Bulletin of the Psychonomic Society
1978, Vol. 12 (2), 162-164

Recognition memory of letter and nonletter configurations matched for imagery

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Some researchers have concluded that nonverbal recognition is generally superior to verbal recognition memory performance. The present study involved two experiments designed to assess claims of superior nonverbal memory. Experiment 1 compared performance for letter (common words) and nonletter (meaningful line drawings) items with matched high-imagery values. Experiment 2 compared performance for matched low-imagery items consisting of letters (pseudowords) and nonletter items (geometric matrices). Performance did not differ significantly between verbal and nonverbal items in either experiment, although the expected effects of presentation rate and type of retrieval task were significant. It was concluded that recognition memory performance is not necessarily dependent upon the "verbalness" or "nonverbalness" of stimulus items.

A number of researchers have made statements about the relative level of visual recognition memory performance of subjects asked to recognize pictorial (nonverbal) stimuli compared with word (verbal) stimuli. For example, Shepard (1967) and Standing (1973) found high retention rates between 95% and 98% for picture recognition memory, while performance for words varied from 85% to 88%. On the other hand, Goldstein and Chance (1970) employed three types of "pictures" and reported hit rates varying from 33% to 71%. While the findings of Shepard, Standing, and others lead to the conclusion that recognition memory performance for pictures is both high and better than that for words, the data reported by Goldstein and Chance suggest that it may be premature to propose such a general conclusion.

Whether the visual configuration presented for study consists of a string of letters or other, nonletter, items is only one characteristic of the stimuli that might be considered important. It is well known that letter strings with high meaningfulness (words) are more easily recognized than letter strings of low meaningfulness (CCC trigrams and pseudowords). When strings of letters are used as stimuli, it is typically assumed that a verbal linguistic process is heavily involved in the storage and retrieval of items, whereas when nonletter items are involved, the role of verbal linguistic processes is less clear. When words are used as stimuli, they typically come from normative lists (e.g., Paivio, Yuille, & Madigan, 1968) where characteristics such as imagery and meaningfulness are specified; however, "pictures" come from relatively heterogeneous pools of items (e.g., vacation slides, magazine advertisements, etc.). As pointed out by Goldstein and Chance (1974), the stimulus category picture is often vague, undefined, and ambiguous. This situation can result in confounded comparisons between homogeneous sets of words with known frequency, imagery, and meaningfulness values and heterogeneous pictures with uncontrolled features. In addition, other factors such as presentation rate and types of retrieval task have varied across studies making a direct comparison of results from different studies tenuous at best.

The present study used sets of letter stimuli ("words") and nonletter configurations ("pictures") to explore conclusions by Standing (1973) and others that recognition memory performance of nonverbal items is generally superior to that for verbal items. Stimuli were selected from a pool of items scaled for imagery and meaningfulness so that letter and nonletter items were homogeneous and had similar values on these attributes. The possible interaction between recognition rates of words vs. pictures under different presentation rates and different types of retrieval tasks was also explored. If recognition memory performance for line drawings is uniformly superior to that for words, then subjects presented with drawings should perform better than those given words regardless of presentation rate or type of retrieval task. However, if performance varies as a function of the similarity or homogeneity of items, as suggested by Goldstein and Chance (1970, 1974), then recognition scores for sets of stimuli matched on imagery should not differ reliably.

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EXPERIMENT 1

Method

Stimuli. Verbal items were 36 common nouns four to seven letters in length from a normative study by Paivio et al. (1968). Selected items had high and homogeneous values of imagery obtained by a 7-point rating scale ranging from low imagery (1) to high imagery (7) and values of meaningfulness obtained by the production method. The mean imagery value was 6.46 (SD = .19) and average meaningfulness was 7.54 (SD = .36). A set of line drawings of common objects was taken from a

children's reading readiness test (Evanecho, Ollila, Downing, & Braun, 1973). A pool of 52 drawings was rated for imagery and meaningfulness using the same procedures as Paivio et al. (1968). Items in both the words set and the line-drawings set were rank ordered according to imagery values, and 16 line drawings were deleted to maximize overlap in ratings between the two sets of items. This procedure resulted in 36 drawings with mean imagery value of 6.01 (SD = .40) and average meaningfulness of 8.09 (SD = .70). The remaining 36 words and 36 drawings were divided into subsets of 18 targets and 18 distractors of each type of stimulus according to the following procedure. The two highest rated items made up the first stimulus pair (one target and one distractor), the next two rated items made up the second pair, and so on. This resulted in 18 pairs of words and 18 pairs of drawings that were closely matched on imagery within each pair and that were very similar in mean imagery ratings between words and drawings. The member of a pair that served as target or distractor was determined by use of a table of random numbers. The only restriction was that for common nouns, the targets and distractors were not allowed to vary by more than one letter in word length.

Selected stimulus items were made into 35-mm slides and projected with Kodak Carousel projectors onto a portable screen 2.5 m from the projectors. Illumination measured by a Weston light meter was 11.76 cd/m^2 when one projector was used in the study phase and 23.53 cd/m^2 when two projectors were used in the retrieval phase of forced-choice conditions.

Subjects and Design. Forty-eight university student volunteers served as subjects. Ages ranged from 17 to 25 with a mean of 19.4 years. They were randomly assigned to six groups of eight subjects each with four males and four females in each group. The six groups were arranged in a 2 (type of stimuli) by 3 (presentation conditions) factorial design. Half the subjects received word stimuli under one of three conditions: (1) slow rate of presentation with forced-choice retrieval, (2) faster rate of presentation with forced-choice retrieval, and (3) the same faster rate of presentation with single-item (yes-no) retrieval. The remaining 24 subjects received line drawings as stimuli under one of these three conditions.

Procedure. Instructions were both read aloud and presented on mimeographed sheets. Stimulus items in the "slow" conditions were presented at a continuous rate of 500 msec exposure time with 5 sec from onset to onset of successive items. Items in the "fast" condition were presented at a rate of 250 msec exposure time with 1,800 msec from onset to onset.

The retrieval task was presented immediately after presentation of the 18-item study list. In the forced-choice conditions, test pairs consisting of one target and distractor were presented for 8 sec with 1 sec between pairs. Response sheets were provided, on which subjects circled the word "left" or "right" indicating which item had been presented in the study list. In the single-item retrieval conditions, 18 targets and 18 distractors were individually presented in a random order. They were presented for 8 sec each with 1 sec between items. Subjects responded by circling the word"yes" or "no" on a response sheet to indicate whether a given test item had been presented in the study list.

Results and Discussion

Analysis of the mean percent correct and d′ revealed very similar performance in retrieval of words (mean percent correct = 94.50, d′ = 3.84) and line drawings (mean percent correct = 95.60, d′ = 4.11). Differences in performance associated with testing conditions were more substantial (forced-choice slow = 99.65%, d′ = 4.99; forced-choice fast = 95.48%, d′ = 3.87; and single-item fast = 90.10%, d′ = 3.07). Analysis of variance applied to these data revealed no significant difference associated with type of stimuli or interaction between type of stimuli and testing conditions ($F < 1$ in each case). However, for percent correct responses, there was a reliable effect associated with testing conditions [$F(2,42) = 12.68$, $p < .001$] that accounted for 37% of the total variance. Very similar results were obtained from analysis of d′ scores [$F(2,42) = 9.71$, $p < .001$].

Experiment 1 showed significant differences replicating the effect of other variables upon recognition memory performance. Faster rates of presentation led to poorer performance than slower rates (Potter & Levy, 1969), and the single-item retrieval task led to poorer performance than the forced-choice task (Underwood, 1972).

The results of Experiment 1 may be limited by a possible ceiling effect. However, if our assumptions of the importance of matching items on imagery are correct, it should be possible to show a similar lack of difference in retrieval of letter strings and nonletter stimuli that are rated low in imagery and meaningfulness. Generally, such low-rated items should be more difficult to retrieve (Paivio, 1971). Thus, Experiment 2 was carried out to check if the lack of difference in retrieval between the two classes of stimuli in Experiment 1 was specific to high-rated items and their corresponding high retrieval rates.

EXPERIMENT 2

Method

Stimuli. The selection and use of stimuli was essentially the same as that followed in Experiment 1. Two sets of 52 stimulus items were selected for scaling on imagery and meaningfulness and 16 items were deleted from each set to give homogeneous values on these attributes. The set of verbal items consisted of computer-generated random strings of four to seven consonants or pseudowords. The 36 pseudowords used for study and retrieval had a mean imagery rating of 2.83 (SD = .59) and an average meaningfulness value of 5.69 (SD = .43). The nonverbal or pictorial items were 4 by 4 black and white matrices previously used by Adamowicz (1976). Their mean rated imagery was 4.01 (SD = .86) and average meaningfulness was 5.64 (SD = .46).

Subjects and Procedure. The subjects were 16 university students from the same pool as those in Experiment 1. These were randomly divided into two groups, one receiving the matrix stimuli ("pictures") and the other receiving the pseudowords using the slow procedure from Experiment 1 (500-msec exposure with 5,000 msec from onset to onset of successive items) with a forced-choice retrieval task.

Results and Discussion

The mean percent correct recognition was 63.2% (d′ = .53) for matrix stimuli and 59.0% (d′ = .37) for pseudowords ($F < 1$ for both percent correct and d′). Thus, in both Experiments 1 and 2 there was no reliable difference in the retrieval of strings of letters (words or

pseudowords) and nonletter stimuli (line drawings and matrices). However, as expected (Paivio, 1971), recognition memory performance for both sets of items having low-rated imagery was substantially lower than for items in Experiment 1 that had high-rated imagery. Thus the results of the present two experiments support the notion that when stimulus items have been explicitly matched on imagery and meaningfulness, there is no difference in visual recognition memory performance for verbal and nonverbal items. Second, this lack of difference holds over different presentation rates, types of retrieval task, and both high- and low-imagery items.

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(Received for publication May 18, 1978.)