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ABSTRACT

This paper discusses cognitive learning in terms of reinforcement theory and presents arguments suggesting that a viable theory of cognition based on reinforcement principles is not out of the question. This position is supported by a discussion of the weaknesses of theories based entirely on contiguity and of considerations that are more positive in their support of a reinforcement view. A provisional framework for explaining how cognitive activity might guide overt behavior is developed, to strengthen the reinforcement view of cognitive learning. (DP)

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ON THE POSSIBILITY OF A REINFORCEMENT THEORY OF COGNITIVE LEARNING

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During the past decade or so, considerable support has arisen for what might be called a neo-Tolmanian view of motivation and learning (e.g., Cofer & Appley, 1964; Atkinson & Wickens, 1971; Estes, 1971; Logan, 1971; Bindra, 1972; Bolles, 1972). In general, the elements of that view are: that learning, properly speaking, is the development of new sequential linkages between cognitive events; that such learning occurs by a principle of sheer contiguity; that, although cognition is something fundamentally different from behavior, it acts to guide behavior; and, thus, that changes in cognitive linkages, as brought about by learning, are reflected in the modification of overt performance.

As has been true since Tolman first espoused it, this sort of approach has a certain phenomenal validity which merits attention and respect. All the same, there are a number of considerations which dictate caution in embracing it. Their net effect is to diminish the attractiveness of the theory and, at the same time, to suggest gently but persistently that, even in cognitive learning, reinforcement is a fundamental variable. I should like to cite those considerations, and to add to them certain others, hoping to persuade you that a reinforcemental theory of cognitive learning is not, at least for the moment, entirely out of the question.

The first of the critical points to be mentioned is a very general one. It is simply that, by any meaningful criterion, cognitive activity is in fact a kind of behavior. Cognitive events arise as responses to other cognitive events or to external stimulation. They serve, in turn, as stimuli to still further cognitive events or to frankly motoric responses. Functionally speaking, they are embedded in the ongoing stream of behavior and are an intrinsic part of it (Skinner, 1964; Berlyne, 1965; Homme, 1965; Smith, 1969).

General though it may be, this point has some relevance to the present discussion. If cognitive events are indeed a form of behavior, they should be subject to the same laws as are other forms of behavior. Specifically, they should manifest learning in accordance with the same rules. It is therefore significant to note that very little firm evidence has emerged from other realms of behavior to indicate that learning can be accomplished by contiguity alone (Smith, 1967; Hilgard & Bower, 1966, pp. 109-110). Admittedly, this matter is still distinctly moot; but the balance of recent thinking with respect to learning-in-general seems to favor reinforcement over simple association. _A priori_, then, one would be inclined to look for reinforcemental factors in cognitive learning, in particular, and not to expect the latter to proceed, uniquely, by association alone.

We need not, however, settle for a mere "_a priori_" on this point. Thus, the second consideration I wish to raise has to do with the failure of pure contiguity in cognitive learning, specifically.

The basic datum, here, is completely familiar. It consists of the well-known fact that a given percept, image, or thought may be followed closely, time and time again, by another one, so that almost unlimited contiguity is provided; and yet, the subsequent occurrence of the first cognition will have no tendency at all to evoke the second. Textbooks sometimes remark upon this fact, and furnish striking instances of it. Each of us, I imagine, can think of equally striking cases in his own experience. The suggestion commonly arising from these circumstances is that reinforcement is involved, somehow, in what appears to be learning by pure association (e.g., Berlyne, 1965, p. 100).

The third and final consideration to be mentioned is one which, again, will be recognized as familiar - and one over which, I dare say, we need not linger. It is the nagging question as to how cognition leads, in the end, to behavior - Guthrie's classical problem of the animal "buried in thought." Both Bindra (1972) and Bolles (1972) have made serious efforts, recently, to resolve that problem; but it seems to me that even their arguments are not entirely persuasive, and that the problem still remains.

Now, the points so-far mentioned are, on the whole, negative They tend mainly to impair a contiguity theory of cognitive learning, and only secondarily, somewhat by default, to strengthen a reinforcement theory. The question arises, then, as to whether any considerations which are more positive in their support of a reinforcement view can be adduced.

Interestingly enough, at least some considerations of this sort have been on record for a good many years. In 1947, in a brief and rather informal paper, R. S. Woodworth gave attention to what he called the "Reënforcement of perception" (Woodworth, 1947). His basic point was one which seems worthy of notice today, and perhaps even of generalization to areas of cognition beyond that of perception.

As Woodworth himself put it, the heart of his argument was the premise that "...perception is always driven by a direct, inherent motive which might be called the will to perceive. Whatever ulterior motives might be present from time to time, this direct perceptual motive is always present in any use of the senses...[1947, p. 123]."

It is true that many, including myself, would be dubious about an "inherent...will to perceive." It is to be noted, however, that Woodworth was willing to recognize "ulterior motives," too; and it would not be difficult to modify his hypothesis somewhat, in the direction thus suggested, to avoid its dependence on anything as problematical as an innate need to perceive. One could simply recognize the fact that veridical perception has great practical utility. In avoiding pain, in finding food or mate, the preliminary response of interpreting sensory input is of obvious value, and the act of perceiving is thus reinforced over and over again. Granting such continual primary reinforcement, we should expect the successful interpretation of sensory input to take on and maintain a strong secondary reinforcemental value of its own - and thus, indeed, to become as rewarding as Woodworth says it is.

It is the main point of the present essay that Woodworth's general line of reasoning could be extended from the realm of perceptual learning to that of associative learning proper. If the act of perception subserves many drives, and can thus be seen as a generalized reinforcer, the act of association surely does so, too, and can likewise be seen as a generalized reinforcer. It is useful to the organism in many ways if one percept, image, or idea, as a stimulus, evokes another, as a response. Sequences of such cognitive S-R's - "associative chains," if you like - enable the organism to test, covertly and tentatively, lines of behavior whose overt expression might be protracted, effortful, and even painful. It would be strange if useful cognitive associations did not begin to carry a secondary-reward value of their own; so that, if the environment, or the organism's own thought processes, imposed upon the organism a pairing of cognitive responses; and if that pairing were of a sort which had been valuable in the past; there would arise a secondary reinforcement effect, and a corresponding strengthening of the tendency for the one cognitive event subsequently to evoke the other. In sum, and in a different idiom, one might say that the organism's "storage of information" is an operant event; and Stein (oral statement, 1968;

cited in Carroll, 1971) has reportedly advanced, in oral discussion, just such a suggestion.

Now, a reinforcemental view of cognitive learning, to be at all complete, ought to be able to offer a self-consistent answer to the riddle of how cognitive activity can guide overt behavior. In the few minutes that remain, I should like to suggest one such answer, provisional though it may be.

Within the frame of reference which has now been developed, then, the organism can be pictured as being equipped with a large number of cognitive S-R habits. When the organism happens to encounter a problem situation, those habits begin to function. The perception of the situation itself evokes a learned imaginal response; that, in general, another such response; that, another; and so on. The organism thus reels off a series of instrumental cognitive responses. Typically, they represent successive overt responses making up some course of action; and, sooner or later, one of the imaged responses finally evokes an imagined punishment or reinforcement.

Now, the fascinating thing about such a sequence is that it seems to act as a surrogate learning experience. If it ends up with imaged punishment, the corresponding sequence of overt responses is not likely to be made. If, on the other hand, it ends up with imaged reinforcement, the likelihood of actual performance is enhanced - quite possibly to the level at which the behavior in question appears explicitly. It is evident, then, that we have here a possible explanation for the effects of cognition upon behavior - if it can be regarded as reasonable that an organism can learn from a sequence of its own images.

It is tempting, of course, to think of the organism as "modelling upon its own imagery." But it really seems most likely that, in the end, imagery will explain the efficacy of modelling, rather than vice-versa. Hence, a real explanation does not seem to lie simply in the direction of modelling.

Another direction does offer at least tentative hope, however. There is now a rather general acceptance of the idea that perception and imagery are essentially similar functions (cf. Neisser, 1972, and Zikmund, 1972) - the one occurring in the presence of the defining stimulus-situation, the other occurring in the absence of that situation. To image a series of events is thus, to some extent, to perceive it. To actually live through a series of events, however, is also to perceive it. It would accordingly follow that what goes on in the nervous system during imagination is rather like what goes on during actual experience with the corresponding environmental circumstances. Given some latitude in expression, it could be said that to image a series of events produces essentially the same neural changes as would be produced by direct experience with the events themselves.

The balance of the argument is perhaps not difficult to anticipate. It would suggest that the organism has had an experience essentially equivalent to that of behaving overtly and, in the case of interest here, being reinforced. Learning has thus occurred, and the effect of that learning has been to link a new series of responses with the problem situation. As the animal is, in fact, still <u>in</u> that situation, the learned responses are cued, and they are carried out.

In this fashion, then, cognition might possibly give rise to behavior. It is worth noting, in closing, that it would do so in a completely determinate way, in accordance with the ordinary principles of learning. The notion that there might be some sort of free decision, on the part of the organism, to "use" its cognitive experience would be, in this framework, completely inappropriate.[1]

[1] I wish to thank Ms. Laureen S. Martin and Professors E. A. Lumsden and R. L. Shull for their helpful comments on an earlier draft of this paper.

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