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Encoding variability with imagery instructions in paired-associate transfer

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Martin's (1968) encoding-variability hypothesis was tested. Subjects learned two paired-associate lists conforming either to an A-B, A-D or to an A-B, C-D paradigm. Prior to learning the second list, one half of the subjects in each condition were instructed to use imagery to learn the list, while the other half received neutral instructions. If the instructions induce the subjects to variably encode the stimuli (i.e., to switch from a verbal to an imaginal code), then the A-D paradigm in effect becomes a C-D paradigm, and associative interference should be reduced. Results of two experiments failed to confirm the predictions. In addition, imagery instructions did not lead to improved second-list learning, even in the C-D condition, suggesting that it may be difficult to produce changes in learning strategies.

Martin (1968) proposed an encoding-variability hypothesis that stated that "analyzable nominal stimuli are variably encodable, and hence may be perceived differently on different occasions" (p. 421). According to his analysis, then, in a negative transfer situation (e.g., A-B, A-D paired associate lists), when the second task involves recoding of the nominal stimulus, negative transfer ought to be reduced, when compared to a situation where recoding is not involved.

To be more specific, the stimuli in the AD paradigm can be chosen so that the functional stimuli for particular sets of pairs need not be the same in both lists. Thus, by recoding the nominal stimuli, the subject could avoid having to unlearn the first-list associations while learning the second-list associations. In this situation, the AD paradigm would become, in effect, a CD paradigm.

Several attempts to verify these predictions have been made, with unsuccessful results. Williams and Underwood (1970) used trigrams as stimuli and tried to induce a change in second-list encoding by underlining a different letter in each trigram. That they were not successful in producing a reduction in negative transfer in the AD paradigm has been taken as evidence that this paradigm is not suitable for demonstrating stimulus selection. However, it may still be a feasible paradigm for studying encoding variability (Hashtroudi & Johnson, 1976).

Tatum (1976, Experiment 2) used the AD and CD paradigms with either high- or low-imagery nouns as stimuli, on the assumption that the low-imagery (abstract) words were more difficult to differentiate and would thus result in more variable encoding than would high-imagery (concrete) words. The predicted interaction between stimulus imagery and paradigm was not found; there was no less negative transfer with abstract words than with concrete words.

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Using a slightly different set of assumptions from that of Tatum (1976), in order to test the claim by mnemonists that images produce no associative interference, Parker and Bass (1975) arrived at predictions opposite those of Tatum. They examined transfer in the AD and CD paradigms as a function of the type of stimuli, either pictures or words. Parker and Bass predicted that the use of pictures as stimuli would reduce the negative transfer in the AD paradigm because the pictures could be encoded either imaginally or verbally, whereas the words would likely be encoded only verbally. The predicted interaction of paradigm and type of stimuli was not found; comparable negative transfer was produced with both types of stimuli.

The failure of abstract words (Tatum, 1976) or of pictures (Parker & Bass, 1975) to produce less negative transfer might have been due to subjects' reluctance to change their encodings across lists. In fact, one reason offered by Williams and Underwood (1970) for not finding stimulus selection, even though different letters in the stimulus trigrams were underlined from the A-B list to the A-D list, was that subjects tend to be stubborn about changing their encodings for the same nominal unit.

Perhaps instructions to subjects to change their encodings of stimuli on the transfer list would be a more compelling means of producing encoding variability. Thus, imagery instructions given immediately before second-list learning, but not before first-list learning, should increase the likelihood that subjects will change from a verbal stimulus encoding to an imaginal stimulus encoding. For concrete words, subjects instructed to use an imagery code on the transfer list should show less negative transfer than subjects not given second-list imagery instructions. However, for abstract words, those

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not easily encoded in the imaginal system, instructions to use imagery should not appreciably influence negative transfer. Only for concrete stimuli, then, are instructions and paradigm predicted to interact, thereby producing a second-order interaction among the three factors of stimulus concreteness, imagery instructions, and paradigm (AD vs. CD).

EXPERIMENT 1

Method

Design and Subjects. The basic design was a 2 by 2 by 2 factorial with the factors of paradigm (AD, CD), instructions (imagery, control), and imagery value of the stimuli (low, high). The use of two sets of lists for each imagery-level condition resulted in 16 cells. The subjects were psychology students serving in experiments as part of a course requirement, and they were assigned to the 16 cells by a method of block randomization. There were six subjects assigned to each cell. Twelve subjects from the low-imagery conditions were replaced because they did not reach criterion on the first list within 30 trials.

Materials. The words used in the paired associate lists were drawn from the Paivio, Yuille, and Madigan (1968) norms. Two pools of words were drawn so that one contained words rated high on imagery (6.00 or above), and the other contained words rated low on imagery (4.50 or below). All words had moderate (10 to 49 per million) or high (A and AA) frequency ratings according to Thorndike and Lorge (1944). There were equal numbers of each type of words.

The stimuli for the high-imagery lists were drawn randomly from the pool of high-imagery words, and the stimuli for the low-imagery lists were drawn from the pool of low-imagery words. Response words for both types of lists were taken randomly from the low-imagery pool. Within each level of imagery, two sets of lists were constructed, where a set consisted of the three lists needed to specify A-B, A-D, and A-B, C-D paradigms. Each list consisted of 12 pairs, and a given word was used in one and only one set of lists. Four random presentation orders of each list were constructed, with the constraint that the pair ending an order could not begin the next order.

Procedure. Prior to learning the first list, all subjects were read a standard set of instructions for paired associate learning. The list was presented by the anticipation method at a 2:2-sec rate, and subjects continued through the list until they achieved 10 correct responses out of the 12 pairs. Any subject not reaching criterion within 30 trials was replaced by the next subject signed up for the experiment.

Following first-list learning, all subjects were given instructions concerning the transfer list. For subjects in the control conditions, the standard instructions were simply repeated. Subjects in the imagery conditions were instructed to form an image of the first member of each pair to help them learn the list. All subjects were given 1 study and 10 anticipation trials on the second list.

Results and Discussion

List 1. The number of trials to criterion was analyzed using a three-way analysis of variance with list sets nested within imagery level. As expected, the low-imagery lists (mean = 16.15) took longer to learn than the high-imagery lists (mean = 6.96) [$F(1,86) = 67.40$, MSe = 30.06]. No other effects were significant.

List 2. The mean total correct responses in the 10 transfer trials is presented in Table 1. Subjects in the AD conditions produced fewer correct responses than subjects in the CD conditions [$F(1,86) = 23.61$, MSe = 322.47], and subjects learning high-imagery lists performed better than subjects learning low-imagery lists [$F(1,86) = 41.91$]. However, neither the Paradigm by Instructions interaction nor the Paradigm by Instructions by Imagery Level interaction was significant (both $Fs < 1$).

Table 1
Mean Number of Correct Responses on List 2

Imagery Value of Stimuli	List 2 Instructions and Paradigm			
	Imagery		Standard	
	A-B, A-D	A-B, C-D	A-B, A-D	A-B, C-D
	10-Trial Totals			
Low	52.5	75.6	53.8	66.4
High	79.0	96.6	74.8	92.8
	First Trial			
Low	.83	2.33	.75	1.58
High	2.50	4.25	2.00	3.42

Since Postman (1971) pointed out that the first trial of transfer is the most sensitive trial to transfer effects from original learning, the number of correct responses on the first trial of transfer was also analyzed. The results of this analysis were similar to the results from the total correct. The AD paradigm produced negative transfer [$F(1,88) = 11.96$, MSe = 3.79], and the high-imagery lists produced more correct responses than the low-imagery lists [$F(1,88) = 17.58$]. (List set was not used as a factor in this analysis.)

The results of this experiment indicate that subjects learning the AD lists did not recode the stimuli using an imaginal code in order to reduce the amount of associative interference. Why the recoding did not occur is not clear, although a number of subjects reported not having enough time to form effective images. The second experiment was designed to give subjects more time to create images.

Another possible explanation for the present results is that the imagery instructions were not effective. Comparison of the number correct anticipations under imagery instructions and under standard instructions in the CD paradigm indicated that, while there was a numerical superiority for the image groups, the difference was not significant for either the high-imagery lists [$t(22) < 1$] or the low-imagery lists [$t(22) = 1.33$]. Thus, it is possible that the instructions were not effective. In the second experiment, the imagery instructions were modified, in hopes of increasing their effectiveness.

EXPERIMENT 2

The procedures were the same as in the previous experiment, but the imagery instructions for the transfer list more strongly emphasized the use of images in learning the word pairs.

Method

Word lists. Word lists were constructed in the same way as in Experiment 1, with the following changes. Only one list was constructed for each level of imagery, and the lists contained 10, instead of 12, pairs.

Procedure. The instructions and presentation rate for List 1 were the same as for those in Experiment 1. Learning was taken to a one-perfect criterion.

Three modifications were made for second-list learning. First, a 4:2-sec rate was used; although the anticipation period was the same, the study period was increased from 2 to 4 sec. Second, the imagery instructions used in Experiment 1 were modified. Subjects given imagery instructions were asked not only to form an image of the first member of the pair, but also to form an image specified by both members of the pair interacting. Third, only five trials were given on the transfer list.

Design and Subjects. The design for this experiment was the same as for Experiment 1, with the exception that only one list set was constructed for each level of imagery. A total of 96 subjects, 12 in each condition, served in this experiment as part of a course requirement. Eight of these subjects, three from the high-imagery conditions and five from the low-imagery conditions, were replaced for not learning the first list to criterion within 40 trials.

Results and Discussion

List 1. Analysis of variance on the number of trials to criterion revealed the expected effect of imagery level, with high-imagery lists learned faster than low-imagery lists [F(1,88) = 21.13, MSe = 55.65]. Unexpectedly, the interaction of Imagery Level by Instructions (a dummy factor for this list) was also significant [F(1,88) = 4.67]. Inspection of the cell means showed that subjects who learned the high-imagery lists and who subsequently received standard instructions for transfer learning took less trials to learn than subjects who subsequently received imagery instructions; the opposite was true for subjects learning low-imagery lists. No other effects were significant.

List 2. The mean total correct responses over the five transfer trials are presented in Table 2. Analysis of these data yielded significant effects of imagery level [F(1,88) = 88.70, MSe = 58.74] and Imagery Level by Instructions [F(1,88) = 5.81]. The paradigm effect did not even approach significance ($F < 1$). The patterns of means in the Imagery Level by Instructions interaction were similar to the pattern found on List 1 learning. It therefore seems reasonable to conclude that the interaction in this analysis was due to the fact that the eight groups were initially unequal in learning ability.

An analysis of covariance using the measure of first-list learning as the covariate was conducted to equate for differences in learning ability. The only significant effect in the analysis of covariance was that of imagery level [F(1,87) = 50.99]. The Imagery Level by Instructions interaction was not significant [F(1,87) = 2.18], indicating that it probably resulted from unequal learning on the first list.

Table 2
Mean Number of Correct Responses on List 2

Imagery Value of Stimuli	List 2 Instructions and Paradigm: Imagery A-B, A-D	Imagery A-B, C-D	Standard A-B, A-D	Standard A-B, C-D
	Five-Trial Totals			
Low	29.0	26.8	22.2	22.8
High	38.1	38.8	38.2	42.9
	First Trial			
Low	2.58	2.32	1.58	2.58
High	4.25	5.00	4.17	5.83

GENERAL DISCUSSION

Instructing subjects to use imagery when learning the second list did not reduce the amount of negative transfer present in the AD paradigm. Presumably, subjects did not recode the stimuli. Lengthening the study interval to 4 sec on the transfer list to allow more time for the creation of images did not differentially reduce the amount of negative transfer; it simply allowed subjects in both instructional conditions to overcome the associative interference.

The finding that instructions to produce images did not result in better performance on the second list in the CD paradigm was somewhat surprising, in light of other research (see reviews by Paivio, 1969, 1971). Although other researchers have found significant improvement in paired associate learning when subjects were instructed to use images, the instructions have been given prior to learning a single list or prior to learning both lists (e.g., Spiker, 1960). Presenting imagery instructions only after subjects have had practice with their own strategies in learning the first list may have negated the effectiveness of the images as mediators. That is, subjects used one strategy and were reluctant to switch. It is also possible that learning a first list with high-imagery value stimuli when standard instructions were given may have produced the same result when instructions to use images were given. In short, while learning the first list, subjects learned to produce images, so that when the image instructions were given, they simply reinforced what the subjects were already doing, and no increase in performance would be expected.

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