Generalization of an instrumental response between words and pictures¹

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The amount of generalization of an instrumental response is greater from pictures to words than from words to pictures only if a more sensitive response index than the gross instrumental response is used. An increase in the electromyogram recorded from the arm muscle was used in the present study as a more sensitive index. The advantages of using changes of EMG amplitude as a response measure are discussed. A possible explanation for the asymmetrical generalization is presented.

The research presented here has two functions: (1) to determine the relative amount of generalization of an instrumental response from words to pictures and from pictures to words, and (2) to demonstrate the value of recording responses that are weaker than the full instrumental response in experiments of this type.

Semantic generalization of a classical conditioned response has been demonstrated many times (see Feather, 1965). Most of these studies use responses, which are characterized by a high degree of unreliability, mediated by the sympathetic nervous system.

A study reported by Branca (1957) on the generalization between words and pictures can serve as an illustration of the problems encountered using GSR as a response. He found that out of 12 Ss, 7 showed generalization from a word to an appropriate picture, while only 1 S showed generalization in the reverse direction. It is difficult to draw any conclusions from this study, however, since 47 of the original 88 students failed for various reasons to meet the criteria of conditioning.

By contrast, such discrete instrumental responses as key presses are quite reliable. For example, Mink (1963) had Ss lever-press to words in a training list. They were then shown a test list containing some of the original training words, associates of the training words, and unrelated control words and were told to press the lever to words they recognized as belonging to the training list. A greater number of lever presses were made to associates than to the unrelated words. When unidirectional associates were used, generalization was

obtained in the direction of the association only.

Dicken (1961), Jenkins (1963), and Kurcz (1964) have all reported semantic generalization of instrumental responses under conditions similar to those used by Mink.

Since instrumental conditioned responses are much more stable than are autonomic conditioned responses, the former are used in the present study. In addition to the discrete response, an electromyogram (EMG) was recorded from the muscle group used to make the instrumental response. Consequently, both full and partial responses could be determined under conditions of high reliability.

SUBJECTS

The Ss for this experiment were 20 undergraduate students enrolled in an introductory course in psychology at the University of California at Berkeley. Participation in the experiment was a course requirement.

APPARATUS

The S was seated in a tablet-arm chair that had a telegraph key mounted on the tablet arm. The key was vertically mounted on a block of wood so that S's arm could be placed in a resting position, with the thumb and index finger uppermost. A piece of clear plastic, 8 cm long, 0.5 cm thick, and 2.5 cm wide, was attached to the telegraph key and extended to the surface of the tablet arm. The S's arm was placed on the platform so that closing the fingers about 1 cm would close the telegraph-key contacts. When the contacts were closed, the S heard a 500-Hz tone. A piece of sheet aluminum, with a right-angle bend, was fixed behind S's elbow. This prevented S from closing the key contacts by moving his entire arm.

Three Beckman biopotential skin electrodes were placed over the forearm flexor digitorum superficiales muscles of the right arm. The electrodes were plugged into a terminal box that led to recording equipment in an adjoining room. A Beckman Type RS oscillograph recorded the EMG from the arm muscle, the make and break of the key contact, and the occurrence of a stimulus slide change. The EMG was amplified initially by Honeywell 108 and 109 amplifiers, with frequencies below 100 Hz and above 1,000 Hz filtered. The signal was then integrated over a 1/5-sec time constant and recorded by the oscillograph pen. Paper speed was

5 mm/sec and the sensitivity was 50 microvolts/cm.

The stimuli were projected for an automatically timed 2-sec interval on a ground-glass back screen using a Kodak Carousel slide projector. Use of a back screen produces a clear image with normal room illumination. The projector and the screen were located 3 ft in front of S.

The stimuli were CVC words and black-and-white line drawings of common objects that could be represented by CVC words, such as hat, pan, car, etc. The words chosen could each be represented by simple drawings. All words used fall in the Thorndike AA category.

PROCEDURE

The training stimuli consisted of 10 words and 10 pictures. The S was told that the experiment involved immediate memory and was instructed to press the key when each training stimulus appeared. The S was also told that following this series of words and pictures another series of words and pictures would be shown that would include the ones first shown, and that he should press the key only to those particular slides shown in the training series.

Immediately after the presentation of the last training stimulus, S was told that he would see a longer series of words and pictures and was reminded to press the key only when a slide appeared that was included in the training set.

The test series consisted of 15 words and 15 pictures arranged as follows:

Five training words presented as words (W-W)

Five training words presented as pictures (W-P)

Five training pictures presented as pictures (P-P)

Five training pictures presented as words (P-W)

Five words not presented in the training series (X-W)

Five pictures not presented in the training series (X-P)

Four stimulus series were used: The different series were constructed so that each stimulus appeared half the time as a picture and half the time as a word. Each S was shown the same series of stimuli four times, each time in a different random order. Each random order consisted of the same 20 training stimuli and the same 30 test stimuli. Each stimulus series was presented individually to five Ss.

The number of full key presses to each of the six categories of test stimuli was tabulated for each of the four trials. The number of partial key presses was also tabulated (a partial key press is defined as at least a twofold increase in the amplitude

Fig. 1. Mean number of full responses per trial.

of the forearm flexor EMG over the resting level).

RESULTS

Full Response

The mean number of key presses during the test trials for each class of test stimuli are shown for each trial in Fig. 1.

An analysis of variance of these data resulted in an insignificant order effect. Since the order effect is not significant, the data have been collapsed over orders. A repeated-measures analysis of variance (4 series by 4 trials by 6 stimulus classes, with repeated measures on the last two factors) was performed. Insignificant F ratios were obtained for series [$F(3,16) < 1, p > .25$], for trials [$F(3,48) = 1.09, p > .25$], for series by trials [$F(9,48) = 1.09, p > .25$], for series by stimulus class [$F(15,18) = 1.11, p > .25$], and for series by trials by stimulus class [$F(45,240) = 1.25, p > .10$]. The F for stimulus class was significant [$F(5,80) = 211.51, p < .01$], and it was significant for trials by stimulus class [$F(15,240) = 1.89, p < .05$]. Significantly more key presses were made to stimuli in Class P-P than to those in Class W-W [$t(38) = 2.84, p < .01$], and more were made to stimuli in Class W-W than to those in Class P-W [$t(38) = 6.70, p < .01$]. There was no significant difference between stimuli in Class P-W and those in Class W-P [$t(38) = 1.89, p > .05$]. The analysis of the full responses indicates that retention for the pictures was higher than that for words, that the retention for both pictures and words was stronger than the generalization from either words to pictures or from pictures to words, and

that there was no significant difference between the number of generalized responses and the tendency to respond to completely unrelated stimuli presented in the test series. The interaction between trials and stimulus class occurs because the number of responses for the retention groups (P-P and W-W) does not change over trials, while for the unrelated and the generalization groups, the number of responses does decrease.

Full Plus Partial Responses

When the number of partial responses are included in the data analysis, the results are different in one important respect. Figure 2 contains the mean number of responses (both full key presses and EMG responses) for each class of stimuli for each trial. The results of the analysis of variance for these data are the same as before. Significantly more responses were made to stimuli in Class P-P than to those in Class W-W [$t(38) = 8.92, p < .01$], as before. However, the difference between Class P-W and Class W-P is now significant [$t(38) = 2.59, p < .05$]. Thus, if the partial responses as indexed by an increase in EMG amplitude are included, the same pattern emerges that is present for the full key presses, except for a significantly greater tendency to respond to the words that were formerly seen as pictures (P-W) than to the pictures that were formerly seen as words (W-P). This latter class of stimuli results in no more responding than does the presentation of unrelated stimuli. Again, the significant Trials by Stimulus Class interaction is due to the tendency for the number of responses made to the unrelated and to the generalization stimuli

Fig. 2. Mean number of full-plus-partial responses per trial.

to decrease while the number of responses made to the retention stimuli remains at the same level.

DISCUSSION

The insensitive measure obtained when using only the full key presses does not show any tendency for generalization to occur in either direction between words and pictures. However, if the more sensitive partial responses, based on the amplitude of the EMG in the arm muscle used to close the key, are included, a significant degree of generalization is found: the degree of generalization from pictures to words is greater than the degree of generalization from words to pictures. Results similar to those reported here have also been found by Jenkins,² who also used an instrumental response. Both sets of results contradict the results reported by Branca. This difference could be due either to the extreme selection of Ss in Branca's study or to the use of classical conditioning in his study rather than the instrumental procedures used in this study.

The higher degree of generalization from pictures to words probably occurs because the Ss tend to code the name of the object shown in the picture verbally when the training slide is presented. Therefore, the tendency for a generalized response to be made in the test series is greater since it has occurred in the training period. This interpretation is supported by a recent study by Jenkins, Neale, & Deno (1967), who found that pictures are more easily remembered than are words. They attribute this finding to the fact that the nonlinguistic representation of a picture is richer than is that for words. They argue that the picture is stored linguistically as well. Therefore, pictures have both a linguistic representation and also contain more distinctive cues than do words. Further evaluation of this interpretation could be done by choosing pictures that vary widely in their tendency to evoke the corresponding word associate, or by having S overtly pronounce the name of the picture when it is shown in this training series. In the former case, the amount of generalization from pictures to words should vary as a function of the strength of the association. In the latter case, the amount of generalization from pictures to words should increase, while the amount of generalization from words to pictures should not be affected.

As a final point, it should be emphasized that EMG response measures appear to be well suited for circumstances in which the E is studying behavioral processes that are not strong enough, or long lasting enough, to result in a full overt response. The EMG is stable and reliable and, for this reason,

seems to be preferable to the labile and unreliable GSR.

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NOTES

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2. Jenkins, J. J. Personal communication, 1966.

Development and persistence of acquired meaning in retarded and normal children¹

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Retarded and normal children were given a task that consisted of acquisition of a favorable impression to a fictitious person and an unfavorable impression to another fictitious person, the reversal of these impressions, and, finally, rating the two persons on a 5-point scale indicating how much S liked or disliked the two persons. Retardates were as good as MA-matched normals in trials to learn and reverse and as fast in their verbal response latencies. In their ratings, retardates did not show a preference for either the acquisition or the reversal experience, whereas the normals were influenced by the reversal experience. Persistence of meaning was hypothesized to follow an ontogenetic pattern of no differentiation through a preference for recency in preadolescents to a primacy preference in young adults.

Since meaning can be conditioned (Staats & Staats, 1958), it should be possible to reverse it. But what would be a S's net impression regarding a set of stimuli for which he develops a favorable connotation and then is made to reverse it through experimental manipulation? Would his first favorable impression persist, or would his more recent unfavorable impression persist? Logically, the impression should revert to neutral, since S should regard the stimuli as neither favorable nor unfavorable. However, in four separate experiments on college students, the acquisition meaning was found to persist (Das & Mitra, 1965; Das,

1969). That is, if Stimulus X is associated with "good" and Y with "bad" in the acquisition period, and then reversed in the reversal period, college students appear to retain their first impressions.

Das (1969) has given a mediational explanation for the primacy effect. It is assumed that, during reversal, S uses his acquisition experience as his frame of reference, and for reversal, switches his responses by using a mediating code such as "now the opposite." Frequent use of the code can strengthen the persistence of the acquisition effect. In fact, one of the four previous experiments tested this by employing a paradigm of multiple acquisition (A) and reversal (R): Ss were given 10 trials for each A or R period in sequences of ARAR, ARRA, or AARR. Persistence of acquired meaning was noticed under all three sequences.

A mediating code should be less efficiently used by children and, specially, by retarded children (Kendler, 1963). If so, the persistence of reversal rather than acquisition meaning will be found with children. The present study examines this by taking normal children from three chronological age groups and a retarded group that finds its chronological and mental age matches in the normal groups. The samples are also compared on proficiency in semantic conditioning and reversal.

SUBJECTS

Three groups of normal Ss and one of retardates were taken from the public schools of the city. The retardates were in special classes, had a mean IQ of 70.64 (± 8.99), a mean MA of 84.25 (± 12.77) months, and a mean CA of 119.5 (± 12.15)

months. They were compared with Grade 1 children on MA (80.79 ± 7.05) and Grade 5 children on CA (121.46 ± 6.76) for their task performance. An additional group of normals from Grade 3 was included to provide a continuum of variation in normal MA and CA. The means and SDs for this group were 107.14 ± 9.46 (MA) and 100.18 ± 3.99 (CA).

PROCEDURE

The Ss anticipated whether the word "good" or the word "bad" would follow when one of the two stimulus words, "Tes" or "Tig," was presented. Tes and Tig were two nonsense syllables of comparable association values taken from Underwood & Schulz (1960). But the Ss were told that these represented the names of two persons, and their task was to guess which one was good and which one was bad.

The syllables were presented on cards by a Hunter Card Master. Each of the 40 Tes and 40 Tig cards was exposed for 10 sec at intervals of 5 sec. With the help of a timer and voice key, each exposure started the timer, and S's anticipation of "good" or "bad" spoken into a microphone shut off the timer, permitting us to record response latency. The cards were arranged in the same random order for each S and could be presented in an endless cycle without interruption.

The task had three phases: acquisition, reversal, and rating the stimuli as likeable or otherwise. The acquisition phase continued until S had made 10 consecutively errorless guesses; then the reversal phase began without interruption. During this phase, E reinforced the previously wrong response as right, and the previously right as wrong, until the criterion of 10 consecutively correct responses was met. A maximum number of 40 trials was given for each phase. If S failed to reach the criterion, he was told which syllable preceded good and which one preceded bad. After instruction, he was given 20 trials to reach the criterion. If instruction occurred during acquisition, the reversal phase followed the 10 criterion trials as usual.

Three techniques were used in rating: (1) A five-step ladder representing the labels of a 5-point scale from "I like him very much" to "I do not like him at all." S was asked to pick up a Tes and a Tig card (Mr. Tes and Mr. Tig for the S) and place these on the steps of the ladder. (2) A sorting task in which five Tes and five Tig cards were set before the S in a random order, and S was asked to pick up all the cards that were good. (3) A modified sorting task during which S was successively presented the five Tes and five Tig cards in a random sequence and allowed to indicate if the card he was