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ABSTRACT

The effect of the interaction between cognitive style differences (field dependence/field independence) and various degrees of visual complexity on pictorial recall memory was explored using three sets of visuals in three different formats--line drawing, black and white, and color. The subjects were 86 undergraduate students enrolled in two core curriculum courses in a liberal arts college. They were administered Witkin's Group Embedded Figures Test (GEFT) and grouped into three levels by their GEFT scores--field dependent, indeterminate, and field independent. Each group was randomly assigned to a particular set of stimulus slides which they viewed in a semi-darkened room. After viewing an individual slide for 20 seconds, the subjects had 4 minutes to write down as many objects as they could recall from the slide. The design of the study was 3 x 3 repeated measures type with three repeated levels of visual complexity and three levels of cognitive style. Analysis of variance (ANOVA) procedures produced a significant main effect for visual complexity, but no significant interaction or main effect for cognitive style. The findings indicated that the cognitive style factor of field dependence was not significantly related to recall memory under the varied levels of the visual factor, although the recall memory was related to the visual presentation mode. The ordering of the means with color highest, followed by black and white and line drawing respectively, suggests that cue summation theory is a valid predictor of visual processing in recall memory. It was concluded that the more realistic cues were more effective coding devices than the less realistic cues in this study. (27 references) (BBM)

Title:

The Effects of Pictorial Complexity and Cognitive Style on Visual Recall Memory

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THE EFFECTS OF PICTORIAL COMPLEXITY AND COGNITIVE STYLE ON VISUAL RECALL MEMORY

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Research in the use of visuals for instructional purposes has increasingly identified the interaction between the learner's individual cognitive skills and the design factors incorporated in the instructional method. Researchers investigating memory processes have theorized multiple processing systems for different modalities of information, with the visual, verbal and auditory being of particular interest to learning theorists (Levie & Levie, 1975; Paivio, 1978; Winn, 1980, 1982). Predictably, research interest has led to detailed explorations of those factors within the area of visual learning which contribute to the effective processing of pictorial material.

Considerable research has addressed the factor of visual complexity in instruction (Dwyer 1972, 1978, 1987). This research was drawn from a larger theoretical controversy which continues regarding visual complexity and human information processing. It has long been contended that the mere addition of visual cues will increase the ability of the viewer to store and retrieve visual information.. This orientation, termed "realism theory" by Dwyer (1967), has strong theoretical antecedents (Dale, 1946; Morris, 1946; Carpenter, 1953 and Gibson, 1954) and is indeed the major premise of cue summation theory (Severin, 1967). Other researchers (Broadbent, 1958, 1965; and Travers, 1964) however, took strong opposition to this theoretic base on the grounds that the human information processing system is of limited capacity and consequently, in times of rapid information reception, irrelevant cues may block the processing of other, more relevant information. Studies (Kanner, 1968; Katzman and Nyenhuis, 1972; Dwyer, 1972, 1978, 1987) have investigated this apparent contradiction with conflicting results.

During the past thirty years, the concept of cognitive style has emerged as an area of substantial research. Messick (1976) defined cognitive style as "consistent patterns of organizing and processing information". The specific cognitive style of field dependence, identified by Witkin, Oltman, Raskin and Karp (1971) is generally defined as the differential ability of individuals to overcome figural embeddedness. This perceptual ability is considered to be representative of a more global ability to impose structure upon perceived information.

A number of researchers have investigated how the aptitude of field dependence relates to an individual's ability to process pictorial information. French (1983) found that field independent subjects experienced less difficulty processing unusually complex material than did field dependent viewers. Wieckowski (1980) found a significant difference in favor of field independent subjects in a pictorial recognition task involving color. These findings, relative to a recognition task, were further substantiated in research conducted by Berry (1984).

More limited research has addressed the effects of visual complexity on recall memory. Sampson (1970) found pictures better than words in both immediate and delayed free recall situations. Ritchey (1982) reported an advantage in recall for outline drawings over detailed drawings. Conversely, Alfahad (1990) found realistic color visuals to be superior to black and white or line drawing visuals in a recall memory task. Recall memory involving the interaction of pictorial complexity and field dependence has, however, not been investigated.

The purpose of this study was to explore the effect of the interaction between cognitive style differences (field dependence/field independence) and various degrees of visual complexity on pictorial recall memory.

METHOD

The stimulus materials used in this study were three sets of visuals, each produced in three visual formats; line drawing, black & white and color. To create the sets of visuals, three different collections of common household items (32 per set) were randomly arranged on a neutral photo backdrop. In selecting the objects, care was taken to ensure that no verbal labels, names or symbols were visible. Each set was photographed on color slides and then later recopied onto black and white slides. A line drawing of each scene was created by an artist working from the projected black and white slides. These drawings were also copied onto 35mm slides. The resulting stimulus materials consisted of three sets of slides, each composed of three different treatment versions of the same image; one rendered in photographic color, another in a black and white photographic format and the third in a line drawing format. The materials were validated by comparison with the Visual Memory Test developed by Salomon & Cohen (1977).

This test was intended to measure an individual's ability to recall a number of objects from a visual stimulus which was presented in a line drawing format. The reported reliability of the test was .74. Pearson Product Moment Correlation Coefficients were calculated between the Visual Memory Test and the three treatments developed for this study. The obtained r values were line drawing-.464, black and white-.469, and color-.504. Each of these values was determined to be significant at the .01 level. Further validation was achieved via regression analysis where the Visual Memory Test was found to explain 21.5% of the variance of the line drawing treatment, 25.4% of the variance of the black and white treatment and 21.9% of the variance of the color treatment.

For purposes of presentation, the slides were organized into sets of three different treatments which could be presented to three separate experimental groups. The ordering of the sets of slides for the study is shown in Table 1. By rotating the slides in this manner, each different set of slides was counterbalanced with each treatment resulting in a repeated measures design which provides greater experimental precision.

Table 1
Ordering of Stimulus Materials

Experimental Group	Color	Black & White	Line Drawing
Group 1 (Set 1)	Scene A	Scene B	Scene C
Group 2 (Set 2)	Scene C	Scene A	Scene B
Group 3 (Set 3)	Scene B	Scene C	Scene A

Subjects for the study were 86 undergraduate students from a liberal arts college enrolled in two core curriculum courses, thereby ensuring a wide representation of majors. The sample consisted of 56 females and 39 males. Any subjects with visual handicaps were eliminated from the sample.

In a class session prior to the experiment sessions, subjects were administered the Group Embedded Figures Test (Witkin et al., 1971). The mean score on this instrument was 10.17 with a standard deviation of 5.06. The Hampel estimate on this data was 10.44 which differed from the mean by less than 10% indicating that the GEFT scores of the subjects were normally distributed. Subjects were grouped into three levels by their GEFT scores (0-8, field dependent; 9-13, indeterminate; 14-18, field independent). The distribution of subjects is shown in Table 2.

Table 2.
Distribution of Subjects by Cognitive Style

Group	N
Field Dependent (1-8)	30
Indeterminate (9-13)	29
Field Independent (14-18)	27
Total	86

Based on the cognitive style scores, subjects were assigned to one of three groups by means of a stratified random sampling procedure. Each group was then randomly assigned to a particular set of stimulus slides. In a semi-darkened room, each group viewed an individual slide for a period of 20 seconds after which the slide was removed and the lights raised. Subjects then received four minutes to write down as many objects as they could recall from the slide. This procedure was repeated again with each of the other two slides assigned to the particular group of subjects with a rest period of five minutes provided between each slide A similar procedure was followed with each of the additional groups.

ANALYSIS

The design of the study was a 3 x 3 repeated measures type with three repeated levels of the visual complexity factor (color, black & white and line drawing) and three levels of the cognitive style factor (field dependent, indeterminate and field independent). Means and standard deviations for the three treatment groups by cognitive style levels is presented in Table 3.

Table 3.
Means and Standard Deviations for Visual Treatments by Cognitive Style Levels (N = 86)

Treatments	FD		IND.		FI		Marginal	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
Color	10.16	2.01	10.41	1.99	10.96	2.00	10.50	2.00
Black & White	8.96	1.79	9.41	1.70	10.15	1.75	9.80	1.78
Line Drawing	8.83	1.93	8.52	1.81	9.55	1.79	8.95	1.84
Marginal	9.32	1.94	9.44	1.80	10.55	1.85	9.75	1.86

Analysis of variance procedures produced a significant main effect for visual complexity (F=12.20, p<.0001), but no significant interaction or main effect for cognitive style. *Post hoc* comparisons via the Scheffé procedure indicated significant differences between all three levels of the complexity factor in the following order: color > black & white > line drawing.

DISCUSSION

The findings indicated that the cognitive style factor of field dependence was not significantly related to recall memory under the varied levels of the visual factor. It was apparent, however, that recall memory was related to the visual presentation mode. The ordering of the means with color highest, followed by black & white and line drawing respectively, suggests that cue summation theory is a valid predictor of visual processing in recall memory. It is further suggested that the "realism" continuum identified by Dwyer is similarly a reliable descriptor of recall processing in that more realistic visuals facilitate recall memory better than do less realistic or visually complex materials.

Although recognition memory tasks are considered to demonstrate the most pure measure of the content of memory, recall tasks provide insight into the encoding and retrieval processes involved in memory (Loftus & Loftus, 1976). It has also been suggested that recall memory tasks involve two separate cognitive processes, a memory search and a recognition process (Anderson & Bower, 1972). This search process would depend on the cues employed in encoding the information in memory and consequently be strongly related to the types of visual cues incorporated in the stimulus. In the present study, it would appear that the color cues performed more effectively in encoding than did the monochrome cues . Similarly, the monochrome information was superior to the line drawing material. It can be concluded, then, that more realistic cues are more effective encoding devices than are less realistic cues. The reasons for this performance may rest in the fact that the realistic cues present a more complete representation of a schema already present in memory, making the encoding/storage process easier. Less realistic materials, on the other hand, may not provide as complete a representation and therefore may not encode as completely.

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