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Hemispheric dominance in recall and recognition

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The present study, using the concept of hemispheric dominance, a differential facility in using the specialized functions of one hemisphere as opposed to the other hemisphere has shown that retention in verbal learning is related to this factor. Of most importance was the finding that auditory presentation was related to left-hemispheric domiance while visual presentaiton was related to right-hemispheric dominance.

Imagery ability, at best, has been an inconsistent predictor of verbal learning performance. Subjective imagery refers to an introspective self-rating of the vividness of imagery. Scales of this factor include the Questionnaire on Mental Imagery (Sheehan, 1967), the Vividness of Visual Imagery Questionnaire (Marks, 1973), and the Verbalizer-Visualizer Questionnaire (A. Richardson, 1977). The majority of studies using these subjective measures have been succinctly summarized by Ernest (1977, p. 187): "In no instance was the ability to use vivid imagery related to learning, nor did imagery vividness interact with other effects."

Objective imagery ability is usually measured by tests of spatial relations, such as flags (Thurstone & Jeffrey, 1956), under the assumption that a good score on the test depends on a subject's ability to mentally manipulate the material, that is, control his visual imagery. Several studies (Christiansen & Stone, 1968; Divesta & Sunshine, 1974; Hollenberg, 1970) using objective imagery as a classifying variable have found that high-imagery-ability subjects learned better than low-imagery-ability subjects. Other investigators (Calvano, 1974; Ernest & Paivio, 1969) have reported negative results.

J. Richardson (1978), using both subjective and objective imagery tests, found neither to be related to learning performance. He did, however, find differences among his subjects with respect to whether they preferred to encode information pictorially or verbally. This preference, however, was independent of imagery ability. Richardson concluded that, if coding preference is the critical factor in determining learning ability, the inconsistent results found in correlating imagery ability and verbal learning are a result of the use of the wrong classifying variable.

This conclusion is consistent with the contention of Zenhausern (1978), who suggests that hemispheric dominance[1] is the appropriate classifying variable. The concept of hemispheric dominance depends on a differential facility in using the specialized abilities of the two hemispheres. While the performance of any task depends on both cerebral hemispheres, the relative contribution of each hemisphere varies from task to task. A left-hemisphere-dominant individual is one who performs better on those tasks to which the left hemisphere makes a greater contribution than the right hemisphere. A right-hemisphere-dominant individual is one who performs better on those tasks to which the right hemisphere makes a greater contribution than the left hemisphere. Thinking style is related to hemispheric dominance in that a right-dominant individual prefers deductive reasoning and depends very strongly on visual imagery in thinking, while a left-dominant individual prefers inductive reasoning and does not depend very strongly on visual imagery in thinking.

The purpose of this paper is to investigate the use of hemispheric dominance as opposed to objective or subjective imagery as a classifying variable in verbal learning.

METHOD

Subjects

Ten male and 10 female graduate and undergraduate volunteers served as subjects in this experiment. By means of the Style of Thinking questionnaire (Zenhausern, 1978) and "Your Style of Learning and Thinking" (Torrance, Reynolds, Ball, & Reigel, 1978), subjects were divided into right and left dominant so that an equal number of males and females were classified as left- and right-hemisphere dominant.

Materials and Apparatus

Questionnaires. The Style of Thinking questionnaire consists of a series of exercises designed to help subjects focus in on the way they think. A final question on whether they think more in words or more in pictures is taken at face value. A person who responds that he thinks in pictures is considered right dominant, while a person who responds that he thinks in words is considered left dominant.

"Your Style of Learning and Thinking" is a 36-item, three-alternative multiple-choice test that gives right, left, and integrated scores. Zenhausern and Repetti (Note 1) found 70% agreement between the two questionnaires, such that those who reported they thought in pictures scored more right responses and those who reported they thought in words scored more left responses. Therefore, subjects in this study who showed agreement between the two questionnaires were classified as left or right dominant.

Stimuli. A total of 160 words were selected from the list provided by Paivio, Yuille, and Madigan (1968) such that 80 words were of low imagery value (range = 1.63-3.43, mean = 2.73) and 80 were of high imagery value (range = 4.17-

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6.80, mean = 6.41). In addition, the words were matched for frequency of use on the basis of the values included in the list. The words were then divided into 10 lists of 16 words each, each consisting of 8 high-imagery and 8 low-imagery words. A Lafayette Instrument Company Model 303 memory drum and Sony Model TC-110B cassette tape recorder were used to present the stimuli.

Procedure. Each subject was exposed to a list of 16 words, presented at 4-sec intervals, either auditorily through the tape recorder or visually through the memory drum. After each list, the subjects were asked to write down all the words they could remember; this procedure was continued for all 10 lists. The auditory and visual presentations were alternated, and the order of auditory or visual presentation first was counterbalanced across subjects. After completion of all 10 lists, subjects were unexpectedly asked for total recall of the words from all lists. Finally, the subject was handed a list of 320 words, including the 160 from the 10 lists interspersed with 160 new words, and asked to circle those he recognized.

RESULTS

Immediate Recall

The number of words recalled was averaged for low and for high imagery value across the five auditory and five visual lists and then was submitted to a split-plot analysis of variance with hemispheric dominance and sex as between-subjects factors and imagery value and input modality as within-subjects factors. A square-root transformation, as suggested by Kirk (1968), was used in the analysis. The main effect of sex was significant [$F(1,16) = 6.75$, $p < .05$], with females (mean = 4.18) recalling significantly more words than males (mean = 3.52). Imagery value was also significant [$F(1,16) = 82.73$, $p < .01$], with high-imagery words (mean = 4.58) recalled more often than low-imagery words (mean = 3.12). The interaction between imagery value and input modality was also significant [$F(1,16) = 6.37$, $p < .05$] and indicated that for high-imagery words, auditory input resulted in better recall than visual input, while for low-imagery words, visual input resulted in better recall than auditory input. This finding was modified, however, by the significant [$F(1,16) = 7.03$, $p < .01$] interaction of hemispheric dominance, input modality, and imagery value. The means for the interaction, presented in Table 1, indicate that for low-imagery words, the means for visual presentation are higher than those for auditory presentation, while for high-imagery words the mean for auditory presentation is lower than visual presentation for the right-dominant individual, but higher for the left-dominant individuals. These findings are consistent with the fact that the left hemisphere is specialized for dealing with sequential auditory input, while the right hemisphere is more capable for visual spatial input.

Table 1
Mean Immediate Recall of High- and Low-Imagery Words for Auditory and Visual Input as a Function of Hemispheric Dominance

	High Imagery		Low Imagery	
	Auditory	Visual	Auditory	Visual
Right Dominant	4.40	4.72	2.86	3.14
Left Dominant	4.94	4.24	3.10	3.38

Total Recall

The total number of words recalled from all lists was subjected to a split-plot analysis of variance with sex and hemispheric dominance as between-subjects factors and input modality and imagery value as within-subjects factors. Again, a square-root transformation was employed. Significant main effects of sex and imagery value indicated that females surpassed males and high-imagery words were recalled more often than low-imagery words. The significant interaction between imagery value and input modality resulted because there was no difference between auditory and visual input for low-imagery words, but visual presentation surpassed auditory presentation for high-imagery words. These results, however, must be modified because of the significant four-way interaction [$F(1,16) = 9.57$, $p < .01$], the means of which can be seen in Table 2.

Left-dominant females surpassed left-dominant males on all conditions, but right-dominant females surpassed right-dominant males for auditory input, while the right-dominant males surpassed the right-dominant females for visual input. Left-dominant females recalled more words than right-dominant females on all conditions, while right-dominant males surpassed left-dominant males on all conditions except for low-imagery words with auditory input.

Total Recognition

The total number of correct recognitions was subjected to a split-plot factorial analysis of variance with the same independent variables as in the two previous designs. A square-root transformation was again used. There was no significant sex difference, but high-imagery words significantly surpassed low-imagery words. The significant [$F(1,16) = 8.78$, $p < .01$] inter-

Table 2
Mean Total Recall of High- and Low-Imagery Words for Auditory and Visual Input as a Function of Sex and Hemispheric Dominance

	Auditory Input				Visual Input			
	High Imagery		Low Imagery		High Imagery		Low Imagery	
	Male	Female	Male	Female	Male	Female	Male	Female
Right Dominant	8.6	9.6	3.2	6.2	11.6	10.8	5.2	4.8
Left Dominant	6.2	10.6	4.6	7.6	6.8	11.6	2.8	8.8

Table 3
Mean Number of Words Recognized for Auditory and Visual Input as a Function of Sex and Hemispheric Dominance

	Auditory Input		Visual Input	
	Males	Females	Males	Females
Right Dominant	20.3	24.2	23.7	23.8
Left Dominant	21.5	26.9	21.4	30.0

action between sex, hemispheric dominance, and input modality is shown in Table 3.

Left-dominant males and females surpassed right-dominant males and females on words that were originally presented auditorily. For the visually presented words, on the other hand, left-dominant females surpassed right-dominant females, while the reverse was true for right- and left-dominant males.

DISCUSSION

In contrast to the results of J. Richardson (1978), who found no interaction between imagery vividness or ability and verbal learning, the use of hemispheric dominance as a classifying variable did result in significant effects. It should be noted that in no case was learning related directly to hemispheric dominance, but complex interaction effects involving dominance, sex, and input modality attest to the importance of these factors. The most intriguing findings indicated a consistent relationship between auditory input and a left-hemispheric style and visual input and a right-hemisphere-dominant style. These results are consistent with the fact that the left hemisphere is specialized for dealing with sequential auditory input, while the right hemipshere is more capable with visual-spatial material. The more specific findings of this study obviously need replication, but their mere existence (in contrast to the findings of J. Richardson) supports the use of hemispheric dominance as a meaningful classifying variable.

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NOTE

1. The term cerebral dominance rather than hemispheric dominance was used in the Zenhausern (1978) article.

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