

A STUDY OF A NEGLECTED PORTION OF THE FIELD
OF LEARNING—THE DEVELOPMENT OF
SENSORY ORGANIZATION*

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THE PROBLEM

The present investigation was designed primarily to demonstrate a type of learning which is not ordinarily recognized in discussions of the nature of learning, and which is not dealt with at all, so far as I know, when such problems have been examined as: what factors influence the rate of learning and forgetting, and what relation does motivation have to learning and to the utilization of habits.

The field of learning is a vast one and a very heterogeneous one. We have put an enormous range of concrete things under this one category, until the activities of which it is said to be a part are almost as broad as life itself. Now, the fact that this field is so heterogeneous, at least in superficial appearance, should long ago have impelled psychologists to a vigorous investigation of the question as to whether this field of learning is functionally homogeneous—i.e., obedient to the same laws and principles—through all of its length and breadth, or whether, as one would be more inclined to suspect, there are subdivisions of the field (and probably a whole hierarchy of smaller subdivisions of these) that are functionally similar in certain respects and functionally dissimilar in other respects. If the latter hypothesis is actually the case, the discovery and demarcation of these functionally distinct divisions of learning is obviously of fundamental importance for research in this field. The different forms of learning cannot be expected to be as distinct from one another as are the ailments that constitute the subject matter of medicine; and yet, the possibility of securing an adequate understanding of learning is probably not much greater, if we do not devote ourselves to the preliminary task of finding how to group concrete examples of learning into functionally distinct classes, than would be the probability of successful research in medicine if the

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research workers in that field simply tried to deal with disease in general, rather than first trying to classify the different types of disorder.

Although the above notions seem fairly obvious, it seems that psychologists generally have been inclined to search for some one formula which would fit the whole field of learning—a sort of universal solvent, as one might say. Perhaps the reason for this is that other sciences have achieved such notable advances by finding that they could reduce to a few basic things what at first looked like hopelessly heterogeneous fields. Whether this is the reason or not, most psychologists have discussed learning as though they thought that the great diversity that seems to exist among the various examples of learning¹ was merely a surface matter, and not any difference of principle of operation. Now, inasmuch as the various theories of the nature of learning are quite different from one another, one might imagine that at least some of these differences must have come from the fact that different psychologists seized on different types of habit in their search for illustrative material which would seem to them most clearly to lay bare the essential nature of learning. Such a factor is partly responsible for the diversity of theories of habit that exist—compare, for example, the illustrative material of apperceptionism and associationism. However, such a factor is not the main source of the differences of interpretation of learning. For, to a really amazing extent, the different theories of learning have appealed to specimen material which is virtually the same in all cases. This fact can be illustrated by taking an example of learning utilized by Koffka (6) in explaining the Gestalt interpretation of learning,

¹In this discussion, I am using the expression “forms of learning” in the sense of “forms of habit.” The term “learning” most naturally should designate the process of acquisition of some new skill or knowledge, etc., rather than the products or residues of this process. However, the term “habit” has no unambiguous meaning in psychology, sometimes being used to designate responses which have been so deeply ingrained by training that they are automatic, and sometimes being used (and I think preferably, since we have no other word to convey this meaning) to designate the after-effects of learning, no matter what has been learned and no matter how slight or how permanent the impression has been. It is in the latter sense that the word “habit” will be used in this paper. Most psychological discussions of the “nature of learning” are really discussions of the nature of habit, in the sense just defined. The association theory, for example, or the theory of redintegration, or Tolman’s theory of sign-gestalt-expectations are not primarily theories of how learning goes on, but are theories concerning the nature of the habits established by learning.

and by showing how readily the other theories of learning could appropriate this same example to explain their interpretations. Koffka uses the example of a small child who reaches for a candle flame, is burned thereby, and who subsequently avoids the flame rather than approaches it. To Koffka this example illustrates a transformation of meaning, or, more particularly, a case of unification. The candle now is not "a pretty thing to be played with," but is "a thing which causes pain." But, to the adherents of the association theory, this example would seem to fit *their* theory perfectly—the child was experiencing the sight of the flame and simultaneously experienced the heat; consequently the sight thereafter recalls the thought of the pain which was experienced, and the candle is avoided. And similarly with the other theories. It is so obvious how the redintegration theory, the conditioning theory, and Tolman's theory would fit this example that there is no need to elaborate.

This fact that there are so many theories, all of which appeal to similar factual material for substantiation, suggests two lines of work for the future. For one thing, if these different theories are really different interpretations, and not merely different terminologies, it is high time that experimental tests were devised to determine which of these theories is most adequate for the description of the material which they all concern. This contest certainly is not one which should be settled on the basis of the relative vociferousness or prestige of the different groups. Situations such as this are urgent challenges for the construction and use of criteria and techniques which will decide between rival theories. Such a welter of theories is no indication of the wealth of psychology—it is a confession of poverty of experimental resourcefulness.

This paper, however, is not devoted to this first task, but turns instead to a second line of work, suggested by the fact that these different theories of learning all appeal to similar illustrative material. As suggested above, in so extensive a field as that of learning, it is highly probable that there are subdivisions of the material which are functionally different from each other, and the discovery of these divisions is consequently of major importance for psychological research and psychological theory. In view of this probability, we need to explore the whole field of learning to discover whether there are some portions of that field not covered by the existing theories. If any such examples are found, clear-cut specimen materials from these

portions of the field should be sought and, in the second place, criteria should be devised and applied to ascertain whether this material really is different in the principles of its operation from the specimen material commonly stressed by the present theories of learning. It is toward these goals that the present study is headed, although it is only a very slight beginning in this work. This investigation did not attempt to ferret out all of the territory not covered by existing theories, nor, even with the field with which it does deal, has it succeeded in devising any crucial tests to determine whether there is any functional novelty in the material found. The contribution of this study is limited to the closer examination and clarification of a particular portion of the field of learning which seems to be distinct from the portions ordinarily studied and to be, for several reasons, of considerable theoretical interest.

The type of learning examined in the present study may seem to many readers to be a type already strongly stressed by Gestalt psychologists, for this investigation is a study of sensory organization, a study of the unification of sensory materials into dynamic or organic wholes. Of course, the phenomenon of sensory organization owes its present solid status in psychology to the Gestalt group. Furthermore, the fact that the learning dealt with in this study is learning which results in the formation of new sensory patterns may likewise sound like material already well worked over by Gestalt psychologists. Their interpretation of learning as a matter of "perceptual reorganization" or of "re-Gestaltling" might make it appear that they already have stressed the sort of material here presented.

However, a rather odd situation prevails in this respect. Although the material of this study is intimately related to the work of Gestalt psychology—one might say accurately that it grows directly out of the Gestalt work—the Gestalt psychologists have given so little attention to this form of learning that some psychologists of other schools [see Braly (2) for example] have accused them of denying the existence of such learning. However, the fact that Gestalt psychologists have given too little attention to this form of learning cannot be attributed to any lack of knowledge on the part of Gestalt psychologists, but must be explained by reference to the psychology of controversy. In their studies of sensory organization, Gestalt workers have had abundant opportunity to observe the dependence of sensory organization on training. A naive subject, for instance, can

see but one of the possible organizations of many of the reversible illusions. A naive subject hears a chord as a unit—it is only with training that he can get a different sensory organization from the stimulation, etc. However, in their discussions of learning, the Gestalt psychologists hardly utilize such material at all. When they talk of learning as a matter of perceptual reorganization, their examples indicate, almost without exception, that they mean by this a change in associated or reintegrated meaning. For example, when Köhler's chimpanzees learned to utilize boxes to reach suspended food, the change was one that could properly be called "perceptual reorganization," since perception is a broad term covering associated meanings as well as direct sensory experience, but the change was not one that could have been called "sensory reorganization."

By the above, I do not mean to imply that Gestalt psychologists have failed to relate their work on sensory organization to the problems of learning. Sensory organization is assigned a place of fundamental importance by them as a factor determining the ease or difficulty of the discovery of solutions or relationships, and by their experimental work they have given abundant proof that this emphasis is warranted. Similarly, with regard to the question of what stimuli will serve to re-arouse established habits, they stress the fact that the important consideration is, not whether the stimulus has some of the absolute properties of the original situation, but whether it has an organization or pattern more or less analogous to that of the original situation or to some relatively independently segregated portion of it. However, the relation which they recognize between sensory organization and learning is not a reversible relationship, as one might say. The importance of sensory organization for learning is stressed, but they assign only a very unimportant rôle to learning as a basis of sensory organization. Thus, Köhler gives the opinion:

It may be that in a very *unstable* constellation, in which a certain form can be seen or organized, past experience of such a form will tend to produce it really, whereas without that previous experience, this would not happen. Even in this case, however, we should still have to explain what factors produced that form in previous life. It is only assumed, then, that conditions were more favorable, and the question remains open whether they were not favorable for its originating directly. In any case, even granting that previous experience of a certain form favors its appearance in the future, we ought to realize

that such an occurrence will be limited to definite cases, namely those in which the actual constellation does not tend decidedly toward other more stable wholes and forms. (7, pp. 208-209)

This skepticism on the question of whether sensory organization can result in any appreciable amount from training may be traced primarily, I believe, to the fact that the Gestalt psychologists have received such strong opposition from other psychologists on this very topic. The Gestalt psychologists have become convinced by their work that spontaneous dynamic organization of psychological processes is a basic phenomenon. Their opponents, however, have generally taken the stand that such organization is a product of past learning or experience, and consequently is not one of the primary data of psychology. The self-confidence of this opposition, it must be admitted, has not grown from any experimental evidence directed specifically at the principles which Gestalt psychology has advanced, but has sprung rather from a strong faith in the strength of the empiricist position in general. This confidence is not altogether surprising, for the empiricist or associationist doctrine has had some notable victories in its long career. First of all, it banished rationalism as a basic method of approach in philosophy. Later it outstripped apperceptionism in the (quite unconscious) race for incorporation into the developing field of experimental psychology. And in relatively recent years, it has helped to force a more critical and scientific approach to the problem of instinctive behavior. Because of the self-assurance thus engendered, the associationists have not hesitated to apply their familiar formula to the new material unearthed by Gestalt psychology. Dashiell, for instance, to quote an extreme example, suggests that probably it is past experience which determines the fact that we see "moving pictures" as moving (3, pp. 404-405).

Naturally, such a determined and dogmatic opposition has led Gestalt psychologists to minimize the evidences of the operation of learning in determining sensory organization, and to stress all of the evidence indicating that sensory organization is the result of spontaneous organizing tendencies of the nervous system. From the experiments of Gottschaldt (4, 5), for example, the thing which they have stressed is, not that training in some cases made it possible to get a sensory organization from his figures which ordinarily would never have stood out, but the fact rather that the organization of the total figure tended to prevent the separate perception of the logically

separable part. One can find in the writings of Gestalt psychologists, if one is interested in the search, various statements indicating their familiarity with the fact that training, set, attitude, etc. help to determine the sensory organization of at least some materials. It is true, moreover, that they describe learning as a matter of perceptual reorganization. However, as noted before, almost all of their examples of learning can be described as cases of changes of meaning—cases where the subjects learn to associate with the sensory material certain other things not sensorially given.

To sum up, then, it may be said that although the sort of learning investigated in the present study is closely related to Gestalt materials, it is not a sort of learning which they have stressed. Quite on the contrary, their position, as well summarized in the above quotation from Köhler, is that learning will be a significant factor in determining sensory organization only in relatively rare cases when the organization naturally is unstable.

However, if we turn now from the Gestalt psychologists and ask whether their opponents have done any better in the matter of giving a place in the field of learning to the matter of sensory organization, we find that the material is quite as much neglected. The chapters on perception, in books of the associationist tradition, repeat over and over the dogma that sensory organization comes from past experience; but when one passes on to the chapters on learning, it seems that such material has been forgotten or discarded, and one finds discussions of learning in terms of stimulus and response connections, in terms of associations of ideas, in terms of redintegrations of meanings, etc., but no records of experiments with sensory organizations due to training.

The recent and very interesting suggestion by Thorndike (11, pp. 338-345) that increase of identifiability of the stimulus is one of the special phases or aspects of learning is one of the discussions which comes nearest to recognizing the sort of learning involved in the present study. However, in his discussion of how greater identifiability is secured, Thorndike clings to his connectionist principles, rather than recognizes the phenomenon of development of sensory organizations.

It was this lack, then, on the part of both of the contending groups that led to the present investigation. The study aims to explore part of the territory of this field of sensory organization in order to dis-

cover whether sensory organizations sometimes develop in a way, and persist with a permanence, which would demand their inclusion in the field of learning as a definite part thereof. It is hoped that this preliminary investigation of such material may pave the way for studies of such learning on many different scores. I might, at the present, comment on only one characteristic of this material which illustrates the point that different portions of the field of learning will obey different principles. As has been clearly shown with some other forms of learning, motivation is sometimes indispensable for the utilization of habits. However, as the reader can very easily demonstrate for himself with the experimental materials of the present study, motivation is not needed at all to secure the utilization of such habits as are involved in the present study.

THE EXPERIMENT WITH INCOMPLETE FIGURES

The first division of the experimental work of this report concerns an experiment with the incomplete or fragmentary visual figures shown in Figures 1 and 2. The experiment demonstrates that with such material as this there is a process of learning which results in habits which have a high degree of permanence. Some of the incidental observations of the experiment throw light on the question of how such habits are formed, and suggest a very tentative theory on the nature of the nervous processes involved.

The suggestion for this first experiment came from Gardner Murphy's discussion (8, pp. 283-287) of a study by R. F. Street (10). The original study by Street was not intended at all as a study of learning, but as a study of a certain type of intelligence-test materials. Street was interested in the question as to what correlation existed between the ability to complete such fragmentary visual figures and ability in ordinary verbal completion tests.² Gardner Murphy, how-

²It may be worthwhile to call attention to a fact which Dr. Klüver brought to my attention, that Street's study has some resemblance, in the materials used, to the earlier studies by van der Torren (12) and the Schobers (9), using some test materials first suggested by Heilbronner and used by him in 1905 for the study of psychiatric cases. Their figures, however, were line drawings in which the full outer contour was given, but in which many of the finer details were omitted in the more difficult figures. It is interesting to note that with such figures children showed, with increasing age, a definite increase in ability to identify the figures. With his material, on the other hand, Street found the children in the 3rd, 6th, and 9th grades all made approximately the same average score.

ever, refers to Street's materials for an altogether different purpose, namely, to illustrate his suggestion that much of complex learning may be interpreted as a matter of perceptual reorganization. When Murphy's book appeared, the second experiment of this paper had already been conducted. The new material which Murphy mentioned seemed, however, to have interesting possibilities as a means

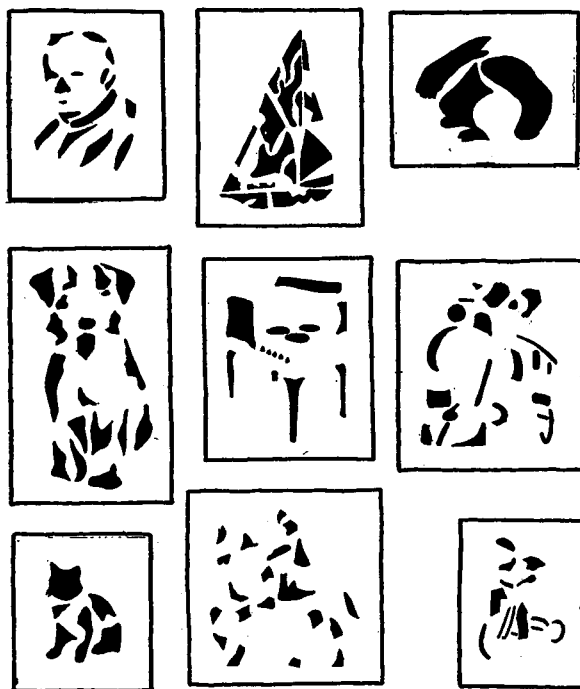


FIGURE 1

NINE FIGURES FROM R. F. STREET (10) USED IN THE FIRST EXPERIMENT

The figures are arranged in the order of their presentation in the first and second testing periods. The figure presented first is the upper left-hand figure, the second figure the one below it, the fourth figure the one at the top of the second column, etc. The fourth figure is an adaptation of one of the simpler of Street's figures; the other eight are reproductions of his figures.

(From R. F. Street's *A Gestalt Completion Test*, 1931, by permission of the publishers, the Bureau of Publication, Teachers College, Columbia University, New York.)

of investigating further some of the problems that had already been dealt with, and consequently, this further experiment was conducted. Although second in point of time, this experiment with incomplete figures is reported first in this article because the procedure and results are somewhat simpler than those of the other experiment.

Experimental Materials and Procedure. Figures 1 and 2 show

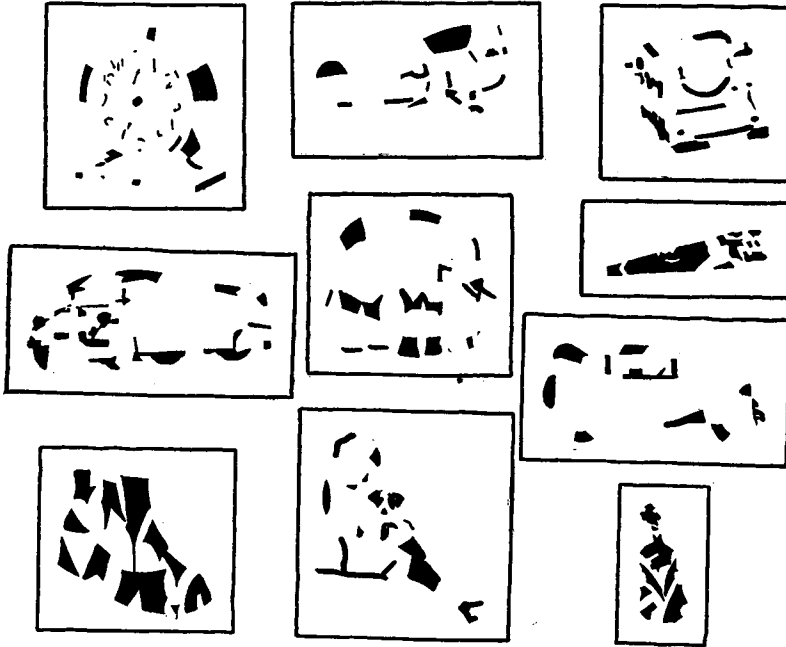


FIGURE 2

ORIGINAL INCOMPLETE FIGURES USED IN THE FIRST EXPERIMENT

As in Figure 1, the above drawings are arranged in the order of presentation in the first and second testing periods, the above drawings being presented as the 10th to the 19th drawings in the series.

the 19 complete figures used as the main stimulus materials in this experiment. As indicated, 8 of these figures were taken from Street's collection, one was an adaption of one of his figures, and the other 10 were new figures constructed on the same principle as Street's figures.

The experiment was conducted as a group experiment, the figures being exposed on a screen by means of an opaque projection lantern. From 9 to 24 subjects were tested at a time. The size of the projected image was 55" x 55" in the case of the drawings which most completely filled up the illuminated portion of the screen. A rough idea of the exposure conditions may be secured from the fact that when the machine was used to project single-spaced typewritten material, a block of typing six inches across and six inches high could be projected on the screen with sufficient clearness that the words could be read in the farthest corner of the room, although isolated typographical errors could not have been detected. Since the detail in the different figures was not nearly so fine, the subjects had no difficulty in seeing the figures clearly, especially since they were allowed to choose whatever position in the room gave them the clearest vision. It might be mentioned incidentally at this point that a comparison of the scores with the positions of the different subjects in the room seems to indicate that the factor of distance from the screen did not have any appreciable influence, if any, on the results.

Four different groups of subjects were used. All of them were summer school students at the University of Arkansas. One of these groups was a control group used as a check on the delayed-recall test given the other three groups. This control group was tested only once, and then with the very brief exposures used in the delayed-recall tests given the other groups. The other three groups were each given three different tests, the first two of which were separated by exactly one day, and the second two of which were separated by 22 to 25 days.

The further details of the procedures used with the three main groups are as follows: *On the first test*, before any of the figures were shown to a group, instructions were first given them covering the following points:

You will be shown some figures which can be seen as well-unified and coherent pictures of certain familiar things, provided you "fill in," as it were, the spaces between the fragments shown. In case you see the correct picture, all of the different marks in each drawing will be seen as belonging to the completed figure. In case you get a pattern which does not utilize all of the fragments, you can know thereby that you have not yet seen the figure intended.

To make these instructions clearer, the simplest figure of all was shown to the group (the first drawing in Figure 1), and the above instructions were repeated with particular reference to this figure. Further instructions were then given regarding the recording by each subject on a sheet of paper of what he had seen and when he had seen it. These further instructions covered these points:

Opposite the number indicating the picture which has been shown, you are to put down one or more words indicating what you have seen in the drawing exposed and, in parentheses, whether you have seen the object clearly and easily, or imperfectly and uncertainly. You are also to mark the approximate amount of time which passed before you saw that object in the drawing exposed. The timing will be indicated to you as follows: as you are watching the picture, the experimenter will call off the time at second intervals for the first five seconds, and at five-second intervals thereafter. You should record the last time called before you saw the object which you record.

After you have secured one organization of the picture, and have jotted down the items asked for above, continue to observe the picture for the full exposure period. In case you see something different during the remaining time, record what is seen, when it was seen, and whether it was seen vaguely or certainly.

Since the various figures were of quite unequal difficulty, the length of the exposure time was varied from twenty seconds for the easiest figures to as much as three minutes for the most difficult. After each figure had been shown, no explanation was given as to what had been represented, and the subjects had been asked also to refrain from comments to one another. At the conclusion of the exposure of all 19 of the figures, the subjects were cautioned that since other groups were to be tested, and since subsequent tests might be given to the same group, they were earnestly requested not to discuss the work with any other person. The material excited an amount of curiosity which makes it impossible to hope that this request was honored in every case, but I have reason to believe that most of the group cooperated in this respect.

The above procedure was the procedure on the first test with all three of the main experimental groups (Groups A, B, and C), with the exception that one of the groups (Group C) was given some further preparation or assistance before each picture was exposed. With this group, before each picture was exposed, the group was told what

class of object would be portrayed. It may be well to list here the descriptions given, together with a brief indication (in parentheses) of the correct answers. The drawings are listed in the order of presentation.

1. (Man's head)
2. An animal (dog, puppy)
3. An animal (cat, dog)
4. A means of transportation (boat, sailboat)
5. A piece of household equipment (stove)
6. An animal and a person (man on horseback)
7. A small land animal (rabbit)
8. A means of transportation (locomotive)
9. A child and a toy (boy and tricycle)
10. A piece of household equipment (alarm clock)
11. A means of transportation (bus, truck)
12. Something used by almost everyone everyday (shoe)
13. A means of transportation (airplane)
14. An animal (elephant)
15. An animal and a person (boy and dog)
16. A commonly-used mechanical device (typewriter)
17. A common tool (saw)
18. A means of transportation (automobile)
19. A musical instrument (violin)

In scoring the papers of all groups, it might be remarked here parenthetically, the procedure followed was naturally that of counting correct any answer indicating the subject had seen the object represented, regardless of whether the specific words used above were given.

In *the second testing period*, for all three of the main experimental groups the conditions and procedure were virtually the same as were used with the Groups A and B described above. The differences were these: (1) the exposure time was shortened in this period, especially for those pictures which had been seen by most of the subjects in the first period; (2) after all of the figures had been exposed, the series was given again, and as each picture was thrown on the screen the group was told what specific object was represented. A good many subjects experienced difficulty in seeing some objects even after they had been named specifically, and consequently the different parts of such objects were pointed out, in order that as many as possible of the subjects might see all of the pictures. On

this second test, Group B was given a little additional help toward seeing the figures intended. Instead of merely naming the object represented, and indicating how the different fragments were related to this intended whole, aid was given by exposing the complete drawing from which the fragments had been taken in the case of drawings of Figure 2. Otherwise the second test was the same for all three main groups.

The *third testing period*, which followed the second period by 22 to 25 days, was the same for all three main groups and for the control group as well, except that it was necessary to give the control group some special instructions, such as had been given in the first testing period with the other groups, to make them understand what was their task. Also the subjects of the main groups were warned that the order of presentation would not be the same as had been used on the previous testings, and that some new figures would be scattered among those previously seen.

In this third testing period, the pictures were exposed for only a very brief time. A shutter tachistoscope had been mounted before

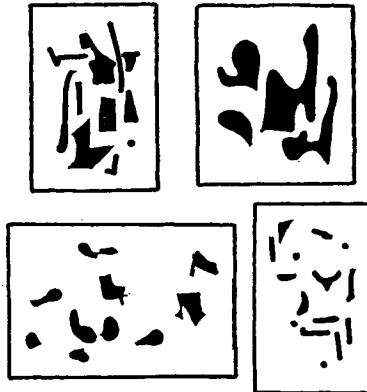


FIGURE 3

FOUR DRAWINGS TYPICAL OF THE NONSENSE DRAWINGS SCATTERED AMONG THE OTHER DRAWINGS IN THE THIRD TEST

the lens of the projection lantern. With the aid of this, each picture was given a first exposure of about .01 second (after a warning signal had been given so that the subjects could get a preliminary

fixation of the center of the exposure screen). After that briefer exposure for each picture, a second exposure of a full second's duration was given for the same picture. The subjects were asked to indicate what they had seen on each exposure. Most of the 13 drawings which were added to the list on this exposure were nonsense drawings, although no mention of this fact was made to the students. Some examples of these added figures are shown in Figure 3.

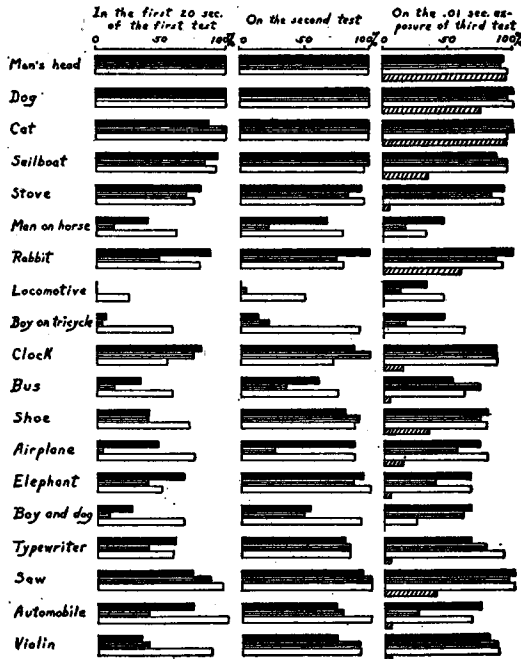


FIGURE 4

PERCENTAGES OF THE DIFFERENT GROUPS SEEING THE DIFFERENT PICTURES IN THE FIRST 20 SECONDS OF EXPOSURE IN THE FIRST TEST, IN THE FULL EXPOSURE ON THE SECOND TEST, AND IN THE FIRST OR VERY BRIEF (.01 SECOND) EXPOSURE OF EACH PICTURE ON THE THIRD TEST

The solid black bars represent the percentages of Group A (N=15—see description of procedure for the conditions used). The bars marked with two horizontal stripes represent Group B (N=23), tested with almost exactly the same procedure as used with Group A. The white bars represent Group C (N=24), which was aided on the first test by having been told what class of object each drawing represented. The bars marked with slanting lines represent the percentages of the control group (N=20), used only with the procedure of the third test.

Results. The graph which shows the results of this first experiment most comprehensively is Figure 4. The title and subtitle of this figure explain what data it presents and explain what groups are represented by the different types of bar.

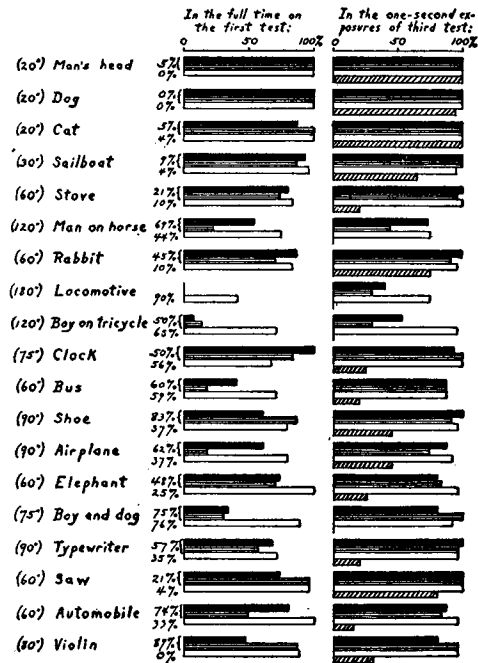


FIGURE 5

PERCENTAGES OF THE VARIOUS GROUPS SEEING THE DIFFERENT PICTURES IN THE FULL EXPOSURE TIMES OF THE FIRST TEST AND IN THE SECOND OR LONGER EXPOSURES OF THE THIRD TEST

For the explanation of what the different types of bar represent, see the subtitle to Figure 4. For the explanation of the numerical entries on the graph, see the text.

In Figure 5 are shown some data supplementary to the data of Figure 4. It will be remembered that on the first test the different drawings were not exposed for equal lengths of time, since some were much more difficult than others. The full exposure times allowed are shown in Figure 5 by the numbers in parentheses to the

left of the words describing the different drawings. The percentages written at the left of the bars for the first test, in Figure 5, indicate *what percentages of the subjects who saw the drawings correctly on the first trial saw them after the first 5 seconds of the exposure had passed*. (The differences in length of the bars for the first test in Figure 4 and Figure 5 indicate, of course, what proportions of each group saw the various figures after the first 20 seconds of each exposure had passed). In order not to make the record too complicated, the data from Group A and Group B have been combined in figuring these percentages of successes after the 5-second point.

In analyzing the general findings indicated by Figures 4 and 5, the following things may be pointed out:

1. The relative difficulty of the various drawings is indicated best by the left-hand column of Figure 4, which shows the percentages of the different groups recognizing the different pictures in the first 20 seconds of the exposure of each on the first test. However, the data on the scores of the control group (see both Figure 4 and Figure 5) throw light on this same matter.

2. The influence of verbal assistance on the difficulty of the task may be seen from the left-hand columns of both Figure 4 and Figure 5. With the more difficult drawings, Group C seems to have been helped in almost every case by having been told what class of object was represented.

3. As is indicated by the percentages expressed in numerical terms in Figure 5, in a large proportion of the cases (especially if we exclude the four easy figures shown first), the correct organization was not gotten promptly, but had to be searched for. It is especially interesting here to consider the record of the control subjects given their first experience of the pictures under the conditions of very brief stimulation used with the other subjects on the third test. Even on the .01 exposure a number of the control subjects saw correctly some fairly difficult figures. An even larger number was able to see some of the fairly difficult figures on the one-second exposure (on which, of course, they presumably had some aid from the .01-second exposure just preceding). The relatively small proportion of the control subjects who succeeded shows, however, that with most of the drawings the correct organization was not the most natural organization for these drawings.

4. The data on the third test for the three main groups show a very firm retention over the interval of 22 to 25 days of no practice. The comparison with the record of the control group shows what a marked influence was exerted by past training. However, the further consideration needs to be taken into account that some of the subjects had not been able to see some of the more difficult figures clearly or at all, even with the assistance given after the second test. Consequently, perhaps a fairer measure of the retention of this material is to be secured by calculating the percentage of the subjects who had seen each figure correctly on their own efforts in the second test who saw the same figures correctly on the third test. Out of 930 cases in which pictures were correctly named on the second test, there were only 28 cases (or 3%) in which errors were made on the third trial. These data are sufficient to raise the question as to whether there is any other type of habit so efficiently retained as habits of sensory organization.

On the third test there were very few cases in which the subjects applied to any of the regular pictures the name of some other one of the things they remembered were in the series. In other words, there must have been relatively little guessing. This same conclusion is indicated by the reactions to the nonsense figures added to the collection on the third test. In only 18% of the cases did the subjects attempt to say what these drawings represented, and in 59% of these cases they indicated that their perceptions were but guesses. In only 6% of the cases did the subjects apply to a nonsense drawing a name which might indicate that it had been confused with some of the regular drawings seen before. It must be remembered, too, that perhaps most of this 6% represented legitimate attempts at identification of drawings recognized as not seen before. The nonsense drawings probably looked as much like "a car," "a dog," or "an airplane," as like anything else.

I might sum up the results of this experiment now in some more general statements. It might be noticed, first of all, that the usual process by which one gets to see these figures is a process whereby the figure changes from one organization to another in an all-or-nothing fashion. It sometimes was true that a subject would notice first one detail of a drawing, and then from that gradually assimilate one portion after another of the rest of the drawing until he was able to see the entire unit; but this was seldom the way in which the

thing happened. The typical process was that the figure would change as an entirety from one pattern to another—often, at first, the figures looked like so many jumbled marks, then one unification might appear which was not very satisfactory, but looked possible. Thus, quite a few subjects saw the drawing of the rabbit first as being “fish jumping out of the water,” or as “seals” or as “arms and hands.” But, since these patterns did not seem adequate, and the examination was continued, the figure would next transform itself, perhaps, into something else, until finally, perhaps, the correct figure was seen. It is interesting that once an organization had been achieved, however, even where it was considered by a subject as being clearly incorrect, it was found hard to exclude that organization and see something else. I regard even this as one clear-cut indication of the influence of learning with regard to sensory organization. It seems as though, with material of this sort, once an organization is achieved, that very fact seems immediately to give a “sticking power” to that organization which tends to block any efforts at reorganization. A “stamping in,” as one might say, seems to follow immediately and so naturally that it is easy to overlook the fact of its presence.

Another general fact not contained in the graphs above is the fact that there are rather consistent differences in the ability to secure the correct organizations from these incomplete figures. This has been determined by correlating the scores from odd and even-numbered pictures in the first experimental period (with the omission of the first drawing exposed) for the 43 subjects who had not received preliminary verbal preparation. The correlation found was .64, which, when corrected for halving of the data, becomes $.78 \pm .045$. This correlation is not appreciably different from the reliability coefficient reported by R. F. Street for the 13 figures which he employed, but it is a figure which may much more reasonably be termed a reliability coefficient than his calculation could be. For, in calculating the reliability of this material, Street's procedure was to correlate the scores made on a first exposure of his material with scores made on a retest with the same material after about a month's time. In view of the extremely firm retention of such learning material, it may easily be seen that Street's two testings must have lacked almost completely the independence which is one of the indispensable conditions for calculating reliability coefficients. His

correlation probably would have been higher than mine if it had not been for the fact that his test was only 13 items long, and that, moreover, certain of his figures were so easy and others so difficult that for all practical purposes his test was even shorter than this.

Theoretical comments on this experiment. These findings suggest a number of principles. In the first place, this experiment seems definitely to establish that sensory organizations may be developed by experience. Second, such sensory organizations, even though achieved only with considerable difficulty in the first instance, are retained with extremely great efficiency and can function even under conditions of very brief stimulation. Third, such sensory organizations are not secured simply as a result of previous training and of present sensory stimulation. The securing of such sensory organizations may be facilitated by ideational processes, or association chains set up by verbal stimuli. This particular fact is one which seems to me to be of considerable theoretical interest, for it seems to prove that the pattern of dynamic stresses which, let us assume, operates spontaneously to hold in place the nonsensical sensory organization which these incomplete figures first tend to assume is subject to weakening and modification by complex thought processes. I am inclined to believe that the process involved may best be thought of in some such way as this, that the task of seeing the correct figures in these incomplete figures is a process of conflict and interaction in the nervous system between the spontaneous organizing factors and the redintegrative patterns, with their own tendencies of stress and closure, which have been derived from the past experience of the person. These habit-derived organizations can win out over the spontaneous organizing influences by various means, as: (a) perhaps the same causal process operates here which Köhler has suggested (7, pp. 185-186) as a possible explanation of the phenomenon of reversible illusions—after one organization has dominated the central processes for a while, its relative strength becomes lessened through some process of fatigue, which makes it possible for some other organization to take the field, even though it was less favored originally; (b) either because of some instructions that have been given or because the subject notices some detail which suggests this or that total figure, the subject redintegrates some sensory organizations derived from his past experience, which redintegrated patterns then tend, though not necessarily immediately, to cause an assimilation of

the present sensory fragments into a new total organization I believe that this latter operation possibly may be envisaged as a process of perceptual overlap, or perceptual superposition, *very probably analogous to the process in a binocular-rivalry situation*. It looks as though it may be that in redintegration there is aroused in the brain a pattern of nervous activity which is similar in distribution and in properties of dynamic organization (except intensity or steadiness) to the pattern of central nervous activity set up directly by sensory stimulation.

THE EXPERIMENT WITH AMBIGUOUS FIGURES

The second experiment employed somewhat different experimental materials, but otherwise was similar in many respects to the experiment described above. The subjects, who were all university students, but not the students involved in the incomplete-figure experiment, were tested in groups of from 10 to 32 students at a time. As above, the stimuli used were visual figures presented by means of the projection lantern. However, in this case, the stimuli were not incomplete and meaningless at first sight, but were ambiguous figures which almost universally yielded a clear-cut and meaningful sensory organization at the very first glance. One of the ambiguous figures used is a somewhat rough copy of the figure "My wife and my mother-in-law," which Boring reproduced (1) from its original appearance in Puck in 1915. The other ambiguous figure, which is not so satisfactory, since the two alternative organizations which are possible for it are not so mutually incompatible, was drawn by myself. For a really satisfactory experiment, it would have been desirable to have had a score or more of such ambiguous figures but these were all that I could secure at the time.

Experimental materials and procedure. Three different experimental procedures were used with the different groups of subjects in this experiment. With the first group of subjects, the visual stimuli were presented without any preliminary preparation of the subjects, except that they were told they were to be shown a pen and ink drawing which they were to examine carefully for a 15-second exposure, and which they would be asked to describe in writing at the completion of the exposure. With the second group, the subjects were given a verbal preparation which might have been expected to favor one

or the other of the possible organizations of the ambiguous figures which were to be seen. With the third group, the procedure differed from the first condition described in that the groups were given special perceptual preparation rather than special verbal preparation, as under the second condition.

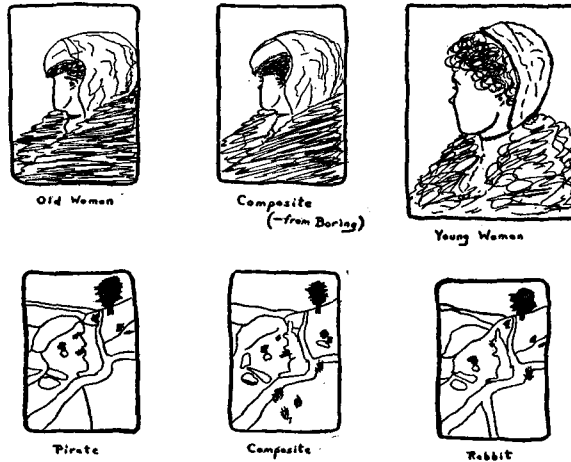


FIGURE 6

THE FIGURES USED IN THE SECOND EXPERIMENT

The two ambiguous figures occupy the center positions; the drawings on the sides are the "single-phase drawings" used with the perceptually prepared subjects.

(From E. G. Boring's "A New Ambiguous Figure," *Amer. J. Psychol.*, 1930, 42, p. 444, by permission of the author and the editor.)

The more exact description of the procedure must be described separately for the different experimental groups. With the subjects given no special preparation for the viewing of the ambiguous figures, the subjects were simply told, as was mentioned above, that they were to examine the drawing exposed on the screen, and at the conclusion of the exposure to write down as complete a description as possible of what they had seen. The young woman-old woman composite was then shown for 15 seconds, and following that the subjects were allowed a period of about two minutes to record their descriptions

of what they had seen. When this writing was finished, the same picture was again given a 15-second exposure, and the subjects were then asked to record any further facts which they had not noticed and recorded in the first case. Finally, still a third 15-second exposure was given, and a third period was given for adding to the previous descriptions. Following these three exposures of the first ambiguous figure, the same routine was followed with the other composite picture, the rabbit-pirate composite. When the three exposures and three recording periods had been completed with this composite, the subjects were asked to speak up and tell what they had seen in the last picture shown. With most of the groups, both of the possible organizations would be mentioned by members of the group. Where all subjects had seen only one organization, however, the experimenter told them what other object might be seen in the picture. Such comments naturally aroused the curiosity of the subjects who had not succeeded in getting both of the possible organizations. (I might mention, incidentally, that in both of these experiments there was no difficulty in getting strong motivation for the work—possibly partly because of the materials and partly because of the rivalry inherent in a group situation). The subjects were then told that the last composite exposed would be exposed again for a two-minute period, that they were to try to see the other possible organization during that time, and that they were to keep a record of the point in time at which they secured the other organization. The timing was done, as in the experiment described above, by my calling out the time in second intervals for the first five seconds, and in 5-second intervals for the remainder of the exposure. At the end of this long exposure, some further assistance was given before the second long exposure. This further assistance consisted of showing for 15 seconds the single-phase drawing stressing the organization which the subjects were having difficulty in seeing. (With some groups, both single-phase drawings had to be shown). Then the composite was shown for another two-minute period. In some cases some subjects were not able to reorganize the composite even with this help. In such cases the single-phase drawing was shown for another 15 seconds, and the composite shown for a sixth and last time. After this series of later trials with the rabbit-pirate composite, the same course was followed with the young woman-old woman composite.

The procedure used with the perceptually prepared groups was exactly similar to the above, except that before the *first* exposure of each composite, the subjects were shown one or the other of the single-phase drawings derived from that same composite. A 30-second exposure period was allowed for this. After this exposure the subjects recorded their descriptions of this picture. No intimations were given that the picture first shown was related to the picture which they were told would be exposed next, and which they were told they would be expected to describe. The subjects working under this condition of preliminary perceptual preparation were divided in two sections. One section viewed the single-phase drawings portraying the old woman and the rabbit respectively; the other section was shown the single-phase drawings portraying the young woman and the pirate respectively.

The procedure used with the verbally prepared groups was exactly similar to the first procedure described above, except that before each composite was shown, the subjects were given a description calling attention to the characteristics of one of the possible pictures of the composite. These verbal descriptions were read aloud twice immediately before the composite was shown. One section of this verbally prepared group listened to the following description of the first composite:

You will be shown a pen and ink drawing of a young woman's head. The head is not only turned to the side, but, in fact, is turned so far around that the young woman's cheek hides her mouth, eyes and most of her nose, so that one can see only the small tip of her nose and her eye-lashes. Her left cheek and ear are clearly visible, as is also the curve of her chin. Her mouth and eyes, however, cannot be seen. A heavy fur collar is around her shoulders, and on her head is a hat with a veil flowing from it back over the back part of her head.

Before the rabbit-pirate composite was shown, this same section listened to the reading of the following description:

The central feature of the second drawing is a man's head. The man has somewhat the appearance of a pirate, with an ear-ring in his ear, a heavy mustache, rather rough face, and a cap or beret on his head. The head is turned to the side, so that one sees the profile of the man's face. Across the man's chest there seems to run a crooked branch of a tree; or it may possibly appear that the head has merely been added to a draw-

ing which, but for the head, would have been the drawing merely of some hills with a path wandering down one of them, with a tree in the distance, etc.

The other section of the verbally prepared subjects listened to descriptions favoring the other possible organization of each composite. For the first composite the description was:

You will be shown a pen and ink drawing of an old woman's head. The head is turned to the side, so that you will see the face in profile. The woman has a large Roman nose, rather shrunken lips, and a rather protruding chin almost hidden in the heavy fur collar of her coat. Her left eye is clearly visible, but her ear, most of her head, and even part of her cheek are covered by a scarf thrown over her head.

For the second composite the description was:

Now you will be shown a second drawing. The central feature of this drawing is a rabbit sitting up on its hind legs by the side of a path which wanders up the hill behind the rabbit. The picture contains other minor details, such as a tree in the background, several hills in the distance, a few rocks scattered about close to the rabbit, and a few clumps of grass near the path. The rabbit, which is seen from the side, looks as though it were perhaps holding some object in its fore paws.

Results. As an examination of the procedure will have indicated, the experiment was calculated to yield results on two questions: (1) what are the influences of prior perceptual and of prior verbal preparation on the seeing of such ambiguous figures? (2) how easy or how difficult is it for subjects to alter their organization of such a figure, once they have been led to see it in one way or the other?

Figure 7 indicates the results of this experiment insofar as they bear on the question of the factors governing the organization which tends to be secured first. From the groups given no special preliminary preparation, which may be regarded as control groups, it may be seen that the two possible organizations of each composite did not seem to be equally easy to secure. Thus, with the old woman-young woman composite, 65% of the subjects saw the young woman and only 35% the old woman. With the rabbit-pirate composite, 73% saw the pirate only, 12% saw the rabbit only, and 12% saw both of the possible organizations. In other words, these ambiguous figures were not evenly balanced—in each picture one of the possible organizations tended to prevail over the other. But now, when we

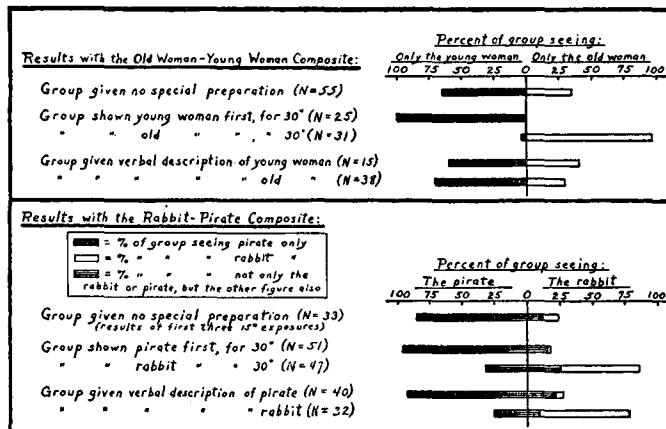


FIGURE 7

RESULTS OF THE FIRST 15-SECOND EXPOSURES OF THE AMBIGUOUS FIGURES TO GROUPS GIVEN DIFFERENT SORTS OF PRELIMINARY PREPARATION

The number of subjects in each group is indicated on the graph. Attention is called to the fact that the portions of the groups represented by the striated segments of the bars are represented twice, appearing on both sides of the 0% line.

turn to the results with the groups given a preliminary perceptual preparation, we find that the prior experience of the single-phase drawings controlled almost entirely the subsequent organization of the composites. Thus, of the group which viewed the single-phase drawing favoring the young woman, not one subject saw the old woman in the composite, even though there are quite a few differences between the single-phase drawing of the young woman and the picture of the young woman in the composite. And of the subjects shown the single-phase drawing of the old woman, only one subject in 31 saw the young woman rather than the old woman in the composite. Somewhat similar are the results with the rabbit-pirate composite, although the influence of prior perceptual preparation is not quite so clear-cut with this figure. After the single-phase pirate had been shown, about 96% saw the pirate in the composite (though in this case they did not see *only* the pirate in all cases, as 16% of the total group were able to see the rabbit as well, in the composite).

Only 2% saw only the rabbit. When the single-phase drawing of the rabbit had been shown beforehand, 26% of the group saw both figures in the composite, 60% saw the rabbit alone, and 6% saw the pirate alone.

In the case of the groups given preliminary verbal preparation, however, the results were not the same for the two composites. As Figure 7 shows, the preliminary verbal preparation determined the subsequent sensory organization of the rabbit-pirate composite *almost* as effectively as the preliminary perceptual training had done with the other groups. But in the case of the young woman-old woman composite, there is no indication at all that the verbal preparation influenced the sensory organization secured when the composite was shown. With the group that had listened to the description of the young woman, the percentages seeing the old woman and the young woman respectively were almost the same as in the case of the control group given no preliminary preparation. Of the subjects who had listened to the description of the *old* woman, a somewhat larger percentage saw the *young* woman, and a somewhat smaller percentage saw the old woman than was the case either with the control group or with the group that had heard the description of the young woman. It is somewhat of a puzzle as to why this difference appeared in the effects of verbal preparation for the two composites, and in the absence of any experimental evidence it is not possible to say with certainty what factor may be the more important. One factor which very possibly had some rôle was that the rabbit-pirate drawing was not of such a nature that either the rabbit or the pirate would necessarily appear as soon as the picture was seen. Frequently the subjects had to examine this drawing for some seconds before they could discern either of these figures in the composite (and some subjects, especially in the unprepared group, did not see either figure in the full 15 seconds of the first exposure of the composite). This fact gave more time for the verbally aroused redintegrations to exert an influence; so that here we probably have a situation somewhat like that existing with the incomplete figures of the first experiment, in which it was found, it will be remembered, that telling the subjects the general class of object represented helped them to achieve the correct sensory organizations. With the young woman-old woman composite, on the other hand, with almost every subject this figure tended to yield one or the other of the possible organizations

in the first instant that the subject viewed the composite. Whatever the factors were that determined such an instantaneous sensory organization, they do not seem to have been processes aroused by the verbal preparations given beforehand. Still another reason why the verbal preparation may have been effective with the rabbit-pirate composite and not with the young woman-old woman composite is very probably this, that the descriptions given of the rabbit and of the pirate aroused redintegrated patterns of quite different nature; whereas in the case of the descriptions of the young woman and old woman respectively the verbally aroused images, as one might say, may not have been well differentiated.

A second aspect of the results with these composite figures concerns the question of whether the achieving of one sensory organization or the other resulted in a habit which would tend to dominate the later organization of the composites. The material discussed above, on the question of the influence of different kinds of preparation, may be considered to have contributed some positive evidence on this question, since the carry-over from the single-phase drawings to the composites was so marked. However, there is some additional material on this question from the series of exposures of each of the composites. For, we can assume that, aside from the influence of learning or of set, one would have expected that as the subjects continued to gaze at these composites they would tend to see the other of the possible organizations. However, this proved very difficult for the subjects. With the young woman-old woman composite not a single subject secured a different sensory organization of the composite in the first three 15-second exposures of it. And in the case of the rabbit-pirate composite this same tendency was revealed, though not in the same extreme degree. Thus, of those who had had no preliminary preparation, 12% were able to see both figures in the course of the first three exposures of the composite. Of the groups given a preliminary perceptual preparation, 49% of those who had seen the single-phase drawing of the rabbit came to see the pirate also in the course of the three 15-second exposures, and 37% of those who had seen the single-phase drawing of the pirate came to see the rabbit also. In the case of the groups given preliminary verbal preparation, 50% of those who had been told about the rabbit came to see both the rabbit and the pirate, and 33% of those told about the pirate came also to see the rabbit.

The same difficulty in changing the sensory organization was seen very clearly in the longer exposures that followed. As was stated above, before the first of these longer exposures the subjects were told what the two possible organizations of the figure were. Before the second of these longer exposures, and before the third also, the single-phase drawings were exposed for 15 seconds each. Even with these aids, however, the subjects only gradually accomplished the task of seeing the other possible figure in the composites, especially with the young woman-old woman composite. Even after they had been told that there was a young woman to be seen, with her head turned partly away, 80% of those who had previously seen the old woman could not see anything else in the first of the two-minute exposures. The single-phase drawing of the young woman was then shown them, but even after viewing it, 29% of these subjects still did not succeed in seeing the young woman in the next two-minute exposure. In the case of the subjects who had seen the young woman at first, somewhat the same difficulties were experienced, but not to an equal degree. A rather odd thing in this connection is that frequently, although the subjects reported details of the pictures which were inconsistent with the organization they had secured, they did not see the other possible organization. Thus, some subjects reported that on the old woman's nose was a wart (the nose of the young woman, in other words), but they did not see the young woman. Others said that the neck of the young woman looked peculiar, that there was a marked swelling on it (the chin of the old woman) and had a gash in it (the old woman's mouth), and yet they did not see the old woman.

However, this above material does not answer in an altogether satisfactory manner our question as to whether learning occurs with such material as this, for the nature of the situation was such that it may well be claimed that the results indicate the operation of set rather than of habit. Of course, this objection itself is not a perfectly clear one, because the phenomena of set and of habit are certainly not devoid of relationship. I believe it is quite safe to say that "set" is, in part at least, a matter of learning. However, it may be that set is something more than habit, and there may be certain functions which can be performed by set which cannot be performed by habit. This source of uncertainty in the interpretation of the above results led to the testing of another group of subjects with a

procedure rather different from that described above. The subjects of this last group were tested individually in my office. Moreover, the composite picture was exposed to them, not on the screen by means of the projection lantern, but merely as drawings on sheets of paper. Some effort was made to find whether different means of preparation or of exposure of the composite would determine the organization of each composite. Some of the subjects were prepared by reading to them the verbal descriptions of one of the possible organizations or the other. With still other subjects no preliminary preparation was given, but the picture was exposed in a manner which I thought might favor the one or the other organization. For this purpose, two pieces of paper had been cut in such a manner that they might be placed with a small opening appearing between them and so that, as the slips were drawn apart, the drawing behind would be seen through a diamond-shaped opening of increasing size. With some subjects the small opening (about $\frac{1}{4}$ inch across) was placed so that the subjects could see, through it, a portion of the composite which belonged to only one of the two organizations. Thus, certain subjects had shown to them in this manner the nose of the young woman, or the eye of the pirate, or the mouth of the old woman, or some similar part. After a fixation had been assumed, with some of the subjects the two sheets were snatched to the sides as swiftly as possible, while the subject meanwhile continued to gaze at the picture, and described what he saw. With other subjects the two sheets of the screen were drawn apart rather slowly, so that the entire drawing was uncovered in about two to three seconds. By means of these tests I hoped to get some insight into the question of what factors dictated what organization was secured by the subjects who had no special preliminary preparation. One hypothesis that naturally had suggested itself was that some subjects tended to see one organization and other subjects tended to see the other one because they had points of fixation which led them first to notice details which would be consistent only with one total organization or the other. However, the results of this special test were quite inconclusive. The slow withdrawals of the paper yielded exactly the same percentage who saw the organization which I had not intended to favor as who saw the one I sought to bring out. With the quick jerking away, there may have been some tendency to see the picture which included as a consistent part the detail which

had been fixated; but the group was too small to have any significance.

However, my main interest in this group of individually tested subjects does not concern this question of the factors influencing the original impression, but concerns rather the contribution of this group to the problem of the rôle of habit in determining the organization of such figures. The manner in which this group was used to get light on this question was this: at a time 12 to 14 days after the subjects had seen these drawings, the young woman-old woman composite was shown to them suddenly, and in an altogether different setting, and they were asked immediately to indicate what they had seen in the composite. This delayed test was given in the midst of an ordinary class discussion. The projection lantern was being used to display some pictures of special types of mental defectives. In the midst of this discussion, without warning, the young woman-old woman composite was flashed on the screen. The exposure of this picture was brief—about a second or less in time—and the subjects were asked then to take paper and write a description of what they had seen. It is interesting that in only one case out of a total of 19 subjects did the sensory organization appear in a different form than had been achieved previously, and then only momentarily before the same organization appeared as had been seen before. Certainly in this test the influence of set can be ruled out as a determinant, since the time that had elapsed was so long and since the physical and psychological setting of the exposure was so changed from that used in the first experience of the figure.

Interpretative comments. Most of what has been said previously, in commenting on the results of the first experiment, seems to apply to the second experiment as well. This second experiment, like the first, shows that when a sensory organization once has been achieved, whatever the factors that have produced it, there seems to be some sort of cohesive force, as one might say, that tends to prevent the person from securing any different sensory organization. This cohesive force seems to be not merely a matter of set, but a matter also of rather permanent habits. Verbal preparation, in the sense of descriptions of possible organizations of the material, seems to be of some value in helping the subjects to organize or reorganize their perceptions, but such verbal preparations seem to be a rather frail governing factor in comparison with the way some other influences,

whatever they may be, tend to dictate the organization when the stimuli first are presented. These main governing factors would hardly appear to be constitutional factors or any habits necessarily of long standing in the person's life, because the preliminary perceptual preparation seems able to dominate very readily. But, whatever the influences are, once an organization is achieved, it tends to stick. The verbally aroused redintegrations are able, in perhaps most cases, to aid in the reorganization of the sensory material, but their work is against odds. The effectiveness of the prior perceptual preparation gives powerful evidence against the theory that thinking is carried mainly in verbal terms, for after viewing the single-phase drawings, the subjects probably could not have given as complete an account as the verbally prepared subjects could have given from the descriptions read them. The descriptions that they wrote down of the single-phase drawings were generally not descriptions (at least in the case of the young woman-old woman composite) which would have differentiated very adequately between the two possible organizations of the composite.

SUMMARY

This paper reports two experiments on the development of sensory organizations by training. It indicates that the achieving of sensory organizations is facilitated by verbally aroused redintegrations to some extent, and by preliminary perceptual preparation to an even greater extent. The results indicate that, once one of the possible organizations of visual material has been achieved, this fact seems to operate immediately to render difficult the achievement of any other of the possible sensory organizations which such material might yield. Moreover, once a sensory organization has been achieved, it seems to be retained very efficiently over considerable periods of time, thus justifying the term "habits of sensory organization."

In studying these problems, two different types of visual stimuli were used. The first experiment utilized incomplete figures which tended to yield rather stable nonsensical patterns at first, but which could be seen as well unified pictures if a person, on the basis of his knowledge of the object represented, "filled in" properly the spaces between the portions of the objects that were directly portrayed. The material used in the second experiment consisted of two ambiguous

figures each of which was capable of yielding two different, but incompatible, meaningful pictures.

In the discussion of the theoretical significance of the findings, attention is called to the fact that such learning as is considered here has been rather generally neglected, both in theoretical discussions of learning and in studies of the factors influencing the rate of learning, the rate of forgetting, etc. The different theories of learning, despite their differences of terminology and emphasis, really appeal to somewhat similar specimens of learning to justify their claims. The psychological group which has dealt most with the sort of learning here exemplified is the Gestalt group, but unfortunately their discussions of learning have given almost no place to such learning because of their strong tendency to emphasize the origins of sensory organization in the spontaneous organizing properties of nervous action. Other psychological schools have generally maintained very dogmatically that sensory organization, insofar as it is a fact, is a product of past training. Their development of this idea, however, has been restricted almost entirely to discussions of perception, and has generally been forgotten when the discussion turned from that topic to the topic of learning.

This investigation is offered mainly as an exploration of a portion of the field of learning which may prove of value as a means of testing the problem as to whether the field of learning is functionally homogeneous throughout its length and breadth, or whether we should be turning our attention to the problem of classifying the materials of learning on the basis of a to-be-discovered hierarchy of functional similarities.

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UNE ÉTUDE D'UNE PORTION NÉGLIGÉE DU CHAMP DE
L'APPRENTISSAGE—LE DÉVELOPPEMENT DE L'ORGANI-
SATION SENSORIELLE

(Résumé)

On rapporte deux expériences sur le développement des habitudes de l'organisation sensorielle. La première expérience a employé les dessins fragmentaires montrés dans Figure 1 et Figure 2. Cette expérience a montré qu'il est plus facile d'obtenir l'organisation sensorielle qu'il faut de tels dessins quand on sait bien la classe générale des objets à laquelle appartient chacun des objets représentés, et que, quand on apprend à voir des figures si incomplètes, on obtient des habitudes qui sont retenues d'une façon très efficace. La deuxième expérience a employé plusieurs figures ambiguës. Elle a montré que la préparation perceptive antérieure est beaucoup plus efficace pour la détermination de comment on voit ces figures que la préparation verbale antérieure, et aussi qu'avec telles figures l'achèvement d'une organisation sensorielle ou d'une autre donne comme résultat la formation définie des habitudes.

Les sections théoriques de l'article appuient sur la nécessité d'essayer de savoir comment on classe les matières du champ de l'apprentissage sur la base de la similarité des principes gouvernants, et condamnent l'essai de découvrir des principes très spécifiques qui seront de valeur dans tout le champ de l'apprentissage.

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EINE UNTERSUCHUNG EINES VERNACHLÄSSIGTEN TEILS DES
GEBIETES DES LERNENS. DIE ENTWICKLUNG DER
SINNESORGANISATION

(Referat)

Zwei Versuche über die Entwicklung der Gewohnheiten der Sinnesorganisation werden angegeben. Bei dem ersten Versuch wurden fragmentarische Zeichnungen, wie in Figur 1 und Figur 2, dargeboten. Dieser Versuch bewies, dass die Erlangung der richtigen Sinnesorganisation solcher Bilder durch die Kenntnis der allgemeinen Klasse der Objekte, der jedes der dargebotenen Bilder angehört, erleichtert wird, und dass das Sehenlernen der unvollkommenen Figuren Gewohnheiten erzeugt, die sehr gründlich behalten werden. Der zweite Versuch verwandte mehrere zweideutige Figuren. Es wurde dadurch nachgewiesen, dass vorangehende Wahrnehmungsvorbereitung viel wirksamer zur Bestimmung ist, wie solche Bilder gesehen werden als vorangehende Verbalvorbereitung, und auch dass bei solchen Figuren die Erlangung einer Sinnesorganisation oder einer anderen eine bestimmte Gewohnheitserzeugung zur Folge hat.

Die theoretischen Teile dieser Abhandlung betonen die Notwendigkeit des Versuches, die Materialien aus dem Gebiet des Lernens auf Grund der Ähnlichkeit der herrschenden Grundsätze einzuteilen, und dass man den Versuch verwerfen sollte, irgend bestimmte Grundsätze zu finden, die für das ganze Gebiet des Lernens gültig sind.

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