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PROBLEM SOLVING: RESPONSE COMPETITION AND THE INFLUENCE OF DRIVE[1]

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Summary.—A functional fixedness problem was constructed which consisted of two sub-tasks. The initial sub-task, termed problem perception, was designed to involve minimal response competition. The second, a functional fixedness sub-task, involved both high and low response competition. Drive level did not influence problem perception time. High drive impaired problem-solving performance by increasing functional fixedness strength when response competition was high. When response competition was low, drive did not influence functional fixedness strength. The obtained interactive effect of drive level with problem difficulty, predicted by Spence's drive theory, was attributed to the interactive effects of drive upon functional fixedness strength.

Glucksberg (1962) applied Spence's drive theory (1956) to a functional fixedness problem. Using Duncker's candle problem (Duncker, 1945), a predicted interaction between drive level and problem complexity was obtained. High drive impaired performance when the response designated as correct was low in the response hierarchy, but tended to facilitate performance when the correct response was high in the response hierarchy.

The measure of functional fixedness strength used in the earlier study was total time to solve the problem. Total time to solve, however, represents more than just functional fixedness strength. In the candle problem, *S* must use a small pasteboard box in order to solve the problem of mounting a candle on a vertical surface. The time score employed included the time from the beginning of the problem until *S* became aware of the nature of the problem, *viz.*, that something was needed to support the candle. This particular portion of solution time can be described as problem perception time. A measure of the strength of functional fixedness is the time from problem perception until the functionally fixed object is used. This portion of total solution time can then be described as functional fixedness time, representing the strength of functional fixedness. These two measures, problem perception time and functional fixedness time, can, in simple problems, comprise total solution time.

Can drive level influence problem solving by influencing the strength of functional fixedness *per se*? According to Spence's drive theory, high drive impairs performance in competitional response situations when the dominant response is incorrect and facilitates performance when the dominant response is correct. If, however, the dominant correct response can be executed rapidly and easily, then the influence of drive level is negligible (Glucksberg, 1962). By

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controlling the position and nature of the correct responses in the response hierarchies in each of the two stages of functional fixedness problems, it would be possible to control and predict the influence of drive level on performance in each of the two stages posited: problem perception and functional fixedness.

This study investigated the influence of strength of drive on functional fixedness strength. A problem was devised in which problem perception does not involve response competition, and in which functional fixedness could be either high or low with respect to response competition. The effect of drive could then be tested under two conditions. When the correct response is low in the response hierarchy (high response competition, strong functional fixedness), a high drive should increase functional fixedness strength, and thus impair problem-solving performance. In contrast, a high drive should have a negligible effect when functional fixedness is weak and the correct overt response can be executed rapidly. Furthermore, the influence of drive should be confined to the functional fixedness portion of the problem only.

METHOD

Subjects.—*S*s were 42 male undergraduates enrolled in psychology courses at Princeton University. Two *S*s were excused when they professed complete ignorance of electrical wiring and refused to try to solve the problem.

Design.—The 2 × 2 factorial design involved two levels of drive and two different response hierarchies in a functional fixedness problem. A description of the problem follows. *S* is required to construct a simple circuit consisting of a pair of flashlight batteries, a DPDT switch, and a 6-v bulb so that operation of the switch turns the bulb on and off. All components are presented mounted on an 8-in. × 12-in. rectangular masonite pegboard. The batteries and bulb are pre-wired to four plastic binding posts mounted on the board, so that *S* must make connections between the binding posts and to screw terminals on the switch. Available to *S* are 4 wires of varying lengths. The wires, added together, are 1¼ in. too short to complete the desired circuit. Also available are a coil of Plasticene modelling clay, 12 in. long, and one of two screwdrivers. In Cond. Dm+ (dominant response correct) the screwdriver supplied was 9 in. long, with a bright silvery blade 6 in. long and a red plastic handle identical in hue and texture to the plastic binding posts. When this screwdriver was supplied, the wires available were not insulated and resembled the screwdriver blade in brightness, gloss, and hue. In Cond. Dm− (dominant response incorrect) the screwdriver was 3¼ in. long, with a 1½-in. blade. This screwdriver had a dark wooden handle and the metal blade was not shiny. The wires available in this condition were insulated with yellow plastic, stripped ¼ in. on each end. Both forms of the problem could be solved in only one way: by using a screwdriver blade to make up for the short wires.

Procedure.—The materials for the problem were placed in standard positions on a table and covered with a flexible sheet of opaque plastic. Posted on a wall to *S*'s left was a simplified diagram of the circuit to be constructed. *S*s were seated at the table and asked to explain the circuit diagram. When they had indicated that the diagram made sense to them they were told: "Under this cover is a board with batteries, a bulb, and a switch mounted on it. The problem is to complete the circuit so that operation of the switch controls the bulb. You may not move any of the components mounted on the board. You may use any of the materials on the table."

In addition to these instructions, high drive *Ss* were told: "As an incentive we are offering a prize of $10.00 for the fastest solution to the problem." Low drive *Ss* were told: "We are interested in finding out how long people take to solve problems of this type." *E* then said, "ready," and started two Standard Electric timers upon removal of the cover.

One measure taken was problem perception time. This was the time taken for *S* to indicate awareness of the nature of the problem (wires too short). The time at which any of the following was first observed served as this measure: any verbalization by *S* that there was not enough wire available, including requests for more wire, any attempts to use modelling clay as a conductor, or any attempt (despite instructions) to move components mounted on the board. The second measure was total time to solve. This was the time at which *S* placed the screwdriver blade into the circuit, irrespective of whether or not the wiring was correct. A score of 20 min. was assigned to *Ss* failing to use the screwdriver blade as part of the circuit. The difference beween these two time scores (net solution time) served as the measure of functional fixedness strength.

Results and Discussion

Seven *Ss* in Cond. Dm+ (two low drive and five high drive) placed the screwdriver blade into the circuit without prior indication that they were aware that the wires were too short. Each of these *S*'s total solution time was considered as the best estimate of problem perception time, yielding net solution times of zero for these seven *Ss*. The means of problem perception times are presented in Table 1. Analysis of variance applied to these scores indicated that neither main effects nor interaction of drive × conditions was significant. Neither drive level nor functional fixedness response hierarchies influenced problem perception time.

TABLE 1
Mean Problem Perception Time

Group: Nature of Dominant Response	Group: Drive Level	Problem Perception Time (min.): *M*	Problem Perception Time (min.): *SD*
Dm+	High	2.29	1.43
	Low	2.60	1.66
Dm−	High	3.96	1.43
	Low	2.70	1.00

TABLE 2
Functional Fixedness Strength: Net Solution Time Scores

Group: Nature of Dominant Response	Group: Drive Level	No Failures	Net Solution Time (min.): *M*	Net Solution Time (min.): *SD*
Dm+	High	0	1.92	3.33
	Low	0	4.39	4.55
Dm−	High	7	13.13	4.54
	Low	1	5.95	5.04

Net solution time means, together with number of failures per group, are presented in Table 2. Even though solution time scores were skewed, analysis of variance and t tests were applied to the net solution time scores (Boneau, 1960). A significant effect of Conditions ($F = 18.84$, $df = 1/36$, $p < .001$) was obtained. The Dm+ form of the problem, as expected, was easier than the DM— form. As expected, the over-all effect of drive level was not significant, while the predicted interaction of drive and nature of the dominant response was obtained ($F = 10.75$, $df = 1/36$, $p < .01$).

Differences between the means of high and low drive groups within response hierarchy conditions were evaluated by t tests. The difference was significant ($t = 3.45$, $p < .01$) in Cond. Dm—, but not in Cond. Dm+. Identical conclusions are reached using the total solution time scores. The influence of drive level on total problem solving performance parallels precisely the influence of drive on functional fixedness.

These data clearly show that drive level can influence functional fixedness strength *per se* and that the influence of drive level upon problem-solving performance was attributable solely to the effect of drive on functional fixedness strength. This is in accord with Spence's drive theory which predicted that the effect of drive would be confined to that aspect of the problem involving high response competition. In this case, this was the functional fixedness sub-task. Given a more difficult and complex problem perception sub-task, i.e., involving high response competition, drive would be expected to influence problem perception in the same way it influenced functional fixedness.

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