavior of the disappointed suitor, the unsuccessful contestant for office, the commuter who misses his train, the girl who goes to the party with high hopes but is there neglected, the girl who enters the university all set for a prompt invitation into a sorority and is then not invited—these behaviors are familiar to all of us and we have all been in similar situations. These are frustrations. Most of them can have serious effects if we are not in some way prepared with alternative courses of action.

Students arrive at college in a remarkable diversity of states of preparation. Some entering students have been used to responsibility, to making their own decisions, even to earning their own livings. Others have had no experience of being on their own. There are girls who have seldom decided what to wear, whether or not to go to a party, what subjects to take in school. Their habit patterns all depend on parental direction and advice. Without it they are often completely

[5] G. V. Hamilton, Personal communication.

at a loss. The symptoms of frustration appear. They become anxious or irritated.

SOURCES OF FRUSTRATION

Other persons are the commonest source of frustration. We are made uneasy when we are with others whose opinions violently oppose our own. During a political campaign the Democrat among Republicans or the Republican among Democrats may find himself disturbed. We tend to learn to keep to the company of people whose opinions are consistent with our own or who are at least not given to the expression of contrary opinions. We also learn (some of us) to be somewhat chary of expressing our controversial opinions in strange company. We learn this because the upsetting of others is upsetting to us. There is interference with our own habits when friends are disturbed.

The failure of other persons to accept our conception of ourself, our role, is disturbing. The maintenance of role depends on some coöperation from others. Being bested in an argument reflects on our information or our capacity for argument. Being defeated at a sport or game in which we think of ourselves as good is disturbing. We learn "alibis." We find reasons for losing that do not reflect on our skill. The strings of our tennis racket were loose. We were up too late the night before. We are a bit out of practice.

Disparaging remarks, particularly those overheard by third persons or a group, can also be very disturbing. They interfere with our role habits and make necessary elaborate readjustments.

Two college teachers were recently complaining of the talkativeness of a third who had monopolized the floor the previous evening. It was pointed out that their annoyance was at least aggravated by the fact that they were themselves used to dominating the conversation. The rest of the evening's company, not being in the habit of holding the floor, were entertained rather than annoyed.

A girl who has, in getting married, established a conventional no-

tion of her role as a married woman, a mother, a hostess, a person of a certain position, may be chronically disturbed by the failure of her husband to live up to his part of such a marriage. His manners may be uncouth, his treatment of her not what her standards demand, his social ambitions may be lacking or quite different from her own. With a drunken or a brutal or unmannerly husband it is difficult to play the role she has conceived for herself.

Next to other persons, *social norms* might be held responsible for tensions in the individual. It would not be correct to make these two classes of tension-producing situations distinct, because social norms are expressed through other persons. By our first class was meant disturbance through the behavior of other individuals as individuals. By *social norms* we mean behavior which is predictable in terms of group.

The outstanding illustration would be the immigrant whose old habits do not fit the habits of his new neighbors. A new language, new food, new forms of entertainment, new clothing fashions, new political ideas and attitudes, new truths assumed—all contribute to keep the immigrant in a chronic disturbed state. What many immigrants to the United States have learned to do as a result of this motivation is to keep to the company of their compatriots and form Italian, German, Turkish, Spanish, Russian neighborhoods where the clash of folkways is at a minimum.

The greatest disturbance is in the second-generation immigrant. The first generation falls back on its own company and may avoid even learning English. The second generation is forced into schools with native children and develops conflict between habits established in parental training and the folkways of the environment. Parental authority depends on habits of obedience. These are broken and confused because the parents are ignorant of American ways which the children learn in school.

In any culture social norms become individual habits because failure to conform to the norm disturbs other persons, and their disturbance is disturbing to the individual. The way in which we dress is part of

what people respond to in us. When our dress is odd or "outlandish," we fail to get the responses on which we must depend. We learn to tell the truth on some occasions and on other occasions to say the conventional thing. When we say "Good morning" to a passing acquaintance, his reply is ready and effortless: he says "Good morning" in return. If we say something else, we disturb the habit sequence of his greeting and we may have to pause and explain ourselves. When we use the conventional words and manner in ordering a dinner we are understood. When we become unconventional we are likely to have our meal postponed.

The words "urbane," "polite," and "civilized" all meant originally "citified." They express the fact that where the population is more dense we acquire more of the social habits that ease our dealings with other men. We acquire more polite ways because we have more disturbing encounters and more "lessons" in urbanity in the city.

Besides those sources of tension that lie in the behavior of other persons toward us and those that come from conflict of social norms with individual habit we may describe certain other sources of tension as specific to the individual. A man may form certain habits while wealthy and have these habits now blocked by the loss of his money. The origins of his tensions are obvious. Encounters with collectors, insults, failure to be given what he attempts to buy on credit, the changed ways of his friends, all are upsetting.

The homeostatic tendencies of free spending habits obviously cannot restore the habits without money. Sometimes the individual so motivated achieves a second fortune. Sometimes what is achieved is only a tendency to preserve the air and manner of wealth while acquiring a new set of habits of actual spending.

In like manner the loss of a leg may interfere with habits previously acquired. But this loss is so definite and final in its nature that the disturbed state to which it leads usually ends in the acquisition of a complete new set of habits and a fairly complete adjustment to the loss. It is interesting to note that far greater psychological damage would follow an injury to a leg that leaves undecided the question

what to do about it. There is no bringing back an amputated leg. The sufferer must do without it. But in the case of the injury, he may be left in doubt as to what is the best course. Doubt, which is a case of having incompatible action patterns both activated, may become chronic, and doubt is disturbing.

Some of the most severe disturbances of equilibrium occur when an individual behaves contrary to his own moral attitudes. Shame and despair are usually so motivated. Occasionally the result is a "nervous breakdown," or suicide. Most of us are kept by our training to a reasonable approximation of moral behavior and are equipped with the ability to excuse such minor deviations as we are led into.

The word "led" is itself an excuse. When we have done something shameful or disgraceful, our commonest defense is that we did not do it; we were led or misled into temptation. "We" (our egos) do only what is creditable. The rest is the work of ignorance, forgetting, physical weakness, fatigue, lack of time, some interfering noble action or good intention, or just accident. We remain what we thought ourselves.

UNCONSCIOUS MOTIVES

One of the effects of the popularization of psychoanalysis has been a tremendous increase in the use of the words "conscious" and "unconscious." In general, these words are used to designate a fairly clear feature of behavior. When we call a motive an *unconscious motive*, we are indicating that the person acting with that motive has not put it into words. He doesn't recognize it, and "recognize" usually means "put the name to." "I recognized the material as wool"; "I recognized him as the grocer's boy"; "I recognized the town as Springfield." In other words, I named these things.

Similarly when we say we are conscious of something we usually mean (though not always) that we can name it, describe it, refer to it. Some of our motives tend strongly to be verbalized. These are the urges, the wishes, the desires, the habits, the needs, the purposes that are of a sort to get talked about.

Children learn the names for certain motives. They learn what to say when asked, "Why are you doing that?" "Why are you here?" "Why won't you go?" They learn also that certain names for motives, certain reasons for action, are acceptable. Others are not. Children learn to keep silent about motives that are not in conformity to social standards.

The word *repression* was introduced by Freud to indicate the inhibition of speech concerning a motive.[6] This inhibition, if it inhibits inner speech also, makes a motive unconscious. Repression assumes that the repressed motive was once conscious. Freud pointed out that the housebreaking of children and the imposition of social standards involve repression. There are certain things not talked about. Mention of them is upsetting to others, and their annoyance or distress produces frustration or annoyance in us, when it does not produce physical punishment.

Repressed motives are still effective in spite of repression. Only now they are not under the control of speech and so not under self-control. They may be evidenced in behavior when they would by no means be allowed free expression. A clenched fist in the presence of an enemy may betray an action tendency that the clencher would not acknowledge. A broken date may represent a dislike that has not been put into words. We say "I forgot." But this means very little. A pleasant prospect would not have been forgotten.

CONFLICTS OF MOTIVES

Carl G. Jung has made popular the term *ambivalence* to describe a state of contradictory motivation, a mixture of hate and love, shame and pride, cruelty and kindness.[7] He pointed out that conflicts of motives can often be discovered through the presence of excitement, which is one of the direct products of conflict. Love and hate turn out to have a peculiar relationship, a highly emotional love betrays the

[6] S. Freud, *New introductory lectures on psycho-analysis* (Trans. by W. J. H. Sprott), New York: Norton, 1933.

[7] C. G. Jung, *Collected papers on analytical psychology* (Edited by C. E. Long). London: Bailliere, Tindall, & Cox, 1922.

presence of hate, and highly energized hate always has some love mixed with it.

Jung further pointed out that in such mixtures of love and hate, approval and disapproval, one of these is likely to be unconscious and the other is recognized (named), talked about, insisted on. The recognized one is likely to be the one socially acceptable. Some parents protest their love for a child when they have by every other action demonstrated that they hate it.

Thus every person becomes in a sense a field for conflicting motives. Much behavior and many desires are inhibited as the result of social disapproval. But behavior inhibited in words may be still present in action and still constitute a dynamic force in conduct. All persons are subject to conflict of motives.

We must learn to control speech and action. There are names we cannot call people, statements we cannot make about people, things we cannot do to people, things we cannot do in the presence of people. We learn to control most of these actions. We learn to inhibit various actions and to repress certain remarks. But we still "think" them. Some of these repressions account for conflict states in us.

A state of conflict is a state in which incompatible action patterns are stimulated and neither completely inhibits the other. The result is that muscular tensions of opposed muscle groups are in evidence and the symptoms of excitement are present. The normal result is an increase in diffuse activity that eventually gets rid of the stimuli to one of the two opposed patterns and thus solves the situation. Romantic love can be described as such an increase in diffuse activity and excitement. It is produced by conflict and is reported not present in cultures like the Trobriands in which social taboos on adolescent love are not enforced. Tristan and Isolde and other great love stories are stories of conflicting motives, of strong ambivalences.

In the presence of disturbing conflicts of motives, some individuals learn to repress one motive, leaving it an effective source of trouble. In the presence of the same disturbing conflict of motives, other individuals learn to distort their reasons for action to bring them in closer agreement with social standards. This adjustment not only diminishes trouble with others; it diminishes trouble within ourselves.

The cheater in college examinations has a number of typical reactions to discovery. The discovery usually involves recognition by himself and others as a dishonest person. This recognition confuses and interferes with many of his self-directed attitudes and with other features of his role. He gets around it by (1) denying the facts, sometimes even to himself, or (2) jumping to the conviction that all students cheat, which makes cheating natural and not particularly bad, or (3) pointing out unfairness in the instructor's behavior or the conduct of the examination which justifies such reprisals as cheating.

We do not expect too much light on a man's motives to come from asking him about them. A very substantial amount of our behavior is determined by motives of which we are not aware or which we refuse to recognize.

SUMMARY OF THE ARGUMENT

The drama of our lives may be described in general terms. We come into the world committed to the maintenance of our constant states. We are, before we have learned anything, *against* many forms of pain, against intense stimuli of any kind, bright light, loud noises, cold or hot baths, sour tastes, bitter tastes, sudden disturbances of equilibrium, pins. We are *for* certain tastes like sugar, certain contacts like the thumb or nipple in the mouth. A list of our inborn "likes" and "dislikes" would be of interest and it remains to be made. But lists of drives are of little importance for adult behavior because the variety of things that men learn to do is so great that no list can cope with it. And even when men learn the same interest, like an addiction to cards, a passion for collecting heads or old maps, a strong addiction to the limelight, a passion for appearing in print, a fondness for dill pickles—all these habit mechanisms, so like drives in their operation, are likely to be only superficially the same. Of two card addicts, one

is found to like pinochle and the other bridge. Or two bridge addicts are found who cannot tolerate each other: one likes to bid recklessly and the other with great caution.

Two children develop habits of leadership, habits of taking the initiative. But one, when leadership met obstacles, has learned violent domination; the other has learned to lead by gentle means.

The boy who is brought up among younger boys or among girls may have formed habits of dominating the situation favored by his superior strength and the mental advantage of greater age. When he moves to a new neighborhood and there are obstacles to his leadership, he tends strongly to develop new methods of dominance rather than to relinquish it. Dominance may thus persist long after the original drive that gave rise to this habit solution has disappeared. Dominance, attention, money, prestige, property may thus become autonomous interests, no longer dependent on the fact that they once served biological drives.

In all cultures children must get the attention of adults in order to quiet hunger, thirst, cold, heat, pain. Attention getting becomes in all cultures to some extent an autonomous interest pursued for its own sake and for no other ulterior motive. It is not an original or inborn drive. It is a motive established by learning. All children have learned methods of getting attention. The presence of other persons who do not notice us does not bother new babies, but it is one of the most distressing experiences an adult can have.

Some writers have suggested calling these learned motives "secondary" drives or "derived" drives. These terms would wrongly imply that they are of secondary importance in behavior. As a matter of fact, learned motives (drives) are often stronger than the primary drives. There are learned food taboos which individuals maintain even to the point of starvation. During the depression of the early 1930's, jumps or falls from tall buildings were not uncommon occurrences. A large number of the fallers or jumpers were men who still had sufficient income to give them many times the creature comforts of the average man. But loss of face (threat to role) or threats to habits of dominance

and habits of playing the "big shot" created distress stronger than the natural avoidances that keep us from jumping from high places.

Many men in that depression turned out to be unemployable in spite of the fact that they were industrious, well informed, well trained. They were so accustomed to command that they could not operate in a subordinate position. Many former officers now in civilian clothes had great difficulty in changing to civilian roles.

If we are to understand the behavior of adults or even of children we need not bother ourselves much with tissue needs. We do well to give our attention to what the child or adult has learned. This is partly because instinctive or native tissue demands are much alike for the whole population and can be taken for granted, while the person we are concerned about must be understood in terms of his individual equipment of habit. What has he learned that makes him a problem? The answer is seldom in terms of instincts that we share with him.

When we know a man's habit equipment, his habit drives, we know the man himself. *He is these habits. It is his individual equipment of habit that enables us to understand him.* This supplies the key to his motives, his interests. It is not enlightening to understand the nature of love and hate. In order to understand a man we must understand the nature of *his* loves and *his* hates. These are not born in him. He learned them. All that was born in him was a capacity for developing any kind of love, normal or perverse, according to his later experience.

Some psychologists have mistakenly attempted to understand men in the light of basic innate or inborn needs. Man cannot be understood in terms of inborn needs. We must know the dynamics of the drives and interests and purposes he himself has developed.

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X

Adjustment Mechanisms

THE last chapter applied the principle of homeostasis to learned reaction patterns, that is, to habits. Applied to habits, the principle is perhaps better called the principle of functional autonomy. It means that specific habits tend to be reëstablished when blocked. They show a persistence of their own. When the father of the family finds his habitual chair occupied he becomes disturbed and cross. Eventually he does something that gets the occupant out of the chair, and the habit carries through. Habit traits, like forms of self-indulgence, sets of polite manners, recklessness in decisions, tend to preserve themselves once they have been established. When a person has been led to establish a whole repertory of habits of dominating others, of bossing his family, interference with these behavior patterns produces agitation, discursive action, and a certain probability that a new method of dominating will be hit upon and dominance will be preserved.

In particular, the principle of functional autonomy or homeostasis was applied to one's role and to those attitudes toward self that were called the ego. The ego, like simple habits and traits, displays functional autonomy and is defended.[1] The learned self-attitudes act, when blocked or interfered with, as motivating forces in the same way in which tissue conditions act as motivating forces. The man who thinks

[1] G. W. Allport, The ego in contemporary psychology, *Psychol. Rev.*, 1943, 50, 451–478. See also E. R. Guthrie, *The psychology of human conflict*, New York: Harper, 1938, pp. 138–139.

of himself as honest tends to carry out an honest response, or to be so disturbed by failure to do the honest thing that he hits upon some substitute, or overcomes the obstacle. The result is that we can say of certain persons that they are honest, that they have high standards, that they cherish grudges or that they forgive readily, or that they are devoted husbands or patriots. They are persons who are made unhappy and disturbed by perceived departures from these standards. We are therefore fairly safe in predicting of them these varieties of behavior. All of these trait words predict behavior. That is all they could be really useful for. The man that we judge has accepted the role of "good citizen" will behave in appropriate ways, and it is his role—the phrase "good citizen" and its related notions—that directs his behavior. His role of "good citizen" is a motive. The whole class of habit attitudes toward the self that we call the ego can be called motives.

In this chapter we are concerned with the kinds of things the organism does to preserve these habits or to act in accord with these motives, when confronted with situations that interfere with or prevent the expression of them.

Interfering with or blocking habit disturbs the organism and produces states of tension. These disturbances and tensions are physical states of the organism and are evidenced in such symptoms as heightened pulse, increased breathing, increase in blood sugar, and in muscular tensions like those that are betrayed in resistance of an arm or leg toward being moved. Such symptoms indicate the presence of physiological states favoring action. These states favor action, but they do not at first determine what the action will be. That depends on what stimuli happen to be about, what stimuli are encountered.

When distress from any source has been relieved (by the removal of drive stimuli or by the carrying through of a blocked habit), the action motivated by this particular form of distress is the specific action that brought relief. Hunger motivates actions leading toward the forms of food that have relieved hunger. Being "not noticed" motivates a child to do the things that have in the past brought him attention.

The reason for this is that nonrelieving actions, actions that leave the distressing stimulation present, are subject to conditioned inhibition. Other actions take their place in association with the distress. The actions that bring relief, on the other hand, get rid of the distressing stimuli, and stimuli that have been gotten rid of are not there to be reconditioned. Their last association is the one with the action that brought relief.

In one sense all motives are very much alike. All tend to produce excitement and diffuse action. When we describe motives and give names to them, we use words like "anxiety," "insecurity," "frustration," "conflict," and the like. We can be more specific and say that a certain man is moved by jealousy, which means frustrated love in which the obstacle, a rival, is part of the stimulus situation. The word "jealousy" does not indicate what the jealous person will do; it indicates only two things, one that he has in the past formed an affection for someone, and the other that his situation contains both the stimuli for the expression of his affection (say the girl) and stimuli blocking this affection (say his rival). A jealous man may weep or rage, he may seek solitude or beat up his rival.

What all motives have in common is a disturbance of equilibrium, that is, a state of tension. In one person this state may be called anxiety; in another, insecurity; in another, frustration. In an explanation of the dynamics of behavior these specific names have less interest and importance than the construct of tension, and we need not worry about specific labels.

The learned equilibrium-restoring reactions which we make to conditions which disturb equilibrium of the physical constant states or the equilibrium of habit are called *adjustment mechanisms*. By this we mean habits of adjustment.

Every person has experienced thousands of tensions—hunger, bladder tension, embarrassments, disappointments—and every person has learned specific and individual ways of reducing tensions. These habits are the ways in which the organism maintains constancy.

Just as there are common situations that produce tension, so also

there are common ways of relieving tension. The ways in which men react to interference with their ego habits are indefinitely varied, but certain of these habit adjustments are commoner than others, common enough to have won names. The reaction patterns which tend to reestablish the ego we may call *defense mechanisms*. Some of the more familiar defense mechanisms we shall now mention.

COMPENSATION

It was Adler who wrote most extensively about one group of defense mechanisms which may be called compensation.[2] By *compensation* we shall mean response to felt inferiority by the development of special abilities or skills in the field of the inferiority. Adler believed that physiological homeostasis includes remarkable tendencies for other organs to take over the work of an injured organ. If, for instance, one kidney is removed because of an infection, the other kidney responds to the increased load thrown upon it by enlarging and increasing its capacity, with the result that the elimination of waste from the blood stream through the kidney goes on normally. The essential constant states in the blood are maintained.

Adler pointed out the analogy between physiological homeostasis and the maintenance of role and ego habits. There are instances of persons in whom strong devotion to physical health and exercise has produced a physique beyond the average in a person who was notably frail. The late Theodore Roosevelt was such a man. Adler believed that inferiorities, where they act as disturbers, furnish a key to many a person's development. The classical illustration would be the Greek orator Demosthenes, who started out with a speech defect and in overcoming it became world famous as a speaker.

Note that inferiority may exist, but it does not act as a motive unless it causes other persons to block our habits, to disturb our conceptions of self, our roles, or to stand in the way of our interests.

Very short stature in a man may act as the disturber that explains

[2] A. Adler, *The practice and theory of individual psychology*, New York: Harcourt, Brace, rev. ed., 1929. Also, by the same author, *Problems of neurosis*, New York: Cosmopolitan, 1930.

his acquiring an incisive manner, erect carriage, and other attention-getting devices which the tall man does not need.

Just how does compensation operate as a motive? We may use an illustration which is speculative rather than factual. This is a field of psychology in which speculation has tended to outstrip the more tedious collection of fact so that scientific verification of general statements is often lacking. The illustration we choose concerns a series of pictures of New York gunmen published by the now-defunct New York *World*.[3]

The subjects of these pictures were killers, given to killing as a profession. Their most conspicuous common feature was their extraordinary light weight. The *World* asserted that their average weight was 120 pounds. They came from slum areas in New York. What would tend to associate undersize with violence and the traits of the killer? We may venture a guess that in the gang neighborhoods the boy who is physically handicapped by size tends to be either bullied or disregarded. Either treatment can be a disturber of habits and so act to motivate a solution. The nature of the solution may depend on accident. One boy may learn to be a clown or comedian and make his way with the gang in that fashion. Another may learn to be subservient and useful to the others and so be tolerated. A third may discover on some occasion on which he is provoked that extreme violence can get attention even from boys stronger and larger than himself. Having escaped from bullying once by extreme violence or the use of firearms, he tends to associate this behavior with the situation and to evoke it when that situation recurs.

We can, if this account is correct, describe this instance of murderous behavior as a compensation for small stature and physical weakness.

RATIONALIZATION

A second common defense mechanism or method of restoring the ego, after criticism, failure, or other cause has disturbed it, is called rationalization. By *rationalization* is meant a verbal redescription of the

[3] E. R. Guthrie, *The psychology of human conflict*, New York: Harper, 1938, p. 126.

disturbing situation which renders the disturbing feature innocuous, that is, which makes the situation no longer disturbing.

Several examples of rationalization have already been used in other contexts. A man who thinks of himself as a good tennis player may be defeated by an opponent whom he regards as distinctly inferior. To accept the natural inference which the behavior of onlookers may reinforce would be very disturbing. The defeated player is under these circumstances likely to hit upon a verbal redescription of the event. The defeat was not a fair trial and so should not carry the inference of inferiority. The rationalizing player describes it as a contest between a superior player who happened to be out of practice, whose racket was defective, who was out of condition because he had spent the previous night at a party, and an inferior player, who for these reasons, won the match.

An enthusiastic Democrat lives to see an overwhelming Republican victory at the polls. It is to him disturbing to be identified by acquaintances as a member of a defeated party. His recent politics are now unpopular. Voicing Democratic opinions provokes acquaintances to unpleasant gloating or to strongly reinforced argument. The partisan whose party has been defeated may learn to adjust to this event by keeping quiet. But large numbers of the partisans of any defeated party learn to redescribe their own position. They had voted as they did only with strong doubts or for some extraordinary reason. They may, many of them, form a new habit of lying about their past behavior and now claim always to have been on the side now triumphant.

Data from the opinion polls show that when public opinion has a strong bent in one direction, the polls tend to overestimate this trend because numerous men will express the prevailing opinion to the interviewer and depart from that stand in a secret ballot.

PROJECTION

A third defense mechanism is *projection*, which may be defined as the attribution to others of disturbing characteristics which the individual himself has been forced to accept as applying to himself.

The easiest illustration of this trait is the fact that students who have been proved beyond reasonable doubt to have cheated in an examination usually defend themselves by asserting that everybody or nearly everybody cheats. This defense tends to render the characteristic "cheating" less disturbing. No trait that is widespread can be very bad.

Clinicians and divorce court officials are familiar with the very common tendency of unfaithful husbands or unfaithful wives to express strong belief that their partners are unfaithful. This projection of the misbehavior upon the spouse tends to appear when it is evident that their own unfaithfulness cannot be hidden.

REGRESSION

A fourth defense mechanism, called *regression*, can be defined as a falling back, in disturbing conditions, on earlier habits for which present habits are inadequate. The concept has been very much misused and misunderstood. It has been used to describe all childish reactions, whereas it should properly be limited to previous reaction patterns of the individual concerned. Where a person is in trouble there is not a tendency for behavior to become childish. There is only a tendency for change produced by excitement and new situations. The fact that childish behavior often appears is explained by the fact that childish habits have not been completely forgotten and are part of the individual's repertory of response.

An effort was made by Mowrer to investigate regression in a simple form in animal behavior.[4] He placed rats one at a time in a box. The floor of the box was a series of parallel metal bars which could be electrically charged so that the rat's feet would connect some pair or pairs of adjacent bars and the rat would then receive a shock. The voltage was built up automatically from zero when the rat entered the box to its maximum at the end of about two minutes. Here it stayed for the rest of fifteen minutes.

[4] O. H. Mowrer, An experimental analogue of regression with incidental observations on "reaction-formation," *J. Abnorm. & Soc. Psychol.*, 1940, 35, 56–87.

Under these disturbing conditions the rats eventually formed the habit of sitting quietly on their hind legs holding the forepaws off the floor grid. This reaction may be called Habit A.

In the second part of the experiment a pedal was introduced into the box. Pressing the pedal shut off the current, which would immediately begin to build up again from zero. The rats eventually learned to press the pedal. This pressing may be called Habit B.

One group of rats first learned Habit A and then Habit B. In some cases Habit A had to be broken up by the experimenter's pinching the animal's hind feet and forcing new behavior. Another group of rats learned only Habit B.

There were now two groups of rats. One had learned Habit A and then Habit B. The other group had learned Habit B only. Both push the pedal when put in the box.

Now a fresh source of trouble is introduced. The wiring is changed to make pressing the pedal ineffective. The pedal no longer gives temporary relief. Under these circumstances the rats with Habit B only continue Habit B. The rats that had earlier acquired Habit A "regress" to this habit.

It should be noted here that regression occurs in the animals that had a previous habit solution to regress to, but it is also true that the conditions of the experiment *do not permit a new solution*. Regression is not a law of behavior, but something that does happen when other solutions are prevented.

The rats which had learned only Habit B persisted in this habit though it was now no longer a solution. Here is a case in which a habit adjustment is persisted in though it is no longer effective. Persistence in habit adjustments after they cease to be adjustive has been observed by Maier in other studies and has been called by him *fixation*. This is very close to the Freudian use of that term, which denotes behavior patterns which are now sex motivated because they happened to be associated with sex tensions which were relieved before the patterns could be unlearned. Freud speaks of parent fixations which render

the particular appearance or manner of a parent a signal for erotic emotion, though it was other features of parental behavior such as fondling that were originally responsible for the emotion.

REPRESSION

A fifth defense mechanism is *repression,* which may be defined as the inhibition of talk about an ego-disturbing situation. This inhibition extends in repression to inner speech or verbal thought.

There have been a number of studies indicating tendencies to forget things that threaten our ego habits. Koch, for instance, found that students remember best the "A" grades they have received on examinations.[5] Next best they remember their failing grades. Least well remembered are their average grades. These results are not definite because actually we might find failing grades in some cases acceptable to the ego, and average grades may have evoked less distinct and characteristic responses and so be harder to distinguish and remember.

Wallen showed student subjects' ratings of personality traits, presumably made by persons knowing them well.[6] He found his subjects tended to forget unfavorable ratings more than favorable ones. All ratings were actually fictitious.

How repression operates can be understood in terms of associative learning. Experiences associated with punishment, or with the equivalent of punishment in that they are disturbing or distressing, tend strongly to teach us to avoid the experience. Distress keeps us active until we have hit upon a response that removes the distress, or that inhibits our response to distress. When this has happened once, the solution becomes our substitute response for the situation that had produced distress.

Because words can serve as very effective siggals for shame, remorse,

[5] H. L. Koch, The influence of some affective factors upon recall, *J. Gen. Psychol.,* 1930, 4, 171–190.

[6] R. Wallen, Ego-involvement as a determinant of selective forgetting, *J. Abnorm. & Soc. Psychol.,* 1942, 37, 20–40. See also F. J. Shaw, Two determinants of selective forgetting, *J. Abnorm. & Soc. Psychol.,* 1944, 39, 434–445.

distress of many varieties, one very obvious solution for distress conditioned upon words is to learn to avoid the words.

The experience of death in the family is a familiar example. The distress which has been caused by the death is revived by the name of the dead person, by many words associated with the person or with his death. Prominent among these is, of course, the word "death" itself. A very common result is for people to learn to avoid mentioning the deceased person by name, and for a tendency to avoid the word "death" to manifest itself in the use of disguised terms for the same event—terms like "passing on," "passing away," "called to his rest," and the like.

Repression is very often associated with the existence of those lasting fears which are called "phobias." The fear of blushing, the fear of high places, the fear of riding in elevators, the fear of cats or of mice, the fear of public notice are often durable because they have produced behavior which avoids the fearsome stimulus. The woman with a mouse fear has learned to avoid mice. The man with a fear of riding on trains has avoided trains for ten years. The preservation of the phobia depends on the fact that these avoidances prevent learning not to be afraid of the fearsome object. To learn not to be afraid of mice, it would be a great advantage to have mice present and to have some response other than fear encouraged.

Repression tends to prevent the cure of a phobia by preventing the verbal signals which have become responsible for distress. When the verbal memory of a humiliating experience tends to produce humiliation and distress, we may learn to avoid the verbal recall by avoiding the words that produce recall. We learn not to mention our failure in the examination, our social blunder, our embarrassing or ridiculous performance. We learn not to mention it to ourselves. This leaves us, in a sense, not cured. When the words are forced upon us by circumstances, we shall be distressed.

Talk about the experience often produces a cure because the talk may occur in circumstances which prevent the distress. We tell a companion

about our humiliating experience and his hearty laughter (since it was not he who was humiliated) may be a stimulus for laughter (probably less hearty) in us. We find we have substituted a tendency to be amused for a tendency to be distressed when the distressing experience is mentioned.

All the defense mechanisms being described in these pages can be similarly explained in terms of associative learning, and the reader of this book can make such explanation an excellent test of his grasp of the general principles governing learning.

FANTASY

Fantasy is a sixth form of defense mechanism. *Fantasy* means preoccupation with goal behavior at an imaginary or "pretend" level. This definition includes both covert behavior or thought and overt behavior. It would name as fantasy the behavior of the boy who, not suspecting observers, is seen to be acting as if he were leading an infantry company, making an oration, holding up a train. Such behavior is necessarily incomplete. It is like the minimal movements which we call covert behavior or thinking in that there is no actual infantry company, no audience, no train to rob.

Fantasy may be maintained entirely within the individual as in daydreaming, or it may be dependent upon symbolic cues as furnished by the motion picture, the radio, or the novel. The reader of a novel is preoccupied with making love, fighting, any of the motivated goal behavior that can be suggested by the words of the novel. By saying that he is preoccupied with such behavior we mean that such behavior has his full attention and therefore offers the signals to which he is responding.

It is this self-maintaining character of fantasy that makes it a possible defense mechanism. It can protect the individual from threats to the ego by distracting from those threats. It serves exactly the same function that a lollipop serves with a crying child. Response to the lollipop inhibits response to the occasion for crying. The two responses are incompatible and cannot both take place. The neglected wife can

prevent having her neglect dominate her behavior through the day by allowing the morning's soap opera to start a train of fantasy. The device will be a little more effective if the heroine of the soap opera is in a situation enough like her own to make the transition easy to begin and easy to maintain. This is the reason for the rags-to-riches theme of so much of our fiction and cinema. The popular novel depends for its popularity on using familiar situations, familiar blocked goals, and on its capacity to enlist absorbed attention.

Even daydreaming may be absorbing, which means that it can be a mode of escape from troubling threats to ego attitudes. We can by daydreaming avoid realizing that we are incompetent, lazy, ignorant, vicious or venal. We can by daydreaming avoid acknowledging failure.

DISPLACEMENT

A seventh form of ego defense has been named *displacement*. The inhibition of goal behavior with a specific goal object frequently results in the expression of the goal behavior toward another similar object. The office employee who has been strongly motivated to abuse his employer may be restrained by his training in deference or respect, but "takes it out" on a subordinate or on his wife. The excessive devotion that a woman shows toward a dog may have as its history a profound disappointment in her failure to have a child.

AGGRESSION

The last of our list of common defense mechanisms is well introduced by the military proverb that the best defense is an offense. All defense mechanisms are the outcome of disturbances or threats to our role, or the more inclusive ego (the ego includes attitudes toward self as well as the concept of self or the accepted description of self). The immediate result of such threats is excitement and new behavior.

Certain kinds of new behavior are possible solutions in that they remove the disturbance or nullify its disturbing quality. These we have been listing. They include a seventh which may be called *aggression*. The individual whose ego is disturbed through criticism,

failure, attack, insult, ridicule, may happen, in his disturbed state to do something aggressive—in the simplest statement, to strike back. Now striking back has a distinct quality that rates it a very effective defense mechanism. It leads effectively to distraction and inhibition of the original distress. A man insults us. We strike him. We are immediately absorbed in a completely new line of behavior in which the insult may even be forgotten. The effectiveness of aggression lies in just this, that it is an immediate cure for our trouble. It may introduce worse trouble, but that will be another story.

It is this tendency for aggression to be hit upon as a defense, as a way out of criticism or humiliation or other threats to our role, that makes us look for a past slight when we see an instance of unusual kindness. Aggression is often retaliation for or resentment of past injury to our role. There may be a kick directed at the door which resists our efforts to open it. This is the primitive behavior out of which aggression as a defense mechanism develops. We reserve the phrase "defense mechanism" for the more complicated behavior in which the distress is not produced by anything so simple as blocked progress through a door, but requires the conflict that results from interference with our conception of ourself.

CONCLUDING NOTE

We must remember that compensation, rationalization, projection, regression, repression, fantasy, displacement, and aggression are just names for some of the commoner forms of adjustment to interference with our ego habits, our role, our sense of our own importance. The list could never be made complete because highly specific forms of adjustment by individuals are discovered continually. And we should not forget that the eight named above are named on the basis of rather superficial characteristics. The variety of ego defense is infinite.

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XI

Control of Behavior

PEOPLE interested in controlling behavior usually have socially approved acts in mind and there is consequently a strong tendency always to think of learning as acquiring some approved habit.[1] "Learning" sometimes is used to mean "improving at something." But there are bad habits as well as good. We may fail to improve in typing because we have acquired a bad habit. This bad habit is just as much learned as the typing with which it interferes.

Punishment is usually administered for acts that are socially disapproved; reward, for acts that are socially approved. But this procedure may be reversed and a child rewarded for performing acts that are not socially approved. Fagin taught his pupils to steal and pick pockets by rewarding their successes and punishing their failures.

Without reading psychology every student knows something about the uses of reward and punishment in controlling behavior. He knows that in general we reward actions we want to encourage and we punish actions we should like to see dropped. We reward virtue and punish vice because that makes children and people learn to do virtuous things and learn not to do vicious ones. Sensible people reward and punish for this reason only, and never just because someone has deserved pain or pleasure. They reward and punish because that is a method of changing people's responses.

We know also without reading psychology what kinds of things

[1] See, for example, the chapters on "learning" in the introductory texts previously listed under "Suggested Readings."

serve as rewards and encourage an action. Parents use candy, a trip to the zoo, praise, signs of affection as rewards to encourage actions of which they approve. They use blows, scolding, restraint of action, confiscation of toys as punishment in order to discourage some habit pattern that has become established and of which they disapprove.

Both reward and punishment are forms of stimulation. Candy stimulates the child's eyes, the skin of his fingers and his tongue and lips, his taste buds. A spanking stimulates pain receptors, strategically placed. But if both punishment and reward are stimuli, what is the difference between them aside from the fact that by reward someone intends to foster a habit and by punishment someone intends to break up a habit?

The difference between reward and punishment as stimuli is that reward is stimulation calculated to protect and cultivate an associative response to a stimulus, and punishment is calculated to break it up. How do they achieve this?

EFFECT OF REWARD

How reward gets its effects will take a bit of explaining. First it should be noted that reward does not produce the first performance of the desired act. Dog biscuit does not make the dog jump through the hoop, or come when called, or follow at heel. The act that we desire to be learned has to be procured by other means. That is why it takes experience to be a good teacher either of children or of animals.

The reward has two distinct uses. It may be used as motivation. The sight of a biscuit may serve to make the dog restless and active and so encourage the possibility of the desired action. Promise of a reward may have the same effect on children. It may serve as the motive or act in much the fashion of a drive. It often shortens the period of waiting until the desired act takes place. But it is not the direct stimulus for the desired act.

What it is that does directly stimulate the desired act is often not clear. We often just wait for it to happen. We put a rat in a box and wait until it pushes on a lever which brings the reward. Or we can

reward some odd and accidental movement and cause it to be repeated and become a habit. When the desired act somehow does take place, what the reward accomplishes is to take the person or animal out of the motivating situation, *to remove the motive*. The effect of this is profound. It leaves the *last association* with the motivating situation the desired act. No unlearning is possible, because unlearning of this association would require the presence of the motivating situation and its association with some different response.

Let us consider a simple illustration. In our laboratory at the University of Washington, we have pigeons which we bring into our psychology classes to demonstrate some of the things we have just been discussing.[2] Each pigeon is kept in a box about 2½ feet square. The front and top of the box are of wire mesh so that the pigeon's behavior is easily observed. At one side of the box toward the lower front corner is a slot. Through this slot a food tray can be made to slide back and forth automatically. Each time the food tray is exposed to the pigeon, it is accompanied by a clicking noise made by the operation of the mechanism. When a pigeon is first placed in this box it learns quite quickly to run to the food tray when it hears the click. We believe that it does so through the process of conditioning described earlier.

But suppose now that we wish to establish some new reaction pattern in the pigeon, an act that we consider, let us say, "good." To take a specific example, suppose that we want the pigeon to peck at a piece of wood which is lowered through the top of the box on a string. We put a hungry pigeon in the box (and thus ensure that it will be active) and expose the food briefly. We then remove the food, blocking the goal-motivated behavior of the pigeon. It becomes active, restless, pecks at the now concealed food tray, backs up, turns, pecks some more, and perhaps then takes a step toward the dangling piece of wood. Quickly we expose the food with accompanying click. The pigeon turns toward the food box and is allowed a few more bits of grain

[2] E. R. Hilgard suggested these demonstrations in the summer of 1947 after hearing of the studies being done with pigeons under the direction of B. F. Skinner of Indiana University.

before the food box is again concealed. The pigeon now runs back to the position where it was just as the food was exposed—it repeats the action that was last associated with the click. Often after doing this, it darts once more for the food box. But we fail to give it food and wait until it has taken a step or steps nearer the dangling piece of wood. Each time that it does so, the food is exposed and the pigeon is allowed to eat. In a relatively short time, by this "approximation"[3] method, we have the pigeon's behavior centered in the vicinity of the dangling wood. We wait until, usually again but a brief time, in the course of the various actions the pigeon makes, it pecks or strikes at the wood. We then expose the food and the pigeon is permitted to eat briefly. When we then conceal the food again, the pigeon moves back toward the wood and pecks and this response will continue to be repeated as long as we continue to reward it. The pigeon has learned the act of which we approve, which we considered "good."

Let's consider another very simple illustration. Suppose we hold up before a hungry dog a dog biscuit. The sight of the biscuit calls out goal behavior in the dog if he has had previous experience in eating biscuit. We will find his saliva flowing. He licks his chops, is very active. In other words he is motivated by the blocking of eating which is impossible with the biscuit still in our hand.

If we wait until the dog barks we may have to wait only a short time, depending on the dog's previous habits. As he barks we give him the biscuit. For the dog the situation is immediately changed. No longer is he standing looking at an inaccessible biscuit. He is absorbed in eating one. The very last act while he stood looking was to bark. That will remain his last association with the "standing-looking" situation. The next time we hold up a biscuit he will tend strongly to bark, even if days or weeks or months have gone by.

EFFECT OF PUNISHMENT

Reward removes the motive. Punishment does something else and has a more simple explanation. In a sense punishment is easier. Since

[3] The term is credited by Hilgard to Skinner.

punishment is used to get rid of a habit that is all too active, we do not often (as we do with reward) run the risk of waiting in vain for the action.

What punishment does is to wait until the situation that causes the obnoxious action is present and then offer violent stimuli that ensure that some new action will be substituted for the obnoxious one. By striking the person, or by shouting at him, or otherwise stimulating him we cause the response to our punishment to be associated with the situation that formerly occasioned the obnoxious action.

If we considered the pigeon's act of pecking at the wood as something "bad" and to be eliminated, this could easily be accomplished. An electrical circuit could be so set up as to result in a shock (punishment) for the pigeon whenever it pecked at the wood. The shock would serve to "break" the habit.

A dog that has formed an annoying habit of killing chickens has been successfully punished by tying about the dog's neck the corpse of a chicken. The presence of the chicken motivates struggles to get rid of it, and these struggles to get rid of the body become associated with the odor of chicken and the sight of feathers. Later on when the dog encounters a chicken, his new behavior is in evidence. He does not, of course, go through all the pantomime of getting rid of an imaginary chicken tied to his collar. That would depend on stimuli furnished by a real chicken tied to him. But there will be called out enough of the avoidance behavior to prevent pursuit and attack.

Dogs that chase cars have been successfully broken of the habit by tying to the dog collar a fifty-foot stout cord and then waiting on a lawn until a car comes by. The dog dashes out after the car but is brought up head over heels by the cord. The stimuli of pursuit are here followed so closely by the behavior of recovering from a fall that when the dog is no longer restrained, the beginning of a dash is his signal for recovering from a fall and the obnoxious habit is broken up.

In punishment we often pay little attention to the new habits that substitute for the old. In our absorption with getting rid of one association we may be providing another that is equally undesirable. The

master who beats his dog for several bad habits may substitute cringing in their place. The parent may substitute hostile attitudes toward himself or abject fear for the minor faults he was correcting with a slap.

SYMBOLIC REWARD AND PUNISHMENT

Tangible objects have the effect of rewards provided that previous experience has associated them with responses that can distract us from prevailing motivation, take us out of a driving situation. But such responses are dependent on our own individual history of conditioning. A pair of ice skates would have little appeal to a Panamanian child. The confections of one country may not interest foreigners. The reward value of objects is relative to the person and not inherent in the object itself.[4]

Tolman points out that objects or actions which lead toward desired goal objects acquire the character of goal objects themselves; they become desirable; behavior is directed toward them. The objects or actions that serve as means toward satisfying desires acquire a value of their own. There is no great mystery about how this can be accomplished. Probably the way in which children or chimpanzees learn to value coins is typical of the way in which things acquire reward value that they did not have. If a chimpanzee is left in a cage with a slot machine which can be operated by tokens and, when a token is placed in the machine, will deliver a grape, the chimpanzee not only learns to go through this routine, but it learns also to take an interest in and to collect tokens even when the machine is not available. The child who has acquired a tendency to "wish for" an occasional ice-cream cone has learned to do that as a result of eating cones, so that the later sight of a cone, the later naming of a cone, or the arousal of any detail of cone behavior tends to arouse eating, and this interferes with other behavior, keeps the child agitated and restless, until the cone-eating has been gone through with or distracted. If, in the course of "ice-cream-cone-restlessness" the use of a coin is followed by satisfaction, the child has acquired a "coin-restlessness." From the former

[4] M. Sherif, *The psychology of social norms*. New York: Harper, 1936, pp. 113–118.

occasion, he has a coin-using behavior pattern. Now, if chance stimuli through association arouse either cone responses or coin responses, the coin has become part of the behavior pattern that tends to be run through, and tends to interfere with other behavior and keep the child upset until he has been given a coin.

Threats are symbolic punishment. A stroll along a row of waterfront beach cottages yielded the following shrill sentence uttered by a woman standing in the front door of her house; the obvious object was a small boy. "If you go off down the beach, I'll whale you till you can't stand up." On this particular small boy the statement had little effect. He appeared unconcerned and continued to play with some object in the gutter. To be effective, the threat must through association arouse behavior that breaks up the undesired pattern. It is to be suspected in this particular case that the necessary associations were lacking and that the shrill-voiced woman was, fortunately, not in the habit of crippling her child by blows.

We may notice incidentally that many parental commands, like a loudly voiced "Don't," do not depend on their symbolism so much as on their intensity for interrupting and altering the undesired behavior. Their effect is due to the sudden sharp noise, just as a dog's bark tends to disrupt behavior by its very loudness, rather than by its meaningfulness.

In a given culture, common habits endow some objects with reward value that is comparatively general.[5] Value itself depends on how widespread are the habits toward the object in question. The value of the American dollar bill in the back country of Brazil is less than the value of so much blank paper. The natives have no name for the green object, no associations with it, no interest in it. We say it has "real" value only because north of Brazil are natives among whom interest habits toward dollar bills are widespread. There the dollar bill has a name, an associated noise that is part of the response repertory of practically all adults. The bill itself is a symbol which means that it is the signal for complex responses associated with the sight of the bill

[5] *Ibid.*, p. 124.

or with its own symbol. The figure "$1" is a symbol of a symbol.

Much reward and punishment among human beings is symbolic. This means that words, gestures, insignia may act as the signals for the objects and events that reward and punish action.

Praise operates as reward when it relieves us of anxieties connected with the ego, when it restores our role or conception of the self.[6] When the husband makes an after-dinner speech he waits anxiously for comments, but particularly for the frank comments of his wife. Not sure of ourselves, we try over and over again until praise relieves our ego tensions. We tend to do that which gets praised because praise, like any reward, removes the motives that have been driving us, the dissatisfactions with ourselves that keep us active. When that particular dissatisfaction comes again, its last association was the action that provoked the praise. We therefore perform the praised act even if we are not observed. It is now conditioned on our own motivation.

Blame, like any punishment, breaks up undesired action by producing distress and defense that tend to replace the blamed action. Reproof is an attack on our habit role, on our notions of ourselves as competent, skilled, virtuous, wise. By the attack we are thrown into distress and must learn a new habit adjustment.

At the beginning of the use of symbolic controls of behavior a child may have had his hand firmly grasped and deflected as he reached for a fragile vase. At the same time he may have heard the words, "No, no." He may have repeated these as he heard them. On a later occasion we may observe the following sequence of behavior: The child sees and reaches toward the vase, then says, "No, no," and retracts his hand.

The phrase "No, no" has now become part of his equipment of voluntary control. When he is led to say, "No, no," his action is checked and inhibited. His behavior is now open to the control of others through symbols. They can cause him to utter the signal and then interrupt the action.

We acquire a tremendous vocabulary of control words. In some

[6] G. W. Allport, Effect: A secondary principle of learning, *Psychol. Rev.*, 1946, 53, 335–347.

persons the phrases expressing approval and disapproval may become a part of the sequence of symbol and action. In others appropriate action may never have been associated with the control words and the person pays "lip service" to morals and behaves in lamentable ways. In short, there may be little connection between the tendency to give the right answers to questions about the rightness or wrongness of acts and the tendency to do the right or the wrong thing when a person is placed in actual temptation.

By *self-control* we mean the acquisition of habit associations with word symbols which make symbolic guidance of behavior possible. When a person tends to follow the symbolic cue with appropriate action we say he has self-control. When a man says, "I shall stop smoking," and we discover him the next day smoking, it is obvious that he is not an illustration of self-control.

Self-control means something more than voluntary control. It means that the word symbols that direct behavior are those related to the role, the concept of the self. The person with self-control acts in ways that are consistent with his role. If he thinks of himself as a combat infantryman, the operation of this thought to hold him to the performance of his mission in combat is an instance of self-control. The college student who has begun to think of himself as a chemist exhibits self-control when that thought proves effective in causing him to spend the evening at study rather than at the movies. A large part of training in medical schools and in other professional schools is devoted to establishing the notion of what a doctor does, how a doctor behaves, or how an engineer meets various kinds of situations. When the medical student or the engineering student has adopted these concepts of word symbols for behavior, they become part of his self. From then on they should determine action.

This is a field in which it is to be hoped that the next generation of psychologists will push research much farther than has been thus far done. The clinical psychologist is intimately concerned with this problem of the voluntary control of behavior and with the establishment of self-control. He is also, incidentally, concerned with the repair

of roles. It is his task to lead patients to change their roles where necessary to bring them more in line with the realities. Many of his patients will have sought his advice because they cannot control their own behavior. He will be confronted with persons who are in a state of conflict between normal interests in persons of the opposite sex, and perverse tendencies to be interested in persons of the same sex; students who cannot make themselves study; alcoholics who cannot leave drink alone; men and women who have lost confidence in themselves as husbands or wives or lawyers or engineers. Self-control demands two things. There must be a concept of the self; and this concept must be effective in directing behavior. Both of these desiderata are the result of associative learning, and open to change through associative learning.

A *voluntary act* is an action that can be initiated by symbolic cues or inhibited by other symbolic cues. Sneezing is called involuntary because we cannot say to ourselves, "No," and then refrain. Signing one's name is a voluntary act because it can be produced at verbal request, or inhibited by words.

Symbols enable us to respond to promised reward or threatened punishment. Social control of individual action is done in part through symbols. We publish laws, put up traffic signs.

The insane are not to be trusted to respond to published rules or printed signs. Children have not yet learned the complex symbolism of public control and so are held in law not responsible. Although there are no confirming studies that we know of, it is safe to assume that there is a relationship between age and the possible remoteness of symbols from actual reward and punishment. In young children punishment must be on the spot and in the situation. The child who has used crayons on the wallpaper, if he is very young, cannot be punished in another room with any discouraging effect on his early artistry. It is possible that a spanking administered while he is in the throes of composition may be effective and make the sight of wallpaper and outstretched crayon a stimulus for moving his hand to a protective position instead of toward the wall. This statement must not be interpreted as favoring such a method of dealing with the

situation. The crime of writing on the wallpaper is much more adequately managed by furnishing interesting crayons and paper to work on, and by making crayon a signal for writing on a horizontal paper surface on a desk.

Older children and grownups can be managed more successfully through symbolic controls. The words carry with them more associations and are therefore more effective as symbolic reward and punishment. It is probably true that there is through most of life a gradual increase in the guiding power of remote symbolic controls.

It is interesting to note that in the onset of alcohol addiction the morning hangover with nausea and a headache does not operate to prevent a repetition of the experience.[7] The victim fails to learn his lesson in part because the situation in bed in the morning is so entirely unlike the situation of the gay evening while alcohol was being drunk. Failure to learn is also in part explained by the fact that alcohol reduces learning. But it is evident that symbolic controls, arguments, pleadings, prohibitions, self-resolutions are of very little effect when matched against the reward value of the alcohol. This reward value is based on the depressant effect of alcohol which makes it relieve tension and anxiety from any source.

We sometimes personify the course of natural events and say that "life teaches us" or that "the world enforces its own rules." Obviously life in general has no particular interest in punishing or rewarding us, but the effects of our own actions may act just as do punishment and reward. For mispronouncing words a young child is punished by failing to be understood and so failing to produce the effects for which he is set. He is punished for bad manners by the annoyance of those about him. He is rewarded for courteous behavior by getting his own way. In a proper family almost no attention need be paid to the teaching of manners, since these will be learned as an adjustment to the ways of the family. Children pick up good manners if good manners carry any weight with their families.

[7] E. R. Guthrie, *The psychology of human conflict*, New York: Harper, 1938, pp. 99–100.

The transmission of custom from one generation to another is accomplished through reward and punishment. Nonconformity produces upsetting confusion and the confusion motivates relearning. We are best aware of the punishing influence of our human environment which drives us to conformity when we observe immigrants into a country forced to learn its speech and its ways, or to establish their own centers of their own folk and language, or to work out individual solutions and confine themselves to occupations and routines in which friction is at a minimum.

CONCLUDING NOTE

The control of behavior through the use of reward and punishment is obviously what has been called in an earlier chapter adjustment viewed from the point of view of the controller rather than from the point of view of the one controlled. The person whose behavior is controlled is adjusting himself to his human environment which contains irascible or well-meaning persons intent on making him different. The principles of learning by which that adjustment is accomplished are just the same as those in evidence when a child adjusts himself to hot radiators or to cold weather or to being very tall. Since hot radiators do not plan their effects, nor does cold weather or tall stature, we cannot speak of these effects as punishment; but the manner in which they affect learning is basically the same as the manner in which parents and authorities reward and punish.

There are no exact laws of reward and punishment for the reason that reward and punishment cannot be defined with the exactitude required by science.[8] We must be content to note that reward has generally an encouraging effect upon an associative connection. The real reason for this is that rewards so often relieve or distract and so remove the motivation and protect it from being associated with other responses. Punishments generally interrupt action and force new associations with the situation and so get rid of the old. But a tremendous

[8] See, for example, P. B. Rice, The ego and the law of effect, *Psychol. Rev.*, 1946, 53, 307–320; O. H. Mowrer, The law of effect and ego psychology, *Psychol. Rev.*, 1946, 53, 321–334.

lot depends on what the reward or the punishment makes the animal do. Striking a horse on the flank with a whip just before he makes a jump may facilitate jumping. Striking him over the nose might prevent it.

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XII

Traits and Their Measurement

IF the members of any large class in an introductory course in psychology are asked what they mean when they use the word "personality" they will give a variety of answers. Most of the following notions would be included:

1. Personality is your outward expression or the way you appear to others.
2. Personality is the way you react to other people.
3. Personality is what you are.
4. Personality is the ability to get along with people, to make friends.
5. Personality means personal charm and magnetism.
6. Personality is what makes you different from other people.
7. Personality is what some people have lots of and others little.
8. Personality is your fundamental disposition.
9. Personality is the way people adjust to situations.

And so on.

There are many more possible answers. Allport has found at least fifty distinguishable meanings in use.[1]

Perhaps most of these definitions are expressions of different views of the same thing; they indicate some picture of the "whole organism," the "integrated person." The indefinite complexity and variety of

[1] G. W. Allport, *Personality,* New York: Holt, 1937, chap. 2.

persons make definition of the complete person necessarily vague. What most of these definitions appear to be groping for is something like the "picture of an individual as an individual"—a picture in words. We get this picture by studying and observing the individual, because what any individual does is the resultant of his whole nature, his past experience, his present condition.

TRAITS

The study and measurement of persons in terms of the whole organism is not possible. All that we can possibly do is to take some specific aspect of behavior, some aspect that can be named and can be recognized by other persons when it is named. When the descriptions of these specific aspects or *traits* are put together, we have done the best we can toward the verbal description of the individual.

Naming traits is essentially what you would do if you were asked to describe someone's personality. You would tell the extent to which he has exhibited in the past certain behavior traits which both you and your questioner can name and recognize.

Physical traits refer to such things as height, weight, skin color, or hair color. We describe people as tall or short or of medium height. They are fat or thin; they are blonds or brunets. These last two terms are, of course, used very inexactly and with little agreement. But these are the terms we must use when we try to describe a person's appearance. Personality traits are the characteristics we must single out in order to convey in words a picture of how an individual behaves.

A personality or behavior trait must indicate some general kind of behavior which we may expect from an individual. Specific habits like nail biting or using the left hand are not called personality traits. When our prediction is more vague and we mean only to forecast that some action or other of a certain kind is to be expected, we speak of a trait. A restaurant customer may be recognized by a waiter as a man who always leaves a quarter under the right-hand edge of his dish. That is a habit, not a trait. All behavior is made up of habits and habit combinations, and traits also are made up of specific habits; but the waiter may

wish to indicate only that the man in question generally does something to benefit those with whom he comes in contact. He calls the man generous. Generosity is a personality trait.

The use of personality traits is something we cannot avoid. We cannot be bothered with lists of specific habits in individuals. We must generalize in describing them. We call Jones industrious. We cannot give the time that would be required to list all the things he actually does, to say that he rises early and prepares the family breakfast, that he repairs leaking faucets, rattling windows, and so on. Industriousness is actually made up of multitudes of specific habits like these; but we have time and opportunity only to suggest a trait, meaning that in a large variety of situations he tackles the job and sees it through.

We must avoid sternly the almost overpowering temptation to think of the behavior as caused by the trait. Traits do not cause behavior. Traits are potential behavior. They represent predictions of behavior, not its causes. It is not intelligence that causes one to make a brilliant speech or to arrive at an acceptable conclusion from the figures of any experiment or to cease taking the wrong bus to the university. Doing these things is what we call intelligence. It is not my dominance that makes me refuse the cup of cold coffee or makes me insist on doing the experiment my way. It is these things that we call dominance. They are dominance.

MEASUREMENT OF TRAITS

Physical traits like height can be measured directly and with high agreement between different observers. All that is required is the observer's judgment that the man is higher than one mark and lower than another, or that he is the same height as a mark on the standard. The measurement must be founded on observation, but observations of length can in a good light and with normal vision be made to agree to a fine point. We are directly comparing two heights.

In measuring *behavioral* or *personality traits,* such as dominance or submissiveness, we cannot make such direct comparison. We have no yardstick. We must therefore measure indirectly through inference

and deduction. One method by which psychologists have undertaken to measure traits is to select a good number of situations that might be expected to test the presence or absence of the trait and to see how the individual says he would respond to these situations.

Suppose we selected fifty situations in which one might respond in a clearly dominant or clearly submissive fashion, for example: Having someone step in front of you in a line-up for theater tickets; having someone else respond, "I'm next," in a grocery store when you yourself are actually next in order to be waited on. In each such situation you might respond wiith protest or you might meekly accept your fate. We may agree to call the person more dominant who protests in these situations than one who does not. A person who, for example, responds with protest in forty out of the fifty situations may be said to be more dominant than one who responds with protest in only thirty out of the fifty situations. If we are justified in making these statements it is because we expect the person who protests more in our sample of fifty situations to be more likely to respond in a similar fashion in new situations not included in our fifty.

The forms in which lists of situations or questions are used to measure personality traits tend to be limited for reasons of convenience in administering and scoring. They may consist of questions for which answers are indicated from among several choices offered (multiple-choice form), or of statements which are to be marked true or false, or of items which are to be responded to by "Yes," "No," or "?" A score on the test might be determined by giving one or two points' credit for each item responded to in a manner characteristic of one possessing the particular trait in question.

The items or statements used in tests of personality traits are selected by one of several techniques of *item analysis*. One simple method is the following: From a large number of trial items designed to test some aspect of the trait, we examine the replies of those who stand high in the trait (say the upper 25 percent), as determined either by total scores or by some other criterion, and the replies of those who stand low (say the lowest 25 percent). We find the proportion of the high group

answering the item as expected and from this subtract the proportion of the low group answering as expected. If the difference is a substantial percentage, the item is retained. It discriminates between high and low. If, however, this difference is small, the item is discarded. It does not discriminate between people who stand high in the trait and those low in the trait. As a result of our item analysis we may discard a large number of items that turn out to be of little value in discriminating between our high and low groups.

MEANING OF A TEST SCORE

G. W. Allport many years ago published a test of ascendance-submission.[2] He used forty-five or fifty items which consisted of the description of a situation and a request that the taker of the test tell what one of four or five lines of action most nearly described how he would behave in a similar situation. Replies were assigned points supposedly corresponding to the significance of the item in the prediction of ascendant or submissive behavior. A person's score on the test is the sum of his points.

These scores, like scores on nearly all similar tests, are found to range from low values received by a very few individuals, through middle values received by many persons, to the extreme high values received by very few persons. If the possible scores are listed from low to high and opposite each measure or score, we tally the number of persons receiving that score, our tallies will form what is called a *frequency distribution*. The frequency distributions which are obtained with psychological tests are remarkably similar, for reasons of a statistical nature, to the familiar bell-shaped, normal distribution curve of statistics.

It is in terms of frequency distributions and the normal distribution in particular that we set our standard in measuring traits. How tall is tall? The only reasonable answer is in terms of a frequency distribution of heights of a particular population. Tall is not to be described in any

[2] G. W. Allport, A test for ascendance-submission, *J. Abnorm. & Soc. Psychol.*, 1928, 23, 118–136.

absolute number of inches. Seven feet is a low ceiling and a tall man and a very tall dog, but a very short oak tree. A score of 100 in a test means nothing to us until we know something of the frequency distribution of the scores in the test. It might turn out to be the lowest score in a thousand cases—or the highest.

Additional insight into the meaning of a test score is obtained if we know what the average score for a defined group is. There are a number of different averages which might be used. One average is the *mean*, which is obtained by adding all the scores and dividing by the number of scores added. Another average is the *median*, which is the point above which and below which 50 percent of the scores fall. A third average is called the *mode*, which is the score most frequently obtained. All of these averages are called measures of *central tendency*, points about which the measures tend to cluster.

If you have a score of 37 on a psychological test, knowing that the mean score is 30 would tell you that you are definitely above average. But you still wouldn't know how much better than average. That would depend upon the spread of scores, the *variability* of the distribution.

There are a number of measures of variability, but the one most commonly used is the *standard deviation*. The standard deviation is a kind of average of the deviations of individual scores from the mean of the distribution. For example, if your score is 37 and the mean of the distribution is 20, your deviation from the mean would be 17 points. A score of 8 would deviate from the mean by −12 points; a score of 16 by −4 points; a score of 32 by 12 points; and so on. To obtain the standard deviation of a distribution of scores, each score may be expressed in terms of its deviation from the mean. These deviations are then squared and the squared deviations are added. The sum of the squared deviations is divided by the number of scores to obtain an average. When we take the square root of this value, we have obtained the standard deviation.

It can be shown that in a normal distribution—any normal distri-

bution—about two thirds of the scores will fall between the mean of the distribution and plus and minus one standard deviation. Suppose, for example, that we have 500 scores and that they form a normal distribution with mean equal to 20 and standard deviation equal to 5. Then between the mean, 20, plus and minus 5 points, we would expect two thirds of the scores to fall. Furthermore, practically all of the scores would fall between the mean and plus and minus three standard deviations, i.e., between 5 and 35. Knowing these facts, it should be immediately apparent to you that if you have a score of 37, you are an extremely exceptional individual.

It would be possible to express your score of 37 in terms of standard deviation units. If we subtract the mean, 20, to obtain your deviation score, 17, and divide this deviation by the standard deviation, 5, we would obtain 3.4. This value, 3.4, is called a *standard score*. Since we know that practically all of the scores would fall between the mean plus and minus three standard deviations, this documents the point made earlier, that your score is an unusually high one.

RELIABILITY AND VALIDITY

No measure of any kind is worth the trouble of making it if it is not consistent. Two different observers should get results that tend to agree. If two different assistants both correct the same set of examination papers and their grades are not in close agreement, we may infer one or both of them are wrong, inaccurate. If a blood sample is divided into two parts and each part sent to a different laboratory for analysis, the reports on the two parts should agree.

In other words, a method of measurement that cannot agree with itself is not reliable. But few methods of measurement so far devised agree perfectly with themselves. If two members of a general psychology class measure the heights of other members of the class, their reports will not agree perfectly. We would, however, expect a considerable amount of correspondence between the two sets of measures—much more than we would expect between their judgments of the degree

of aggressiveness possessed by the individual members of the class.

What is needed is a measure of correspondence to determine how reliable a given set of measurements is. In the case of test scores, we might ask the extent to which we would obtain comparable sets of scores from two forms of the same test; the extent to which scores obtained from administering the test today would agree with the scores obtained tomorrow for the same subjects. The extent to which there is correspondence present is a measure of the test's *reliability*.

There is another need for a measure of correspondence. Psychological tests do not measure directly what they are supposed to measure. Most of them measure constructs, not facts. No one ever saw aggressiveness. Aggressiveness as a trait is a construct; it is inferred from facts. No one ever saw intelligence. We can see an act that we may pronounce intelligent, but the trait intelligence is something not directly observable. Since psychological traits are constructs, we must have some method for determining how well our test measures whatever it is that we think it is measuring. The extent to which it does is a measure of the test's *validity*. Our method for determining this is not a perfect one. It consists in measuring the agreement between two radically different measures of the trait. Usually one of the measures is available and is called the *criterion*. When intelligence tests were first developed, psychologists used teachers' judgments of children's performance in school, expressed in terms of grades, as their criterion for validating the tests. That this criterion itself is subject to a number of sources of error and is not perfectly reliable must be recognized as an inherent difficulty in the validation of all tests. Statisticians and psychologists who construct tests, however, have devised some remarkable techniques for handling the problem.

The measure which is used in determining reliability and validity is the *correlation coefficient*. Let us suppose that we have two forms of a test designed to measure aggressiveness. Are our measures reliable? We determine this by giving the tests to a large group of subjects. For each subject we have a score on both forms of the test. These scores

are transformed into standard scores, and the standard score of each subject on one form of the test is multiplied by his standard score on the other form. These products, when summed for all subjects and divided by the number of subjects, give us the correlation coefficient.

If two sets of measures are in agreement, then a person with a high score on one test should also have a high score on the second; a person with a low score on one should have a low score on the second; and a person with an average score on one should have an average score on the second. It can be shown that the average of the products of a complete distribution of paired standard scores can range from 1.00 to —1.00. When high scores on one test are paired with comparably high scores on the second, and low scores on one with comparably low scores on the other, so that there is perfect agreement, the coefficient will be equal to 1.00. If high scores on one test are paired with low scores on the other, the coefficient will be negative and in the case of perfect inverse agreement will be equal to —1.00. When no relationship is present between the two sets of measures, the coefficient is equal to zero.

For most psychological tests, the agreement between comparable forms of the same test ranges from .85 to .95. These coefficients are called *reliability coefficients*.

The determination of the degree of validity of our test of aggressiveness is not as simple as the determination of its reliability. One possible way in which we might approach the problem would be to have each subject judged as to his degree of aggressiveness by a number of individuals who have had an opportunity to observe him in a variety of situations. We could then correlate our test scores with the average rating given to each of the subjects. It is highly probable that this coefficient, the *validity coefficient*, would be much lower than our reliability coefficient. For one reason, the judgments, our criterion, would not be perfectly reliable, and we have already seen that our test is not perfectly reliable. We thus have at least two sources of error entering into our validity coefficient.

We cannot in this book go any further into the statistical methods

which have become the tools of science in practically all fields.[3] The descriptions we have given here are highly oversimplified and incomplete. As with any other topic dealt with in an introductory text, this is but an introduction.

PERSONALITY TESTS

Many of the current psychological tests of personality traits were derived from an inventory constructed by Woodworth during World War I, which was designed to measure the ability to stand the stress of military life. This test consisted of 116 questions to be answered "True" or "False," depending upon whether or not the subject thought the item to be characteristic of himself. Typical items were: Do you have nightmares? Are you bothered by a feeling that things are not real? Do you make friends easily? Are you troubled with the idea that people are watching you?

More recent tests of this type include the Thurstone Neurotic Inventory, the Bernreuter Personality Inventory, the Guilford-Martin Inventories, and the Bell Adjustment Inventory.[4] The reliability coefficients of these tests usually turn out to be satisfactory, .85 and above. The situation is not the same with respect to validity. Few, if any, satisfactory validity coefficients are available for personality tests of this type.[5] One of the main difficulties, of course, is in getting satisfactory criterion groups against which to validate the test scores.

Many of the readers of this book will at some time or other have taken the Strong Vocational Interest Blank. This test was constructed by submitting several hundred items to representatives of about 20 different professions or vocations including physicians, lawyers, insurance salesmen, vacuum cleaner salesmen, and others. After an item, which might be, for example, "witty people" or "symphony concerts," each subject drew a circle around an L, and I, or a D, to indicate "like," "indifferent," or "dislike."

[3] There are various texts which emphasize the applications of statistical methods to psychological problems. See A. L. Edwards, *Statistical analysis for students in psychology and education*, New York: Rinehart, 1946; J. P. Guilford, *Fundamental statistics in psychology and education*, New York: McGraw-Hill, 1942; H. E. Garrett, *Statistics in psychology and education*, New York: Longmans, Green, 3rd ed. 1947.

[4] A description of most of these tests can be found in E. B. Greene, *Measurements of human behavior*, New York: Odyssey, 1941, chap. 17.

[5] A. Ellis, The validity of personality questionnaires, *Psychol. Bull.*, 1946, 43, 385–440.

Strong then took his returns from all his groups and determined what proportion of total subjects circled each letter for each item. He then found how members of each profession or occupation had answered the item. Answers to the item were for that profession weighted according to the extent they departed from the general population. (Strong assumed that his two hundred physicians, two hundred insurance men, etc., would represent the general public.) If of the general group 60 percent indicated that they liked witty people, and only 46 percent of architects made this answer, this answer would receive a negative weight in measuring architectural interest.

Strong has evidence of a certain stability of the pattern of interests measured by his test through college years. There is also some evidence that those with high interest scores in a particular profession tend to be more successful in terms of income. College freshmen, for example, who stood high in the interests of insurance men tended, years later, if they became insurance salesmen, to sell more insurance than the college freshmen who made low scores in the insurance men's interests.

RATING METHODS

Rating methods for the measurement of personality traits make use of the judgments of a number of persons acquainted with the individual under consideration.[6] The *rank order method* of rating, which is sometimes used, calls on the judges to arrange a number of persons in the order in which a certain trait is evident. The judges are merely asked to indicate the rank order of a number of individuals in the trait. From a collection of the ranks by many judges we can discover the extent to which they tend to agree. Basically this is like comparing

[6] For a detailed discussion of rating methods, see E. S. Jones, Subjective evaluations of personality, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, pp. 139–169.

lengths and judging relative positions, as would be necessary in reading a thermometer or a galvanometer or a height. But the traits being judged vary greatly in the objectivity with which men can judge them. Few or no traits are judged with such high agreement among judges as would be shown in reading a galvanometer scale or taking a reading of blood pressure. Some traits can, however, be judged with considerable agreement.

Another rating method which is in widespread use in the rating of employees in industry is the *graphic scale*. Supervisors are asked to rate such traits as "punctuality," "efficiency," or "responsibility" of the employees they supervise. The ratings may be made by having the supervisor put a check on a line which is supposed to indicate various degrees of the trait. The checks may be given a numerical value by dividing the line into five or seven equal parts and assigning numbers to the checks, depending upon the section of the scale in which they fall.

At the University of Washington, members of the teaching staff may request that a study be made of the opinion their students hold of their quality as teachers. This is done by means of a *man-to-man scale*. The rating of an individual instructor is undertaken by asking each of his students to write down the names of five college teachers known to them, one outstandingly good, one superior, one about average, one somewhat below, and one distinctly poor. The students are then asked, with regard to each of five traits, to judge where the instructor being rated belongs when his name is placed among the five teachers being used as a sort of scale.

The resulting ratings turn out to have a satisfactory reliability, as measured by correlating the pooled judgments of ten students with the pooled judgments of ten other students. The reliability coefficient in this case is equal to .80, whereas the reliability of single student ratings was .30.

It is quite to be expected that we may depend more surely on the pooled judgment of ten judges, regardless of the particular rating method used, than on single judgments. But what we can depend on

ratings for is to be consistent or reliable. We have not yet demonstrated their *validity*. To demonstrate that would require that we show judgments to correlate highly with some other independent measure of the trait. Validity is ordinarily much harder to establish than reliability, as we have said before.

ERRORS IN RATINGS

There are several common sources of error inherent in the use of rating scales. One of these sources of error is a tendency, when an individual is being rated on a number of traits, for a *halo effect* to be in evidence. By this is meant a tendency to allow a general attitude of approval or disapproval by the judge to color the ratings of all traits. The individual regarded with favor turns out to be high in all desirable qualities. If the judge likes him he tends to judge his scholarship, his industry, his coöperativeness, his special skills all with a favorable bias.

Another persistent form of error in the use of ratings by acquaintances is a strong tendency to up-grade, to be lenient in making the rating. In University of Washington judgments of faculty by students, students were asked to use a scale that would have made 3.5 the average rating. Actually the average of a large number of student ratings was above this value. Teachers are judged with a certain tendency to up-grade.

Tendencies shown for preferential use of certain positions often turn up also. For instance, the use of the highest and the lowest scores may tend to be avoided on a graphic rating scale. Over-use of middle scores, like the tendency to up-grade, can sometimes be corrected by showing the number of individuals to be placed in each position on the scale.

Many studies of the use of judges in rating personality traits have established some tentative general rules. There is, according to Hollingworth, no such thing as a general judicial capacity in judging people.[7] Judges differ in their ability to judge any particular trait. Other

[7] H. L. Hollingworth, *Judging human character*, New York: Appleton-Century, 1922.

studies have demonstrated that one reason for disagreement between raters is that they have encountered the persons rated in different types of situations. This is what makes a larger number of judges deliver a more reliable judgment. Individual biases and the effects of chance encounters tend to neutralize when many judges are used.

It has been observed that judgments have increased reliability when the judges have similar educational and professional backgrounds; but it should be noticed by the student that this does not at all guarantee validity. In fact, similar educational and professional backgrounds in judges may well serve to make consistent some group prejudice.

According to Conrad it is quite legitimate to judge a judge by his tendency to agree with the combined judgments.[8] At the University of Washington, teachers being considered for promotion are rated by their colleagues. When one of these colleagues is found to assign ratings far from the combined ratings of all other judges this is taken to indicate a possible bias or prejudice, and in extreme cases the judgment is not entered on the record. In the several cases in which this happened there was independent testimony of prejudice.

In the actual use of rating scales, discussing the distribution of abilities, describing how to use the scale, cautioning against the halo effect, the tendency to avoid extremes, overrating, prejudice—all pay dividends in increased reliabilities of the ratings.

DIRECT OBSERVATION AND SOCIOMETRIC TECHNIQUES

Personality traits may also be studied through *direct observation* of samples of behavior. By noting certain features of the behavior of children for short intervals of time scattered over a long period, the frequencies of various kinds of behavior can be observed—how often this particular child strikes another, cries, has a temper tantrum.

The studies of honesty made by Hartshorne and May are a variant

[8] H. S. Conrad, The personal equation in ratings: I. An experimental determination. *J. Genet. Psychol.*, 1932, 41, 267–293; The personal equation in ratings: II. A systematic evaluation. *J. Educ. Psychol.*, 1933, 24, 39–46.

of such behavior sampling.[9] Hartshorne and May exposed children to certain forms of temptation to cheat or steal or lie and recorded the results as a measure of the general trait of honesty. They found only slight intercorrelations between different forms of honesty measured by different situations. That a child will cheat by retaining some pennies which apparently are not to be checked does not indicate that he will be the one to cheat in an examination.

Another approach to the description of personality is in terms of the *sociometric techniques* devised by Moreno.[10] Members of a group that have become well acquainted vote on their preferences for one another. It is found that certain individuals tend to receive many votes. These are called *stars*. Others receive few votes or no votes, and are called *isolates*. Those who vote for one another are called *mutual pairs*. This method is effective in designating the unhappy and badly adjusted individuals in a group, and also in determining who are the leaders.

ATTITUDE SCALES

The word *attitude* is generally used by psychologists to describe general kinds of word reaction to situations and objects, just as the word *trait* is used to indicate a kind or variety of behavior reaction. Both attitude and trait are aspects of personality. As in the case of traits, an attitude is actually made up of specific associations. In particular situations, the past experience of an individual will lead to a specific answer to a particular word stimulus. This answer will depend on his past associations. But we are often not interested in the specific answer and want only to know whether it will be favorable or unfavorable, hostile or suspicious. The poll interviewer is usually not interested in the particular phrases you will use in response to his questions. He needs to know only whether you believe or disbelieve, support or oppose, like or dislike, or, in some cases, the extent of your reaction. Whether you express this by saying "No, indeed" or "Hell,

[9] H. Hartshorne and M. A. May, Studies in deceit, in *Studies in the nature of character* (3 vols.), New York: Macmillan, 1928.

[10] J. L. Moreno, Who shall survive? A new approach to the problem of human interrelations, *Nerv. Ment. Dis. Monogr.*, 1934, No. 58.

no" is not of importance to him, though it may be quite characteristic of you. You could not use any phrase that was not established in your own individual past experience. You are limited to a repertory of responses formed in your past experience.

In the measurement of attitudes there have been two major techniques in recent use. One of these was proposed by Thurstone in 1929;[11] the other was proposed by Rensis Likert in 1932.[12] Each of these techniques is designed to put the measurement of attitude on a scientific basis, which means reducing it to public facts and getting agreement on the method of measurement.

The Thurstone technique selects a number of phrases which presumably express degrees of an attitude toward some issue. Judges are asked to arrange the items on a nine-point scale from favorable to unfavorable. The judges are not to respond in terms of their own attitude. By pooling the judgments of the judges (finding an average position given each item), scale values are then assigned the items. Ambiguous items which the judges have disagreed on and scattered all over the scale are discarded. The final scale should have from 18 to 22 items, each separated by approximately half a scale unit. The subject, when taking the test, checks the items he agrees with, and his score is the median of the scale values of the items checked. A test of this sort can be made to measure attitudes with a reliability of over .90 between two different forms of the test made as nearly equivalent as practicable.

The technique used by Likert is very like the construction of a test for a personality trait. The subject is offered many items and on each one is asked to indicate his attitude on a five-point scale ranging from "strongly disagree" to "strongly agree." The test is then given to a number of persons, and on the basis of their scores a high group and a low group are chosen. Each item is then examined to see whether it tends to differentiate the high group from the low group. The test

[11] L. L. Thurstone and E. J. Chave, *The measurement of attitude*, Chicago: University of Chicago Press, 1929.

[12] R. Likert, A technique for the measurement of attitudes, *Arch. Psychol.*, N. Y., 1932, No. 140.

usually has 20 to 25 items. Like the Thurstone technique of measuring attitude, the Likert technique can be made to give high reliability between equivalent forms.

The validity of these techniques is harder to establish. The proof of validity must lie in the ability of the measure to predict how some independent measure of the attitude will result or to predict how the population examined will behave in this respect on a later occasion.

INTERVIEWS AND ATTITUDES

Attitudes may be investigated through another method which does not use a preformed test. This is the method of interview which does not readily yield reliable measures of degree in attitudes but has some great advantages in yielding new information. The methods of Thurstone and Likert cannot possibly do more than measure the extent and degree of certain attitudes which have been described and formulated in advance by the investigators. The method of interview may bring out attitudes or formulations of attitudes which had not been suspected by the investigators before the interview.

Interviews may be described as either *free* or *standardized*. In the free interview the interviewee is encouraged to talk on the topic of interest, and notes are taken during or immediately after the interview. Such notes should select the key phrases used by the person himself. The part of the interviewer is not to talk but to keep the other talking until he has fully expressed his attitude on the topic. The standardized interview uses a set of questions or points to be covered. This procedure may have advantages where interviewers are not trained persons or where interviewers cannot be assembled for careful briefing before making a survey.

CLINICAL INTERVIEWS

Interviews may also be used to probe such things as ambitions, interests, daydreams, fears, worries, anxieties, and adjustments as well as attitudes. Interviews which attempt to go beyond surface expressions and probe basic motivations are called *depth* interviews and are fre-

quently used by clinicians. A psychoanalysis, for example, consists in a series of such interviews, in which the analyst aims to lead his patient to expose the basic conflicts which lie behind his difficulties. Carl Rogers is the chief exponent of another type of clinical interview which he has called the *nondirective* interview.[13] This consists in a series of interviews with a troubled patient, in which the interviewer plays the part of a rather passive but sympathetic and intelligent listener. He is the audience that encourages the patient to keep examining, describing, reformulating his problem until eventually the patient himself makes his decision, meets his difficulty, reorients his attitude, and is relieved of trouble. This assumes that the patient is a "going concern" and capable of adjusting himself with time and help. There are countless cases in which with such help the mother who is having difficulty with a child, the wife who is not getting on with her husband, the student whose studies have somehow stalled can be assisted to reëxamine their situations and bring about a solution of their own.

Rogers has recorded and analyzed many interviews and has tentative evidence that the solution of a troubled state is seldom reached by active advice from the interviewer, but rather by a very gradual process of review and reëxamination on the part of the patient. Most patients attempt to throw the burden of choice on the interviewer. Advice, however, will often be followed only to show that it was wrong unless the patient has been led actually to make up his own mind. He must be led to make his own suggestions, and the interviewer should limit himself to showing that he is listening and to an occasional rephrasing of some conclusion that the patient has reached and expressed himself. Much of the interviewer's conversation should consist of "uh-huh" or its equivalent. Many counselors or teachers who have interviewed hundreds of persons tend to confirm these statements of Rogers, but only a small beginning has been made toward their objective proof.

Many of Rogers' points are obviously valid. The chief fault of teachers in giving advice is to fail to hear the student out and thus not know

[13] C. R. Rogers, *Counseling and psychotherapy*, Boston: Houghton Mifflin, 1942.

what the problem really is. We can all confirm Rogers' statement that the ostensible purpose of the patient's visit is seldom the real source of trouble. The student who asks advice about how to study turns out to be in trouble because quarreling parents each are demanding that he take sides. The student who expresses a doubt about a choice of courses is in some instances in a deep indecision over a love affair. None of these should be construed to mean that we should withhold advice or information where it is obviously advice or information that is wanted. The student who asks the way to the college lost-and-found department should obviously be told where it is.

PROJECTIVE TECHNIQUES

In addition to tests, inventories, questionnaires, and the various types of interview, another important method of examining personality may be described as the projective technique.[14] These techniques, like the free interview, encourage the subject to express himself through some novel stimulus situation which (1) encourages talk, (2) is not associated with conventional reserves, and (3) offers free play to inner interests and motives which are part of the internal stress situations operating within the organism.

The word association test which the reader of this book took some time ago is an illustration of such projective techniques. Most of the responses to that test are common and depend on experiences which we have shared with others. However, persons suffering from a state of conflict, frustration, an ambition, a strong wish, a fear, or a dread are likely to have it intrude into their word responses.

At the University of Washington, a class of eighty was asked to have paper and pencil ready, and on hearing a single stimulus word to write rapidly the first word that this stimulus evoked and follow that with the first word the response evoked and continue this until

[14] R. W. White, Interpretation of imaginative productions, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, pp. 214–251. H. Sargent, Projective methods: Their origins, theory, and applications in personality research, *Psychol. Bull.*, 1945, 42, 257–293. Excellent descriptions of projective techniques may be found in these two articles.

50 spaces had been filled. Eight of the class, started by the initial signal, which was the word "fish," got around to mention of a mid-term examination they were to take in another course the next hour. Another set of popular words that occurred in many lists included "canoe," "moonlight," "lake." The occasion had happened to coincide with the first week of summer weather and the university operates a canoehouse on Lake Washington.

The most widely used projective technique is the Rorschach ink blot test. This consists of a set of ink blots. The subject is instructed to look at the ink blots one at a time and to describe what they suggest to him—what they look like. Every person is familiar with the fact that in looking at a cloud bank, the face of a cliff, or any complex pattern, we tend to "see" figures which are in part subjective and private, figures which other persons may not see even when their attention is called to them.

It is well known to psychologists that what is seen under these circumstances is partly determined by the factors in the organism and partly by the stimulus. The determiners of behavior lie more within the organism than without. States of hunger, fear, or dread, states of pleasant expectation, hope, all tend strongly to determine not only what responses will be made to the stimulus situation but even tend to determine what stimuli will be reacted to, what we will notice. Thus a subject properly managed will, when asked to describe what he sees in the ink blot figure, tend to name some features which represent common interests and would be named or readily perceived by others, and, in addition, to name features which are determined by his private motives, interests, ambitions, fears, and other tendencies.

There is already a considerable literature on the Rorschach ink blot test and its use. The Rorschach test has thus far not been subjected to scientific controls. The claims of many persons to expertness in the use of the test are not subjected to anything resembling a scientific check. The "expert" may diagnose personality through the use of the test and, if the traits he claims to find evidence for have not as yet

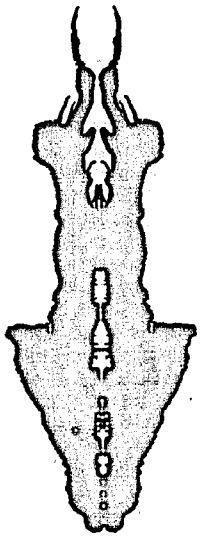

FIG. 5. An Ink Blot Similar to Those Used in the Rorschach Test. Subjects are shown 10 such blots, some in color, and asked to tell what they see. An expert in the interpretation of the Rorschach test believes that the responses of subjects to these blots provide many insights into personality.

been successfully measured or verified by psychologists, there is no way of checking the "expert's" claims.

It is unfortunate that the test lays itself open to this misuse, because it has promising qualities and certain distinct advantages. It taps behavior in subjects without putting them on their guard. To the situation of discussing the ink blot no conventional cautions or inhibitions apply. The novelty of the situation is a great advantage.

Another projective technique is the Thematic Apperception Test.[15] This consists of a set of pictures in which the situations portrayed are complex but not definite. The person taking the test is asked who the characters might be, what they are doing, why, what will happen next. In other words, he makes up a story about the picture.

As in the case of the ink blot test, the story which a person makes up about the picture is very likely indeed to be influenced strongly by the inner state of the person himself—by his likes, dislikes, ambitions, fears. The characters of the story often appear to be thinly disguised representations of characters about whom the person is concerned, and the story is often very plausibly interpreted as an account of a past event in the person's life, or a statement of a possible way out from some difficulty the person faces, or the embodiment of his wishes or dreads.

It is obvious, however, that the interpretation of a Thematic Apperception Test is made scientific only with great difficulty. To be scientific it must be reduced to factual terms which any observer will accept. It cannot be left as the intuitive judgment of one person or a small group of persons, even if they can demonstrate their own capacity to predict behavior through their testing. That would demonstrate only a capacity in the expert, like expert tea tasting, which has no connection with science. Some doctors can "smell" certain diseases. This is a fortunate skill, but it is not science. It could be science only if the

[15] The Thematic Apperception Test is described in H. A. Murray, *et al.*, *Explorations in personality*, New York: Oxford University Press, 1938. See also C. D. Morgan and H. A. Murray, A method for investigating fantasies: The Thematic Apperception Test. *Arch. Neurol. & Psychiat.*, 1935, 34, 289–306.

"smell" could be so described that any observer could recognize it from the description.

Various other forms of projective techniques have been used. A person may be confronted with an incomplete sentence and asked to finish it. If the beginning is sufficiently vague, an opportunity is provided for the internal states of the person to affect the completion and direct the thought.

With children promising results have been secured from the use of play techniques. The child is placed before some dolls and other toys such as furniture, automobiles, or the like, and the manner of his play is observed. It is often clear that the dolls have been made by the child in some sense equivalent to the people with whom he is concerned, and the play events represent resentments, jealousies, wishes, dreads of the child himself.

In considering all of these projective techniques it should be borne in mind that all behavior is determined in terms of present stimuli and organic state and past experience. We react only when stimulated, and the pattern of that reaction is what it must be in terms of organic condition. This is one of the necessary assumptions of science. This makes it entirely legitimate to infer the inner motivation of a person from his behavior when we can describe the signs in recognizable and objective terms and also define an objective and observable meaning for the motive.

There are some advantages common to all the projective techniques for probing personality. The subject of the inquiry has little notion of what reactions will be noticed by the experimenter or what significance will be attributed to them, nor can he tell what the socially approved answers are. In taking a test like the Strong Vocational Interest Blank, a person who wishes to convey the impression that he shares the interests of professional psychologists can easily recognize how a psychologist would probably answer many items. In other words, an intelligent student can on request repeat the Strong test and make a much higher score as psychologist. This is a great disadvantage in a test

because it makes valid results depend on getting a high degree of coöperation from the person being tested. In applicants for a job, for instance, there would be a strong tendency to answer as they believe the holders of such jobs would answer. Such replies would invalidate the results.

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XIII

Personality Disorders

PERSONALITY is the end result of the interaction of organism and environment. Personality traits, we assume, are developed by individuals as adjustments to their environments. Some individuals, however, force us to give special attention to them by the fact that the traits and mechanisms they have developed have taken an exaggerated form, or have become fixated, to the extent that they interfere seriously with the lives of their friends or families, or with the capacity of the organism to adjust to new situations. The adjustment mechanism of fantasy, for example, may result in a complete flight from reality. Rationalization may be used to reinforce false beliefs of self-importance. Alcohol, at first a means of escape from conflict, may become a mode of life that makes the individual a social liability. When these essentially adjustive reactions thus impair the capacity of the organism to make new adjustments, we have at hand something that common sense refers to as a "mental breakdown."

Impairment of the adjustive capacity itself may be severe or mild. The classification of the types of breakdown is in a state of change. At the beginning of this century the classification was based almost purely on symptoms, but the addition of knowledge concerning the ways in which breakdowns are brought about and the ways in which recoveries take place has tended to obscure the distinctions between some of the different forms of mental disease. Among the more severe

disorders in which the determining causes are still very obscure are the *psychoses*. These include the cases in which there is a distinct loss of contact with reality. The psychotic may be and often is dangerous, not only to himself but to others, whereas, in the less severe disorders, the *psychoneuroses*, the individual is more of an annoyance than a danger. The psychoneuroses include the more familiar cases in which an individual has not been able to surmount some difficulty of choice, in which some form of conflict has, for the time being, impaired the ability to make decisions or resolve problems.

FUNCTIONAL PSYCHOSES

Of the psychoses the main classes tend to be defined in terms of symptoms. A high school boy is noticed to be going to the wrong classes occasionally, to be withdrawn from most of his previous friendships and associations. His gradual withdrawal may eventually reach such a point that he refuses to answer questions or engage in conversation. He shows no concern on hearing of the death of a friend, though later he gives evidence of remembering that the death took place. He begins to develop oddities of speech and appears to be lost in deep thought. He may report that he hears "tiny voices" whispering to him—"voices" which others are unable to hear. The symptoms which this boy has developed are apt to lead the clinician to classify him as a case of *schizophrenia*.

Another patient who has been brought to a clinic talks almost continually to the clinician. He is restless and excited and easily distracted. His speech shifts rapidly from topic to topic with perhaps a number of vulgar comments interspersed. He appears confident, highly confident, of his abilities and tells of a plan he has for making the world a better place to live in. While he is describing this plan in his rapid speech, he gestures vigorously with his hands and may prance around the room. The clinician would probably diagnose this individual as a case of *mania*. This same patient may possibly at a later stage appear depressed, extremely sad, and with many symptoms of anxiety. If viewed at this time by the clinician, he would probably

be classified as a case of *depression*. A clinician who knew of both stages would diagnose the patient as a *manic-depressive* case. In fact, it was quite customary in the past to diagnose any case of mania or depression as a manic-depressive case in the belief that these stages were but part of a single cycle. There are good reasons to believe that this is not true.[1] Only a minority of depressed individuals pass into a manic stage and only a somewhat larger proportion of manic cases pass into a depressed stage.[2] It is probable that in the future, mania and depression will more often be diagnosed as distinct disorders rather than as stages in a manic-depressive cycle.

A girl who is exceedingly ambitious gradually begins to develop behavior patterns which seem somewhat strange to her friends. She states that when she walks into a room where people are conversing, the conversation stops. She expresses the belief that this is because she was the topic of their conversation. She expresses the belief also that most of the people she thought were her friends now spend much of their time saying "mean" things about her. Her failure to be elected to the sorority of her choice some years ago she now blames on the "plottings" of some of these so-called friends. She expresses the belief also that her instructors do not like her, the reason for their dislike being that she knows more than they. She is quick to take any statement made as having some reference to her. In an advanced stage, she may even begin to express the belief that "people" are plotting to kill her, trying to poison her food, or set traps for her. This girl would probably be diagnosed as a case of *paranoia*. The major symptoms of paranoia consist of *delusions* (false beliefs), which are often well organized and which begin to dominate the patient's behavior. These delusions frequently take the form described above and when they do are called delusions of persecution. Delusions of grandeur (beliefs of extreme self-importance) may also be present.

The behavior disorders which have just been described are usually

[1] N. Cameron, The functional psychoses, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, p. 874.
[2] *Ibid.*, p. 885.

called *functional* psychoses for the reason that no organic basis, in the sense of brain damage or damage to the nervous or glandular system, is known for them.

Classifying the functional psychoses on the basis of symptoms has not proved entirely satisfactory.[8] Many patients diagnosed as schizophrenic show symptoms of the manic, or depressed, or paranoid patient. And many manic and depressed patients may also show some of the symptoms of the schizophrenic. The pictures of the pure symptoms of the various functional psychoses are not often to be found in exactly that form in the patient in the clinic. This will be true of the psychoneuroses also.

PSYCHONEUROSES

Some readers of this book may have had no acquaintance with a psychotic. The development of a psychosis usually requires that the patient be hospitalized in order to prevent him from harming himself or others, or because he is too dependent on care to be left to his own devices. There is no reader of this book, however, who will not have had frequent acquaintance with mild or severe instances of psychoneurosis, and with the common symptoms of psychoneurosis most of us are familiar from our own experience. We have all known anxious periods in which we were tense and sleep was difficult. We have all had periods in which decisions were harder to make than usual. This mood is one of the ordinary results of fatigue. We have all experienced periods when appetite failed us, or periods when we were concerned about our health and worried over symptoms that were really of minor importance. We all suffer occasionally from ungrounded fear or from unjustified depression. We have all made health or headache or illness an excuse for the avoidance of unpleasant duty. In one artillery battery at an officers' training school it was noticed that the average attendance at sick call was from Monday through Friday just over thirty men; but the average dropped to a bit over two on Saturday when leave was possible.

[8] *Ibid.*, pp. 870–871.

The psychoneuroses are named in terms of the prominent symptom group that characterizes the case. Most of us are not psychoneurotics. We are said to be suffering from a psychoneurosis only when we exhibit a number of the above symptoms persistently and under circumstances in which most men would find the symptoms transient.

If fatigue and exhaustion are the most prominent symptoms complained of by the patient, he is said to be neurasthenic. This term originally meant "nerve weakness," but the fatigue complained of is not a physical fatigue resulting from exercise of nerves. Our nerves are less affected by physical fatigue than our muscles.

The fatigue complained of by the neurasthenic may be the product of associative learning. The psychoneurotic has sufficient conflict and tension in his response to ensure that unusual physical fatigue is present, but the reactions first made to physical muscular fatigue may be easily conditioned upon the thought of activity or the sight of work. Many persons have remarked this phenomenon in the form of "museum fatigue," which is the reaction that overtakes us on entering a museum and encountering the sights that had on a former occasion accompanied an actual fatigue.

If the outstanding symptom complained of by the patient is anxiety, and its common symptoms of quickened heartbeat, periods of holding the breath or of difficulty with the breath, "nervous" indigestion, tension are present, the condition is named *anxiety neurosis*. All of these symptoms may be also present in neurasthenia, but in neurasthenia the outstanding and conspicuous complaint is exhaustion or fatigue.

The student will notice that in the psychoneuroses there is no clear-cut syndrome of symptoms or definite and characteristic group of symptoms that characterizes neurasthenia, hysteria, anxiety neurosis, or psychasthenia. One symptom which might be (for the purpose of naming) set down as characteristic of an anxiety neurosis is the presence of phobias or morbid fears. A patient complains that she is unable to go out in the evening because bright lights make her feel "as if I am going to faint." She has obvious great dread of this feeling. One result of this premonitory distress has been to keep her at home

in a darkened room as soon as darkness arrives. She has not encountered bright lights for months because she has avoided them.

This is a characteristic of the phobias. They last indefinitely because they lead to behavior that avoids the frightening stimulus, and so they cannot be unlearned. To learn to react differently to bright lights the girl had eventually to be encouraged to face them under favorable and distracting conditions which avoided panic and got rid of the phobia through reassociation.

The second form of psychoneurosis mentioned above, hysteria, is the least definite group of psychoneuroses. Hysteria is represented in military cases by soldiers who exhibit the symptoms of illness, aches and pains, muscular weakness or paralysis, deafness, blindness, the inability to respond to touch on some area of the body, where no physical basis for the symptom can be discovered. The outstanding feature of these symptoms is that they serve to get the patient out of trouble or danger. They get him sent back to the hospital or invalided home, or, perhaps, just to sick call instead of arduous exercise. The illnesses are said to be unreal or imaginary. Exactly the same thing can be observed in an aging dog that limps painfully and slowly to its outdoor bed on winter nights, but dashes briskly into the house in the morning after a sleep in chill quarters.

The hysteric symptom, whether it is a simulated illness, an anesthesia or inability to sense, or a paralysis, has been learned as a way out of trouble just as a cat learns its way out of a puzzle box. The symptom has been hit upon perhaps by accident, more often as a result of the questions of a medical examiner. It is maintained so long as it means escape.

One essential difference between hysteria and the other forms of psychoneurosis should be mentioned. The hysteric has, so far as he himself is concerned, made his adjustment. His solution is not acceptable to others. It is his friends or family or employer or the public that suffers from hysteria, not the hysteric.

Less well established in current usage, the fourth group of psychoneuroses, psychasthenia, has as its outstanding symptom a depression

of action and inability to make decisions. As in the other psychoneuroses, the whole list of symptoms may be in evidence in psychasthenia; there are often phobias, anxiety states, nightmares, and all the rest. We speak of the case as a psychasthenic if the conspicuous feature of his trouble is depression and indecision.

THEORIES OF BEHAVIOR DISORDERS

The student should recognize that the diagnosis and treatment of behavior disorders is a relatively new development, with contributions from psychology, medicine, and psychiatry. We do not as yet know the precise causes of these disorders, and for the functional psychoses and psychoneuroses described, we have no consistent evidence of an organic basis underlying them. It may be that in the future some structural defect or change in the central nervous system or the glandular system may be found for these disorders, but the evidence at hand at the present time does not seem to point in that direction. Instead the prevailing view seems to be that these disorders have their basis and development in the experiences of the individual; in the conflicts and problems each must face and in the adjustments he must make to these. These conjectures are to some extent a matter of theory, and some theorists have preferred to look for an answer in terms of body build, which is supposed to be associated with a particular type of temperament, which in turn is supposed to predispose the individual toward the development of a particular type of behavior disorder.

Kretschmer, a German psychiatrist, believed that individuals who were classified as manic-depressives and those who showed the symptoms of schizophrenia differed radically in their body types.[4] There were, for Kretschmer, four main body types. He used the word *pyknic* to describe one type of physique. This is the Greek word for "compact," and Kretschmer describes pyknics as compact, round-chested, short-necked, and full-faced. Another type was the *leptosome,* from the Greek meaning "thin," "weak-body," who was long-legged, short

[4] E. Kretschmer, *Physique and character* (Trans. by W. J. H. Sprott), New York: Harcourt, Brace, 1925.

in the trunk, narrow-shouldered, and thin. The *athletic* type was the well-developed, muscular type, with broad shoulders and narrow hips. The athletic type was considered a sort of subgroup under the leptosome classification. To take care of what is left over, there is the *dysplastic* or mixed type.

The athletic, dysplastic, and in particular, the leptosome, Kretschmer believed, possessed a schizoid temperament which tended toward seclusiveness and withdrawal, the major symptoms of the schizophrenic. The pyknic, he believed, possessed a cycloid temperament which tended toward emotional ups and downs, the symptoms of manic-depressive psychosis. Research has not confirmed this association of pyknic body build and a cycloid temperament, or leptosome and athletic with schizoid.[5]

A more recent and more elaborate effort to type people has been made by Sheldon.[6] Sheldon reminds us that the developing human ovum early displays three distinct tissues, an inner lining, a middle tissue, and an outer layer. From the *endo*—or inner—layer, the stomach and digestive organs develop. From the *meso*—or middle—layer, the bones and muscles develop. The *ecto*—or outer—layer is primarily responsible for the development of the skin, sense organs, brain, and nervous system.

Sheldon believes that the adult human being can on examination be judged in terms of his relative development in each of these three tissue areas. He suggests assigning to a person three numbers, each figure designating on a seven-point scale the individual's development in each of these directions. The first number refers to endomorphic, the second to mesomorphic, and the third to ectomorphic development. To say that Mr. X is 1–7–1 is to say that his abdominal-visceral development is extremely slight (1); his bone, muscle, and connective tissue development is extreme (7); and his development of surface area in proportion to his mass slight (1).

[5] See, for example, the discussions by D. G. Paterson, *Physique and intellect*, New York: Appleton-Century, 1930, chap. 7; A. Anastasi, *Differential psychology*, New York: Macmillan, 1937, chap. 9.

[6] W. H. Sheldon, S. S. Stevens, and W. B. Tucker, *The varieties of physique*, New York: Harper, 1940; W. H. Sheldon and S. S. Stevens, *The varieties of temperament*, New York: Harper, 1944.

Sheldon believes that the physical endomorph (7–1–1) displays what he calls *viscerotonia* or love of comfort and relaxation, greed for affection and approval, and need of people when in trouble. The extreme mesomorph (1–7–1) exhibits *somatotonia* or need for exercise, directness of manner, and need of action when troubled, energetic action. The extreme ectomorph (1–1–7) shows *cerebrotonia*. (The brain and spinal cord develop in the embryo from the outer layer.) The cerebrotonic shows restraint in posture, tenseness, poor sleep habits, need of solitude when troubled, and appears to be under strong inhibitory control.

The efforts of Kretschmer and Sheldon to discover a classification of men that will let us know just what to expect of a man when we know his type are here described only because they represent such a strong and recurrent interest of mankind, not at all because they have been scientifically validated. Thus far no one of the many systems proposed has stood the test of examination. We do not find that men can be divided into pyknics and leptosomes, or ecto-, meso-, and endomorphs with associated types of temperament and personality. This point of view probably finds widespread acceptance by the general public because of an earnest desire for a short-cut method of understanding behavior.[7] The appeal of constitutional-type theories for a number of biologically trained scientists perhaps lies in the feeling that by somehow clothing personality and behavior disorders in constitutional terms, scientific respectability is thereby gained. The evidence at the present time is not sufficient to decide this question one way or the other. The trend, however, among practicing clinicians is to emphasize the origins of behavior disorders in terms of conflict and adjustment of the organism, a point of view stressed by the psychoanalysts.

[7] A. Anastasi, *op. cit.*, p. 221.

PSYCHOANALYTIC TREATMENT

The theory and methods of psychoanalysis developed out of the practical clinical experience of Freud. On the basis of this experience, Freud formulated the belief that personality disorders are the result of trauma or shocks experienced in early childhood or infancy and centering around the sexual urge.[8] Psychoanalytic theory has undergone many changes since the early days of Freud, and modern psychoanalysts emphasize other drives in addition to sex.[9] But stress is still placed on conflict and the adjustments which are made to conflict.

Psychoanalysis as a method of treatment of personality disorders consists in a protracted series of interviews in which the patient is encouraged to talk about himself freely and to follow freely the associations of his dreams.[10] It is expected that the associative train of thought will eventually lead to the emotionally charged experience which has been forgotten so far as conscious memory is concerned. The patient has forgotten or repressed the experience because of the unpleasant associations which accompanied it at the time it occurred.

The eventual recall of the incident, with the assistance of the psychoanalyst, is accompanied by distress and excitement, but the result of bringing the experience out into the open where it can be examined is to bring relief from the distressing psychoneurotic symptoms. These symptoms are simply the result of the organism's adjustments to the conflict produced by the experience. When the experience is recalled, no longer repressed, the symptoms disappear.

Most methods of *psychotherapy* (treatment of personality disorders) are based on some form of the "talking out" process. The treatment or

[8] Freud developed his theories in numerous papers and books. A summary of the psychoanalytic point of view concerning early experiences can be found in M. A. Ribble, Infantile experience in relation to personality development, in J. McV. Hunt (ed.), *Personality and behavior disorders* (2 vols.), New York: Ronald, 1944, pp. 621–651.

[9] See F. Alexander, T. M. French, *et al.*, *Psychoanalytic theory*, New York: Ronald, 1946; K. Horney, *New ways in psychoanalysis*, New York: Norton, 1939; K. Horney, *Our inner conflicts*, New York: Norton, 1945.

[10] A description of the psychoanalytic method of treatment can be found in G. Murphy and F. Jensen, *Approaches to personality*, New York: Coward-McCann, 1933, chap. 4.

guidance given by counseling services, child guidance clinics, and mental hygiene centers consists essentially in inducing the patient to verbalize his problem and thus to render it capable of solution. A major difference in various methods of psychotherapy lies mainly in the nature of the role assumed by the clinician, counselor, or interviewer. He may be "active" or "passive"; "directive" or "nondirective"; offering interpretation or refraining from it. However, psychoanalysis and other less protracted forms of psychotherapy all depend upon the patient's coming to recognize, to verbalize, the sources of his conflict.

This therapeutic effect is sometimes achieved, as can be recognized from personal experience, by a more brief "talking out" to a sympathetic friend or listener. In the course of such a "talking out" there is much chance for a relief of irritations and angers and fears through their expression. "Confession," it is said, "is good for the soul." This is not a psychological law, but a statement of what is very often true. Why should confession bring relief?

For one thing, confession is usually a direct gratification of one strong component of the conflict. The interest in talking about what is foremost in thought and wish is the natural result of a lifetime of doing just that. It is an entrenched habit attitude.

Another advantage of "talking it out" lies in the chances for reconditioning made available. Suppose we have been guilty of a breach of good manners and have been anxious and upset. When we recount it to another, the other person is not depressed. It was not his misfortune. He can even find it highly amusing, and there is a possibility that his amusement will be a signal for amusement in us. We share laughter and the expression of moods because we have experienced these with others, and their expression becomes the signal for our own reaction.

Anxiety over our own faults and shortcomings, our sins of commission and omission, the things we have left undone and the things we have done—these may lose their troubling power if we talk them over with another.

Nondirective therapy as advocated and practiced by Rogers,[11] and others obviously depends on the adjustive capacity of the individual. It aims to give opportunity for the patient's own self-direction to take over. This is possible in a large number of persons who seek advice. An intelligent and understanding listener is what is needed rather than advice. With the encouragement of such a listener the patient lays out his situation and forms his own attitude with the whole situation before him. Rogers is probably quite correct in saying that much advice given by counselors has a fatal defect in that the person advised does not make the course advised his own choice, and so cannot carry it out with conviction or enthusiasm.

Rogers points out also that a great many persons seeking advice do not raise the issues which are really giving trouble. Shyness or embarrassment prevents them from mentioning the real disturber, which will appear only as confidence is established in the adviser. The patient or the client is often unaware or only vaguely aware of what is really troubling him. A student appears to ask advice about how to study. How to study is a problem that worries almost no one who is interested in his subjects and for whom the world is going well. It develops that what really is the trouble is that the student's parents have recently separated and each is making a campaign for the son's support and affection. Each wishes the son to be a partisan. This conflict is mentioned only after much other conversation.

Nondirective therapy, because it assumes that, given a chance to talk things out, the patient will work out his own compromise or settlement, is not useful in the psychoses. The psychotic is incapable of regaining his equilibrium through conversation. And very few psychoneurotics are capable of arriving at a solution of their troubles in a short series of interviews and "talking it out." This form of therapy is most applicable to the less severe maladjustments—those that have not progressed to the point of interfering with the adjusting capacity itself.

[11] C. R. Rogers, *Counseling and psychotherapy*, Boston: Houghton Mifflin, 1942.

AIDS TO DIAGNOSIS AND THERAPY OF PSYCHONEUROSES

Among the devices of the earlier psychoanalysts for establishing the relations essential to an analysis, and for indicating the nature of the fundamental conflicts involved in the psychoneurosis, were accounts of dreams by the patient. Freud had pointed out that in dreams wishes which the patient himself is not able to describe or name get expression. The form of this expression may be a private symbolism that can be understood only after exploring all the relevant associations that it calls up in the patient. In other words, the patient may have a dream which is afterward judged by the analyst and the patient himself to express a wish for death, although the patient does not realize that this is the nature of the wish.

Jung, a Swiss psychoanalyst who broke with the Freudian group to set up his own "system" of psychoanalysis, was the first user of another device for getting at the nature of a conflict. This was the "Jung Association Test," which uses a list of words that can be read to a subject who is instructed to respond to each word with the first word that the stimulus word calls up to him. The test is usually given with a stop watch or other time-recording device, and the length of the interval between the stimulus word and the response is observed. When the stimulus word suggests a word which is repressed, there is a delay in responding. Used originally for attempts to determine guilt or innocence, on the theory that certain words connected with a crime would be disturbing only to the criminal, this technique has also been used by psychoanalysts to establish more prompt rapport between analyst and patient.

More modern devices for gaining insight into the deeper elements of psychoneurotic conflicts are the Thematic Apperception Test, the use of stage devices for acting out a situation related to the conflict, and the use of Pentothal Sodium or other narcotics for inducing free conversation about troubles with less than normal conscious repression.

Use has been made of all these in military hospitals during and since the war.

In all of these devices the theory is that the deep sources of anxiety and conflict tend to be expressed when the ordinary restrictions on speech are removed, the habits of reserve which prevent us from speaking what is in our minds. In the Thematic Apperception Test the picture is being described without identification of the characters, which allows the repressed fears or wishes to be expressed as if they were just the fears and wishes of a character in the picture. Children, playing with toys, can be encouraged to express attitudes which might take much longer observation to discover if the toys include a number of dolls which may easily represent the father or mother, or brothers or sisters of different ages. Violent expressions of hostility or interest sometimes develop and can be readily identified with the child's attitudes toward those about him.

Through the use of such a drug as Pentothal Sodium a soldier who was in an extreme state of conflict, with many of the physical attendant symptoms and perhaps even unapproachable for conversation about his condition, could be put in a drowsy but talkative state in which his troubles readily found expression. A serious component in his disorder might be found to be strong feelings of guilt over his responsibility for the death of a comrade. Such feelings of guilt sometimes appeared to have earlier preparation in some childhood incident in which responsibility for the death of a playmate, or for some less serious event, had been deeply felt but not talked about. Armed with such knowledge, the psychiatrist may be able to retrain attitudes and relieve the tension of conflict.

It should be noticed that all of the various methods for getting insight into the motives behind mental conflict are also methods for getting at the patient's history. It goes without saying that the first concern in the treatment of any mental patient is to get as full and as understanding a history as possible. In personality disorders, as in all other behavior, the individual is responding in terms of his past experience. His acts, his speech, his wants, his role—all must have

had their beginnings in his past. In many instances a good history of the situations to which he has been exposed is sufficient to describe his trouble and to indicate the treatment.

Pierre Janet, French psychiatrist and psychologist at the clinic at Salpêtrière in the environs of Paris, has pointed out that many persons who were in mental distress have discovered for themselves ways of economizing their energy and simplifying their lives to a point at which they could make a tolerable adjustment. Others have hit upon sources of excitement which enable them to establish the new habits necessary for a cure. Religion has traditionally offered a number of devices for the relief of distress, not the least of which is the central faith itself which, like wartime patriotism, may serve to give meaning to a life which the individual is incapable of working out for himself.

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XIV

Intelligence

IT was a very practical problem that gave a start to the intelligence testing movement. In 1904 the Paris school directors appointed a commission which was made responsible for picking out in advance the children who would not be able to profit by ordinary instruction in the schools and who would require special training.

Alfred Binet, one of the members of the commission, had been working on the problem of mental ability, and he and his co-worker, Simon, developed a series of graded tests which they believed would serve the purpose. By studying the performance of students on the tests, for example, they hoped to be able to differentiate between those students who were dull and incapable of ordinary instruction and those who were not.

A great deal of labor and painstaking analysis went into the tests developed by Binet and Simon. By the year 1908, they had collected a series of items which had been scaled according to difficulty. Each item was classified according to the average age of children who could correctly answer it. A series of items which could be answered by the average five-year-old child made up the test for that age level. Similar tests were prepared for ages three to thirteen. Using tests at various age levels, it was then possible to examine children until the test was found at which the child was able to pass all but one of the items.

If a child passed all but one of the items, let us say at the five-year level, he would be given 12×5 or 60 months' credit. Credit for additional months was given for all items passed in tests at the higher age levels. The total credit in months received by the child was called his *mental age*. To say that a child has a mental age of eight is to say that his performance on tests like those of Binet and Simon is what children of that age average. The child tested may actually be older or younger. He might be ten or eleven, six or seven.

CONCEPT OF INTELLIGENCE QUOTIENT

When an eight-year-old child passes tests which are just possible for the average ten-year-old child, he is obviously bright. If he can do no better than the average four-year-old, he is obviously very dull indeed. The concept of the *intelligence quotient* tried to say just how bright or how dull he is. The widespread use of this concept is due to Terman, who revised one of Binet's scales for American use. Terman divided the child's mental age (MA) by his chronological age (CA) to obtain the intelligence quotient (IQ). That is,

$$IQ = \frac{MA}{CA}$$

This ratio was then multiplied by 100 to give the IQ because some people are not at home among decimals.

When MA = CA, or, for example, when the eight-year-old boy just succeeds in passing the tests passed by average eight-year-olds, his intelligence quotient is obviously 100. This figure then indicates average intelligence. Quotients above 100 indicate higher than average intelligence and quotients below 100, less than average. A child's IQ, as measured by the Terman scale, is an indication of his *rate of mental development*. It shows whether he is getting on faster or slower than other children.

Terman's first revision of the Binet-Simon test was published in

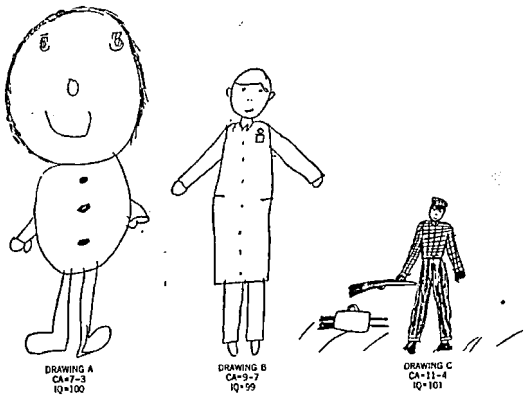

FIG. 6. Performance of Three Girls of Average Ability, but with Different Chronological Ages, on the Goodenough Test. Notice that as age increases, the body proportions of the drawings become more accurate and that more details, especially clothing details, are added. A comparison of the three drawings indicates some of the additional changes that occur with increased age. In Drawing A, the hair is still confined to the circumference of the head, the nose is represented by a circle rather than by two dots, the ears are misplaced, the neck is omitted, and the shoulders are not represented, the arms not being attached at the proper place on the body. Drawing C shows the more mature way of joining the legs to the body; the legs are no longer far apart from each other but are represented as meeting at the point of junction with the body. In this drawing, some finger details have been added and the costume of the man shows no incongruities. (Reproduced through the courtesy of L. B. Heathers, Institute of Child Development, University of Washington.)

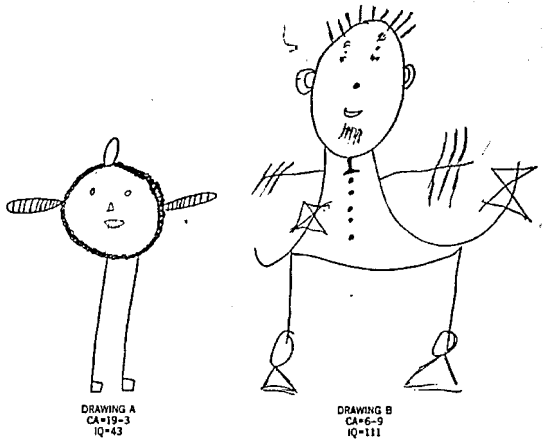

FIG. 7. Performance of Two "Atypical" Girls on the Goodenough Test. Drawing A was made by a girl in an institution for mental defectives. Her chronological age was 19-3 and her IQ on the Revised Stanford-Binet, Form L, was 43. Although the girl's motor coördination is good, her drawing is quite childlike. The trunk is omitted entirely, the arms are attached to the head, the hair circles the entire head, the facial features remain quite simple, and the legs are still represented by parallel lines. Drawing B is that of a girl whose chronological age is 6-9; on this test her IQ is 111. Although her drawing is adequate so far as the number of details included is concerned, her manner of representing these details is quite individual and atypical. Two things are noteworthy about this drawing: (1) the preservation of certain forms such as the triangular feet and clothing details and the straight, vertical lines for hair and fingers; (2) the inconsistency in maturity level of the drawing. The inclusion of eyelashes and fingers and the beginning of relatively good proportions in the ears suggest a higher level of maturity than would be expected from the way the legs, arms, and trunk are represented. A drawing of this type causes one to question the personality adjustment of the drawer. (Reproduced through the courtesy of L. B. Heathers, Institute of Child Development, University of Washington.)

1916.[1] In 1937 there was a thorough revision of the 1916 edition.[2] The 1937 edition has two forms which are equivalent. Each form has 129 items and contains tests ranging from two years through those adjusted to a superior adult. The test is scored by first finding the base year—the highest year at which the child passes all tests. Beyond this year the child is given credit for extra months according to the proportion of items passed at the higher year levels. The MA is found by adding the base year and the months' credits received at the higher years. The test is most reliable for the years six to eighteen. Test scores obtained for earlier years are not very reliable. At all ages low scores tend to be more reliable than high scores.

Successful responses to many of the items on Terman's revision of the Binet test are dependent upon language. In order to cover performances not so dependent upon verbal ability, the test is often supplemented by other kinds of tests, for example, *form boards* in which cutout shapes are to be fitted into their proper holes, or *picture completion* tests in which a picture is shown with some important detail lacking and the child is asked or directed to finish the drawing.[3]

Goodenough of the University of Minnesota is responsible for a test which consists in asking a child to draw a picture of a man.[4] The resultant picture is then scored according to its features. Experience has shown that older children add certain features which younger children tend to neglect.

ARMY TESTS

World War I saw the first extensive practical use of tests. The War Department set up a section of psychologists under the surgeon general; their chief contribution was the development and use of two

[1] L. M. Terman, *The measurement of intelligence*, Boston: Houghton Mifflin, 1916.
[2] L. M. Terman and M. A. Merrill, *Measuring intelligence*, Boston: Houghton Mifflin, 1937.
[3] For a description of various other tests, see E. B. Greene, *Measurements of human behavior*, New York: Odyssey, 1941.
[4] F. L. Goodenough, *Measurement of intelligence by drawings*, Yonkers: World Book, 1926.

tests.[5] One, called Army Alpha, was given to about 1,700,000 men. Army Beta was devised for the testing of illiterates and used pantomime directions rather than written and spoken instructions.

Between wars the War Department did not pursue the development of tests, but with the approach of World War II, a strong organization in the Adjutant General's Office developed many forms of a new test, the General Classification Test, which was given to the great majority of all inducted men.[6] This test aimed at a general prediction of capacity for army jobs and was a practical success in that it gave important information about a man and could lead to far more

TABLE 1. GRADE DISTRIBUTION OF MEN PROCESSED THROUGH RECEPTION CENTERS, 1940–1944

Army Grade	Standard Score Limits	Percentage of Total Group
I	130 and above	6.0
II	110–129	26.5
III	90–109	30.5
IV	60–89	27.7
V	59 and below	9.3

The distribution of scores is based upon examinations given to 8,293,879 men. Various forms of the Army General Classification Test were used, the scores on each form being transmuted to give a mean of 100 and a standard deviation of 20. The reliability coefficients of the various forms ranged from .82 to .97. Men were classified into one of the five grades on the basis of their test scores. (From Staff, Personnel Research Section, Classification and Replacement Branch, The Adjutant General's Office. The Army General Classification Test. *Psychol. Bull.*, 1945, 42, 760–768.)

effective use of men than was possible without it. Some jobs could be performed by men with low AGCT scores. But it was recognized that many jobs were not performed satisfactorily by men who made

[5] C. S. Yoakum and R. M. Yerkes, *Army mental tests*, New York: Holt, 1920.
[6] Staff, Personnel Research Section, Classification and Replacement Branch, The Adjutant General's Office. The Army General Classification Test, *Psychol. Bull.*, 1945, 42, 760–768.

such scores. Men making high scores had higher chances of succeeding in nearly any army career.

LEVELS OF INTELLIGENCE SCORES

We can get a much clearer notion of what a 1937 Stanford-Binet IQ means in terms of the accompanying tabulation which shows what percentage of the children tested made the various scores.[7]

1937 Stanford-Binet IQ	*Description*	*Percent*
140 and above	Genius or near genius	1.3
130–139	Very superior	3.1
120–129	Superior	8.2
110–119	Bright	18.1
90–109	Average	46.5
80–89	Dull	14.5
70–79	Inferior	5.6
50–69	Moron	2.7
20–49	Imbecile	
0–19	Idiot	

A more vivid impression of these terms can be given by a description of the behavior characteristics that accompany them. *Idiots*, for example, never learn the more common dangers. They require constant supervision and care if they are to be maintained alive. Many of them cannot feed themselves. If you try to imagine an adult with the capacity of a child not yet two years old, you will have some idea of what is meant by an IQ of 0–19. Idiots do not have offspring. There is therefore a continuous selection against the appearance of idiocy and the extent to which it can be attributed to inheritance, or the percentage of instances in which idiocy can be blamed on the biological inheritance, is a problem not yet solved. It is not a condition with a single cause. Just as the failure of an automobile to give satisfactory performance can have a multitude of causes, so there can be an indefinitely large number of causes of idiocy.

[7] M. A. Merrill, Significance of IQ's on the revised S-B scales, *J. Educ. Psychol.*, 1938, 29, 641–651.

The *imbecile* may be described as a person who never learns much facility with speech, who can be taught (in many lessons) to do very simple work of routine nature like dressing and undressing, making beds, and such tasks. The imbecile can be imagined as an adult with the mind of a child from 3 to 7 years old.

By *moron* we designate persons who may be able to read and write a little; they are persons of little judgment and with very little anticipation of the consequences of their actions. They can be taught simple and routine jobs, and, so long as the conditions of the job remain the same, continue to perform them.

What is meant by *average intelligence* is already well understood. Some persons of average intelligence go to college, but the number is small. The college population is drawn almost entirely from persons who make above-average scores in intelligence tests. If average persons go to college, they very seldom graduate, and, it may safely be said, they are practically always toward the bottom of the class. It may be remarked in passing that they have plenty of competition for bottom position from the bright, lazy students or the bright, uninterested student.

Of the persons with IQ's of over 110, we find rapidly increasing proportions of college graduates, members of the so-called learned professions—lawyers, doctors, engineers, ministers, teachers. Terman's researchers investigated the later careers of a large number of children who had made extremely high scores in mental tests given to California school children. These children, whom Terman described as geniuses because they had performed in tests as well as the average child almost one and one-half times their ages, were studied some years after their first test and found to be interestingly different from other persons.[8] Many of them were leading rather ordinary lives when described in terms of income or occupation, but there was nearly always added a hobby that was remarkable, or an avocation not common. Of course the group as a whole had won many more distinctions than persons who

[8] B. S. Burks, *et al.*, The promise of youth, in *Genetic studies of genius* (3 vols.), Stanford: Stanford University Press, 1930. A more recent report was announced in the summer of 1947.

years earlier had made lower scores. This group was distinctly intellectual.

Estimates have been made of the IQ's of a number of men well known in history.[9] These IQ's are based on the biographical accounts of the childhood of the men mentioned, and the authors use their own familiarity with children at various intelligence levels to judge what IQ these historical characters would have attained. The list has considerable interest and some objectivity.

Estimated Stanford-Binet IQ	*Individual*
200	Galton
185	Goethe, Leibniz
170	Voltaire
165	J. Q. Adams
166	Tennyson
150	Bryant, Wordsworth, Mozart, Longfellow, Hugo
145	Jefferson, Emerson, Franklin, Galileo, Milton, Webster, Laplace
140	Carlyle, Kepler
135	Darwin, Kant, Napoleon
130	Newton, Spinoza
125	Washington, Lincoln, Linnaeus
105	Faraday

Galton, for example, whose IQ was estimated to be close to 200, wrote the following letter to his sister the day before his fifth birthday:

My Dear Adele,

I am 4 years old and I can read any English book. I can say all the Latin Substantives and Adjectives and active verbs besides 52 lines of Latin poetry. I can cast up any sum in addition and can multiply by 2, 3, 4, 5, 6, 7, 8, [9], 10, [11].

I can also say the pence table. I read French a little and I know the clock.

Francis Galton

Febuary 15, 1827.

[9] C. M. Cox, *et al.*, The early mental traits of three hundred geniuses, in *Genetic studies of genius* (3 vols.), Stanford: Stanford University Press, 1926.

Terman, who made the estimate of Galton's IQ, has this to say about the letter: "The only misspelling is in the date. The numbers 9 and 11 are bracketed above, because little Francis, evidently feeling that he had claimed too much, had scratched out one of these numbers with his knife and had pasted paper over the other."[10]

Another man who was definitely a genius was the mathematician Gauss, the son of a contractor. On one occasion, before he was three, he was watching his father make out the pay roll for his workmen. At the end of a long computation, the child remarked, "Father, the reckoning is wrong, it should be . . . ." A check of the calculations proved that the figure named by Gauss was correct.[11] E. T. Bell, who gives this account of Gauss, cites another bit of evidence of unusual intelligence in the same great mathematician:

Shortly after his seventh birthday Gauss entered his first school, a squalid relic of the Middle Ages run by a virile brute, one Büttner, whose idea of teaching the hundred or so boys in his charge was to thrash them into such a state of terrified stupidity that they forgot their own names. More of the good old days for which sentimental reactionaries long. It was in this hell-hole that Gauss found his fortune.

Nothing extraordinary happened during the first two years. Then, in his tenth year, Gauss was admitted to the class in arithmetic. As it was the beginning class none of the boys had ever heard of an arithmetical progression. It was easy then for the heroic Büttner to give out a long problem in addition whose answer he could find by a formula in a few seconds. The problem was of the following sort, 81,297 + 81,495 + 81,693 + . . . + 100,899, where the step from one number to the next is the same all along (here 198), and a given number of terms (here 100) are to be added.

It was the custom of the school for the boy who first got the answer to lay his slate on the table; the next laid his slate on top of the first, and so on. Büttner had barely finished stating the problem when Gauss flung his slate on the table: "There it lies," he said—"*Ligget se*" in his peasant

[10] L. M. Terman, The intelligence of Francis Galton in childhood, *Amer. J. Psychol.*, 1917, 28, 209–215.

[11] E. T. Bell, *Men of mathematics*, New York: Simon and Schuster, 1937, p. 221.

dialect. Then, for the ensuing hour, while the other boys toiled, he sat with his hands folded, favored now and then by a sarcastic glance from Büttner, who imagined the youngest pupil in the class was just another blockhead. At the end of the period Büttner looked over the slates. On Gauss' slate there appeared but a single number. To the end of his days Gauss loved to tell how the one number he had written was the correct answer and how all the others were wrong. Gauss had not been shown the trick for doing such problems rapidly. It is very ordinary once it is known, but for a boy of ten to find it instantaneously by himself is not so ordinary.

This opened the door through which Gauss passed on to immortality. Büttner was so astonished at what the boy of ten had done without instruction that he promptly redeemed himself and to at least one of his pupils became a humane teacher. Out of his own pocket he paid for the best textbook on arithmetic obtainable and presented it to Gauss. The boy flashed through the book. "He is beyond me," Büttner said; "I can teach him nothing more."[12]

ENVIRONMENT AND HEREDITY

Obviously what is directly tested by a test is not an underlying "capacity" but a specific response to a specific stimulus. This response is the result of learning. By testing for the results of learning we infer the ability to learn. Hence any test that pretends to give us the relative positions of two persons in native (hereditary) intelligence—to say that one man or one group is innately brighter than another—must assume that both men or both groups have been exposed to a chance to learn the item, or that there is no selection of items that would favor one over the other.

For instance, the Army Alpha test of World War I was devised for soldiers. When the Army Alpha is given to women, do the comparative scores give us any information on the relative native brightness of men and women? At the University of Washington in 1919, all students were given the Army Alpha test. Men averaged a score of 134; women averaged 132. The difference, though minute, was reliable because of the large numbers concerned. But the test contains many items that

[12] Reprinted from *Men of Mathematics* by permission of Simon and Schuster, Inc. Copyright, 1937, by E. T. Bell. Pp. 221–222.

demand information more likely to be encountered by men than women, for example, "Does a sergeant outrank a corporal?" Such a test does not provide a basis for pronouncing on the relative intelligence of the two sexes.

In the construction of a test we must therefore try for items that represent situations to which the great majority of the population we are studying has been exposed. This desirable end can never be perfectly attained. When we examine the results of tests given to city and to country children, for example, what can we infer from the fact that city children regularly make higher scores? Do they therefore have higher intelligence?

A study made by J. S. Hinds reports the following average IQ scores made by Texas high school students:[13]

Group	*Average IQ*
City	100.5
Town	98.0
Small town	84.4
Country-rural	77.0

Similiar results have been found in Europe. In one study, city and country children made the following average (not IQ) scores:[14]

Group	*Average Score*
Parisian children	219.0
Rural French children	185.5
Roman children	211.8
Rural Italian children	185.9
Hamburg children	216.4
Rural German children	195.9

It is obvious that there are profound differences in the environment and upbringing of city children and country children. The kinds of tools with which they are familiar are different. City life is compara-

[13] J. S. Hinds, Comparison of country and city high school children, *J. Educ. Res.*, 1922, 5, 120–124.

[14] O. Klineberg, A study of psychological differences between "racial" and national groups in Europe, *Arch. Psychol.*, N. Y., 1931, No. 132.

tively independent of darkness and light, cold and warmth, rain and fair weather, snow, sleet. City children are exposed to far more rapid change and complexity in their human environment and to an enormously increased quantity of speech. They attend schools which are greatly superior to those attended by rural children. These environmental differences leave their mark and are undoubtedly reflected in test scores. We can predict that city children will make higher school grades (where these depend upon verbal examination), or that their performance will be higher in all tasks which have been shown to correlate highly with intelligence tests, but we have no way of separating the environmental from hereditary factors influencing performance on the tests.

Much the same interpretation must be given the results of tests on Negro and white in southern and northern states. The Army Alpha and Beta tests showed higher averages of Northerners, Negro or white, over Southerners, and for whites, northern and southern, over Negroes. These results predict success in school and various other achievements, but they do not decide *one way or the other* any question of inherited superiority of one racial stock over the other. We know that in general northern schools are superior to southern, and that the educational opportunities for the white are greater than those for the Negro.

Similiar evidence that environment affects test score is contained in a study of English "canal-boat" children.[15] These children are relatively isolated from contacts and schooling. Among the older folk many cannot read or write. The average IQ of these children whose homes were on canal boats was found to be 70 for the whole population studied, but when the averages of different age groups were calculated, the IQ's were found to decrease with age. This held true within families. The younger children had higher IQ's than the older children in the same family.

Such studies imply that certain environments can depress the IQ, and removal from these environments should tend to restore intelligence

[15] H. Gordon, Mental and scholastic tests among retarded children, London: Board of Education, 1923, Pamphlet No. 44.

toward normal development. One study from a series made at the University of Iowa bears upon this point.[16] This study dealt with 154 infants whose parents came from low econmic levels. Eighty of the mothers of these children were available for testing; their mean IQ was 88. Of the 110 fathers for whom information was available, about one half were unskilled laborers. The infants were placed in foster homes where the foster parents were above the average in occupational level. The mean age of the children at the time of placement was 2.8 months; none was older than 6.0 months.

The first intelligence test was given at the age of two years. Only 3 percent of the children tested below 90, and 69 per cent tested above 110. The mean IQ for all children was 116. In a second test given at the age of four years, the children were found to be still above average.

These studies and numerous others like them do not mean that a moron or a dull child can be removed from its home environment and placed in a superior home, to turn out eventually a genius. Inheritance sets limits to the possible development of individuals. What these studies do indicate is a certain range within which the IQ can be made to fluctuate under favorable and unfavorable environments. The exact extent of the effect of environment on IQ has not yet been accurately determined, but we may suggest that the range is at least plus or minus 15 points. By this we mean that three persons who would all, in an average environment, reach IQ's of 100, would reach 85, 100, and 115 if one were placed in a very unfavorable, one in an average, and one in a favorable environment.

From the use of the word "intelligence" we may assume that its most common meaning is "a general tendency toward achievement." But achievement of any sort has indefinitely varied and numerous determiners. Some of these are, of course, included in inheritance. The mere fact that whether a particular fertilized ovum develops into a cockroach or a "Caucasian" can be accurately predicted by knowing its parents establishes the importance of inheritance. And it is evident

[16] M. Skodak, Children in foster homes, *Univ. Iowa Stud. Child Welf.*, 1939, 16, No. 1.

that differences within the same species can be to a degree predicted by knowledge of parentage. The extra degree of resemblance between identical twins is an indication of this effect of parentage.

The ways in which parentage can affect intelligence are probably as varied and numerous as the ways in which intelligence is affected by environment and opportunity. We assume that the biological inheritance is manifest in children in the form of physical structures just as family resemblances are obviously involved in inheritance. But we thus far remain ignorant of the physical structures associated with differences in intelligence. We cannot determine by any known features of brain structure the intelligence of a man whose body now lies in the morgue.

We accept, therefore, the statement that intelligence has many different and independent sources or determiners, some of these lying in the biological strain or inherited structure and some of them consisting in habits which depended on education and example.

How can training make an individual "brighter"? The answer probably is that how a person will respond to a situation depends on what his previous experience with that situation has been. Previous learning may favor or make impossible certain new learning. If a psychologist and a botanist encounter a strange plant in a college garden, the botanist, observing certain features of the plant, can identify its genus and family and thereby remember innumerable features of this plant which the psychologist cannot remember because he has never learned any words for them and has no notion of botanical classification. Here is a case in which a botanist, because of his previous training, can remember a mass of facts about a plant casually encountered and the psychologist, even if drilled for a time in these new facts, would promptly forget them.

Children brought up in a household in which books are read and talked about, and intellectual topics have provoked argument and study, have a tremendous start over children whose homes do not offer these advantages.

SOME FALSE BELIEFS

No account of intelligence should end without noticing some common beliefs about that trait that have been demonstrated to be false.

One of these, which has been mentioned before, is that very bright persons tend to be weak and sickly. It is probable that this belief arises from the fact that bright children are advanced in school grade and so get compared with older and larger children. Among children of their own age bright children prove to be above average size and to have better than average health.[17]

Another general belief—that very bright persons are less able to develop mechanical skills than are the less bright—probably originates in a tendency toward compensatory thinking in parents, and in part may be based on a factor of interest. Bright pupils may have distracting interests that interfere with mechanical interests.

Another widespread belief is that a big brain is associated with intelligence. There is no evidence to support this view.[18] This notion that brain weight is associated with mental capacity is connected with a widespread conviction (among many men and some women) that men are brighter than women. There are many differences between men and women for which there is adequate evidence, but this not one of them. Particular intelligence tests may give results in favor of one sex or the other by a small margin, but there is no evidence of a general and consistent superiority of men.

Just following World War I, during which the Army's use of intelligence tests had made them familiar to millions, it was assumed by many psychologists that through the use of such tests it would be possible to select personnel for any task. Large department stores and large factories gave tests to all employees, expecting to find that they would serve to select from possible applicants for jobs those who would

[17] L. M. Terman, *et al.*, Mental and physical traits of a thousand gifted children, in *Genetic studies of genius* (3 vols.), Stanford: Stanford University Press, 1925.

[18] D. G. Paterson, *Physique and intellect*, New York: Appleton-Century, 1930, pp. 80–122.

be of greater service. The use of tests for selection and for vocational advice has proved to be much more complex a subject than was at first thought. Many factors other than those measured by the tests affected success.

Among the first disappointments with the new tests were attempts to use them for the selection of clerks, or of salesmen. Experience soon demonstrated that it was not the applicants making the highest scores in "intelligence" tests who sold the largest amounts of goods for the firm.

One of the reasons for these early failures was, of course, the fact that motivation often has more importance in determining performance than such a trait or group of traits as that called "intelligence." Another important reason has explained the continued failure to find tests which would give accurate predictions of success in such vocations as teaching, selling, management, and the like. This is the fact that in these vocations there are many ways of being successful. Good teaching can be done in many different ways. Some good teachers are noisy and some are quiet, some good teachers are large and some small. Some good teachers are brilliant and original contributors to the field of knowledge in which they teach, but there are other good teachers who actually capitalize their own ineptitude and are led by it to induce students to pitch in and work for themselves. There are diffident and retiring salesmen whose diffidence has somehow the effect of encouraging their customers to help sell themselves a bill of goods, and salesmen who are distinguished by the absence of diffidence. A very successful real-estate salesman recently explained that his stammer had been his stock in trade and had proved so disarming that customers met him halfway. In a vocation like selling or teaching, then, we shall not expect to find easily a test that will pick out the good salesmen or the good teachers. A test that picked out one sort of good teacher might miss many other sorts. The same difficulty was experienced by the Army in its search for tests for leadership ability. It was of first importance that the officer training be offered to potential good leaders, because good leadership is probably the most important requirement of a good army.

The difficulty lay in the fact that there are many different ways of being a good leader, and good leaders may be very different sorts of persons.

In these cases, where direct testing fails because the skill or the capacity has a wide variety of expressions, the most reliable approach has been the examination of the past record. The judgement of associates as to an officer's performance as a leader is likely to be a good prediction of his performance in new circumstances. The past record of a teacher as judged by the rating of students is a good—probably the best available—basis for judging future performance. At the University of Washington 52 instructors rated as teachers by their students in 1931 had roughly the same order of merit when judged by their students in 1945. Some had improved and some deteriorated. The correlation between the two sets of ratings was .54.

DEFINITIONS OF INTELLIGENCE

It is highly significant that the Adjutant General's Office called its chief test the General Classification Test, and not an intelligence test. A decision that involved the Army in no theories of the nature of intelligence, and did not invite arguments over the inherited nature of the differences found between men. The test was named for its chief purpose, which was the assignment of men to duty which would accord with their capacities. Like the psychologists of the Adjutant General's Office, other psychologists are still noncommittal concerning what they believe is the basic nature of intelligence. You will recall that the definition used in this chapter is "a general tendency toward achievement." It is interesting to note that psychologists still find occasion for referring to such a general tendency in spite of the vagueness of the conception. We know roughly what we mean by general intelligence, and we can with a certain rough consistency find measures for it in our tests.

There have been many efforts to define intelligence in some way more objective than "a general tendency toward achievement." As it stands, this definition makes of intelligence one of the less scientific concepts. When we get down to cases and are compelled to use instances of specific achievements rather than achievement in general, there is

less than perfect agreement among observers as to what constitutes achievement. Does the child who succeeds in being extremely annoying to his elders earn a mark for achievement? Does the child who succeeds in getting his own way through making himself an intolerable nuisance earn a mark for achievement? The definition of intelligence as a general tendency toward achievement is actually more practical than scientific.

Efforts to substitute for this definition more scientific concepts have thus far failed. The reason they have failed is probably that the practical importance of achievement requires that it be recognized, even if achievement is too vague a term for exact scientific use. What is judged to be achievement obviously depends on who the judges are. Success on the stage or in sports is valued differently in different countries and in different levels of society in the same country. Skill in picking pockets is not likely to be included in any intelligence test, because the testers do not value such achievement.

Many years ago Thorndike suggested that we would do well to distinguish three kinds of intelligence. This was equivalent to saying that we would do well to distinguish three fields of achievement. One of these was achievement with things—the tendency to develop skills with tools or with the manipulation of material objects. A second was achievement with persons—the ability to persuade, command, understand, please, or coöperate with other persons. The third was the ability to manage ideas and words—the type of achievement exhibited by the mathematical physicist or the worker in symbolic logic. The only objection to recognizing these three fields of achievement is that there are as many fields of achievement as we wish to recognize, and it is misleading to speak as if each kind of performance has corresponding to it a variety of intelligence. We do better to retain the concept of general intelligence in spite of its vaguenesses, and to recognize that we can also measure skills in and aptitude for any special variety of achievement that becomes important. We can construct tests for measuring the degree of achievement already reached in typing, in the inspection of ball bearings, in the use of plumbers' tools. We may also be

able to develop tests which enable us to predict which persons will most readily develop such skills with training. We can distinguish between these special skills and special aptitudes and the general aptitude which we call intelligence.

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XV

Attending and Perceiving

FORTUNATELY for us we can hear only a tiny fraction of the air waves about us and can see only a very small proportion of the radiation that strikes our bodies; we have to smell only a minute sample of what is in our neighborhood; our taste is limited to a reasonably small sampling of the select bites that we take out of our physical environment. The room is filled with the ethereal humming of a thousand radio stations, not to mention the hundreds of faulty electric razors, hair dryers, vacuum cleaners, and other electrical gadgets that are broadcasting occasionally in our neighborhood. But we hear only the sound waves into which our radio transmutes all these forms of radiation. Just as the radio selects our program out of dozens that are available in sufficient strength, so our sense organs select the light rays, the sound waves, the surfaces to be touched, the odors, the stimuli to which we respond.

Even though our sense organs are available for only a very small fraction of the potential stimuli in our neighborhood, they are bombarded with a constant barrage. While the radio is playing we may be carrying on a conversation stimulating our ears; our speech muscles stimulate themselves by their own contractions. Sense organs in the foot are being stimulated by contact with the shoe; and, now that it is mentioned, pressure of the belt around our waist and that of the chair against our back are noticeable. If we are swinging a foot in time to the radio music, sense organs in foot muscles and tendons are stimulated.

Light waves strike the eyes from various sources: from the books on a shelf, the person we are talking to, the electric lamp. What rays strike our eyes depends on which way we are facing, how our eyes are turned, whether the lids are open.

If it has been some time since we have eaten we may also notice from time to time certain feelings in the neighborhood of our stomach.

PROCESS OF ATTENDING

In all this mass of stimulation certain sources appear to stand out and others fade into the background. There is a continual change of emphasis. William James compared our awareness of our environment to the light from a ranging spotlight which clearly lights up the object on which it is focused, the blurred edges of the light merging into an outer region of darkness. We describe what we are aware of as a part that is in *focus* and a part that is *marginal*, in the fringe of awareness.

Another pair of terms is readily applied to the object of our attention. Part stands out as *figure*, the pattern seen, the noise heard, and part is *background* or, to use the term psychologists are adopting, ground. Figure and ground may interchange while we attend. What stood out now recedes and becomes ground. What was ground now becomes figure.

But there is much more to the process of attending than this clearness and fading of stimulation. Attending is an active response of the organism. As a response, *attending* may be defined as taking a posture or making movements that facilitate the reception of certain groups of stimuli and facilitate response to these stimuli.

Visual attending is, of course, looking. Looking consists in turning the head, turning the eyes, focusing the lens of the eye, inhibiting rival movements that would interfere with maximum stimulation, and focusing of rays from an object or a source of stimulation. Looking, it is very evident, is a complicated action. It is easy to observe in others. Listening (auditory attending) is likewise complicated. We sometimes cock the head. We become quiet. We adjust the tension of our eardrums to the anticipated pitch. Listening for a shrill noise is different

from listening for a low-pitched noise. The runner in a track meet, listening for the starting gun, is poised for his start, and this readiness for a specific response is part of his attending. The timer with his stop

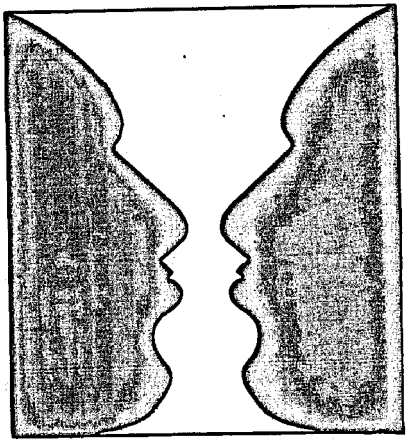

FIG. 8. A Reversible Figure. The white vase (figure) may stand out at first, the black sections serving as ground. With continued fixation, the profiles of two faces will stand out—figure and ground have shifted.

watch has an entirely different response in readiness. There is no such thing as "just looking," or "just listening." Looking and listening are states of readiness for receiving a signal and for doing something at that signal. What we are ready to do may be to count, to note down, or merely to note.

Everyone who has been in a schoolroom has memories of being told

to "pay attention." What the teacher means by this is that we should stop talking, quit fidgeting in our chairs, stop shifting from one foot to another, or give up our preparations for poking the boy ahead. We are to look directly at something and also to listen. In other words, we are to *inhibit* responses to certain sources of stimulation and to *orient* ourselves to other sources. We are to prepare ourselves to respond to the coming event, the sound of a voice or the sight of a diagram on the blackboard, and to continue to respond to this source of stimulation.

Much of our attending is done without any request or any intention on our part. When we are walking on the street we respond to the blast of an automobile horn without any preliminary adjustment of sense organs or muscles. The horn was designed to get response even from the inattentive. Certain classes of stimuli get ready attention. A shout "Look out," the bright flash of an electric sign, a gun shot, the sudden screech of brakes, a slamming door, sudden movement in an otherwise still landscape, intense odors—to these we respond readily.

When a student is responding to his own verbal stimulation in inner speech, daydreaming of a vacation trip which he has planned, and the instructor asks a question, the student may respond, "I'm sorry, I didn't hear the question—I wasn't paying attention." The student's verbal responses to his own verbal stimulation were not compatible with verbal responses to the instructor's stimulation. We cannot say the student was not attending; but we can say that he was attending and responding to something other than the instructor.

We can, of course, respond to more than one source of stimulation at a time, but this is almost always limited to cases in which different sense organs and different muscle groups are involved. We can follow the radio music by tapping a foot and carry on a conversation with a friend at the same time. But if the music stops and a radio speech begins, we find that our conversation interferes with our efforts to respond to the radio. We may find that we respond alternately to the words from the radio and the words from our friend with resultant gaps in what we hear from each. To become thoroughly aware of such interferences it is only necessary to try to write the word "republican" on

a sheet of paper and at the same time to spell aloud the word "university."

A man working on a mathematics problem may be quite surprised to have someone call his attention to the fact that he is scratching his arm or biting his pencil; occasionally he may be surprised to be told he is smoking a cigarette. Long-practiced actions may involve such limited signals and such limited muscular groups that they can be carried on without interfering with other actions.

Only a skilled driver can carry on a conversation in traffic. The traffic is responded to surely, promptly, and accurately. In this case the individual has become capable of two independent reactions. He is attentive to the road and to the conversation. If his attention were divided, both driving and conversation would suffer.

One reason why the beginning driver is at a disadvantage in this situation is that word signals are an essential part of his driving. He continuously gives himself directions in the language of his instructor, and this language interferes with any conversation. Only when driving no longer depends on verbal rules and signals can it be carried on without stopping talk.

FACTORS INFLUENCING ATTENDING

Attending is a response process. It will be recalled that response is dealt with as a function of the organism and of the situation, $R = f(O,S)$. There are certain conditions that facilitate attending to something, and other conditions that distract us. Some of these conditions favoring or hindering attending lie in the stimulus situation and some of them are characteristics of the organism.

Conditions in the stimulus situation which favor visual attending include *movement*. When the rest of the visual field is stationary, a slight movement of a part tends to cause us to look in that direction. Movement is apparent in the outer borders or periphery of the field. Try looking straight ahead, fixating some point directly ahead. Then move a pencil out to one side to a point where it is no longer seen. Just at the point where the pencil disappears, motion of the pencil

back and forth will be seen quite easily. In driving a car across a street crossing, we can look straight ahead and be confident that the movement of other cars in the periphery will be seen.

The magician makes great use of the attention-getting value of movement to keep his audience from attending to what he is really doing. A sudden movement of his hand, or a movement of his assistant across the stage will cause many people in the audience to look toward the movement and so not notice what he has done.

Another characteristic of stimuli that compels attending is *intensity*. Of two noises the louder, of two pressures the stronger, of two lights the brighter, are more apt to evoke a response than the less intense. Very similar to intensity is *contrast*. In a black field, a white spot is noticed. A newspaper page blank, except for a small advertisement in the center, favors our seeing the advertisement. A sudden lull in the noise of the symphony will not quite compete for effect with a sudden fortissimo, but it tends to be noticed.

Another condition favoring attending is *incongruity*. This has sometimes been mistaken for mere novelty but mere newness does not get noticed. Attending is favored when some features of a situation tend to evoke one set of responses, and other features tend to evoke incompatible responses. We would notice a pink hair ribbon on a marine more readily than we would notice the same ribbon on a girl. The instructor may recapture the attention of a class by stating a paradox. By dressing or behaving in ways that are unconventional, novel, or puzzling, we take advantage of this tendency of others to notice the incongruous in order to attract attention to ourselves. College teachers have been known to throw chalk or to use indiscreet language in order to get the attention of a class.

In securing visual attention to the printed page, advertisers know that *position* makes a real difference in the number of people who notice an advertisement. The upper half of the page is worth more because more people notice what is there. The left-hand side has an advantage over the right. This is, of course, related to conditions in the organism. In English we start by habit in the upper left and read

across and down. If we read from right to left, the advantage of the left side would probably not exist.

All these rules of attending must include the assumption "Other things being equal." Intensity, contrast, movement, novelty—all interact and complicate the picture. And *the conditions of the stimulus situation are not independent of the conditions in the organism* that determine attending.

A shop specializing in nuts has rigged a strong ventilating fan to blow the odors of roasting nuts over passers-by. Whether this gets favorable or unfavorable attention (attention and eventual purchase or attention and then disgusted retreat) depends on our organic conditions at the moment. The old-fashioned saloon had swinging half doors on the street that permitted the odor of beer to strike pedestrians. Its effect would depend on the past associations of the passer-by. If that particular odor had in the past been associated with pleasant drinking and relaxation, it was a powerful motive for interrupting the walk past. Its appeal varied with the condition of thirst of the passing prospect.

Soldiers at the front are reported to spend much daydreaming time on luxurious beds, clean sheets. The tired motorist notices hotel signs in the evening more than in the morning.

Interests and attitudes, conditioned by previous learning, are also important factors favoring attending. Three men may tour a country and come home with three different accounts. What they have seen is different because their interests and training are different. Two men may read a newspaper. One's eyes fall upon items that bear on business and the state of the market. The other notices items that betray weakness in the political party in power, in the government. This pattern may be one of impatient revolt against authority that was established during childhood under a father whose authority was occasionally harshly enforced and occasionally eluded.

Store windows get prompt attention usually from those for whom they were designed. The sportsman's eye is caught by fishing tackle that the amateur cabinet maker does not notice.

PRIMING

Attending can be primed by warning stimuli or verbal instructions. A friend telephones to say that he will drop by. We now attend to slight sounds from the entryway that would have been unnoticed before the telephone conversation.

An item in the newspaper may cause a woman spending the evening alone in a house to listen intently all evening for sounds of prowlers or intruders. The companionship of a cat can be an important relief from anxious listening because it furnishes auditory and visual stimuli to which responses are not aggravators of the evening's terror but the familiar routines of response that we establish toward our pets.

DISTRACTIONS

It was long believed that study was always facilitated by quiet and that distractions, induced by competing sources of stimulation, decreased efficiency of work. But more recent experiments indicate that the reaction of the organism depends, for one thing, on the attitude of the subject toward the distraction. In one study, subjects who were told beforehand that distraction had been found to result in decreased performance actually showed a decrease under test conditions.[1] Subjects who were told that distraction had been found to result in improved performance showed improvement under test conditions.

Whether distractions can compete for attention successfully depends on habit also. The student who began actual study when he first sat at the library table learns to disregard passers-by and his neighbors. But if, when he began to use the library table either the charm of a near by coed or an unusually dull passage in his book gave the advantage to the distraction, this advantage is likely to be maintained and strengthened. In a recent lecture course a building near by was in process of noisy construction. Some students learned to disregard the noise completely. Others were gradually won over to give the noise

[1] K. H. Baker, Pre-experimental set in distraction experiments, *J. Gen. Psychol.*, 1937, 16, 471–488.

their entire indignant attention and could not follow the lecture. Which of these two outcomes happened depended on the beginnings. If for the first day or two the lecture competed successfully, those fortunate students learned to be not annoyed or distracted by the noise of riveting. Students who attended to the riveters at the beginning, and responded with expressions of annoyance, found this habit more firmly established each day.

SENSORY MECHANISMS

If we insist on a strict division of labor, it is for the physiologist and not the psychologist to investigate how the special receptors work. Actually both physiologists and psychologists have contributed to what is known of the structure and operation of the special senses.

The psychologist is interested in how the receptor organs like eyes, ears, nose, the organs in the inner ear sensitive to motion, and all the special senses operate, because it is only through these senses that men gain knowledge of the world. Sensory stimuli are the guides to conduct, the immediate occasions for all behavior.

The eye is, for example, the instrument involved in judgments of distance, size, color, shape, movement, and many other interpretations of the world. In these interpretations the eye is assisted by other receptors. The enjoyment of a steak and the behavior directed toward a steak are in part occasioned by its color and shape as registered through the eyes, but the steak's aroma and texture and other qualities involve more receptors, the olfactory organs in the nose, tactual receptors in the skin and mucous membrane, the taste buds in the surface of the tongue and pharnyx, and temperature receptors on these various surfaces.

THE VISUAL RECEPTOR

The eye is a natural camera. Its boxlike structure admits light rays only through a small aperture and by means of a lens focuses light on a sensitive surface. Light entering the eye is refracted by the transparent cornea at the front of the eyeball. The cornea, the watery

humor behind the cornea in which the lens is placed, and the transparent tissue behind the lens filling the rest of the hollow sphere of the eyeball, make up the focusing system of the eye, which corresponds to the lens system of a camera. In front of the lens is the iris diaphragm, a circular muscle with a central aperture, the pupil. The iris has both radial and circular muscle fibers which can either enlarge the pupil or narrow the pupil to regulate the amount of light falling on the sensitive retina. In a very bright light the pupils may be observed to narrow to pinhead size and only a small portion of the light falling on the cornea is admitted. The resulting protection of the retina is adequate for most changes in light, but a brilliant sunlight on snow may require added protection through dark glasses or snow glasses. When the aperture is narrow, the image is more distinct, but less bright.

If a card is held for a time over one eye while looking toward a window, the sudden removal of the card will be followed by a quick contraction of both pupils, which demonstrates that this protective pupilary reflex involves nerve connections between the retina of one eye through the optic nerve to the brain and out to the iris diaphragm of the other eye.

Behind the iris diaphragm is the *lens*. The lens is held in place by a circular muscle which by contracting or relaxing can change the convexity of the lens and so adjust its focusing of the rays from objects at different distances on the light-sensitive membrane, the retina. When the eye is set for a distant object the circular muscle is relaxed and the lens is comparatively flat. The images of objects nearer the eye are blurred. Fixating a near object involves the contraction of the circular muscle and a resulting increased convexity of the lens and a consequent clear picture on the retina.

The rear inner surface of the spherical eyeball is covered with a very complex sensitive membrane, the retina. In the retina are the actual cells sensitive to light. These are the *rods* and *cones*, named for their shapes, which are closely packed in the retina. The cones are most heavily concentrated in a spot near the center of the retina called

the *fovea*. This is the point of clearest vision. The cones are sensitive to color as well as to brightness. Toward the periphery of the retina the proportion of cones to rods grows smaller and there is a consequent decrease in sensitivity to color, since the rods are activated only by changes in the brightness of light and not by changes in its color.

We could, instead of referring to color and intensity of light rays, speak of wave lengths and of wave amplitudes, since the physical basis of color is difference in wave lengths of light and the physical basis for brightness is difference in the amplitude of light waves.

Light, focused into an image of the scene before the eye, falls on the retina and there sets up chemical changes in the rods and cones analogous to the changes produced in the sensitive film of a camera. It is these chemical changes that initiate nerve impulses which travel along the optic nerves and eventually to the visual center of the brain at the rear of the cerebral cortex. Nerve fibers from the left half of each retina lead to the left half of the visual area in the brain and fibers from the right half of each retina to the right half of the visual area. Fibers cross at a point called the *optic chiasm*. Since the images on the retinas are reversed as in a camera, the right side of objects looked at is seen with the left half of the brain and the left side of objects with the right half of the visual area. There is a point for point correspondence or projection of retina on the *visual area* of the cortex.

SPACE AND DEPTH PERCEPTION

The preceding paragraphs give a rather sketchy description of the mechanics of vision. We may now consider some features of the use or function of the eyes—not simply how the eye works, but how the eye works for its possessor.

It should be first noted that there are great individual differences in sensitivity. Most persons are familiar with the system of measuring sensitivity differences in terms of average vision at 20 feet. Vision which is 20/20 may be defined as the ability to distinguish at 20 feet what the average person can distinguish at that distance. Vision which

is 20/10 then means the ability to read at 20 feet what the average person can distinguish at 10 feet only. This is, of course, much better than ordinary vision. Vision which is 20/200 means that an individual can just distinguish at 20 feet what the average person can distinguish at 200 feet and represents vision much below average.

One of the uses of the eye most important to its owner is the adjustment of response to the distance of objects and the perception of depth or the relative distances of objects from the eye. There are a number of clues or signs on which such perception depends. Some of these are furnished by the eye itself and some are signs in the environment which gain their sign character through learning. Some of them depend on the coördination of the two eyes and are called *binocular cues*. Others are furnished through the operation of a single eye, and would, for instance, be available to a person who has lost the vision of one eye.

Among the latter, the *monocular cues*, can be included *interposition*. Objects which block the vision of portions of other objects tend to be reacted to as nearer. There is no mystery about the acquisition of this perception because the interposed object is actually nearer, and experience gradually establishes this. Another monocular cue is clearness or *aerial perspective*. Experience establishes that of a number of hills seen in the distance, the more hazy are the more distant. Since the haze is ordinarily a function of the amount of intervening atmosphere, this perception is interposition and is a natural outcome of experience in walking toward objects. Notable illusions occur when normal atmospheric conditions do not prevail. Objects in a fog tend to be seen as more remote than is actually the case, and since they, being actually near by, subtend a large angle at the eye, they have the appearance of abnormally great size—they "loom."

This angle subtended at the eye, which determines the actual size of the image on the retina, is a further cue to distance when the object is familiar. The smaller the angle subtended, the more distant the object. As we look down the highway or the railroad track the width between the rails or between the sides of the pavement gives an in-

creasingly narrow image as the rails or the pavement recedes. It is probable that in small children there is a period when the convergence of the rails would fail to be perceived as a recession into the distance. With adults long experience has established that the rails do not converge.

A familiar illusion is experienced by persons waiting on a railroad platform for a local train while an express thunders by at high speed. The rear end of the express has the appearance of rapidly shrinking in size. Normally receding objects maintain their *size constancy* even as their images diminish in size. There is no mystery in this, since it is experience that establishes that the object which apparently shrank is again normal when we approach it and touch or manipulate it. In the case of the receding express train the diminution of the image is rapid beyond experience and is therefore open to erroneous perception. It is very doubtful that we could find railroad section hands of long experience who preserve the illusion. A related illusion or, more correctly, a near-illusion, is experienced by passengers in a plane who may have a distinct impression on their first flights that they are looking at toy villages rather than at houses of normal size. This would not be called an illusion unless the houses were actually "taken for" toys, which, of course, they are not.

Another monocular cue to depth and distance is the *accommodation* of the lens of the eye to a shape which will produce a clear image. This requires that the lens be more convex for nearby objects and the cues furnished by the circular muscle in making this accommodation may serve as indications of distance.

One more monocular cue deserves mention, *relative motion*. If the head is moved from side to side it will be noticed that near objects appear to move in a direction opposite to the direction of the movement of the head, and that distant objects appear to move with the head. In touring in the country the distant hills appear to be keeping up with the car, while the roadside bushes are rapidly left behind. Actual motion changes radically the images of nearby objects but makes far less change in the images of distant objects, and this effect

is established by experience as a cue to the distance of objects, and also as a cue to motion.

Binocular cues depend on the fact that the two eyes are separated in space and that the images on the two retinas are therefore not identical. In nearby objects the right eye sees farther around to the right of the object, and the left eye farther around to the left. The two eyes do not picture nearby objects against the same background, as can be quickly verified by holding up a finger and looking at it with eyes closed alternately. The finger appears to jump right and left. The differences in the images on the two retinas increase with the nearness of the object looked at and therefore furnish good cues for the perception of distance. The stereopticon makes use of such cues by using pictures taken by what really constitutes two different cameras with lenses separated by a normal interocular distance or more.

Another binocular cue is furnished by the fact that in bringing the eyes to bear on an object so that the two images will have a maximal coincidence on corresponding areas of the two retinas, the external muscles of the eyes must operate to make the eyes converge at the proper angle. Cues from the external muscles thus give indications of the distance of the object upon which the eyes converge. Beyond 60 feet the change in the angle of convergence is so slight that this cue fails to operate. On a battleship where the objectives of a range finder may be 20 or 30 feet apart instead of less than three inches, as in the case of the eyes, the angle of convergence can accurately fix distances up to several miles.

MOVEMENT

A number of visual cues make possible adjustment of behavior to movement. Because a moving object has its image displaced on the retina, such displacement is reacted to as movement of the object, even though in some cases this is an illusion as it is on the screen of the motion-picture theatre. The successive images on the screen make a series of separate, motionless shadows, but are perceived as moving persons and objects. When an object actually moves across the field

of vision it successively occupies a continuous series of positions from the first position to the last. It is sufficient for the motion picture to flash on the screen a limited series of positions for this to be interpreted as a continuous movement. This has been called the *phi phenomenon*. In its simplest form a bright area thrown upon a screen which disappears and is quickly succeeded by another similar area in a nearby place gives the illusion of a continuous movement from the first position to the second.

Another illusion of movement appears when a pinpoint of light is viewed in a dark room. The source of light appears to move. The lack of a background to which movement can be referred subjects the perception of the position of the light to wayward factors such as movements of the eyes, of the head.

OBJECT CONSTANCY

Space as perceived by any specific person has certain attributes which we do not include in our notions of "real" space. Space as perceived is always perceived from some specific place. Space as described in plane and solid geometry is described as viewed from nowhere in particular. The image of any object diminishes as the distance between us and the object increases. The rails of the track across a stretch of flat country appear to meet. In the image they make a narrow V. We learn to discount these features of the visual image that depend on the perceiver and on the circumstances of the perception. We learn to behave as if people remain the same size as they approach us, though their images grow rapidly. We learn to behave as if the object has a continued existence even when its image disappears with the closing of the eyes or with a turn of the head. The stimulation from an object can change radically, but if it changes in certain definite ways we behave as if the object has retained its size and position and its other qualities which have been attached to it by associative experience. If a coin is turned about one of its diameters as we view it, its image contour changes from a circle through a series of ellipses to a straight edge. We do not react as if the coin had

changed its shape because experience has established that the series of image changes depended on changes in our relation to the coin. We perceive the series of changes as a shifting of the coin's position with reference to our own, and not as an alteration of shape.

Drastic changes in the intensity of stimuli from an object may be perceived as changes in general illumination rather than changes in the color or nature of the object. When general illumination is decreased there comes a point at which we would be unable to distinguish the red cover of a book on the table before us as red. But we still react to it as red. In fact, if it is covered with a sheet of paper and becomes invisible, we still react to it as a red book and would select it if asked by a friend to hand him the red book. Our perceptual reactions to objects and events are evidently affected by many determiners, which include not only the stimuli we are receiving from them, but the recent history of our responses to them and a wealth of previous experiences which give meaning to a multitude of signs and cues.

COLOR

It has been pointed out before that light waves differ in wave length and in their energy. The rods and cones are activated as sense organs by only a short series of such waves. The shortest wave lengths which are effective for vision are seen as violet, and the longest as red. Most of the light which strikes the eye contains a mixture of wave lengths, and it is only in the laboratory that anything approximating a pure color can be readily experienced.

When sunlight is directed through a prism, the waves of different lengths are separated because the long rays which account for red color are refracted less than the short or violet rays. The order of the colors of the prism-refracted beam of white light is: red, orange, yellow, yellow-green, green, greenish blue, blue, violet. These colors do not include all the possible colors or hues. Purples and carmines are produced by mixing light from opposite ends of the spectrum.

Colors can differ in two qualities besides hue, namely, saturation and brightness. The saturation of a color depends primarily on the purity

of the wave length involved. The brightness of a color depends primarily on the energy or amplitude of the light waves. These two qualities are, however, to some extent interrelated. A decrease in brightness is accompanied with some decrease in saturation. A book whose color could be described as a highly saturated red will, as the light diminishes, still be seen as red, but the color will appear less saturated.

Any color can be produced by a mixture of three primaries, red, green and blue. Usually a fourth is used, yellow, in order to describe color mixtures. Yellow can be produced by mixing wave lengths corresponding to red and green, but yellow is not readily described as reddish-green. The mixture of pigments is very different from the mixture of lights. When blue and yellow wave lengths are mixed, the result is a neutral gray if the proportions are right. But the mixture of blue and yellow pigments will result in green. The reason for this is that both blue and yellow pigments reflect some green, and when they are mixed the reflected blue and yellow produce a neutral gray, leaving green as the observed result.

Hues which mix to produce gray are called *complementary hues*. Each color has its complementary, the complementary of red being a blue-green. If two colors which are not complementaries are mixed the result is an intermediate hue and its saturation always less than the saturation of either component. Mixtures of colors always result in some loss of saturation.

If you stare at a patch of red for a short period and then look at a blank wall you will notice a corresponding patch on the wall which is the complement of the red to which your eyes had been exposed. A spot of blue stared at for a time will result in a yellow *after-image*. A white spot on a dark ground will result in a negative after-image which is dark on a light ground. Fixating a point on the window for a time will result in a very brief positive after-image when the eyes are closed. This is followed quickly by a negative after-image in which the colors of the landscape will be the complementaries of those actually seen.

These after-images are probably attributable to chemical processes in

the rods and cones which reverse the changes produced by exposure to light. In the camera film these chemical changes are irreversible. But in the eye there is a continuous tendency to reëstablish the norm which was disturbed by exposure to light. This probably accounts for the fact that the negative after-images are complementaries of the original colors. The complementary of a color is the color to which the reverse photochemical process gives rise.

ADAPTATION

Earlier in this chapter it was mentioned that the eye adjusts itself to the total amount of light by changes in the size of the pupil. There is another form of adaptation to the total amount of light received which is accomplished by the retina. It is this adaptation for which it is necessary to wait when we enter a motion-picture theatre from bright daylight. It requires many minutes before we are able to make out the features of other persons in the darkened theatre. The eye is said to have become *dark-adapted*. When we leave the theatre and reënter the bright sunlight we are for a brief period dazzled. But it requires much less time for the retina to adapt to an increase in brightness than it does to adapt to a decrease. Where good vision in very dim light is important as it is for piloting a plane at night or for a night lookout at sea, wearing red goggles for a period will allow the retina to adapt to darkness. The modern automobiles have devices for dimming the lights on the dashboard. This allows a glance at the instruments without the loss of the dark-adaptation, which loss would very much reduce the visibility of the road ahead.

CONTRAST

If yellow and blue are placed side by side, each appears more saturated than when shown alone. The probable reason for this is that in its almost constant movement the eye exposes parts of the retina in which blue has set up its reverse process to yellow light, and the combination of direct stimulation by yellow light and the yellow after-image of the blue produce the more saturated yellow. Gray on

a white background looks much darker than it does on a black background. Fixating a blue patch on a neutral gray background tends to produce an appearance of yellow at the gray edges of the patch.

COLOR BLINDNESS

Some people are born without the ability to see certain colors. The most common form of color blindness is the inability to distinguish red from green. Color mixtures which have red or green components are confused because the red or green component is not responded to. Many men are unable to distinguish the red and green signals used for traffic lights or railroad signals. Color blindness is rare among women and about 3 percent of men are definitely defective in color vision. The corresponding figure for women would be in the neighborhood of two in one thousand. The trait is believed to be inherited and to be transmitted through the mother to sons but not to daughters. Most ground-living animals are color blind. Experiments indicate that the dog, the cat, the rabbit, the cow, all fail to distinguish color and react only to differences in brightness. Birds, monkeys, apes, have about the same range of color perception as man.

HEARING

The ear exhibits as intricate a specialized structure for the reception of sound as the eye has for the reception of light. As in the case of light, the receptor reacts only to a very limited range of the physical stimuli, but is sensitive to fine differences and many patterns within that range.

Sound waves are normally received by the mechanism of the ear from the air. They consist in alternate condensations and rarefactions of the air set up by some vibrating elastic body like the string of a musical instrument or the vocal cords, or by devices which produce pulsations in the air by other means as do whistles. The rate at which sound waves travel through the air depends somewhat on the air temperature and the proportion of moisture. The rate averages about 1,090 feet per second. The chief characteristics of sound waves in air

can be recorded in a number of ways—by making a sound-actuated diaphragm actuate a cutting tool as in the old-fashioned phonograph, or by causing the waves to vary the characteristics of an electric current and by amplifying the current actuate a mechanical tool which will inscribe a record as is done in more modern phonograph recordings, or by causing the fluctuating electric current to regulate the intensity of illumination which is in turn recorded on a moving film.

Sounds may be distinguished as *noises,* in which there is no outstanding regularity or periodicity. Pure *tones* represent simple, regular pulsations like those produced by a tuning fork or by a Galton whistle. The graph of a pure tone on a phonograph disc is a simple sine curve. We hear very few pure tones. Even the flute represents a combination of two or more tones and other musical instruments produce more complex combinations of tones. It is these complexities that account for the different quality or *timbre* of the different instruments of an orchestra, which enable us, for instance, to recognize the sound of an English horn or of a clarinet even when they play the same note.

What we hear has a close dependence on the nature of the physical properties of the sounds affecting the ear. High and low pitches, from the squeaking of a mouse to the zoom of a base viol, correspond to differences in the frequency of the sound waves. Frequency may be defined as the number of complete condensation-rarefaction cycles per second. In the case of pure tones, the greater the frequency the higher the pitch. The ear responds in a normal young person to frequencies from about 20 per second to about 20,000 per second. As people grow older this upper limit diminishes and many older persons cannot hear a tone of 20,000 per second. The range of sounds to which dogs can respond is, roughly, from 30 to 35,000 per second. Sporting magazines advertise whistles which cannot be heard by people but are clearly audible to dogs. Cats hear sounds from approximately 35 per second frequency to 50,000. Bats depend on the echoes from very shrill cries for guiding their flight and avoiding obstacles. These cries are quite inaudible to man, but they have been recorded.

The statement that pitch is a direct function of frequency requires

some qualification. An increase in the loudness or intensity of a high note will raise its psychological pitch. An increase in the intensity of a note of low frequency decreases its psychological or perceived pitch.

There is a rough correspondence between the amplitude of sound vibrations and loudness of the perceived sounds. But the loudness of sounds depends also on the frequency of the sound vibrations because the ear is more sensitive in the middle ranges. Sounds in the neighborhood of the human voice are heard at lesser amplitude than sounds of lower or higher frequencies.

Many vibrating objects vibrate not only as wholes but also in integral fractions. A violin string, for example, produces many *overtones* by vibrating in halves, thirds, fourths as well as throughout its whole length. The frequency of the vibration of the two halves is double the frequency at which the whole string vibrates, and the pitch is therefore higher. The half-vibration produces the first overtone, or octave. A light touch at the middle point of the string would "damp" the vibration of the string as a whole and leave audible only the overtones. If one strikes middle C on the piano with the key of one octave below held down, the lower key will be heard to give its first octave, the tone of the key which was struck.

When two series of sound waves of the same frequency reach the ear the result is a blended tone. If the two are in phase with each other, the loudness of the total result is increased. If the two are completely out of phase so that the crest of one wave would coincide with the trough of the other, the result is silence.

If, however, the two frequencies are slightly different the loudness will be increased while the two are in phase and diminished when they are out of phase. If, for instance, a note of 512 vibrations per second is sounded with one of 513, the second overtakes the phase of the first one each second and there is heard a *beat*. Tones of 400 and 410 would produce ten beats per second. When the number of beats per second increases the first effect is to lose the quality of beats and give an impression of roughness or dissonance. When the frequencies of two tones differ by as much as 50 vibrations per second there can

be heard a *difference tone* with a pitch like the pitch of a tone whose frequency is the difference between the frequencies of the two original tones. For instance, tones of 250 and 310 vibrations per second would, when sounded together, produce an additional tone of 60 vibrations per second.

Two tones are said to have *consonance* when they tend to sound like one tone. When they do not blend they are said to be *dissonant*. Helmholtz believed that two tones are consonant to the degree that their vibration frequencies have simple ratios, but this opinion requires revision. Naïve listeners do not find that when a note of 400 vibrations per second is sounded with another whose frequency is varied, the consonance of the two is greater for simple ratios of the frequencies like 3:2 or 4:3 or 5:4. Dissonance is heard by nearly all listeners when the differences between the frequencies are 40 or less, but untrained persons find combinations with the standard note of 400 consonant where the differences are over 50 per second, whether they are in simple ratios like 4:3 or 3:2 or not.

One sound can *mask* another. That it is necessary to raise the voice in order to be heard in a noisy room is of course a commonplace observation. Engineers dealing with sound use masking in order to get a unit scale of noise. Noise is measured by the point to which it will mask a series of whistle tones of known intensity.

STRUCTURE OF THE EAR

Although the visible structure of the external ear is no longer as mobile as its muscular equipment would indicate it once was, its obvious utility is in gathering and concentrating sound waves into the external canal leading to the real sense organ of hearing. These air waves set into vibration the ear drum in the middle ear, a membrane stretched across the end of the external canal. On the inside of the drum membrane a set of three tiny bones, called the hammer, the anvil, and the stirrup, from their shapes, conveys the motion of the drum to an oval window leading to a liquid-filled cavity, the cochlea, named for its resemblance to the shape of a spiral shell. Across

the middle of this winding chamber is a membrane (the Basilar membrane) on the length of which is found the *organ of Corti*, the actual sense organ of hearing. Sounds of different pitches set up vibrations in the drum, the bones of the middle ear, the fluid of the cochlea, and these in turn produce different patterns of vibration along the basilar membrane and hence excite different patterns of nerve impulses from the length of the organ of Corti. Wever and Bray, in a series of experiments in the early 1930's, established that impulses set up in the auditory nerve leading from the organ of Corti tend to reproduce the frequencies imposed on the ear drum.[2] It was possible to hear speech amplified from such nerve impulses in the auditory nerve of a cat when words were spoken in the neighborhood of the cat.

LOCALIZATION OF SOUND

The ear is a distance receptor, but its accuracy in locating the sources of stimulation is not comparable to the accuracy of the eye. The reason for this is, of course, the difference between light, which travels in straight lines, and sound, which readily turns corners. For the localization of sound sources by the ears alone we depend on the differences in the effects in the two ears. When the sound is from the right there are two sources of difference in its effect. The sound will be more intense in the right ear. The sound waves will reach the right ear in a phase earlier than that arriving at the left ear at the same instant. In other words, the crest of the sound wave will strike the right ear first.

The result of the position of the two ears is that it is not possible to locate accurately sounds from sources in the median plane between the two ears. A shot or a short whistle heard in the dark is likely to be incorrectly located if it is directly ahead or directly behind. When a sound is continued, the device of turning the head quickly discloses whether it is ahead or behind. Actually the median plane between

[2] E. G. Wever and C. W. Bray, The nature of acoustic response: the relation between sound frequency and frequency of impulses in the auditory nerve, *J. Exp. Psychol.*, 1930, 13, 373–387.

the two ears is not the only locus of confusion in locating the source of sounds. The location of any sound in so far as it depends on the ears alone is indeterminate within a cone whose axis is the line between the ears and whose surface passes through the source. At any point on such a cone the differences in intensity and phase in the two ears would be roughly equal. It is of possible interest to note that shrill sounds of which the wave length is so short that the distance between wave crests is about the same as the added distance which the wave must travel to reach the more distant ear, result in depriving us of that particular cue to direction. This would not be true of the deep note of a fog horn in which the crests are several feet apart.

TASTE AND SMELL

Scattered over the tongue and adjacent areas of the mucous membrane lining the mouth and upper throat are small papillae or "buds" which contain the chemical receptors for taste. It is usually a surprise to most persons to learn that most food flavors involve not only the stimulation of the taste buds but also stimulation of the olfactory membrane which contains the receptors for smell, and of temperature receptors and touch receptors in the mouth. There are actually only four tastes: sour, sweet, salty, and bitter. Quinine and unsweetened coffee are both bitter, and are likely to be confused if air is prevented from carrying the odor of these substances to the organs of smell. Onion and apple can be similarly confused when odor is eliminated and we depend on taste alone.

The receptors for sweet, sour, salt, and bitter are not equally spaced over the tongue. The tip of the tongue is most sensitive to sweet, the sides to sour, and the base to bitter. Receptors sensitive to salt appear to be scattered well over the whole surface. It is worth notice that, as in the case of all receptors, the organs of taste are strategically situated at the food intake, which is one of the prime uses of the mouth, somehow minimized in dentifrice advertisements.

As in the case of color sensitivity, contrast effects are also present in tastes. Sours are more sour after tasting something sweet. Lemonade

which would otherwise be sweet enough requires more sugar to be palatable after eating candy. Adaptation effects are also in evidence. Sweetened food tastes less sweet as we continue to eat it.

To be tastable, substances must be soluble in water, and it is assumed that taste is a chemical sense in that the activation of the sense organ depends on certain chemical processes being directly initiated in the receptor.

Odors, like tastes, exhibit adaptation. Continued exposure to a perfume causes it to lose its stimulating quality. We notice the odor of the drug store or of the grocery or market only on entering.

The physical nature of the stimulation of olfactory receptors is still obscure. The startling suggestion of Miles and Beck[8] that odor is dependent on the opacity of odorous gases to heat rays, and that the actual stimulation of the receptor is in the form of such radiation from the body itself has not been refuted by experiment. The fact that such a theory can be so much as suggested illustrates our general ignorance of the details of olfactory stimulation.

CUTANEOUS SENSES

Sense organs in the skin are responsible for psychological experiences of cold, warmth, pressure, pain, and of varieties and combinations of these. A generation ago introductory courses in psychology devoted much laboratory time to the various senses and the majority of students were surprised to find for the first time that not the whole surface of the skin is sensitive to light touch, or to warmth or to cold. It was also usually a surprise for the beginning student to discover that experiences or sensations of warmth did not originate at the same points as sensations of cold. Light touch on the back of the hand tends to be limited to the immediate neighborhood of the roots of body hairs, where sensory nerve endings are coiled.

The perception of warmth and cold does not depend upon the

[8] W. R. Miles and L. H. Beck, Infrared absorption in field studies of olfaction in bees, *Science*, 1947, 106, 512 (Abstract). See also by the same authors: Some theoretical and experimental relationships between infrared absorption and olfaction, *Science*, 1947, 106, 511 (Abstract).

absolute temperature of stimulating object, but upon the relation of that temperature to the temperature of the skin. Because contact with objects at skin temperature produces no temperature sensation, this is called a *psychological zero* point. Contact with an object above the skin temperature is experienced as warm. If the object is many degrees above skin temperature it will be experienced as heat, or, at a higher point, as pain. Many of the body receptors respond to very intense stimulation with pain. When the stimulating object is colder than the skin temperature it feels cool, cold, or painful according to the degree of the difference.

In the cases of the skin senses both contrast effects and adaptation are also present. We are insensitive to the pressure or touch of our glasses or of our belt after wearing them for a few moments.

KINESTHETIC SENSITIVITY

The receptors in our muscles, tendons, and joints are called *proprioceptors* because it is through them that we are able to respond to our own movements and posture. These receptors are stimulated by the pressures and the distortions caused by the tensing of muscles and the movements of bones in joints and by stresses on tendons. With these sense organs as with the others it requires active change of state to produce stimulation. A person sitting in a chair who falls asleep may often be surprised on waking to find that he has dropped his book and that his arm is hanging downward instead of supporting the book. We are often unaware of a long maintained posture until some slight movement acts as the adequate stimulus for proprioceptors.

In some cases of advanced syphilitic infection of the central nervous system, the cell bodies of the proprioceptive sensory cells are destroyed in their ganglia along the spinal cord. The result is to make the patient unable to respond correctly to the actual movement of his own legs. Some patients learn with difficulty and with many false movements to watch their feet and legs and to make the visual stimuli the signals for movements of walking. Coördination remains poor. In a normal person one step is the signal for the next. Walking is achieved

by a multitude of coördinated reflexes and learned responses all depending on proprioceptors for their signals.

LABYRINTHINE RECEPTORS

Important sense organs for movement and the maintainance of equilibrium are in the bony structure of the skull alongside the cochlea, the sense organ of hearing. These sense organs are contained in the semicircular canals and in the utricle and saccule. These organs are responsible for most of the reflexes which maintain posture and for such experiences as dizziness. The utricle and saccule have hair cells which project into a gelatinous mass containing small bits of calcium carbonate. The direction of gravity, or any acceleration or slowing up of movement causes the particles of calcium carbonate to distort the position of the hair cells and this serves as the actual occasion for activating the sensory impulse which reports the movement or the direction of gravitation. It is known that some deaf-mutes in whom this portion of the ear structure is defective, are subject to disorientation when under water in a swimming pool. They are unable to respond correctly to the direction of gravity.

The semicircular canals are in three separate places at right angles to each other. The fluid of one or more of the canals is supposed to be set in motion by any rotation of the head and this motion to affect hair cells which extend into the fluid at the enlarged end of the canal. The changed position of the hair cell is probably the adequate stimulus for response to turning movements of the head.

In these inner ear organs adaptation is also evident. To continued uniform rotation we cease to respond, so far as the semicircular canals are concerned, but a sudden stop will cause responses appropriate to a start in the opposite direction of rotation.

PERCEIVING

We almost never—probably never—respond naïvely to the simple character of a stimulus. Our response is always conditioned by past learning, affected by prior response, by our posture and action, by the

condition of the organism (whether fatigued, hungry, excited, or depressed), and by complicated interrelationships of the other stimuli acting. The effects of any stimulus depend on all these things.

Psychologists of a generation ago devoted their time to efforts to analyze the effects of a given stimulus into "pure" characteristics. The effect of stimulation from light waves, for example, was analyzed into *hue, saturation,* and *brightness.* These were thought to be the elemental qualities of visual sensations, the ultimate units of experience. Experience was thought of as made up of combinations of these elemental qualities.

But stimuli are not experienced in this separate fashion in everyday life. We do not "see" red just as red and nothing but red. What we see is the redness of a book, of a dress, or of a tie. The effects of any given stimulation are, in other words, conditioned by the organism receiving the stimulation. We react to a situation by interpreting, evaluating, judging.

If someone placed on the desk a number of objects, a key chain, a cigarette lighter, a pencil, and asked you what you saw, you would probably name these objects. But you do not, in the strict sense of the word, see these things. You can see only certain forms or patterns of darkness and brightness or certain colors, certain lines. You cannot see the nonvisual properties that a key chain must have, its weight, its temperature, its hardness.

We say that we hear someone coming up the stairs. In the strict sense again, we cannot hear people. We can only hear sounds. We do not in the strict sense smell onions cooking. Neither the onions nor the cooking can reach the olfactory membrane in the nose. We smell minute quantities of gaseous material that have entered our nostril.

When we say we hear burglars, see people, smell cooking, feel sand, we are interpreting certain stimuli in terms of certain modifications produced in us by past learning.

The names of the objects we think we see are our interpretations. An Eskimo would look at these same objects and "see" something entirely different.

Perceiving, which, like attending, is a process, involves the interpretation of stimulation. We perceive meanings in the things that stimulate us. We hear a sound, but we perceive what the sound means. When we touch a table top in the dark, and feel a sudden coolness and lessened resistance to the motion of our finger across the surface, the coolness and lessened resistance is perceived as a spot of moisture. The motion-picture screen offers a series of pictures of a man. In each picture he appears several inches to the left of the last. We interpret or perceive this as a picture of a man moving to our left. We assume that he has moved in a continuous motion from where we first saw him to where we last saw him. The actual pictures had no such continuity. In between pictures there was nothing but darkness.

Evidently perceiving does not all come from the stimuli. The perceiver contributes most of his interpretation. A broken circle, for instance, tends strongly to be perceived, if we are allowed just a glimpse of it, as a complete circle. Other familiar patterns show this tendency to *closure*, to be perceived as complete when they are incomplete. Our tendency to fail to notice errors in the typed page illustrates the same phenomenon. We see the complete or correct word.[4]

When a series of tappings is spaced equally we tend strongly to hear it in groups of three or in some other pattern. This grouping is the contribution of the perceiver and depends on conditions within himself. What the perceiver contributes will depend on his previous experiences with similar stimuli. What he contributes will also depend not just on the stimuli we who are watching him have in mind, but on all the other stimuli acting on him, including stimuli from his own current actions and posture. The mother with a boy overseas tends to perceive all steps on the porch in midmorning as the postman. The girl who has quarreled with her lover hears each ring of the telephone bell as his ring.

Perceiving of an ordinary object like a chair or a fountain pen thus depends on (1) the stimuli it is giving sense organs at the moment;

[4] Additional examples may be found in G. W. Hartmann, *Gestalt psychology*, New York: Ronald, 1935.

on (2) the stimuli the organism is getting from other external sources; on (3) relations between these external stimuli; on (4) stimuli from the organism's response to the stimuli mentioned in (1) and (2) and from the organism's current actions or posture; and on (5) the past associations of all these stimuli mentioned.

The dependence of perceiving on relations between external stimuli may be illustrated in many ways. An observer who confronts a child with three red boxes and one yellow box and finds that the child always picks up the yellow box might conclude that "yellowness" is the important determiner of the response. But when he finds that the presentation of three blue boxes and a green one always results in the choice of the green he may begin to realize that it is not "yellowness" but "difference" that is responded to.

When we perceive a melody it is not the individual notes that are important but their pitch and time relationships, the sequences of low-high and high-low, the lengths of the intervals between notes. We can occasionally recognize a melody from hearing it tapped on a table.

Responding to relations between stimuli is not a mysterious process at all. An ordinary beam balance does the same thing. The way it will tilt depends not on the absolute weight put on one end, but on which end is heavier. Perceiving visual patterns depends on the patterning of darker and lighter but not on the absolute amounts of light except as these determine relative darkness and lightness. This is proved by the fact that objects are still recognizable when the illumination is sharply reduced.

MINIMAL RESPONSES

Objects look heavy or light. They do this in spite of the fact that the eye is not a weighing device but a receptor for light. What really happens is that the visual pattern of stimuli evokes through past associations the responses used in lifting objects.

Usually these responses are minimal. That means that they consist in very slight responses of the appropriate muscles, so slight we cannot

usually see the resulting movements, but they are enough to serve as signals in the control of behavior. When an object "looks" heavy, the heaviness is our perception of the actual set of our own muscles which are responding slightly but in the pattern required for a strong lift.

You can experiment with this perception of heaviness and lightness by fastening a cube of lead in one corner of a cigar box. When naïve persons pick up the box their responses are adjusted by their past experiences with such boxes. The box looks light because such boxes in the past have yielded to slight effort in lifting.

The existence of minimal responses that are the basic components of perceiving is not always demonstrable. A generation ago the instrument sometimes used for demonstrating activity in muscles whose use was merely "thought of" or intended was called a *plethysmograph.* It consisted of a water jacket into which the arm or leg could be thrust and a tube in which changes in water level could be noted as the arm or leg increased or decreased in volume. The increase in volume resulted from an increase in the blood supply to the active muscles.

A more modern method takes advantage of the fact that when either nerves or muscles are active action currents are set up which can be measured through the use of amplifiers. In this way Max found that the lips of ordinary subjects are active when a sentence is "thought," while the fingers are inactive.[5] The lip activity is not sufficient to cause visible movement of the lips. In deaf-mutes the case is reversed. Their finger muscles show electrical signs of activity while the lips are quiet.

It is probable that these minimal responses which take place in perceiving can serve as signals because they can stimulate receptors in the muscles. Perceiving is then not just a passive awareness of a situation but a response process that can initiate overt action and inhibit overt action.

[5] L. W. Max, An experimental study of the motor theory of consciousness. IV. Action-current responses in the deaf during awakening, kinesthetic imagery, and abstract thinking, *J. Comp. Psychol.*, 1937, 24, 301–344.

It will repay us to stop to consider this signaling ability of perceptions because it has a profound effect on behavior. It means that in man responses can be evoked in the absence of the external stimuli associated with the response. We can be made to react "as if" to the presence of a dog or to the presence of a fire without the sight or smell or touch of the animal or the event. If by any means our perceptual response can be set off by a heard word or by something we have read, this response itself can act as a signal for appropriate behavior.

We may undertake to elaborate an illustration. All persons have had some experience with fire. All persons have acquired certain associative responses which are signaled by the sight of flames. These will differ from person to person, because they depend on individual experience with flames. One person has far less tendency to hold away from the flame, not having shared the experience of being singed, which has established in another person a strong avoidance at the sight of a nearby flame.

These associative responses may be minimal movements which are barely or not at all visible to an observer. They could be detected by amplifying the action currents from the muscles involved, though they do not go so far as actual movement of the limbs. They are checked movements—the beginnings of movements.

When these beginnings of action have been associated with appropriate words, so that the word may evoke the minimal action and the minimal action tends to evoke the appropriate word, we have ideas, thoughts, concepts. At this point we are concerned with the fact that perceptual responses extend the range of stimuli which can call out responses in us. The person who has established such perceptual minimal responses to fire or flame can now be put on his guard by a word, or by any cue that evokes his perception of fire. The word need not have accompanied the original painful experience. It need only have been associated with the perceptual revival of the original experience.

A child is frightened by a dog. We can understand in terms of associative learning how stimuli which accompanied the original ex-

perience can call out the excitement and the defensive movements made at that time. We note, however, that weeks later the child shows great disturbance on hearing a distant barking, in spite of the fact that the frightening experience did not involve any barking. How can a bark, without being associated with the fright, get the ability to frighten? The answer is that the original experience involved the perception of "dog," something already familiar and something to which minimal responses are already attached. This perception accompanies the fright and becomes an associative signal for fright. On later occasions anything that evokes the perception has become a signal for fright. The distant barking leads to perceptual responses. The perception is the cue for fright.

MEANING

The inevitable tendency to give meaning to stimuli, to interpret the situation has certain disadvantages as well as certain advantages. In reading and listening we tend strongly to assume meaning in what we hear. One of the writers of this book was once on the topic of sensory experience in a class in general psychology. Telling the class that he had a letter from a psychologist working in this field, he read: "I have just finished some observations on the radiophores in which I think you will be interested. The trinemias measured twelve lampteres across, but were indicationate to the repopitation of the gamma books . . . ."

Many will recognize this immediately for what it is, double talk or sheer nonsense. But the listeners listened without being disturbed, getting from it much the same vague perception that we get from the average political speech or from most of the thousands of banquet talks that are epidemic in a college community about commencement time.

SUGGESTIBILITY

Very closely related to attending and perceiving is a characteristic of organisms called *suggestibility*. The suggestible individual is one

who tends to respond uncritically, accept interpretations suggested by others. Suggestibility is a characteristic which people exhibit in different degrees, and which can be increased or diminished by controlling the conditions of stimulation and previous learning. The suggestible person tends to perceive in terms of what he thinks others perceive. His perceptions of the flavor of foods, of the temperature of the room or its stuffiness, of the merit of a singer, of the signs of the weather, are all strongly affected by the reactions of those about him.

Temporary states of suggestibility can be established by the preceding stimulation. If an instructor in the classroom, lecturing on olfactory sensitivity, opens a bottle and asks students to raise their hands as soon as they smell the odor from the bottle, as a rule some students in the front row will eventually raise their hands and will then be quickly followed by others who see them. The bottle turns out, of course, to contain water.

If a student in a line at a cafeteria picks up the top tray and then takes the second, replacing the first, those who follow will frequently go through the same ritual under a vague perception that something is wrong with the top tray. In the familiar "shaggy dog" stories, in which a long pointless anecdote is followed by the laughter of those "in the know," laughter of those not initiated often follows as though they had seen the point.

We tend to follow the cues offered by other persons in perceiving ourselves as well or ill. The bedside manner of the physician has a great effect upon his patients. The sugar pill administered with confidence may bring about a reversal of behavior when the behavior of illness has been based on suggestion rather than on physical weakness.

There is also a strong tendency for perceiving to be affected by wishes and desires. Many individuals claim to recognize the voice of a dead relative when a medium has set the stage for that perception. When a Puget Sound photographer had at the request of a medium printed in on a portrait of a client a shadowy face, the face was nearly always recognized by the client as that of a relative said by the medium to be attempting communication.

HYPNOSIS

In the clinic and the laboratory a heightened state of suggestibility called *hypnosis* can be induced in some subjects. This state can be facilitated by using such devices as a bright metal ball held before the forehead and fixated by the subject. The clinician uses verbal commands to induce a state of heightened attending to a limited source of stimulation. The commands are essentially conflicting. The subject is told to relax or to sleep, but the general situation keeps him from carrying out that direction. With continued fixation eye-muscle strain is set up. The subject is told that he is becoming sleepy and accepts this interpretation by assuming the role of sleep but not by actually going to sleep. He is absorbed in this role.[6]

In some instances the subject accepts other suggestions from the clinician; that he will have complete *amnesia* (failure of memory) for the events taking place; that he will be insensitive to physical pain; that he is growing cold or warm; that he cannot see certain individuals. Accepting the interpretation of the clinician, the subject acts as if these interpretations are correct. Response to the events taking place and response to painful stimuli can be demonstrated to occur, but in accepting the clinician's interpretation, the subject behaves as if this were not the case. Pain may elicit reflex movement, but will not be verbally acknowledged.

Some subjects accept posthypnotic suggestions. Told to ask a question when the clinician takes his handkerchief out of his pocket or to leave the room when the clock strikes four, the subject will often carry out the direction and, on being asked why, will provide some excuse for his behavior other than that he had been told to perform the act by the clinician.

The state of hypnosis differs radically from sleep. One illustration of the difference is the fact that in sleep the reflex knee jerk to a tap on the patellar tendon diminishes or disappears but it is present in

[6] R. W. White, A preface to the theory of hypnotism, *J. Abnorm. & Soc. Psychol.*, 1941, 36, 477–505.

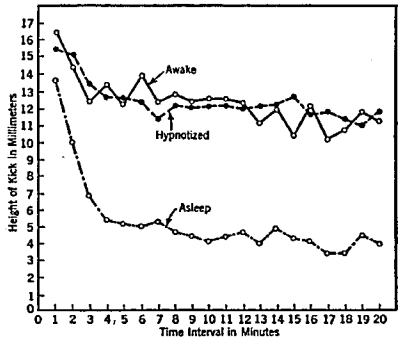

FIG. 9. The Course of the Patellar Reflex in Subjects Under Various Conditions over a Period of 20 Minutes. Note that the patellar reflex diminishes considerably in the "asleep" group whereas there is little difference between the "awake" and "hypnotized" groups. (From M. J. Bass, Differentiation of the hypnotic trance from normal sleep, *J. Exp. Psychol.*, 1931, 5, 382–399.)

hypnosis.[7] Respiratory records taken from hypnotized subjects are also more characteristic of records obtained from waking periods than from periods of sleep.[8] Similar findings have been obtained with records of brain waves.[9]

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XVI

Learning as Improvement

COMMON sense means by the word "learning" the *acquisition of a skill,* which in its turn means the ability to achieve some goal or end result in reduced time, with fewer errors, with less expenditure of energy, and with increased certainty. When we use the word "learning" in this sense, the process includes many reassociations; it requires that many responses to stimuli cease to be given as well as that many new responses be established. When we speak of learning a skill, such as learning to tie a bowknot, or learning to cook pancakes, or piano playing, typing, receiving code, we are using the word in the sense of "improvement," and not in the sense of conditioning or association by contiguity.[1]

All learning, in this sense as well as in the sense of changed response to stimulus, however, conforms to the principle of association. But learning to type means not just the establishment of a conditioned response but the acquiring of many thousands of conditioned responses and the replacement of other thousands by these.

Both teachers and students are interested in the practical issue of improvement. Can the psychology of learning offer any suggestions toward effective and economical learning in the sense of learning a skill or an art? This question will be considered in the pages following.

[1] Much of the experimental literature on learning as improvement is covered in J. A. McGeoch, *The psychology of human learning,* New York: Longmans, Green, 1942.

LEARNING BY PART-WHOLE METHODS

Let us suppose you are required to learn a poem or a part in a play. Shall it be practiced as a whole, that is, by reading it straight through, or shall it be practiced by learning a section or a verse at a time and then going on to the next?

There is an obvious associative fault in the part-by-part method. If you are learning a poem verse by verse and practice the first verse over and over, you are following the last line of the verse by the first. This associative sequence may rise to confound you when you later try to repeat the poem as a whole. All you can think of when you give the last line is the beginning line.

Probably for this reason studies tend to indicate that when material to be learned is not so long as to induce fatigue of attention, or radical shifts of posture, the "whole" method has an advantage, and learning by reciting the whole selection takes less time and fewer repetitions. If the learner would be fatigued or discouraged in going over the whole material, it is best broken up into parts.

A question very closely related to this concerns *massed versus distributed practice*. If you wish to learn to type is it better to practice a half-hour a day, an hour, two hours, or eight hours?

The answer to this question is very much the same as the answer to the question of whole or part learning. In general, distributed practice has the advantage over more massed practice periods. A half-hour a day at the typewriter will give you a specific skill, say 40 words a minute, with less total time spent in practice than will longer periods.

The reason for this appears to be that long periods of practice bring fatigue, and fatigue may introduce bad habits that actually interfere with performance. One should practice only for such time as he is improving, if he wishes to get his skill in minimum time.

LEARNING OF MEANINGFUL MATERIAL

The greater ease with which we can learn *meaningful material* as contrasted with less meaningful material is well known. It was men-

tioned before that the average student in college can recall about eight digits that he hears read aloud. But some freight conductors of long service can walk the length of a twenty- to forty-car train and then jot down the initials and numbers of all the cars. These may run to two hundred digits plus an assortment of initials like P.R.R. for Pennsylvania Railroad. But to the experienced conductor these car numbers have meaning. Some of them are individually familiar and are recognized. C.B.Q. 243,197 is a car that had been on the repair track the previous week. Its number is not six separate digits any more than his friend Peterson's name is just eight letters in a series. More than that, he knows the system of numbering used by each railroad, numbers beginning with 25 designate gondolas, those beginning with 30 are automobile boxcars, and so forth.

The student with a better background of knowledge has a great advantage in learning in the fields where he is well versed. What he reads is only partly new and much of it has been already learned. One advantage of meaningful material lies in the fact that it is already learned in certain details. Another lies in the fact that once material is perceived in its setting and in its relations to other material it can be recalled as a whole and is open to more "reminders" or associative cues.

INSIGHT AND LEARNING

In the chapter on perception it was pointed out that perceptual response is a response to total situations and that the organism contributes in two ways to what is perceived. What is perceived depends on the past learning of the organism. And it also depends upon the present response condition of the organism, what it is doing, what desires or wishes have been aroused, what fears and apprehensions it is suffering. All these factors help determine the resulting perception.

Köhler, a German psychologist, was interested in perceptual processes in relation to the broader question of problem solving.[2] He observed in certain situations that an animal, instead of engaging in apparent trial-

[2] W. Köhler, *The mentality of apes*, New York: Harcourt, Brace, 2nd ed., 1927.

and-error behavior, would solve a problem by *insight*. An illustration will serve to indicate what Köhler means by insight into a problem.

Chimpanzees in a cage were confronted with a banana lying on the floor outside the bars of the cage and at a distance too great to reach. If a stick was placed in the cage, according to Köhler, the ape would at some time or other suddenly pick up the stick and use it to retrieve the banana. Sometimes this action can be observed to follow a quiet period in which the ape looks at the stick and at the fruit.

If, instead of one stick long enough to reach the banana, two short sticks, of which one can be made to fit into the end of the other, are placed in the cage, there is sometimes to be seen the same sudden insight. After a period of quiet observation the ape will pick up the two sticks, fit them together and immediately use the lengthened tool to pull in the fruit to a point within arm reach. Here a complex situation is suddenly reacted to in relation to a goal object and a solution reached without anything resembling a long series of trial and error.

These insights are demonstrable in animal learning and are characteristic of human learning.

The presence or absence of insight into a problem has important effects on the retention of a solution. The solution that is arrived at by accident may be retained if conditions are very closely repeated on another occasion. The solution arrived at with insight into relationships is likely to be repeatable in a variety of conditions.

How to get from one part of a city to another is obviously facilitated by a map which makes an intelligible scheme out of a long series of turns. Once having learned how to use a map to get from one point to another, this knowledge can be applied in the solution of a wide variety of transportation problems.

When a field or situation is organized by perception, the *complex* of elements may now be responded to as a simple response.[3] Probably the simplest illustration of this is in trying to remember a series of digits. The average college student can repeat about eight digits read

[3] G. Katona, *Organizing and memorizing*, New York: Columbia University Press, 1940. This book emphasizes the role of organization in memory.

to him at the rate of one a second, for example, 7-3-9-4-2-6-8-1. But if he "organizes" these by two's or by three's, he can repeat a much longer series. For example 73-94-26-81 is more readily repeated than 7-3-9-4-2-6-8-1. Probably 739-426-81 is still more readily repeated. The 739 perceived as a number is more readily repeated than when perceived as three separate digits. The series of letters, T-h-e-r-e-w-i-l-l-b-e-n-o-f-i-n-a-l-e-x-a-m-i-n-a-t-i-o-n is much more easily repeated if perceived as "There will be no final examination."

Insight is not a special kind of learning, nor does it stand in opposition to associative learning. So far as we know, the principle of association holds when insight occurs as well as when there is trial and error without insight. The insight, once arrived at, is subject to associative laws. Whether or not the insight will take place depends on the previously acquired repertory of perceptual responses. It would, for instance, probably be found that apes without a previous trial-and-error experience with sticks would not suddenly perceive the stick as a tool for banana harvesting.

Wickens had some subjects place the hand in such a way that a finger touched an electrode and received a shock.[4] A conditioned signal preceded the shock. Subjects learned to extend the finger at the signal and so avoid shock.

Now the hand was turned so that extending the finger brought it into close contact with the electrode. Without any experience of shock, the signal now is followed by flexion, not extension of the finger. This response is believed to illustrate the presence of insight and perhaps does. It is also mistakenly thought, by some observers, to disprove the principle of association because that principle would supposedly predict extension not flexion at the signal, since the signal has accompanied extension and never flexion. We may well doubt that a subject with no previous experience of shocks and no verbal understanding of electricity would respond in this way. But normal American college

[4] D. D. Wickens, The transference of conditioned excitation and conditioned inhibition from one muscle group to the antagonistic muscle group. *J. Exp. Psychol.*, 1938, 25, 127–140.

students with hands placed on an electrode that completes a circuit, and with one or more experiences of shock from the contact, will, as soon as their hands are turned, be set for getting away expeditiously. Probably Wickens's subjects need not have been shocked even once but merely told to expect a shock. The subjects were exhibiting insight, but this insight had been acquired by previous experiences in removing the finger from harm and by previous experiences with shock from contact with an electrode. Insight is the end result of previous trial-and-error learning. Babies presumably start life without it. They acquire it by experience.

ATTITUDE AND SET

One striking feature of learning has been noticed by most observers. That is the dependence of learning on attitude and set. Many persons find they have no ability to follow a route over which they have been driven, but if they are once compelled to find their own way it is now possible to repeat the trip independently. Whether or not a student remembers a lecture depends on his own behavior. He does not learn what the lecturer says. He learns only what the lecturer has caused him to do.[5]

If a student is told at the beginning of a lecture that he will be called on for a summary during the last ten minutes he will remember much more than he will without this warning. What the warning has really done is to motivate him to active rehearsal of a summary as he listens. He learns what he does and his own summary is therefore learned.

Any reader can verify this with a book. On some occasion when he finds himself scanning the text and turning pages without remembering, let him read a section, close the book, and attempt to write a summary. Often this "set" involved in intending to write a summary

[5] Students who copy a list of words with and without a warning that they will be tested for retention of the list show expected differences in their reproductions. They are able to reproduce more of the words they are "set" to learn. See J. Peterson, The effect of attitude on immediate and delayed reproduction—a class experiment, *J. Educ. Psychol.*, 1916, 7, 523–532.

is sufficient to ensure that he actively selects and rehearses portions for the summary as he reads.[6] This is active reading instead of the passive scanning that he was doing before. If he finds himself still at a loss and unable to recall all the sense of the page, let him open the book and read again. This time the sense of the paragraphs will tend to stand out. The missing ideas almost leap to the eye. His attempt to write a summary has produced a set for noticing and rephrasing.

LEARNING AND AGE

Learning capacity is a function of age. The ability to learn new material rises rapidly in childhood, and the rate of rise declines until at about the age of 25 there is no further increase. Between 25 and 45 or 50 there is possibly a slow decline and after that age a more rapid decline.[7] The word "possibly" is used here intentionally because in the studies on which this statement is based it is not certain that the lessened interest of older persons rather than a diminished learning capacity is involved.

It should be noticed also that the common impression that children learn more readily than adults is not borne out by measurements of learning ability. Our impression that children learn more readily probably comes from the effect of habits already established in older people.[8] Lacking such fixed habits, children are more impressionable and more easily changed. Children pick up the accent of the region where they live more readily than do adults, whose accent has already been formed elsewhere. The habits we have once established are resistant to change. The increasing conservatism of age probably has this factor as one of its determining conditions.

Pavlov found that dogs fed meat powder for a year showed no in-

[6] Subjects show better retention when a large part of their reading time is spent in active recitation than when the full time is devoted to reading. See A. I. Gates, Recitation as a factor in memorizing, *Arch. Psychol.*, N. Y., 1917, No. 40.

[7] H. E. Jones, H. Conrad; and A. Horn, Psychological studies of motion pictures. II. Observation and recall as a function of age, *Univ. Calif. Publ. Psychol.*, 1928, No. 6.

[8] F. L. Ruch, The differentiative effects of age upon learning, *J. Genet. Psychol.*, 1934, 11, 261–286.

TABLE 2. AVERAGE PROFICIENCY IN MOTOR AND VERBAL LEARNING OF THREE AGE GROUPS: RESULTS EXPRESSED AS PERCENTAGES OF THE AVERAGES FOR THE YOUNGEST GROUP

Learning Task	Young Group 12–17	Middle-Aged Group 34–59	Old Group 60–85
Motor learning			
Direct vision	100	98	82
Mirror vision	100	96	54
Verbal learning			
Paired associates (man-boy, etc.)	100	90	82
Nonsense equations ($F \times A = S$)	100	80	48
False multiplications ($4 \times 3 = 10$)	100	72	47

Note that the proficiency of the oldest group is less than that of the middle-aged group, but that the difference is greatest where the learning task differs from previously learned habits. The direct-vision task involved simple eye-hand coördination; the mirror-vision task involved conflict with established habits. The paired associates were logical associations; the false multiplications involved conflict with previously established habits. Would the nonsense equations conflict with previous habits? How would you account for the performance of the old group at this task? (From F. L. Ruch, The differentiative effects of age upon human learning, *J. Gen. Psychol.*, 1934, 11, 261–286.)

terest in milk, while those fed milk for a year showed no interest in meat powder. The acceptance of milk by a dog that has been fed only on meat powder requires giving up the habits by which the meat powder is eaten. Milk must be lapped, for which the meat powder dog is not prepared. Lapping has followed thirst and the presence of water but is not set off by hunger and food. The way in which people cling to the food interests that they have once established is well known to all of us.

This increasing conservatism of habits as they get established gives the impression that learning capacity diminishes with age more rapidly than it actually does.

MEASURING THE PROGRESS OF LEARNING

Whether we are dealing with learning in the sense of association or in the sense of improvement, it is of great importance to work out methods of measuring learning. In the chapter on associative learning,

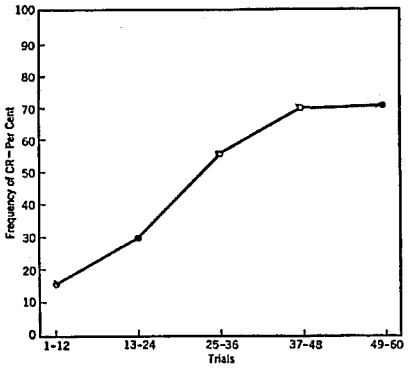

FIG. 10. The Measure of the Strength of a Conditioned Response. Each point represents the mean percentage frequency of the conditioned response from 10 subjects within the trials indicated on the base line. The conditioned stimulus was an increase in illumination. An air puff (unconditioned stimulus) to the cornea of the eye regularly followed the visual stimulus at an interval of 600 ms. Sixty paired light and air-puff stimuli were presented in groups of 12, spaced at approximately 30 seconds, with a 2-minute rest period between sets of 12. (From E. R. Hilgard, R. K. Campbell, and W. N. Sears, Conditioned discrimination: The effect of knowledge of stimulus-relationships, *Amer. J. Psychol.*, 1938, 51, 498–506.)

it was mentioned that the percentage of the time a certain response follows a particular stimulus can be thought of as a measure of the strength of the association between that particular stimulus and that certain response. So can the vigor of a response be, for some purposes,

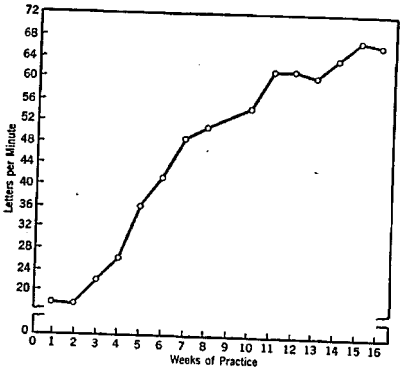

FIG. 11. Learning Curve for Receiving Telegraphic Code. Scores are based upon performance during a 2-minute test period. The points plotted are the averages of 20 to 43 subjects. All subjects were students in a course in Practical Radio organized during the war. (From H. B. Reed and H. A. Zinszer, The occurence of plateaus in telegraphy, *J. Exp. Psychol.*, 1943, 33, 130–135.)

thought of as a measure of the strength of an association. And so also can the length of the *latent period* between stimulus and response. These last measures are not necessarily in agreement with the first, but they are all possible measures of the strength of an association.

When we are dealing with learning as *improvement*, a very different set of measures is required. The measure of learning to type, for in-

stance, can be the number of words per minute that has been attained. Another measure of the increasing skill is the decrease in the number of errors made per page or per hundred words. Instead of words per minute, we could record number of minutes required to type a given number of pages.

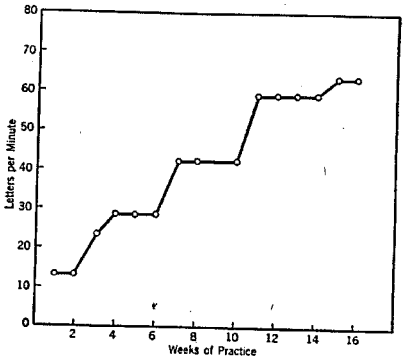

FIG. 12. Individual Learning Curve for Receiving Telegraphic Code. This is the record of the progress of a single subject. Compare with the curve based upon the average performance of all subjects, Fig. 11. (From H. B. Reed and H. A. Zinszer, The occurrence of plateaus in telegraphy, *J. Exp. Psychol.*, 1943, 33, 130–135.)

With any of these measures it is possible to plot a *learning curve*. On the base line we could indicate number of trials or practice periods and on the vertical axis the number of errors, number of seconds or minutes required for one performance, or number of performances per unit of time.

There are several statements that should be made about such curves. In the first place there is no basic learning curve or "real" learning curve. The curves depend on the nature of the task, on the extent of previous skill, and on the conditions of practice. The only statement that holds of all learning curves is that they eventually show diminishing returns for the practice put in under a given set of conditions. We reach a point where one practice period or one trial does not result in as great improvement as formerly.

All learning curves are irregular and show great fluctuations. On successive trials there are so many possible causes for variability that these fluctuations are best written off as due to chance. Much depends on the attention of the organism which selects the stimuli that will be responded to. Very small distractions of attention may have large results in changing behavior.

It was said that all learning curves flatten out eventually and the rate of improvement reaches zero under a given set of conditions. In verbal learning, whether this consists in rote learning of a poem or in mastering the material of a college course as measured by examinations, and in most motor learning, skating, typing, shooting, painting, we never approximate any real *physiological limits*. The limits are not set by our nervous system and muscles but by the conditions of our motivation. Nearly any student, by putting in increased time on a college course, can better his performance. The majority are motivated only to do fairly well. When they reach the approximate performance of the class average, interest flags. If the motivation derives from the group and not from the subject, if a student works because he sees he is behind the others and not through curiosity or enthusiasm for mathematics, or physics, or whatever the course may be, there is indeed a *practical limit* on what he may learn. The leveling-off of learning curves is an indication that the practical limit, under present conditions of motivation, has been reached.

If a learning curve were to show the same degree of improvement from trial to trial, the result would be a curve which was a straight line. This might happen if the various elements of a task were all of

equal difficulty and were acquired one by one. This condition is never met for long. In ordinary tasks and skills the elements that must be acquired through proper association of stimuli and responses are of unequal difficulty and the easiest are learned first, the more difficult in later trials. In this case the curve will show most improvement at the beginning of practice and less and less as practice continues. Such a curve is said to be *negatively accelerated*. Negative acceleration is also likely to be present when previously learned skills can be used in the new task.

SKILLED ACTIONS

Skilled action is smooth and comparatively effortless. The unskilled driver of a car grips his wheel, is tense, is incapable of carrying on a conversation while in traffic. The skilled driver is relaxed except in those muscles required for driving. Why should long practice tend to bring about this graceful and effortless action?

The reason is that fatigue and the muscular strain that is felt as effort both act as disturbers, as motives. They tend to inhibit movement and change behavior. Just as we learn not to bump our heads getting into the new car with a lower door-opening, so we tend to unlearn the actions that bring punishment in the form of fatigue and effort.

The worker who has spent years at certain forms of heavy labor, using a shovel, pitching hay, piling lumber, sawing timber, learns to eliminate many of the waste motions made by the beginner and to use just the muscles necessary for the action and to use these just to the necessary extent. His actual exertion in performing a task may be only a fraction of what was first required because the pain of fatigue and effort serves as motivation for learning the easy way. Increasing age intensifies this effect because action becomes more painful. The eight-year-old boy makes his way to school with much waste effort. Other interests compete and complicate his progress. His forty-year-old teacher does not stop to throw stones, climb fences, tussle with acquaintances, try an occasional broad jump.

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XVII

Remembering

IN order to talk about a thing we must name it. But naming things carries its own risks. The first names we use are names for solid physical objects. They have a capacity for staying the same long enough for us to learn a symbol for them. A broom can offer us recognizable sequences of stimuli day after day. To our routinized habits, chairs, knives, dishes, and ropes function in dependable ways.

In order to study memory we had to name it. But we chose as a title for this chapter the word "remembering," just as for Chapter XV we chose "attending and perceiving" rather than "attention and perception." For that, there was a reason. When we use a name for a thing there is a very strong tendency for most people to endow it immediately with some of the qualities of a physical object, an object like a brick or a frying pan. We assume physical objects to be there when we are not noticing them. If we encounter them after a day's absence we assume they were there all the time.

We do not assume this of noises or of events in general. The locomotive whistle is nowhere when it is not in action. Actions are transient. They come and go and when they go, they go nowhere. They cease to be at all.

By using "remembering," the name for an action, we are less likely to fall into some of the errors that common sense falls into on the subject of memory. We are less likely to think of memory as a place

where thoughts are kept as Plato did. He suggests that memory is like an aviary in which a man has imprisoned many birds. When he wants to get one of these birds again, there it is, even if he can not always put his hands immediately on it. There is a certain plausible likeness between this image and the fact that once we have had an idea it is somehow ours and the problem is now to recapture it. We all know that 5 times 7 is 35. Where was this knowledge five minutes ago? We were certainly not thinking just that; but we insist that even five minutes ago we knew that 5 times 7 equaled 35. This bit of knowledge we say was "in our minds," "in our memories," in our "subconscious mind."

These phrases mean little or nothing. The verifiable fact is that the bit of knowledge can be revived with proper stimuli. But that capacity for being revived is the mark of an event rather than of an object.

If we use the word "remembering" instead of "memory" we are less likely to speak of it as something that can be exercised like a muscle and grow large and strong as a result. We shall be disappointed if we try to think of memory either as a receptacle where thoughts can be kept or as an effector like a muscle that can be exercised and its daily growth measured.

Remembering is a process like learning. In fact, it is one way of viewing learning; remembering always requires learning. *Remembering* is the later evocation of learning. The evidence for remembering consists of responses to stimuli. If learning is said to be the formation of an association between stimulus and response, then memory (remembering) is said to occur when at a later date the stimulus evokes the same, or recognizably similar, response. We call two responses the same response when the second is enough similar to allow us to treat it as equivalent to the first. It is philosophers, not psychologists, who permit themselves to become disturbed and bothered over this issue of whether two instances of one kind of event can be called the same event. Psychologists speak of responses occurring again, thoughts as recurring, two events as being the same response or thought, happening twice.

If we learn today that two times two equals four we say we remember when on a future occasion "two times two" evokes the response "four" in us. If once "two times two" evokes "four" and then on a later occasion fails to call out "four" we say forgetting has occurred. *Forgetting* is the loss of an association or a complex associative process after it has been once established. The rememberings and forgettings that we are most commonly interested in are not, however, simple responses to simple stimuli of the nature described. They are rather acts and skills that involve whole series of associations and repertories of responses.

Tennis is a case in point. Learning tennis requires that many hundreds of different responses be associated with the right stimuli, or, in other words, that we learn to do the right thing in hundreds of different tennis situations, a hard service to our backhand, a lob, a fast return toward our back line while we are there. The responses learned have one common quality: they must result in batting the ball over the net into the opponent's court.

In golf we also learn to do a thousand things in a thousand different situations. They must all contribute toward getting the ball in the cup with a minimum number of strokes.

We may be studying a textbook. The remembering and forgetting we are interested in may concern how we will later answer certain questions, or whether we will exhibit certain behavior later or when possible signals for that behavior occur.

FORGETTING AS A FUNCTION OF TIME

Many years ago the members of a women's club had arranged for a series of lectures by a young Frenchman. He was allowed to speak in French since all the women had previously studied French. One Wednesday afternoon he explained, in French, that on the following Wednesday he had an engagement in New York and could not be present. On that following Wednesday all the women appeared for the lecture.

Our most charitable interpretation of their presence would be that forgetting had occurred during the week's interval. But the unanimous character of the failure led to the suspicion that the proper associations had failed to be established at the prior meeting, either through inattention or inadequate French.

Until recently psychologists have believed that forgetting was a simple function of time. It was assumed, as we must still assume, that learning makes some change in the physical structure of the organism, leaving a *trace* or *engram*. No such traces or engrams have ever been discovered in post-mortem examinations of human beings or animals, but we assume their presence if the organism shows signs of responding differently to stimuli (which is learning). These traces or engrams are therefore constructs, not facts. Early psychologists believed that these traces decayed with time and gave this reason as their explanation of the very common loss of learning or skill with time.

The German psychologist Ebbinghaus conducted some elaborate and extended experiments on himself as a subject, and was the first serious experimenter in the field of forgetting.[1] Ebbinghaus learned series of *nonsense syllables* which he could see one at a time in a given order. He chose nonsense syllables like "mem," "gen," "tiv," on the ground that they had no previous associations. Ebbinghaus repeated series of nonsense syllables over and over until he was able to repeat the whole series without referring to the printed stimulus. He then recorded the number of repetitions it had required to reach this stage of skill.

Then he allowed an interval of time to go by and measured the amount of forgetting by an ingenious *savings method*. At the end of the interval he practiced the series of nonsense syllables over again until he could repeat it once clear through without prompting. Then he recorded the number of repetitions required for relearning. The difference between this number and the original number of repetitions

[1] H. Ebbinghaus, *Memory* (Trans. by H. A. Ruger), New York: Teachers College, Columbia University, 1913.

represented what was "saved" in learning by the remnants of the first learning. For instance, if the series took twenty-four repetitions to learn, and at the end of an hour it took him twelve repetitions to get to the point of one unprompted repetition, he argued that 50 percent of the original learning still remained after one hour.

Since Ebbinghaus had to use different series of nonsense syllables for each time interval he investigated this was a long and involved research. Its outcome was to show that forgetting was very rapid at first and then less and less rapid with succeeding intervals of time. We forget a great deal between learning and twenty minutes later. After one day, forgetting is going on very slowly.

RETROACTIVE INHIBITION

The trouble with the theory that forgetting is a simple function of time, as Ebbinghaus's results would indicate, is that during the time interval the organism is undergoing constant modifications by new experiences and new traces are being formed. Obviously if in that interval a stimulus becomes associated with a new response it will lose its power to call out the first and this failure to respond would be indistinguishable from forgetting. Perhaps this process is what forgetting is.

Modern investigators have found that forgetting or remembering may depend on what experiences occur in the time interval rather than just on time itself. Some of these experiences may facilitate and some may interfere with remembering. The tendency for some experiences to interfere with remembering by establishing new and incompatible associations to stimuli is called *retroactive inhibition*. The tendency for some new experiences to aid in the remembering of old experiences is called *retroactive facilitation*.

Studies by Jenkins and Dallenbach[2] and by Van Ormer[3] have been concerned with the phenomenon of retroactive inhibition. They have

[2] J. G. Jenkins and K. Dallenbach, Obliviscence during sleep and waking, *Amer. J. Psychol.*, 1924, 35, 605–612.

[3] E. B. Van Ormer, Retention after intervals of sleep and waking, *Arch. Psychol.*, N. Y., 1932, No. 137.

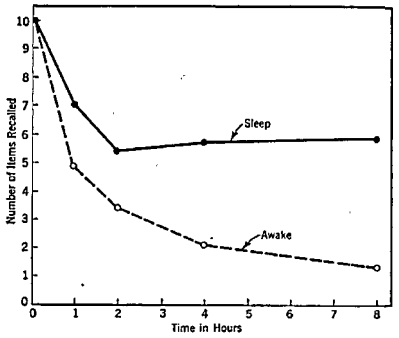


FIG. 13. The Average Number of Syllables Reproduced by Two Subjects After Various Time Intervals of Sleep and Waking. The points plotted are the averages for 2 subjects. The subjects lived in the Psychological Laboratory during the course of the experiment, from April 14, 1923 to June 7, 1923. When the subjects were to be tested after a period of sleep, the learning ordinarily occurred shortly after 11:30 at night. When they were to be tested after a period of waking activity, the learning ordinarily occurred between 8:00 and 10:00 A.M. The experimenters conclude: "The results of our Study as a whole indicate that forgetting is not so much a matter of the decay of old impressions and associations as it is a matter of the interference, inhibition, or obliteration of the old by the new." (From J. G. Jenkins and K. M. Dallenbach, Obliviscence during sleep and waking, *Amer. J. Psychol.*, 1924, 35, 605–612.)

shown that there is remarkably less forgetting during sleep than during an equally long period awake. If forgetting were a mere function of time this would not be true. Forgetting evidently depends on what happens in the interval, and there is less forgetting during sleep because there is little activity and therefore little chance for reconditioning.

BARTLETT'S STUDIES

Bartlett, the British psychologist, has written a book that deals with certain distortions to which remembered items are subject.[4] His research method was to have a selection read to one person and have that person write out what he had heard as he recalled it immediately after hearing it, then have this account read to a second person. This was carried out through a series of persons.

When a folk tale of the Micmac Indians is thus passed through some seven or eight Oxford students, it gradually takes on the character of some Oxford incident. Each person repeating what he has heard tends to make errors in the direction of his own past learning. He uses phrases that are his own habits. What is unfamiliar in the selection read is either not noticed, or serves to touch off some similar response that is already habitual. Just as a profane man, in quoting his friends, uses profanity where there was none, so do we all impose on our accounts of events our own words and phrases. Our memories are distorted in advance by our previous training, or by our subsequent experiences.

The same phenomenon is evident in drawing. Bartlett used a picture of a sacred owl drawn as often seen in Egyptian remains. This quickly became transformed in subsequent reproductions to a line drawing of a house cat.

We draw not what we see but what we have learned to draw. We repeat not what we hear but what we have learned to say. Our own memories are dependent not just on the remembered event but on the

[4] F. C. Bartlett, *Remembering*, Cambridge, England: Cambridge University Press, 1932. See also G. W. Allport and L. Postman, *The psychology of rumor*, New York: Holt, 1947.

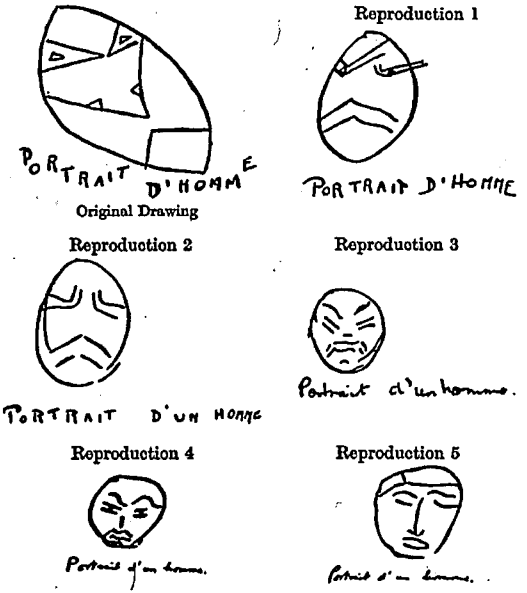
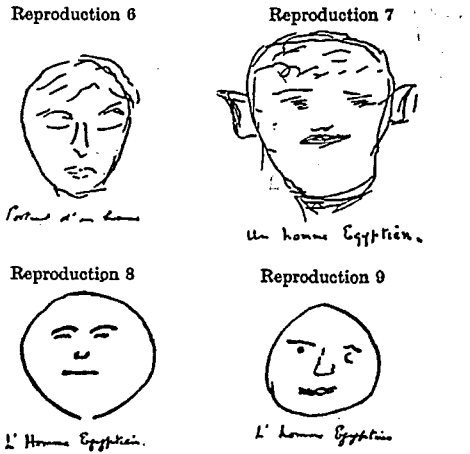


FIG. 14. The Tendency of Unfamiliar Features to be Transformed in the Direction of the Familiar in Successive Reproductions of a Drawing. "Though the series is a very short one, all the characteristics of the original which have any peculiarity are lost. The face is tilted upwards immediately, becomes oval and then round, acquires eyes, a nose and a mouth all of conventional form. There is considerable elaboration up to this point, when the title changes; and then simplification at once sets in again. No doubt the name given had a good deal to do with the form reproduced, but the whole series shows how speedily a pictorial representation may change all of its leading characteristics in the direction of some schematic form already current in the group of subjects who attempt its reproduction." (From F. C. Bartlett, *Remembering*, Cambridge, England: Cambridge University Press, 1932, pp. 178–179.)

responses we were prepared to make to that event by our own previous experience, and also on such changed responses as we have established as habit since the event.

If we leave home at twenty and visit home each Christmas thereafter, our memories of our parents are likely to be the responses made to



them while we were still living at home. Though we have seen the changes that time brings, the graying hair and the gradual loss of erect carriage, we are increasingly startled by these because our memories revert to the distant past and were not successfully revised on the last visit, which was too brief to reassociate the fuller early memories.

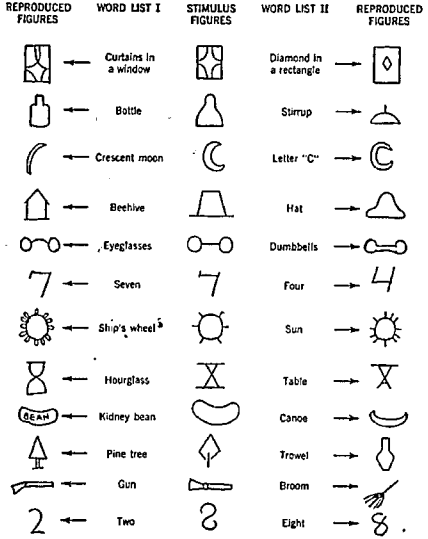


FIG. 15. The Influence of Language on the Reproduction of Visually Perceived Figures. A set of 12 drawings was so constructed that each drawing would resemble two objects. One group of subjects was told, just before the exposure of the stimulus figure: "The next figure resembles . . ." and the appropriate stimulus word from List I was named. Another group was told: "The next figure resembles . . ." but the appropriate stimulus word from List II was named. The reproductions above are not based upon the drawings of any one subject, but illustrate some of the more drastic shifts in the reproductions of the figures in conformity with the stimulus words associated with them. (From L. Carmichael, H. P. Hogan, and A. A. Walter, An experimental study of the effect of language on the reproduction of visually perceived form, *J. Exp. Psychol.*, 1932, 15, 73–86.)

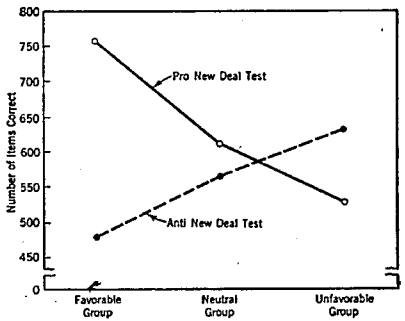


FIG. 16. Number of Correct Responses Made by Groups with Differing Attitudes Toward the New Deal When Tested for Retention of Material Favorable and Unfavorable to the New Deal. Three groups of subjects were used in this study with 48 subjects in each group. One group was favorable, one neutral, and one unfavorable in attitude toward the New Deal. All three groups heard a short speech in which half the material presented was unfavorable and half favorable to the New Deal. The subjects were not aware of the true purpose of the study, but believed that their ability to remember was being tested independently of any consideration of their attitudes. At the conclusion of the speech, all subjects were given a multiple-choice test over the material presented. The test consisted of an equal number of items on the favorable and unfavorable aspects of the New Deal presented in the speech. The results presented above show the total number of correct items for each of the three groups on the unfavorable and favorable parts of the test. (From A. L. Edwards, Political frames of reference as a factor influencing recognition, *J. Abnorm. & Soc. Psychol.*, 1941, 36, 34–50.)

MEASURING FORGETTING

There are a number of common methods of measuring the progress of forgetting. One of these is the method of *recall.* Once material has been learned, the learner, after an appropriate time, is asked to recall it and to write or pronounce or otherwise demonstrate the recall. The amount produced on the request to recall is the measure of remembering. Ordinary college essay examinations are illustrations of the recall method of measuring retention. "What are the five simple machines?" This question may elicit from a beginning physics student anything from none to all of the list of five.

The method of *recognition,* if used to test the student's retention of the list of machines, might offer a number of names and find out whether the student recognizes the names of the simple machines. Witnesses may be called on to name which of several photographs is the likeness of a person whose identity is in question. The ordinary multiple-choice questions used in classroom examinations are illustrations of the method of recognition.

The two methods, recall and recognition, really differ only in degree. The method of recall offers a limited stimulus cue and requires the phrasing or performing of a response. The method of recognition offers much more complete cues, but requires that a choice be made between them. In both cases the proper answer depends on previous associations.

Another method has been already described, the *savings* method used by Ebbinghaus. Its use consists in learning some material to a certain point of excellence, allowing an interval to go by, and then finding out how much practice is required to recover the former skill.

TECHNIQUES OF EFFICIENT STUDY

As the outcome of a considerable body of experiments and observation we can put down a number of rules or techniques for facilitating remembering. By observing these, time and energy can be saved and the probability of recall increased. Most of these rules deal with re-

membering verbal materials as is required for academic success.[5]

Obviously we cannot remember what we have never learned. Therefore the conditions which favor learning also play an important part in remembering. So far as can be known, learning requires that there be responses, that the organism be active. The association of a response with a new stimulus—which is the elemental or basic fact of learning—cannot take place in the absence of either the response or the stimulus. Learning something requires that we be doing something. A relaxed attitude or posture may prevent this. At the University of Washington, a committee of admirers once presented an overstuffed chair to a football player. Later, on discussing his scholarship difficulties with a psychologist, they reclaimed the chair and put it in storage.

The traveler who sketches scenes on his travels can throw away his sketch book and still remember a wealth of detail of what he saw. He remembers it because in the act of sketching he has responded to the detail. And his own responses are learned.

Many students have never learned how to read a book. Their reading habits have been established by popular magazines and are limited to fiction. Many returned veterans who had for four years read for entertainment only (which is an activity very different from reading for information) found they had lost whatever ability they had once possessed. Reading for entertainment is passive. Study of a college text requires active response.

Much of student study time is wasted in rereading what is already known when this time could be devoted to what has not yet been learned. The first step in preparing an assignment should be to determine what you do know. In studying either lecture notes or text you can determine what you know by writing out or outlining the argument of the lecture or the text. Review and study can then be selective and efficient, and a return to the textbook will show what was not learned but must be.

Surveys show that good college students spend less time at their

[5] The student who is having difficulties with his college work would do well to consult F. P. Robinson, *Effective study,* New York: Harper, 1947. This book has a good discussion of efficient techniques of study.

studies than do poor students. Capacity for learning or intelligence is obviously a factor in this, but Pressey has shown that more efficient habits of work require less time and produce higher grades.[6]

Relating material to one's own experience and to other courses is an advantage in that it is one way of making the material meaningful. This can be greatly facilitated by making a point of talking the material over with another person. Discussion establishes many interassociations and new meanings. If advanced work required the close attention and repeated study the beginner must give, it would be impossible for students to cover the heavy reading assignments. Actually they can cover them because certain parts are now familiar and can be skimmed. Also, new material is related to old and may require very little new effort. When a zoologist is told that an animal is a vertebrate, he now knows more about that animal than any nonzoologist knows about any animal, even his own dog. The one word carries a whole bookful of information.

When a student confronts an examination, his preparation can be facilitated by his attempting to anticipate the questions. This means really finding out what it is that is to be learned. There is a familiar parlor trick which consists in challenging a crowd with a problem. The problem is stated in this fashion: A bus leaves Seattle with 18 passengers. It stops and discharges 2 and takes on 5. It stops again and 7 get off while 1 gets on. At the next stop 5 descend and 2 get aboard. After continuing this until it is evident that all present are very intent on their arithmetic count, the speaker asks: "How many stops did the bus make?"

Because textbooks and instructors are not intent on misleading us, we can assume that what is emphasized in text and lecture is the important material. A student may find that by asking himself what questions could be asked on this material he has anticipated the examination.

Nearly any technical course and any technical book can be analyzed into (1) vocabulary and terms, (2) facts, (3) techniques and methods,

[6] S. L. Pressey, *et al.*, *Research adventures in university teaching*, Bloomington: Public School Publishing Co., 1927.

(4) applications, (5) theory and point of view, (6) general principles. This analysis applies to the social sciences, to psychology, and, in fact, to nearly all science courses. The student who tries to recognize items under these headings will find them a frame of reference that will facilitate remembering.

In each field there is a certain vocabulary to learn. This is different in physics, chemistry, English, drama, psychology, and sociology. Familiarity with this vocabulary can almost be used as a measure of mastery of the field. These words are the devices that are used for unifying and organizing ideas in the field.

The facts in a given field are the raw stuff of the science. They are not really "raw" because they already include descriptions. Facts are statements, not things.

The general principles used are either based on assumptions made largely because they seem to work, or based on accumulations of facts. They did not originate in these accumulations. They originated when some intelligent man applied an idea already familiar to new circumstances to which it had not been previously applied. But general principles can be checked with accumulations of facts.

Techniques are the ways of operating. Mathematics offers many techniques to science. We get averages, calculate correlations, work out curves which approximate the data. Chemists have certain routines for determining acidity, for identifying elements or compounds in a sample. There are methods for testing the significance of a difference between two measures, for measuring the rate of fall of a falling body or determining specific gravity.

Applications involve facing new situations and interpreting them in terms of what we have learned or applying our techniques. The war developed practically no new principles, but it encouraged thousands of new applications of techniques already known.

CONCENTRATION AND INTEREST

Many students complain that they are unable to concentrate, and share the common delusion that concentration, just concentration in

general, is something that can be learned or improved. The same students who believe that their difficulty is lack of ability to concentrate will be found giving full and satisfactory attention to a motion picture or a mystery or to a girl friend. The difficulty is not that concentration is defective but that the textbook does not compete with these other items in interest and motivation.

But interest itself and motivation are matters of learning. Once mathematical habits are established, a mathematics problem can arouse the interest of a puzzle. If the theories of the psychological textbook have once been grasped, an apparent contradiction between two paragraphs can be disturbing enough to motivate close attention or argument. To a research scientist who has learned the main theories in his field, a problem in theory on which research may throw light can be far more absorbing than a bridge game. Other persons who have not the scientist's background of habit cannot understand his devotion. Pavlov spent a lifetime of research on questions raised by the "psychic" secretion (conditioned secretion) of the salivary glands. Coghill spent about a quarter of a century in research upon the behavior of a very simple organism. What were the very first manifestations of behavior? What occasioned them? How describe the actual beginnings of movement in animals? Do these consist in local reactions of a few muscles or in large reactions that involve many muscles?

If a student finds that he must pass an examination over material that does not interest him, he can in some cases cultivate an interest. Deciding to take an interest is not enough, however. Interest is not directly under voluntary control. It must be approached indirectly. In the hope that the interest will prove contagious, the student can cultivate acquantances who are interested in the material. We are stirred by the questions and attention of others to be interested in many things which do not interest us in themselves. Or the student can get interested in mastering the subject for the sake of the task—to better his own record, to set marks to shoot at. The method of reading, closing the book, and attempting a summary can be interesting aside from the nature of the material to be learned. Having set himself to write

a summary, the inability to write when he closes the book may be disturbing enough to motivate a rereading in which there is now active response.

A counselor or adviser can sometimes arouse interests through relating a subject to interests already established. Many college teachers noticed that their army and navy students averaged very low interest in topics that were not directly concerned with their own military careers or essential to the grade record that would affect advancement. Certain Army Student Training Program sections training in psychology reached very low levels of interest when it became known that no commissions would be allotted graduates, and that there was no assurance that they would be assigned to psychological work. In some schools certain men were interested however when it was made clear that the work would apply after the war toward graduate degrees in psychology. This assurance was effective with men whose ambitions included becoming psychologists.

A college counselor was called on by a girl of average ability who was attending college, so far as the counselor could tell, just because her parents insisted. She was making a scholastic failure. Her own ambition was to get married, but this escape was blocked because her parents considered her too young. It is possible that the counselor's best course would have been to persuade her to leave school for a job; but the college counselor thought of his job as the salvaging of college careers, not as doing the best he could for the state. He asked what sort of man the girl intended to marry. A college man? Preferably a professional man? Did she realize that he might not be able to afford a maid? Could she cook and keep house? What would their friends be like? Would she be able to talk with them or with her husband intelligently? She decided to enter a home economics course with the chemistry requirement waived and to take some child psychology. She followed this program and graduated with "C" grades.

How all this might end is, of course, a different story. A determination to marry a professional man might well lead to the refusal of a more promising husband who was in business or a skilled workman.

The point is that studies related to her ambition borrowed interest from that ambition.

MEMORY SYSTEMS

No chapter on remembering would be complete without some word concerning memory systems, the devices by which men have claimed to improve memory. The word "claimed" is a bit misleading because many of the methods work up to a certain point.

It will be recalled that the technical vocabularies of science, particularly the classification systems for classifying species or facts, are really *mnemonic devices,* tools for making it easy to remember a great many things in their appropriate settings. It was suggested that the word "vertebrate" has for the professional zoologist acquired a system of associations that is the equivalent of a long book. Knowing that an organism is a vertebrate carries with it all this knowledge. For the psychologist the word "forgetting" carries a mass of theory and relevant facts. Memory systems are a little more spectacular and a great deal less useful than the systems of scientific terms used by scientists. They consist in rules for establishing certain associations that can on a later occasion be reviewed and ensure memory.

If, for instance, we wish to ensure remembering a certain telephone number we can look for associations that would not ordinarily be made. The number 5231 may turn out to be the number of weeks in a year followed by the number of years of one's age. Once this is noticed, the number has an added chance to be recalled. We may note that Mr. Calkins has wrinkles that could be calked or that Mr. Shaeffer has a military bearing that suggests SHAEF, Supreme Headquarters American Expeditionary Force. These may serve to call up the name when we notice the physical feature again. Or they may not.

Probably the best way to remember people's names is to do as good salesmen and good politicians do, use the names frequently while in conversation in their presence, and while looking at them. The sight of a face has little chance to suggest a name that has not been pronounced

while looking at the face. To become a signal for saying the name, the face must have accompanied the saying of the name.

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XVIII

Thinking

MANY people would deny that we can see people think, but no one would deny that we can at least look at people who are doing thinking. One of the writers of this book was recently watching a group of students who were taking an examination in an advanced statistical course. The examination consisted of problems which could not be worked by just memorizing formulas and substituting values in solving, but the problems required putting together in a context which had not been discussed various formulas and facts which had previously been discussed. A student had to decide which of a number of things that he had previously learned applied to the solution of the problem before him.

After the examination several students expressed the feeling that it was a good examination. As one of them put it, "It made you think." How much of this thinking could the instructor see? The behavior the instructor observed included biting of pencils, squirming in the seat, shifting position, occasional smiles followed by rapid writing of symbols, crossing out of symbols, head shakings, and so forth. The instructor could also observe the final response or the answer the student had recorded on his paper. The students who took the examination would all agree that the examination made them think. Just what do they mean by this?

NATURE OF THINKING

For psychologists, *thinking* is a process which may be aroused by a problem situation, and it is a process which intervenes between the facing of a problem (stimulus) and a final response (solution of problem or, as the case may be, giving up of attempts to solve a problem).

When a human being faces a problem, the problem evokes a response which, in turn, becomes the stimulus for another response, and this in turn the stimulus for a third, and so forth. These responses are not easily observable. They may consist of fine muscular movements, particularly the movements that are involved in language responses and inner speech. In the examination that was spoken of above, these responses of inner speech were not observed, but there have been experiments in which inner speech can be made a matter of record.

Jacobson, who had been interested for a number of years in training people to relax, noticed that so long as the external muscles of the eye were not relaxed, there were continuous movements of the cornea which would be visible even under the closed lid of the eye.[1] He found that subjects who had reached a state of advanced relaxation were unable to picture moving objects unless they were able to move their eyes. That is, in order to imagine or picture a man walking from left to right across the street, it would be necessary for the person doing this imagining to move his eyes in the way appropriate to following the motion of the man. When such movements did not occur because of the relaxation of the muscles of the eye, the image of the man simply would not move. Jacobson also found that when a subject had been sufficiently relaxed so far as speech muscles were concerned, he was unable to think a sentence. The words would not form themselves unless there were slight contractions of the speech muscles used in uttering the sentence.

Another investigator, Max, attached electrodes to the lips of his subjects and amplified the currents which were the result of minute move-

[1] E. Jacobson, Electrophysiology of mental activities, *Amer. J. Psychol.*, 1932, 44, 677–694.

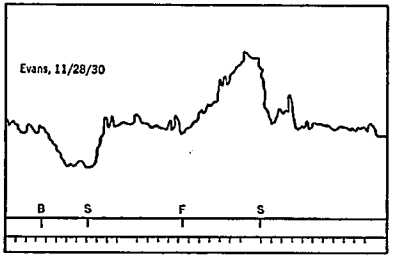

FIG. 17. Record of Unconscious Postural Movements During Imagination of Posture. The record is made in the following way: A hook is attached to the subject's collar. A thread extends from the hook to a recording device through a pulley arrangement. Movement of the subject forward results in an upward slope of the tracing. A fall in the tracing indicates a backward postural movement. The bottom line indicates time in 5-second intervals with one mark omitted at the end of each minute. "At the beginning of the reproduced record, the subject was standing in a normal manner, with lids closed. At B he had just been told to imagine himself bending far backward but not to move. Almost immediately at the conclusion of the instruction his body began to move backward, as is shown by the fall in the line. In less than fifteen seconds he had swayed backward some two and one-half inches and appeared to be nearly balanced on his heels, and consequently unable to sway any farther without falling. At S he was commanded to stop the imagination. Recovery began at once and was complete in some eight seconds. After about three-quarters of a minute of rest the subject was told to imagine himself leaning far forward but not to move. The tracings may be seen to move sharply upward at once. Measurements made of the record show that in the course of about thirty seconds the subject had swayed forward over four inches." (From C. L. Hull, *Hypnosis and suggestibility*, New York: Appleton-Century, 1933, pp. 44–45.)

ments of the lips.[2] With normal subjects, he found that much lip activity was evidenced by his record when the subjects were asked to think sentences. When the electrodes were placed on the subjects' fingers, there was no evidence of the same type of activity. However, when the experiment was repeated on deaf-mutes, electrodes on the lips did not result in showing activity accompanying the thinking of a sentence, whereas electrodes placed on the fingers showed that the thinking of a sentence by a deaf-mute involves great activity in the fingers.

The reader can, to some extent, observe similar reactions in himself. Try thinking of the word "bubble" with your mouth open, or try closing your eyes and getting the visual imagery of a campfire. Think of green leaves being put on the fire and the smoke curling on up toward the sky. Most people will find that their eyeballs move up in a way that would be necessary to follow the motion of the smoke. Try to picture a ship on a rolling sea moving with an up-and-down motion. Notice whether this requires that your own eyes move up and down as they would in following this motion.

Another approach toward studying the thinking process is to find out what subjects are able to tell us as they work at a problem. This method was used by Ruger in studying the attempts of subjects to solve mechanical puzzles.[3] He observed the methods that subjects used to work the puzzles and the remarks that they made while working them. He recorded the comments they made after solving the puzzle, and noted the time taken.

Ruger observed that most people working on a mechanical puzzle engage in random and undirected movements and manipulations. After they have reached a solution, they have little or no ability to state how they worked the puzzle. Ruger found that one thing which hindered the solution of the puzzle was a tendency of subjects to keep on

[2] L. W. Max, An experimental study of the motor theory of consciousness. IV. Action-current responses in the deaf during awakening, kinesthetic imagery and abstract thinking, *J. Comp. Psychol.*, 1937, 24, 301–344.

[3] H. A. Ruger, Psychology of efficiency, *Arch. Psychol.*, N. Y., 1910, No. 15.

with one mode of attack in spite of the fact that it had been proved unsuccessful.

Maier's studies[4] of student efforts to solve problems give results similar to those of Ruger. Delays in solving a problem could usually be attributed to continuing attempts to carry through some wrong mode of attack. We may note that this persistence with unsuccessful methods is also very characteristic of the feeble-minded. They will repeat a procedure over and over again in spite of the fact that it has been proved unsuccessful.

PROBLEM SOLVING

John Dewey has made an effort to describe the conditions which give rise to thinking, and to analyze the typical steps that we use in problem solving.[5] Dewey contends that when we confront a situation for which we have adequate habit patterns, no thinking occurs and no thinking is necessary. If a fly should alight on a man's nose, he would normally brush it off without giving the problem any thought. If, however, he is a soldier standing at attention in an inspection, the fly on the nose might require something resembling thinking. When we approach a door, reach out, take hold of the handle, and open the door, no thinking is necessary. But if we find the door locked, thinking will occur. The inadequacy of old reaction patterns to a situation sets the stage for thinking. It does not mean, however, that thinking always follows.

Thinking, then, normally originates in a problem. A problem situation is a situation which motivates to action and at the same time interferes with action. It usually involves conflict. The result of facing a problem is that we are disturbed. Tensions are produced. Action is checked. The second step described by Dewey is that relevent data and facts are brought into play. We think of the experiences we have had in like situations. Sometimes new combinations of earlier responses are made. The third step is the appearance of suggested solutions.

[4] N. R. F. Maier, An aspect of human reasoning, *Brit. J. Psychol.*, 1933, 24, 144–155.
[5] J. Dewey, *How we think*, Boston: Heath, 1910.

These may be called hypotheses. We think of one or more possible ways out of the difficulty, of solving the problem. The fourth step consists in the testing of these hypotheses, checking them against other relevant facts. The fifth step consists in the acceptance or rejection of an hypothesis. In case the hypothesis is rejected, new hypotheses occur and the sequence is repeated.

Dewey illustrates this process with an experience of one of his students, the result of noticing a white pole extending from the upper deck of a ferry on which he was riding. What was the purpose of the pole? The first hypothesis, that it was a flag pole, was rejected because no ropes or gear was attached. The second hypothesis, that it was a radio mast, was rejected because ferry boats did not carry such equipment. The third hypothesis, that it was purely ornamental, was rejected because tugs also had the white pole and tugs were not given to ornamentation. The fourth hypothesis, that it might be used in guiding the boat, was judged satisfactory because (a) the pole was lower than the pilot house and could be seen by the pilot; (b) the tip was higher than the base of the pole and the pole would thus appear to project out in front of the boat when viewed from the pilot house; (c) some guide would be needed because of the forward position of the pilot house.

It is obvious that thinking in the above situation might have been avoided entirely or minimized by appealing to the authority of the pilot at once. Any necessity for thinking could have been avoided simply by asking someone who knew. Many persons show a strong tendency to avoid thinking by so appealing to authority. We also escape from many problem situations by withdrawing from the situation rather than by solving them. Problem situations are very much like the situations described earlier which lead to conflict; in fact, a frequent accompaniment of thinking is excited emotion, annoyance, frustration, and so forth. That thinking is disturbing is probably one reason why so many of us avoid it.

It is also obvious that in the case of the white pole, just described, the hypotheses that occurred were based on previous facts and observation. Without such facts there could be no hypotheses and no thinking.

One of the requirements of fruitful thinking is that the individual shall possess a background of experience based on previous learning. When two individuals who are faced with the same problem arrive at very different solutions, the cause may lie in the fact that their informational backgrounds are radically different. They do not have the same sets of facts to go on. Individuals may differ also in their abilities to combine the elements of separate past experiences. This would affect their ability to think of hypotheses and to check those they did think of.

PROBLEM SOLVING IN TERMS OF WORDS

Do we always think in words? The answer to that question is undoubtedly "No." We may think in terms of gestures or in terms of images. However, it is probably true that human beings, in solving the problems that confront them, do so largely in terms of words.

Going to lunch may involve practically no thinking at all. If there is some particular restaurant which we are in the habit of patronizing, if the route which we take to that restaurant has been well established by habit, we make no choices, encounter no conflicts, and simply enter upon a series of responses that end up in sitting down at our accustomed table. If, however, on some occasion we make our way to the restaurant, and then find the door locked, and a notice on the door stating that the restaurant is not open for business, thinking will undoubtedly occur, and this thinking will very likely be in terms of words. Prominent among these words will be the names of other restaurants.

A routine act like the tying of a shoelace in the morning may require no verbal accompaniment and no thought accompaniment, but, if, in the process of tying the lace, we break it, words will probably enter into the solution of the problem.

We may rise in the morning, go through our morning routine, eat our habitual breakfast, and go to the garage and get in the front seat of the car. Habit may have taken care of all this series of activities. When we put our foot on the starter button, there may be no result. This situation offers strong motivation because of the interruption of

habit. Most persons in this situation proceed to a certain amount of manipulation of the fixtures of the car. They turn the ignition on and off. They step repeatedly on the starter button—the persistence in a mode of attack noted earlier. Words and old conversation associated with the driving of an automobile will occur. They may recall a description by a friend of a similar situation, and a statement of its solution. What they eventually do is dependent on their word habits and word equipment.

F. H. Allport has analyzed the way in which we acquire our vocabulary and the use of words.[6] We learn words and the use of words in the same way in which we learn other reactions, other behavior. The learning process, so far as language is concerned, may be said to begin in the random articulation of sounds, playing with sounds. Long before a baby can talk, it has made most of the sounds in the English language. Suppose one of these sounds is "da." When the infant makes the sound, a connection is established between this sound and the muscular action that he uses in producing it. A baby hears his own sound, and the heard sound becomes a signal for the muscular activity necessary to produce the sound.

The next event in the series may be the pronounciation of the word "doll" by an adult. This sound may be similar enough to the sound that the baby has made to elicit a reaction in the baby. The baby then repeats the sound. Suppose the adult shows the baby a doll and says the word at the same time. The baby responds to the auditory stimulus and to the visual-vocal association. The sight of the doll may now become a signal that causes the baby to produce the sound. The word is now the symbol of the object. The baby is eventually able to respond with the word in the absence of the object. The word has become associated with other words or with other situations that occur in play, and the word can become a signal for appropriate behavior in the baby even in the absence of the physical object itself.

There is a very natural error made by many people. This consists in speaking of thinking as though it were an activity in itself, not related

[6] F. H. Allport, *Social psychology*, Boston: Houghton Mifflin, 1924.

to words. Many expressions in common use betray this error. We speak of thought and its verbal expression as though they were two radically different things. Actually, *much of our thinking is best described as language in use.* We do not have the thought and then later find a word for it. The thought consists in the proper use of the word.

DEVELOPMENT OF CONCEPTS

The first words that a child learns to use are usually names for concrete objects like a doll, or a dog, a spoon and knife, a drinking cup. The reason for learning nouns before verbs is obvious. Nouns represent stable groups of stimulation which recur in much the same pattern time and again, and so are readily associated. But even these common names for ordinary objects begin to change their nature with use. At first the names are associated with specific objects. The word "dog" may have been used in association with the family's black-and-white cocker spaniel. As the child's experiences become extended, the same word may be associated with other dogs until eventually the word has become a name for a species instead of a name for an individual. The word may have at first been associated with reaching out and petting. The child meets new and strange dogs, and the word again is a signal for reaching out and petting, but the strange dog's shyness or hostility may break up this response. In time the signal "dog" means something very abstract and general indeed. It stands for something of no particular size and no particular color. There is left attached to the signal only certain very general response attitudes. A word is now said to carry a concept.

Obviously the use of common language is going to depend on common experience. Imagine the difficulty of conveying to another person the meaning of the word "ball" or "roundness" if it were not possible to point to objects, or to use the hands, or to show drawings.

These are the difficulties that we actually have with such concepts as "justice" and "democracy." In the case of these symbols, there never was any collection of stimuli such as is offered by an orange or a dog. They are highly abstract. It takes long experience to learn their meanings. In the Middle Ages, when most of the population of Europe was illiterate, the meanings of concepts like justice were portrayed for the ignorant by the use of picture symbols. Justice was a blindfolded woman holding a scale.

We have recently fought a war against fascism and a war to save democracy. But we would find that the meaning of these concepts is not at all the same for all individuals. One of the first discoveries made by our propagandists was that to people brought up under some of the European regimes the word "democracy" meant "decadent," "corrupt," and many other undesirable things. Part of the meaning of the word for Americans is the favorable attitude aroused by the word. In Germany, the word carried an unfavorable attitude, an attitude of rejection.

The attitude attached to a word has a profound effect upon the rest of its meaning.[7] People who look with favor upon socialism describe socialism as government by, for, and of the people, or as a planned economy. They assert that it is consistent with freedom of speech, the press, assembly, and religion. People who disapprove of socialism, that is, people for whom socialism arouses an attitude of rejection, tend to define socialism in terms of sharing the wealth, radicalism, placing the welfare of the state above the welfare of the individual. When people enter into an argument about socialism, or other abstract terms, they are, as a rule, arguing about very different things.

Group life and group association establish common attitudes in the members of the group. In fact, a group can ordinarily be defined in terms of the shared attitudes among its members. The acceptance of a statement as true, often, therefore, depends on membership in a group. The same statement in another group would be rejected. What Americans may take for granted as basic truths may have very little acceptance among other peoples. Statements accepted in one century may be rejected in a later century.

[7] A. L. Edwards, Studies in stereotypes: I. The directionality and uniformity of responses to stereotypes, *J. Soc. Psychol.*, 1940, 12, 357–366. Four dimensions of political stereotypes, *J. Abnorm. & Soc. Psychol.*, 1940, 35, 566–572.

DO ANIMALS THINK?

Many persons would deny that animals other than man engage in anything that resembles thinking. Man is supposed to be guided by reason and other animals by instincts that are irrational in character. Careful observation of animals, however, shows that they can react to relations, to symbols, and even to abstractions under some circumstances. They can solve problems which require the putting together of separate experiences. They can make discriminatory responses, respond to the object that is darker than another object, or larger than another object, to the quality of roundness or triangularity even when these are not associated with any specific object.

Animals are, however, handicapped in making such discriminations because they do not have the verbal repertory of man. A dog can learn to push his way through a door that is marked by a circle, even though the circle is different in size on different occasions and different in color on different occasions. He could then be said to be responding to "circularity." This reaction is much more difficult for the dog than it would be for man because man can say the word "round," since the concept of roundness or circularity has already its established symbol in man. It is therefore much easier for him to notice since it has been noticed before.

SOURCES OF ERROR IN THINKING

A prevalent mistaken notion about thinking is the notion that primitive man does not engage in thinking of the sort that civilized man exhibits. We know now that primitive man reasons just as logically as any other man. This might be put in a different way by saying that we know that civilized man's reasoning is just as often illogical as that of primitive man. Primitive folk start with sets of premises different from the ones that we use, but once we grant their premises, their conclusions are just as valid as our own. Because we do not start from the same assumptions that they make, their thought appears to us to be irrational.

It would, of course, be highly absurd to pretend to write down

rules for correct thinking. The truth or falsity of a statement is a function of the group in which it is made. But it is possible to describe some of the ways in which members of our own social order are led toward conclusions that most persons agree to be false. One of these ways is the use of *emotionally toned words* in thinking. We may have strong attitudes of acceptance or rejection attached to words like "capitalist," "free enterprise," "red," "bolshevik," "international banker." If we do have such emotional attitudes attached to these words, it will be impossible for us to use them without the risk of being led astray by our emotion.

Another common fault of thinking is the failure to consider all of the data, particularly the data which disagree with our conclusions. The naturalist Charles Darwin always made a practice of recording cases which were contrary to his own hypothesis, because he was aware that we have a tendency to forget things which contradict our own opinions. Still another common source of error is the use of unwarranted assumptions. We may start thinking with assumptions that are contrary to the facts. A fourth source of error lies in the tendency for thinking to be directed by desire rather than by facts, for desires often select the facts which we give attention to. On the eve of an election, it is well known that both Democrats and Republicans tend to exaggerate their chances of success, even among fellow partisans.

A fifth common source of error is early indoctrination with beliefs which we continue to accept uncritically. Most Americans are born into their political parties, which means only, of course, that they have accepted the phrases and attitudes which prevailed in the family when they entered it. At the same time, most Americans believe that their choice of parties is a result of careful judgment and decision on their own part.

A sixth source of error is the strong tendency to think in all-or-none terms. We are prone to judge things bad or good, black or white, strong or weak, large or small. This tendency does not originate in the nature of the situations themselves but in the nature of human responses to situations which tend to be either approach or avoidance.

Another common source of error is the failure to recognize that situations and things change with time. We attempt to meet new situations with old methods. What was good enough for our fathers is good enough for us.

SCIENCE AS AN AID IN CLEAR THINKING

It has been well demonstrated that the general methods of science are a protection against the sources of error mentioned. Science is impossible in areas where words have strong emotional tone. It is not an accident that the first sciences developed were in areas where conflicts of human interests were at a minimum. One of the basic rules of science is the collection of relevant data without prejudice. The scientific tradition involves protection against unwarranted assumptions by demanding publication and free discussion, which give a chance for criticism and contradiction. Another essential of the scientific tradition is the introduction of measurement instead of all-or-none concepts. For the scientist things are not black or white; they have a place on a scale of intensity.

No person can be just a scientist. All persons must have likes and dislikes, ambitions, loyalties, faiths which have origins beyond the field of science. But to the student of psychology as a science certain strong advantages should accrue. Knowing how they originate, he should be better able to view his likes and dislikes objectively. His ambitions should be more closely patterned on what is possible because he knows more of human capacities. His loyalties should be better chosen because he is aware how false leaders and sham causes win adherents. His faiths should be consistent with the forms of truths that have passed the test of objectivity and have been exposed to the open criticism of his fellow men.

SUGGESTED READINGS

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TABLE 3. THE MOST FREQUENT RESPONSES TO THE STIMULUS WORDS, ON PAGE 34

Stimulus Word	Most Frequent Response	Second Most Frequent Response	Third Most Frequent Response
1. Table	Chair	Wood	Furniture
2. Man	Woman	Male	Boy
3. Red	Color	Blue	White
4. Dark	Light	Night	Black
5. Hammer	Nail	Nails	Tool
6. Butter	Bread	Milk	Yellow
7. King	Queen	Ruler	Crown
8. Salt	Pepper	Sugar	Taste
9. Green	Grass	Color	Yellow
10. Loud	Noise	Soft	Noisy
11. Long	Short	Distance	Length
12. Foot	Hand	Shoe	Limb
13. Sweet	Sour	Sugar	Candy
14. Window	Glass	Light	Pane
15. Chair	Table	Seat	Sit
16. Black	White	Dark	Color

The order of the response words given above is based upon the reactions of 1,000 subjects tested some years ago and some change is to be expected. For example, general psychology students at the University of Washington tend to give 'saw' in response to 'hammer' more frequently than 'tool.' During the war years, the stimulus word 'butter' evoked many responses of 'OPA,' 'rationing,' 'points,' and so forth. Can you account for any 'unusual' or 'different' responses upon your part? (From G. H. Kent and A. J. Rosanoff, A study of association in insanity. *Amer. J. Insanity,* 1910, 67, 37–96.)

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