Correlation of stimulus and response dimensions in paired-associate learning¹

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Trigrams varying in association value were paired with numeral responses in paired-associate lists with 1:1 S-R assignments. When the pairings systematically correlated the stimulus and response dimensions, performance was facilitated relative to list pairings that were random with regard to positions on the dimensions. Second lists were presented with new stimuli, using either the same rule, a different rule, or a random arrangement, but ceiling effects obscured analysis of differential transfer. The procedure can be related to reversal shift phenomena, and has implications for serial learning.

Given the distinction between the paired-associate (PA) task and procedure (Goss, 1961), PA procedures have been used to study conceptual behavior in "rote" situations. One such method has used the assignment of a common response to more than one stimulus within the list, creating a conceptual paradigm, i.e., N stimuli for each response. This method has been used to study reversal shift phenomena and the role of mediating responses (e.g., Marquette & Goulet, 1968). Another method for the study of conceptual behavior in the PA situation without the N:1 assignment is exemplified by the mediation literature (e.g., Dallett, 1964) and the coding-mnemonic literature (e.g., Underwood & Erlebacher, 1965), where the relationship within each pair is studied with 1:1 pairings.

The present investigation concerns another paradigm for the study of processing activity in rote situations, in addition to the N:1 and coding paradigms. This "processing" paradigm basically requires that the stimulus items be ordered along some dimension, and that the responses are also ordered on some dimension, so that the assignment of responses to the stimuli (1:1) can involve the systematic correlation of these items in terms of relative positions on their dimensions. For example, numerical responses might be assigned to trigram stimuli that vary within the list on meaningfulness, thus correlating the dimension of numerosity with association value by assigning the largest number to the most meaningful stimulus, the second largest number to the next most meaningful stimulus, and so on. A random pairing of the same stimuli and responses in

another list would serve as an appropriate control. If facilitation is observed for the systematic pairings, it cannot be due to the grouping of equivalents since the pairings are 1:1, and it cannot be attributed to mnemonic coding specific to each pair since the "correlation" involves relative positions at the level of list composition.

The present experiment was an attempt to explore this type of arrangement, and extend it to the study of reversal phenomena, by using second lists having either the same rule, a new rule, or a random pairing of items. Here shifts are used with reference to rules correlating dimensions rather than within or between dimensions per se.

SUBJECTS

One hundred and forty-four introductory psychology students served in partial fulfillment of course requirements, and all were naive with respect to previous participation in verbal learning studies.

PROCEDURE

The experimental design was a 2 by 3 by 3 factorial for instructions, first task S-R relationship, and second task S-R relationship. Each S learned two PA lists, half being specifically instructed with three sample trigrams that the items used as stimuli differed in terms of meaningfulness, but not informed of the pairing relationship, with the other half of the Ss not instructed about the stimulus dimension. All Ss were informed of the response pool (1-9).

Two sets of nine CVCs were selected, varying in association value (Archer, 1960) from 20 to 100 in increments of 10. Each set was paired with the digits 1-9 as responses, with three arrangements: increasing (I)—CVC₂₀-1, CVC₃₀-2, etc.; decreasing (D)—CVC₂₀-9, CVC₃₀-8, etc.; and random (R). Each S learned one list from the three arrangements of one set of CVCs, then a second list from one of the three arrangements of the other set, with each set used equally often as the first and second.

The materials were presented by the anticipation method at a 2.2-sec rate, with a 4-sec intertrial interval and about 4 min between the lists. Three different random orders of the lists were used in presentation. The first trial served as a guessing trial since the responses were known, and two consecutive perfect trials served as the criterion.

RESULTS

Since the number of errors on the sets did not differ ($t < 1$), the sets were pooled

in subsequent analyses. Table 1 summarizes first list performance for all groups ($N = 24$ each). For 2 by 3 by 3 analyses of variance, the instructions main effect was not significant for any of the measures in Table 1, with $F_s(1,126) < 1$. The first task S-R assignment produced a main effect for errors and last error trial [$F_s(2,126) = 4.64$ and 4.17, respectively, $p < 0.025$] but was only marginal in the trials to criterion data [$F(2,126) = 2.96$, $p < 0.10$]. There were no interactions with first list assignment. The dummy main effect, second task assignment, was not significant [$F_s(2,126) < 1$], although an interaction with instructions was present in the trials to criterion data [$F(2,126) = 3.12$, $p < 0.05$]. However, this interaction was not significant in the error or last error trial data [$F_s(2,126) = 1.35$ and 2.16], and there were no triple interactions.

The second list performance should allow the consideration of intrarule shifts (I to I and D to D) and shifts to new rules (I to D or D to I), but Table 2 indicates that uniformly rapid acquisition resulted for all groups. For a 2 by 3 by 3 analysis, trials to criterion on the second list failed to show any significant effects, and the number of errors indicated only marginal effects for first and second list S-R assignments [$F_s(2,126) = 2.75$ and 3.03, $p < 0.10$], with no interactions between first and second list assignments for any measures.

A plot of trial-by-trial performance failed to reveal any first-trial differences, although, over the early trials, the RI group did not perform as well as did II and DI, nor did the RD group perform as well as ID and DD, but the RR group was not handicapped relative to the IR and DR groups. II, DD, and RR were quite comparable, as may be seen in Table 2 for overall performance as well. Similar results

Table 1
First List Performance by Groups and Instruction Conditions (SDs are in Parentheses)

Group	Trials to Criterion	Total Errors	Trial of Last Error
Increasing			
Instructed	12.75 (3.46)	40.66 (13.97)	6.81 (2.16)
Uninstructed	13.04 (4.70)	44.50 (19.68)	7.32 (3.87)
Decreasing			
Instructed	13.70 (5.65)	43.29 (19.03)	7.86 (3.83)
Uninstructed	14.58 (6.71)	48.50 (22.81)	8.32 (4.19)
Random			
Instructed	16.00 (6.41)	56.41 (33.09)	9.09 (4.77)
Uninstructed	15.37 (6.42)	56.54 (26.41)	9.65 (4.74)

Table 2
Second List Performance by Groups, Pooled
Over Instruction Conditions, With First and
Second List Assignments Used in Notation
(SDs are in Parentheses)

Group	Trials to Criterion	Total Errors	Trial of Last Error
II	8.81 (4.00)	27.56 (15.76)	4.90 (2.82)
ID	9.00 (4.00)	28.50 (16.27)	5.02 (2.76)
IR	8.50 (1.83)	25.38 (4.73)	4.29 (0.71)
DI	7.94 (3.41)	21.69 (8.68)	3.87 (1.54)
DD	8.75 (3.23)	27.44 (9.98)	4.74 (2.03)
DR	8.13 (2.22)	21.06 (4.99)	3.84 (0.86)
RI	10.19 (5.69)	31.81 (21.48)	5.89 (4.21)
RD	10.31 (4.37)	33.50 (14.58)	5.70 (2.76)
RR	7.81 (2.10)	23.44 (9.73)	4.05 (1.36)

obtained in the number of trials to successive criteria. The performance ceiling on the second list confounds any assessment of rule shift effects by transfer analyses, as the outcomes would be largely determined by the first-list differences.

DISCUSSION

Systematic assignment produced better performance with 1:1 assignment of responses, suggesting information processing at the list level rather than at the pair or stimulus-equivalence level. This facilitation was observed with the demanding anticipation method and fairly rapid presentation rates. A similar procedure was used for single-list acquisition by McGuire (1961) by

correlating the diameter of circles to response numerosity, but with the Ss informed of the relation. The present attempt to extend this paradigm to multiple-list learning and systematic conceptual shift behavior was not completely successful, due to the ceiling effect, but certain points should be noted.

First, there is the interesting finding that the RR group performed as well as did the successive rule groups, and switching to rules from R assignments produced the slowest learning. This suggests that the R lists allowed the Ss to select some functional stimulus (e.g., single letters), and that this was not useful with the rule assignments, since the rule usage requires stimulus learning for dimensional matching. In addition, the meaningfulness dimension is somewhat ambiguous, and while the Ss seemed to detect the dimensionality per se, since no instruction effect resulted, it is possible that the Ss' assessment of order may have been either unsuccessful or idiosyncratic, so that the nominally systematic pairings were nearly random arrangements. A second experiment had the Ss rank the trigrams on meaningfulness prior to learning as one test of this latter possibility. The Ss were corrected by "right" or "wrong," with the systematic pairings based on each S's ranking, with other procedures the same. Only the D rule produced facilitation, so that either the correction procedure changed the effect, although this response discovery technique seems favorable, or simple ranking was not adequate to produce stable dimensions.

An alternative to allowing each S to dimensionalize the materials would be the laboratory establishment of order in unordered items. An obvious method would be serial learning, and the serial to

PA tests of the position hypothesis for the cue in serial learning have followed this general method, with the PA lists constructed with pairings either related or not related to prior serial position (cf. Young, 1968). Data in support of the position hypothesis augment the processing paradigm, but the present data, without serial familiarization, indicate that such tests may require a control group in order to distinguish the effects of rule behavior from connections due to position cues. It seems clear that this paradigm has utility for the study of conceptual behavior and warrants further study to place it precisely on the continuum of mediational theories.

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NOTE

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