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The Impact of two Modes of Representing Information by means of Slides, given Differences in Learners' Cognitive Restructuring Ability

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ABSTRACT

The Impact of two Modes of Representing Information by means of Slides, given Differences in Learners' Cognitive Restructuring Ability

Pierre Lavoie

This media study investigated the impact of alternative modes of representing information in a visual learning task, given learners who differed with respect to their cognitive restructuring abilities. The short-circuiting condition comprised pairs of slides in which a close-up was followed by a long shot. The supplanting condition consisted of pairs of slides in which a close-up was followed by a long shot whose relevant detail had been highlighted. While the short-circuiting condition required the subjects to single out a detail from each of the technical visual displays, the supplanting condition was presumed to imitate this ability symbolically. It was hypothesized that while field-independent individuals perform alike when exposed to either treatment condition, field-dependent individuals perform better when exposed to the supplanting condition. The sample consisted of 120 college students registered in psychology courses. The experimenter administered the Group Embedded Figures Test

(GEFT) to the subjects' subgroups previously recruited, presented either treatment condition randomly, and administered the visual identification posttest. Considering the data of the whole sample, an analysis of variance was performed by means of multiple regression. A 2 x 2 factorial analysis of variance was then performed, considering only the data of the subjects who scored in the extreme quartiles of the GEFT. The outcomes of the statistical analyses have indicated a significant ability effect ($p < .001$), but no treatment effect and no interaction. It was concluded that the emergence of an aptitude-treatment interaction (ATI) might have been precluded either because the alternative modes of representing information did not differ enough and/or because other abilities were influencing task success.

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The Impact of two Modes of Representing Information by means of Slides, given Differences in Learners' Cognitive Restructuring Ability

Chapter 1

Problem Statement

Introduction to Context of Problem

Addressing the issue of media research so as to produce generalizable knowledge, several researchers (Carrier & Clark, 1978; Clark, 1975, 1978, 1980; Clark & Snow, 1975; Dwyer, 1978; Levie & Dickie, 1973; Meierhenry, 1980; Salomon, 1974b; Salomon & Clark, 1977; Shapiro, 1975) have suggested that research questions should be conceptualized so as to deepen our understanding of what functions media attributes can accomplish for different learners and different tasks. Research questions should especially deal with psychological functions that media attributes can accomplish under different conditions and for different learners (Levie, 1978; Levie & Dickie, 1973; Salomon, 1979; Salomon & Clark, 1977; Salomon & Cohen, 1977; Shapiro, 1975).

Statement of the Problem

The purpose of this study was to investigate the differential effects of two modes of representing information by means of slides in a visual learning task, given learners who differ with respect to their initial relevant abilities. The mental skill that was called for by the selected task consisted of singling out details from their general contexts. The subjects were shown either a sequence of pairs of slides in which each pair comprised a close-up that was followed by a long shot or another sequence in which each pair consisted of a close-up that was followed by a long shot whose relevant part had been highlighted. The underlying assumption was that visual learning might be enhanced by applying such modes of representing information methodically. By highlighting the relevant detail of a visual display, the instructional format was presumed to imitate a process of mental elaboration symbolically; that is, information pick-up, visual search, or exploration in order to establish the part/whole relationship. Thus, this experiment was devoted to the question of how differences among the selected symbolic representations affect the acquisition of knowledge, given learners who differ with respect to their cognitive restructuring abilities.

Chapter 2

Literature Review

Related Research

Visual perception. Neisser (1967) defined cognition as "all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" (p. 4). Cognition is a constructive process that leaves traces behind. The schema, which is such a construction, integrates all the information known about the object, scene, or event into a systematic framework used during perceptual processing. The schema is "that portion of the entire perceptual cycle which is internal to the perceiver, modifiable by experience, and somehow specific to what is being perceived" (Neisser, 1976, p. 54).

Accordingly, the cognitive structures which are crucial for vision consist of schemata which are plans for perceptual action as well as readiness for certain kinds of information (Neisser, 1976). By selecting the kind of information that is picked up from the environment, the schema controls the activity of looking. The information picked up modifies, in turn, the original schema. So the schemata direct perceptual activity, and are modified as it occurs (Neisser, 1976). Similar ideas had been expressed by Hochberg (1978), and Palmer (1977).

The present discussion focuses primarily on vision but one must keep in mind that schemata are not visual, auditory, or tactile, but perceptual; when attending to an object, scene, or event, the perceiver seeks, accepts, and integrates every sort of information regardless of the sensory modality.

Palmer (1975) proposed an information processing model of perception to account for the way by which the perceiver arrives at meaningful interpretations from retinal information. In his view, perception of meaning also depends on schematic control of information pick-up; that is, the stored information about the world plays a central role in the interpretation of sensory data.

The schema, which relates the perceiver to his environment, is at the heart of the perceptual system. "Sensory features 'look for' possible interpretations within the available conceptual schemata, and the possible interpretations 'look for' confirming sensory information among the features being extracted" (Palmer, 1975, p. 295). Thus, two processes are simultaneously involved in perceptual interpretation. Sensory data, by being incorporated into a global interpretation, play a bottom-up role; and expectations, by looking for confirming sensory information, play a top-down role. The end result should be the identification or understanding of a visual display, object, scene, or event.

<u>Symbolic representations and cognition</u>. Levie and Dickie (1973) defined media attributes as the "properties

of stimulus materials which are manifest in the physical parameters of media" (p. 860). These structural components of a medium influence the kind of material that may be presented as well as the manner in which it is presented (Shapiro, 1975). The development of new media technologies leads to new modes of representing information; that is, to new symbol systems (Salomon, 1974b, 1979). Symbol systems can be defined as modes of appearance which consist of a "set of elements that refer in specifiable ways to domains of reference and are interrelated according to some syntactic rules or conventions" (Salomon, 1979, p. 20).

Addressing the issue of the similarity between the symbol systems and their concrete referents so that meaning may be construed, Salomon (1979) argued that similarity is moderated by perceptual schemata. As discussed in the preceding section, perception of meaning is mediated by schemata that generate expectations and search for confirming sensory data. Whether these sensory data are similar to their concrete referents do not matter, as long as they are interpreted as doing so.[1]

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[1]All other things being equal, the extraction of knowledge from a symbolic representation requires that learners understand the convention of representation which is used to convey the information. Thus, one could speak of visual literacy; that is, "the ability to manipulate symbols in visual format for thinking and communicating" (Y. W. Chen's cited in Hill, 1981, p. 45).

As pointed out by Salomon (1979), a previously encountered symbolic representation gives rise to an internal representation that is now perceived as the real object, scene, or event. Hence, the internal representation, rather than the similarity between the symbol system and its concrete referent, determines how a symbolic representation is to be perceived.

The acquisition of knowledge from a symbolic representation calls for skills in information reception and processing. Recoding is the process by which a symbolic representation is transformed, elaborated on, and translated into an internal representation preferred by the perceiver or required by the task (Salomon, 1979). This process entails covert mediative activities such as visualizing, analyzing, comparing, contrasting, labeling, differentiating, hypothesis-generating, and other activities of manipulating information (Salomon, 1974b, 1979). The amount of recoding which is required so that meaning may be construed depends on the correspondence, match, or congruence between the symbolic representation and the perceiver's internal representation. Since the process of knowledge acquisition is mediated by the schema, a symbolic representation that deviates from one's anticipation requires a more elaborate chain of mental transformations. So to the extent that information is coded or represented differentially, knowledge extraction would call for different amounts of mental elaboration (Salomon, 1974b, 1979).

Addressing the issue of the relationship between the learners' individual differences and the way in which information is represented, Salomon (1979) argued that a symbolic representation that corresponds better to one's schema is easier to process; that is, less recoding is needed so that knowledge may be extracted. Salomon (1974a) reported data which support the proposition that the effectiveness of a given symbol system differs with respect to learners' abilities. While low ability learners are favored by a symbolic representation that imitates or circumvents some of the translation processes, high ability learners perform better when required to apply their own recoding strategies.[2] So taking account of individual differences, a given symbolic representation may be more effective by placing a lighter or heavier burden on the receiver of the message.

Symbol systems vary as to the mental skills (e.g., singling out details from visual displays, laying out solid objects into two-dimensional plans, changing the point of view of objects, etc.) they activate in the process of knowledge acquisition. Psychological requirements of the task, whether actually imposed or self-selected, also play an important role in determining

---

[2]High and low ability mean that learners score differently on the relevant aptitude test. It could be the expression of different cognitive styles.

which mental skills are relevant in the process of knowledge extraction (Gibson, 1969; Haber & Hershenson, 1980; Neisser, 1967; Salomon, 1979). Perception of the task determines what and how information is to be processed, thus entailing a top-down process; and the symbol system encountered determines which mental skill is relevant and how much recoding or elaboration is required, thus entailing a bottom-up process (Salomon, 1979). Since symbol systems and task requirements both influence the kinds of mental skills that are required in the process of knowledge acquisition, they should interact in some way. Relative to the knowledge one wishes to develop in a learner, a given symbol system may be more appropriate than another if it conveys the critical features that are required by the task. Thus, learning is maximized when a symbol system calls for mental skills which are compatible with those required by the task to be performed (Salomon, 1979; Salomon & Cohen, 1977).

In this section we have argued that symbol systems vary as to the mental skills and the amount of recoding they require, that symbol systems have differential effects with respect to learners' abilities, and that task requirements vary in regard to the mental skills they activate. This suggests a three-way interaction between the symbol systems, the learners' abilities, and the demands of the task (Salomon, 1979; Salomon & Cohen, 1977). For effective learning to occur, a match needs to be established between the mental skills called for by the symbol system, the psychological requirements of the task, and the learner's level of mastery of these skills (Salomon, 1979).

Cognitive styles. Cognitive styles reflect individual differences in modes of acquiring, processing, and using information (Ragan, 1978). Similar ideas had been expressed by Goodenough (1976), Greco and Mc Clung (1979), Kogan (1979), and Witkin, Moore, Goodenough, and Cox (1977). Since cognitive styles are concerned with the manner and form of cognition, they deal with processes rather than abilities.

According to Witkin and Goodenough (1981), the most general dimension of cognitive functioning which has been identified is that of the field-dependence-independence. The field-dependence-independence dimension reflects the tendency of a perceiver to be influenced by a prevailing background or context in which information is embedded.

This psychological dimension was initially assessed by two tests that were quite cumbersome; that is, the Body Adjustment Test (BAT) and the Rod-and-Frame Test (RFT). The BAT requires the subject to adjust a chair to the upright, when seated in a tilted chair which is in a tilted room (Witkin, Oltman, Raskin, & Karp, 1971; Witkin & Goodenough, 1981). The RFT requires the subject to adjust to the upright a tilted luminous rod which is inside a luminous frame tilted independently, when seated in a totally dark room (Witkin et al., 1971; Witkin & Goodenough, 1981). The field-dependence-independence dimension may nowadays be assessed by the Embedded Figures Tests whose criterion measure entails the overcoming of an embedding context. These tests, which call for cognitive restructuring skills, require the subject to locate a simple figure embedded in a complex one. The score reflects a tendency, in varying degrees of strength, toward a global or an analytic mode of perceiving.

Field-dependent and field-independent people differ in regard to their degrees of autonomy of external referents. Analytic or field-independent individuals are likely to overcome embedding contexts and to restructure their initial perceptual experiences. Global or field-dependent persons have more difficulties in overcoming embedding contexts; that is, they are more dependent on the prevailing organization of perceptual fields.

The field-dependence-independence dimension is a cognitive style that is consistent in a very wide array of perceptual situations which share the requirement of perceptual disembedding, such as perceptual activities, intellectual functioning, and social-interpersonal behaviors (Goodenough, 1976; Witkin et al., 1971, 1977; Witkin & Goodenough, 1981). This psychological dimension is self-consistent among tasks featuring actual stimulus configuration or spatial material. This concept may also be applied to intellectual activities which deal with symbolic representations or thinking, such as in problem solving tasks which require the subject to use a critical element in a context that is different from the one in which it was presented. Field-dependent and field-independent people also differ as to their social-interpersonal behaviors along with their educational-vocational interests. Field-dependent individuals tend to be outgoing; they are skilled in getting along with people. They often express interest in educational-vocational areas which feature social content and which require social skills. Field-independent individuals tend to have an impersonal orientation; they are more contained and individualistic. They often express interest in educational-vocational areas that are more solitary as to their work requirements and more abstract as to their substantial contents (Goodenough, 1976; Witkin et al., 1977; Witkin & Goodenough, 1981).

Recent studies have stressed the role of the field-dependence-independence dimension in concept and discrimination learning (Goodenough, 1976; Greco & Mc Clung, 1979; Witkin et al., 1977). Field-independent persons can, as required by the task, restructure material which has little inherent organization. Because of their abilities in overcoming embedding contexts, they can identify more easily the important attributes of stimulus materials, whether or not they are conspicuous. Field-dependent individuals are more dependent on the prevailing organization of perceptual fields. Because of their difficulties in overcoming embedding contexts, they tend to be dominated by the most salient cues of stimulus materials, whether or not they are relevant to the task at hand.

Synthesis. The constructs which underlie the present experiment have been discussed in the previous sections; namely, the issues of schema, of recoding processes entailed by symbolic representations, and of cognitive styles. The schema relates the perceiver to his environment (i.e., it generates expectations and searches for confirming sensory data) so as to construe meaning from a specific perceptual situation. The physical parameters of media comprise inherent attributes which may entail different recoding strategies; that is, knowledge extraction may require different amounts of mental elaboration, given alternative symbolic representations. Cognitive styles, which represent consistencies in modes of acquiring and processing information, are manifest when extracting knowledge from symbolic representations; therefore, they should be considered when exposing learners to such instructional communications.

Taken together, these theoretical matters suggest that psychological functions of symbolic representations may be assessed by training subjects to the requirements of a given perceptual task so as to induce a schema, by manipulating symbolic representations so that they require different amounts of mental elaboration, and by measuring the impact on perceivers who differ with regard to their relevant cognitive styles. The evidence of the psychological impact of alternative symbolic representations could be inferred from the interactional patterns of the data; that is, whether alternative symbolic representations generate significant variations on the criterion measure, given subjects who differ as to their cognitive styles.

Importance of Problem within the Context of Available Research

Research on interactions between cognitive styles and instructional treatments is an emerging research focus. Although research evidence is limited, it seems that field-dependent people, who have difficulties restructuring their perceptual fields, are aided by instructional formats that symbolize this cognitive process (Goodenough, 1976; Greco & Mc Clung, 1979; Jonassen, 1979; Kogan, 1979; Witkin et al., 1977).

Research on the psychological impact of media's symbol systems is a meaningful line of research. Several researchers (Clark, 1980; Olson, 1974; Salomon, 1979; Salomon & Cohen, 1977) have argued that media research should be conceptualized in terms of the psychological functions that symbol systems can accomplish in interaction with learners and learning task. Such an approach requires the differentiation of media's symbol systems as means of activating, supplanting, or short-circuiting specific processes of mental elaboration.

Salomon (1974a) investigated the issue of the relationship between learners' attributes and media's symbol systems. The results have shown that high ability subjects tend to prefer modes of representing information which activate or call for specific processes of mental elaboration already available in their repertoires. Such symbolic representations place the information processing burden on the learner in the process of knowledge acquisition. On the other hand, low ability subjects require symbolic representations which actually provide the transformations they cannot provide for themselves. As far as the mode of representing information being used is congruent with the learner's internal representation or schema, a symbolic representation that imitates or supplants a specific process of mental elaboration relieves the learner of the burden of processing great amounts of information. In other words, it makes it mentally easier for the learner to extract knowledge from a symbolic representation.

These research trends suggest that alternative modes of representing information may have differential effects upon learners who differ in regard to their cognitive styles. Nevertheless, further research efforts are needed to support this proposition and to isolate other media attributes which may imitate some specific processes of mental elaboration symbolically. This experiment investigated the differential effects of two static codes, given learners who differed in regard to their initial relevant abilities. As pointed out by Salomon (1972), the symbolic imitation of static spatial relations should also be considered.

Chapter 3

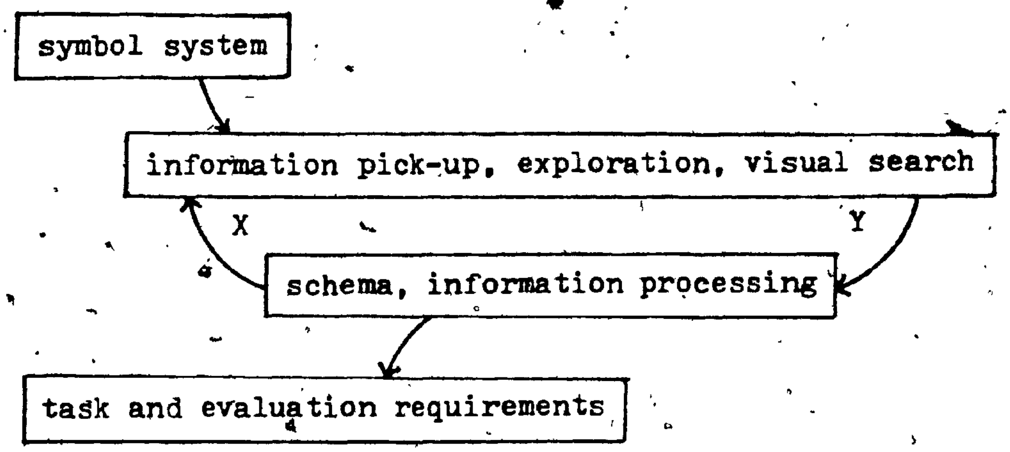
Objectives

Hypotheses in Relation to Problem Statement

The purpose of this study was to investigate the differential effects of two modes of representing information in a visual learning task, given learners who differ with respect to their cognitive restructuring abilities. In the short-circuiting condition the learners were presented a sequence of pairs of slides; each pair comprising a close-up that was followed by a long shot. In the supplanting condition the learners were presented a sequence of pairs of slides; each pair consisting of a close-up that was followed by a long shot in which a relevant detail had been highlighted. The mental skill that was called for by the selected task consisted of singling out a detail from each of the technical visual displays. The criterion measure that was used to evaluate knowledge acquisition was a visual identification posttest which required the learner to locate, among the lettered parts of each long shot, the detail that was supposed to be singled out.

Since the information was differently coded or represented, the process of knowledge acquisition was expected to call for different processes of mental elaboration. While the short-circuiting condition required the learners to single out a detail from the whole visual display, the supplanting condition, by highlighting the relevant part of a visual display, was presumed to imitate this process of mental elaboration symbolically; that is, this symbolic representation was expected to relieve the learners of the burden of information pick-up, visual search, or exploration in order to establish the part/whole relationship.

Thus, it was reasoned that, depending on the learners' abilities in overcoming embedding contexts, these two modes of representing information might be of psychological significance (i.e., whether the instructional format calls for or whether it imitates specific processes of mental elaboration symbolically might have differential effects upon learners who differ with respect to their cognitive restructuring abilities). Field-dependent people, who have difficulties in overcoming embedding contexts, might profit more from an instructional format that imitates symbolically some of the processes of mental elaboration that are entailed by the mental skill which is called for by the task. Therefore, it was hypothesized that while field-independent individuals perform alike when exposed to either of the treatment conditions, field-dependent individuals perform better when exposed to the supplanting condition (see Figures 1 and 2).



(X) Bottom-up Process

(Y) Top-down Process

<u>Figure 1</u>. Conceptual Entailment Structure of the Theoretical Hypothesis.[a] (Arrow tails are concept entailed, and arrow heads are concept entailing).

[a] Theoretical hypothesis: By highlighting the relevant detail of a visual display, the supplanting condition imitates symbolically a specific process of mental elaboration the learner would have to carry on by himself otherwise; that is, information pick-up, exploration, or visual search in order to establish the part/whole relationship.

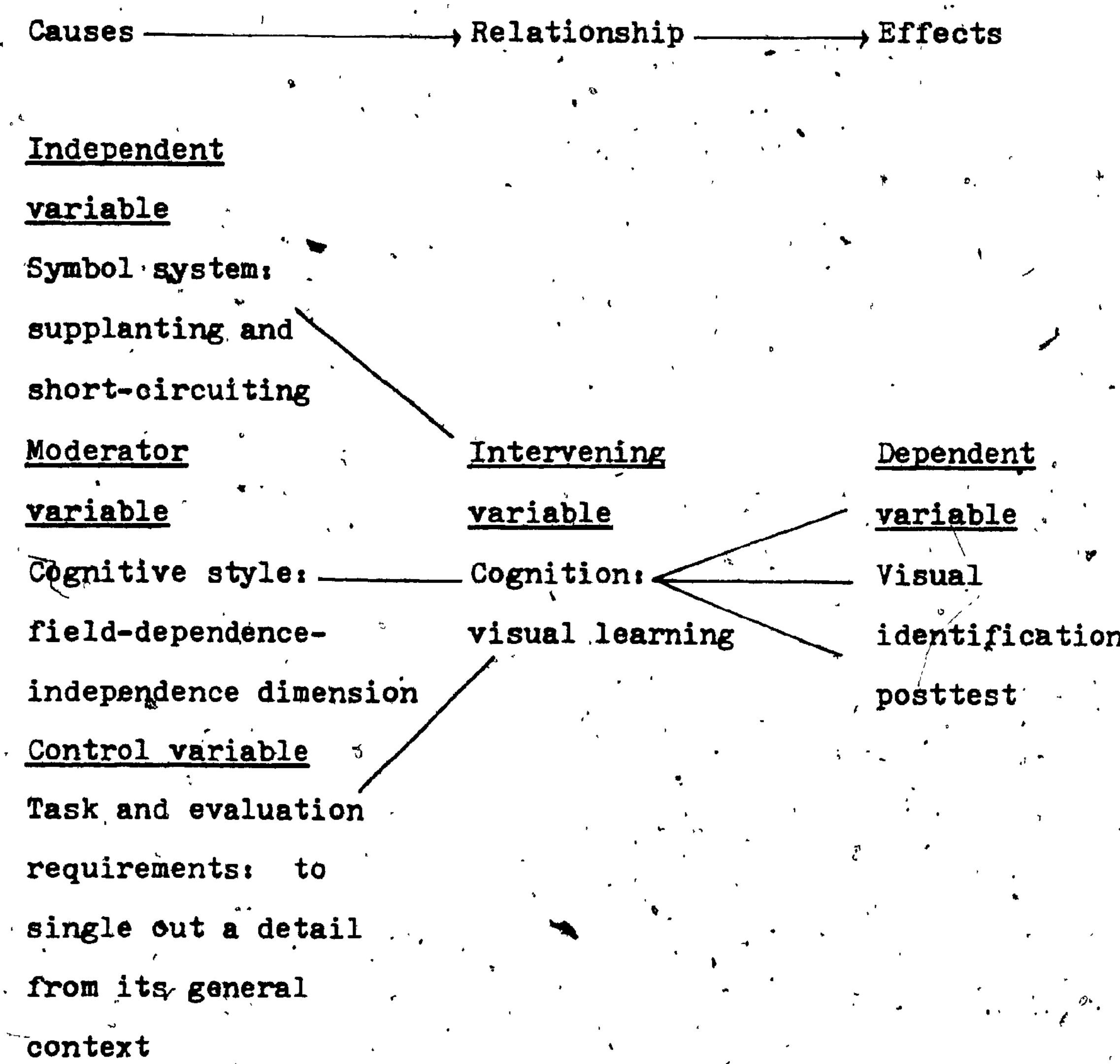


Figure 2. Relationship between the Variables.[a]

[a]Operational hypothesis: While field-independent individuals perform alike when exposed to either of the treatment conditions, field-dependent individuals perform better when exposed to the supplanting condition.

Rationale for Hypotheses

Salomon (1974a) investigated, among other things, the issue of relationship between learners' attributes and media's symbol systems. He hypothesized that symbol systems that supplant specific processes of mental elaboration would be of particular advantage to learners who score low on the relevant aptitude test. The results have shown that while low ability learners profit more from symbolic representations that supplant specific processes of mental elaboration, high ability learners perform less well following such symbolic representations and much better following other modes of representing information which call for skills already available in their repertoires. It seems that interference may occur when high ability learners are exposed to symbol systems which supplant mental skills they have already mastered.

Tidhar (1973), who investigated the relative effectiveness of visual reminders on learning by TV, hypothesized that visual reminders would have differential effects upon learners who differ with respect to their levels of intelligence and their aptitudes in memorizing visual details. The results have shown that learners who score low on the intelligence test and/or the visual memory aptitude test learn more when visual reminders are introduced during the TV presentation, whether the verbal component consists of statements or questions. For learners who score high on the intelligence test and/or the visual memory aptitude test, the use of verbal statements is as effective as the introduction of visual reminders.

Reviewing research on interaction between the field-dependence-independence dimension and instructional formats, Goodenough (1976), and Witkin et al. (1977) reported that field-dependent individuals, who have difficulties in overcoming embedding contexts, may be at a disadvantage when exposed to unstructured instructional materials. When the instructional material is organized so that cognitive restructuring abilities are not called for, field-dependent and field-independent individuals are not likely to differ.

The results of these experiments suggest that low ability learners perform better when exposed to instructional formats which supplant specific processes of mental elaboration they would have to activate by themselves otherwise. When exposed to such modes of representing information, high ability learners either perform less well or as effectively as when exposed to symbolic representations which call for mental skills already available in their repertoires.

Operational Definition of Variables

Field-dependence-independence dimension. The field-dependence-independence dimension reflects the tendency of a perceiver to be influenced by a prevailing background or context in which information is embedded. Field-independent individuals, who are likely to overcome embedding contexts, score high on the Group Embedded

Figures Test (GEFT). Field-dependent persons, who have more difficulties in overcoming embedding contexts, score low on the GEFT.

Short-circuiting. A sequence of pairs of slides in which each pair consisted of a close-up that was followed by a long shot of the same visual display. The short-circuiting condition required the learner to single out a detail from each of the technical visual displays.

Supplanting. A sequence of pairs of slides in which each pair consisted of a close-up that was followed by a long shot whose relevant detail had been highlighted. By highlighting the relevant detail of a technical visual display, the supplanting condition was presumed to imitate symbolically a covert process of mental elaboration the learner would have to activate on his own otherwise; that is, information pick-up, visual search, or exploration in order to single out a detail from each of the technical visual displays.

Visual identification posttest. A test which required the learner to locate, among the lettered parts of each long shot, the detail that was supposed to be singled out.

Chapter 4

Method

Sample

The sample consisted of 120 subjects of whom 35 were males and 85 were females, and whose age ranged from 17 to 25 years old. The subjects were registered in a compulsory or elective psychology course at Cégep de Rosemont or at Cégep de Maisonneuve, both in Montréal. Since many programs require that students take psychology course(s), the sample was presumed to be representative of the Cégep population.

Research Design

The data of the whole sample were considered in carrying out an analysis of variance by means of multiple regression; that is, the moderator variable was interval in level. Descriptive statistics were also calculated.

Some subjects were then, on a post hoc basis, assigned to one of the following four treatment by ability categories: short-circuiting by low GEFT score, supplanting by low GEFT score, short-circuiting by high GEFT score, and supplanting by high GEFT score. The subjects who scored in the extreme quartiles of the GEFT were classified as having a high or low score. Similar extreme-groups design had already been used in other exploratory studies (Carrier & Clark, 1978; Greco & Mc Clung, 1979). A two-way analysis of variance along with some descriptive statistics were performed on the data of this 2 x 2 factorial design:

X_1	Y_1	O_1
X_2	Y_1	O_2
X_1	Y_2	O_3
X_2	Y_2	O_4

Treatments (X)

X_1 Short-circuiting Condition

X_2 Supplanting Condition

Moderator (Y)

Y_1 High GEFT Score

Y_2 Low GEFT Score

Observations (O)

$O_1 \ldots O_4$ Visual Identification Posttest

Figure 3. Extreme-groups Factorial Design

Rationale for research design. As pointed out by Salomon (1979), to test whether alternative modes of representing information vary as to the amount of mental elaboration or recoding they require, one should use one mode of representing information that deviates from learners' schemata and compare it with an alternative mode of representing information that imitates symbolically some of the processes of mental elaboration that are required by the former. Symbolic representations that deviate from learners' schemata require a more elaborate chain of mental transformations; thus leading to difficulties, errors, slow execution, and variations among individuals (Salomon, 1979). By studying the interactional patterns between posttest scores and learners' initial relevant abilities, it should be possible to test whether alternative modes of representing information require different amounts of mental elaboration.

In this research, the GEFT assessed the learners' initial relevant abilities. The GEFT was selected as a moderator variable because it calls for the same kind of mental skill as the one required by the task to be performed; that is, singling out a detail from an embedding context. By exposing different abilities learners to the alternative symbolic representations, it was possible to test whether the two modes of representing information varied with respect to the amount of mental elaboration they required. The evidence of these internal processes could be inferred from the interactional patterns of the data (i.e., whether the two modes of representing information generated significant variations on the visual identification posttest, given learners who differed as to their cognitive restructuring abilities).

Materials

Treatment conditions. The independent variable was two sequences of pairs of slides; each pair comprising a close-up followed by a long shot of the same visual display. The short-circuiting condition consisted of pairs of slides in which a close-up was followed by a long shot. The supplanting condition consisted of pairs of slides in which a close-up was followed by a long shot whose relevant detail had been highlighted. The pairs of slides were arranged at random for each treatment condition, so as to prevent an order effect that may have resulted otherwise. The content of the black-and-white slides was complex visual displays such as engines, petrochemical complexes, industrial complexes, control boards, and other such technological devices which comprised several distinct parts. The subjects were presented a sequence of 3 pairs of slides in the example section, 5 pairs of slides in the practice section, and 26 pairs of slides in the experimentation section. Each slide was projected for 5 sec. A black slide was projected for 3 sec between each pair of slides.

The slides were projected at 3 meters from a screen in a room lightly illuminated. The advance of the projector was controlled by a Wollensak tape recorder. The subjects were seated within 3 meters of the screen.

Pilot study. A pilot study of the experimentation was conducted to determine whether the number of slides along with the time of projection did produce some variations on the visual identification posttest. Three subjects were exposed to the first version of the experiment whose slides were projected for 4 sec. The short-circuiting condition seemed appropriate for the pilot study because the task it entailed was presumably more difficult than that of the supplanting condition. The subjects' scores on the visual identification posttest were 7, 14, and 17. The subjects were sometimes annoyed during the experimentation; and thereafter reported that the slides were not projected for long enough, that too many slides were projected, and that the content of the slides was sometimes too dense. As a result, the procedure was modified so that the slides were projected for 5 sec. Two subjects were exposed to the short-circuiting condition, and their scores on the visual identification posttest were 14 and 19. The subjects thereafter reported that, despite the number of slides, it was nevertheless feasible. Further, the pilot study confirmed the validity of the projection conditions, of the order in which the steps were undertaken, and of the directions.

Production of visual displays. Color and black-and-white photographs were first reproduced from encyclopaedias with fine-grain, black-and-white films (FX-ASA 32) that were overexposed 1 1/2 time at f/16. These films were developed and printed on 12.7 x 17.78 cm and 20.32 x 25.4 cm glossy, double weight, high-contrast paper. Each 20.32 x 25.4 cm print was mounted on a 27.94 x 35.56 cm two-ply, hard cardboard (bristol), and then framed with a two-ply, black cardboard (mayfair) mounted as overlay on the bristol. The close-ups were produced by positioning a clear acetate over the relevant part of each long shot and scoring its contour with a swivel knife, so as to make a stencil from which the contour of the part was traced on 22.86 x 30.48 cm drawing paper and then cut out with a swivel knife. Each mask was mounted as overlay on the bristol, so that only the close-up emerged. The highlighted long shots were produced by masking the relevant detail of each 12.7 x 17.78 cm print with frisket film, airbrushing the print with photo-retouching grays (Grumbacher's gamma), and framing it with a two-ply, black cardboard (mayfair). The close-ups, the long shots, and the highlighted long shots were photographed with fine-grain, black-and-white films (FX-ASA 32) which were handled as ASA 100 films exposed normally at f/16, and then processed for slides. The test items were produced by laying a 22.86 x 30.48 cm clear acetate over each 20.32 x 25.4 cm print, mounting it as overlay on the bristol, and numbering the print and lettering its parts with red, 28pt (didot), dry-transfer letters. These test items were then shot with slow, color reversal films (EKT-ASA 50, tungsten) which were exposed normally at f/16.

Measures

The moderator variable for main study was the GEFT, and the dependent variable consisted of a visual identification posttest.

The GEFT requires the subject to locate a simple figure embedded in a complex one. This test is divided into three parts, consisting of 7, 9, and 9 items. The time limits are 2, 5, and 5 minutes, respectively. While the first section is for practice only, the number of simple figures correctly traced on the second and third parts constitutes the raw score on the GEFT. The more figures correctly traced, the more analytic the subject. The GEFT was selected as a moderator variable because the visual demand of the instrument is similar to that of the task.

The visual identification posttest consisted of 26 multiple-choice items that required the subject to locate, among the lettered parts of each long shot presented during the experimentation, the detail that was supposed to be singled out. Each slide, which proposed four response alternatives, was projected for 5 sec. The test items were projected in a random order. A black slide was projected for 5 sec between each test item, thus permitting the subject to write his answer on the response sheet provided (see Appendix A).

Procedure

The experiment was run once a week at each Cégep, during the study periods. The subjects were previously recruited by the experimenter who visited about 50 psychology classes. The experimenter told the students that he was doing an experiment about visual perception which consists of evaluating two modes of representing information by means of slides, given learners who differ as to some aspects of their personalities; that they would first be administered a test which assesses some perceptual and social aspects of their personalities, and would then be exposed to a sequence of slides; and that they would finally be given their scores on the personality test along with the interpretation and some information about the nature of the experiment. The subjects who volunteered to participate were told where and when the experiment would be run. The experimenter did such recruitment for 6 weeks; that is, until 60 subjects had been exposed to each mode of representing information.

Whenever the experiment was run, the experimenter first introduced himself and acquainted the subjects with the purpose of the experiment; that is, a media study which investigates the differential effects of two modes of representing information by means of slides, given learners who differ as to some aspects of their personalities. The subjects were told that the experiment would be done in two steps whose first would assess their cognitive styles, and whose second would consist of the projection of visual displays along with the administration of concomitant test items. The subjects were also told that, generally, the task would consist of singling out a part from its general context and that they would have to work individually, in silence, and without taking any note (see Appendix B). The size of the groups ranged from 2 to 20 subjects.

The experimenter distributed the French GEFT booklets along with the response sheets of the visual identification posttest, which were respectively numbered alike so as to preserve the subjects' anonymity and privacy. The subjects were administered the GEFT according to the French version of the manual for the embedded figures tests (Witkin et al., 1971/1978).

The experimenter selected randomly the treatment condition that was subsequently presented to the subjects. By means of examples and practice, the subjects were given an opportunity to acquire knowledge and experience about the task and evaluation requirements. The parenthetical matters (e.g., EXAMPLE: task) that will appear in the following paragraphs refer to the critical steps of the experiment, and coincide with the captions of the slide series.

The subjects were informed about the task requirements; that is, to single out a detail from its general context. They were then exposed to the examples of the task (EXAMPLE: task) which consisted of 3 pairs of slides that represented the treatment condition they were eventually administered. Such an introduction was expected to give the subjects an opportunity to understand the convention of representation that was used to convey the information; thus preparing them as to which kind of mental skill would be required so that knowledge may be extracted. The subjects were also informed about the evaluation requirements: To locate, among the items of each visual display, the part they were supposed to find. They were then exposed to the examples of the test (EXAMPLE: test) which assessed whether the subjects had found the parts in the whole visual displays. Few researches (Levie & Levie, 1975; Tversky, 1975) have shown that considerable retention may occur when learners are tested in a way that is anticipated. This suggests that recoding strategies are also influenced by the criterion measure that is used to evaluate knowledge acquisition. The example section, which consisted of 3 pairs of slides and whose purpose was to give the subjects an opportunity to acquire knowledge and experience about the task and evaluation requirements, was repeated two times for each group of subjects, no matter which treatment condition was administered.

The subjects were exposed to the practice section whose purpose was to promote better understanding of the task and evaluation requirements. This section consisted of 5 pairs of slides (PRACTICE: task) and 5 test items (PRACTICE: test). The items in the practice section were not included in the total score. However, the experimenter scanned this section before correcting the response sheets, so as to ascertain that the subjects understood the task and evaluation requirements.

The subjects were administered the experimentation section which consisted of 26 pairs of slides (EXPERIMENTATION: task) and 26 test items (EXPERIMENTATION: test).

The subjects were finally told their scores on the GEFT along with the interpretation and more information about the nature and rationale of the experiment (see Appendix C).

Chapter 5

Results

The first statistics that were calculated consisted of an analysis of variance and some descriptive statistics which considered all the data of the sample; that is, 120 subjects of whom 35 were males and 85 were females (see Appendix D). Analysis of variance was performed by means of multiple regression (i.e., the moderator variable was interval in level). Such statistical procedures increase measurement precision. A 2 x 2 factorial analysis of variance was then performed, considering only the data of the learners who scored either low or high on the GEFT; that is, 59 subjects of whom 18 were males and 41 were females (see Appendix D). The latter two-way ANOVA was performed because it suited better the extreme-groups design entailed by the hypothesis.

Statistics of Sample Data

The subjects' subgroups that were administered the different treatment conditions performed in a similar fashion on the ability (GEFT) test. As shown in the top part of Table 1, the mean and the standard deviation of the ability (GEFT) test are 11.67 and 3.81 for the learners who were exposed to the short-circuiting condition, and 12.23 and 4.23 for those who were exposed

Table 1

Means and Standard Deviations of GEFT and Posttest Scores for each Treatment Condition

Mode of representing information	M	SD	n
	Ability test (GEFT)[a]		
Short-circuiting	11.67	3.81	60
Supplanting	12.23	4.23	60
	Visual identification posttest[b]		
Short-circuiting	16.37	3.31	60
Supplanting	16.67	3.55	60

Note. N = 120.

[a]Maximum score = 18. [b]Maximum score = 26.

to the supplanting condition.

The subjects' subgroups that were administered the different treatment conditions performed alike on the visual identification posttest. As shown in the bottom part of Table 1, the mean and the standard deviation of the visual identification posttest are 16.37 and 3.31 for the learners who were exposed to the short-circuiting condition, and 16.67 and 3.55 for those who were exposed to the supplanting condition.

The scores on the visual identification posttest were related to the subjects' abilities on the GEFT, but were not influenced by the treatment conditions that were administered to these subjects' abilities subgroups. The outcome of the regression analysis (Table 2) indicates a significant ability effect, F (1, 116) = 25.71, $p < .001$; but no significant treatment effect and no interaction.

Table 2

Regression Analysis of Visual Identification Posttest by Ability, and Treatment

Source	SS	df	MS	F
Ability (GEFT)	251.69	1	251.69	25.71*
Treatment	.27	1	.27	.03
Ability by Treatment	4.55	1	4.55	.47
Error	1135.46	116	9.79	

*$p < .001$.

Considering all the data (N = 120), the correlation coefficient between the GEFT and the visual identification posttest is r = .48 for the subjects' subgroups who were exposed to the short-circuiting condition (n = 60), and

$r = .38$ for the subjects' subgroups who were exposed to the supplanting condition ($n = 60$); each of them is significant ($p < .01$, two-tailed test), according to the Fisher's test of significance for testing the hypothesis that $\rho = 0$. The scatter diagrams, which depict the relationship between the GEFT and the visual identification posttest for each treatment condition, illustrate a linear relationship.

Statistics of Extreme-groups Design

Based upon GEFT scores, subjects were split so that a two-way ANOVA could be performed. Descriptive statistics were also calculated. The only data that were considered in carrying out these statistics came from the subjects whose scores on the GEFT approximated the first or the fourth quartile (see Footnote[b] at the bottom of Table 3). The scores of these subjects' subgroups approximate the women's norms as reported in the French version of the manual for the embedded figures test (Witkin et al., 1971/1978).

The statistics of the GEFT differed with regard to the learners' abilities, but were quite similar with regard to the treatment conditions that were administered to these subjects' abilities subgroups. As shown in the top part of Table 4, the mean and the standard deviation of the GEFT for the low ability subjects are 6.18 and 1.75 for those who were exposed to the short-circuiting condition, and 5.64 and 1.82 for those who were

Table 3

Values of GEFT Extreme Quartiles in Norms Manual[a] and Experiment

	Quartile	
GEFT	1st	4th
Norms manual		
Men	0-11	17-18
Women	0-8	16-18
Experiment[b]	0-8	15-18

[a]Norms reported in the French version of the manual for the embedded figures test (Witkin, Oltman, Raskin, & Karp, 1971/1978). [b]These GEFT scores approximate the actual values of the extreme quartiles which slightly differed in the two treatment conditions, and which were decimal quantities.

administered the supplanting condition. The mean and the standard deviation of the GEFT for the high ability subjects are 16.31 and 1.21 for those who were exposed to the short-circuiting condition, and 16.57 and 1.22 for those who were administered the supplanting condition.

The statistics of the visual identification posttest differed with respect to the learners' abilities (GEFT)

Table 4

Means and Standard Deviations of GEFT and Posttest Ability Subgroups for each Treatment Condition

Mode of representing information	Low ability[a]			High ability[b]		
	M	SD	n	M	SD	n
			Ability test (GEFT)[c]			
Short-circuiting	6.18	1.75	11	16.31	1.21	16
Supplanting	5.64	1.82	11	16.57	1.22	21
			Visual identification posttest[d]			
Short-circuiting	14.09	3.56	11	18.37	2.39	16
Supplanting	13.91	4.13	11	18.14	2.73	21

Note. n = 59.

[a]The low ability subgroup consists of the subjects whose GEFT scores approximated the 1st quartile. [b]The high ability subgroup consists of the subjects whose GEFT scores approximated the 4th quartile. [c]Maximum score = 18. [d]Maximum score = 26.

subgroups, but were quite similar with regard to the treatment conditions that were administered to these subgroups. As shown in the bottom part of Table 4, the mean and the standard deviation of the visual identification posttest for the low ability subjects are 14.09 and 3.56 for those who were exposed to the short-circuiting condition, and 13.91 and 4.13 for those who were administered the supplanting condition. The mean and the standard deviation of the visual identification posttest for the high ability subjects are 18.37 and 2.39 for those who were exposed to the short-circuiting condition, and 18.14 and 2.73 for those who were administered the supplanting condition.

The scores on the visual identification posttest were related to the subjects' abilities on the GEFT, but were not influenced by the treatment conditions that were administered to these subjects' abilities subgroups. The outcome of the 2 x 2 factorial analysis of variance (Table 5) indicates a significant ability effect, F (1, 55) = 25.74, $p < .001$; but no significant treatment effect and no interaction.

Considering only the data of the extreme-groups design ($n = 59$), the correlation coefficient between the GEFT and the visual identification posttest is $r = .56$ for the subjects' subgroups who were exposed to the short-circuiting condition (n = 27), and $r = .5$ for the subjects' subgroups who were exposed to the supplanting condition ($n = 32$); each of them is significant ($p < .01$, two-tailed

Table 5

Analysis of Variance of Visual Identification Posttest by Ability, and Treatment

Source	SS	df	MS	F
Ability (GEFT)	249.02	1	249.02	25.74*
Treatment	.66	1	.66	.07
Ability by Treatment	.009	1	.009	.001
Error	532.14	55	9.67	

*p < .001.

test), according to the Fisher's test of signifioance for testing the hypothesis that $\rho = 0$.

Summary

Whether the tests of significance that were conducted considered all the data or only those of the subjects whose scores on the GEFT were in the extreme quartiles, the results were alike; that is, while the subjects' abilities on the GEFT accounted for some of the variability on the visual identification posttest, the treatment conditions that were administered to these subjects' abilities subgroups did not account for any of the variability on the visual identification posttest.

Chapter 6

Discussion

Since this experiment was derived from the Salomon's (1974a) first experiment, we shall first stress the similarities and differences between the present experiment and Salomon's. The focus of the Salomon experiment was twofold; that is, he concurrently investigated ATI and development of mental ability. The ability pretest was a cue-attendance test. The task required the subjects to single out details 80 times from each of the three paintings and report them in writing. The symbolic representations were a modeling condition, a short-circuiting condition, and an activation condition. The modeling condition consisted of repeatedly zooming in and out on details, the short-circuiting condition comprised series of pairs of slides whose first depicted one painting and whose second depicted one detail, and the activation condition consisted of static slides from which the subjects were required to report the details they noticed. The ability posttest was a cue-attendance task. The results have shown that an ATI emerged between the cue-attendance pretest and the conditions of modeling and activation and that the subjects significantly increased their cue-attendance abilities.

In the first publication of his research report, Salomon (1972) stressed the need for investigating static codes as a means of imitating spatial relations symbolically. The present experiment focused on ATI between learners' cognitive restructuring abilities and static modes of representing information. The ability pretest was the GEFT. The task required the subjects to single out a detail from each of the 26 visual displays. The symbolic representations (i.e., independent variable) were a supplanting condition and a short-circuiting condition. The supplanting condition consisted of a sequence of pairs of slides; the first showed one part of a visual display, and the second displayed the whole picture in which a relevant detail had been highlighted. The short-circuiting condition comprised a sequence of pairs of slides; the first showed one part of a visual display, and the second presented the whole picture. The knowledge acquisition posttest was a visual identification task. The results have shown that no ATI emerged from this experiment.

These two experiments mainly differed with respect to their symbolic representations and to their foci. The short-circuiting condition consisted of pairs of slides in both experiments. The supplanting conditions were distinct: While the visuals showed zooming in on details in the Salomon experiment, they presented highlighted details in the present experiment. The order of presentation of the shots also differed; that is, while the long shots preceded the close-ups in the Salomon experiment, the close-ups preceded the long shots in the present experiment. In the present experiment, it was reasoned that since the long shots of the supplanting condition are presumed to symbolize a final state of knowledge extraction, they should be projected after the close-ups.

In the Salomon experiment, the subjects were pretested and posttested on their cue-attendance abilities because the focus of the research was to investigate ATI as well as skill development. The cue-attendance tests were complex visual displays from which the subjects were required to report in writing the maximum number of items they noticed. In the present experiment, the subjects' abilities were only pretested. The GEFT was selected as a moderator variable because it calls, as the task, for the ability to single out details from their general contexts, and thus seemed appropriate to induce ATI. Since the focus of the present experiment was exclusively ATI, the subjects were posttested on knowledge acquisition only.

It was hypothesized, in the present experiment, that while field-independent people perform alike when exposed to either treatment condition, field-dependent people perform better when exposed to the supplanting condition. The results have rather shown a significant ability effect, but no significant treatment effect; that is, while the field-independent individuals performed alike when exposed to either treatment condition, the field-dependent individuals also performed alike when exposed to either treatment condition but significantly less well than the field-independent individuals.

Each treatment condition induced a moderate positive correlation coefficient between the GEFT and the visual identification posttest; meaning that both treatment conditions called about equally for the cognitive restructuring ability. Since the field-dependent individuals performed alike when exposed to either treatment condition, we must question the supplanting condition. This mode of representing information did not seem to imitate the cognitive restructuring ability symbolically; consequently, we must challenge the efficacy of the highlight technique as a means of supplanting the cognitive restructuring ability. So the treatment conditions might not have differed enough; that is, the alternative modes of representing information might not have called for sufficiently dissimilar abilities, thus precluding the emergence of an ATI.

Other experiments (Salomon, 1974a; Salomon & Cohen, 1977), whose task was similar to the one of this experiment but whose symbolic representations differed, have shown that other abilities were influencing task success.

In a second experiment, Salomon (1974a) investigated the role of verbal ability in singling out details from their general contexts. As in the first experiment, he concurrently investigated ATI and development of mental ability. The ability pretests were a cue-attendance test, the GEFT, and a verbal ability test. The task required the subjects to single out details 80 times from each of the three paintings and of reporting them verbally. The symbolic representations were a modeling condition and an activation condition, with and without induced verbalization. The modeling condition consisted of repeatedly zooming in and out on details, and the activation condition comprised static slides from which the subjects were required to report the details they noticed. The ability posttests consisted of a cue-attendance test and an organization measure. When the cue-attendance posttest scores were regressed on the verbal ability pretest scores, an interaction emerged between the modeling-no-verbalization condition and the activation-no-verbalization condition. Thus, it seems that verbal ability might be called for when singling out details.

Salomon and Cohen (1977) did a correlational analysis to investigate the psychological impact of symbolic systems. The ability pretests consisted, among other ones, of a detail and concept test, a detail and whole test, a visual memory test, and a space construction test. The task required the subjects to single out details from a 8-minute television film. The symbolic representations included, among other ones, a Z version and a CU version. The Z version consisted of repeatedly zooming in and out on details, and the CU version comprised numerous long shots interchanged with close-ups. The knowledge acquisition posttests were a specific knowledge posttest and a general knowledge posttest. The correlation coefficients between the abilities pretested and the specific knowledge posttest were moderately positive for the subjects' subgroup who was exposed to the CU version, but about zero for the subjects' subgroup who was exposed to the Z version. This correlational pattern clearly shows that while the CU version called for the abilities pretested, the Z version did not; that is, the Z version imitated these abilities symbolically.

The results of these experiments show that the task of singling out details might call for verbal ability (Salomon, 1974a); and for abilities in relating details to conceptual and perceptual wholes, visual memory, and space construction (Salomon & Cohen, 1977). However, the symbolic representations partly differed from those of the present experiment.

Addressing the issue of abilities in the context of ATI investigations, Carrier and Clark (1978) and Tobias (1976) argued that while some abilities may be critical at the outset of a given task, other abilities may be required as the subjects progress through the task. This emphasizes the need for collecting data on many relevant abilities when investigating ATIs. Although it might be difficult to know in advance which abilities would be initially and subsequently called for by a given task, research evidence may suggest some abilities that could be considered.

Coming back to the present experiment and considering the extreme-groups design, it appears that each treatment condition induced a moderate positive correlation coefficient ($\underline{r}$ = .5) between the GEFT and the visual identification posttest. These correlation coefficients mean that, for each treatment condition, about 25% of the visual identification posttest variance is associated with changes in the subjects' cognitive restructuring ability, and that 75% is not. This suggests that other ability(ies) might also have influenced task success in this experiment.

All of the previous reasonings along with the research evidence reported suggest that, in the present experiment, the emergence of an ATI might have been precluded either because the alternative modes of representing information did not call for different amounts of cognitive restructuring ability and/or because the symbolic representations called for other abilities. Research evidence (Salomon, 1974a; Salomon & Cohen, 1977) has shown that other abilities were called for in experiments whose task was similar to the one of this experiment. However, the symbolic representations partly differed from those of the present experiment. Whether the present treatment conditions would call for other abilities and, more pertinently, whether the abilities referred to would be differentially required by the alternative modes of representing information is, however, unknown. For ATI to emerge, the treatment conditions that are administered to the subjects' subgroups should induce significantly different correlation coefficients between the subjects' abilities and the visual identification posttest; this means that the alternative symbolic representations call for dissimilar abilities. An analysis of covariance design would increase measurement precision.

For effective learning to occur, a match needs to be established between the mental skills called for by the symbol system, the psychological requirements of the task, and the learner's level of mastery of these skills (Salomon, 1979). The emergence of ATIs requires that alternative symbolic representations induce different psychological requirements for a given task, so as to fit the learners' abilities or cognitive styles.

In the context of ATI research, there is a need for elaborating more systematic ways of designing alternative symbolic representations, so that they induce different psychological requirements. The learners' abilities must also be thoroughly assessed, so as to consider the abilities which are initially called for by a given task as well as those which are required as the subjects progress through the task. Further research that isolates media attributes which interact with learners' abilities is clearly needed, so as to create a body of research from which it would be possible to prescribe instructional treatments that fit learners' abilities or cognitive styles. Thus, research efforts should investigate ATIs that would be applicable in classrooms.

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Appendix A

Response Sheet

Identification

No.: ________________ Date: ____________

Age: ________________ Sex: ____________

Have you ever done the GEFT? __________

-Locate, among the items of each visual display, the part you were supposed to find.

-Circle the right answer.

Example

001- A B C D   003- A B C D

002- A B C D

Practice

01- A B C D   04- A B C D

02- A B C D   05- A B C D

03- A B C D

-Locate, among the items of each visual display, the part you were supposed to find.

-Circle the right answer.

Experimentation

1-	A	B	C	D	14-	A	B	C	D
2-	A	B	C	D	15-	A	B	C	D
3-	A	B	C	D	16-	A	B	C	D
4-	A	B	C	D	17-	A	B	C	D
5-	A	B	C	D	18-	A	B	C	D
6-	A	B	C	D	19-	A	B	C	D
7-	A	B	C	D	20-	A	B	C	D
8-	A	B	C	D	21-	A	B	C	D
9-	A	B	C	D	22-	A	B	C	D
10-	A	B	C	D	23-	A	B	C	D
11-	A	B	C	D	24-	A	B	C	D
12-	A	B	C	D	25-	A	B	C	D
13-	A	B	C	D	26-	A	B	C	D

Appendix B

Directions and Scoring Key

B.1- Introduction

The experimenter introduces himself.

Purpose of the study.

Steps.

Task and rules.

B.2- Administration of the Group Embedded Figures Test (GEFT)

B.3- Administration of the Treatment Conditions

a. Identification on the response sheet.

b. Task and evaluation requirements: example.

c. Task and evaluation requirements: practice.

d. Experimentation.

e. Visual identification posttest.

B.4- Scoring Key

B.1- Introduction

The experimenter introduces himself: name, degree, and university.

"This is a media study which investigates the differential effects of two modes of representing information by means of slides, given learners who differ as to some aspects of their personalities."

"The experiment is going to be done in two steps:
- assessment of your cognitive style;
- projection of the visual displays along with concomitant test items."

"Task and rules during the experiment:
- Generally, your task consists of singling out a part from its general context.
- You should work individually, in silence, and without taking any note."

The experimenter answers questions.

B.2- Administration of the GEFT

The experimenter distributes the French GEFT booklets and the response sheets, which are respectively numbered alike so as to preserve the subjects' anonymity and privacy.

> "Verify whether the number which is written on the booklet is the same as the one which is written on the response sheet."

The experimenter administers the GEFT according to the French version of the manual for the embedded figures tests (Witkin et al., 1971/1978), and collects the GEFT booklets.

> "Remember your number if you want to know your score at the end of the experiment."

B.3- Administration of the Treatment Conditions

The experimenter selects randomly the treatment condition that is going to be presented.

a. Identification on the response sheet

> "Fill in the identification section on the response sheet."

b. Task and evaluation requirements: examples

"This section consists of 3 examples that will help you to understand the task and evaluation requirements."

"You are going to see 3 pairs of slides. The first slide of each pair shows one part of a technical visual display. The second slide presents the whole picture."

"Your task is to find the part in the whole visual display."

"The part you have to find has the same orientation in both slides of each pair."

The experimenter projects the 3 pairs of slides (EXAMPLE: task), and suspends the projection (PAUSE). The parenthetical matters refer to the critical steps of the experiment, and coincide with the captions of the slide series. He then answers questions. This step may be repeated.

Each slide is projected for 5 sec. A black slide is projected for 3 sec between each pair of slides.

"You are now going to take the test of the example section."

This test assesses whether the subjects have found the parts in the whole visual displays.

"You should locate, among the items of each visual display, the part you were supposed to find."

"Circle the right answer on your response sheet: example section."

"The slides of the test are presented in an order that is different from the one of the slides of the task."

The experimenter projects the slides (EXAMPLE: test), and suspends the projection (PAUSE). He then gives the right answers, and answers questions. This step may be repeated.

Each slide is projected for 5 sec. A black slide is projected for 5 sec between each test item, thus permitting the learner to circle the right answer on the response sheet provided.

c. Task and evaluation requirements: practice

"This practice section will help you to have a better understanding of the task and evaluation requirements."

"You are going to practice on a sequence of 5 pairs of slides."

The experimenter projects the 5 pairs of slides (PRACTICE: task), and suspends the projection (PAUSE).

"You are now going to take the test of the practice section."

"You have 5 sec, between each slide, to circle the right answer on your response sheet: practice section."

The experimenter projects the slides (PRACTICE: test), suspends the projection (PAUSE), and answers questions.

The items in the practice section are not included in the total score. However, the experimenter will scan this section before correcting each response sheet, so as to ascertain that the subject understood the task and evaluation requirements.

d. Experimentation

"Practice is over."

"You are now going to see a sequence of 26 pairs of slides."

The experimenter projects the 26 pairs of slides (EXPERIMENTATION: task), and suspends the projection (PAUSE).

e. Visual identification posttest

"You are finally going to take the test of the experimentation section."

"You have 5 sec, between each slide, to circle the right answer on your response sheet: experimentation section."

The experimenter projects the slides (EXPERIMENTATION: test), and suspends the projection (PAUSE).

The experimenter collects the response sheets, projects the source of the visuals, asks comments about the experiment, and answers questions.

He then gives the learner their scores on the GEFT along with the interpretation, and explains the nature of the experiment (see Appendix C).

B.4- Scoring Key

Eyample section

001- B	003- A
002- D	

Practice section

01- C	04- A
02- B	05- D
03- B	

Eyperimentation section

1- D	14- D
2- C	15- C
3- B	16- A
4- A	17- B
5- C	18- C
6- A	19- A
7- C	20- D
8- B	21- B
9- A	22- A
10- D	23- C
11- C	24- D
12- C	25- B
13- B	26- D

Appendix C

Information to Subjects

These information may be transmitted verbally, after the experiment, to the subjects who wish to know more about their cognitive styles and about the nature of the experiment.

Cognitive Styles

Cognitive styles. Cognitive styles reflect individual differences in modes of acquiring, processing, and using information (Ragan, 1978).

Field-dependence-independence cognitive style. The field-dependence-independence dimension was initially assessed by two tests that were quite cumbersome; that is, the Body Adjustment Test (BAT) and the Rod-and-Frame Test (RFT). The BAT requires the subject to adjust a chair to the upright, when seated in a tilted chair which is in a tilted room (Witkin et al., 1971; Witkin & Goodenough, 1981). The RFT requires the subject to adjust to the upright a tilted luminous rod which is inside a luminous frame tilted independently, when seated in a totally dark room (Witkin et al., 1971; Witkin & Goodenough, 1981). The field-dependence-independence dimension may nowadays be assessed by the GEFT which requires the subject to locate a simple figure embedded in a complex one. The score reflects the tendency of a perceiver to be influenced by a prevailing background or context in which information is embedded.

Interpretation of the GEFT. Field-dependent and field-independent people differ with respect to their degrees of autonomy of external referents. Field-independent individuals are likely to overcome embedding contexts. Field-dependent persons have more difficulties in overcoming embedding contexts.

The field-dependence-independence dimension is a cognitive style that is consistent in a very wide array of perceptual situations which share the requirement of perceptual disembedding (Goodenough, 1976; Witkin et al., 1971, 1977; Witkin & Goodenough, 1981). The field-dependence-independence dimension is self-consistent among tasks featuring actual stimulus configuration or spatial material. This concept may also be applied to intellectual activities which deal with symbolic representations or thinking, such as in problem solving tasks which require the subject to use a critical element in a context that is different from the one in which it was presented.

Field-dependent and field-independent individuals are just different: no ones are better than the others.

Characteristics of field-dependent individuals. They tend to be outgoing; they are skilled in getting along with people. They often express interest in educational-vocational areas which feature social content and which require social skills.

Characteristics of field-independent individuals. They tend to have an impersonal orientation; they are more contained and individualistic. They often express interest in educational-vocational areas that are more solitary as to their work requirements and more abstract as to their substantial contents.

Modes of Representing Information

Purpose of the experiment. To investigate the differential effects of two modes of representing information by means of slides, given learners who differ with respect to their cognitive styles.

Modes of representing information. The experimenter shows few examples of the two modes of representing information: 1- CU-LS: standard visual displays

2- CU-LS(H): modified visual displays

Hypotheses. Field-independent individuals perform alike when exposed to either mode of representing information. Field-dependent individuals perform better when exposed to the modified visual displays.

Rationale. Field-dependent people, who have difficulties in overcoming embedding contexts, may profit more from the mode of representing information that imitates symbolically some of the cognitive processes they would have to carry on themselves otherwise; that is, visual search or exploration in order to find the part in the whole visual display.

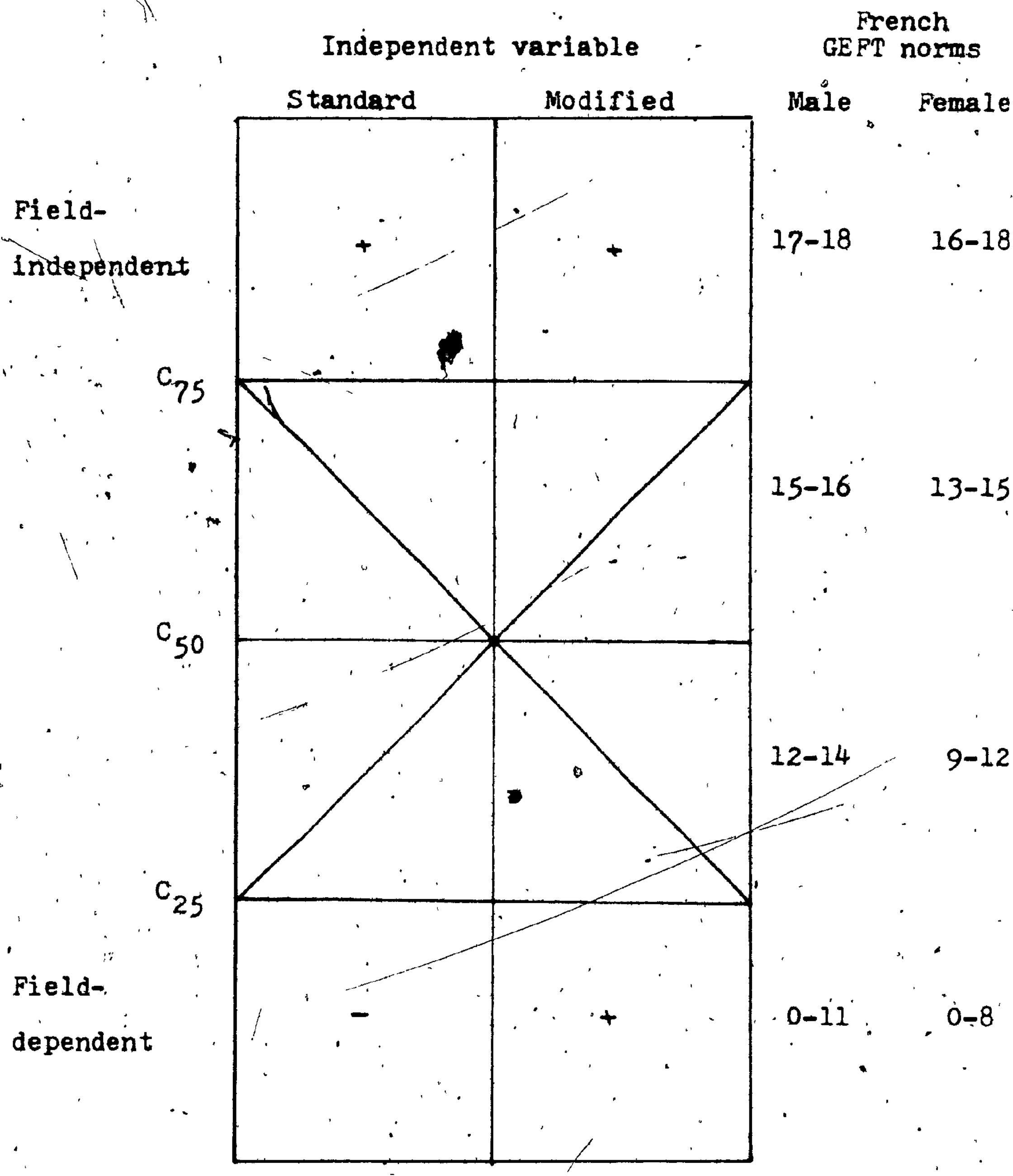

Figure C-1. Research Design, Hypotheses, and French GEFT Norms.

Appendix D

Raw Scores of Sample Data

Table D-1

Raw Scores of Subjects for Short-circuiting Condition

GEFT scores[a]	Posttest scores[b]
18	22
18	22
18	20
18	18
17	17
17	17
17	19
16	14
16	15
16	22
15	17
15	16
15	19
15	19
15	19

Note. *n* = 60.

[a]Maximum score = 18. 1st quartile = 0-8, and 4th quartile = 15-18. [b]Maximum score = 26.

(table continues)

GEFT scores	Posttest scores
15	18
14	19
14	17
14	19
14	17
14	20
14	17
13	16
13	15
13	18
13	17
12	11
12	16
12	23
12	17
12	21
11	14
11	14
11	16
11	17
11	16
10	20
10	18

(table continues)

GEFT scores	Posttest scores
10	13
9	20
9	12
9	12
9	16
9	18
9	12
9	13
9	10
9	17
9	16
8	13
8	17
8	16
7	13
7	13
6	11
6	14
6	7
6	13
4	18
2	20

Table D-2

Raw Scores of Subjects for Supplanting Condition

GEFT scores[a]	Posttest scores[b]
18	16
18	16
18	18
18	21
18	19
18	11
18	18
17	21
17	20
17	15
17	17
16	17
16	22
16	22
16	20
15	20
15	19
15	19
15	18

Note. $n = 60$.

[a]Maximum score = 18. 1st quartile = 0-8, and 4th quartile = 15-18. [b]Maximum score = 26.

(table continues)

GEFT scores	Posttest scores
15	14
15	18
14	19
14	19
14	17
14	11
14	20
14	18
14	17
13	18
13	21
13	14
13	13
13	16
12	18
11	18
11	19
11	12
11	10
10	18
10	13
10	22
10	21

(table continues)

GEFT scores	Posttest scores
10	15
10	13
9	15
9	17
9	21
9	16
9	12
8	11
8	15
7	21
7	6
7	13
6	19
5	14
4	17
4	14
3	11
3	12