Generalization gradients from "reaction time" or latencies of the white rat to visual brightness[1]

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Presentations of a light stimulus S^D (milk-reinforced), interspersed with varying S^Δ light stimuli (not reinforced), yielded generalization gradients of response latency ("reaction time") for 2 albino rats. Gradients also appeared when "failure to respond" was used as the behavioral measure. The latter type of gradient changed with continued training, first in the direction of indicating increased discriminative sensitivity, and then toward less sensitivity.

Although "reaction time" is generally studied with humans as Ss, lower organisms can also be used provided the verbal instructional variables are replaced by appropriate non-verbal discriminative stimuli and correlated operant reinforcement contingencies. Stebbins & Lanson (1961) have in this way studied some hitherto unexplored relations between latency and theoretically important parameters such as amount and schedule of reinforcement (Stebbins, 1962; Stebbins & Lanson, 1962). The present paper employs a procedure similar to theirs to secure from rats generalization gradients for visual brightness.

METHOD

Subjects

Two male albino rats, Charles River CD, approximately 100 days old on arrival in the laboratory.

Apparatus

The experimental chamber was a modified Lehigh Valley Electronics unit, Model No. 1316. It contained as the experimental operandum a plastic translucent hinged panel mounted on one wall of the chamber. This panel, which required 10 gm pressure for microswitch closure, was transilluminated by means of a Kodak Carousel slide projector outside the chamber. The brightness of this panel could be varied in 13 steps (6 S^Δ values on either side of S^D) from 0.30 to 3.75 log ft. lamberts by neutral density filters used as slides in the projector. The experimental chamber was illuminated in no other way. The blower in the projector, another mounted in the chamber itself, and a 7-1/2 in. separate fan behind both projector and chamber provided ventilation and some measure of sound masking. The experiment was programmed by transistorized digital-logic circuitry. Data were recorded on counters, and print tape.

Procedure

The animals were reduced to 75% ± 5% of their individual ad libitum weights and subsequently kept at that same percentage of the weight of a third animal which served as a standard and which was maintained throughout the experiment on ad lib feeding. Reinforcement (S^R) following a panel press response was 3 sec. of access to a dipper coming up from a reservoir and holding approximately 0.02 cc of a 50% mixture by volume of condensed milk (Borden's Eagle Brand) and water. The training and testing procedures can be described in terms of cycles as follows: (a) A cycle began with the experimental chamber dark and quiet. The first panel press response turned on a 1k cps, approximately 40 db (re. 0.0002 dynes/cm^2) tone; if a second response occurred within the next 5 sec., the tone went off, returning the animal to the original dark-quiet condition which then remained in effect until another response was made which restored the tone, following which, if another response were again made within 5 sec., the dark-quiet condition was again restored, and so on until the tone-producing response and the next response were separated by at least 5 sec. When the tone was on at least for 5 sec., the next component of the cycle came into effect. (b) This second component was initiated by onset of a light which continued with the tone until both were terminated together. If the light in that cycle was an S^D presentation, the first response in its presence was reinforced and also terminated the tone-light, thus placing the animal in the dark-quiet condition of the next cycle; if the light in that cycle was any of the S^Δ values, no response during it was reinforced and the light continued for its full scheduled duration (10 sec.) in which any number of nonreinforced responses could be made, the tone-light being then terminated and the animal placed in the dark-quiet condition of the next cycle.

The following features of this schedule may be noted: having the animal produce the tone of each cycle helped insure its closeness to the response key when the light came on; the re-cycling of the dark-quiet phase served to cut down on "false or anticipatory" reactions to the next light stimuli; the S^D, if not responded to, was the same length (10 sec.) as each S^Δ, so that the "stimulus hold" period imposed on the response no different requirement in S^D than in S^Δ; the 10 sec. maximum duration of light acted to "shape" a short response latency; a free-operant situation prevailed at all times; the re-appearances of S^D intermingled with S^Δs provided a schedule of behavior maintenance as opposed to generalization testing in extinction.

The S^D brightness intensity was 2.1 log ft. lamberts. Rats were first trained to this value only, for four hourly sessions on a regular reinforcement schedule, but with the 2-response sequence as described above in effect. Beginning with the fifth session, the twelve

S^{Δ} stimulus values were added and, together with the S^{D}, were exhibited to the animal in mixed order. In each session, frequency of S^{D} presentation approximately equalled the total of all S^{Δ} occurrences. The principal data taken were the latencies of the first response to each S^{Δ} and S^{D} presentation.

Results and Discussion

Figure 1A shows both rats' latencies averaged for each of the 13 test brightnesses. Generalization gradients emerge with the present procedure, although the weakness of the albino's visual brightness discriminative system may perhaps account for the shallow curvature of the gradient. A 5X change in the 1/latency is noted, but this occurs over a range of approximately 3.5 log units of brightness. The reversal in the function at 3.0 log ft. lamberts adds a complexity to the gradient form. The control data shown in Fig. 2 indicate that this added complexity does not arise from the independent effects of absolute light stimulus intensity on response latency. Thus, although a number of studies (e.g. Chocolle, 1940; Hull, 1951) have shown a relation of this sort, there is no reason to believe that it holds under our present conditions, since latency is about the same over the intensity range used when reinforcement conditions are equal for all intensities.

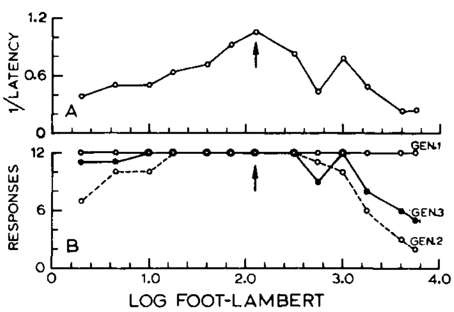

Fig. 1. *Panel A* **shows reciprocals of mean latencies of both animals at each stimulus intensity. Each point is the mean of both animals' mean response latency to each stimulus averaged across the last 11 sessions. S^{D} is indicated by the arrow.** *Panel B* **shows total number of times on which a latency was recorded (up to 10 sec.) for both animals, each of which had 6 opportunities to respond to each S^{Δ} stimulus in each of the sessions plotted. The S^{D} value (arrow) occurred with a frequency approximately equal to the total of all S^{Δ}s and the point plotted here may be understood to indicate not 12 opportunities, but rather that no presentation of S^{D} ever yielded a failure to respond within a 10 sec. interval. "Gen 1" indicates the first session of testing during which each rat received his first 6 exposures to the range of S^{Δ}; "Gen 2," six exposures of each rat to the stimulus range during the middle of the 32 training sessions; and "Gen 3," the last 6 exposures of each rat in the 32nd training session.**

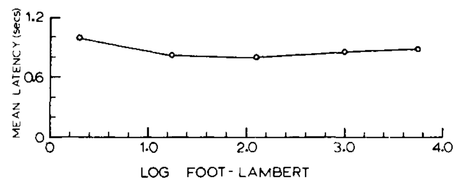

Fig. 2. Mean values for 1024 latencies from one rat to each of 5 stimulus intensities. Reinforcement occurred for each response at each intensity. Each intensity was in effect for two entire sessions on two different days; during each session 512 latencies were recorded. The order of use of intensities was randomized.

A characteristic of the gradient also seen in Fig. 1A is an asymmetry characterized by longer latencies at the higher stimulus intensities. Although our brightnesses are higher than those reported as aversive levels (e.g. Keller, 1941; Kaplan, 1952), our own rats responded indifferently to them during initial sessions (some indication of this is seen in the function labelled "Gen 1" of Fig. 1B). Longer latencies at high S^{Δ} values develop only after some appreciable amount of exposure to the stimuli (*vide*, Fig. 1B).

The number of "failures to respond" to test stimuli generally increased as training progressed, especially at the ends of the stimulus range, and these data may themselves be used to plot a generalization gradient (c.f. Winograd, Cohen, & Cole, 1965). Such gradients from our data are plotted in Fig. 1B taken at three different stages of training. These appear first to sharpen, and later to flatten somewhat, with training time.

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Note

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