A LOGICAL ANALYSIS OF LEARNING, CONDITIONING
AND RELATED PROCESSES

by

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(with 7 Figs)

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The following analysis is strictly elementary. It does not purport to solve any problems. It may enable the results of certain experiments to be stated more clearly, and possibly suggest further experiments, or help to compose differences between different workers which are mainly due to differences of terminology. I shall be concerned with processes which bring about changes in an animal's behaviour. The change may be called learning, conditioning, trauma, development and so on, according to circumstances.

Let \( X \) be a group of animals (human or non-human) which have not undergone an experience \( E \), and which are considered to be so similar that the differences between them are irrelevant to the experiments considered. Let \( X' \) be some or all of these animals after they have undergone an experience \( E \). The nature of the experience is not specified. It may be purely sensory (e.g. "imprinting") or sensory and motor, e.g. many learning processes. We shall discuss later whether we can legitimately include other changes. It may be necessary to specify that \( X' \) are examined over a certain time only, for example from 1 to 90 days after the experience \( E \).

Let \( \alpha, \beta, \gamma, \delta, \ldots \) be a set of situations in which an animal can be placed, in each of which it undergoes an experience of a particular kind. I use the word situations rather than experiences because the internal state of the animal as well as its sensory input must be considered. I think first of situations in which similar sensory experiences are encountered, for example \( \beta \) could be a situation in which a member of the opposite sex, or a model of such a member, gives visual, but not auditory, chemical, or tactile signals to \( X \) or \( X' \). However, it will generally be found that analysis is impossible unless we specify something about the internal state of \( X \) or \( X' \), which can often be stated in terms of drive. For example "Hungry bird seeing green caterpillar" is best regarded as a different situation from "Full
bird seeing green caterpillar”. “Oestrous female with adult male” as a different situation from “Dioestrous female with adult male”. In general at least some of the situations in which an animal is placed will produce either the experience E itself, or some other experience which will alter the animal’s behaviour in a manner relevant to the experiment. If this is so, we may have a state of affairs which can be expressed as follows. An animal of class X which has been in situation α can still be regarded as belonging to class X. One which has been in situation β (say a bird given a distasteful black and yellow insect which it seized in its beak and rejected) has passed into class X’. One which has been in situation γ (say a bird given a black and yellow insect which was not distasteful and which was eaten) has passed into another class X”, and cannot be used again for the particular experiment which we are considering. Similarly exposure to some situations will take a member of class X’ out of that class. The recognition of what experiences change an animal’s behaviour is a characteristic of the successful student of psychology or ethology. I assume, by the way, that none of the situations nor the experience E lead to the animal’s death. One can inhibit any activity by killing an animal. We shall discuss later whether mutilations can be included.

Let R be an item of the animal’s behaviour which is judged to be a response to the situation in which it is placed. The sign + denotes that the response is given, — that it is not given 1).

We can now proceed to classify all our situations into four classes, shown in Fig. 1. That is to say a situation α, β, etc., is said to belong to class A if both X and X’ give a negative response, to class B if X gives a negative response, X’ a positive response, and so on. In any set of experiments we shall certainly find situations belonging to at least one class, we may find situations belonging to two, three, or all four classes. It follows that the

1) In fact a response is almost always graded. The frequency with which it is given may be graded. If it is very occasionally given in an unexpected situation, this is often called a “vacuum activity”. The result that 10% or so of the animals do not give it when expected is so familiar that it has no name, though it often evokes linguistic behaviour in experimenters. If the response is given, its intensity can often be measured, sometimes in several different ways. For example, the frequency or the depth of breathing may be increased. Even in such cases we can always draw the line between — and + somewhere. The most satisfactory experiments are those in which there is no difficulty in drawing it. If, for example, in one set of situations 90% of the animals snapped at an object presented at least once within a minute, while in another set 5% snapped within this time, we shall certainly regard the first response as +, the second as —, even if some animals snap several times, and situations are later found giving intermediate results.

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