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1.1 Behaviorism

John B. Watson, 1924

1. Looking back over the history of the behavioristic movement since it began in overt form in 1912, it seems hard at first sight to understand why behaviorism has had to weather such a continuous storm.

2. Behaviorism, as I tried to develop it in my lectures at Columbia in 1912 and in my earliest writings, was an attempt to do one thing - to apply to the experimental study of man the same kind of procedure and the same language of description that many research men had found useful for so many years in the study of animals lower than man. We believed then, as we do now, that man is an animal different from other animals only in the types of behavior he displays.

3. I think the forcing of this conviction caused most of the storm. It brought out the same type of resistance that appeared when Darwin's "Origin of Species" was first published. Human beings do not want to class themselves with other animals. They are willing to admit that they are animals but "something else in addition." It is this "something else" that causes the trouble.

4. Behaviorism, on the contrary, holds that the subject matter of human psychology IS THE BEHAVIOR OF THE HUMAN BEING. Behaviorism claims that consciousness is neither a definite nor a usable concept. The behaviorist, who has been trained always as an experimentalist, holds, further, that belief in the existence of consciousness goes back to the ancient days of superstition and magic.

5. The great mass of the people even today has not yet progressed very far away from savagery - it wants to believe in magic.

6. One example of such a religious concept is that every individual has a SOUL which is separate and distinct from the BODY. This soul is really a part of a supreme being. This ancient view led to the philosophical platform called "dualism." This dogma has been present in human psychology from earliest antiquity. No one has ever touched a soul, or seen one in a test tube, or has in any way come into relationship with it as he has with the other objects of
his daily experience. Nevertheless, to doubt its existence is to become a heretic and once might possibly even have led to the loss of one's head. Even today the man holding a public position dare not question it.

7. With the development of the physical sciences which came with the renaissance, a certain release from this stifling soul cloud was obtained. A man could think of astronomy, of the celestial bodies and their motions, of gravitation and the like, without involving soul.

8. The behaviorist asks: Why don't we make what we can observe the real field of psychology? Let us limit ourselves to things that can be observed, and formulate laws concerning only those things. Now what can we observe? We can observe BEHAVIOR - WHAT THE ORGANISM DOES OR SAYS. And let us point out at once: that SAYING is doing - that is, BEHAVING. Speaking overtly to ourselves (thinking) is just as objective a type of behavior as baseball.

9. The rule, or measuring rod, which the behaviorist puts in front of him always is: Can I describe this BIT of behavior I see in terms of "STIMULUS and response"? By stimulus we mean any object in the general environment or any change in the tissues themselves due to the physiological condition of the animal, such as the change we get when we keep an animal from sex activity, when we keep it from feeding, when we keep it from building a nest. By response we mean anything the animal does - such as turning toward or away from a light, jumping at a sound, and more highly organized activities such as building a skyscraper, drawing plans, having babies, writing books, and the like.

10. Behaviorism, as you have already grasped from our preliminary discussion, is, then, a natural science that takes the whole field of human adjustments as its own. Its closest scientific companion is physiology. Indeed you may wonder, as we proceed, whether behaviorism can be differentiated from that science. It is different from physiology only in the grouping of its problems, not in fundamentals or in central viewpoint. Physiology is particularly interested in the functioning of parts of the animal - for example, its digestive system, the circulatory system, the nervous system, the excretory systems, the mechanics of neural and muscular response. Behaviorism, on the other hand, while it is intensely interested in all of the functioning of these parts, is intrinsically interested in what the whole animal will do from morning to night and from night to morning.

11. The interest of the behaviorist in man's doings is more than the interest of the spectator - he wants to control man's reactions as physical scientists want to control and manipulate other natural phenomena. It is the business
of behavioristic psychology to be able to predict and to control human activity. To do this it must gather scientific data by experimental methods. Only then can the trained behaviorist predict, given the stimulus, what reaction will take place; or, given the reaction, state what the situation or stimulus is that has caused the reaction.

1.2 Cybernetics
Norbert Wiener, November 1948

1. Cybernetics is a word invented to define a new field in science. It combines under one heading the study of what in a human context is sometimes loosely described as thinking and in engineering is known as control and communication. In other words, cybernetics attempts to find the common elements in the functioning of automatic machines and of the human nervous system, and to develop a theory which will cover the entire field of control and communication in machines and in living organisms.

2. It is well known that between the most complex activities of the human brain and the operations of a simple adding machine there is a wide area where brain and machine overlap. In their more elaborate forms, modern COMPUTING MACHINES are capable of memory, association, choice and many other brain functions. Indeed the experts have gone so far in the elaboration of such machines that we can say the human brain behaves very much like machines. The construction of more and more complex mechanisms actually is bringing us closer to an understanding of how the brain itself operates.

3. The word cybernetics is taken from the Greek KYBERNETES, meaning steersman.

4. The new approach represented by cybernetics - an integration of studies which is not strictly biological or strictly physical, but a combination of the two - has already given evidence that it may help to solve many problems in engineering, in physiology and very likely psychiatry.
5. This work represents the outcome of a program undertaken jointly several years ago by the writer and Arturo Rosenblueth, then of the Harvard Medical School and now of the National Institute of Cardiology of Mexico. Dr. Rosenblueth is a physiologist; I am a mathematician. For many years Dr. Rosenblueth and I had shared the conviction that the most fruitful areas for the growth of the sciences were those which had been neglected as no-man's lands between the various established fields. Dr. Rosenblueth always insisted that a proper exploration of these blank spaces on the map of science could be made only by a team of scientists, each a specialist but each possessing a thoroughly sound acquaintance with the fields of his fellows.

6. These begin with perhaps the simplest question of all: how the brain avoids gross blunders or gross miscarriages of activity due to the malfunction of individual parts. Similar questions referring to the computing machine are of great practical importance, for here a chain of operations, each of which covers only a fraction of a millionth of a second, may last a matter of hours or days. It is quite possible for a chain of computational operations to involve a billion separate steps. Under these circumstances, the chance that at least one operation will go amiss is far from negligible, even though the reliability of modern electronic apparatus has exceeded the most sanguine expectations.

7. In ordinary computational practice by hand or by desk machines, it is the custom to check every step of the computation and, when an error is found, to localize it by a backward process starting from the first point where the error is noted. To do this with a high-speed machine, the check must proceed at the pace of the original machine, or the whole effective order of speed of the machine will conform to that of the slower process of checking.

8. A much better method of checking, and in fact the one generally used in practice, is to refer every operation simultaneously to two or three separate mechanisms. When two such mechanisms are used, their answers are automatically collated against each other; and if there is a discrepancy, all data are transferred to permanent storage the machine stops and a signal is sent to the operator that something is wrong. The operator then compares the results, and is guided by them in his search for the malfunctioning part, perhaps a tube which has burned out and needs replacement. If three separate mechanisms are used for each stage, there will practically always be agreement between two of the three mechanisms, and this agreement will give the required result. In this case the collation mechanism accepts the majority report, and the machine need not stop. There is a signal, however, indicating where and how the minority report differs from the majority.
report. If this occurs at the first moment of discrepancy, the indication of the position of the error may be very precise.

9. It is conceivable, and not implausible, that at least two of the elements of this process are also represented in the nervous system. It is hardly to be expected that any important message is entrusted for transmission to a single neurone, or that an important operation is entrusted to a single neuronal mechanism. Like the computing machine, the brain probably works on a variant of the famous principle expounded by Lewis Carroll in THE HUNTING OF THE SNARK: "What I tell you three times is true."

10. It is also improbable that the various channels available for the transfer of information generally go from one end of their course to the other without connecting with one another. It is much more probable that when a message reaches a certain level of the nervous system, it may leave that point and proceed to the next by one or more alternative routes. There may be parts of the nervous system, especially in the cortex, where this interchangeability is much limited or abolished. Still, the principle holds, and it probably holds most clearly for the relatively unspecialized cortical areas which serve the purpose of association and of what we call the higher mental functions.

11. So far we have been considering errors in performance that are normal, and pathological only in an extended sense. Let us now turn to those that are much more clearly pathological.

12. This distinction between functional and organic disorders is illuminated by the consideration of the computing machine. It is not the empty physical structure of the computing machine that corresponds to the brain - to the adult brain, at least - but the combination of this structure with the instructions given it at the beginning of a chain of operations and with all the additional stored and gained from outside in the course of its operation.

13. There is therefore nothing surprising in considering the functional mental disorders fundamentally as diseases of memory, of the circulating information kept by the brain in active state and of the long-time permeability of synapses.

14. In long-established cases of mental disorder, the permanent memory is as badly deranged as the circulating memory. We do not seem to possess any purely pharmaceutical or surgical weapon for intervening selectively in the permanent memory. This is where psychoanalysis and the other psychotherapeutic measures come in.
15. Whether psychoanalysis is taken in the orthodox Freudian sense or in the modified senses of Jung and of Adler, or whether the psychotherapy is not strictly psychoanalytic at all, the treatment is clearly based on the concept that the stored information of the mind lies on many levels of accessibility. The effect and accessibility of this stored information are vitally conditioned by affective experiences that we cannot always uncover by introspection. The technique of the psychoanalyst consists in a series of means to discover and interpret these hidden memories, to make the patient accept them for what they are, and thus to modify, if not their content, at least the affective tone they carry, and make them less harmful.

Scientific American, November 1948

1. A Physical gestalten
   by Wolfgang Köhler, 1938

1. When spatial, visual, auditory and intellectual processes are such as to display properties other than could be derived from the parts in summation, they may be regarded as unities illustrating what we mean by the word "Gestalten".

2. Thus an electric circuit is a physical system precisely because the conditions prevailing at any given point are determined by those obtaining in all the other parts. Contrariwise, a group of electrical circuits completely insulated from each other constitutes a complex of independent, single systems. This complex is a "whole" only in the mind of one who chances to think of it as such; from the physical standpoint it is a summation of independent entities.

3. Now, although these facts are obviously familiar to physicists, they are often neglected in the theoretical treatment of biological problems. An example from the psychophysiology of space perception will illustrate this: when a number of stimuli act on different points of the sense organ at the same time, it has been the custom to interpret the action of each stimulus separately, and the total process has been considered a summation of the elementary processes which each stimulus would have aroused. A visual perception was thus physiologically ascribed to a mosaic of local nervous excitations in the visual cortex, each excitation corresponding to a single stimulus point on the retina and a single point of the object in space. Even Helmhotz proceeded in sense physiology upon this presupposition, although it is clear that the nervous system would have to satisfy very special
conditions to make such a view tenable - namely, the nervous system could not be a single physical system.

4. For a time this method of treatment seemed adequate but, with the progress of psychology, difficulties began to appear which could not be covered up by the introduction of "psychological" hypotheses. And it was essentially this which led V.Ehrenfels to raise the "GELSTALT" problem.

5. If, in the case of vision, we assume that each physically isolable stimulus produces an independent optical excitation, the PROBLEM, then, is to explain the unity of visual experience. As so-called optical illusions show, we do not see individual fractions of a thing; instead, the mode of appearance of each part depends not only upon the stimulation arising at THAT point but upon the conditions prevailing at other points as well. Since this fact does not bear out the assumption of isolated excitations, its explanation has been sought in terms of "HIGHER MENTAL PROCESSES". And yet, had it not been for this assumption probably no one would have thought to maintain that visual "GESTALTEN" occur only as products of mental activity. The REAL assumption, of course, was that to be scientific one had to treat wholes as bare aggregates.

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Back up

1.B The Mathematics of Communication
Warren Weaver, July 1949

1. Having calculated the entropy (or the information, or the freedom of choice) of a certain information source, one can compare it to the maximum value this entropy could have, subject only to the condition that the source continue to employ the same symbols. The ratio of the actual to the maximum entropy is called the relative entropy of the source. If the relative entropy of a certain source is, say, eight-tenths, this means roughly that this source is, in its choice of symbols to form a message, about 80 per cent as free as it could possibly be with these same symbols. One minus the relative entropy is called the "redundancy." That is to say, this fraction of the message is unnecessary in the sense that if it were missing the message would still be essentially complete, or at least could be completed.

2. It is most interesting to note that the redundancy of English is just about 50 per cent. In other words, about half of the letters or words we choose in
writing or speaking are under our free choice, and about half are really controlled by the statistical structure of the language, although we are not ordinarily aware of it. Incidentally, this is just about the minimum of freedom (or relative entropy) in the choice of letters that one must have to be able to construct satisfactory crossword puzzles. In a language that had only 20 per cent of freedom, or 80 per cent redundancy, it would be impossible to construct crossword puzzles in sufficient complexity and number to make the game popular.

3. Now since English is about 50 per cent redundant, it would be possible to save about one-half the time of ordinary telegraphy by a proper encoding process, provided one transmitted over a noiseless channel. When there is noise on a channel, however, there is some real advantage in not using a coding process that eliminates all of the redundancy. For the remaining redundancy helps combat the noise. It is the high redundancy of English, for example, that makes it easy to correct errors in spelling that have arisen during transmission.

Scientific American, July 1949

2.1 How to teach animals
by B.F. Skinner, December 1951

1. Teaching, it is often said, is an art, but we have increasing reason to hope that it may eventually become a science. We have already discovered enough about the nature of learning to devise training techniques which are much more effective and give more reliable results than the rule-of-thumb methods of the past. Tested on animals, the new techniques have proved superior to traditional methods of professional animal trainers; they yield more remarkable results with much less effort.

2. It takes rather subtle laboratory conditions to test an animal's full learning capacity, but the reader will be surprised at how much he can accomplish even under informal circumstances at home. Since nearly everyone at some time or other has tried, or wished he knew how, to train a dog, a cat or some other animal, perhaps the most useful way to explain the learning process is to describe some simple experiments which the reader can perform himself.

3. "Catch your rabbit" is the first item in a well-known recipe for rabbit stew. Your first move, of course, is to choose an experimental subject. Any
available animal - a cat, a dog, a pigeon, a mouse, a parrot, a chicken, a pig
will do. (Children or other member of your family may also be available, but
it is suggested that you save them until you have had practice with less
valuable material.) Suppose you choose a dog.

4. The second thing you will need is something your subject wants, say food.
This serves as a reward or - to use a term which is less likely to be
misunderstood - a "reinforcement" for the desired behavior. Many things
besides food are reinforcing - for example, simply letting the dog out for a
run - but food is usually the easiest to administer in the kind of experiment
to be described here. If you use food, you must of course perform the
experiment when the dog is hungry, perhaps just before his dinnertime.

5. The reinforcement gives you a means of control over the behavior of the
animal. It rests on the simple principle that whenever something reinforces a
particular activity of an organism, it increases the chances that the organism
will repeat that behavior. This makes it possible to shape an animal's
behavior almost as a sculptor shapes a lump of clay. There is of course
nothing new in this principle. What is new is a better understanding of the
conditions under which reinforcement works best.

6. To be effective a reinforcement must be given almost simultaneously with
the desired behavior; a delay of even one second destroys much of the
effect. This means that the offer of food in the usual way is likely to be
ineffective; it is not fast enough. The best way to reinforce the behavior with
the necessary speed is to use a "conditioned" reinforcer. This is a signal
which the animal is conditioned to associate with food. The animal is always
given food immediately after the signal, and the signal itself then becomes
the reinforcer. The better the association between the two events, the better
the result.

7. For the conditioned reinforcer you need a clear signal which can be given
instantly and to which the subject is sure to respond. It may be a noise or a
flash of light. A whistle is not effective because of the time it takes to draw a
breath before blowing it. A visual signal like a wave of the arm may not
always be seen by the animal. A convenient signal is a rap on a table with a
small hard object or the noise of a high-pitched device such as a "cricket."

8. You are now ready to start the experiment with your dog. Work in a
convenient place as free as possible from distraction. Let us say that you
have chosen a "cricket" as your conditioned reinforcer. To build up the effect
of the reinforcer begin by tossing a few scraps of food, one at a time and not
oftener than once or twice a minute, where the dog may eat them. Use
scraps of food so small that 30 or 40 will not greatly reduce the animal's
hunger. As soon as the dog eats each scrap readily and without delay, begin

to pair the cricket with the food. Sound the cricket and then toss a piece of

food. Wait half a minute or so and repeat. Sound the cricket suddenly,

without any preparatory movements such as reaching for food.

9. At this stage your subject will probably show well-marked begging

behavior. It may watch you intently, perhaps jump on you, and so on. You

must break up this behavior, because it will interfere with other parts of the

experiment. Never sound the cricket or give food when the dog is close to

you or facing you. Wait until it turns away, then reinforce. Your conditioned

reinforcer is working properly when your subject turns immediately and

approaches the spot where it receives food. Test this several times. Wait

until the dog is in a fairly unusual position, then sound the signal. Time spent

in making sure the dog immediately approaches the food will later be saved

manyfold.

10. Now, having established the noise as the reinforcer, you may begin

teaching the dog. To get the feel of the technique start with some simple

task, such as getting the dog to approach the handle on a low cupboard door

and touch it with its nose. At first you reinforce any activity which would be

part of the final completed act of approaching and touching the handle of the

cupboard. The only permissible contact between you and the dog is via the

cricket and the food. Do not touch the dog, talk to it, coax it, "draw its

attention" or interfere in any other way with the experiment. If your subject

just sits, you may have to begin by reinforcing any movement, however

slight. As soon as the dog moves, sound the cricket and give food.

Remember that your reaction time is important. Try to reinforce as nearly

simultaneously with the movement as possible.

Scientific American, December 1951

2.2 Eye movement and visual perception

David Noton and Lawrence Stark, 1971

1. Recently at the University of California at Berkeley we have developed a

hypothesis about visual perception that predicts and explains this apparent

regularity of eye movement. Essentially we propose that in the internal

representation or memory of the picture the features are linked together in

sequence by the memory of the eye movement required to look from one

feature to the next. Thus the eye would tend to move from feature to feature

in a fixed order, scanning the picture.
2. Most of Yarbus' recordings are summaries of many fixations and do not contain complete information on the ordering of the fixations. Thus the regularities of eye movements predicted by our hypothesis could not be definitely confirmed from this data. To eliminate this constraint and to subject our hypothesis to a more specific test we recently made a new series of recordings of eye movements during visual perception.

3. Our subjects viewed line drawings of simple objects and abstract symbols as we measured their eye movements (using photocells to determine the movements of the "white" of the eye) and recorded them on magnetic tape. We thereby obtained a permanent record of the order of fixations made by the subjects and could play it back later at a lower speed, analyzing it at length for cycles and other regularities of movement. As in the earlier experiments, the drawings were fairly large and close to the subject's eyes, a typical drawing subtending about 20 degrees at the eye. In addition we drew the pictures with quite thin lines and displayed them with an underpowered slide projector, throwing a dim image on a screen that was fully exposed to the ordinary light in the laboratory. In this way we produced an image of low visibility and could be sure that the subject would have to look directly (focally) at each picture that interested him, thus revealing to our recording equipment the locus of his attention.

4. our initial results amply confirmed the previous impression of cycles of eye movements. We found that when a subject viewed a picture under these conditions, his eyes usually scanned it following - intermittently but repeatedly - a fixed path, which we have termed his "scan path" for that picture. The occurrences of the scan path were separated by periods in which the fixations were ordered in a less regular manner.

5. Each scan path was characteristic of a given subject viewing a given picture. A subject had a different scan path for every picture he viewed, and for a given picture each subject had a different scan path. A typical scan path for our pictures consisted of about ten fixations and lasted for from three to five seconds. Scan paths usually occupied from 25 to 35 percent of the subject's viewing time, the rest being devoted to less regular eye movements.

6. It must be added that scan paths were not always observed. Certain pictures (one of a telephone, for example) seemed often not to provoke a repetitive response, although no definite common characteristic could be discerned in such pictures. The commonest reaction, however, was to exhibit a scan path.
7. This demonstration of the existence of scan paths strengthened and clarified our ideas about visual perception. In accordance with the serial hypothesis, we assume that the internal representation of an object in the memory system is an assemblage of features. To this we add a crucial hypothesis: that the features are assembled in a format we have termed a "feature ring". The ring is a sequence of sensory and motor memory traces, alternately recording a feature of the object and the eye movement required to reach the next feature. The feature ring establishes of fixed ordering of features and eye movements, corresponding to a scan path on the object.

Scientific American, 1971

2. A Sign-gestalt or conditioned reflex?
Edward Chace Tolman, 1933

1. It appears that what our conditioned response friends really do is to divide all responses into two sorts - positive and negative. And they argue that in a trial and error situation the acts which get learned are those which result in bringing the animal into the presence of further stimuli to which positive responses are already attached. And the acts which do not get learned are those which result in bringing the animal into the presence of further stimuli to which negative responses are already attached. These resultant positive and negative responses get conditioned back to the cue stimuli. It must be noted, however, that the positive and negative responses which thus get conditioned back may in concrete terms be as different from the original responses from which they are supposed to be derived as entering is from eating or as not-entering is from jumping back and squealing. But this last is a little point which is not stressed by the theory. Our conditioned response friends are truly both serpentish and dovelike.

2. But let us not be too captious. For it must be admitted that this conditioned response formula, even though it be thus a bit - shall we say - jesuitical, is really surprisingly workable. It can be applied usefully to most discrimination box and maze problems and as such, it seems to provide a helpful schema for holding together past results and for predicting future ones. Nevertheless my purpose here must be to show that there are (or at any rate there ought to be) types of maze or discrimination box finding for which this all-useful though emasculated conditioned response formula will not hold.

3. By way of a first example, let me return to an experiment of my own which used a discrimination box like that just shown. After having, as part of another problem, overstrained rats in this discrimination box, I tried putting
them directly into the food compartments and shocking them then and there. Then I carried them immediately around to S and started a run in the usual fashion. My assumption was that as a result of all their preceding training, in which they had been running through the box as the way to get to food, the rats would have built up what in my barbarous terminology I have called sign-gestalt expectations. These sign-gestalt expectations I assumed would be to the effect that the earlier part of the discrimination apparatus would have become a sign or a set of signs to the rats that the encountering of the food compartments was to be achieved by running through this discrimination apparatus. And, if the rats had built up such sign-gestalt expectations, I assumed further that a single experience of the changed character of the food compartments (or, as I should put it, this changed character of the significates of the sign-gestalts) should have been enough so that upon being reintroduced to the signs (that is to the first parts of the discrimination box) the rats would at once have inferred or remembered this new changed character in the goal compartments. And hence they should have refused to run.

4. But alas, no such thing. Each rat (I must confess that I tried it with only four), after having been shocked in the food compartment and then carried to the starting point, immediately dashed off gaily and just as usual through the whole discrimination apparatus and bang whack into the very food compartment in which he had just been shocked. If the rats had sign-gestalt expectations, then sign-gestalt expectations are not as intelligent as I have supposed them to be.

Psychological Review, May 1933

2.B Eye, Brain and Vision

David Hubel, 1988 (Nobel Prize 1981)

1. Small spots generally produce weak responses or none. To evoke a response, we first have to find the appropriate part of the visual field to stimulate, that is, the appropriate part of the screen that the animal is facing: we have to find the receptive field of the cell. It then turns out that the most effective way to influence a cell is to sweep some kind of line across the receptive field, in a direction perpendicular to the line’s orientation. The line can be light on a dark background (a slit) or a dark bar on a white background or an edge boundary between dark and light. Some cells prefer one of these stimuli over the other two, often very strongly; others respond about equally well to all three types of stimuli. What is critical is the orientation of the line: a typical cell responds best to some optimum stimulus orientation.
2. In a single experiment we can test the responses of 200 to 300 cells simply by learning all about one cell and then pushing the electrode ahead to the next cell to study it. Because once you have inserted the delicate electrode you obviously can't move it sideways without destroying it or the even more delicate cortex, this technique limits your examination to cells lying in a straight line. Fifty cells per millimeter of penetration is about the maximum we can get with present methods. When the orientation preferences of a few hundred or a thousand cells are examined, all orientations turn out to be about equally represented - vertical, horizontal, and every possible oblique. Considering the nature of the world we look at, containing as it does trees and horizons, the question arises whether any particular orientations, such as vertical and horizontal, are better represented than the others. Answers differ with different laboratory results, but everyone agrees that if biases do exist, they must be small - small enough to require statistics to discern them, which may mean they are negligible!

3. In the monkey striate cortex, about 70 to 80 percent of cells have this property of orientation specificity. In the cat, all cortical cells seem to be orientation selective, even those with direct geniculate input.

4. We find striking differences among orientation-specific cells, not just in optimum stimulus orientation or in the position of the receptive field on the retina, but in the way cells behave. The most useful distinction is between two classes of cells: simple and complex. As their names suggest, the two types differ in the complexity of their behavior, and we make the reasonable assumption that the cells with the simpler behavior are closer in the circuit to the input of the cortex.

2.C The Genes for Colour Vision
Jeremy Nathans, 1989

1. We therefore concluded that these genes encode the red and green pigments, and later studies we did with Plantanida confirmed this belief. The third gene, now known to encode the blue pigment, came from chromosome 7, a finding that is consistent with the notion that variant blue color vision is determined by a nonsex chromosome.

2. The significant homology between the rhodopsin gene and the three cone-pigment genes suggested that all four genes had indeed evolved from the same ancestor. The available evidence supported the notion that at some
early stage a primordial gene had given rise to three others: the rhodopsin
gene, the blue-pigment gene and a third gene that encoded a pigment
sensitive to light in the red-to-green part of visible spectrum. This third gene
recently duplicated, yielding a red- and a green-pigment gene.

3. We think the red- and green-pigment genes are the product of fairly
recent duplication, because they have a strikingly high degree of homology:
a full 98 percent of their DNA is identical, suggesting it has had little time to
change. The idea that the event took place not long ago, at least in
evolutionary terms, is supported by the findings of Gerald H. Jacobs of the
University of California at Santa Barbara, who worked with Bowmaker and
Mollon. They have shown that New World (South American) monkeys have
only a single visual-pigment gene on the X-chromosome. In contrast, Old
World (African) monkeys, which are more closely related to human beings,
appear to have two visual-pigment genes on that chromosome. The addition
of the second X-chromosome gene must have occurred some time after the
separation of South America and Africa, and hence of the gene pools of the
New and Old World monkeys, some 40 million years ago.

Scientific American, February 1989

PART 2 TEXT D

2.D How to make a language user
Allan Collins and Ross Quillian, 1972

1. Concepts are represented by lists in computers because present day
computers are serial processors. If parallel machines were built, then the
necessity for ordering properties in a list would disappear. In fact human
concepts are probably more like hooks and nodes in a network from which
many different properties hang.

2. So far, this just describes an association network of concepts which we
think is a thoroughly plausible way to start building a computer memory to
mimic human memory. Giuliano (1963) has indicated how such an
association network could be represented in an analog computer. The trouble
with a simple association network is that it does not specify the relation of
properties to concepts. Worms are related to birds because birds eat them
(though they are undoubtedly related in other ways too), and to dogs
because worms live in the dog's coat of hair. The particular relation is as
important to the property as the concepts that are related. Any memory
structure that sloughs over these differences could never deal very
intelligently with human language.
3. The relations between concepts are as varied as concepts themselves; indeed, relations are concepts and can be handled in many of the same ways as concepts that correspond to nouns or adjectives. Even adjective concepts such as red or square differ in their relation to different concepts they modify. For example, green is related to grass in a different way than yellow is to canary. Both relations are different from the relation of blue to sky, since the blue is only in the atmosphere of earth during the day. These examples illustrate that relations can be quite complex, even though the question of "What color is grass?" can be answered without getting into these complexities. Any representation of relations in a computer must permit them to be as detailed as necessary; in other words, the description of a relation must be embeddable.

4. There is no reason why a semantic memory should consist only of a network of descriptive properties. Concepts are built up out of sensori-motor experience as well as language use, and there is every evidence that people utilize imagery extensively. (See, for example, Paivio, 1969; Bower, in press; Begg & Paivio, 1970.) In computers, the work of Gelernter (1963) and Baylor (1971) suggests that it would be helpful to project concepts on a display screen where they can be manipulated as geometric forms rather than property lists. This could be done within a semantic memory by an image generation routine which uses descriptive properties as stored variables for constructing a visual image. For a concept like canary, the color attribute would produce a light yellow color in the image, whereas, for bird, the lack of a specific color value would produce a color-vague image like those shown in a dictionary.

in Organization of Memory
Tulving and Donaldson,
subject, who was instructed that he would be tested for recall. The sentences differed systematically in their grammatical forms; They might be either active or passive, affirmative or negative, declarative or interrogative. The subject's responses were then scored both for semantic accuracy (did he recall one of the eight sentences, regardless of grammatical form?) and for syntactic accuracy (given that a sentence was recalled, was its grammatical form correct?). The results of a preliminary study using this general approach have already been reported by Miller (1962).

2. The syntactic description used here is essentially Chomsky's (1957). According to Chomsky's grammar, most sentences are derived from more fundamental ones by certain special rules, called transformations. The fundamental, or kernel (K), sentences are, in the vocabulary of traditional grammar, simple, active, affirmative, declarative sentences, such as THE BOY HAS HIT THE BALL, THE GIRL HAS WORN THE JEWEL, etc. Only three grammatical transformations are considered in this experiment: the negative (N), the passive (P), and the interrogative (Q). When the N transformation is applied to THE BOY HAS HIT THE BALL it produces a new sentence. THE BOY HASN'T HIT THE BALL. When P is applied to the same K sentence, it produces THE BALL HAS BEEN HIT BY THE BOY. The Q transformation applied to the same K sentence produces HAS THE BALL BEEN HIT BY THE BOY? These transformations may also be applied in combination to produce, for example, a passive-negative-question (PNQ), HASN'T THE BALL BEEN HIT BY THE BOY?


PART 2 TEXT F

2.F Personality and Assessment

Walter Mischel, 1968

1. Personality theory, experimental personality research, and assessment have quite different histories and their mutual implications have not been explored thoroughly. Courses on personality theory usually review the concepts advocated by different authors and offer omnibus surveys of psychological conceptions of man. Personality assessment, on the other hand, typically is relegated into the "how to do it" practical domain, and is inserted as an applied, independent course on assorted measurement techniques. Especially distressing, most approaches to personality still remain largely separated from developments in behavior theory and experimental research, in spite of many protests and some major efforts to the contrary (Bandura & Walters, 1963; Rotter, 1954).
2. Progress in the area of personality psychology and assessment has been hindered by the failure to apply relevant principles about the conditions that produce, maintain, and modify social behavior. The principles that emerge from basic research too often have not been seen as directly relevant to the understanding of the determinants of test responses in the clinic or the assessment project. It is as if we live in two independent worlds: the abstractions and artificial situations of the laboratory and the realities of life. In part this dualism between research and practice has resulted from the failure of basic psychological research to deal with social problems relevant to persons. Until fairly recently most experimental research offered as an aid in the understanding of human social behavior was not only nonsocial, in the sense of not dealing with interpersonal conditions, but also nonhuman, the subjects usually being rats, pigeons or monkeys. Research with persons was confined largely to correlational studies, most frequently interrelating the checking responses of college students on different paper-and-pencil inventories. More recently, however, exciting progress has occurred in experimental social research with people. The resulting principles and techniques are being applied to the measurement and modification of the complex problems of persons - often severely disturbed persons.


3.1 Measuring intelligence
Lewis Terman and Maud Merrill, 1937

1. The major faults of the original Stanford-Binet scale have long been recognized. Although affording a satisfactorily valid and reliable measure over a fairly wide intermediate range, it was especially defective at both extremes. Abilities below the mental level of four years or above that of the average adult were very inadequately sampled. In the range from five to ten years the standardization was surprisingly correct, considering the rather small number of subjects on which it was based, but above ten it yielded scores that were progressively too low. A number of tests in the scale were unsatisfactory because of low validity, difficulty of scoring, susceptibility to coaching, etc. The instructions both for administration and scoring in numerous instances lacked the precision which is necessary to insure objectivity and comparability of results. Finally, one of the severest limitations to the usefulness of the scale was the fact that no alternative form was available for use in retesting or as a safeguard against coaching.

2. In the revision here offered we have provided two scales which differ almost completely in content, but are mutually equivalent with respect to difficulty, range, reliability, and validity. The scales are designated as Form L
and Form M. In content Form L bears greater resemblance to the original Stanford-Binet, but neither form can be recommended above the other. Both, we believe, are relatively free from the grosser faults of the old scale. They cover a far wider range, they are more accurately standardized throughout, the tests provide a richer sampling of abilities, and the procedures have been more rigidly defined. On the whole they are somewhat less verbal than the old scale, especially in the lower years. The revision utilizes the assumptions, methods and principles of the age scale as conceived by Binet. There are of course other systems of tests which are meritorious, but for the all-round clinical appraisal of a subject's intellectual level the Binet type of scale has no serious rival.

3. For the younger subjects the scale has been made incomparably more interesting and also more valid by the liberal use of diminutive objects, brightly colored cubes, wooden beads, and other attractive materials. In general, however, the content of the new scales resembles that of the old and includes such well-known test as comprehension, absurdities, word-naming, drawing designs, memory for digits, giving differences and similarities, defining abstract terms, etc.

4. Our efforts to increase the number of non-verbal tests were successful chiefly at the lower levels. Like other investigators we have found that is extremely difficult to devise non-verbal tests for the upper levels which satisfy the requirements of validity, reliability, and time economy. At these levels the major intellectual differences between subjects reduce largely to differences in the ability to do conceptual thinking, and facility in dealing with concepts is most readily sampled by the use of verbal tests. Language, essentially, is the short-hand of the higher thought processes, and the level at which this short-hand functions is one of the most important determinants of the level of the processes themselves.

5. One of the important aims of the revision was to secure greater objectivity of scoring. Where judgment is involved in evaluating responses to an item, definite principles and classified illustrations have been given to guide the examiner. Ease and objectivity of scoring have in fact often played a crucial role in the selection and rejection of test items. The part played by subjective judgment cannot be wholly eliminated from a test of the Binet type, but we have tried to bring it as near as possible to the irreducible minimum.

6. Hardly less important than the selection of suitable tests has been the selection of subjects for use in the standardization of the scales. We have devoted more than ordinary effort to secure a representative sampling of the white child population in the United States between the ages of two and eighteen years. Besides increasing the number of subjects tested to 100 at
each half-year level below six, to 200 at each age between six and fourteen, and to 100 at each age from fifteen to eighteen, we have made a stubborn attempt to avoid sampling errors inherent in age, grade location, nationality, and geographical distribution. We do not flatter ourselves that we have been entirely successful, but our data represent a much closer approximation to an unbiased sampling than has heretofore been attained in the standardization of any scale for individual examining. The fact that the same subjects were used in the standardization of Form L and Form M has made it possible to guarantee almost perfect equivalence of the scores yielded by the two scales.

GEORGE G. HARRAP & COMPANY LTD.
London, Bombay, Sydney, 1937

PART 3 TEXT 2

3.2 The Measurement of Abilities
Philip E. Vernon, 1965

1. Fallacious Views of Mental Organization.- Correlational investigations have assumed especial importance in recent years, since they enable us to clarify our conceptions of human abilities, and of the organization or structure of the mind. The layman's notions as to what abilities exist, and what each ability includes or excludes, are extremely loose, and the same was true of psychological theory throughout most of last century. Teachers and parents are heard to remark: "Johnny is poor at book-learning, but he makes up for it by his cleverness with his hands. He will be a good mechanic when he grows up." "Mary has an excellent memory and good power of attention." "Willie is slow but sure," and so on. Such statements are now known, as a result of experimental investigation, to be largely fallacious. Only exact study can tell us how far the slow person is likely to be sure, whether manual ability in a boy has any predictive value for mechanical ability in a man, whether there is any such entity in the mind as memory. Again, the so-called faculty school of psychologists of a hundred years ago considered the mind to be made up of a number of distinct powers or faculties such as reasoning, judgment, imagination, etc. Indeed, it was at one time regarded as the main object of education to train each of these faculties by providing children with appropriate 'mental gymnastics.' As soon, however, as scientific psychologists tried to define the faculties precisely and measure them, and to determine the effects upon them of various types of training, they fell into discredit. A priori analysis has not even been able to decide what is the true nature of intelligence. The accounts of it given by different writers have been extremely varied and discrepant. Nowadays, therefore, such problems, both of theory and practice, are approached by means of experimental studies of correlations between tests. For they all eventually resolve into the question - what correlates with what?
2. The Scientific Definition of an Ability. - First we must define what we mean by an ability, capacity, or faculty. It implies the existence of a group or category of performances which correlate highly with one another, and which are relatively distinct from (i.e. give low correlations with) other performances. Take, for example, mechanical ability. Some people are better than others at tasks involving manipulations of mechanisms, and this ability is fairly consistent or general in the sense that those who are good at one such task are also usually good at others. The consistency is not perfect. A may be specially good with meccano, less clever with locks, B the opposite, C the best with electrical fittings, and so on. But if there was no appreciable correlation between these and other similar performances, if they were all found to be specific, we should not be entitled to regard mechanical ability as a real entity. Another important condition is that the performance should be fairly reliable. We do not expect perfect stability, but if people fluctuated wildly in their success at mechanical tasks from day to day, we should hardly recognize the existence of mechanical ability. There is a further possibility, namely, that the various performances may intercorrelate well, but that the correlations may be accounted for by some other common factor such as general intelligence (the age factor, we will assume, has already been eliminated). Mechanical ability would not then be anything distinctive. However, intelligence tests can be applied to the same persons who take the mechanical tests, and intelligence can be partialed out or held constant. It is then found that the mechanical tests still overlap, or show positive correlations with one another over and above their correlations due to the intelligence factor. We are, therefore, able to accept mechanical ability as something consistent and distinctive. Tests of it do correlate sufficiently well and reliably for us to postulate some common element running through them.

3. A common element such as this is often referred to as a group factor, since it occurs in a group of performances of a certain restricted type. It differs from a general factor like intelligence, which is found to run through an extremely wide range of tests, which indeed enters to some extent into all abilities.

4. Since the consistency of overlapping of different mechanical tests is not perfect, no one test can give a really adequate measurement of mechanical ability. But by combining several tests we are likely to get a result much more representative of the group factor as a whole. The same applies, of course, in the measurement of educational abilities. We do not expect long-division sums alone to tell us how good pupils are at arithmetic, although they provide some indication of the ability. Instead we set several types of
sums, and try to cover the whole field of arithmetic which the pupils are supposed to know.

5. Arithmetic is likely to yield a group factor similar to the mechanical ability factor. But many of the facilities assumed by psychologists in the past, or by laymen at the present time, fail to stand up to the criteria enumerated above. Memory, for example, refers to so many different things, that it is meaningless to talk of so-and-so as having a good or bad memory in general, or of 'training children's memory.' The speeds with which people learn various sorts of material, and their retentiveness (i.e. the amount of such material which they can recall after an interval), give only moderate or low inter-correlations, especially when the influence of intelligence is removed. Probably there exist several small group factors, each representing memory for a certain narrow range of material. In other words, there may be several types, but no single entity, of memory.

6. The notion that mental speed differs from, and is usually opposed to, mental accuracy or power also appears to be fallacious. If there were two quite distinct abilities, then tests of speed should give high correlations with one another, and low or negative correlations with tests of accuracy or power. Under appropriate conditions of testing, difficult untimed tests and easy speeded tests do yield somewhat different results; thus a partial distinction is indicated. But they still correlate positively to a moderate or a high degree, showing that, on the whole, those who are 'slow' at mental work are more likely to be 'unsure' than 'sure.'

7. All Mental Abilities are Positively Inter-correlated.- Let us now turn to the wider problem - what abilities does the mind contain, and how are they organized or inter-related? A first, extremely important fact is that all tests of mental abilities tend to give positive inter-correlations. Even tests of manual, physical, and other non-intellectual functions also usually correlate positively with one another and with mental tests, though the coefficients are often very small, whereas the coefficients among tests of intellectual functions are generally moderate to high. In selected groups, such as university students, occasional negative correlations may arise; but these are not typical, and they are seldom statistically significant.

University of London Press, 1965
St Paul's House, Warwick Lane, London EC4
pp. 130-132

PART 3 TEXT A

3A The Louisville Twin Study
Ronald Wilson, 1983
1. A longitudinal research program with infant twins offers a powerful resource to study the determinants of behavioral development. Monozygotic (MZ) twins provide the rare natural experiment with humans in which two zygotes share exactly the same genotype and are raised in the same family environment.

2. Dizygotic (DZ) twins, by contrast, share a variable number of genes in common (50 % on the average), proportionally the same as any other pair of siblings from the same family. However, dizygotic twins have further shared the homogeneous experiences of being born and raised as twins, which should enhance their similarity in comparison to siblings. If the collective influences of gene action and prenatal and postnatal environment dictate the course of mental development, then the contribution of the various factors may be estimated from comparison of monozygotic twins with dizygotic twins and nontwin siblings.

3. The Louisville Twin Study was initiated more than 25 years ago (Falkner, 1957), and the backbone of the program is the large number of young twins who have made regular visits to the study for testing. At present, there are 494 pairs of twins active in the longitudinal study, ranging in age from three months to 15 years. Recruitment has been an ongoing process, with 25-35 pairs added each year since 1963.

4. The twins have been recruited from the Board of Health records of twin births in the metropolitan Louisville area, and a special effort has been made to make the sample as representative as possible. In terms of socio-economic status, 27 % of the twin families are ranked in the lowest two deciles of the occupational rating scale (Reiss, 1961); 11 % are in the highest two deciles. The other families are distributed in roughly equal proportions among the six intermediate deciles (8.8 %-11.8 %). Attribution has been minimal because of intensive efforts to follow up on families that move frequently and to maintain their cooperation.

5. Zygosity determination.- Zygosity was established for same-sex pairs by blood typing on 22 or more red cell antigens (Wilson, 1980). If the results were concordant for all antiserum tests, the twins were classified as monozygotic; if the results were discordant for any test, dizygotic. For technical reasons, the blood typing was deferred until the twins were 3 years old, so the infant tests were completed before zygosity was established. Opposite-sex twins were classified as dizygotic on the basis of the sex difference.

The Society for Research in Child Development, Inc.
3. B Tests as instruments of research

Ronald Wilson, 1983

1. Ages at testing.- The twins are tested initially at 3 months of age, and they make subsequent visits every 3 months during the first year, every 6 months during the second and third years, and annually thereafter to age 9 years. A final follow-up test is scheduled at age 15 years; The ongoing nature of recruitment means that many twins have not completed 15 full years in the program, but nearly two-thirds of the sample have test data covering at least 6 consecutive years.

2. Test of mental development.- The tests employed in this program have been selected from the best standardized and most carefully constructed psychometric tests available. In this regard, some new and revised tests for preschool children have become available within the past 15 years which represent major advances in assessment. Bayley's life-time work in mental development culminated in the Bayley Scales of Infant Development (1969), and it was the first well-standardized instrument for infant appraisal. The Stanford-Binet Form L-M was restandardized on a fresh sample in 1972 (Terman & Merrill, 1973), and these new norms corrected for many of the deficiencies in the original 1937 standardization sample.

3. The Wechsler Preschool and Primary Scale of Intelligence (WPPSI) was published in 1967 (Wechsler, 1967), and it represented a well-standardized downward extension of the Wechsler Intelligence Scale for Children. The McCarthy Scales of Children's Abilities (McCarthy, 1972) were recently published, and while the scales differed somewhat in focus from the Binet and WPPSI - particularly by avoiding any reference to IQ - nevertheless they sampled domains of cognitive abilities that were collectively metricized by a general cognitive index. Finally, the revised version of the Wechsler Intelligence Scale for Children (WISC-R) was released in 1974, and it updated the norms, items, and scoring of the WISC to contemporary standards (Wechsler, 1974).

4. The importance of such standardized psychometric instruments can hardly be over-estimated. They furnish a means of appraising mental development during a period of rapid growth, as well as a means of obtaining a reliable assessment of individual differences. Children are compared with a representative sample of their age peers, and their relative placement (whether advanced or delayed) is expressed in a standard-score format that remains constant across ages and tests. Episodes of acceleration and lag now
become interpretable as genuine phenomena, not simply as by-products of measurement error.

5. These crucial features of standardization and scoring have never been available in previous tests, and in a literal sense the recent tests may be classified as benchmarks of mental measurement. When employed with a longitudinal twin sample from birth into the school years, the tests yield a detailed picture of each twin's mental development from infancy onward and a measure of concordance among co-twins.

6. Tests and ages. - The Bayley Mental Scale has been administered at 3, 6, 9, 12, 18 and 24 months of age; the Stanford-Binet at 30 and 36 months; the WPPSI at 4, 5, and 6 years; and the WISC or WISC-R at 7, 8, 9, and 15 years. Recently the McCarthy test has been substituted for the WPPSI at 4 years because it gives a broader sample of the child's behavior at this age. Each test converts the raw scores into age-adjusted standard scores with a mean of 100 and SD of 16 (15 for the WPPSI and WISC).

7. At each visit, the twins were tested by separate examiners, who also alternated between the twins over successive visits. The test procedures were rehearsed intensively to assure comparability among examiners, and the test scoring was verified by a third examiner before the scores were recorded.

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4.1 The origin of language
Orvis C. Irwin, 1949

1. A question frequently asked about our investigation is, "where do you get your babies?" Obviously this is the simplest aspect of the whole endeavor, for there are plenty of babies in the world. However, the question does lead directly to the general problem of sampling the population of babies. One good source of subjects is a nursery connected with the obstetrical department of a hospital, and a great deal of our work has been done in this situation.

2. The home is another natural laboratory for this work. After a baby is taken home from the hospital, it is visited at regular intervals of two weeks or a month throughout infancy. At each visit a sample of the baby's speech, as uttered on a number of breaths, is written down in the International Alphabet. If care is taken to select homes of different socio-economic status,
the speech sound samples may reflect a number of variables operating in the home situation, and the data subsequently may be analyzed in terms of these variables.

3. We have studied infants' speech development in several other situations: in orphanages, where retardation in speech is notoriously frequent; in state institutions for the feeble-minded; in schools for the deaf, where the investigation of how children deaf from birth achieve intelligible speech makes a valuable comparison with the development of speech in the normal infant.

4. The earliest sounds made by a new-born babe are monosyllabic cries. During the first few days of life the infant most frequently gives voice to eight distinguishable sounds, which represent about a fifth of the sound elements used by adults. These eight include only five of about a dozen vowel sounds listed in the International Phonetic Alphabet, and three consonants of a possible two dozen. Its most frequent cry by far is æ, like the vowel of the word fat; this sound amounts to 90 per cent of an infant's vowel utterances. In one study involving 40 babies under 10 days of age, it was found to be the only vowel used by all the subjects. The other four early vowel sounds are I as in fit, E as in set, ^ as in up and u as in food. The three consonants are h, l and the glottal stop, a consonant formed by pressure of the breath behind the closed glottis.

5. Vowels are usually classified into three groups: front, middle and back, corresponding to the parts of the mouth and tongue used in their phonation. The sound I, as in fit, is a front vowel. The sound u, as in food, is a back vowel. An infant's vowel repertoire consists mostly of front vowels. In its consonant equipment the opposite is usually true: two of the three consonants it uses are phonated by the back mouth parts, namely h and the glottal stop.

6. As the infant grows older, non-crying sounds begin to dominate the cries. The soft cooings and utterances that delight parents become more frequent. The child achieves increasing control of the mouth parts for vocalizing back vowels and front consonants - the labials, dentals and postdentals. Then begins a long period of meaningless babbling. Babbling has a real function in speech development; it is a practice period for control of the sound elements of language. The baby seems to be trying out new vowel and consonant combinations in a bewildering array. He repeats these sounds over and over again on varying pitches, with varying intensities and cadences. He mouths them, gets the kinesthetic feel of them with lips, tongue and cheeks, and unconsciously and endlessly practices them. Significantly, after a year of this,
meaningful words - at first mere approximations of words - begin to appear upon the background of infantile babbling.

7. Meaningful words appear toward the end of the first year or the beginning of the second year of life. At first they constitute a very small proportion of the infant's vocalization, but during the later part of the second year they become prominent. A word usually passes through an interesting transformation. At first it is a crude approximation. In nurseries the world over, the baby lies in a crib and babbles meaningless sounds such as "mamama" or "adadada." Under the coaching of parents, these babblings are abbreviated to "mama" and to "daddy." This is the way one child learned the word milk: at first it was "meme," then "mik mik" and finally milk. Pillow is often pronounced "pido." In the case of another child, the more difficult word please evolved from "be" through the series "ble," "pez," "pwez" to please. Sometimes the first words exhibit an onomatopoeic character. Thus a watch is a "tick tick"; a dog a "bow wow"; and a cow a "moo moo."

8. There are no fundamental group differences in the inherent phonetic equipment of human beings. In the first 10 days of life, boys and girls, white children and Negroes make pretty much the same sounds. But by the time they begin to form word patterns, some sex differences do appear. For instance, at a year and a half, girls exceed boys in the ability to use consonants at the beginning, in the middle and at the end of a word. The mean number of consonants used by girls in the initial position is 8.7 as against 7.7 for boys. For the medial position, the mean for girls is 7.9 and for boys 6.9. In the final position, girls use 2.9 consonants while boys use 2.4.

9. The average eight-month-old child is unable to use words. At 10 months he probably will have one word; at 12 months, about three words. At a year and a half, his vocabulary may be 20 words. During the next three months it will jump to over 100, and at two years it may contain as many as 250 words.

10. We can study the differences in speech development of infants in different home environments. A comparison of the speech of babies of working-class families with those whose fathers are doctors, lawyers, teachers or business owners is shown in the chart on this page. These curves are based on the frequency criterion of speech development. By this criterion the speech development of babies in homes of workers is considerably below that of the professional group. One suggested explanation is that the experience of the worker's child is more manual, while the environment in the professional household is highly verbal.
11. We have found that low-grade feeble-minded children, that is, idiots and imbeciles, in the fourth year of life possess the speech-sound status of year-old infants. When these children were examined a year later, they had made no progress whatever. This degree of speech retardation is practically hopeless.

Scientific American, 1949

4.2 Social Attachments in Infancy

S.R. Schaffer and Peggy Emerson, 1964

1. One reason for the dearth of studies may well lie in the strangle-hold which an almost universally accepted theory can sometimes exercise on research. Fortunately, controversy has now been stimulated by two developments: Harlow's intriguing work on the infant-mother relationship in the monkey, which casts doubt on the all-important role previously attributed to the infant's feeding experiences in the establishment of affectional bonds (Harlow, 1958, 1961; Harlow and Zimmermann, 1959), and the challenging theory which Bowlby (1958) has advanced to account for the nature and formation of the child's tie to the mother. In his paper Bowlby attacks the secondary drive theory of social development, suggesting instead that social tendencies are primary and that a number of inborn behavior patterns (such as following, clinging, sucking, smiling, and crying) serve to bind the child to the mother from the beginning. To emphasize this change in theoretical orientation he has proposed to drop the term emotional dependence and substitute the term attachment.

2. Our suggestion is that the core of the attachment function is represented by one of the simplest yet most fundamental elements in social behavior, namely the tendency of the young to seek the proximity of certain other members of the species. Approaching attachment in this way, we are dealing with a relatively clear-cut, easily identifiable behavior tendency which may be observed to occur almost universally amongst animals as well as in man. Its biological usefulness in a condition of infantile helplessness is obvious enough to need no further comment. It is likely that we are confronted here with one of the most basic requirements of the young organism to which powerful emotions are linked but to which, in the early stages of development, direct behavioral expression is generally given. Such a fundamental tendency must be isolated, named and studied, and it appears to us that the most economical usage of the term attachment is represented by this tendency.

3. A further advantage of this conception of attachment lies in the linkage which may be made between proximity seeking and proximity avoidance.
Attachments are generally focused on certain specific individuals only, while to others fear responses may be shown. That proximity avoidance (or, as it has been more commonly labeled, fear of strangers or eight-months'-anxiety) is in some way related to proximity seeking has been widely accepted, though, apart from some preliminary suggestions by Benjamin (1959), Freedman (1961) and Spitz (1950) we are still largely ignorant about the details of such interaction.

An operational criterion for attachment
4. Some further examination of the attachment concept is necessary if we are to make suggestions as to how it may most suitably be recognized and assessed. It is well established that, from about the second or third month on, an infant will behave differently with his mother as compared to strangers. He may smile and vocalize at her more readily, he may visually follow her more than he would other people and he is likely to quieten sooner when picked up by her after crying. Perceptual discrimination has thus taken place: the infant is now able to recognize his mother. This is clearly a necessary precondition to the formation of an attachment to a specific individual, but the ability to recognize the familiar person cannot, by itself, be regarded as evidence of attachment. Thus, in a study by Schaffer and Callender (Schaffer, 1958; Schaffer and Callender, 1959) of the reaction of infants to hospitalization, evidence of separation protest did not emerge until approximately seven months of age, i.e. long after perceptual discrimination had taken place. The infant who views his mother's absence with equanimity and readily accepts a strange caretaker can hardly be said to have formed attachment to the former, however readily he may be able to distinguish her from an unfamiliar nurse. To characterize recognition and quicker reactivity as attachment is thus a highly doubtful supposition. Moreover, all the evidence from studies of smiling (Ahrens, 1954; Spitz and Wolf, 1946) suggests that right up to six to eight months of age the infant is not responding to the adult as another person, i.e. in a characteristic social manner, but is merely reacting to the perception of certain primitive stimulus configurations. That a familiar configuration can elicit a response more speedily and intensely than an unfamiliar one can be readily understood without evoking the concept of attachment.

5. Another precondition appears necessary. If by attachment a particular kind of relationship to a particular kind of object is implied, then one can hardly look for such a relationship until the individual is capable of having the concept of an object. In order to form a permanent bond with another person it is necessary to conceive of this person as an entity apart from the self, with an independent existence in time and space. Attachment involves detachment, and here Piaget's (1953, 1955) demonstration of the stages through which the infant must progress before he can conserve the object
becomes highly relevant to the understanding of early social behavior. Up to the first quarter of the first year, Piaget has shown, a state of 'adualism' exists, in which there is no distinction between the self and the environment.

6. As his criterion for object conservation Piaget used the infant's reaction to the departure of an object from the immediate perceptual field. Similarly, we propose to use the separation response of an infant as our operational criterion for the existence of social attachments.

Summary of empirical study

7. The study takes the form of a longitudinal follow-up, in which sixty infants were investigated at four-weekly intervals from the early weeks on up to the end of the first year and again at eighteen months of age. With the use of an attachment scale, based on seven everyday separation situations, the following three main parameters were explored: the age at onset of specific attachments, the intensity of such attachments and the number of objects to whom attachments are formed. A measure of fear of strangers was also included.

8. Results indicate that the age at onset of specific attachments is generally to be found in the third quarter of the first year, but that this is preceded by a phase of indiscriminate attachment increases most in the first month following onset and that thereafter fluctuations occur in individual cases which make long-term prediction difficult; and that multiplicity of objects can be found in some instances at the very beginning of the specific attachment phase, becoming the rule in most of the remaining cases very soon thereafter.


PART 4 TEXT A

Back up

4.A Discrimination of depth in premotor infants
T.G.R. Bower, 1964

1. Nine infants aged 70-85 days at testing were used as subjects. Testing and training took place in an experimental room bare of furniture save that described below. The walls of the room were coarsely textured brick. The infants lay in a crib inclined at 45° to the brown wooden table on which it stood. The infants' heads were clasped between two yielding pads, the left hand one of which contained a microswitch whose closing operated an event
recorder placed below the table. Immediately in front of the crib was a gap in the table beneath which an experimenter was positioned. When the event recorder closed, the experimenter emerged from below the table and peek-a-booed at the infant for 15 sec. and then subsided out of sight once more. Three ft from the infant on the table was placed a white paper cube 12 x 12 x 12 in, which served as conditioned stimulus. The experimenter was able to introduce a screen from below in front of the crib for timeouts, changing the stimuli, etc. The cube thus served as a conditioned stimulus, the leftward head turn as an operant response and the peek-a-boo as reinforcement.

2. Initially a discrimination between cube present and cube absent was trained. Then head turning was shaped in half-hour sessions to a criterion of VR 5 for one experimental hour, with 15-sec. timeouts every minute.

3. Generalization testing was conducted in the following way. Four generalization presentations were used. (1) 12 in cube at 3 ft distance. (2) 12 in cube at 9 ft distance. (3) 36 in cube at 3 ft distance. (4) 36 in cube at 9 ft distance. Each was presented for four 30 sec. periods in counterbalanced order. Number of responses given to each was tallied.

   From Psychonomic Science, 1964, 1, 368

4.B The Follow-Up Study of Adult Achievement
Harold Skeels, July 1949

1. The purpose of this follow-up study was to obtain answers to a few very simple questions: what happened to the two groups of children when they became adults? How were the differences in mental growth in childhood reflected in adult achievement and adjustment? Were the two divergent pathways maintained or did they converge over the years? Were there significant changes indicating improvement or regression within and between groups? Was there a relation between adult status and such factors as social history, health history, or environmental experiences?

2. The adult follow-up study began 20 years after the post-experimental follow-up (Skeels & Skodak, 1965). The initial task was to locate and obtain information on every single case in the two groups.

3. Three essential qualities determine the success of locating the subjects of an in-the-field follow-up study: flexibility, ingenuity, and tenacity. The conclusion was reached that ordinary citizens should not try to disappear - they can always be located through patient effort.
4. Some quotations from the investigator's trip reports illustrate the ingenuity and tenacity that were employed in searching for the subjects in this study. Names and places have been changed for obvious reasons.

5. On October 6, I flew from Des Moines to Hawk City, and picked up a rental car to visit several towns to have interviews with adoptive parents and children, and to make inquiry on some cases where we did not have a recent address.

   Drove to Sutton, a town of about 1500, to inquire about the Hawkins family. Since they were not listed in Polk's Directory or the telephone directory I surmised that the family no longer lived there.

   Stopped at the Post Office and since this was a small rural community, I did not state my mission, but simply said I was with the Public Health Service; that I used to be with the University of Iowa; that I had not been back to Iowa for 14 years; that I was a friend of the Hawkins family and since I was in that part of the country, I was quite anxious to learn where they were. The post-master thought for a moment and said, "Yes, they moved away from here years ago." I indicated that I had assumed that. He then said, "I think if you will call Hazel Wilford, she can probably tell you their present location."

   I telephoned this lady and stated my interest, and she said, "Oh yes, they live at Cambridge, Iowa." She stated that they had moved there many years ago. I then said I believed they had two children, a boy and a girl. "Oh yes," she said, "the boy lives at Holdrege, Minnesota, is married and has two children, and the girl lives in Oklahoma. I don't know the exact address, but she is married and has two children. Oh, wait a minute! My sister says she has three children."

Skeels (HM)
"Adult status of children with contrasting early life experience"
1966, 31, n°105

Part 4 TEXT C
Back up

4.C The Origins of Fear
Richard Rose and Blaine Ditto, 1983

1. Developmental studies of common fears have a long research history. Epidemiological, observational, and experimental studies have been conducted to determine the nature, causes, and outcome of childhood and adolescent fears. An early suggestion, recently popularized by sociologists, is that our common fears are vestigial expressions of ancestral dangers.

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2. Eighty-five years ago, G. Stanley Hall evaluated the self-reported fears of 1,701 students "mostly under 23 years of age." Hall observed that the fears could be grouped into a few categories such as those of animals, water, death, and disease. Noting that a fear of snakes was the most frequently reported fear, he suggested that the relative prevalence of contemporary fears reflects past conditions better than it does present ones. There is, he concluded, "a peculiar prepotent quality about some... fears that suggests some... ancient origin" (Hall, 1897, p. 245).

3. The prepotency that Hall attributed to certain fear stimuli has been studied experimentally by others (Holmes, 1935; Ohman, Erixon, & Lofberg, 1975; Rachman, 1978; Valentine, 1930), and it finds corroboration in results of recent epidemiological surveys (Abe, 1972; Agras, Sylvester, & Oliveau, 1969; Snaith, 1968). Some fears, such as those of snakes and thunderstorms, are far too common to be attributed solely to direct exposure; others, including fears of dentists and electric outlets, are far too rare. A Darwinian hypothesis of biological preparedness (Darwin, 1877) is thus suggested by the data (Marks, 1969; Seligman, 1971). Consistent with that hypothesis is evidence of heritable variation in the intensity of common fears of evolutionary significance (Rose, Miller, Pogue-Geile, & Cardwell, 1981).

4. Further, the intensity of common fears differs during development: Hall noted that fears of strangers and blood decline with age, while fears of snakes and storms increase. Prevalence data, obtained from a household survey (Agras et al., 1969), provide additional evidence that different fears exhibit different developmental patterns. Some fears, such as those of cemeteries and injections, are common among children and adolescents but rare in adults. Others, including fears of illness and death, exhibit peak prevalence in later maturity. The factors responsible for such consistent developmental patterns may be quite complex, but it is likely that genetic factors play some role. Evidence that intensities of many common fears vary during development suggests the hypothesis that genetic influences on fearfulness also vary with age. The result: the mixture of environmental and genetic determinants of different dimensions of fear will not be uniform throughout development.

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4.D Questions which clarify

John P. Rickards, 1979
1. By developing an experimental paradigm and some ingenuous experiments within it, Ernst Rothkopf (see, for example, Rothkopf, 1966) created an entire area of educational research, that of adjunct questions.

2. Rothkopf's paradigm consists of interspersing questions in a passage of text contiguous to the material to which they relate. Typically, one or two adjunct questions are inserted either before (prequestions) or after (postquestions) a segment of roughly one or two pages of text, with the total text passage ranging from 1,000 to 5,000 words in length. Questions and text segments appear on separate sheets of paper and the reader is not allowed to take notes while reading. After reading the entire passage, examination is then made of the amount of questioned (intentional) and nonquestioned (incidental) passage material retained by the readers. The typical finding in studies of this sort (see Anderson & Biddle, 1975, for a review) is that the prequestion group retains roughly the same amount of material directly questioned as the postquestion group, and that both adjunct question groups retain more of the questioned material than a reading-only control group. This has been called the "direct instructive effect" (Rothkopf, 1966) or more simply the "direct effect" (Anderson & Biddle, 1975). More important, adjunct question studies have generally demonstrated that a postquestion group produces more recall of material not actually questioned than a prequestion group or a reading-only control condition. It is this so-called "mathemagenic" (Rothkopf, 1975) which has received the greater degree of empirical attention.

3. The adjunct question paradigm and the associated concept of mathemagenic behavior were born in a climate of neobehaviorism, and the early theory and research clearly reflect this heritage. However, in concert with other areas of human learning research, the "associative model" (Rothkopf, 1965, p. 194) which served as a basis for the early work with adjunct questions in text has given way to a more cognitive view of learning. This new orientation is demonstrated in the concepts and language Rothkopf (1976) now uses to describe mathemagenic behaviors. Terms such as "selection, mental elaboration and... integrations with previously learned information" (Rothkopf, 1976, p. 116) are all suggestive of this new cognitive orientation. Unfortunately, however, further analysis of the concept of "mathemagenic behavior" is not readily achieved due to the amorphous character of the term.

Review of Educational Research
Spring, 1979, Vol. 49, n° 2, Pp. 181-196
5.A Opinions and social pressure
Solomon Asch, 1955

1. That social influences shape every person's practices, judgments and beliefs is a truism to which anyone will readily assent. A child masters his "native" dialect down to the finest nuances; a member of a tribe of cannibals accepts cannibalism as altogether fitting and proper. All the social sciences take their departure from the observation of the profound effects that groups exert on their members. For psychologists, group pressure upon the minds of individuals raises a host of questions they would like to investigate in detail.

2. How, and to what extent, do social forces constrain people's opinions and attitudes? This question is especially pertinent in our day. The same epoch that has witnessed the unprecedented technical extension of communication has also brought into existence the deliberate manipulation of opinion and the "engineering of consent." There are many good reasons why, as citizens and as scientists, we should be concerned with studying the ways in which human beings form their opinions and the role that social conditions play.

3. Studies of these questions began with the interest in hypnosis aroused by the French physician Jean Martin Charcot (a teacher of Sigmund Freud) toward the end of the 19th century. Charcot believed that only hysterical patients could be fully hypnotized, but this view was soon challenged by two other physicians, Hippolyte Bernheim and A. A. Liébeault, who demonstrated that they could put most people under the hypnotic spell. Bernheim proposed that hypnosis was but an extreme form of a normal psychological process which became known as "suggestibility." It was shown that monotonous reiteration of instructions could induce in normal persons in the waking state involuntary bodily changes such as swaying or rigidity of the arms, and sensations such as warmth and odor.

4. It was not long before social thinkers seized upon these discoveries as a basis for explaining numerous social phenomena, from the spread of opinion to the formation of crowds and the following of leaders. The sociologist Gabriel Tarde summed it all up in the aphorism: "Social man is a somnambulist."

5. When the new discipline of social psychology was born at the beginning of this century, its first experiments were essentially adaptations of the suggestion demonstration. The technique generally followed a simple plan. The subjects, usually college students, were asked to give their opinions or preferences concerning various matters; some time later they were again asked to state their choices, but now they were also informed of the opinions held by authorities or large groups of their peers on the same matters. (Often the alleged consensus was fictitious.) Most of these studies had substantially the same result: confronted with opinions contrary to their own, many subjects apparently shifted their judgments in the direction of the views of the majorities or the experts.
1. There is an experiment in psychology that you can perform easily in your own home if you have a child three or four years old. Buy two toys that you are fairly sure will be equally attractive to the child. Show them both to him and say: "Here are two nice toys. This one is for you to keep. The other I must give back to the store." You then hand the child the toy that is his to keep and ask: "Which of the two toys do you like better?" Studies have shown that in such a situation most children will tell you they prefer the toy they are to keep.

2. This response of children seems to conflict with the old saying that the grass is always greener on the other side of the fence. Do adults respond in the same way under similar circumstances or does the adage indeed become true as we grow older? The question is of considerable interest because the adult world is filled with choices and alternative courses of action that are often about equally attractive. When they make a choice of a college or a car or a spouse or a home or a political candidate, do most people remain satisfied with their choice or do they tend to wish they had made a different one? Naturally any choice may turn out to be a bad one on the basis of some objective measurement, but the question is: does some psychological process come into play immediately after the making of a choice that colors one's attitude, either favorably or unfavorably, towards the decision?

3. To illuminate this question there is another experiment one can do at home, this time using an adult as a subject rather than a child. Buy two presents for your wife, again choosing things you are reasonably sure she will find about equally attractive. Find some plausible excuse for having both of them in your possession, show them to your wife and ask her to tell you how attractive each one is to her. After you have obtained a good measurement of attractiveness, tell her that she can have one of them, whichever she chooses. The other you will return to the store. After she has made her choice, ask her once more to evaluate the attractiveness of each of them. If you compare the evaluations of attractiveness before and after the choice, you will probably find that the chosen present has increased in attractiveness and the rejected one decreased.

4. Such behavior can be explained by a new theory concerning "cognitive dissonance." This theory centers around the idea that if a person knows various things that are not psychologically consistent with one another, he will, in a variety of ways try to make them more consistent. Two items of information that psychologically do not fit together are said to be a dissonant relation to each other. The items of information may be about behaviour,
feelings, opinions, things in the environment and so on. The word "cognitive" simply emphasizes that the theory deals with relations among items of information.

5. Such items can of course be changed. A person can change his opinion; he can change his behavior, thereby changing the information he has about it; he can even distort his perception and his information about the world around him. Changes in items of information that produce or restore consistency are referred to as dissonance-reducing changes.

Scientific American, 1962

5.2 “How to cause discord in three easy lessons”

Muzaffer Sherif, 1956

1. When the two groups in the camp had developed group organization and spirit, we proceeded to the experimental studies of intergroup relations. The groups had had no previous encounters; indeed, in the 1954 camp at Robber's Cave the two groups came in separate buses and were kept apart while each acquired a group feeling.

2. Our working hypothesis was that when two groups have conflicting aims - i.e., when one can achieve its ends only at the expense of the other - their members will become hostile to each other even though the groups are composed of normal well-adjusted individuals. There is a corollary to this assumption which we shall consider later. To produce friction between the groups of boys we arranged a tournament of games: baseball, touch football, a tug-of-war, a treasure hunt and so on. The tournament started in a spirit of good sportsmanship. But as it progressed good feeling soon evaporated. The members of each group began to call their rivals "stinkers," "sneaks" and «cheaters." They refused to have anything more to do with individuals in the opposing group. The boys in the 1949 camp turned against buddies whom they had chosen as "best friends" when they first arrived at the camp. A large proportion of the boys in each group gave negative ratings to all the boys in the other. The rival groups made threatening posters and planned raids, collecting secret hoards of green apples for ammunition. In the Robber's Cave camp the Eagles, after a defeat in a tournament game, burned a banner left behind by the Rattlers; the next morning the Battlers seized the Eagles' flag when they arrived on the athletic field. From that time on name-calling, scuffles and raids were the rule of the day.

3. Within each group, of course, solidarity increased. There were changes: one group deposed its leader because he could not "take it' in the contests with the adversary; another group overnight made something of a hero of a big boy who had previously been regarded as a bully. But morale and cooperativeness within the group became stronger. It is noteworthy that this
heightening of cooperativeness and generally democratic behavior* did not carry over to the group's relations with other groups.

4. We now turned to the other side of the problem: How can two groups in conflict be brought into harmony? We first undertook to test the theory that pleasant social contacts between members of conflicting groups will reduce friction between them. In the 1954 camp we brought the hostile Rattlers and Eagles together for social events: going to the movies, eating in the same dining room and so on. But far from reducing conflict, these situations only served as opportunities for the rival groups to berate and attack each other. In the dining-hall line they shoved each other aside, and the group that lost the contest for the head of the line shouted "Ladies first!" at the winner. They threw paper, food and vile names at each other at the tables. An Eagle bumped by a Rattler was admonished by his fellow Eagles to brush "the dirt" off his clothes.

5. We then returned to the corollary of our assumption about the creation of conflict. Just a competition generates friction, working in a common endeavor should promote harmony. It seemed to us, considering group relations in the everyday world, that where harmony between groups is established, the most decisive factor is the existence of "superordinate" goals which have a compelling appeal for both but which neither could achieve without the other. To test this hypothesis experimentally, we created a series of urgent, and natural, situations which challenged our boys.

6. One was a breakdown in the water supply. Water came to our camp in pipes from a tank about a mile away. We arranged to interrupt it and then called the boys together to inform them of the crisis. Both groups promptly volunteered to search the water line for the trouble. They worked together harmoniously, and before the end of the afternoon they had located and corrected the difficulty.

7. A similar opportunity offered itself when the boys requested a movie. We told them that the camp could not afford to rent one. The two groups then got together, figured out how much each group would have to contribute, chose the film by a vote and enjoyed the showing together.

8. One day the two groups went on an outing at a lake some distance away. A large truck was to go to town for food. But when everyone was hungry and ready to eat, it developed that the truck would not start (we had taken care of that). The boys got a rope – the same rope they had used in their acrimonious tug-of-war – and all pulled together to start the truck.

9. These joint efforts did not immediately dispel hostility. At first the groups returned to the old bickering and name-calling as soon as the job in hand was finished. But gradually the series of cooperative acts reduced friction and conflict.

Scientific American, 1956
Back up