

TOLMAN ON ASSOCIATIVE LEARNING

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Professor Tolman has recently published an article in the *PSYCHOLOGICAL REVIEW* entitled 'The acquisition of string-pulling by rats—Conditioned response or sign-Gestalt?', and in it an experiment by McCulloch and some observations of Tolman's own are subjected to two analyses, one in terms of conditioning and one in terms of sign-gestalt-expectation. The rat-subjects were found to conform to the sign-gestalt description and not to the description in terms of associative learning.

In the course of the experiment the rats learned to pull in a food-pan by means of a string and so to obtain food. It is this learning which is analyzed in terms of the two theories. The writer is taking the liberty of suggesting a radically different stimulus-response analysis.

Before training has taken place the behavior which can be expected of the rat judging from Tolman's own account is as follows:

1. If hungry the rat will eat food from the pan if this is placed before him.

2. If the pan is gently removed while the rat is eating and its foot is on the edge of the pan, the rat will pull back on the pan.

3. If the pan is pulled farther under the same conditions, the rat will 'scrabble' and catch the string in mouth or paw.

4. The rat will pick up a string on which food is smeared.

5. It will seize and pull on the string if the string is 'jiggled.'

6. If the pan is out of reach, the rat *will not* without certain training pull in on the string and obtain food.

After the training has taken place the rat will, if hungry, pull in the string until the pan is within reach and proceed to eat.

What must be accounted for by a theory of learning is this difference between the behavior of the rat before and after training.

Training consists in first allowing a hungry rat to eat food from the pan and then, while it is eating, drawing the pan slowly away in such a manner as to induce the rat to clutch the pan and draw it back. This the unsophisticated rat can be counted on to do. After this has been done several times, the pan with string attached is drawn slowly out of reach of the rat while the rat is 'scrabbling' for the pan. The rat will then sometimes paw the string and pull or take the string into its mouth and pull. By increasing gradually the distance to which the pan is removed the rat will eventually pull the pan in from a distance of 50 cm.

In a very curious stimulus-response analysis of this series of events Tolman states that *the* unconditioned stimulus is food in the pan, that *the* unconditioned response is eating, that *the* to-be-substituted stimulus is the string, and that *the* conditioned response is seizing and pulling. He then points out that "the learned (*i.e.*, the supposedly conditioned) response of pulling the string is not, as it seems to me [Tolman] it should be according to a strict conditioned response interpretation, either the original unconditioned response of eating, or a response 'closely' related to the latter."

Actually we are here dealing with at least five 'unconditioned' stimuli and their responses, the five listed above. These five are, of course, 'unconditioned' only in the sense that cue and response have been already connected by association and can be depended on when the experiment begins. My objections to the emphasis on an 'unconditioned' stimulus have been stated elsewhere. The 'unconditioned' stimulus is never the sole 'cause' of the response, but only the convenient final touch by which the response can be released under the conditions of an experiment. The rat must be hungry, active, not engaged in fighting, he must be right-side-up, and so on. It is impossible and impractical to enumerate all the stimulus elements which co-operate in any response. We usually take most of them for granted.

What needs to be explained is how the animal comes to pull on the string when hungry and confronted with the string and with food-box out of reach.

A conditioned response explanation would only point out that by enticing the rat to pull under these circumstances the rat will later pull under these circumstances without the enticement. Jiggling the string, pulling on the box while the rat's foot was on the edge, smearing the string with food, all these were just inducements to get the rat to pull on the string. These were what may be called the unconditioned stimuli. After a little of this, the rat pulls on seeing the string.

The rôle played by the reward is a complex one, but not too complex to be understood if one is so disposed. If the string were very long, fatigue and distraction would eventually cause the rat to cease pulling and the association of string and pull would be dis-established. With the string still present the rat would be doing something else and so there would be a conditioned inhibition of the string-pulling.

If the rat is allowed to eat to satiety, hunger disappears, and there is no chance for a conditioned inhibition of pulling as a response to hunger plus sight-of-string. Hunger is now absent. When it recurs together with the sight of the string, the rat will pull again. This may be weeks later.

If the rat is not allowed to eat to satiety, the nibble of food starts salivation and movements of eating; these will surely add to the drive and the 'integration' of the rat's behavior, and some saliva flow and chewing movements may survive to the next trial. The rat will now pull with a set to eat. By set is meant nothing more mysterious than saliva flow and eating movements such as are not incompatible with the absence of food. In this sense the string becomes what Tolman calls a 'sign-gestalt-expectation-hypothesis.' And it really does. If Tolman will be careful not to attribute to animals expectations that involve language, I have no objection to his use of the word. Not that I shall use it myself.

For Tolman this sign- . . . -hypothesis is an 'intervening variable.' In order to get on to any actual movement on the

part of the rat he devises a new principle of learning (number 4): "The outward expression of such an acquired set (expectation) is that the animal (given the proper conditions of motivation) tends to behave to the more immediate stimulus-object in either the way to get to or the way to avoid such more distant stimulus-objects." In contrast to this, the stimulus-response description in terms of associative learning predicts the consequent behavior directly without recourse to this intervening variable.

If this article has conveyed the impression that the writer finds the sign-gestalt description incorrect, that was not its intention. Things do become signs of things to come. All of the seven kinds of learning listed by Tolman do occur, and many other kinds as well. We all learn at times to react to a signal with behavior appropriate to what is to follow. This is Tolman's 'signal learning' and is number 2 of his list. In my own case I have also observed numerous learned reactions to signals, but reactions which were highly inappropriate. For this I can find no provision in Tolman's list, which seems to apply only to the behavior of very nice and very wise people. The description of my wrong acts in terms of association seems to me, at least, to be as a rule very apt.

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