AMPLITUDE-INDUCTION GRADIENT OF A SMALL HUMAN OPERANT IN AN ESCAPE-AVOIDANCE SITUATION[1]

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"Shaping up" a response in short order has become a routine stratagem in conditioning demonstrations. The rat arrives quickly at bar pressing, or the pigeon at key pecking, when closer and closer approximations to the required behavior receive judicious reinforcement. In systematic studies of response differentiation, the progressive shift of the response along some chosen dimension (such as amplitude) is attributed to induction, which is the counterpart of stimulus generalization in discrimination work.

When a response is reinforced, further members of the response class of which the reinforced response is a member are made more likely to occur. Should the response class be divided into subclasses, it is assumed that the reinforcement strengthens most that subclass of which the reinforced response is a member and proportionately less the subclasses located to either side of it along the dimension. By selective reinforcement, one can move the modal subclass up or down a particular dimension more or less at will and, in doing so, perhaps observe extreme values which would have been quite improbable initially.

Investigations of amplitude differentiation have usually followed the pattern of getting the subject over higher and higher hurdles. Responses have been dichotomized into those which met or failed to meet the current reinforcement contingency, and little note has been taken of the *amount* by which the criterion level was exceeded or undershot. The response-induction gradient has consequently failed to achieve the kind of direct confirmation attained for the stimulus-generalization gradient.

The preliminary finding reported here stems from further processing of data from one of the subjects in a previous study (Hefferline, Keenan, & Harford, 1959), which published only his cumulative record for the reinforced response. In Fig. 1 we repeat the curve (heavy line) and add a family of curves for amplitude values of the same operant which were too large or too small to qualify for reinforcement. (The amplitude criterion had both a lower and an upper limit.)

The experimental arrangements for this subject will be reviewed briefly. He sat in a reclining chair in a shielded enclosure designed for electromyographic recording (Hefferline, 1958). Four pairs of electrodes, three of them dummies, were attached, with the recording pair fastened to the left hand in such a fashion as to detect minute thumb contractions. The size of the contraction to be reinforced was determined on the basis of 10 minutes of operant-level observation (OL 1), while the subject listened to music through earphones.

The subject was told that after this period of clear music, noise would be added through the phones, and that his task was to make a specific response—so small as to be invisible and one which he must discover for himself—which would temporarily turn off the noise or, when noise was not present, postpone its recurrence. (The response eliminated or postponed noise for 15 seconds.)

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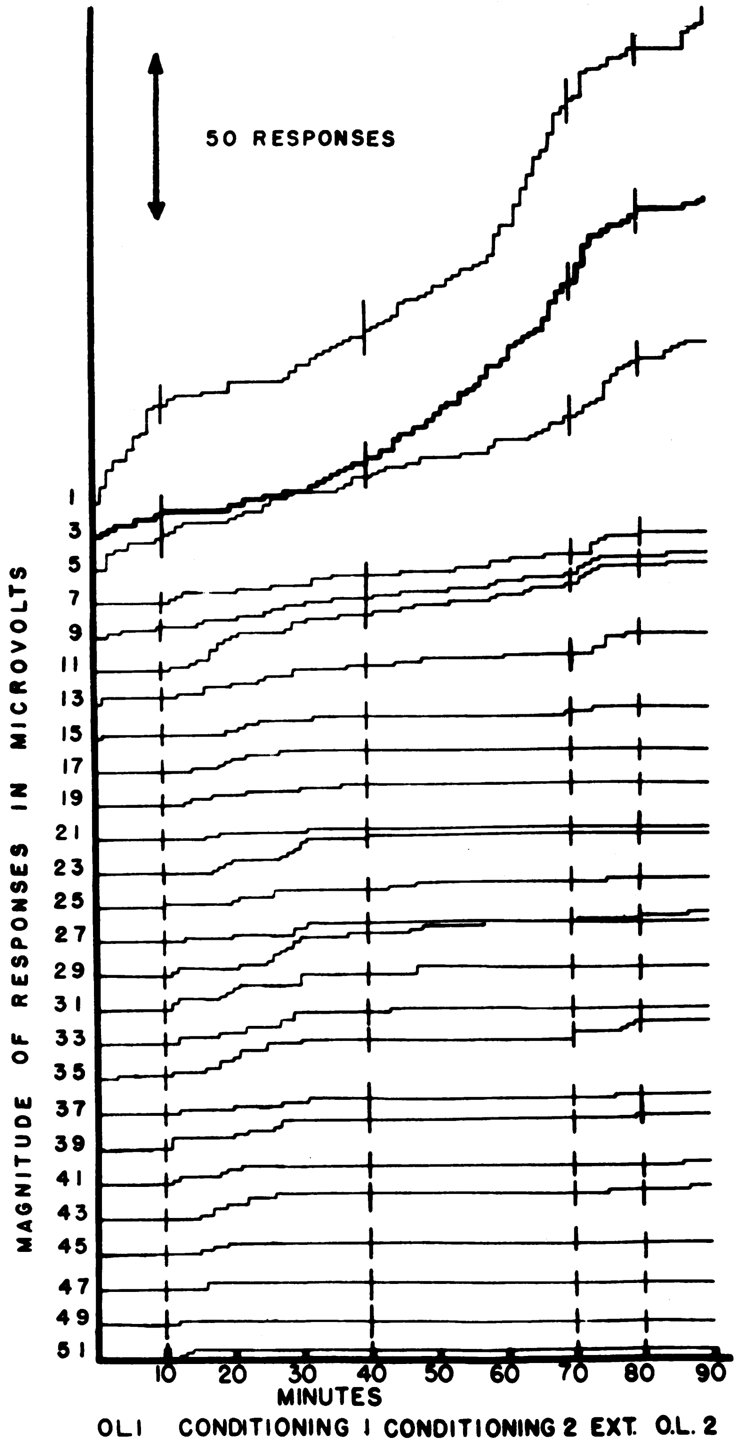

Figure 1. Amplitude-induction gradient of a small operant (thumb contraction) for a single human subject in an escape-avoidance situation. OL 1 and OL 2 are initial and final operant-level determinations, and EXT is extinction. Values on the ordinate represent midpoints of steps 2 microvolts wide in size of electromyographic signal.

As may be seen in Fig. 1, during two 30-minute conditioning periods separated by a 5-minute intermission, the reinforced operant's rate accelerated steadily. At the end of conditioning, noise was being avoided continuously for as much as a minute or more at a time. Ten minutes of extinction reduced the response to its initial rate, as indicated by a second operant-level determination (OL 2).

Before considering the inductive aspects of reinforcement, it may be noted that during OL 1 the response spectrum was narrow, with large amplitudes occurring only infrequently or not at all. (Values shown on the ordinate are midpoints of subclasses 2 microvolts wide.) A high rate is seen for the very smallest response, 1 microvolt, but this entire curve is suspect. The signal was so close to the bucked-out noise level of the system that minute changes of level probably produced "responses" artifactually. Eliminating this smallest category leaves us with a one-sided array of subclasses.

The first reinforcement was obtained at once after onset of noise, but it was more than 10 minutes before the next. The initial effect of the first reinforcement appears most markedly in those subclasses just above that of the reinforced response. Larger amplitudes follow shortly in an irregular manner over the whole spectrum. Most of these had not occurred a single time during OL 1.

The larger values then diminish in frequency and disappear more or less in order of decreasing size, while those subclasses just slightly larger than the reinforced one do not disappear but seem to settle to a steady low rate. With the beginning of extinction, responses recur throughout most of the spectrum. The subclasses nearest the reinforced one display the form of typical extinction curves.

When the subject was asked later to state what he had done to obtain reinforcement, his markedly in those subclasses just above that of the reinforced response. Larger amplitudes follow shortly in an irregular manner over the whole spectrum. Most of these had not oc- discovered an effective response sequence, which consisted of subtle rowing movements with both hands, infinitesimal wriggles of both ankles, a slight displacement of the jaw to the left, breathing out—and then waiting.

A full-scale study of the induction gradient will be undertaken shortly, making use of a rather elaborate electronic impulse analyzer constructed for this and other work. This instrument, partially described elsewhere (Hefferline, Keenan, Harford, & Birch, 1960), provides and records automatic reinforcement, and, in addition, detects and records seven other amplitude values of the operant.

In the projected study, instead of termination or postponement of an aversive stimulus, reinforcement will consist of an increase in numerical score displayed to the subject by an illuminated readout system. Further, the response to be reinforced will be selected from the middle of the spectrum in order to make possible the recording of a two-sided gradient.

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