Stimulus coding and selection as a function of response relatedness¹

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Two groups of Ss learned a paired-associate list with stimulus compounds consisting of color frames and CCC trigrams. Responses were words that were related to appropriately coded trigrams in one condition but not in the other. Three subgroups in each condition learned a transfer list having color alone, trigram alone, or trigram-color combinations as stimuli. A significant interaction found in the transfer test indicated that Ss in the related condition had been influenced by the response terms to code and use the trigram components rather than color as the functional stimulus in learning of the list.

Previous studies have shown that the likelihood of S using a particular element in a stimulus compound as the "functional" stimulus during paired-associates learning is dependent on the relative meaningfulness of the elements in the compound. Thus, with compounds consisting of color and verbal items, S tends to select color as the functional stimulus if the verbal component is low in meaningfulness. If the verbal items are high in meaningfulness, S may select either component, with the verbal element being somewhat preferable to color (Underwood, Ham, & Ekstrand, 1962; Young, Teeters, & Zelazny, 1966). Similar studies, using compounds composed of purely verbal items from different levels of meaningfulness, have supported the conclusion that S uses the more meaningful element as the functional stimulus (Cohen & Musgrave, 1964; Spear, Ekstrand, & Underwood, 1964).

Other factors that have been shown to influence the stimulus-selection process are intralist similarity of elements (Cohen & Musgrave, 1966), "distinctiveness" of words (Jacobus & Leonard, 1968), and spatial position of the various elements in a compound (Cohen & Musgrave, 1964, 1966; Postman & Greenbloom, 1967).

Solso (1968) has demonstrated that characteristics of the response member of a pair can also influence selection of particular elements in a stimulus compound. For example, S may use color rather than a high meaningful word as the functional stimulus if the color has a high preexperimental association with the

response member. The present study represents a further investigation of the role of response characteristics in stimulus selection. Moreover, an attempt was made to bring about selection of low meaningful elements over high, contrary to S's normal selection habits.

An additional feature of the present study was the incorporation of a stimulus-coding factor into the selection process. Specifically, consonant-syllable trigrams were combined with colors to form stimulus compounds. While S should normally select color as the functional stimulus, it was expected that he could be influenced to select the trigram if the response word was preexperimentally related to the coded trigram. The appropriate coding process, in this case, involved the insertion of other letters into the consonant syllable. Faced with such a stimulus compound as FML and a colored frame, for example, S might select FML if the response word were GIRL. This selection process would thus entail the intermediate step of coding FML as FeMaLe. That Ss can be influenced to use such a code when responses are trigrams and related words are stimuli (i.e., response coding) was demonstrated by Podd & Spear (1967).

SUBJECTS AND DESIGN

A total of 84 undergraduates (36 males, 48 females) were used as Ss. All Ss were enrolled in introductory psychology classes at Oswego and had not served in any previous verbal-learning experiments.

The design required that one group of Ss learn an original list with trigram members of stimulus compounds related to appropriately paired response words (Condition R). The other group learned a list in which trigrams and response words were inappropriately paired and unrelated (Condition U). To test for stimulus selection, each group was divided into three subgroups for learning of a transfer list. While responses in the transfer list were the same as in List 1, the stimulus terms for experimental groups were either color alone (Groups R-C and U-C) or trigram alone (Groups R-T and U-T); control groups (R-TC and U-TC) had a continuation of the trigram-color compounds used in List 1.

MATERIALS

Two different seven-pair lists were used in original learning. The stimulus items were trigram-color compounds; responses were common English words. The trigrams

were consonant syllables, ranging in association value from 58% to 79% (Witmer, 1935). Intralist formal similarity among trigrams was high to minimize the possibility that a single letter from a given trigram would be used as the functional stimulus. Color components consisted of rectangular frames drawn around trigrams with a felt-tip pen.

The two lists used for original learning differed in terms of the relatedness of coded trigrams to words in the respective pairs. List R pairs were drawn from materials used by Podd & Spear (1967). List U consisted of the same stimuli and responses used in List R, but they were inappropriately paired so as to be unrelated. The particular color paired with a given trigram was the same in both lists. Finally, there appeared to be no obvious relationship between the colors and words used in the various pairings.

PROCEDURE

Assignment of Ss to conditions (six males and eight females per group) was carried out by means of a randomized schedule sheet and Ss' order of appearance in the laboratory. For both original learning and transfer, lists were presented on a Stowe memory drum at a 2:2-sec rate, with an intertrial interval of 4 sec. Four different randomized orders of the pairs were used. Approximately 2 min elapsed between original learning and transfer trials. Anticipation learning was used throughout.

Prior to original learning, S was told that both trigram and color would appear together as the stimulus on all trials. The intent of these instructions was to inform S of the nature of the stimulus compound without biasing him in selecting one component or the other as the functional stimulus. Original learning was continued until S reached a criterion of one perfect recitation of the list in a single trial. The transfer list was presented for 10 trials, with S instructed to give as many correct responses as possible on the first trial. Prior to the transfer test, S was again fully informed as to the nature of the stimuli that would be presented.

RESULTS AND DISCUSSION

An analysis of variance performed on List 1 trials to criterion showed significant effects of the relatedness factor [$F(1,78) = 64.36, p < .001$], with R groups requiring fewer trials to learn. Neither the "dummy" variable of stimulus change nor the interaction was significant. The superiority of Condition R over Condition U suggests that Ss in the former groups were indeed using coded trigrams as the functional stimulus in learning of the list.

Fig. 1. Mean number of correct responses over 10 transfer trials.

More direct evidence for stimulus selection is provided by the results from the transfer test. As can be seen in Fig. 1, trigram alone was a completely effective stimulus in Condition R, with performance under color alone being markedly inferior. In Condition U, trigram alone was somewhat better than color alone early in learning, but the difference diminished quite rapidly.

Because of differences associated with the relatedness factor in List 1 learning, loss scores were computed prior to analyses of transfer performance. Following Underwood et al's (1962) formula, each experimental S's score was subtracted from the appropriate control-group mean to determine individual loss scores.

An analysis of variance performed on Trial 1 loss scores showed significant effects of stimulus change [$F(1,52) = 53.81, p < .001$] and the interaction with the relatedness factor [$F(1,52) = 9.46, p < .01$]. Because of the significant interaction, further analyses were performed to determine the simple effects of stimulus change under the two relatedness conditions. Using the error term from the overall analysis of variance, it was found that trigram alone was significantly better than color alone under both conditions; however, the level of significance was greater under Condition R ($t = 7.36, p < .001$) than under Condition U ($t = 3.01, p < .01$). These results thus demonstrate the effectiveness of the relatedness factor in bringing about

selection of trigram rather than of color as the functional stimulus in learning List 1.

A final analysis was conducted to determine differences in performance across the 10 transfer trials. Again using loss scores, significant differences were found for both stimulus change [$F(1,52) = 21.09, p < .001$] and the interaction with relatedness [$F(1,52) = 10.20, p < .01$]. While the difference between the trigram and color-alone groups was significant under Condition R ($t = 5.49, p < .001$), the difference between the corresponding Condition U groups was not ($t = 0.99$). These results thus strengthen the conclusion that Ss in Condition R were using coded trigrams as stimuli and rejecting the color component. The preference for trigram components in Condition U, on the other hand, was much weaker and more temporary.

Although the results of this study were in accord with the hypothesis that selection habits can be influenced by response terms and mediated by stimulus coding, this conclusion is weakened somewhat by the finding that trigram components were selected over color by Ss in Condition U. It was expected that Ss in this condition would tend to select color as the functional stimulus, consistent with results of previous studies (Solso, 1968; Underwood, Ham, & Ekstrand, 1962; Young, Teeters, & Zelazny, 1966). One reason for this discrepancy may be that the color components in the present study

were less discriminable than in previous studies. Whereas the color frames in the present study consisted of thin lines drawn with a felt-tip pen, both Solso (1968) and Underwood et al (1962) used frames having a ¼-in. width made from colored cards or from construction paper. Although the procedures used by Young et al (1966) are not clear with respect to composition of the color components, it appears that verbal items were printed in various colors of ink. It is conceivable that the differences in preparation of color components is responsible for the lower use of color stimuli by Condition U Ss in the present study.

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NOTES

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