THE NEGATIVE EFFECT OF PREVIOUS EXPERIENCE
ON PRODUCTIVE THINKING

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The part which is played by past experience in human problem-solving behavior has long been a subject for experiment and discussion. Investigations viewing the evidence from different theoretical vantage points have arrived at diverse conclusions, which in some instances identify problem solving with trial-and-error learning (3), in other cases (1, 8) consider past experience in general as providing the raw materials out of which a problem-solving response may be fabricated, and on occasion some investigators have even neglected to consider the question of past experience as essential for a problem-solving theory (9). One of the reasons for the diversity of roles which have been accorded to past experience is that problem solving is by no means a unitary process. Although in all problem solving a solution is arrived at, the processes of behavior whereby the solution is achieved are of several different kinds. Maier (8) has served to clarify this issue by sharpening the often labored distinction between reproductive and productive thinking. His discussion was developed in terms of the part which past experience may play in each type of performance. Reproductive thinking, Maier believes, is characterized by the solution of problems by means of the existence of stimulus equivalences in the novel (or problem) situation and in the previously mastered situation. Thus, for him, reproductive thinking and transfer of training are to be considered closely similar if not identical phenomena. Productive thinking, however, is not merely the process of arriving at a solution through the direct application of previous learning. In productive thinking past experience is repatterned and restructured to meet current demands, and is thus the counterpart of reasoning as Maier has defined that term (6). In the present study we are concerned with the relation of past experience to the productive thinking process, and not with reproductive thinking.

Probably the studies which have contributed most directly to an understanding of the manner in which the background of past experiences influences the nature of human productive thinking are those of Maier (6, 7) and Duncker (2). Maier, in his examination of the relation between stimulus equivalence and reasoning (8), identified several ways in which past experience may affect problem-solving activities. Problem solving may be facilitated by equivalences which exist in the immediate problem situation and in past experience. Further, as he has shown elsewhere (6), and as Birch (1) has shown for the chimpanzee, the background of past learning represents an essential repertoire of behavior which must be available for restructuring when new situational demands develop. On the other hand, productive thinking is impossible if the individual is chained to the past. The past experience may become a hindrance and an obstacle which blocks productive thinking and reduces behavior to stereotyped and fruitless essays.

It is primarily with this negative effect which may be exercised by past experience that Duncker has dealt in
his problem-solving experiments (2). In a series of situations designed to study what he terms "functional-fixedness," Duncker tried to determine the manner in which the previous utilization of an object for a dissimilar function in the same problem context affected its availability in subsequent problem solving, and found that such specific experience made the objects previously utilized in this manner significantly less available as instruments when the problem presented for solution was changed. Two weaknesses in experimental design limit the generality of the inferences which may be drawn from Duncker's results. In the first place, by using the same objective situation for both his "pre-utilization" experience and for his new problem-solving task, he makes it impossible to determine whether the difficulty in using a previously utilized object for the solution of a new problem derives from the limitation of the functional properties of this object by the prior experience, from the establishment of false problem-solving directions, from the development of attitudes of completion ("over and done with") on the part of the S which effectively remove the already-used object from the field of activity, or from any of a variety of other effects. Secondly, in selecting the different tools which would be available to the Ss in their problem-solving activities, Duncker made no attempt to equate the instruments for different degrees of objective adequacy as tools in solving the problem. Obviously, if the objects in the "pre-utilization" group are objectively less adequate as tools then are the non-pre-utilized materials, the scales are weighted in favor of fewer solutions for the "pre-utilization" group. In not a few instances Duncker's problem situations may be criticized on these grounds, and the question arises as to whether his results derive as much from the pre-experimental object selection as from the effects of pre-utilization of the materials by the subjects.

To remove these impediments to interpretation of this aspect of the effects of previous experience on problem solving, it is necessary to study the problem under conditions in which the background of prior specific experience is obtained by the Ss in a situation remote from the crucial problem-solving task, and to contrast as problem-solving tools objects whose adequacy as instruments is objectively equal. The design of the present study stems from these considerations.

**Subjects and Procedure**

Twenty-five students at the City College, New York, were used as Ss in this experiment. These Ss were divided into three groups, a control group and two experimental groups. The control group had 6 Ss, and the experimental groups contained 10 and 9 Ss, respectively.

As the crucial problem-solving task in this experiment, all Ss were required to solve the two-cord problem used extensively by Maier (7) in his studies of "direction" in problem solving. In this problem the S is required to tie together the free ends of two cords which are suspended from the ceiling to the floor of a corridor. The distance between the two cords is such that the S cannot reach one cord if the other is held. In our arrangement the problem could be solved only if the S would tie a weight to the end of one of the strings and thus convert it into a pendulum which could be set swinging and then be caught on its upswing while the stationary cord was held. The two cords could then be tied together and the problem solved. In our situation only two objects could be utilized as weights. The first of these objects was an electrical switch and the second, an electrical relay. The conditions of pretest training involved the acquisition of differential prior experience with these objects by our Ss. The pretest training was conducted as follows:

Group S contained 9 Ss who were given the pretest task of completing an electrical circuit on a "bread-board" by using a switch, which had
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to be installed if the circuit were to be completed and controllable.

- Group R consisted of 10 Ss who received pre-test training in the completion of an identical circuit by the use of a relay, which is essentially a switch.

Group C, the control group, consisted of 6 engineering students with a wide variety of electrical experience. These Ss were given no pretraining. The Ss in groups R and S had had little or no experience with electrical wiring.

Shortly after having completed the pretesting tasks, the Ss were presented with the two-cord problem and asked to solve it by using the objects lying before them on a table. Only two objects were present, a switch and a relay, each identical with the ones used in the pretraining period.

Since the two-cord problem is very difficult to solve without the presentation of “direction”-producing hints, such hints were presented by E 9 min. after the presentation of the problem. The hints consisted in brushing against the string or strings and “accidentally” setting them swinging. Solutions were always achieved within 3 min. after the presentation of hints. All Ss were individually tested. Upon completing the two-cord problem, the Ss were asked why they had chosen either the switch or the relay as the pendulum weight.

RESULTS

The results reported will deal primarily with the nature of the choice of objects made by the Ss in the critical task situation. These data for all groups are shown in Table I. The control group chose equally between the switch and the relay as pendulum weights which might be utilized for the solution of the two-cord problem. These data indicate that for individuals with prior experience which is not heavily weighted in favor of either the switch or the relay, no significant difference exists between the objects in terms of their utility as tools in solving the two-cord problem.

The behavior of the Ss who had received specific pre-utilization experience with either the switch or the relay differed in a striking manner from the behavior of the Ss who had not received such experience. Those who had initially been trained to complete an electrical circuit with a relay never utilized this object as the pendulum weight for the solution of the two-cord problem. In every instance the Ss chose the switch, an object not previously manipulated, as the object which was to be converted into a pendulum bob in the solution of the two-cord problem. On the other hand, the Ss who had initially been trained to use a switch for the completion of an electrical circuit preponderantly chose the relay as the pendulum weight in solving the two-cord problem.

If the results on solving the two-cord problem for both the switch and relay pre-utilization groups are combined, it is found that 17 of the 19 Ss used that object with which they had had no pre-experimental training as the problem-solving tool. There are less than five chances in one hundred that such results could have occurred as the result of chance fluctuations in responding on the part of the Ss. It may, therefore, be inferred that the nature of the previous specific experiences of the Ss were influential in determining their problem-solving choices.

The replies which the Ss made to the question, “Why did you use the switch (or relay) as the pendulum weight?” further indicate that the pre-utilization experiences exercised a decisive effect upon their problem-solving efforts. Those Ss who used

| TABLE I |
| FREQUENCY OF CHOICE OF OBJECTS IN PROBLEM SOLUTION |

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>No. Using Relay</th>
<th>No. Using Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (C)</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Exper. (R)</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Exper. (S)</td>
<td>9</td>
<td>7</td>
<td>2</td>
</tr>
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the switch as the pendulum weight in the two-cord problem offered varying reasons for its superiority over the relay as a pendulum bob. They claimed that it was easier to attach, more compact, etc. The Ss who tended to use the relay as the pendulum bob in solving the two-cord problem proffered equally "good" reasons for their selection. The relay, they claimed, was easier to attach, heavier, etc. In both groups of Ss individuals became somewhat defensive when queried as to the reasons for their choices, and typically replied by prefacing their answers with the remark, "Anyone can see that this one is better as a pendulum weight." A number of Ss even went so far as to say, "any fool can see that this one is better." Since these remarks are directed with equal vehemence at either the switch or at the relay, it is clear that the Ss were not advancing objective reasons for their choices, but were, rather, revealing the effects which their prior specific experience was having on their perceptions.

**Discussion**

Although the present study was designed primarily to explore a neglected aspect of problem-solving behavior, it has some significance for problem-solving theory and provides clarifications for several important questions. In the first place, the results reveal that the question of the role played by past experience in productive thinking cannot receive a uniform answer until the nature of the past experience is clearly understood. Even though this study indicates that prior experience of a specific kind with a potential problem-solving tool effectively prevents this instrument from being used in problem solution, there is little doubt on the basis of other studies (1, 4) that a different kind of experience may enhance the value of an object as a tool in problem solving. Therefore, what appears to be important for problem solving is not that an individual's performance is dependent upon past experience per se, but rather that different kinds of experience are differentially effective in influencing the content of problem-solving behavior. Our results therefore are in accord with those of Katona (5), who found that how and what an individual learned and not simply whether he learned determined the amount of positive transfer effect that occurred in subsequent learning.

Perhaps the most interesting phase of our results concerns the manner in which the individual's previous experience influenced his perceptions. The pre-utilization experience apparently changed the perceived properties of the object previously used in a different context to such a degree that its problem-solving characteristic could not be readily seen. This change in perception was probably based on the manner in which the previous experience had emphasized the instrument as an electrical object and so made for extreme difficulty in perceiving it in terms of its general characteristic of mass, which is essential for pendulum construction. The kind of previous experience presented therefore functioned to limit the number of the properties of the object that could be perceived by the S.

These results suggest that there are two phenomenally describable kinds of learning that may be important in problem solving. The first variety of learning involves the acquisition by S of certain broad, non-specific, general notions about the properties of the object or method experienced. This was undoubtedly the case in Birch's study of chimpanzee problem...
solving (1), where young chimpanzees who were initially incapable of using a stick to take distant food into reach manifested this ability after a very short period of play with sticks. It is this general, broad, nonspecific experience which seems to provide the repertoire of experience essential for productive thinking.

A second type of learning involves the acquisition of experiences which convert the initial perception of broad general properties of an object into perceptions of specific limited functional characteristics. It is this second variety of learning which appears to have occurred in the pre-utilization experiences of the Ss in our study and to have produced what Duncker (2) refers to as “functional fixedness” in problem-solving perceptions. Such fixedness limits the range of perceptual organizations capable of being developed by the S and so interferes with problem solving.

SUMMARY

The present study was designed to investigate the effects of specific experience with objects in unrelated situations upon their utilizability as problem-solving instruments. The results revealed that specific prior experience limited the perception of object properties and made the experienced materials less available as problem-solving tools. These results are discussed in connection with Duncker's hypothesis of "functional fixedness," and as contributions to the general areas of transfer and of productive thinking.

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REFERENCES