Generalization and response latency¹

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The present experiments investigated generalization in a reaction time situation where the generalization stimulus, a tone, preceded the reaction time signal, a light. The hypotheses under investigation were that the duration of the cue stimulus would determine the degree of generalization (Experiment I) and that the response latency independent of the stimulus duration would be related to the amount of generalization (Experiment II). A particular generalization test stimulus (a tone of 40, 45, 50, 60, 65, or 70 dB) was presented only once always following two bar-pressing responses to training stimulus (tone of 55 dB) under each of two conditions of stimulus duration in Experiment I and under each of two conditions of response latency in Experiment II. It was found that under the condition of short response latency generalization was broader.

Intuitively, if stimulus duration is very short, discrimination of any of the characteristics of the stimulus will be poor; or, to put it another way, there will be more tendency to generalize. With the discrimination procedure, this relationship was obtained by Graham and Kemp (1938). They illuminated both half fields at the same intensity, and asked S to fixate at their center. When S was ready, E released a shutter which added an additional flash to one half field, and S then reported whether he saw it or not. They found that, with intensity constant, the just noticeable difference became large when duration of the incremental flash was made short. Similar results have been obtained in a classical conditioning situation (Hartman & Grant, 1962). In this experiment, the CS-UCS interval took the place of duration of the flash in Graham and Kemp's experiment, and the conditioned response instead of the verbal report was the recorded indicator response.

A question naturally arises as to whether, using the generalization procedure, the asserted relationship also holds in the case of a voluntary response with its latency controlled.

EXPERIMENT I

Method

Subjects. The Ss were 25 freshmen attending an introductory psychology course at National Taiwan University.

Apparatus. The response was recorded on a polygraph which measured S's reaction to the stimulus. The essential part of the apparatus consisted of a response bar coupled directly to four coil springs and indirectly to a coil spring connected with a recording pen of the polygraph by means of a string passing over pulleys. When the bar was pressed downward to a distance, all the springs were stretched by the same distance.

Procedure. The procedure adopted was a version of the reaction-time technique, with modifications made with an eye to controlling response latency. The stimulus tone was presented for a certain duration of time, the termination of which was followed immediately by a light signal. The S was asked to press a bar to the tone at the time of the light signal. Therefore, response latency to the tone was equivalent to duration of the tone plus reaction time to the light signal. In this way, assuming the variation of reaction times to the light signal to be relatively small, the response latency could be manipulated by just manipulating the stimulus duration.

The S was seated in a soundproof room. The only noise in the room was that of an air-conditioner. The earphones were then put on. The S was told that he would receive tones of brief duration only from the right receiver, with a light signal immediately following. The light signal, consisting of the illumination of a disk of 7.5 cm diameter, was at eye level 50 cm away. The S rested the heel of his hand on the surface of a 25 x 25 cm board. In the middle of the board was a square hole of 3.5 x 4 cm such that the response bar protruded from the surface by 6.5 cm. The S's index finger rested on the top of the response key.

The S was then told that he would hear tones in a group of three, the first and second tones always the same and the third tone occasionally different from the former. He was instructed to press the response key until its tip reached the surface of the board to the first and second tones exactly at the time of the light signal, not earlier or later, and then to release the pressure immediately. If he judged the third tone different from the first and second, he was not to press the response key even if there was the light signal immediately following. He was instructed not to guess, and to press the response key in the same way whenever he was unable to distinguish the third tone from the first and second with confidence.

Hereafter, the administration of a group of the three tones will be referred to as a trial. Before the experiment proper, three practice trials were run. On the first of these, three tones of 200 msec. duration, 1000 cps, and 55 dB were given. The light signal, the onset of which coincided with the termination of the tone, was of 250 msec. duration. The S was instructed from an intercom system to press the key to every tone. The three tones in any trial were 1000 cps and separated from each other by 1.5 to 2 sec. The second and third practice trials were the same as the first except that the third tones were 35 to 75 dB respectively, and S was instructed not to press the bar to the third tones. Then

the generalization procedure proper began. The inter-trial interval was 6 to 8 sec. The further characterization of the procedure is as follows: (a) Within each trial, the three tones had the same duration. The first and second tones were training stimuli of the intensity level of 55 dB. Therefore, a generalized response was always obtained after two responses to the training stimulus. (b) The tone duration, depending on whether the to-be-manipulated response latency was short or long, was either 100 or 300 msec. respectively. The tone durations were alternated in a group of three trials. (c) Within each group of three trials of the same tone duration there was one trial with the third tone same as the training one. (d) The test tones were of 40, 45, 50, 60, 65, and 70 dB, each of which was presented to an S twice, once on a short tone trial, once on a long tone trial. (e) Under the restrictions so far stated, eight lists of random presentation orders were prepared. Each S was tested with only one of the lists. Every list contained 18 trials.

Results

Generalized responses. Since, for each S, generalization tests were carried out only once with each test tone under each of the conditions of tone duration, which were used in order to manipulate response latency, it is possible to compare the effects of stimulus duration on generalization intra-individually. For this purpose, the frequency of generalization was obtained by counting the number of generalized responses to test tones presented under each of the two conditions. The main reason for using this measure is that, with only a few exceptions, the magnitudes of generalized responses were the same as that of the training response. In terms of the frequency of generalization, 14 of the 25 Ss showed greater generalization under the condition of the short response latency, eight Ss made the same frequency of generalization, and only one S showed more response under the condition of the long response latency. Two Ss were discarded, because they failed to respond more than once to the third tones which were actually the same as the training tone, indicating that they were guessing without following the instructions. According to the sign test, the difference in the frequency of generalization produced by the manipulation of response latency was very significant ($p < .001$).

To find the breadth of generalization under each condition, the weakest and the strongest tones to which Ss responded were averaged, respectively. The responses to the short stimulus were 49.3 and 63.5 dB for the weak and for the strong as compared with 52.8 and 60.2 dB for the long stimulus. According to the sign test, the difference in the breadths of generalization is very significant with $p = .0002$ (15 plus, 7 equal, and 1 minus). There is an indication of stimulus intensity effect, since the training tone of 55 dB is displaced considerably to the left of the center of the range of generalization under each condition.

Response magnitude. There were only 12% of generalized responses whose magnitude measures differed from that of the training response. The latter was equivalent to .035 joules of work. The failure to obtain a clean gradient of response magnitude may have been due to the insensitivity of the measure.

EXPERIMENT II

As to the asserted relationship between response latency and generalization, the results of Experiment I apply only to the case in which the stimulus duration is fairly long in comparison with the response latencies under consideration, since that part of the stimulus persisting beyond the onset of the reaction time signal is ineffective. Experiment I, therefore, investigated only the relationship between stimulus duration and the degree of generalization with response latency adjusted to stimulus duration. Experiment II was, then, designed to manipulate response latency independently of stimulus duration. In addition, an attempt was made to correlate response magnitude with stimulus condition.

Method

Subjects. The Ss were 20 seniors and graduate students of the Department of Psychology, National Taiwan University.

Apparatus. The main feature of the apparatus consisted of a response key coupled to a weight of 500 gm and a spring connected with a polygraph recording pen by means of two strings passing over pulleys. When the response key was pressed downward to a given distance, the weight was lifted and the spring stretched to the same distance. Therefore, the work done by a force applied to the key could be measured in terms of energy. There was a second weight (1000 gm) 3.5 cm above the first so that when the key was pressed to a distance more than 3.5 cm both weights were lifted. In this way, S could be instructed to press the key in two steps, and the response became graded.

Procedure. All the procedures were the same as those of Experiment I except the following: (a) The response key protruded from the surface of the board by 7 cm, and S was instructed to press the key in two steps. (b) The stimulus duration was equal to 100 msec. under two conditions of response latency. In the short latency condition, there was no gap between the termination of the stimulus and the onset of the reaction time signal. In the long latency condition the above two events were separated by 400 msec. (c) During the practice trials, there was 200 msec. between these two events, and the stimulus duration was also adjusted to 100 msec. (d) The three tones in any trial were separated from each other by 3 to 4 sec.

Results

Generalized responses. As in Experiment I, in terms of the frequency of generalization, greater generalization was obtained under the condition of the short re-

sponse latency ($p < .003$; 11 cases of greater generalization, 6 cases of equal one, 1 case of smaller one, and 2 cases omitted for the same reason as in Experiment I).

Again, the breadths of generalization were found to be (49.7 dB, 61.7 dB) and (53.3 dB, 60.3 dB) under the conditions of the short and long response latencies respectively. The difference in the breadths of generalization was very significant with $p < .006$ (12 plus, 4 equal, and 2 minus).

Response magnitude. Since 21% of generalized responses were smaller in magnitude than the response to the training stimulus, it becomes more or less meaningful to find gradients of generalization by averaging response magnitudes for each test stimulus. Table 1 shows the gradients of generalization under the conditions of the short and long response latencies. It is apparent that a flatter gradient was obtained under the condition of the short response latency.

Table 1. Gradients of Generalization under the Conditions of Short and Long Response Latencies

Condition	Stimuli ^a						
	40	45	50	55	60	65	70
Short	483 ^b	514	4650	7000	5444	1744	106
Long	0	389	564	7000	5056	492	97

^a 55-dB tone was the training stimulus.

^b The unit is in gm cm. One gm cm is equivalent to the work by 1 gm of force in producing 1 cm displacement in the direction of the force. The work done in stretching the spring of the recording pen was very small and hence omitted (its maximum is less than 1 gm cm).

DISCUSSION

With the present experimental procedure, the phenomenon of generalization was not only established for an individual S but obtained in a manner not directly influenced by the effects of extinction trials (test trials in the present case) carried out with other test stimuli (because a particular test stimulus was presented only once and always following two responses to the training stimulus).

The main findings of the present experiment support our common notion that in a rush we tend to make more mistakes or, in other words, more generalization.

References

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