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ABSTRACT

The purpose of this study is to determine the effects of varying pictorial detail and presentation strategy on learners of varying grade levels in a visually transmitted concept formation task. Specifically, line drawings containing only relevant details and halftones containing relevant and irrelevant detail were presented successively and simultaneously to three separate populations of fifth grade, ninth grade, and fifteenth grade subjects. A randomized posttest only control group experimental design was employed in a school related concept formation task. A lack of practical differences in performance was found. The resulting similar effects across grade level suggest that a common line drawing-halftone format and presentation strategy can be used over a wide variety of student population, thus eliminating the expense of preparing separate visual materials for each grade level. (Author/JK)

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THE EFFECTS OF VARYING PICTORIAL DETAIL AND PRESENTATION STRATEGY ON CONCEPT FORMATION

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The Effects of Varying Pictorial Detail and Presentation Strategy on Concept Formation

Traditionally, instructional decision makers have had to use a variety of intuitive methods to design and present visuals instead of basing fundamental selection decisions on emperical evidence. A need for the systematic evaluation of the relative effectiveness of varied pictorial illustrations on the attainment of specific learning tasks has been cited by many researchers. Gropper (1966) stated that research on visuals must proceed on the basis of an analytic look at the roles they play in instruction and these roles may vary depending on the type of learning and task posed the learner. Dwyer (1969) indicated that much remains to be done in the area of the identification of the physical characteristics contained within the various types of visual illustrations which facilitate student achievement of different types of educational objectives.

In any instructional development the decisions related to the selection of appropriate visual materials and methods for instructional purposes are many faceted. For example is it the amount of detail that is important or is it the presentation strategy that is critical? Are the effects the same for all students or should the amount of detail and presentation strategy differ with varying age groups? If effective use of pictures is to be made then evidence must be gathered and subsequent rules generated.

PURPOSE

The purpose of this study was to provide evidence and answers to the following questions as they relate to a specific instructional task (concept attainment) where the message to be transmitted was primarily dependent on the visual channel. (1) When using a line drawing-halftone format does varying amount of detail in the pictorial image effect performance? (2) Is the strategy of presenting simultaneous exemplars and nonexemplars superior to a successive presentation of exemplars and nonexemplars? (3) Are the effects of varying amounts of detail and different presentation strategies the same at different grade levels? (4) Do the main effects of amount of pictorial detail, presentation strategy and grade level interact? (5) In a second similar task are the effects the same or will there be a training effect? (6) Are there any rules for instructional development which can be generated from this study?

RELATED RESEARCH

A considerable body of research has accumulated on the effects of such variables as pictorial detail, presentation strategy and grade level on concept formation.

PICTORIAL DETAIL

Travers (1967) indicated that visual presentations designed for concept learning can be presented with varying amounts of relevant and irrelevant information. This relevant-irrelevant dimension of pictorial stimulus can be related to the use of line drawings and halftones, since halftones carry many irrelevant dimensions while the line drawings carry little more than the essential information. He further stated the importance, for practical and theoretical reasons, to determine the extent to which irrelevant dimensions affect the learning of a concept.

In concept learning the superiority of line drawings over those containing greater detail is well documented. Travers (1967), when reviewing the evidence on current concept formation literature, stated it seems clear that most information is transmitted through boundaries and hence a representation which emphasizes the boundaries and de-emphasizes other information provides an effective means of transmission.

Further support for this position was found in the work of Hunt (1962) when he summarized the evidence on irrelevant dimensions citing a series of studies conducted by Bourne and his students. They indicated that as the number of irrelevant dimensions increase, the number of errors in concept learning also increases.

Walker and Bourne (1961) stated that performance should depend upon the amount of relevant information. They conducted an experiment to investigate the relationship between concept identification and the amount of relevant stimulus information under varying conditions of irrelevant information. They predicted and the results confirmed a linear decrement in performance with increased irrelevant information. In addition, performance decreased with increased relevant information.

The above resulted in the first hypothesis:

H1 In the fifth grade, ninth grade, and fifteenth grade populations under study, subjects who are exposed to exemplars containing only relevant detail will identify more test exemplars correctly than those who are exposed to exemplars containing relevant and irrelevant detail.

PRESENTATION STRATEGY

Bourne, Goldstein, and Link (1964) pointed out that method of presentation can be considered a continuum of stimulus availability. Operational definition of the points on the continuum is possible in terms of the number of previously presented instances to which the subject has access on any trial. With the successive method of presentation only one instance at a time is made available to the subject. In the simultaneous condition the subject has access to additional instances.

Smuckler (1967) in her review of concept identification studies using method of presentation as a variable, reported two types of findings. An earlier group of studies, Nadelman (1957) and Reed (1960), reported no differences between the methods of presentation. Another more recent group, Bourne (1963), Hovland and Weiss (1953), Cahill and Hovland (1960), Kates and Yudin (1964), reported the superiority of the simultaneous strategy over the successive and none of the studies reported the superiority of the successive strategy.

The above resulted in the second hypothesis:

H2 In the fifth grade, ninth grade and fifteenth grade populations under study subjects who are exposed to a simultaneous presentation of exemplars and nonexemplars will identify more test exemplars correctly than those who are exposed to a successive presentation of exemplars and nonexemplars.

GRADE LEVEL

Kindler (1961) summarized the studies in concept learning related to the age and mental age variable. He reported that as children grow older they attain concepts more efficiently and as mental age increases concepts are attained more efficiently. The

increased ability to attain concepts with age has further support in the works of Inhelder and Piaget (1958), Steffe and Parr (1968), Yudin and Kates (1963) and Fredrick (1968).

The above resulted in the third hypothesis:

H3 In the fifth grade, ninth grade and fifteenth grade populations under study subjects will correctly identify test exemplars in direct relation to their grade level.

The following questions were raised:

Q1 Will the main effect variables of amount of detail, presentation strategy and grade level interact?

Q2 Will the effects on concept 1 be the same on a second similar concept or will there be a training effect which will tend to wash out differences?

DESIGN

In order to test the hypotheses and provide data to answer the questions, two 3x2x2 (grade level x pictorial detail x presentation strategy) factorial post-test only designs were used. As a result, measures were obtained from each achievement level on four methods of presentation: SUR--relevant successive; SIR--relevant simultaneous; SURI--relevant and irrelevant successive; SIRI--relevant and irrelevant simultaneous. A control group measure was collected for each grade level in order to determine prior knowledge of the concepts selected.

CRITERIAL MEASURE

The task and criterial measures were based on Bruner's (1961) model for concept formation. The data gathering instrument used was a simplified yes-no variation response technique to test the recognition of exemplars. After each encounter with the concept test instance the subject was asked to decide if the instances represented the concept just presented. The final form taken was a

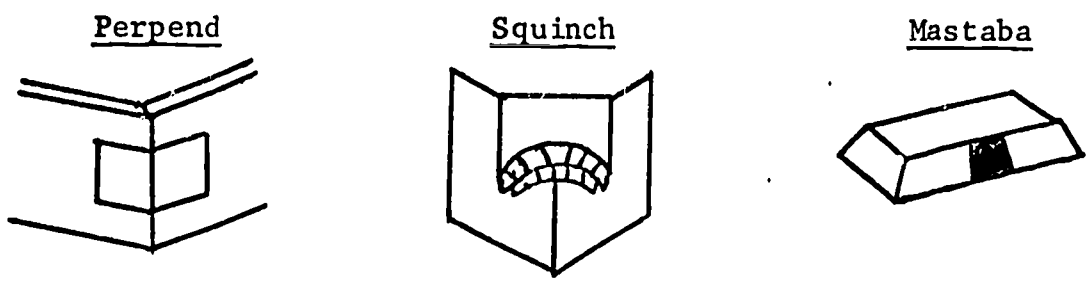
standardized paper-pencil response sheet which was prepared to correspond to the testing sequence within the presentation.

MATERIAL

The concepts used were a compromise between experimental and practical decisions as they related to a school setting. Three meaningful architectural concepts--perpend, squinch and mastaba--were selected. They are shown in Figure 1. The concepts met the following selection criteria: (1) be suitable for a task which would be transmitted through the visual channel; (2) have specific characteristics that were identifiable and classifiable; (3) be comparable to previous experimental material; (4) be meaningful concepts in terms of content and yet unfamiliar to participating subjects; (5) be selected from a single related school subject; and (6) be comparable to a content area found within a school program.

FIGURE 1

A DISPLAY OF THE MEANINGFUL ARCHITECTURAL CONCEPTS PERPEND, SQUINCH, AND MASTABA (Line Drawing Format)



In order to determine the effects of the pictorial stimuli the following decisions were made about the presentation of the task.

1. The task was to be transmitted through the visual channel only. By keeping the presentation visual a determination could be made of the effects of the visual stimuli alone.
2. The pictorial stimuli was prepared in two basic variations--line drawing and halftone. Relevant and irrelevant information was limited to the figure image. The two variations are shown in Figure 2.

FIGURE 2

A DISPLAY OF THE LINE DRAWING AND HALFTONE VARIATIONS OF THE PICTORIAL STIMULI

Line Drawing (Relevant)

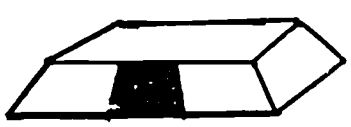
Halftone (Relevant and Irrelevant)

3. The pictorial stimuli was standardized to vary across three dimensions--length of line, degree of angles and orientation. All stimuli were controlled to maintain constant perspective, image size, density and <u>one</u> exemplar intradifference in order to attribute any differences to the amount of detail. The exemplar intradifferences can be seen in Figure 3.

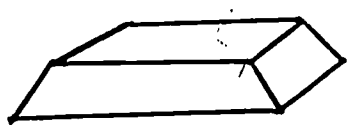
FIGURE 3

A DISPLAY OF EXEMPLAR INTRADIFFERENCES AND CONTROLLED PERSPECTIVE, IMAGE SIZE AND DENSITY WITHIN THE STIMULI (Line Drawing Format)

<u>Exemplar</u>



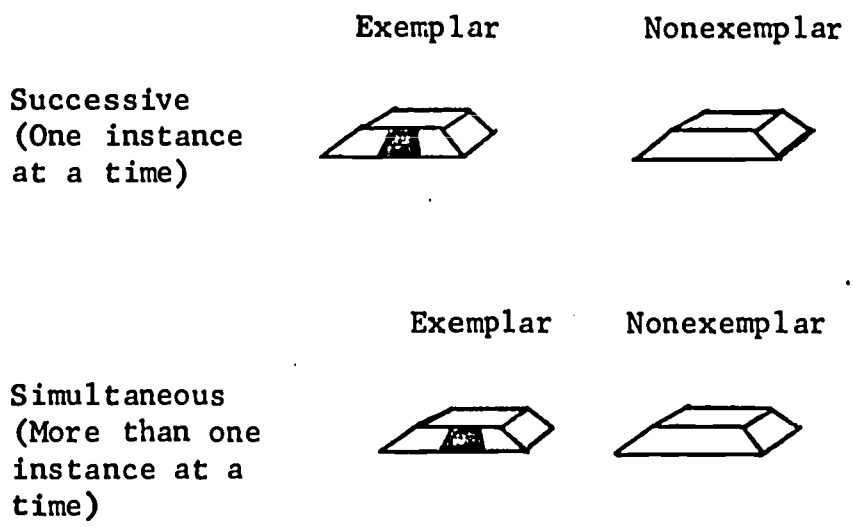
<u>Nonexemplar</u>



4. The presentation strategy resulted in two basic variations: a successive presentation of exemplars and nonexemplars and a simultaneous presentation of exemplars and nonexemplars. The presentation variations can be seen in Figure 4.

FIGURE 4

A DISPLAY OF SUCCESSIVE AND SIMULTANEOUS PRESENTATION VARIATIONS (Line Drawing Format)



5. The amount of observation time per instance was an important control variable if a comparable determination of the effects of varied methods of presentation was to be made. One second was used for the observation time per instance in the successive strategy and two seconds were used for the observation time during the simultaneous strategy.

6. The variations and controls placed on the pictorial images were organized into a task that was defined as increasingly difficult; difficulty being an inference based upon attribute definition, pilot and study results.

POPULATION

One hundred and fifty voluntary pupils in the Detroit Metropolitan area served as subjects for the experimental populations. The subjects were selected from three grade levels--fifth, ninth and fifteenth. Each grade level population consisted of fifty subjects. Subjects were randomly assigned to one of four treatment groups or to the control group within their grade level. In general, subjects had only limited experience with the field of architecture and little opportunity for formal experience with the concepts used.

PROCEDURES

A standardized set of directions and instructions was prepared for each treatment group. One hundred and four presentation instances for varied treatments were developed and produced. All instances were prepared with a black image on 8½"x11" white bond paper. Instatype captions designating exemplar and nonexemplar were added where appropriate before being photographically reproduced in the 2"x2" black and white slide presentation format. The resulting sets of treatment slides each containing the instructions and directions, the training concept (perpend), concept 1 (squinch) and concept 2 (mastaba) were presented on standardized slide synchronized projection equipment. All treatment presentations were tested to meet operational criteria and functioned as expected.

All subjects were presented, under the instruction and training condition, eight instructional instances (labeled figures with taped instructions) followed by two test instances (unlabeled figures); eight training instances (labeled figures in treatment condition) and four test instances (unlabeled figures) until a total of sixteen training and six test instances were presented. Under treatment conditions of pictorial stimuli concept 1 (squinch) with 28 labeled

instances was followed by twleve unlabeled test instances. This in turn was followed by concept 2 (mastaba) using the same format.

Instances were presented in the same order for all groups at all grade levels. In the successive condition each concept instance was exposed for one second. In the simultaneous condition each concept instance was exposed for two seconds while test instances were exposed for five seconds.

The presentations were administered to all groups in a standard manner both within and between grade levels. All answer sheets were hand scored and totaled. Raw scores were entered on the grade level summary sheets. Calculations were made using a Friden Model 1162 electronic calculator.

RESULTS AND DISCUSSION-CONCEPT 1

An ANOVA was computed for the dependent variable number of correct responses for concept 1 (squinch). The main effects tested for significance were amount of pictorial detail, presentation strategy and grade level. Interactions resulting from these main effects were also tested.

The mean number of correct responses for each treatment group is listed in Table I.

TABLE I

MEAN NUMBER OF CORRECT RESPONSES FOR EACH CELL IN CONCEPT 1 (SQUINCH)

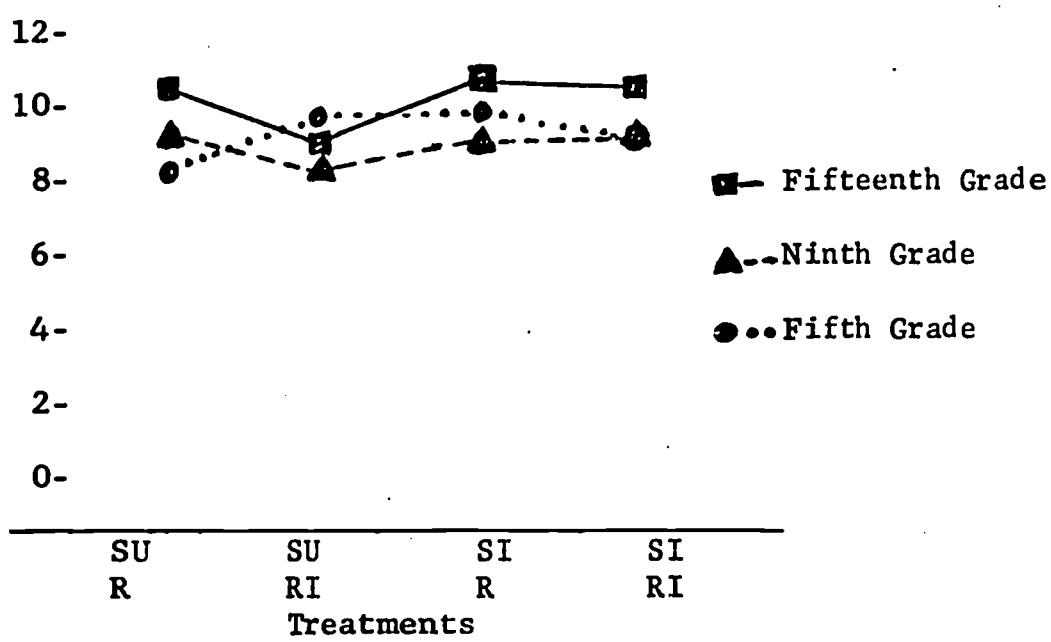
Presentation Strategy	Pictorial Detail	Grade Level 5	9	15	Mean by Treatment	Mean of Presentation Strategy	Mean of Detail
SU	R	8.6	9.3	10.4	9.4	SU 9.25	R9.75
	RI	9.4	8.9	9.0	9.1		
SI	R	10.1	9.3	10.9	10.1	SI 9.8	I 9.3
	RI	9.0	9.0	10.5	9.5		
		9.3	9.1	10.2			

SU-Successive R-Relevant
SI-Simultaneous RI-Relevant/Irrelevant

As shown in Figure 5 there were small differences in any treatment at any grade level.

FIGURE 5

PLOTTED MEANS OF CORRECT RESPONSES AS A RESULT OF TREATMENTS FOR CONCEPT 1 (SQUINCH)



The summary of the ANOVA with the number of correct responses as the dependent variable is shown in Table II.

TABLE II

SUMMARY OF ANOVA FOR FORMATION WITH NUMBER OF CORRECT RESPONSES ON CONCEPT 1 (SQUINCH) AS THE DEPENDENT VARIABLE

Component	SS	df	MV	F
Grade	27.14	2	13.57	5.32*
Strategy	8.53	1	8.53	3.34*
Detail	6.53	1	6.53	2.56
Detail x Strategy	.54	1	.54	.21
Grade x Strategy	4.50	2	2.25	.88
Grade x Detail	3.00	2	1.50	.60
Grade x Detail x Str.	11.03	2	5.51	2.16
WSS Error	278.60	108	2.55	----

*$p < .05$

Significant F ratios were obtained for the two main effects--grade level ($p < .05$) and strategy ($p < .05$). The main effect pictorial detail and all interactions yielded no significant F ratios.

PICTORIAL DETAIL H_1

According to hypothesis 1 relevant mean scores should have been significantly larger than relevent/irrelevant mean scores. The relevant mean scores (9.3, 9.3, 10.6) were in fact larger than the relevant/irrelevant mean scores (9.2, 8.9, 9.7) but were not significant. Hypothesis 1 was rejected since variations in the amount of pictorial detail did not change the acquisition performance for any of the groups.

PRESENTATION STRATEGY H_2

According to hypothesis 2, simultaneous mean scores should have been significantly larger than successive mean scores. The simultaneous mean scores (9.6, 9.1, 10.7) were in fact larger than the successive mean scores (9.0, 9.1, 9.7) and were significant at the $p < .05$ level. Hypothesis 2 was accepted since the simultaneous strategy did change the acquisition performance.

GRADE LEVEL H_3

According to hypothesis 3 grade level scores should have been significantly different in direct relation to the grade level reached. The grade level mean scores (fifth grade 9.3, ninth grade 9.1, fifteenth grade 10.2) were significant at the $p < .05$ level. However, hypothesis 3 was rejected; grade level did change the acquisition performance but not in direct relation to the grade level reached.

INTERACTIONS

There were no significant F ratios found for any of the interactions. The answer to the question related to interactions between the main effect variables would be no. The data suggests that the main effect variables were independent of each other.

The most important finding in this study was the lack of large practical differences in performance as it related to the amount of pictorial detail, presentation strategy and grade level. The absence of practical differences was unexpected because the theory related to each of the variables would indicate that differences should exist.

GRADE LEVEL

The most interesting aspect of the lack of practical differences was found in the performance of the subjects from the varied grade levels involved. The initial differences found between grade levels were not in the predicted order. A possible explanation for the differing results may be found in the trials procedure used in this study. The differences in acquiring concept 1 "washed out" in the second concept. The "washout" effect can be attributed to the practice and transfer which resulted between similar concepts.

In an attempt to relate more to classroom practice a fixed number of trials strategy was used instead of a trials to criterion strategy. In the trials to criterion strategy a predetermined performance level is established for each individual to check if the concept has in fact been attained. In the fixed number of trials strategy a performance level is established for the group and attainment of the concept is not confirmed on an individual basis. The lack of differences in performance between the varied grade levels demonstrates the remarkable flexibility of subjects to process information in a similar manner when a fixed number of trials strategy is used in concept formation. However, the lack of differences between grade level remains to be determined by further investigation.

PICTORIAL DETAIL

In addition, the amount of detail contained in the figure image also resulted in equally small differences being found in performance between the line drawing-halftone variations used. The lack of differences can probably be attributed to the amount of irrelevant detail contained in the halftone format. The indications from the data suggest that the amount of irrelevant detail contained in the halftone figure image was insufficient to interfere with the processing of the relevant information presented. This was unexpected since the halftone according to Travers contained many irrelevant dimensions and an undetermined amount of irrelevant information. The lack of differences between the line drawings-halftone format suggests that a "tolerance" level exists for some irrelevant detail in a picture. The "tolerance" level seems to be such that subjects perform equally with either the line drawing or the halftone figure image format. The additional irrelevant information contained in the halftone figure image evidently can be processed along with the relevant information by the subjects without a decrease in performance. The "tolerance" level for some excessive detail suggests that simple visuals can be designed to carry increased amounts of realism. The increased realism can be processed by the subjects without compromising the advantages of simplification.

PRESENTATION STRATEGY

The presentation strategy produced initial differences on concept 1 but with practice the effect was "washed out" in the second similar concept. The lack of larger differences can probably be attributed to the figure image. The figure image was controlled in order to attribute any resulting differences in performance to the varied amounts of pictorial detail. These controls resulted in a minimal visual scanning task. The effects of the presentation

strategy were probably further reduced by the structural image similarity found between the architectural concepts used and the undetermined effects of practice and transfer to the second similar concept. The lack of differences in this study suggests that the minimal visual scanning task reduced or minimized the advantage of the simultaneous strategy to a point where with practice the subjects could process the information presented in either strategy about equally.

CONCEPT 2

An ANOVA was computed for the dependent variable number of correct responses for concept 2 (mastaba). The main effects tested for significance were amount of pictorial detail, presentation strategy and grade level. Interaction resulting from these main effects were also tested.

The mean number of correct responses for each treatment group are listed in Table III.

TABLE III

MEAN NUMBER OF CORRECT RESPONSES FOR EACH CELL IN CONCEPT 2 (MASTABA)

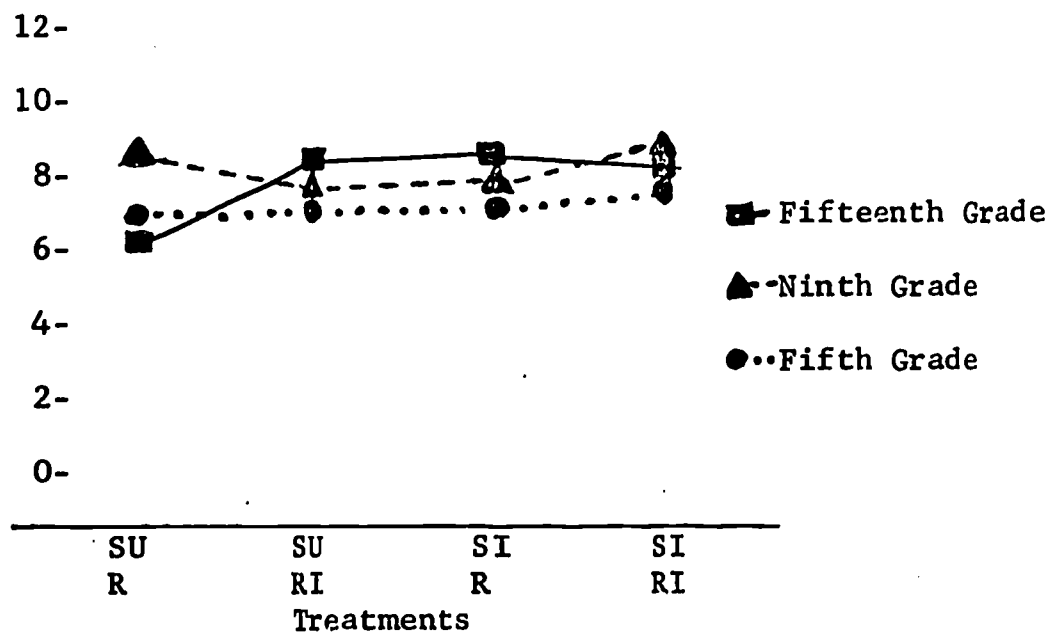
Presentation Strategy	Pictorial Detail	Grade Level 5	9	15	Mean by Treatment	Mean of Presentation Strategy	Mean of Detail
SU	R	6.4	8.1	6.1	6.8	SU 7.1	R 7.1
	RI	6.8	7.6	7.8	7.4		
SI	R	6.9	7.2	7.8	7.3	SI 7.0	I 7.1
	RI	6.6	6.9	6.7	6.7		
		6.7	7.5	7.1			

SU-Successive R-Relevant
SI-Simultaneous RI-Relevant/Irrelevant

As shown in Figure 6 there were small differences in any treatment at any grade level.

FIGURE 6

PLOTTED MEANS OF CORRECT RESPONSES AS A RESULT OF TREATMENTS FOR CONCEPT 2 (MASTABA)



The summary of the ANOVA with the number of correct responses as the dependent variable is shown in Table IV.

TABLE IV

SUMMARY OF ANOVA FOR FORMATION WITH NUMBER OF CORRECT RESPONSES ON CONCEPT 2 (MASTABA) AS THE DEPENDENT VARIABLE

Component	SS	df	MV	F
Grade	12.05	2	6.08	2.16
Strategy	0.41	1	0.41	0.14
Detail	0.01	1	0.01	0.00
Detail x Strategy	9.07	1	9.07	3.22*
Grade x Strategy	7.12	2	3.56	1.26
Grade x Detail	2.52	2	1.26	.62
Grade x Detail x Str.	11.85	2	5.92	2.10
WSS Error	306.30	108	2.81	

*($p < .05$)

No significant F ratios were obtained for any main effect. A significant F ratio was obtained for the amount of detail and presentation strategy interaction ($p < .05$). Other interactions resulted in no significance.

The answer to the question will the effects on concept 1 be the same on a second similar concept would be no. The significant main effects occuring with the first concept "washed out" as no permanence of effects was found in the acquisition of the second concept. In addition no interactions were found in concept 1 but a detail x strategy interaction was found in concept 2. The data suggests that with practice the small differences related to the main effects had even less effect on a second similar concept.

DETAIL x STRATEGY INTERACTION

Another finding in this study was that an interaction took place in the second concept. In the easier concept with fewer critical attributes no interactions were found. In the more difficult concept with more criterial attributes, even with practice and the "wash out" of the significant main effects, a detail x strategy interaction still took place. The means related to the detail x strategy interaction in concept 1 and 2 can be compared in Table V.

TABLE V

MEANS RELATED TO THE DETAIL x STRATEGY INTERACTION IN CONCEPT 1 AND CONCEPT 2

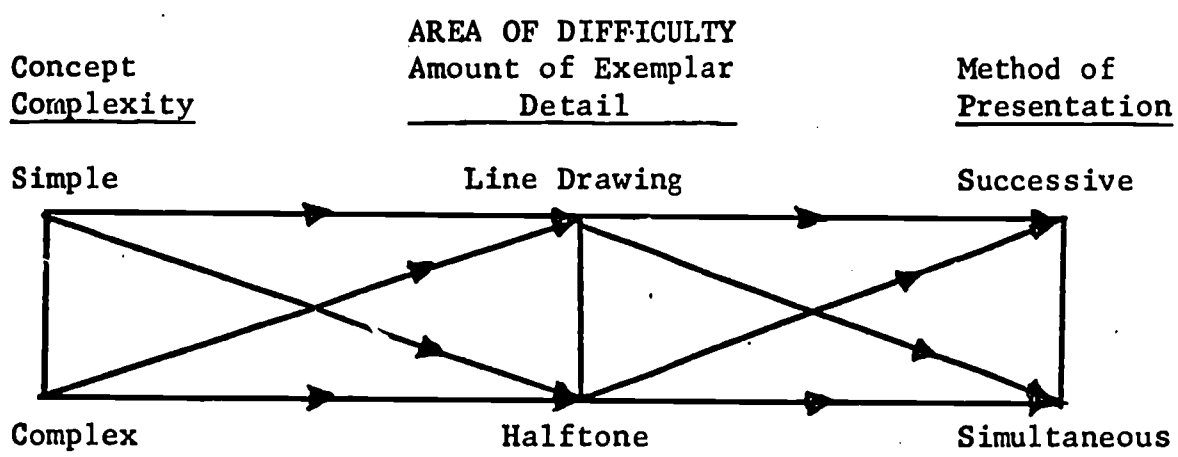
	Concept 1 (Easy)			Concept 2 (More Difficult)	
R	9.4	10.1	R	6.8	7.3
RI	9.1	9.5	RI	7.4	6.7
	SU	SI		SU	SI

In concept 1 and 2 small differences were found related to the amount of pictorial detail and they were not significant. In the easier concept the small differences related to presentation strategy were significant even with irrelevant detail present; however, there was no detail x strategy interaction. In the more difficult concept almost no differences were found in the main effects but a detail x strategy interaction did take place.

It is indicated from the data, as shown by the means related to the detail x strategy interaction, that there may be a relationship between the number of criterial attributes contained in a concept and the effect that varying amounts of pictorial exemplar detail has on a given presentation strategy. The relationship would be complex because it involves three areas of difficulty. The relationship can be seen in Figure 7.

FIGURE 7

THE RELATIONSHIP BETWEEN CONCEPT COMPLEXITY, EXEMPLAR DETAIL AND PRESENTATION STRATEGY



The first area of difficulty is related to the complexity of the concept in terms of the number of critical attributes present. The second area of difficulty is the amount of exemplar detail

contained in the line drawing-halftone format. The third area of difficulty is the method of presenting the images successively or simultaneously. In this relationship there are eight possible combinations of presenting instances. The presentation combinations are summarized in Table VI.

TABLE VI

PRESENTATION COMBINATIONS

	Concept Complexity	Amount of Exemplar Detail	Method of Presentation
1	Simple	Line Drawing	Successive
2	Simple	Line Drawing	Simultaneous
3	Simple	Halftone	Successive
4	Simple	Halftone	Simultaneous
5	Complex	Line Drawing	Successive
6	Complex	Line Drawing	Simultaneous
7	Complex	Halftone	Successive
8	Complex	Halftone	Simultaneous

In the easier concept with fewer attributes the subjects were able to process the information in both the simple line drawings and the halftones equally. The simultaneous strategy - sulted in small but significant differences but these differences were found across varying amounts of detail. The small but significant differences found in the simultaneous strategy can probably be attributed to the reduced memory requirement since in the simultaneous strategy comparisons could be made easier because both instances were available.

In the more complex concept with more attributes the subjects were unable to process the information contained in the simple line drawings and halftones in the same manner as in the easier concept. When the more complex concept was presented in the line drawing format, either successively or simultaneously, the results were similar to the easier concept. However, when the complex concept was presented in the halftone format the performance change as shown by the mean number of correct responses related to pictorial detail in Table V.

The higher mean performance of the halftone presented successively, which was probably responsible for the detail x strategy interaction, is unexplained. Perhaps it may be attributed to the fixed number of trials strategy employed and if a trials to criterion strategy had been used no interaction would have taken place; or it may be the result of the undetermined practice and training effect. The unexplained difference remains to be determined by further investigation.

The decrease in performance in the simultaneous presentation of halftones might be attributed to the inability of the subjects to process the increased amounts of information. The unexpected decrease in performance suggests that as concept complexity increases there is a limit to the amount of detail that can be processed in a given presentation strategy. In more complex concepts where a fixed number of trials strategy is used subjects seem able to process the information in the simple line drawing, but if irrelevant detail is added to the line drawings performance changes. The successive presentation of halftones results in better performance when compared to the simultaneous presentation of halftones. This relationship between concept complexity and the effects that varying amounts of

exemplar detail have on a given presentation strategy is undetermined but it should also be investigated further.

IMPLICATIONS

If the findings in the present study can be substantiated by additional investigations then they have a number of important practical implications for the instructional development and use of visuals in concept formation when a fixed number of exposures is used as a strategy. The most important implication is that the resulting similar effects across grade levels suggest that a common line drawing-halftone format and presentation strategy can be used with equal effectiveness with a wide range of the present student population from the fifth grade to the fifteenth grade.

The ability of subjects to process equally the simple line drawing and the halftone with its increased realism has additional implications, since the halftone carrying increased realism without compromising the advantages of simplification would provide a meaningful alternative to present design practices.

The similar effects across grade levels suggest that a common line drawing-halftone format can be used. If a common picture can be used instead of preparing different pictorial variations for subjects from late elementary school through college, common pictorial formats could be employed. Economically this would eliminate the need for producing multiple variations of the same pictorial stimulus. In addition, if a common presentation strategy could be used with similar effects from late elementary school through college the result would be a simplification of the instructional decisions related to the proper strategy used with a large segment of the student population.

If the relationship between the complexity of a concept and the effect that varying amounts of exemplar detail have on a given presentation is established, it seems that the complexity of a concept and the amount of exemplar detail contained in the pictorial stimuli will determine the presentation strategy to be used. In simple concepts having few attributes the simultaneous presentation of line drawings or halftones is more effective. In complex concepts having many attributes the strategy to be used would be changed. Simple line drawings could still be presented simultaneously but halftones and pictures containing additional irrelevant detail would be presented successively since in the simultaneous presentation performance seems to decrease.

FURTHER RESEARCH

In order to substantiate the findings further investigations are needed to provide possible answers to the unexplained questions raised by this study. Some of the questions to be answered are:

1. If a trials to criterion strategy had been used instead of a fixed number of trials would the results remain the same or would performance have been in the predicted order?

2. What were the effects of practice and transfer on the second similar task? If the concepts were equal in complexity would the effects increase? Would the effects change if dissimilar concepts had been used.

3. If a "tolerance" level for some irrelevant detail in a picture exists, then what are its limits? Is the "tolerance" level the same for all populations studied or does it vary with grade level? Is the "tolerance" level the same in differing concepts with dissimilar pictorial stimulus?

4. Will concepts of differing complexity and varied amounts of detail result in performance differences based upon varied presentation strategies? Will the effects be the same when different variations of the stimulus are used? When different tasks are employed will the results be the same?

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