DOCUMENT RESUME

ED 163 905 IR 006 218

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TITLE Relationships of Selected Perceptual Variables to Leveling/Sharpening in the Memory of Sequential Visual Images.
PUB DATE Apr 78
NOTE 11p.; Paper presented at the Annual Meeting of the Association for Educational Communications and Technology (Kansas City, Missouri, April 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Educational Research; *Memory; Perception Tests; *Recall (Psychological); *Retention Studies; Sequential Learning; *Visualization; Visual Measures; *Visual Perception

ABSTRACT

This study was designed to examine relationships between three variables of analysis/integration skill in visual perception and the tendency to retain differentiated memories of sequential visual images in a sample of 206 university undergraduates. Correlation techniques and factor analysis were used to analyze relationships between the perceptual variables and the memory variable. While some relationships between perceptual skill and memory were found which were statistically significant, variations in neither individual perceptual skills nor in factors which they formed in combination were found to account for a sufficient portion of variance in visual memory functioning to be of practical importance. Leveling/sharpening in visual memory appeared to be largely independent of the specific perceptual skills measured in this study. (Author)

RELATIONSHIPS OF SELECTED PERCEPTUAL VARIABLES TO LEVELING/SHARPENING IN THE MEMORY OF SEQUENTIAL VISUAL IMAGES

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Introduction

In studying the impact of visual materials in instruction, consideration must be made of the memory retention element of learning; learners are not likely to benefit from instruction which they do not remember. Considerable interest has therefore arisen in the factors which operate in the process of the remembering of visual images. Memory of images has been defined and studied in numerous ways, one of which has been the Leveling/Sharpening dimension of cognitive control. This memory dimension concerns individual differences in the ability to retain and recall discrete images of gradually changing, sequentially presented stimuli. When processing sequentially occurring stimuli, Levelers tend to assimilate or merge new stimuli with memories of previous ones and thus construct relatively undifferentiated impressions of ongoing experiences. Sharpeners, on the other hand, tend to maintain discrete impressions and memories of sequentially presented stimuli so that elements retain their individuality. While Leveling/Sharpening has been demonstrated to operate in verbal serial learning (Gardner and Long, 1960) and in recall of verbal story material (Berkowitz, 1957; Holzman and Gardner, 1960), it has primarily been studied in relationship to visual (i.e., pictorial) stimulus material. Since it has been relatively well validated by research, Leveling/Sharpening was selected as the variable representing memory for visual images for this study.

Several types of variables might be predicted to be related to memory performance with visual images. One group of intuitively related variables are those concerning visual perception skills. A logical question is "What

relationship is there between skills in perceiving images and the ability or tendency to remember them?" In the particular case of Leveling/Sharpening memory performance, involving gradually changing sequential images, it would seem that perceptual skills concerned with speed and accuracy in scanning, analyzing, and integrating image details or elements might be important. The purpose of this study was to examine the relationships between three selected variables of analysis/integration skill in visual perception and the Leveling/Sharpening aspect of memory of sequential visual images.

Procedures

Subjects. The subjects for this study were a group of 206 undergraduate volunteers enrolled in education courses at the University of Oklahoma. This sample contained a ratio of females to males of approximately 2.3 to one and a total of 12 individuals of racial minorities. No attempt was made to examine or control for differences in perceptual functioning and patterns between male and female subjects or between the Caucasian racial majority and ethnic minorities. Since some differences in perceptual performance have been observed between these groups and since the sample used was not drawn at random, this may have had some bearing on the results of the study which was not accounted for in the data analysis.

The subjects were not tested for visual handicaps. However, all subjects were questioned concerning such handicaps, and all reported that they had none except those ameliorated by corrective optics. It was assumed, on this basis, that all subjects were normally sighted or wore optics which gave them normal visual acuity. All subjects who reported that they wore corrective optics were required to wear them during all testing for this study.

Testing Instruments Used. The subjects were given a battery of four tests: three tests of perceptual skills in analyzing and integrating visual figures and details, and a test of Leveling/Sharpening tendencies. The four tests used were the following:

1. Successive Perception Test I (SPT-1): SPT-1 (U. S. Army Air Corps, 1944) is a test in motion picture form which was developed for use in the World War II Aviation Psychology Program as part of the pilot selection and training program. It is now used in research to test for Lowenfeld's visual/haptic cognitive style typology.[1] SPT-1 is concerned with the ability to observe visual figures a small portion at a time and then mentally integrate the pieces into a whole visual image. The test consists of three practice items and 35 actual test items. In each item, the subject views a pattern a small section at a time behind a moving slot and is then shown five similar variants from which must be selected the one which matches the pattern seen behind the slot. The measure yielded by the test is the number of patterns correctly selected.

2. Hidden Figures Test (HFT): Hidden Figures (French, Ekstrom, and Price, 1963) is sometimes used as an alternative to Witkin's Embedded Figures Test to assess the cognitive style of field independence/field dependence. It requires the subject to overcome embeddedness in figure/ground perception and to locate simple geometric figures which are embedded or disguised within complex ones. The test is divided into two parts and consists of 16 or 32 items, depending on whether both parts are used. All 32 items were used in this study. The score yielded by HFT is the number of simple figures correctly located after an adjustment is made for guessing.

3. Matching Familiar Figures (MFF): MFF (Kagan, 1969) is frequently used to assess the cognitive style dimension of reflectivity/impulsivity. It requires the subject to use visual analysis skills. The subject must examine a standard in the form of a black and white line drawing of a figure (such as a lion, a bed, a flower, etc.) and then look at a series of similar variants and select the one which is identical to the standard. The standard

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[1] For general information on cognitive styles, the following article may be consulted: Ausburn, L. J., & Ausburn, F. B. Cognitive styles: Some information and implications for instructional design. Educational Communication and Technology (formerly A V Communication Review). In press.

remains in the subject's view at all times. The adult form of MFF consists of 12 test items with eight variants per item. Dependent measures obtained are total number of identification errors (accuracy of visual analysis and comparison) and mean latency or time to first response (speed of visual analysis and comparison).

4. Leveling-Sharpening House Test (LSHT): The test used to assess Leveling/Sharpening in memory was Santostefano's (1971) Leveling-Sharpening House Test. This test consists of 60 black line drawings of a scene containing a two-story house with windows, a door, a weathervane, a chimney, a sidewalk, a fence, a cloud, a tree, and a sun. The intact picture is displayed three times. Then one element (the doorknob) is omitted, and the picture is again shown three times. An additional element is omitted every third trial until a total of 19 elements are omitted from the original display, with the least conspicuous element eliminated first and the most conspicuous last. Each picture is displayed for five seconds. The subject is asked to tell the examiner when something looks different from the previous picture. LSHT yields three measures: the point at which a change is first correctly noted, a total number of correct changes reported, and a "leveling-sharpening ratio," which reflects a mean number of changes which go undetected. This third measure was the one selected for this study. The smaller the leveling-sharpening ratio, the greater the operation of sharpening in an individual's memory of visual images.

Testing Procedures. The 206 subjects were administered SPT-1 via a video tape made from the black and white motion picture version in groups ranging in size from 21 to 38 persons. The HFT was given to the subjects in the same groups and at the same sitting as the administration of SPT-I.

The MFF and the LSHT were administered individually to each subject. These two tests were given during the same sitting.

All testing was done by three examiners, using standardized instructions and scoring forms.

Data Analysis: The relationships among the variables were studied with a correlational analysis which included zero-order, partial, and multiple correlations. The variables were then collapsed and further studied with an orthogonal factor analysis.

Results

A simple zero-order Pearson correlation analysis yielded the correlations among variables shown in Table 1.

Table 1
Correlation Matrix for All Variables

	SPT-1	HFT	MFF ERRORS	MFF LATENCY	LSHT
SPT-1	1.000	.575**	-.540**	.2[illegible]**	-.226**
HFT		1.000	-.367**	.012	-.179*
MFF ERRORS			1.000	-.596**	.189**
MFF LATENCY				1.000	-.012
LSHT					1.000

*$p < .05$
**$p < .01$

This correlation matrix indicates statistically significant relationships both among the perceptual variables and between three of the perceptual variables and the memory variable. Specifically, memory for sequential visual images as measured by LSHT shows significant relationship with the following perceptual skills, in decending order of strength of relationship:

a. integrating partial visual images, measured by SPT-1 (r = -.226)

b. accuracy in analyzing and comparing visual details, measured by MFF errors (r = .189)

c. separating figure from embedding ground, measured by HFT (r = -.179)

Since the MFF error and HFT variables are considerably related to SPT-1 ($r = -.540$ and $r = .575$, respectively) as well as to the LSHT memory variable, partial correlations were computed between each of these variables and the memory variable to see if they were still significantly related to memory with the effects of SPT-1 removed. The following partial correlations were obtained:

a. partial correlation between HFT and LSHT, with SPT-1 held constant = -.061

b. partial correlation between MFF errors and LSHT, with SPT-1 held constant = .082

These partial correlations indicate that the observed relationships between the memory variable represented by LSHT and the perception skills represented by HFT and MFF errors can be attributed primarily to their mutual relationships with the perceptual skill of integration of visual details represented by SPT-1.

A multiple correlation coefficient was also calculated in order to determine the degree of total, overall relationship of the visual perception variables to memory for visual images. This multiple correlation was found to be statistically significant ($R = .26$; $p = .01$).

In totality, the correlational analysis indicated that the four perceptual skill variables measured here are, as a group related to Leveling/Sharpening in memory of sequential visual images. Three of the perceptual skill variables measured are individually related to memory. However, the primary perception skill found to be related to memory is the ability to integrate visual elements into whole images; the other perceptual skills appear to be related to memory through mutual r[illegible]onships with this integration variable.

It is extremely important that while the overall relationship between the group of perceptual skills and the memory variable is statistically significant, the coefficient of multiple determination if quite small ($R^2 = .07$). This means that only 7% of the variance in Leveling/Sharpening performance is attributable to variance in the specific perception skills measured here,

which is clearly not enough variance to be of any great practical significance. The large majority of variance in memory performance must be attributed to some other source.

The variables of the study were collapsed and studied further with a factor analysis. The correlation matrix generated a two-factor matrix, rotated orthogonally to Varimax criterion. Table 2 shows the rotated factor matrix.

Table 2
Factor Matrix Rotated to Varimax Criterion

	FACTOR I	FACTOR II
SPT-1	.6911	.3024
HFT	.6817	.0639
MFF ERRORS	-.4346	-.6915
MFF LATENCY	.0269	.7076
LSHT	-.2906	-.0487

Both factors have eigen values considerably greater than 1.00. The two factors account for 100% of the common variance among the variables and for 45.87% of the total score variance, which indicates the presence of considerable specific variance in the individual variables.

Factor I, characterized by substantial loadings of SPT-1, HFT, and MFF errors and a modest loading of LSHT, appears to represent "Analysis and Integration of Visual Elements." Factor II, which shows substantial loadings of MFF errors and MFF latency and a modest loading of SPT-1, appears to represent "Effectiveness in Scanning Visual Arrays." The Leveling/Sharpening memory variable shows a modest loading on Factor I (-.29) and therefore a relationship to the perceptual factor it represents. However, it is important that the communality for the memory variable ($h^2 = .086$) is

small in terms of practical importance. This communality indicates that only approximately 9% of the variance in memory functioning is accounted for by the two perceptual factors.

Conclusions

In this study, a group of specific analysis/integration perceptual skills were studied in relationship to Leveling/Sharpening in memory of visual images. Study was made of both the relationships of the individual perception skills to the memory variable, and of their contributions when reduced to perceptual factors. The findings in both cases were similar. In both cases, statistically significant relationships were found, indicating that visual memory is related to both the individual perception skills and to at least one general factor generated by them. However, these relationships fell short of practical significance, accounting for only a small percentage of the total variance in the memory variable. Since variance in neither the individual perception skills tested here nor the broader factors they generated accounted for a large portion of the memory function variance, the majority of its variance appears to be independent of these skills. This suggests several possible alternative sources of variation in Leveling/Sharpening performance in visual memory, including the following:

A. relationships with other perceptual variables not tested here

B. relationships with other types of variables not tested here

C. a largely independent "Memory Organization" factor

It is suggested that further studies be conducted in order to examine these possibilities.

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