JOURNAL OF VERBAL LEARNING AND VERBAL BEHAVIOR 9, 529–533 (1970)

Imagery as a Relational Organizer in Associative Learning[1]

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Mental imagery improves paired-associate (PA) learning relative to overt rehearsal. The effect might be due to increased reliability of stimulus encoding or to increased relational association produced by imagery. These hypotheses expect different outcomes when imagery and rote-rehearsal *S*s are compared on memory tests of stimulus recognition and on recall of the response term conditional upon stimulus recognition. The *S*s learned PAs using one of three methods—rote repetition, interactive imagery, or separation imagery. Associative recall was highest for interactive-imagery *S*s and lower and equal for rote- and separation-imagery *S*s. No differences in stimulus recognition appeared. Such evidence supports the relational-organizing interpretation of the PA effect of imagery in opposition to the stimulus-distinctiveness or reliable-encoding explanations.

It has been shown repeatedly that mental imagery is a beneficial associative aid (cf. Bower, 1970; Paivio, 1969). In learning word-word paired associates, adult *S*s instructed to make up mental pictures of interactions between the referents of the words learn the associations much faster than almost any suitable control *S*s (cf. Bower, 1970). Recall by *S*s using the imagery mnemonic has been compared to and has been found to exceed significantly that of *S*s given rote-rehearsal instructions, of *S*s reading the word pair in the context of a meaningful sentence, of *S*s told to produce a meaningful sentence linking the word pair, and finally of control *S*s merely told to learn by whatever methods they typically use (Winzenz & Bower, in press). Because interactive imagery is such a potent method for associating meaningful words, it is important to try to get some explanation for its effectiveness. The present paper attempts to argue and show experimentally that one class of explanations is more probable than another.

At an abstract level, there would appear to be two alternative classes of explanations for the efficacy of imagery in PA learning, say, in comparison to verbal rote repetition. One class of explanations supposes that the imagery effect is due to some benefit regarding the differentiation of the individual elements in the pairs; the other class of explanations attributes the effect to the element-to-element association process itself. These two views will be elaborated further.

The differentiation type of explanation has several variants, depending on the specific concepts emphasized. It would postulate, for instance, that the encoding of an item by imagery *S*s results in a more distinctive functional stimulus than is produced in control *S*s. That is, the word plus imaginal code is a more distinctive, more isolated, more outstanding stimulus complex than is the word alone. Due to this greater distinctiveness, such paired items are more resistant to intralist generalization from other pairs in the list, so the associations suffer less interference and recall is higher. An alternative form of this approach assumes that each item has a hierarchy of possible implicit encodings (including referent imagery), that one such encoding of the stimulus item is aroused and associated to the response term on the study trial, and that this same encoding must be rearoused by the

[1] This research was supported by Grant MH-13950 to the author from the National Institute of Mental Health. Appreciation is expressed to Miss Judy Ford for assisting in the collection and analysis of the data.

stimulus item on the test trial in order for recall to occur. On this view, *reliability* of encoding is the potent factor in recall. Therefore, this view should postulate that imaginal encoding of a stimulus word is particularly reliable or stable compared to verbal encoding. Perhaps the verbal-rehearsal *S* varies from one occasion to the next in selecting a functional cue from a word—a letter one time, a phoneme or syllable the next, a meaning or stray verbal associate the next time, and so on—and this variability in implicit coding lowers the level of recall and the speed of learning.

The second class of explanations ascribes the imagery effect to better or stronger associations rather than to item-distinctiveness factors. One example is the hypothesis that associating requires that *S* find a relation between the two items, and the further supposition that imagery is a versatile method for depicting spatial relationships among objects, relationships that confer "perceptual unity" upon the objects to be associated (Asch, 1969). A second hypothesis of this form would suppose that imagery instructions have their main effect through inducing *S* to link the two words (usually nouns) as semantic concepts in predicate expressions of the form "actor-action-object." According to this latter view, the linguistic predicate generated by *S* serves as a good relational connective between the two nouns to be associated.

In the experiment below, *S*s using interactive imagery are compared to *S*s learning by rote repetition, by having each A–B learning pair be tested later for recognition of A and for recall of B to A as a cue. If the "distinctiveness" theory were correct, then imagery *S*s should exceed rote *S*s in stimulus recognition and in response recall given stimulus recognition. If the "relational association" hypotheses were correct, then imagery *S*s should exceed rote *S*s on recall given stimulus recognition, but they should not differ on stimulus recognition.

A third condition was tested along with the former two, based on the hypothesis that associative strength of A–B can be varied within imagery conditions. Let us call the former condition "interactive imagery"—wherein *S* was enjoined to construct an imaginary scene depicting some interaction between the A and B objects. The alternate condition will be called "separation imagery." The instructions to *S*s in this condition were to vividly image the A and B referents but to keep them noninteracting, well separated in imaginal space, as though they were separate, still photographs on different walls of a room. If one believed that the benefit of interactive imagery were due to relational associating, then this separation-imagery condition would be expected to produce the same probability of stimulus recognition as the interactive condition, but a drastically reduced conditional probability of PA response recall given stimulus recognition. On the other hand, the earlier distinctiveness hypothesis would expect these separation-imagery *S*s to show higher stimulus recognition than rote *S*s but perhaps with poorer recall given recognition than the *S*s generating interactive imagery.

METHOD

Design. Three groups of *S*s studied word-word paired associates after receiving instructions to learn using either (*a*) overt rote repetition of the word pair, (*b*) construction of an interactive scene in imagery, or (*c*) imagery of the objects noninteracting and separated in "imaginal space." The study trial was followed by a test for stimulus recognition and for PA recall given recognition. The procedure was repeated on three different lists of 30 PAs.

Materials and procedure. All words were concrete nouns selected for high imagery from the norms published by Paivio, Yuille, and Madigan (1968). The words were paired arbitrarily but avoiding obvious relations. There were 90 pairs shown in three lists of 30, each pair presented for 10 sec in the window of a memory drum. Each study list of 30 pairs was followed by a test list of 60 words, the left-hand ("stimulus") members of the 30 pairs of the study list scrambled in with 30 new concrete nouns (as "distractors" or "lures"). Each test word appeared for 10 sec during which *S* (*a*) rated the likelihood that he had seen it on the prior study list by checking off a 5-point scale ranging over the values "Sure Old, Think Old, Don't

Know, Think New, Sure New," and (*b*) if *S* thought the word had appeared in the prior list, he tried to recall the other word paired with it. No feedback was given on test trials. Each list received one study trial followed by one test trial. The three lists were presented in the same order to all *S*s, with a 60-sec rest between lists.

The instructions to the rote *S*s emphasized overt repetition of each word pair. Although data were not recorded, it was noted that most of these *S*s repeated each pair aloud about four or five times during the 10-sec presentation interval. The interactive-imagery *S*s were told to visualize the objects denoted by the words of a pair and to imagine these interacting in some vivid way in an integrative scene. Instructions to separation-imagery *S*s emphasized visualizing the two objects noninteracting, far separated in the "left versus right sides of the imaginary visual field." All *S*s appeared to understand such instructions. It was emphasized that *S* was to try using only the instructed learning method and no other, and they were reminded of their prescribed method between lists.

The *S*s were 30 high school graduates (ages 17–22) solicited through an ad in a local newspaper. Many were college students on summer vacations, and they were paid for their 1-hr participation. Ten *S*s, five males and five females, were assigned in random alternation to the three instructional conditions.

Results

Performance of the three groups on the three lists was consistently ordered, so average results pooled across lists give all the relevant information. The major results are displayed in Table 1 giving percentage stimulus recognition, response recalls, and conditional response recall given stimulus recognition. For these purposes, a rating of "Sure Old" and "Think Old" were counted as recognitions of an Old stimulus. The salient facts to be gathered from Table 1 are, comparing across the three instructional conditions, that stimulus recognition differs very little, whereas recall differs greatly as does recall conditional upon positive recognition. Details and statistical confirmation of these summaries follow.

TABLE 1

Percentage of Recognition, Recalls, and Conditional Recall Given Recognition for the Three Groups Pooling all Three Lists

Group	Recognition	Recall	Recall given recognition
Interactive imagery	.87	.53	.61
Separation imagery	.83	.27	.34
Rote repetition	.84	.30	.36

First, the recognition scores shown in Table 1 are the probabilities of *S* saying "Old" to an Old stimulus, the so-called "hit rate." The differences among the three hit rates are small and statistically insignificant. The proportions of "false alarms," judging novel distractors as Old items, were .06, .06, and .09 for the two imagery groups and the rote-repetition *S*s, respectively. Since the rote *S*s were slightly lower than the interactive-imagery *S*s on hit rate and slightly higher on false alarms, statistical tests were done on a hits-minus-false alarm index of discrimination, using the three lists within the day as a separate factor. Although a significant effect due to list appeared (recognition improved over the three lists), the effect due to instructional conditions was not significant, $F(2, 27) = 2.23$, $p > .05$. The conclusion is therefore that imaging the referent of a word does not enhance later recognition memory relative to rote repetition of the word.

Second, the differences between conditions in recall are quite substantial (cf. Table 1). The Interactive Imagery condition clearly exceeds the other two conditions ($p < .001$ in each case), but the latter groups do not differ from one another. A similar picture is revealed by the conditional probability of recall given stimulus recognition. Analysis of variance on this conditional measure, using lists as a factor, showed a significant list effect (recall improved over lists) and a highly significant effect of instructional conditions, $F(2, 27) = 8.04$, $p < .01$. The differences in recall among conditions were entirely due to differing percentages of omissions since overt recall errors were infrequent (occurring on about 6% of the tests) and nearly equal across instructional conditions.

Discussion

The results show that interactive-imagery instructions enhance paired-associate learning without increasing stimulus recognition. Such results argue that the benefit due to imagery in associative learning is concerned with the "relational associating" part of the process rather than with the "stimulus encoding" part. If stimulus recognition is accepted as an index of reliability of stimulus encoding, then the absence of recognition differences undercuts the "reliable stimulus coding" hypothesis about imagery. Also, the fact that separation-imagery *S*s recall so poorly is evidence that the customary benefit of imagery in paired associates is in the associative part, not the stimulus differentiation part. The claim that imaginal elaboration does *not* enhance stimulus differentiation is significant in so far as most explanations of imagery effects refer to this factor. Theories of this genre include Paivio's (1969) "conceptual peg" hypothesis, plus several hypotheses suggested by Bower (1970) which involve "personalized instantiation" of general concepts or "selection of a good cue" from among multiple cues alleged to be provided by imagery.

We have found no effect of imaging the referent of a word upon later recognition of that word. One may question whether our data are compatible with previous results which appeared to demonstrate that "picturability" increased later recognition memory. For instance, Gorman (1961) demonstrated higher recognition memory for concrete nouns than for abstract nouns, and Jenkins, Neale, and Deno (1967) demonstrated higher recognition memory for pictures of objects than for their corresponding names. Such results are quite reliable, having been replicated in several laboratories. The picture versus word result is explicable on the supposition that common-object pictures are stored both visually and in terms of the verbal labels they elicit, that both of these codes may be retained, and that memory for either of the two codes will exceed memory for the verbal label alone. Gorman's results are not necessarily incompatible with ours, since she compared concrete versus abstract nouns within *S*s whereas we compared imagining versus rote repetition of concrete nouns between *S*s, her *S*s were rapidly paced (1 sec per item) at study and testing whereas our *S*s had more leisurely trials (10 sec per item), and so on. But rather than stressing our null result on imaging and recognition, one should instead emphasize the positive conclusion that differences in associative recall between rote *S*s and interactive-imagery *S*s remain quite substantial even when only recognized stimulus items are considered.

The present results delimit the main effect of imaginal elaboration in PA to the associative phase; the difference in recall between interactive versus separation imagery refines the associative hypothesis to some extent. The recall differences between the two imagery conditions are analogous to those reported by Epstein, Rock, and Zuckerman (1960) for pictures and by Rohwer (1966) for nouns embedded in sentence contexts. Epstein et al. (1960) showed that two pictured objects are more easily associated if they are shown in some kind of spatial interaction (e.g., a ROCK breaking a BOTTLE) as opposed to depicting the two objects side by side. Rohwer (1966) found that noun-noun PA recall was facilitated when at input the nouns were connected by a verb or preposition (e.g., The ROCK breaks the BOTTLE) as opposed to a conjunction (The ROCK and/or the BOTTLE). The relevance of Rohwer's findings to the present results stems from incidental observations on how interactive- versus separation-imagery *S*s verbally described their imaginal scenes. The typical interactive scene was described by phrases relating the two nouns as grammatical subject and object connected by a verb or preposition. The predominant form was "actor-action-object" sentences. On the other hand, *S*s in the Separation-Imagery condition described their imaginal scenes with conjunctions: "an A over here *and* a B over there." In each case, the main nouns might be embellished by adjectival modifiers, but the base syntactic form usually involved predication for interactive *S*s and the conjunction "and" for separation *S*s.

Such parallels lead one to suspect that this recall pattern with pictures, images, and word contexts is being produced by one and the same relational generating system. This may be a "conceptual deep structure" (cf. Shank, 1969) into which sentences and perceptual experiences are translated for storage and out of which either surface sentences, imagery, or drawings may be generated, depending on the material and the task demands. At present, this hypothesis is rather indeterminate and further research is required to refine or extend it.

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(Received April 27, 1970)