BOOK REVIEWS

Learning beyond stimulus–response

Stuart Sutherland

Contemporary Animal Learning Theory. By Anthony Dickinson. Pp.177. Hbk ISBN 0-521-23469-7; pbk ISBN 0-521-29962-4. (Cambridge University Press: 1981.) Hbk £12.50, $27.50; pbk £3.95, $9.95.

SINCE the time of Pavlov, most theories of animal learning have been distorted by the idea that all that an animal can learn are connections between stimuli and responses. Until recently, there were few who stood out against such S-R theorizing, though even in the 1940s and 1950s there were distinguished exceptions such as Edward Tolman and Karl Lashley. Moreover, even when S-R theories were at their height, many interesting phenomena were discovered that could not readily be fitted into such an impoverished view of the mental capacities of animals, and that drove theorists to propose increasingly *ad hoc* and implausible mechanisms, including internal and unobservable responses.

Contemporary Animal Learning Theory is appropriately entitled, since Anthony Dickinson ignores both the follies and the findings of the past: indeed, out of the hundred or so references cited only three are dated before 1967, although many of the phenomena with which he deals (for example, overshadowing, blocking, latent inhibition and secondary reinforcement) were discovered long before. Since there has been a great deal of recent work on these phenomena, his failure to trace the origins of the discoveries is perhaps no great matter and does not affect the explanations he proposes. Dr Dickinson maintains, with Locke, that learning is based on the detection of associations between events (including as one kind of event the animal's own responses). He acknowledges that animals may learn more complex rules (for example, always to select the odd shape of a set of shapes presented), but his book is concerned only with the laws of association learning: these turn out to be much more complicated than anything foreshadowed by Locke.

Most S-R theorists have supposed that responses are learned solely because they are rewarded. One amongst many results that reveals the inadequacy of this view is the following. An animal is trained to press a bar to obtain sucrose pellets; it is then given sucrose outside the apparatus and afterwards made violently sick, a procedure that produces an aversion to sucrose. If replaced in the bar-pressing apparatus, the animal will no longer press the bar. According to Dr Dickinson, it has learned the connection between an action (bar-pressing) and a specific event (availability of sucrose pellets) and once the pellets become aversive, it ceases to press the bar.

To illustrate the kind of theorizing with which Dr Dickinson deals, consider the following finding. If an animal is exposed to a tone that is always followed by shock but receives shock equally often when the tone is not present, it learns little or nothing about the connection between tone and shock. From a survival view point this is clearly sensible since there is in fact no causal connection between tone and shock. Nevertheless, all the older theories of learning predict that the animal will learn that shock follows tone. It is hard to believe that animals calculate the relative frequencies with which the shock occurs in the presence and in the absence of the tone. R.A. Rescorla and A.R. Wagner have put forward an ingenious resolution of this problem. They assume that there is a finite limit to the total strength of the associative bonds formed between any set of stimuli and an event associated with those stimuli. Now in the experiment described, the stimuli that are associated with the shock include not merely the tone but stimuli from the apparatus in which the animal is placed: moreover, the latter stimuli are always associated with the shock whereas the tone is only associated with it on half of its occurrences. At first, associative bonds between the shock and both tone and apparatus will be formed. But when the combined strengths of these bonds reaches its limit, the associative bonds between apparatus and shock will continue to gain in strength on trials on which shock is given without the tone, and the strength gained will be deducted from the strength of the bonds between tone and shock. Eventually the association between tone and shock will be reduced to zero. It is as though someone has a finite sum of money to invest, and once all of it has been invested, any one investment can only be increased by reducing another.

This kind of theory explains many other findings: for example, it explains why, if a strong and a weak stimulus are presented simultaneously and always followed by shock, the animal learns only the association between the more salient stimulus and the shock even though it will learn the association between the weaker stimulus and the shock perfectly well if that stimulus is presented on its own in association with shock.

It was said of E.C. Tolman who produced an earlier but much vaguer version of association theory that "he left the animal lost in thought" — he could not explain what led an animal to act on the knowledge acquired through association. Dr Dickinson tries to overcome this problem by assuming that animals can make simple inferences: from a knowledge that bar-pressing leads to food, they can infer that they must press the bar to obtain food when hungry and hence they act. Unfortunately, not all responses are determined so logically. There are experiments that suggest that both animals and people sometimes learn to make a response to the stimulus and continue to make it even when the contingencies between events change. Someone who has been in a car accident may be unable to control his fear when next in a car, even though he knows that his recent experience has not changed the probability of a further car accident. It remains obscure what determines whether an organism will learn a direct connection between a stimulus and a response with the result that the response is involuntarily produced whenever the stimulus occurs.

Although recent theories of animal learning are more rigorous than previous accounts, they are not easy to grasp. *Contemporary Animal Learning Theory* is not for the casual reader, but it is well organized and carefully argued and is the best introduction to a field that ten years ago appeared to many to be moribund. □

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Crustacean 2 in 1

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The Biology of Mysids and Euphausiids. Advances in Marine Biology, 18. By J. Mauchline. Pp.677. ISBN 0-12-026118-9. (Academic: 1981.) £38.60, $89.

THIS volume contains separate reviews of two orders of Crustacea that were formerly joined in the order Schizopoda. Because of similarities in their compound eyes, it has been argued recently that the Schizopoda should be revived, but at present the Mysidacea are assigned to the superorder Peracarida and the Euphausiacea to the superorder Eucarida (but not to the decapods as Mauchline states in his preface).

The justification given for combining