2

Common factors in learning theories

There is today no shortage of dispute among those working in the fields of learning theory and behaviour modification. New experimental techniques, and new theoretical attacks on old problems mean that any overview is likely to be temporary. But it is possible to draw out some themes from previous work, at least from the selection of theories examined in the last chapter, before going on to look at particular experimental questions.

Species differences

First of all, of course, it is obvious that the theories are about animal learning, or are theories which are being tested in animal experiments. We shall see later that this does not imply a lack of concern with the human condition altogether. Also, the theories are attempts to discover principles about animals in general, even though evidence from only a few species is quoted and most of the data concern laboratory rats. All the theories are open to criticism on this account — there may be enormous differences between

species (and especially differences between the human species and all others) which mean that the search for general principles will always end in disillusion. Martin Seligman (1970), for instance, argued that there could be no general laws of learning; but subsequently has been concerned to establish a very general theory about the cause and cure of human depression, based on laboratory experiments with dogs (Seligman, 1975).

Clearly, learning theories are based on the assumption that there is some discoverable logic to behaviour, over and above the biological details of species differences. This assumption is older than Darwin and in some senses theories about learning from experience are more philosophical than biological. Ideas in learning theory, like ideas in just about everything else, go back to Aristotle, and the first case in point is the concern with generalizations over and above species differences. To introduce *De motu animalium,* Aristotle says:

> "The movements of the animals that belong to each genus, and how these are differentiated, and what the reasons are for the particular characters of each — all this we have considered elsewhere. But now we must consider in general the common reason for moving with any movement whatever." (from Nussbaum, 1978)

Translating movement into behaviour, this would serve to introduce almost any learning theory, since it is common reasons, and general principles, that are almost always being sought. The particular theory which Aristotle introduces is not unlike Tolman's: movement in animals arises when 'the painful is avoided and the pleasant pursued' (from Nussbaum, 1978, p. 44, but in general 'the movers of the animal are reasoning and imagination and choice and wish and appetite. And all of these can be reduced to thought and desire' (from Nussbaum, 1978, p. 38). For Aristotle thought and desire are apparent in movement from place to place, just as purpose and cognition are revealed, according to Tolman, in maze-learning, and in this case differences between the human species and others are often ignored.

As I write this on his eightieth birthday, I am prompted to acknowledge that Sir Karl Popper, the distinguished philosopher and in some ways the Aristotle of today, is also someone who has tried hard to establish logical principles of behaviour that trans-

23

cend species differences. Sir Karl is very fond of provocatively comparing Einstein with the amoeba: 'from the amoeba to Einstein is just one step'. This is because of a philosophical theory about the growth of knowledge with learning from experience: 'From the amoeba to Einstein, the growth of knowledge is always the same'. It is the same because, according to Popper 'All *organisms* are constantly, day and night, *engaged in problem solving',* and 'Problem solving always proceeds by the method of trial and error' (Popper, 1972, pp. 246, 261, 242 respectively; see Magee, 1975 pp. 56—73). This is a rather special sort of theory, which attempts to interpret many different kinds of things as a sequence of variation and selective retention, rather as in Darwinian evolution. But it contains strange echoes of the cats' trial-and-error solutions in Thorndike's problem boxes, and Watson also used the device of saying 'No new principle is needed in passing from the unicellular organisms to man' (Watson, 1914, p. 318).

This is not the place to disagree with Popper, or even with Watson — I am quoting the 'amoeba to Einstein' comparison to suggest that from Watson to Popper is just one step, and that it may sometimes be respectable to put species differences to one side. But it must be said that the learning abilities of amoeba tend to be vastly overrated. Both Watson and Popper had read the work of Herbert Spencer Jennings, who assumed that if only amoebae were the size of dogs we would assess amoeba intelligence as just like the dog's (Jennings, 1906, p. 336). This is utter nonsense (Bovee and Lahn, 1973). Not only is it absurd to think of amoebae playfully fetching sticks, or obeying their master's voice, there is not a scrap of decent evidence to suggest that amoebae have any kind of conditioned reflexes, let alone trial-and-error learning. Some amoebae move around a lot, and will slide around inedible obstacles, and engulf and consume palatable ones (some amoebae being ecologically classified as 'carnivorous predators'). To this extent they are solving objective problems of life, and they are certainly exhibiting a variety of objectively classifiable behaviours: they share both these features with Einstein. But if it is only one step between the amoeba and Einstein, it is a step with a very large number of stages, of which the most significant are having a nervous system — of even the jellyfish type; having a brain and spinal cord; being a mammal; being a person; and last, but not least, knowing some physics.

24

It is usually a flaw in learning theories that, even if these big stages are acknowledged, some of the smaller ones, such as the gaps between rat and monkey, and monkey and man, are not; but it is probably necessary to stand well back from species differences in order to distinguish the wood from the trees, and to claim general principles and universal laws. A biological approach to the study of behaviour which is perhaps more realistic can be found in Lea (1984; see also Walker, 1983).

Once one suspends belief in species differences, then any codification of learning from experience could be called general. But although there are as many learning theories as there are theorists, there is always some attempt to narrow down, and specify, basic processes in terms of which a wide range of possibilities can be understood. Either the exterior conditions under which learning may or may not be supposed to occur are specified, or alternatively an attempt may be made to specify internal theoretical mechanisms.

Association by contiguity in time

It is sometimes said that the first learning theorists were 'British empiricist' philosophers, who stressed that sense experience, plus subsequent mental operations, determined human thought. The association of ideas due to contiguity in time was introduced by Locke (1632—1704), who was English, as an afterthought to explain irrational connections of ideas, such as aversions to foods whose ingestion has only accidentally preceded illness, or a dislike of books resulting from painful experiences at school. Berkeley (I685—1753), who was Irish, said that it was only because initially arbitrary visual experiences are observed 'constantly to go together' with tangible ideas of size and distance, as when we actually walk towards someone else and touch them, that we can have visual ideas of size and distance. Hume (1711—76), who was Scottish, said that all inferences from experience are based on custom, or habit; that custom is the 'great guide of human life'; and that exactly the same principles determine cognition in people as in animals. Hume then obviously has a claim to be the first learning theorist, and, according to the recent biography (Cohen, 1979), he was a direct influence on J.B. Watson, who was exhilarated and liberated by his first reading of Hume, and read him

again while running his first experiments. Hume mentioned both the mere contiguity of events, and the special case of reward and punishment:

> "animals and men learn many things from experience, and infer, that the same events will always follow from the same causes. By this principle they become acquainted with the more obvious properties of external objects.... This is still more obvious from the effects of discipline and education on animals, who, by the proper application of rewards and punishments, may be taught any course of action, and most contrary to their natural instincts and propensities." (Hume, 1777/1970, p. 105)

The principle of association of ideas by the contiguity of events in time was incorporated into many philosophical systems until the nineteenth century. The most important is the system of Herbert Spencer since he combined the principle of association with a general theory of evolution (his term, not Darwin's) and a concept of reflex action, which guided the theories of Pavlov (1927, p. 9) and Maudsley (see chapter 9). Spencer's two-volume *Principles of Psychology* (1855) is based on association by contiguity, which he supposes to be due to the results of waves of activity passing through the nervous system:

> "Hence the growth of intelligence at large depends on the law, that when any two psychical states occur in immediate succession, an effect is produced such that if the first subsequently recurs there is a certain tendency for the second to follow it…….By this law, if it is the true one, must be interpretable all the phenomena, from the lowest to the highest." (Spencer, 1855/ 1899, p. 425)

If there is a single feature common to all learning theories, it is the principle that, when one thing follows another in the experience of an individual animal or person, something happens, so that those two things become in some way more associated than they were before. Exactly what has to follow what, and exactly what happens then that produces the observed increase in association between these two units, are of course matters of some dispute. The associated things in the original theories were always mental impressions or ideas, and currently a similar level of association would be said to exist between 'central representations'. But those

interested in underlying mechanisms have been inclined to assume that waves of activity in the cerebral cortex, or the firing tendencies of individual neurons, must be the physiological causes of psychological effects. And perhaps the most notable aspect of the twentieth-century, and mainly American, interpretation of associations is an insistence that behavioural description is more important than hypothetical neurological changes, or unmeasureable subjective impressions. The typical behaviourist, such as Watson or Skinner, resents the nervous system just as much as he resents subjective ideas, if not more so, since neural events are remote from the here-and-now physical interaction of the whole animal with the world.

Whatever the things associated, whether mental ideas or behaviourally defined stimuli and responses, there are a number of possible forms that associations might take. The most notable tradition in learning theory has been to restrict associations to modifications of the input—output rebound effect which is inherent in the physiological concept of a reflex. Thus Thorndike's connections were between sensory feelings and impulses to respond, and many subsequent writers supposed that learning consists mainly in alterations to stimulus-response connections, or S-R bonds. There are other possible forms of association, of course, and some of these others have current interest. Mackintosh (1974) interprets the results of trial-and-error learning in terms of associations between responses and their consequences, which would be response-stimulus or 'R-S' connections. Thus, according to this view, in Thorndike's experiment the cat learns an association between the response of pressing a latch, and the stimulus of getting out and eating fish. On the other hand Mackintosh suggests that in Pavlovian experiments an association is commonly formed between two stimuli (giving an 'S-S' connection) — for instance when the dog forms an association between the stimulus of hearing the buzzer and the stimulus of tasting the meat.

These last examples point to the role of purpose or desire in the process of learning, or, to use more objective terms, to the role of drive conditions and motivating stimuli. Thorndike assumed that motivating stimuli were essential for any trial-and-error learning to take place: if one were not dissatisfied with error, or satisfied with success, then there would be no mechanism of selecting one

27

response over another, and changing behaviour. However, since Tolman's experiments, it has become necessary to distinguish between *learning and performance*— it is assumed that rats can learn the way through a maze with no reward, but will only actually perform the learned act, that is run through the maze correctly, when there is a goal of food at the end. For many practical purposes, it is performance that counts, and therefore the goal, or the motivation, or the drive is paramount. But with the possible exception of Skinnerians who take into account only 'reinforcement', most theorists distinguish in some way between pure practice, or the acquisition of neutral information, on the one hand; and motivating conditions which may influence learning, and will certainly determine actual behaviour, on the other hand. Even for highly charged behaviours, neutral information may be necessary. 'I have to drink' says thirst; 'Here's drink' says the cognitive map. The cognitive map and the thirst are separate, because rats will learn where water is even when they are not thirsty (Spence and Lippsit, 1946).

Voluntary and involuntary behaviour

The effects of learning from experience and the effects of motivation have thus to be kept separate, even though it may be rare to find effects of one kind in the absence of those of the other. But motivation enters into another important distinction — between voluntary and involuntary behaviour. There is a sense in which Thorndike's cats were working out for themselves a solution to a problem, and were voluntarily learning to get out of the box in which they were confined. It is certainly arguable that, if a cat successfully scratches at the door to be let out, it is leaving the house of its own volition. By comparison, Pavlov's dogs, strapped in a stand, learned in a more passive way — there was no active responding necessary for them to try out, and the criterion of learning was that salivation, a glandular response which is surely involuntary, occurred when an external stimulus, the buzzer, was imposed on the animals. There is an input versus output distinction here as well; although standing and listening, or sitting and watching, may be voluntary and relatively passive, while running away, or panic-stricken struggling, may be involuntary and re-

28

latively active. Perceiving is in any case often regarded as active, involving attention and expectancies, whether voluntary or not, but I think it is still best to talk both about stimuli, as involving the sense organs, and responses, as requiring motor apparatus. Digging the garden uses up a lot more calories than watching television, and the amount of energy, or effort, or concentration that is used or needed in a given activity will usually have something to do with motivation.

There are in fact many tricky difficulties involved in making satisfactory distinctions between voluntary and involuntary responses, but running about and waving the forelimbs tend to be more readily put to the service of anticipated goals than, say, insomnia or nausea. Some of these difficulties will come up in later chapters. Perhaps the simplest distinction is that learning to be motivated may be different from motivated learning, that is, learning to want something, or learning to be afraid, differs from learning how to get what is wanted, or how to avoid what is feared.

Nurture versus nature in the control of behaviour

It would be possible to construct a pessimistic learning theory, which listed all the difficulties involved in ever learning anything, and specified the various conditions under which learning is extremely unlikely. But, as a matter of fact, most of the learning theorists so far mentioned have been great optimists. They believed in the first place that learning, according to the principles they Laid down, was a widespread influence on behaviour throughout the animal kingdom; and in the second place that if only the same principles of learning were properly applied to human life, there would result vastly improved techniques of everything from child-rearing and sex education to the management of schizophrenia and industrial relations. Clearly, if general principles exist and we can discover the fundamental laws of a universal logic of behaviour, then there might be some benefits to be derived from applying them. Perhaps almost as important as the laws themselves is the optimism that there are new solutions to old problems. At any rate, as of now, there are numerous journals devoted to behaviour modification or behaviour therapy which, although they are proceeding under their own steam of practical

29

usefulness, owe a great deal of their initial impetus to the theories discussed in this and the last chapter. I shall return to the question of how this came about in later chapters.

30