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Interactive hypermedia: A comparative study of the effects of real-time motion videodisc versus still frame and of cognitive style on Cetacea Animals Knowledge Test for second-grade students

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INTERACTIVE HYPERMEDIA: A COMPARATIVE STUDY OF THE EFFECTS OF REAL-TIME MOTION VIDEODISC VERSUS STILL FRAME AND OF COGNITIVE STYLE ON CETACEA ANIMALS KNOWLEDGE TEST FOR SECOND GRADE STUDENTS

by

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Approved by

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APPROVAL PAGE

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The purpose of this study was to determine the effects of real-time motion vs still frame presentation mode and cognitive style (field dependent versus field independent) on a interactive hypermedia knowledge task.

The field dependent and field independent cognitive style dimensions of 121 second grade students were determined by the administration of the Children's Embedded Figure Test. Forty field dependent individuals and 40 field independent individuals were selected, randomly assigned to treatment groups, and administered the Cetacea Animals Knowledge Test pre-test. Two groups each of 20 field dependent individuals and 20 field independent individuals received the hypermedia still frame presentation; two groups each of 20 field dependent individuals and 20 field independent individuals received the hypermedia real-time motion presentation. All groups were administered the Cetacea Animals knowledge test post-test.

The results of a 2x2 analysis of covariance indicated a significant effect of cognitive style on the post-test scores; field independent students scored higher than field dependent students. There were no differences between hypermedia still frame and real-time motion treatment sub-groups, and no interaction effects between cognitive style field independent and field dependent dimension and hypermedia still frame and real-time motion presentation treatment.

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This dissertation is dedicated to my children, Laurie, Lisa and Bob, and Dan and Pat, who have watched me grow and develop through this process; hopefully, I have been a role model for them.

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CHAPTER I

INTRODUCTION

The educational system in the United States at all levels (K-adult) has taken advantage of technology to enhance and facilitate teaching and learning. While video presentations and computer-assisted-instruction have existed for some time, the use of hypermedia was a relatively new development. Studies showed that children learned effectively using video and computer-assisted-instruction technology. The question remains, how well do children learn using hypermedia technology?

Hypermedia is a computer-driven lesson involving visual and audio media such as written text, graphics, sounds, and video, driven by computer software (Watson, Nelson, & Busch, 1988). Most of the hypermedia instructional projects in recent years (Watson et al., 1988) have involved interactive videodisc technology.

One such project was "Sea Mammals," developed by the Children and Technology Project, University of North Carolina at Greensboro (Watson, Meshot, and Hagaman, 1988). Sea Mammals was a hypermedia lesson for kindergarten through second grade children that teaches key constructs which children need in order to classify types of sea mammals. The lesson was designed to include text and the latest multimedia technology (e.g., videodisc real-time images, free-hand graphics, scanned graphics, animation, and digital sound). The constructs was described with text and reinforced via videodisc motion and graphic animation.

Nelson (1989) evaluated Sea Mammals using first grade students. Her study compared learning under hypermedia and teacher mediation, hypermedia without teacher mediation, traditional teaching with pictures similar to the videodisc images, and a control group. She found that first grade students learned more effectively using a linear hypermedia lesson than under a traditional teacher-mediated lesson. There was no significant difference between the hypermedia and teacher mediation, and hypermedia without teacher mediation treatment groups. The students in Nelson's study were not classified according to field dependent and field independent cognitive style dimension.

Hammond (1985) argued that educators should recognize and respect the learner as an individual, and determine how the computer can be used by the student in a meaningful way. Thus, it was critical that the learner's cognitive style match the computer-driven media enabling the student to derive maximum benefit from the presentation (Cross, 1976; Ausburn & Ausburn, 1978; Brittian, Dunkel, & Coull, 1979; Hammand, 1985). Hammond (1985, p. 158) asserted that instructional material must be presented in a form which will interact with the learner's cognitive style; otherwise the learner appeared "uncooperative and poorly motivated." There appeared to be no empirical studies of the combined effects of hypermedia presentation and field dependent and field independent cognitive style on learning.

Much research on cognitive style has its base in Witkin's research on field dependence and field independence, and spacial-visualization abilities (Witkin & Goodenough, 1981). Individual differences between field dependent and field independent learners can be found at every age beginning as early as preschool and kindergarten.

Need for the Research

The typical format of visual media has been composed of text and television. Field dependent individuals scored higher on knowledge tests following television presentations as opposed to text or audio presentations; field independent subjects scored higher following audio and written instructions than they did after television instruction (Hammond, 1985; Danielson, Seiler, & Friedrich, 1979).

Field dependent individuals tended to perceive globally and recognized the most noticeable cues; however, these may be irrelevant to perception (Moore, 1985; Goodenough, 1976; Greco & McClung, 1979; Witkin & Goodenough, 1981; Good & Brophy, 1990). For these learners, linear format of still frame presentation may be less appropriate for learning. If the use of motion added to the linear format (i.e., hypermedia) enhances the ability for field dependent individuals to perceive the important salient features, then the design of hypermedia might enhance perception and facilitate learning for field dependent individuals.

Field independent individuals have the ability to identify the important salient features whether or not they are made noticeable (Moore, 1985; Goodenough, 1976; Greco & McClung, 1979; Witkin & Goodenough, 1981; Good & Brophy, 1990). These learners reorder perceptions and format does not seem to hinder learning. Therefore, a linear format with use of motion may not enhance learning more than any other instructional format.

Hypermedia (still frame versus real-time motion) is an instructional tool that helps improve the education of children (Nelson, 1989). However, research needs to be conducted to tell us how, and how well, hypermedia helps educate students according to field dependent or field independent cognitive style dimension. If research supports the conceptualization that for certain cognitive style dimension, a specific format of hypermedia is more effective, then instructional developers may use that fact in designing future learning packages.

Purpose of Research

The purpose of this study was two-fold: one, to determine the effects of real-time motion verses still frame presentation mode (independent variable); and two, to determine the effects of cognitive style field independent versus field dependent dimension (independent variable) on a knowledge task (Cetacea Animals). Further, the study considered whether there was an interaction of presentation mode (real-time motion versus still frame) and cognitive style (field dependent versus field independent) dimension on the Cetacea Animal Knowledge Test (dependent variable) post-test score. The Cetacea Animal Knowledge Test pre-test score served as the covariate.

Statement of Hypotheses

The following research hypotheses were formulated:

1. Field independent subjects will score significantly higher on the Cetacea Animals Knowledge Test adjusted post-test scores than will field dependent subjects, regardless of treatment.

2. There will be a significant interaction between cognitive style and presentation mode on the Cetacea Animal Knowledge Test adjusted post-test scores.

In the event that there is an interaction, the following hypotheses will be examined to determine the following simple effects:

2a. Field independent subjects will score equally well on the Cetacea Animal Knowledge Test under the still frame (Version 1) or real-time (Version 2) presentation mode treatment conditions.

2b. Field dependent subjects' Cetacea Animals Knowledge Test adjusted post-test scores will be significantly higher following real-time (Version 2) presentation mode treatment than will be field dependent subjects' Cetacea Animals Knowledge Test adjusted post-test scores who receive still frame (Version 1) presentation mode treatment.

Assumptions

One hundred twenty-one (121) subjects were chosen from six second-grade classrooms located in two public primary schools in the Guilford County school system. One was located in the northeast and the other was in the northwest part of the county. There were a total of 24,499 students including 17.79% black students in the county school system.

The total student population in the sample schools was 376 and 543, respectively. The percentage of black students in the total student population was 29.03 and 4.68, respectively. The overall average percentage of black students in the study sample (16.86%) was similar to the total average in the county school system. The socioeconomic status for these schools ranged from poverty level to upperclass.

The schools employ 21 and 23 teachers, respectively and have access to art, physical-education, music, library-media, speech, computer, learning-disabled, and psychology specialists. The treatment sample consisted of 80 subjects who were exposed to either real-time or still frame hypermedia presentation mode treatment. It is assumed that subjects in this study were representative of the second grade population from similar types of schools in North Carolina.

Limitations of the Study

A volunteer sample was used; therefore, the results of this study can only be generalized to populations which have similar characteristics to the sample in this study.

Definition of Terms

Cognitive Style: Ausburn and Ausburn (1978) defined learner aptitude "in terms of cognitive style, or the aptitude for the modes or manners of information processing that may be required by a certain learning task" (p. 337). The cognitive style field dependence and field independence continuum described by Herman A. Witkin (1981) was used in this study.

Field Dependent Cognitive Style: Ausburn and Ausburn (1978) describe field dependence as a tendency for persons to perceive information globally. The field dependent person perceives the information as it exists and tends to remember the most noticeable cues, which may or may not be a relevant part of the perception

(Moore, 1985; Goodenough, 1976; Greco & McClung, 1979; Witkin & Goodenough, 1981; Good & Brophy, 1990). For this study, subjects were designated as field dependent if they scored nine or below on the Children's Embedded Figures Test (Witkin, Oltman, Raskin & Karp, 1971).

Field Independent Cognitive Style: Ausburn and Ausburn (1978) described field independence as a person's ability to perceive information analytically. Field independent individuals tend to identify the salient visual cues whether or not they were made noticeable (Moore, 1985; Goodenough, 1976; Greco & McClung, 1979; Witkin & Goodenough, 1981; Good & Brophy, 1990). For this study, subjects were designated as field independent if they scored 14 or above on the Children's Embedded Figures Test (Witkin, Oltman, Raskin & Karp, 1971).

Hypermedia: Hypermedia, was a computer-driven lesson involving written text, graphics, sounds, and videodisc still frame and real-time motion driven by computer software. The computer software used in this study was HyperCard authoring language created by Bill Atkinson and produced by The Apple Corporation for the Macintosh personal computer in October, 1987.

The hypermedia instructional delivery system is composed of recorded video material from a videodisc shown on a 13 inch video monitor, and text and graphic images shown on a computer monitor, presented under computer control using HyperCard software. This study used two versions of the hypermedia lesson, Cetacea Animals (Version 1, Version 2), which have exactly the same content about whales and dolphins but the presentation of the videodisc visual information is different. Version 1 has real-time visuals and Version 2 has still frame visuals. The total presentation times for both versions of Cetacea Animals was 20 minutes.

Real-time Presentation: Real-time presentation referred to the speed of the videodisc images (30 frames per second) and included color, motion and sound. The viewing time of the real-time videodisc information (24 film sequences) ranged from 4 seconds to 28 seconds for a total of 212 seconds (3.5 minutes) and averaged 8.83 seconds for each real-time motion sequence (see Appendix D).

Still frame Presentation: Still frame presentation referred to the speed of the videodisc images (frame by frame) and included color and no sound. The viewing time of the still frame videodisc information (52 stills) ranged from 4 seconds to 28 seconds for a total of 212 seconds (3.5 minutes) and averaged 4.07 seconds for each still frame sequence (see Appendix D).

CHAPTER 2

REVIEW OF RELATED RESEARCH

The review of the literature included an overview of important studies that relate to the independent variables: field dependent and field independent cognitive style dimensions, and still frame and real-time motion hypermedia presentation mode. The final section provided a summary of the theoretical framework on which this research was based.

Introduction

The computer was as familiar as the chalkboard to today's generation of students. Quality Educational Data, a Denver Research Firm, reported the following national ratios of computers per student: in 1983, one terminal for 125 students; in 1989, one terminal for 32 students; and in 1991, one terminal for every 22 students. By 1994, Quality Educational Data. predicted a one to 11 ratio (Ordovensky, 1990). Computer technology in education has proliferated in our country's school systems.

On National Public Radio, Weekend Edition, Sanchez (1989) reported on the Use Of Computers in Schools. During 1989, 49 states reported new initiatives in educational technology. Almost all states have policies regulating the integration of computers into educational curricula. In the spring of 1990, Texas was the first state to allow computer hardware and software to be purchased with the monies appropriated for text books. The report concluded that our present teaching and learning practices in education will be altered by the computer.

Several research studies have identified positive ways computers have been integrated into educational programs. Woodward, Carnine and Gersten (1988) researched teaching problem-solving through computer-simulation. They found that well-developed, well-executed, computer-assisted-instruction could be a powerful supplement to good classroom instruction. Cosky (1980) argued that one of the chief advantages of computer-based curricula was its capacity to individualize the form, content, and pace of learning to fit the learner's needs. However, Hammond (1985) reported that there was little research or speculation on the place of the learner as a receiver of "computerated" teaching. Hammond (1985) argued that "Computers have been used in education for instruction and learning for two decades, but little attention has been paid to the way in which learners interact with screen displays and the ways in which their cognitive style and visual preferences may facilitate or inhibit their learning" (p. 155). If these technologies are to be effective, learner preferences for, or dominant modes of, information processing must be matched (Saracho, 1984; Messick, 1984; Green, 1985).

Literature Relevant to Field Dependent Versus Field Independent Cognitive Style Dimension

Cognitive Style: Cognitive style concerns individual differences in all processes by which knowledge is acquired (Ausburn & Ausburn, 1978). Individuals' distinctive cognitive styles are primarily the characteristics which determine how people process information. Generally, all individuals share these three characteristics: one, perceptual style, a personal way of gathering and organizing information; two, the actual processing of information; and three, personality and social skill, a way of reacting to different situations (Witkin, Moore, Goodenough, & Cox, 1977; Saracho, 1983, 1984,1985; Messick, 1984).

Several dimensions of cognitive styles have been identified through research over the last several years. Of the nine cognitive styles listed by Messick (1966, p. 38), this study deals with his first, field dependence versus field independence.

1. <u>Field independence/field dependence</u>: Involves the tendency to perceive a perceptual field either analytically or globally; entails the ability to experience items as discrete from their background and to overcome embeddedness.
2. <u>Scanning (scanning/focusing)</u>: Involves differences in the manner and extensiveness with which attention and concentration are deployed and distributed when dealing with a stimulus field. An extension of this factor of cognitive style is seen in Bruner's well-known studies of his four ideal strategies for concept attainment (Bruner, Goodnow, & Austin, 1956).
3. <u>Breadth of categorizing</u>: Involves preferences for either broad inclusiveness or narrow exclusiveness in establishing ranges for categories.
4. <u>Conceptualizing styles</u>: Involves preferred approaches to categorizing perceived similarities and differences among stimuli and with conceptualizing approaches as bases for forming concepts.
5. <u>Cognitive complexity/simplicity</u>: Involves differences in tendency to construe the world in a multidimensional and complex way.
6. <u>Reflectivity/impulsivity (cognitive tempo)</u>: Involves tendency, when faced with simultaneous response alternatives, to select either careful deliberation and relative certainty of response correctness or speed of response and high risk of incorrect response.
7. <u>Leveling/sharpening</u>: Involves differences in mode of assimilation of sequential stimuli in memory, with preference given either to merging the stimuli into relatively undifferentiated recollections or to maintaining discrete experiences in memory.
8. <u>Constricted/flexible field control (field articulation)</u>: Involves differences in handling a stimulus field containing contradiction and cognitive interference; entails ability to withhold attention selectively from irrelevant intrusions and focus on a central task.
9. <u>Tolerance for incongruous or unrealistic experiences</u>: Involves willingness to accept perceptions at variance with conventional experience.

Field dependence versus field independence dimension has been the most widely investigated construct; it has also been studied in young children (Kogan, 1976).

Field Dependent/Field Independent: Individuals' ways of perceiving, thinking, and remembering are influenced by their field dependent or field independent cognitive style dimension (Saracho, 1984). According to Saracho (1983, p. 229), "individuals actively process and transform incoming information, categorizing new knowledge and integrating it within their memory structure." Of Messick's (1966) nine cognitive style dimensions, field dependent versus field independent is unique as well as highly consistent and stable. Field dependent individuals are global, dependent upon authority, observant of the faces of those around them for information, and gregarious; field independent individuals, on the other hand, are analytical, independent of authority, and socially detached (Witkin, Dyk, Paterson, Goodenough, & Karp, 1974; Witkin, Moore, Goodenough, & Cox, 1977; Saracho, 1983, 1984, 1985; Messick, 1984).

When Witkin et al. (1977) began their investigation of field dependent versus field independent cognitive style dimension, they studied the individual differences in perception of the "upright," the extent of reliance on body or visual field as primary referents. They hypothesized that cognitive restructuring ability was a very general competence related to performance in tests of perception of the upright. The direction of the perceived upright was ordinarily determined by two sets of experiences working in tandem. Witkin and Goodenough (1981, p. 8) explained the two experiences and how they worked:

> First, the field around us, apprehended through vision, usually has the character of a framework, the main axes of which correspond to the true vertical and horizontal directions of

> space. This framework provides one ready basis for establishing the upright. Second, the direction of gravity, apprehended through the vestibular, tactile, and kinesthetic senses, provides another definition of the vertical direction of space. Since the upright indicated by the external field and the upright indicated by the gravitational pull coincide in direction, the outcome is the same whether either determinant alone or both in combination are used as referents.

Witkin et al. (1977) found that the subjects were markedly different from one another in performance on the orientation tasks used in these studies. This finding suggested that people have preferred ways of integrating the diverse sources of information available to them for locating the upright. Thus, the early definition of field dependent versus field independent represented contrasting tendencies to rely primarily on body or field, rather than distinct types of performance to perceive the upright.

Next, the construct was expanded to include perceptual tasks that required the subject to disembed an item from an organized field separate from the "body-field juxtaposition or perception of the upright" (Witkin & Goodenough, 1981, p.15). Their findings suggested that the field dependent versus field independent dimension might be conceived as involving individual differences in ease or difficulty in separating an item from an embedding context. Field dependence versus field independence was thus conceived to be "a perceptual-analytical ability, that manifests itself pervasively through an individual's perceptual functioning" (Witkin & Goodenough, 1981, p. 15).

The next stage of development examined two relationships: one, the relation between disembedding ability in perception and disembedding ability in intellectual functioning; and two, the relation between disembedding ability and structuring ability. In the first relationship, subjects identified as field dependent in perception of the upright had greater difficulty in problem solving than field independent subjects. The problems were solved by taking an element critical for solution out of the context in which it was presented and restructuring the problem so that the element was used in a different context (Glucksberg, 1958). Gluckberg's (1958) study showed that greater or lesser disembedding or analytical ability showed itself across an individual's perceptual and intellectual activities.

Research on the second issue, the relationship between disembedding and structuring, tested the hypothesis that underlying both was a tendency to deal with the field in a more active or passive manner. The manner was to leave the stimulus material as presented or to break up the organized pattern and expose the embedded figure. Field independent subjects imposed a structure on the field and experienced it as organized while, field dependent subjects did not impose a structure on the field and perceived it as disorganized (Witkin & Goodenough, 1981). The enlarged dimensions of individual differences was now described as an articulated field approach at one extreme and a global field approach at the other extreme (Witkin et al., 1977).

Subsequent research linked the individual differences described thus far to differences in control, defenses, body concept, and self. These differences were perceived to be linked to psychological differentiation constructs which separate the person's perceptions from the world. Differentiation used in this context referred to the complexity of structure of a psychological system. The person's differentiations result in his perceiving the world on a continuum; that is, one's perception may range from no boundaries with self to discrete and structured ones. The more differentiated the person becomes, the more he views the world as distinct from self. As the person becomes differentiated, he develops a feeling of self as an individual, distinct from others, and internalizes standards to guide his view of the world and of self (Witkin, Oltman, Raskin & Karp, 1971).

Several studies have sought to find the source of differences among people in their development of differentiation. Families were studied and the potential relationships between the extent of a child's field dependence and the degree to which his early socialization experiences hampered or fostered achievement of separate, autonomous functioning were sought. Witkin et al. (1971, p. 12) listed the following as socialization experiences which seemed to affect the development of differentiation:

> the extent of opportunity for and encouragement of separation, particularly from the mother; the manner of dealing with the child's expression of impulse, particularly whether or not it serves to help him identify and internalize standards; and characteristics of parents themselves which influence their role in the separation process and in the regulation of impulse. The finding that more field-independent children have interacted with their parents in ways that fostered separate, autonomous functioning has been confirmed in a number of studies.

Several studies have supported Witkin's cultural hypothesis and have shown that cultural groups stressing traditional social values exhibited more field dependence than American or Americanized groups in which these values were less rigidly enforced (Ausburn & Ausburn, 1978).

<u>Assessment Instruments</u>: Herman A. Witkin and his colleagues began the delineation of the field dependent field independent cognitive style construct using several tests which observed the subjects' "variations in ability to perceive the upright in the absence of normally-available orienting stimuli" (Melancon & Thompson, 1987, p. 1).

In the "body-adjustment" tests, the subject was seated in a small tilted room that could be displaced clockwise or counterclockwise; his own chair could be displaced by the experimenter in a similar fashion, independent of the room. When given the task of adjusting the chair (and therefore his own body) from an initially tilted position to the upright, with the surrounding room in a tilted position, some subjects aligned the body with the tilted position and reported that they were sitting perfectly straight. Clearly, such subjects were using the external visual field as the primary referent for perception of the upright, essentially to the exclusion of sensations from the body. At the opposite extreme of the performance range were subjects who brought the body close to the true (gravitational) upright. It seemed equally evident that for these subjects the body served as the primary referent for perception of the upright (Witkin & Goodenough, 1981).

In the "rod-and-frame" tests, the subject was seated in a totally darkened room and shown a tilted luminous square frame, within which was a luminous rod, pivoted at the same center as the frame and able to be tilted separately. The subject's task was to adjust the rod to the upright while the frame remained in its initial position of tilt. The subject, then, had to determine the position of an external object (the rod) in space, rather than the position of the body itself. The subject was provided an opportunity to use body or field as referent (Witkin & Goodenough, 1981).

Thus, the field dependent subject tilted his body toward the tilted room in the Body Adjustment Test and tilted the rod toward the tilted frame in the Rod and Frame Test. Conversely, the field independent subject brought his body close to the true upright in the Body Adjustment Test, regardless of room position, and was also likely to separate rod from frame in the Rod and Frame Test.

The Rod and Frame Test and the Body Adjustment Test lead to the development of the Embedded Figures Test. The Embedded Figures Test required the subject to find a simple figure hidden in a complex design. Those who found it difficult to find the hidden figure were described as field dependent while those who separated the hidden figure from the background were termed field independent. The Witkin group established developmental stability of the field dependent and field independent construct with two separate samples (8 and 13 years; 10, 14, 17, and 24 years). At this time, there was no embedded figures test for children younger than ten years old.

Karp and Konstadt (1971) developed a Children's Embedded Figures Test appropriate for children as young as five years (Witkin et al., 1971). In contrast to the adult Embedded Figures Test geometric design, the Children's Embedded Figures Test presented a tent or a house embedded in a complex, meaningful picture. The Children's Embedded Figures Test assessed the child's ability to break up an organized visual field in order to keep a part of it separate from that field (Witkin et al., 1971). In doing so the child's perceptual style was identified. The field dependence perceptual style viewed parts of a given field as fused. The field independence perceptual style viewed parts of a given field as discrete. Thus, the field dependent child could not separate the tent or the house from the total picture. The field independent child, on the other hand, differentiated the house or tent from the whole. The scores from the Children's Embedded Figures Test formed a continuous distribution, placing the individual on a continuous scale.

Gholson (1980) reported in his review of the literature that the Children's Embedded Figures Test may reveal differences between normal and underachieving readers. Elkind et al. (1965), for example, reported that children who were two years behind their peers on tests of reading achievement showed more errors on a hidden-figures task and were classified as field dependent. Research has shown that the child's perceptual independence from background stimuli increased developmentally and, compared to normal readers, underachievers progressed toward field independence at a slower pace (Witkin et al., 1971). Others have obtained similar findings using the Children's Embedded Figures Test

(Witkin, Dyk, Paterson, Goodenough, & Karp, 1962; Guyer & Friedman, 1975; Sabatino & Ysseldyke, 1972).

Gender difference may not manifest itself on the Children's Embedded Figures Test before the age of eight or on the Embedded Figures Test in the elderly (Witkin et al., 1971). During the growth years, an individual's score on the field-dependence dimension showed marked relative stability (Witkin et al., 1971).

Age Difference: The sum of the empirical evidence appeared to support the view that the field dependent versus field independent construct has remained intact despite the task modifications required to assess the construct in younger children (Kogan, 1976). Kogan (1976) argued that "it is reasonable to assume that the long-term stability of field independence versus field dependence can, at the very least, be extended downward to the first year of school" (p. 11).

Saracho (1983, 1984) asserted that research studies usually showed young children as primarily field dependent. As they developed, children increased their ability to pick out the embedded figure from its complex environment. Although evidence suggested that absolute levels of cognitive styles increased at certain age levels, individuals tended to maintain their cognitive style characteristics relative to their peer group (Ausburn & Ausburn, 1978). The degree of field independence increased as the child matured to young adulthood, at which time, the person became more field dependent and continued to become more field dependent as he aged (Witkin, Goodenough, & Karp, 1967; Cecchini & Pizzamiglio, 1975). Several other studies have provided evidence that individuals became more field dependent until they reached age 30 (Saracho, 1984).

Gender Differences: Most research studies reporting gender differences across the ages have found that males tended to be more field independent while females were more field dependent (Witkin et al., 1971; Bush & Coward, 1974; McGilligan & Barclay, 1974; Perney, 1976). Although females were verbally precocious compared to males, eventually males catch up, but females retained a slight edge in all areas of verbal functioning (Sherman, 1978). Much of the research in spatial perception studying visual-spatial perception used male subjects.

Spatial skills tended to be related to field independent cognitive style and males have been found to be superior to females in visual-spatial perception (Maccoby & Jacklin, 1974). In order to be successful in engineering, mechanical arts, architecture and mathematics, visual-spatial skills were needed. Sherman (1978) objected to the view that males were superior to females in visual spatial skills. She argued that, one, different tests were used to measure those skills and, two, differences between the genders in spatial training had not been controlled. Sherman (1978) found that when school curricula was similar for the two genders, performance was essentially the same.

Several studies found that socialization process affected girls' performance in math and science (Aiken, 1970; Fennema, 1984; Travers & McKnight, 1985; Lockheed et al., 1985; Moody & Linn, 1986). Aiken (1970) suggested that male mathematic achievement over females may be greater for two reasons: male pursuit of mathematics in the higher grade levels and greater cultural reinforcement for interest in math. Fennema (1984) suggested that the difference in male superiority over females in mathematics may be because of the cultural stereotyping of math as a male domain. According to the students interviewed in Travers and McKnight's (1985) study, math was not identified as a male domain. The males subjects were not as strong in their views about math being a male domain as were the females subjects.

Males may have achieved success in math and science because as children, they were encouraged in different interests and styles of play than girls. Boys watched TV science show, read more books, magazines and newspaper articles on science, and worked with science projects and hobbies. Females as children were more often reinforced to interact on a social level and to be familiar with social rules (Moody & Linn, 1986). The socialization of males and females appeared to be related to the development of field dependent versus field independent cognitive style dimension.

The cross-cultural studies that Witkin and Goodenough (1981) observed have also identified sources of gender difference in field dependence versus field independence. They found that the more pronounced the differences between male and female roles, the more likelihood that there were differences in cognitive style.

Ability: In general, cognitive styles apparently were minimally related to traditional measures of general ability (Ausburn & Ausburn, 1978; Golberson, Weinstein & Sharabany, 1985). Scores for field independence correlated significantly with the analytic factor of the Wechsler Adult Intelligence Scale but only at a low and usually nonsignificant level with both the verbal-comprehension and attention-concentration factor IQs (Witkin et al., 1971). Field dependent people tended to score relatively low in cognitive restructuring skills and high in interpersonal competencies. This dimension, however, was a matter of their habitual style of information processing rather than a cognitive deficiency (Witkin, Moore, Goodenough, & Cox, 1977). Field independent people tended to score relatively high in cognitive restructuring skills and low in interpersonal competencies (Witkin & Goodenough, 1981).

Messick (1984) differentiated cognitive styles from abilities in four ways. First, he stated that abilities deal with the content of cognition (the question of what), whereas style referred to the manner in which behavior occurred (the question of how). Second, he observed that abilities tended to have a unipolar dimension with a single attribute (intelligence), whereas cognitive style measures were bipolar dimensions with two opposing attributes (field dependent field independent). Third, he argued that a value was attached to ability, but no value was attached to cognitive styles because each end of the continuum was assumed to have positive values. In conclusion, Messick pointed out that abilities were related to a wide variety of behaviors and situations but not to field dependent versus field independent cognitive style dimension.

Academic Achievement: Many studies showed that field independent students scored higher than field dependent students on tests in school. Field dependent students may need more explicit instructions in learning strategy and more exact definitions of performance goals than field independent students (Witkin et al., 1977).

Field dependent students did not perform as well as field independent students on standardized tests (Saracho & Spondek, 1984). Field independent students actively abstracted and cognitively restructured important information by providing structure for an ambiguous stimulus complex whereas field dependent learners appeared to display a more passive, spectator approach and processed the stimulus structure as given (Witkin et al., 1977).

Field dependent and field independent learners differed more in their learning and memory processes than in how much they learned and remembered (Goodenough, 1976). According to Davis and Frank (1979), field dependent learners appeared to remember fewer concepts when the task required an increased amount of information to be processed and stored in short-term memory whereas field independent learners were successful in processing and recalling concepts from short-term memory. Another study suggested that in the absence of interference and limited information, no difference was found between field dependent and field independent students (Davis & Frank, 1979).

Unlike field independent students, field dependent students were unable to use a schema to assist their recall and retrieval of information. Spiro and Tierre (1980) suggested that field dependent learners were more text bound than field independent students because they were unable to impose a previously-acquired, applicable schema on a new form of information.

Color cueing aids field dependent students more than field independent students. Konkiel (1981) found that color cueing helped field dependent students to disembedded critical features from a complex map field better than field independent students.

One researcher argued that the reason field dependent students obtained lower scores than field independent students was that higher scores reflected treatments not designed for field dependent subjects (Golberson et al., 1985). Golberson et al. (1985) designed their study to include training conditions that were suited to the subject's cognitive style and found that field dependent eight-year-old children were able to perform developmentally appropriate tasks at the same level as their field independent age peers. In addition, both groups out-performed six-year-old field independent children.

Ethnic Differences: Some researchers have concluded that Blacks tend to be field dependent and therefore have a lower level of academic achievement because of stylistic differences in learning (Olstad, Juarez, Davenport, & Haury, 1981). Shade (1984) suggested that Black Americans have developed a specific method for organizing and processing information and have unique cultural patterns.

Field dependent cognitive style of Black Americans was studied by Shade (1984) using his information processing paradigm, illustrating the way that Black Americans perceived, encoded, represented and analyzed information. Shade found that Black Americans received information through their kinetic and tactile senses while the preferred modality in the American culture generally was visual.

The cueing selection for many Black Americans was people and events which reflected their socialization process, person orientation rather than object-thing orientation (Shade, 1984; Prom, 1982). This finding was different from the general cue selection preference of ideas and objects.

The preferred cognitive style of Black Americans was field dependent and was incompatible with current school practice. The incompatibility seems greater when analytic skills, impersonal orientation, and working independently were needed for success in learning mathematics and science curricula, for example (Olstad et al., 1981; Shade, 1984).

Ethnic differences in cognitive style may be responsible for academic performance. Olstad et al. (1981) suggested that science and math instructions should include the following: one, the use of more global skills; two, a more personal orientation; three, more group work; and four, social interactions. It was their belief that the above suggestions would provide a comfortable domain for Black American learners.

Mode of Presentation: Field independent learners scored higher from instruction delivered in either audio or written form, but field dependent learners generally scored higher from television presentations (Hammond, 1985; Danielson, Seiler, & Friedrich, 1979). Field independent boys in grades one through three had significantly higher reading achievement scores than field dependent subjects. In addition, field independent first grade children scored higher than field dependent first grade students on reading achievement tests (Good & Brophy, 1990).

A basic difference between field dependent and field independent individuals, according to Good and Brophy (1990, pp. 612-613), was that field independent individuals "perceive more analytically. They can separate stimuli from context, so their perceptions are less affected when changes in contexts are introduced. Field dependent individuals have difficulty differentiating stimuli from the contexts in which they were embedded, so their perceptions were easily affected by manipulations of the surrounding contexts."

It would seem reasonable that field dependent individuals would score higher following a television media format because this media seems to allow the salient point to be highlighted and perceived and subsequently chosen over the surrounding contexts. It would also seem reasonable that field independent individuals' scores from a television media format would be the same as from a text and audio format because field independent persons are less affected by context changes.

One study supports the prediction that field independent subjects will score higher from video media under a visual location task but contradicts the expectation for field dependent cognitive style dimension. Moore's (1985) study systematically examined the effects of multiple and linear visual videotape presentations and cognitive style on performance in a visual location task.

The linear visual location task in Moore's (1985) study was to select a criterion picture from a group of three similar pictures after viewing three quadrants (in random order) of the criterion picture. The two treatments (linear and multiple) were developed from black and white 2x2 slides (15 pictures) which were then videotaped.

The linear presentation consisted of viewing each quadrant of the criterion picture separately for 2 seconds, one after another. Next, the criterion picture was presented with two similar pictures for a total of 6 seconds.

The multiple presentation consisted of presenting each of the quadrants simultaneously on the screen for a period of 6 seconds. Next, the criterion pictures were presented with the other two similar pictures for 6 seconds. Both treatment groups saw the same materials. The videotape was presented in real-time motion (30 frames per second).

Moore (1985) found that field independent students scored significantly higher than field dependent students in identifying the criterion picture among the three pictures. According to Witkin, Oltman, Goodenough, Friedman and Owen (1971), field independent students were expected to perceive the important salient feature of a visual presentation regardless of whether it was made relevant. Field independent students were predicted to score higher than field dependent students even though prior studies would predict that field dependent students score higher from television presentations (Danielson, Seiler, & Friedrich, 1979).

In contradiction to his hypothesis, Moore (1985) also found that field dependent persons scored higher under a linear presentation condition than they did for a multiple presentation condition in a visual location task. This finding was totally in contradiction to Moore's (1985) hypothesis. Moore (1985) had hypothesized, based on a prior study (Whitley & Moore, 1979), that multiple presentation of three quadrants would be beneficial to field dependent subjects in selecting the criterion pictures because all visual information would be there on the screen at one time. Moore (1985) suggested that the videotape presentation study enabled the field dependent person to perceive four important salient views of the picture for 2 seconds each, one after another in a linear fashion.

Literature Relevant to Hypermedia

Hypermedia. Hypermedia was a computer-driven lesson involving visual and audio media such as written text, graphics, sounds, and video driven by computer authoring software (Watson, Nelson, & Busch, 1988). Several software authoring systems and languages have been developed to enable non-programmers to create lessons using hypermedia technology. HyperCard, created by Bill Atkinson and produced by The Apple Corporation for the Macintosh personal computer, was an easy to use, powerful authoring language that was a perfect driver for developing hypermedia. It arrived in the market place in October, 1987, and was offered free of charge with a purchase of a Macintosh computer. Because of its widespread availability, several instructional packages subsequently were developed.

Some of the projects that have surfaced using HyperCard to drive a hypermedia presentation have been mentioned in the literature. Watson et al. (1988) identified the following examples of hypermedia projects. Larry Friedlander and Charles Kerns, professors at Stanford University, created the Shakespeare Project, an interactive hypermedia system using HyperCard. This program includes Hamlet's picture on the color monitor, the written script on the Macintosh screen, a dictionary of archaic words, still frame pictures of historic Shakespearean sites, and information about Shakespeare and his era. Fabrice Florin, a consultant to The Apple Corporation, has developed Atlas, a view of the world through hypermedia presentation. The student can study the globe from the screen, pick a place of interest, and view still photographs of the chosen location. Harvard classicist Gregory Crane created Perseus Project, an interactive hypermedia course on the early Greek Civilization. Perseus includes an historical atlas of the Persian Wars, an archaeological catalog, and texts of Greek tragedies. Pratt Institute and Jerry Whiteley developed the Albers Project, a hypermedia project converting the art book Interaction of Color from print technology to cognitive technology. Margo Nanny, through a National Science Grant, repurposed a program taken from the Children's Television Workshop, Square One, to serve as a guide for transferring other video productions.

J. Allen Watson, director of the Children and Technology (CAT) Project at the University of North Carolina at Greensboro, produced and directed Sea Mammals, described earlier in Chapter 1. The project used Pioneer's Encyclopedia of Animals, Volume 1, Mammals 1, Carnivores and Sea Mammals videodisc and rearranged (repurposed) its sea mammals video-image sequences through the programming capabilities of HyperCard. The hypermedia lesson included text, digitilized sound, graphics, and animated scanned images from textbook pictures to produce a 15 minute lesson about whales and a 12 minute lesson about seals.

The above overview was a brief description of several hypermedia projects. None of the hypermedia projects classified their subjects for field dependent versus field independent cognitive style dimension.

Only Sea Mammals was studied for learning under hypermedia and teacher mediation, hypermedia without teacher mediation, traditional teaching including pictures similar to the videodisc images, and a control group (Nelson, 1989). Nelson (1989) found that first graders learned more effectively under a linear hypermedia lesson with teacher mediation and a hypermedia lesson without teacher mediation than under a traditional teacher-mediated lesson.

Theoretical Framework

The theoretical framework used in this study was information-processing theory using the "cognitive structuralist" (Bruner & Kennedy, 1966) direction and included key constructs of other cognitive psychologists Piaget and Vygotsky. According to Bruner's (Bruner & Kennedy, 1966, p. 23) theory, "knowledge is organized into categories that simplify the task of processing and retaining information by allowing us to interpret the new with reference to the familiar". This means that human beings selected input and organize it into categories that became more integrated, differentiated and mediated by language with development. At first the child learned how to manipulate the environment overtly (enactive mode). Next, the child became capable of understanding knowledge presented in the iconic mode via pictures, images, or memories. Around adolescence, a person became able to understand and manipulate purely abstract concepts which represent knowledge in the symbolic mode. Bruner's three general modes of representation of knowledge were similar to the Sensorimotor-Preoperational (0-7 years), Concrete (7 to 11) and Formal (11 and above) developmental stages postulated by Piaget (1963).

Piaget's (1963) developmental framework defined cognitive processes as a means of gaining and organizing information about the environment and about oneself in relation to one's environment. As children take in the world, the picture that they obtain is biased on the condition of their own colored lens. The present focus of the lens was tinted by the childrens' past experiences and their current stage of internal maturation (Thomas, 1979).

Piaget (1963) applied the label of "assimilation" to the process of taking in or understanding events of the world by matching the perceived features of those events to one's style of adjustment (schemas). Sometimes the schemas and the perceived structure of events do not match even when the child tried to adjust the schemas. The perception was ignored and not assimilated or there was dissatisfaction with the perceived environment; available schemas and efforts to achieve a match continued (Good & Brophy, 1990). Piaget (1963, p.141) explained:

> New objects which present themselves to consciousness do not have their own qualities which can be isolated...they are vague, nebulous, become unassimilable, and thus they create a discomfort from which there emerges sooner or later a new differentiation of the schemas of assimilation.

The new differentiation of the schemas of assimilation was called accommodation (Murray, 1979). Under pressures from perceived realities of the environment, schemes were altered in form or multiplied to accommodate in order to permit the assimilation of events that otherwise would be incomprehensible.

Children developed cognitive skills to perform problem solving skills and reasoning (assimilation and accommodation) from social interactions with adults or more capable peers. A child goes through a "zone of proximal development" when he learns from adult directives but does not necessarily understand the directives

(Vygotsky, 1978). The adult may give directions at different levels of difficulty and suggest behavioral responses ("other regulation"). If there was sufficient experience in the adult-child interaction relative to the task, the child's performance may result from the internalization of the appropriate response ("self-regulation"). The child's ability to engage in a mental or cognitive process and successfully complete a task without adult supervision or mediation was critical. Just as important was the "type" of adult assistance, scaffolding, which causes the child to make the transition across the zone of proximal development from other-regulation to self-regulation (Emihovich & Miller, in press).

Hypermedia fits into this conceptual framework because the computer was a cultural device which amplified cognitive processes and facilitated mediated activity (Emihovich & Miller, in press). The computer became more that just a tool when interactive software (e.g., HyperCard) was used. Emihovich and Miller (in press) argued that the computer functioned as a "sign" (something that gives feedback) since the programmed lesson used and the subsequent messages on the screen operated as a communicative language in its own right. In other words, people using computers were in effect talking to them and receiving information in return. Often teachers using computers with children referred to the computer as telling the student what went wrong or what to do next. This view suggested that the computer was treated as another interactional partner and not simply as a tool (Emihovich & Miller, in press).

The above perspective does not decrease the importance of Vygotsky's (1978) ideas of the origins of thought as located within adult-child interactions; it rather, suggested the possibility that the future link of cognition and social interaction may need to be broadened to include an intelligent interactive tutor system like a computer (Emihovich & Miller, in press). Emihovich and Miller (in press) argued that from a cognitive perspective, using the computer allowed the teacher to make "meaning" more explicit to the students and to make clear the connection between speech and thinking. In other words, an attribute of the computer was explicitness of meaning. The computer only accepted inputs that were clearly defined. Wertsch (1979, p. 21) asserted that "adult directives to children which do not elicit the intended behaviors and must be followed by explicit directives which do elicit the appropriate behaviors are probably an important learning tool for the child going through the zone of proximal development" (p. 21). It would seem reasonable that computer driven hypermedia would be identified as an intelligent interactive tutor system.

Summary

The existence of cognitive style was well established (Green, 1985). Several reliable and valid tests have been developed to identify field dependent and field independent cognitive style dimension in preschool children to the elderly (Witkin & Goodenough, 1981). Studies have shown that the distribution of field dependent and field independent cognitive style dimension were stable across populations (Witkin & Goodenough, 1981).

In the review of related literature, one study found that first grade children scored higher using a hypermedia lesson than traditional teaching (Nelson, 1989). Moore's (1985) study suggested that field dependent individuals scored higher using a linear video tape presentation than a multiple videotape presentation. However, no empirical evidence can be found concerning the use of field dependent versus field independent cognitive style dimension in the design of hypermedia. Hypermedia was designed using videodisc still frame and real-time motion.

This study was an attempt to add empirical evidence to the effectiveness of hypermedia (real-time motion/still frame) presentation mode on a knowledge task for second grade children classified according to field dependent versus field independent cognitive style dimension.

The methodology for this study is presented in Chapter 3.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The purpose of the study was to determine the effects of two methods of presentation of hypermedia (real-time motion and still frames) about whales and dolphins (Cetacea Animals) presented to second grade students. The study also considered whether the measures of achievement on the Cetacea Animals Knowledge test were affected by the interaction of two variables: hypermedia presentation mode (real-time motion and still frames) and cognitive style (field dependent versus field independent).

This chapter presented two major sections. The first described the development work and a pilot study conducted: 1) to prepare and formatively evaluate the Cetacea Animals hypermedia lessons; 2) to develop, formatively evaluate, practice administration and, assess content validity and reliability of the Cetacea Animals Knowledge Test; 3) to practice administration of and estimate reliability of the Children's Embedded Figures Test; and 4) to execute a small scale pilot study which used the methodology of the main study and addressed the research questions of the dissertation. The second major section described of the main study.

I. Materials Development and Pilot Study

Preparation of the Instructional Presentation

Development: Cetacea Animals, a hypermedia lesson about whales and dolphins (see Appendix C), was a modified version of Watson's (1988) Sea Mammals and developed under the supervision of J. Allen Watson. Cetacea Animals was programmed with HyperCard authoring language into two versions, Version 1 using still frames and Version 2, real-time motion. In both versions, the topics were described with text and reinforced with videodisc images. Cetacea Animals used the visuals from the videodisc, Encyclopedia of Animals, Volume 1, Mammals 1, Carnivores and Sea Mammals (1987).

Cetacea Animals Version 1 has 52 stills presented for 4 seconds each with an overall total of 212 seconds while Version 2 has 24 real-time motion clips presented for 4 to 28 seconds with an overall total of 212 seconds. Both versions were viewed by the subject for twenty minutes.

Cetacea Animals (versions 1 and 2) included the following eight topics: 1) the Cetacea animals' common names (whale, dolphin), their characteristics (flipper, blowhole), and basic need (air); 2) the Cetacea animals' habitats; 3) the smallest Cetacea animal; 4) the largest Cetacea animal; 5) the female Cetacea animal and calf; 6) the Cetacea animals communicate; 7) the Cetacea animals' blow hole; 8) the Cetacea animals' tail and flippers.

In addition the lesson provided two review sequences: one, Spell, Say, and Draw, reinforced the location of the flippers, tail and blowhole; and two, Points to Remember, reinforced facts and rules about Cetacea animals which were presented in the eight topics listed above.

Both versions of Cetacea Animals included text and hypermedia technology (e.g., videodisc images, scanned graphics, and digital sound). However, the videodisc images in Version 1 (still) did not have sound accompanying the still frames while images in Version 2 (motion) had sound accompanying the real-time motion. The inability of the videodisc to produce sound was a confounding variable.

The scanned graphics (pictures read into the computer by a scanner [as opposed to images drawn freehand] and imported into the HyperCard stacks) were pictures of a whale and a dolphin viewed on the computer screen which enabled the subject to view body parts (flippers, tail, blowhole). The whale, dolphin and body parts were also identified by digital sound prerecorded and stored in the computer memory. The digital sound was heard as the computer displayed the picture and text on the screen. For example, the picture and text identifying the whale's blowhole was accompanied with a digital sound statement of the word "blowhole."

At the conclusion of all the topic presentations, subjects were asked to draw their concept of a whale. The drawing was done on the computer screen using the computer mouse. The videodisc monitor displayed a picture of a whale for students to use as a reference. This activity was an exercise for enjoyment and was not assessed.

Formative Evaluation: A formative evaluation was planned for the instructional materials and test instrument developed for this research project. Scriven, Tyler, and Gagne, (1967) and Cronbach (1975) defined formative evaluation as the collection of data and information during the development of instruction which can be used to improve the effectiveness of the instruction. This study used two types of formative evaluation: one, the one to one stage identified and removed the most obvious errors in the instruction after gathering information from the initial reaction to the content from the learners; and two, the field trial attempted to create a learning situation that closely resembled the ultimate use of the instructional materials (Dick & Carey, 1985).

The procedure for the evaluation consisted of the researcher and an instructional design specialist observing all subjects as they viewed and interacted with both versions of Cetacea Animals. The subjects for this task were two males and one female (one black male) who were first grade students in a Greensboro City primary public school. The first grade students' teacher was the researcher's consultant. The one-to-one method evaluated Version 1 and Version 2 of Cetacea Animals on the following criteria: one, design of instructional presentation; two, text and picture consistency; three, age-appropriate language; and four, clarity of directions.

All of the subjects had positive reactions towards the instructional presentations viewed on the computer and videodisc monitor. The text on the computer screens was easily read and the function of the graphics (desk, apple, arrow and TV symbols) appeared to have been understood. One subject was confused about where to look at a specific time. To prevent any confusion, a verbal cue was added ("Ready?") at the end of each text screen before the subject branched to the videodisc visuals and after the videodisc visual was completed. All of the subjects reacted favorably toward using the mouse to control the computer as they navigated through the lesson content. Subjects manipulated the mouse effectively while drawing their picture of a whale on the computer screen.

The one-to-one evaluation pointed out inconsistencies in the introduction of Cetacea Animals. Cetacea Animals had originally been introduced to subjects with information and visuals about sea mammals. However, the introduction was changed to include text descriptions and videodisc images of an otter and a sea lion to provide contrast with non-Cetacea animals. In addition, the main menu allowed subjects to choose a lesson at random rather than follow the lessons in order The researcher decided that, for this study, subjects would be directed to follow the lesson topics sequentially preventing a confounding variable.

The subjects reacted favorably to all of the eight lessons and to the two reinforcement sections. The Say, Spell And Draw reinforcement section included digital sound added to the graphic picture of the whale, dolphin, and body parts (blowhole, flipper and tail) . All of the subjects enjoyed drawing their image of a whale and using the erase feature. Using the erase feature varied the length of the drawing time. The researcher decided to eliminate the erase feature and direct the subjects to draw their best pictures within a 2 minute time frame.

Cetacea Animals Knowledge Test

Development: The Cetacea Animals Knowledge Test, a multiple-choice test of knowledge, was developed using the following procedures. The instructional objectives (see Appendix B) were specified by the researcher for the instructional presentation in Cetacea Animals. Next, an initial set of 32 draft questions was written based on the instructional objectives. Directions for test administration were developed and two practice questions were added to the test questions. A group of judges including three higher education faculty (Administration, Educational Research, and Library Science and Information Services) and three 1st grade teachers (Greensboro City primary school) were asked to classify each draft test question according to Bloom's (1956) Taxonomy of Educational Objectives and to assign each test question to one of the instructional objectives. The judges' responses were then compared to the researcher's initial classification responses and each question was reclassified when necessary. There were 24 knowledge questions and four comprehension questions identified after the classification task (see Appendix B) was completed.

The next step was to select pictures to represent the answer and distractors for each of the questions. The pictures were found in children's books and magazines, removed and mounted on regular paper, zeroxed, and placed into a notebook.

Formative Evaluation: The Children's Embedded Figures test was formatively evaluated by 5 subjects, three boys and two girls (one black male, one black female) who were first grade students in a Greensboro City primary public school. Two methods were used in evaluating the Children's Embedded Figures Test. The first method was a one-on-one evaluation which obtained initial reactions to the test questions, answers, and distractors. The second method consisted of a field test in which the items were administered to the subjects.

The Cetacea Animals Knowledge Test test was reviewed by each subject and their teacher for text and picture consistency, appropriate language, and directions. The subjects apparently understood the text (questions, answers and distractors) but were confused with the visual representation of the answers and all of the distractors. The subjects appeared to have trouble understanding the images because they were either too detailed or the color was distracting. The teacher concurred with the subjects' feedback and suggested using pictures from the student's worksheets. After acceptable pictures were identified, all of the pictorial representation of the answer and the distractors were replaced.

A field test of the revised Cetacea Animals Knowledge Test was set up in two parts. First, a testing situation was set up with one subject in the following manner. The researcher read the Cetacea Animals Knowledge Test, test questions and distractors; the answer and distractors were shown to the subject. The subject was directed to answer the question by pointing to the answer (either text or picture) and to write the appropriate letter (A, B, C, or D) on the Cetacea Animals Knowledge Test answer sheet. The subject responded without difficulty. However, after careful consideration, it was decided to have the researcher mark the answer on the Cetacea Animals Knowledge Test answer sheet in order to reduce the possibility of distraction.

The second part of the field test involved 4 subjects taking the test in a group setting. The researcher read the Cetacea Animals Knowledge Test test questions and distractors at the same time the answer and distractors were pointed out to the subject. Subjects were directed to answer the question by writing the appropriate letter (A, B, C, or D) on the Cetacea Animals Knowledge Test answer sheet. The subjects appeared to understand the testing process but had difficulty with one part of the test. On four of the test questions the subject was required to point to the model of a whale and identify body parts. The subject pointed to the answer to the question but the researcher could not absolutely rule out the other subjects copying the response. Therefore, the researcher decided to test all subjects individually. In addition, a 1 minute time limit was imposed for each response; the test score was computed by counting the number of correct responses.

The formative evaluation produced a 28 question pilot draft in which each question, answer, and distractor was visually depicted (text and picture) on a 8.5 inch x 11 inch paper page. The pages were placed in individual plastic protectors and put together in a three-ring notebook. There were four questions (numbers: 15, 16, 17, 28) on the test that had either "A. Right" or "B. Wrong" answers. Three of these questions required the subject to point to whale's body-parts on a miniature scale-model of a blue whale. The fourth question asked the subject to look at a model of a porpoise and identify it as a Cetacea animal by its blowhole classification.

Psychometric Evidence: The Cetacea Animals Knowledge Test was administered individually to a sample group of 15 eight-month 1st graders who were in a Greensboro City primary public school. The answers to the test questions were marked on the answer sheet by the researcher after the subject pointed to and/or said the answer. Administration of the Cetacea Animals Knowledge Test took an average of 15 minutes for each subject. The time lapse from pre-test to treatment was two days. The post-test was administered individually immediately following the treatment.

Item analysis provided evidence on the difficulty and the discriminating power of the Cetacea Animals Knowledge Test items at pre-test and the post-test. Item discrimination power described the relationship of item scores with scores on the total test and were indexed by an item-correlation coefficient. Negative coefficients identified undesirable items.

The analysis of the pre-test and the post-test data was computed using SPSS-X Statistical Package for the Social Sciences (Nie, 1983). Six questions were negatively correlated with the total scores on the pre-test and four questions were negatively correlated with the total scores on the post-test (see Appendix F). Each test question, answer and distractors were evaluated for content and difficulty; all were retained.

The position of the answers among the discriminators was also examined, revealing 14 A, 9 C, 3 B, and 2 D correct responses. It was decided to rearrange the position of the A answer responses to reflect a more random distribution. The final form consisted of 10 A, 6B, 6C, and 6D correct answers.

Reliability: Reliability was estimated for the Cetacea Animals Knowledge Test to determine whether or not the test consistently measured the trait. The pre-test and the post-test internal-consistency (Cronbach Alpha) coefficients were .66 and .75, respectively. These were considered to be low but adequate. The test-retest reliability correlation was only .35. However, low correlation might be expected because the responses at pre-test were basically uninformed since subjects had not had any instruction; post-test scores systematically reflected the effects of instruction. It was assumed that the Cetacea Animals Knowledge Test (see Appendix F) was a reasonably reliable instrument for use with children in the six-nine year age range.

Children's Embedded Figures Test

Measurement of Cognitive Style: The Children's Embedded Figures Test (Karp & Konstadt, 1971) was used to assess the field dependent versus field independent cognitive style dimension.

The training session before the actual testing process consisted of showing the subject a plywood cutout of a tent and a house and asking the subject to identify the same cutout form in subsequent colored pictures. During the training session the subject had to correctly select two items in succession. If the subject missed the discriminating answer after two additional times, the training was discontinued and the testing was stopped.

The test was divided into sections and continued as long as the subject could successfully choose the cutouts. If the subject could not identify the cutout in five consecutive tries, the testing was discontinued. The subject's responses to the test pictures were scored 1 or 0. The total score eqûaled the number of test items the subject answered correctly. The possible maximum score was 25. There was no time limit for the testing period (Witkin, Oltman, Raskin, Karp, 1971).

The Children's Embedded Figures Test was standardized using 160 children ranging in age from five to 12 years. These children were randomly selected from two elementary public schools in the northeast. The children were divided equally into four age groups (5-6 years, 7-8 years 9-10 years, and 11-12 years) which contained an equal number of males and females. The 5-6 year group could not be used to determine reliability estimates based on internal consistency methods because a large number of children did not finish all of the test items. The internal consistency reliability estimates ranged from .83 to .90 for three age groups and were comparable to those obtained for the Embedded Figures Test (Witkin et al., 1971).

Another reliability study was done by Dreyer, Nebelkopf and Dreyer (1969) and was reported by Witkin et al. (1971). Forty six children ages five to six years of age were tested and retested five to six months later using the Children's Embedded Figures Test; correlation was .87. Based in this study, one may assume that the Children's Embedded Figures Test provided a stable measurement for children in the five to six year age range.

Validity for the Children's Embedded Figures Test for young children was difficult to establish. Correlating the Children's Embedded Figures Test with the Embedded Figures Test scores was hampered by reports that the children found the Embedded Figures Test too difficult. Concurrent validity has been established for the nine to 10 and 11 to 12 age groups, with validity coefficients for the Children's Embedded Figures Test ranging between .71 to .85, respectively (Witkin et al., 1971). However, Witkin et al. (1971) recommended that the Children's Embedded Figures Test be used for research purposes even though the validation data were sparse and incomplete.

A study of Children's Embedded Figures Test construct validity was undertaken using 28 children who ranged in age from five to 12 years and were enrolled in a rural Midwest public school (Glynn & Stoner, 1987). (Construct validity was defined by Anastasi [1982, p.144] as "the extent to which the test may be said to measure a theoretical construct or trait.") The purpose of the study was to "investigate age differentiation and divergent validity of the children's test using the Matching Familiar Figures Test (Kagan, Rosman, Day, Albert, & Phillips, 1964) as a comparison measure" (p. 1036). The Matching Familiar Figures Test was an individual test for children designed to distinguish individuals with impulsive and reflective cognitive styles. Glynn and Stoner (1987) found that the Children's Embedded Figures Test "reflects a theoretically expected difference in performance with age (age differentiation) and correlates low with a measure of a different construct (divergent validity)" (p. 53). Glynn and Stoner (1987) concluded that the Children's Embedded Figures Test correlated low (r=.32) with the Matching Familiar Figures Test and therefore the Children's Embedded Figures Test measured a different construct.

Pilot Study Procedures and Methods

Sample: Fifteen first graders with parental (or guardian) permission (see Appendix A) from a Greensboro City primary public school were used as subjects. These 15 included 12 males (eight white, four black) and three females (two white, one black), aged six to nine-years-old. The mean age for this sample was 7.5 years with a standard deviation of .8.

Procedure: The researcher classified the above subjects using Witkin's et al. (1971) Children's Embedded Figures Test according to the testing procedure described in the test manual. The subjects were tested in half-hour time slots averaging 3 subjects a day over a period of five days. The answers were tabulated on an answer sheet (optical scan) and scored after the last subject was tested.

Since the test manual set no guidelines for classification, the median score, 16, was used to divide the Children's Embedded Figures Test scores into field dependent versus field independent groups. Out of the 15 subjects tested using the Children's Embedded Figures Test, eight subjects had scores of 15 or less (field dependent subjects) and seven subjects had scores of 16 and above (field dependent subjects).

The field independent group totaled 7 subjects, five males and two females, including one black male. The mean age for the field independent sample group was 7.6 years with a standard deviation of .5.

The field dependent group totaled 8 subjects, seven males and one female, including three black males and one black female. The mean age for the field dependent sample was 7.5 years with a standard deviation of 1.1.

Descriptive statistics summaries and performance on the Children's Embedded Figures Test are reported in Table 3.1.

TABLE 3.1
Descriptive Statistics for Children's Embedded Figures Test Scores: Mean, Standard Deviation, and Range

Cognitive Style	n	M	s	Range
Field Independent Group	7	19.28	2.05	16-22
Field Dependent Group	8	9.63	1.05	6-15
Total	15	14.13	5.58	6-22

The Children's Embedded Figures Test score internal consistency reliability estimate of .89 was comparable to those obtained during the standardization of the Children's Embedded Figures Test (.83 to .93) (Witkin et al., 1971).

The 8 field dependent subjects were randomly subdivided into two treatment groups, A (n=4) and B (n=4); the 7 field independent subjects were randomly subdivided into two treatment groups, C (n=4) and D (n=3). Subjects were assigned to groups in order to balance gender and race within each treatment group.

The composition of the distributions of field dependent versus field independent subjects according to gender and race and treatment levels are listed in Table 3.2.

TABLE 3.2
Distribution of Field Dependent Versus Field Independent Subjects According to Gender and Race and Treatment Levels

	MALE		FEMALE	
	WM	BM	WF	BF
Field Dependent				
Still Frame (A)	2	1	0	1
Real-time Motion (B)	2	2	0	0
Field Independent				
Still Frame (C)	3	0	1	0
Real-time Motion (D)	1	1	1	0
Total	8	4	2	1

Analysis of Data from the Pilot Study

Procedures: The Cetacea Animals Knowledge Test was administered before and after the Cetacea Animals hypermedia treatment. Developed especially for this study, the Cetacea Animals Knowledge Test was a content test of knowledge about Cetacea Animals. The field dependent subjects in group A viewed Cetacea Animal, Version 1 (still frames) and the field dependent subjects in group B viewed Version 2 (real-time motion). The field dependent subjects in group C viewed Cetacea Animal, Version 1 (still frames) and the field dependent subjects in group D viewed Version 2 (real-time motion).

The procedures for testing and treatment were completed in three weeks using the following format. All of the subjects were pre-tested individually within a 2 day period. Following pre-tests, each subject was treated with the assigned lesson and immediately post-tested.

Treatment: The researcher provided each participating subject with a period for getting acquainted with the computer and the computer input (mouse) before viewing the lesson. The researcher identified each of the hardware components on the table (eg., the computer, the videodisc monitor, the videodisc player, and the computer mouse) in front of the subjects. The functions of the computer mouse were explained in age-appropriate language and the researcher demonstrated how the mouse button functions. Finally, each subject practiced manipulating the mouse, moving it until he was comfortable with this activity. After the researcher determined that the subject had demonstrated successful use of the computer mouse, the subject was directed to follow the lesson topics in sequence.

At the end of the get acquainted period, the researcher asked the subject, "Do you have any questions?" The researcher waited for a response and answered the student's questions. The researcher said to the subject, "I will answer any questions that you have about how to make the computer work for you. You just need to ask me. From now on, I cannot answer any questions about the information I will read to you on the computer screen or the pictures that you see on the videodisc monitor. After you finish using the computer, I will ask you some questions about Cetacea Animals. Before we begin are there any more questions?" The researcher followed a specific protocol (see Appendix C) to insure consistency during treatment.

Statistical Design: A 2x2 analysis of covariance design was used to test the hypotheses for the pilot study data. The dependent variable was measured by the post-test score on the Cetacea Animals Knowledge Test. The independent variables were hypermedia presentation mode (real-time motion and still frame treatments) and a cognitive style variable with two levels (field dependent versus field independent). The covariate was obtained from the Cetacea Animals Knowledge Test pre-test scores.

Table 3.3 illustrates the 2x2 analysis of covariance design.

TABLE 3.3
Illustration of 2X2 Analysis of Covariance Design

	Hypermedia Presentation Mode	
Cognitive Style	Still Frame	Real-Time Motion
Field Dependent	A, n=4	B, n=4
Field Independent	C, n=4	D, n=3
Total	n=8	n=7

The design statistically controls for any initial differences in the subjects which might have been present. Analysis of covariance allowed comparison of the dependent measures (post-test scores), after they have been adjusted for any differences in the pre-test scores. Alpha error was set at .05 level.

Results: The pre-test scores means before treatment are presented in Table 3.4. Field independent subjects scored higher than field dependent subjects.

TABLE 3.4

Pre-test Cetacea Animals Knowledge Test Means by Levels of Cognitive Style and Presentation Mode

	Hypermedia Presentation Mode		
Cognitive Style	Still Frame	Real-Time Motion	Total Score
Field Dependent	15.75	13.50	14.63
Field Independent	18.33	17.00	17.67
Total	17.04	15.25	

The analysis of variance showed no significant difference for either presentation mode (still frames, real-time motion) and cognitive style (field dependent versus field independent) and there was no significant interaction. The null hypotheses that the samples were chosen from the same populations with equal averages was retained.

The post-test scores means after treatment are presented in Table 3.5. Field independent subjects scored higher than field dependent subjects. Both field dependent and field independent subjects scored higher under real-time motion. There was no significant interaction between cognitive style and treatment for this target population.

TABLE 3.5
Post-test Cetacea Animals Knowledge Test Means by Levels of Cognitive Style and Presentation Mode

	Hypermedia Presentation Mode		
Cognitive Style	Still Frame	Real-Time Motion	Total Score
Field Dependent	22.00	23.00	21.00
Field Independent	24.33	24.00	24.15
Total	23.50	23.00	

The results of the two-way analysis of covariance are reported in Table 3.6.

Table 3.6
Analysis of Covariance of Cetacea Animals Knowledge Test

Source	DF	MS	F	Sig of F
Pre-test	1	21.582	1.692	.223
cov.	2	2.660	.209	.815
Main Effect				
Pre. Mode	1	3.192	.250	.628
Cog. Style	1	1.266	.099	.759
Pre. Mode * Cog. Style	1	2.442	.191	.671
Residual	10	12.759		
Total	14	11.210		

p=< .05

The covariate adjustment for Cetacea Animals Knowledge Test pre-test scores was not effective, (F[1,10] 1.692, p= .223). The findings of the analysis of covariance showed no significant effects for the main effect or interaction.

Conclusions from the Pilot Study: The following recommendations for the main research study were based on the pilot study results. The main study should use a larger group of subjects in order to assure a representative sample of the population and to achieve reasonable power. A power analysis was done and the number of subjects for each treatment group will be 20.

The students were timed as they were tested and viewed their presentation mode. The breakdown of time was 15 minutes for each pre-test and post-test, and 20 minutes for the presentation mode. The breakdown of time for the presentation mode revealed 14.5 minutes for reading the text, 3.5 minutes for the videodisc presentation, and 2 minutes for drawing their picture of a Cetacea animal.

According to their score on the Children's Embedded Figures Test, the subjects will be placed into either the field dependent, field independent, or the middle group. Splitting the sample in thirds instead of at the median score, will maximize the difference of field dependent versus field independent subjects.

The pilot study subjects were tested and treated in the back of the classroom behind a room divider. The researcher could not guarantee that voices and treatment sounds were not overheard by the other subjects. To insure privacy and to eliminate distractions, the individual subject must be taken to a quiet area to be tested and treated during the same time slot.

In order to prevent the confounding of historical events with treatment, all subjects in each classroom will be pre-tested, treated and post-tested in a following order: a group A subject, a group B subject, a group C subject, a group D subject, the next A subject, the next B, in this fashion until all children in the classroom had participated.

There were no changes or revisions in the procedures administering the Children's Embedded Figures Test and the Cetacea Animals Knowledge Test.

II Main Study

Subjects: One hundred and twenty-one second graders with parental (or guardian) permission (Appendix A) from two Guilford County primary public schools (six classrooms) were used as subjects. There were 71 boys and 50 girls for this study (including seven black males and eight black females) who were seven to nine-years-old. The mean age for this sample was 7.5 years with a standard deviation of .8.

The researcher met with each of the principals of the participating schools to discuss the study plan. She then met with each group of second-grade teachers during which time they were given a schedule, a demonstration of the testing procedure, and a reference article explaining Witkin's field dependent versus field independent cognitive style. The subjects were classified using Witkin's Children's Embedded Figures Test, using the testing procedure described in the test manual. The subjects were tested in half-hour time slots. An average of eight subjects a day were tested over a period of 15 days. The answers were tabulated on an answer sheet (optical scan) and scored after the last subject was tested.

Out of the original 121 subjects who took the Children's Embedded Figures Test, 40 subjects had scores of nine or less (field dependent subjects) and 40 had scores of 14 and above (field independent subjects). The middle group of 41 subjects were excluded from the study because their scores fell in the middle third of the total sample.

The 80 subjects for this investigation included 47 boys and 33 girls (including five black males and seven black females) aged seven to eight-years-old. The mean age for this sample was 7.45 years with a standard deviation of .4. The sample was required with at least 20 subjects in each cell and these subjects were grouped into the above categories in approximate thirds.

The frequency distribution of total test scores on the Children's Embedded Figures Test and field dependent, field independent and middle grouping are reported in Table 3.7.

TABLE 3.7

Frequency Distribution and Field Independent Versus Field Dependent Grouping Based on the Total Children's Embedded Figures Test Scores

Score	Frequency	Total	Group
23	***	3	Field Independent
22	**	3	N=40
21	*	3	
20	***	3	
19	*******	7	
18	***	3	
17	*****	5	
16	********	8	
15	***	3	
14	*****	5	
13	*********	9	Middle (Excluded)
12	***********	11	N=4
11	************	12	
10	*********	9	
9	*********	9	Field Dependent
8	***************	15	N =40
7	******	6	
6	*****	5	
5	*****	5	
		N =40	

Descriptive statistical summaries (n, mean, SD and range) for Cetacea Animals Knowledge Test are reported in Table 3.8.

TABLE 3.8
Descriptive Statistics for the Children's Embedded Figures Test Scores

	n	M	s	Range
Field Dependent Group	40	7.45	1.32	5-9
Field Independent Group	40	17.73	2.66	14-23
Total Scores	121	12.2	4.6	5-23

An internal consistency reliability estimate of .82 for the total Children's Embedded Figures Test scores was comparable to those obtained during the standardization of the Children's Embedded Figures Test (.83 to .93) (Witkin et al., 1971). Although the internal consistency reliability estimate on the Children's Embedded Figures Test was .01 lower than the scores Witkin (1971) reported, it was close enough to be a reasonably reliable instrument.

The 40 field dependent subjects were randomly subdivided into two treatment groups, group A (n=20) and group B (n=20); the 40 field dependent subjects were randomly subdivided into two treatment groups, group C (n=20) and group D (n=20). The subjects were assigned to groups in order to balance gender and race within treatment groups.

The composition of the distributions of subjects according to treatment level, cognitive style gender and race is listed in Table 3.9.

TABLE 3.9
Distribution of Subjects According to Treatment Level, Cognitive Style, Gender, and Race

	MALE		FEMALE		
	WM	BM	WF	BF	TOT
Field Dependent					
Still Frame (A)	10	2	6	2	20
Real-time Motion (B)	10	2	5	3	20
Field Independent					
Still Frame (C)	10	1	8	1	20
Real-time Motion (D)	12	0	7	1	20
Total	42	5	26	7	

Overview of the Design of the Study: The Cetacea Animals Knowledge Test, a content valid and reliable test of knowledge about Cetacea Animals developed in the pilot study activities especially for this study, was administered both before and after treatment. The field dependent subjects in group A viewed Cetacea Animal, Version 1 (still frames) and the field dependent subjects in group B viewed Version 2 (real-time motion). The field dependent subjects in group C viewed Cetacea Animal, Version 1 (still frames) and the field dependent subjects in group D viewed Version 2 (real-time motion).

Procedures: The following administration times were estimated for each subject: 15 minutes for the pre-test, 20 minutes for the treatment, 15 minutes for the post-test, and 10 minutes for travel to and from class. In order to prevent the confounding of historical events with treatment, all subjects in each classroom were pre-tested, treated and post-tested in the following order: a group A subject, a group B subject, a group C subject, a group D subject, the next A subject, the next B, in this fashion until all children in the classroom had participated.

Treatment: Before viewing the lesson, the researcher provided a period in order to get acquainted with the computer and the computer input (mouse) for each participating subject. The researcher identified each of the hardware components on the table (eg., the computer, the videodisc monitor, the videodisc player, and the computer mouse) in front of the subject. The functions of the computer mouse were explained in age appropriate language. Next, the researcher demonstrated how the mouse button functioned. Finally, each subject practiced manipulating the mouse and moving it until he was comfortable with this activity. The researcher determined that the subject demonstrated successful use of the computer mouse. The subject was directed to follow the lesson topics in sequence.

At the end of the get acquainted period, the researcher asked the subject, "Do you have any questions?" The researcher waited for a response and answered the student's questions. The researcher said to the subject, "I will answer any questions that you have about how to make the computer work for you. You just need to ask me. From now on, I cannot answer any questions about the information I will read to you on the computer screen or the pictures that you see on the videodisc monitor. After you finish using the computer, I will ask you some questions about Cetacea Animals. Before we begin are there any more questions?" The researcher followed a specific protocol (see Appendix C) to insure consistency during treatment.

Statistical Design: A 2x2 analysis of covariate design was used to test the hypotheses listed in Chapter 1. The dependent variable was the post-test score on the Cetacea Animals Knowledge Test. The independent variables were hypermedia presentation mode (real-time motion versus still frame treatments) and a cognitive style (field dependent versus field independent). The covariate was obtained from the Cetacea Animals Knowledge Test pre-test scores.

Table 3.10 describes the number of subjects at each of the levels of the independent variables. Alpha error was set at .05 level.

TABLE 3.10
Number of Subjects at Each of the Levels of the Independent Variables

	Hypermedia Presentation Mode	
Cognitive Style	Still Frame	Real-Time Motion
Field Dependent	A, 20	B, 20
Field Independent	C, 20	D, 20
Total	40	40

Statistical Assumptions

The basic statistical assumptions for analysis of covariance were the same as for analysis of variance. In analysis of variance, it was assumed that the observations within each cell were independent, and the random sample of the population of observations were normally distributed. It was further assumed that the cell variances in the population were equal. In analysis of covariance, it was also assumed that the covariate was not influenced by the treatment and was linearly related to the dependent variable; this relationship was similar in all treatment groups.

The analysis of covariance assumptions were examined by inspection of the scatterplot of the covariate and the dependent variables. The scatterplot appeared linear by exhibiting fairly uniformed scattering of points in a positive direction with no increasing or decreasing of variability in the points.

Prior to analysis of covariance, simple linear regression was used to examine the homogeneity of regressive slopes. The results supported the assertion of homogeneity of regression slopes.

It was believed that the assumptions were satisfied for both the analysis of variance and the analysis of covariance statistical procedures.

CHAPTER 4

RESULTS

The purpose of this chapter was to present the results of the analysis of covariance which determined the effects of the presentation mode (real-time motion versus still frames) and cognitive style (field dependent versus field independent) on the Cetacea Animals Knowledge Test. The study also considered whether the measures of achievement on the Cetacea Animals Knowledge Test were affected by the interaction of presentation mode (real-time motion versus still frames) and cognitive style (field dependent versus field independent).

The dependent variable used in this study measured the number of correct responses on the Cetacea Animals Knowledge Test. The independent variables were Cetacea Animals hypermedia presentation mode (real-time motion versus still frame) and cognitive style (field dependent versus field independent) cognitive style dimension. The covariate was the score on the Cetacea Animals Knowledge Test pre-test.

Statistical Analysis

Descriptive statistics for the Cetacea Animals Knowledge Test pre-test scores, summarized by type of hypermedia presentation mode, cognitive style, gender, and race, are shown in Table 4.1.

TABLE 4.1

Means, Standard Deviation, and n of Cetacea Animals Knowledge Test Pre-test Scores by Type of Hypermedia Presentation Mode, Cognitive Style, Gender, and Race

Presentation Mode	Mean	SD	n
STILL FRAME	12.33	5.56	40
Male	12.09	5.38	22
White	12.47	5.39	19
Black	9.67	5.69	3
Female	12.61	5.92	18
White	12.73	5.81	15
Black	12.00	7.81	3
REAL-TIME MOTION	12.85	5.65.	40
Male	13.04	5.71	24
White	13.59	5.62	22
Black	7.00	2.83	2
Female	12.56	5.72	16
White	13.33	5.68	12
Black	10.25	5.97	4

The total possible score for the Cetacea Animal Knowledge Test pre-test was 28.00 and the scores ranged from 7 to 22. Females scored higher (12.61) than males (12.09) under still frame presentation mode but black males had the lowest mean (9.67). Black females had the largest amount of variability among the scores (standard deviation= 7.81) under still frame presentation mode. Males scored higher (13.04) than females (12.56) under real-time presentation mode and black males had the lowest mean (7.00). Black males had the smallest amount of variability among the scores (standard deviation = 2.83) under real-time presentation mode.

The Cetacea Animals Knowledge Test pre-test and the post-test internal-consistency (Cronbach Alpha) coefficients were .52 and .74, respectively. The scores were comparable to those obtained from the pilot study (.66 and .75). The test-retest reliability correlation was .65 and was acceptable.

The mean and standard deviation of the pretest Cetacea Animals Knowledge Test scores for the four groups are presented in Table 4.2

TABLE 4.2
Pre-test Cetacea Animals Knowledge Test Means and Standard Deviations by Levels of Cognitive Style and Presentation Mode

	Hypermedia Presentation Mode					
Cognitive Style	Still Frame		Real-Time Motion		Overall	
	M	SD	M	SD	M	SD
Field Dependent	14.15	3.25	15.60	3.55	14.87	3.40
Field Independent	16.10	2.57	15.40	3.10	15.75	2.85
Overall	15.13	2.93	15.50	3.33		

Field dependent students had a higher mean score for real-time motion than for still frame presentation mode. Field independent students had a higher mean score for still frame than for real-time motion presentation modes. Cetacea Animals Knowledge Test pre-test mean scores were very similar.

The analysis of variance for between group pre-test means showed no significant difference for either presentation mode or cognitive style. There was no significant interaction of presentation mode and cognitive style. The null hypotheses that the samples were chosen from populations with identical averages was retained.

The post-test Cetacea Animals Knowledge Test means by levels of cognitive style and presentation mode are shown in Table 4.3

TABLE 4.3
<u>Post-test Cetacea Animals Knowledge Test Means and Standard Deviation by Levels of Cognitive Style and Presentation Mode</u>

	Hypermedia Presentation Mode					
Cognitive Style	Still Frame		Real-Time Motion		Overall	
	M	SD	M	SD	M	SD
Field Dependent	20.75	4.10	22.35	3.86	21.55	3.98
Field Independent	23.55	2.37	23.55	3.05	23.55	2.73
Overall	22.15	3.35	22.95	3.48		

The total possible score for the Cetacea Animal Knowledge Test post-test was 28.00 and the scores ranged from 11 to 28. The overall mean scores for cognitive style showed that field independent subjects had a mean two points higher than that of field dependent subjects. The overall mean scores for hypermedia presentation mode showed that real-time motion mean scores were slightly higher than still frame mean scores.

Analysis of covariance was used to compare group means on the dependent variable, the Cetacea Animals Knowledge Test post-test means, after these group means had been adjusted for group differences.

A summary table of the results of the two-way analysis of covariance is presented in Table 4.4.

Table 4.4
Analysis of Covariance of Cetacea Animals Knowledge Test Post-test Scores

Source	DF	MS	F	Sig of F
Pre-test	1	342.960	42.815	.0001*
cov	2	9.063	.921	.403
Main Effect				
Pre. Mode	1	6.405	.800	.374
Cog. Style	1	41.582	5.191	.026*
Pre. Mode X Cog. Style.	1	.358	.045	.833
Residual	75	8.010		
Total	79	12.552		

*$p<.05$.

The covariate adjustment using the Cetacea Animals Knowledge Test pre-test accounted for a significant amount of the variability in the Cetacea Animals Knowledge Test post-test ($F[1,75] = 48.82$, $p < .0001$) and the F-ratio for hypermedia presentation modes was not significant. The hypermedia presentation mode by cognitive style interaction was also not significant; therefore, the effect of hypermedia presentation modes had no effect either considered by themselves or in interaction with cognitive style dimensions.

However the F-ratio for the main effect of cognitive style was significant. There appears to be a cognitive style dimension difference in levels of achievement, but no hypermedia presentation mode difference.

Means of the Cetacea Animals Knowledge Test post-test scores, adjusted for Cetacea Animals Knowledge Test pre-test, are presented in Table 4.5.

Table 4.5
<u>Adjusted Cetacea Animals Knowledge Test Post-test Means for Level of Cognitive Style</u>

	Adjusted Mean
Cognitive Style	
Field Independent	23.28
Field Dependent	21.82
Presentation Mode	
Real-time	22.83
Still Frame	22.27

There was a 1.46 point difference between the adjusted Cetacea Animals Knowledge Test post-test mean scores for field dependent versus field independent subjects. Field independent subjects scored higher than field dependent subjects.

Test of Hypothesis

The following three null hypotheses were tested using the 2x2 analysis of covariance:

1. The null hypothesis for the cognitive style dimension states that there was no main effect on adjusted Cetacea Animals Knowledge Test post-test score due to field dependent versus field independent cognitive style; the population means were equal. The significant F-ratio ($F[1,75] = 5.19$, $p= .03$) for cognitive style dimension led to the rejection of the first null hypothesis and supported the alternative hypothesis that the field independent and field dependent populations had average scores on the Cetacea Animals Knowledge Test post-test. Field independent students had a higher adjusted mean score (23.28) than field dependent students (21.82). The following research hypothesis was supported by the alternative hypothesis:

HA 1. Field independent subjects will score significantly higher on the content-valid test than will field dependent subjects regardless of treatment.

2. The null hypothesis for hypermedia presentation mode states that there was no main effect on adjusted Cetacea Animals Knowledge Test post-test scores due to still frame versus real-time motion; these sub-population averages were equal.

The second null hypothesis was tested and retained. The F-ratio presentation mode for hypermedia was not significant. Therefore, it was concluded that the populations of subjects experiencing still frame versus real-time motion did not differ in their level of achievement.

3. The null hypothesis for interaction effects of cognitive style dimension and hypermedia presentation mode states that there

was no interaction; therefore, the main effects of these two independent variables would be added together to determine their combined effect.

The interaction null hypothesis was tested and retained. The F-ratio was not significant.

Summary

This chapter has presented the results from a study of the relationship between cognitive style dimensions, field dependent versus field independent, and hypermedia presentational mode, still frame versus real-time motion. The results were as follows:

1. There was a significant difference between the two cognitive style groups in the mean score on the post-test (a main effect).

2. Field independent students had significantly higher adjusted mean scores on the Cetacea Animals Knowledge Test post-test than field dependent students (a main effect).

3. There was no significant difference between presentation modes or a significant interaction between presentation mode and cognitive style on the Cetacea Animals Knowledge Test post-test scores.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In recent years educational technology has attempted to develop an empirical base which considered the interaction of computer driven instructional media and cognitive style. This study was an attempt to contribute to the empirical base of research on hypermedia technology and cognitive style.

The purpose of this study was to determine the effects of real-time motion versus still frame presentation mode and field dependent versus field independent cognitive style on a knowledge task. Specifically, the purpose was to answer the following research questions:

1. Are there overall differences on content-valid test scores when field dependent and field independent subjects are compared?
2. Are there overall differences on content-valid test scores when motion and still modes of presentation are compared?
3. Is there an interaction of cognitive style and treatment variables for the content-valid test scores?

The presentation mode for this study required subjects to view a hypermedia presentation which consisted of eight lessons about Cetacea animals. Two groups viewed the still frame version of Cetacea Animals and two groups viewed the real-time motion version. After treatment subjects were required to answer a 28 item multiple choice test (Cetacea Animals Knowledge Test) about Cetacea animals. Based on the results from the pilot study, the Cetacea Animals Knowledge Test was judged to be a content valid and reliable test of knowledge about Cetacea animals

The field dependent versus field independent cognitive style dimensions of 121 second grade subjects were determined by the administration of the Children's Embedded Figure Test. Forty field dependent and 40 field independent individuals were selected, randomly assigned to treatment groups, and administered the Cetacea Animals Knowledge Test pre-test. Two groups each of 20 field dependent individuals and 20 field independent individuals received the hypermedia still frame presentation; two groups each of 20 field dependent individuals and 20 field independent individuals received the hypermedia real-time motion presentation.

The following results were obtained using a 2x2 analysis of covariance statistical procedure. Overall field independent subjects had significantly higher adjusted mean scores on the Cetacea Animals Knowledge Test post-test than did field dependent subjects. There was no significant difference between hypermedia presentation modes on the Cetacea Animals Knowledge Test post-test. There was no significant interaction between cognitive style and hypermedia presentation mode independent variables on the Cetacea Animals Knowledge Test post-test.

This study supported the following conclusions regarding the relationship of field dependent versus field independent cognitive style dimension and still frame versus real-time presentation modes. In addition, this study answered the following research questions.

1. Are there overall differences on content-valid test scores when field dependent and field independent subjects are compared?

Examination of the cognitive style dimension independent variable showed an overall significant difference on the Cetacea Animals Knowledge Test post-test. Field independent subjects scored higher on the Cetacea Animals Knowledge Test post-test than field dependent subjects. Field independent individuals can separate stimuli from context, so their perceptions were less affected when changes in contexts were introduced (Moore, 1985; Goodenough, 1976; Greco & McClung, 1979; Witkin & Goodenough, 1981; Good & Brophy, 1990).

Field independent individuals scored the same on real-time motion and still frames presentation modes. The presentation modes included text throughout the instruction and audio during the

Spell, Say, and Draw reinforcement sequence. The videodisc real-time motion included audio and color whereas the still frame version included color and no audio. Field independent individuals scored higher from instruction delivered in either audio or written form than television (Hammond, 1985).

Ausburn and Ausburn (1978) asserted that field dependent individuals tended to perceive information globally as it existed, remembering the most noticeable cues, which may be an irrelevant part of perception. It would seem reasonable that field dependent individuals scored higher from a television media format because this media allowed the salient point to be highlighted, perceived, and subsequently chosen over the surrounding contexts. Moore (1985) found that field dependent individuals scored higher from a linear, video tape presentation than from a multiple image video tape presentation. Field dependent individuals scored higher on the real-time motion than on the still frame presentation mode.

2. Are there overall differences on content-valid test scores when motion and still modes of presentation are compared?

Hypermedia presentation modes were presented as linear visual presentations that included real-life motion and still frame videodisc images, text, and graphics. Real-time motion post-test means were slightly but not significantly higher than still frame post-test means.

The study by Nelson (1989) was the only one found that compared two forms of hypermedia. She found that first grade subjects learned more effectively under a linear hypermedia lesson than under a traditional teacher-mediated lesson. There was no significant difference between hypermedia and teacher mediation, and hypermedia without teacher mediation treatment groups.

The present study took a second look at hypermedia and found that hypermedia can be presented to learners with either still frames or real-time motion videodisc images. There were no studies that examined the interaction of field dependent versus field independent cognitive style dimension and still frame versus real-time motion presentation mode.

3. Is there an interaction of cognitive style and treatment variables for the content-valid test scores?

There was no interaction between cognitive style dimension and hypermedia presentation mode, which was a negative finding. Hammond (1985, p. 158) asserted that there was an interaction between cognitive style and "perception of the material displayed on the (computer) monitor and the television screen." He suggested that instructional material should be presented in a form which will provide a match with the learner's preferred cognitive style.

Here is a list of several factors which came into play with this study and are discussed below: videodisc presentation time; prior knowledge; presentation modes; Cetacea Animals Knowledge Test; and working with the computer and learning.

The presentation time for the still frame videodisc visuals was 4 seconds. It was determined that 4 seconds would be enough time for the subject to become familiar with the information in the still frame visual. Still frame presentation time was equal to the real-time videodisc presentation.

The videodisc presentation time might have been a problem. There might not have been enough time given to the videodisc visuals. The total times for the presentation modes were 20 minutes each and only 3.5 minutes total were devoted to the videodisc visuals. Because of this brevity of viewing time, the images presented by the videodisc might not have been noticed within the total lesson and therefore would not have been separated out and compared. Examination of the time log for the still frame and real-time motion sequences (See Appendix E) showed both sequences ranging from 4 seconds to 28 seconds. For example, one still frame was shown for 4 seconds in a presentation if the real-time motion was 4 seconds; but seven still frames were shown for 4 seconds each in a presentation if the real-time motion was 28 seconds. If more that one still frame was shown to the subject at a time, it might have given the illusion of motion. Field independent subjects scored the same on real-time motion and still frame; they might have seen the two versions as motion. On the other hand, field dependent subjects scored higher on real-time motion than still frame and if the still frame had stayed on longer than 4 seconds, the subject might have taken a second look. Four seconds apparently did not satisfy and familiarize the field dependent subject with the information in the still frame visual.

The Cetacea Animal Knowledge Test was designed to test for prior knowledge of whales and dolphins. Although subjects were tested for prior knowledge, the Cetacea Animals Knowledge Test instrument might not have asked the right questions. The videodisc images of Cetacea animals presented in this study would be very hard to offer children in book form and in real-life situations. The pictures on the videodisc were a conglomerate of films from several Cetacea animal, sea lion, and sea otter habitats around the world. It would be hard to depict the animal in its various habitats by a black and white text book picture and the chances of the child visiting the animal's natural habitat is remote. But subjects could have had prior knowledge of Cetacea animals from television or Sea World. The videodisc images might have reinforced old knowledge rather than introduced new knowledge. In addition, the subjects were not asked specifically if they had prior knowledge from television and Sea World.

The presentations were formatively evaluated by a very small sample of first grade subjects (one field independent white male, one field dependent black male, and one field dependent female). The Cetacea Animal hypermedia presentations need to be formatively evaluated again with second grade subjects even if there are no revisions. Repeating the evaluation process with a larger group of second grade subjects would identify the difficulty level of content in the Cetacea Animal presentation mode.

An examination of the Cetacea Animals Knowledge Test revealed that the total correlation for two questions in the main study post-test (see Appendix F) were very low but positive. In addition, only seven questions had positive correlation above .40 and 19 questions had a total correlation that ranged from .0 to .30.

An examination of the pilot and main study pre-test and the post-test means revealed that the Cetacea Animals Knowledge Test appeared to have been too easy for the second grade sample. The pilot test means were 16.00 on the pre-test and 23.26 on the post-test out of a possible mean score of 28.00. The main study means were 15.31 on the pre-test and 22.55 on the post-test out of a possible mean score of 28.00. Both the pre-test and post-test scores were negatively skewed; there appeared to have been a ceiling effect. Therefore, the subjects appeared to have prior knowledge about Cetacea animals, making the Cetacea Animals Knowledge Test non challenging. In addition there was no significant difference of presentation mode on the Cetacea Animal Knowledge Test post-test.

Thus, though the test was likely to be content-valid and reliable, it appears to have been too easy. Not only should the Cetacea Animals Knowledge Test be reevaluated for content and prior knowledge but it should be revised and reevaluated using a much larger sample. The Cetacea Animals Knowledge Test was formatively evaluated by a small group of 5 subjects, three boys (one black) and two girls (one black). The sample for the formative evaluation after Cetacea Animals Knowledge Test is revised must be more representative.

The subjects in this study interacted with the computer and therefore were actively engaged in learning. The presentation mode was controlled by the subject using the computer mouse input device, and the lesson sequence was fixed and linear. However, the subjects in the study may have been distracted by using the computer mouse and therefore perhaps missing the impact under the still frame and the real-time motion presentation mode. Field dependent subjects in Moore's (1985) study scored higher under a linear video tape presentation. The difference between Moore's

(1985) study and the present study may be that his subjects were passively viewing the videotape presentation and therefore more focused on the task.

Recommendations

In order to refine and further substantiate the findings of this study, the following recommendations are made:

1. Still frame images should be visualized for longer than four seconds each.

2. The videodisc sequences should be longer than 3.5 minutes or 1/5 of the total lesson time.

3. The hypermedia presentations need to be formatively evaluated again with a larger sample of subjects.

4. The test items need to be examined for content choices and difficulty.

5 The test items need to be formatively evaluated with a larger sample of subjects.

6. The subjects need to be tested for prior knowledge and asked if they have seen a television special on whales and dolphins, and if they have visited Sea World.

Suggestions for future research include the following:

1. Consider a greater number of Black American male subjects for the study.

The five Black American males (two real-time motion and three still frames) were a very small sample size for this study. Black males who were generally field dependent did better on the still frame presentation mode than the real-time presentation mode. But, according to Shade, (1984) Black Americans are generally mismatched with the American school system and the attrition rate for Black male students is approximately 30% nationwide. Specifically, teaching methods must be found that help the predominantly field dependent Black American male learner connect with curricula.

2. Consider a study that takes an indepth look at an individual while he is interacting with a hypermedia lesson.

Develop a case study approach by asking a sample of field dependent versus field independent learners introspective and retrospective questions while completing tasks which require complex transfer of information using a hypermedia presentation.

The computer acts as a spontaneous teacher mediator giving information to the learner at his request. Questions relating to student-computer interaction would reveal the dynamics of the relationship in addition to verifying the cognitive style characteristics. Specific questions relating to the transfer of information across the "zone of proximal development" would relate to the dynamics of branching to various sources of information in the lesson. The student would be observed for overt behavior and asked for example, "What path did you follow in order to make sense of the information? How did you make hypermedia work for you?"

The study would be a beginning attempt to identify cognitive style processing using hypermedia. The information would help to accommodate individual cognitive styles rather than designing a hypermedia lesson and hoping that it is effective.

Conclusion

Hypermedia is in the initial stage of research. It arrived on the educational media scene in 1987, on the heels of HyperCard authoring language. So far, there have been two studies that have evaluated the effect of hypermedia in a learning situation with children who were in primary school.

Hypermedia is a way of coupling a videodisc and a personal computer that offers new opportunities for presenting instructional material in applications as demonstrated in this study. Hypermedia makes an individualized instructional delivery system possible. The technology accommodates a range of individual characteristics, including cognitive style. In addition, hypermedia incorporates many unique attributes such as high level of interaction, branching capabilities, text and illustration potentials, and strategies for individual instruction.

What this study tried to identify was the kind of adoptions to hypermedia presentation that should be made to accommodate field dependent versus field independent cognitive style dimension. Although hypermedia presentation mode still frame and real-time motion did not show an overall significant difference on the post-test, it has great potential for learning which needs to be explored. Hopefully, this study will serve as a spring board for further research to add to the empirical evidence relative to field dependent versus field independent cognitive style dimension-hypermedia interaction.

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APPENDIX A
PERMISSION LETTER AND CONSENT FORM

Dear Parent /Guardian: September 1990

Your child has been selected to participate in a study on the effectiveness of Hypermedia technology and children's cognitive styles at _______ Elementary School.

This study is designed to evaluate the instructional value of the videodisc pictures in a lesson about whales and dolphins. A videodisc can be thought of as a phonograph record which uses a beam of light for playback instead of a needle. In addition to sound, the videodisc has still and moving pictures. During the study the text is presented on a computer screen and is read to each child. The children do not need to be able to read or have any computer or keyboard skills.

Children who participate in the study will be first tested for their cognitive style. The test used to identify how your child learns is very simple. There is a short training period before the test begins. A plywood model of a house or tent is given to the child to hold in their hand or place on the table in front of them. Next, the child will look at a series of pictures and asked to pick out the tent or house hidden in the picture. The cognitive style test will be administered to all of the children who participate in the study.

After the cognitive style test, your child will be assigned to one of four groups. The groups will be taught to use the hypermedia lesson, Cetacea Animals Version I or 2. Before and after your child views Cetacea Animals, a test will be administered. The entire procedure takes approximately an hour and a half of the child's time.

The study has been reviewed by the appropriate committees, administrators and teachers in your school system. In no way will the information received from this study or your response to this letter affect your child's normal course of study, grade or academic standing in the school. The Cetacea Animal Knowledge Test scores are kept confidential and destroyed at the conclusion of the study.

Please indicate whether or not your child may participate in this study. If you indicate that your child may participate and later reconsider, or if your child wants to stop participation during any phase of the study, she/he may do so immediately. Also on the same form, please indicate if you wish to receive a group summary of the results of this study and your child's cognitive style dimension by checking the box at the bottom of the next page.

Thank-you for your consideration.

Carole J. Meshot

Please Return This Form to the School Tomorrow

Parent/Guardian's Permission Form

Child's Name:

____

_______ My child has permission to participate in this study.

_______ My child may not participate in this study.

_______ I give permission to share my child's cognitive style dimension with my child's teacher.

____
Parent/Guardian Signature

____
Date

Your child can withdraw from the study at any point in time without penalty. Non-participation in the study will in no way affect the status of your child in class or at this school. Knowledge test data will be numerically coded, kept confidential and destroyed at the conclusion of the study.

___I do wish to receive a group summary of the results of this study and my child's classification, which will be available in the school at the beginning of the next school year.

APPENDIX B
CLASSIFICATION OF OBJECTIVES

CLASSIFICATION OF OBJECTIVES

**GIVEN A SET OF 4 PICTURES (P) OR A MODEL OF A BLUE WHALE (M), THE STUDENT WILL BE ABLE TO:

		*EDUCATIONAL OBJECTIVES	
Introduction	QUESTION	KNOWLEDGE	COMPREHEN.
(P)select a Cetacea animal	1,3	1,3	
(P) (M)select a characteristic of the Cetacea animal flipper and blowhole	6,10,28	6,10	28
(P)select at least one example of Cetacea animals basic needs	21		21
Habitat			
(P)select where whales and dolphins live	2,12,14	2,12,14	
Smallest			
(P)select the smallest Cetacea animal.	4	4	
(P)select one example that identifies the size of a dolphin	27	27	
Largest			
(P)select the largest Cetacea animal	5,18	5,18	
Mother/calf			
(P)select the baby Cetacea animal name	11	11	
(P)select location where whale and dolphin calves are born	9	9	
(P)select location where whales and dolphin calves breathe	7	7	
(P)select description of how whales-dolphins help their baby calves surface for air	22	22	
Sounds			
(P)select one example of how dolphins and whales keep together as a group	8	8	
Breathing			
(M)select blowhole location	16	16	
(P)select the location of general environment for breathing	23	23	
(P)select the description of function of blowhole and breathing behavior	20,24,26	20,24,26	
Moving			
(P)select analogous example of function of flippers and tail	25	25	
(P) (M)select the location of flippers and tail	15,17	15,17	
GIVEN THE RESTRICTION OF NOT USING THE FLIPPER OR TAIL, THE STUDENT WILL BE ABLE TO:			
(P)predict movement of Cetacea animal	13,19		13,19

* BLOOMS TAXONOMY, 1956

** The task changes according to the stimili presented eg., picture of the answer with three distractors (P) or point out the body part on the model of a blue whale (M).

APPENDIX C
TREATMENT PROTOCAL AND LESSON HYPERCARDS

TREATMENT PROTOCAL

The following treatment protocal for was used both for the pilot and the main study.

1. The researcher read the following verbal directions: "This is a lesson on whales and dolphins. You will see and hear information on the computer screen and you will also see and hear (say hear only if using, Cetacea Animals, Version 2 [real-time motion] only) information on this screen (point to the videodisc monitor). I will ask you if you are ready before I read the words on the computer screen. Then, I will read the words on the computer screen to you and you can read along with me to yourself. I will tell you when to click the mouse on the arrow button or the television button by saying, "Ready?" Please, move the computer cursor over the picture button on the computer screen, press the mouse button, and count to one before releasing the mouse button. I can not answer any questions about the information I read to you or the pictures that you see while you are using the computer."

2. Say, "Ready" and read the text on the computer screen to the student.

3. Say to the child, "Please, put the computer cursor over the picture button on the computer screen, press the mouse button, and count to one before releasing the mouse button."

4. Say, "Ready," read the text and repeat number 3 until the menu screen appears on the computer screen.

5. Choose the first lesson in the upper left corner of the menu screen. Say, "Ready" and read the title. Say to the student, "Please, put the computer cursor over the arrow picture button on the computer screen, press the mouse button, and count to one before releasing the mouse button."

6. Say, "Ready" and read the text on the computer screen to the student.

7. Say to the student, "Ready? Please, put the computer cursor over the picture button that looks like a TV picture, press the mouse button, and count to one before releasing the mouse button."

8. Keep silent while the student is watching the still frame or the real-time motion presentations on the monitor screen.

9. Say to the student, "Ready? Please, put the computer cursor over the picture button that looks like an arrow, press the mouse button, and count to one before releasing the mouse button."

10. Repeat step numbered 4 to number 9 listed above for all eight lessons.

11. Say to the student, "Please, put the computer cursor over the picture button, Say and Spell and Draw, which is at the bottom right side of the computer screen. Press the mouse button and count to one before releasing the mouse button." Say, "Ready?" and read the text on the screen.

12. Keep silent as the student sees a graphic picture of a whale, while hearing and seeing the word spelled. When the presentation is complete, say to the student, "Ready? Please, put the computer cursor over the picture button that looks like a arrow, press the mouse button, and count to one before releasing the mouse button." Repeat the above sequence for the graphic picture of the whale, the dolphin, the flipper, the blowhole, and the tail. The last card in the sequence is an interactive drawing exercise that asks the student to draw a picture of a whale. A picture of a whale is displayed on the videodisc monitor for the student to use as reference.

13. Say to the student, " Please draw a whale on the computer screen (point to the screen) using the mouse. There is a picture on the videodisc monitor screen (point to the screen) that you can look at if you forgot how a whale looks." Allow the student two minutes to draw the picture.

14. Say to the student, "Please, place the computer cursor over the picture button that looks like a picture of an arrow, press

the mouse button, and count to one before releasing the mouse button."

15. Say to the student, "Please, put the computer cursor over the picture button, <u>Points To Remember</u>, which is at the bottom on the right side of the computer screen. Press the mouse button and count to one before releasing the mouse button."

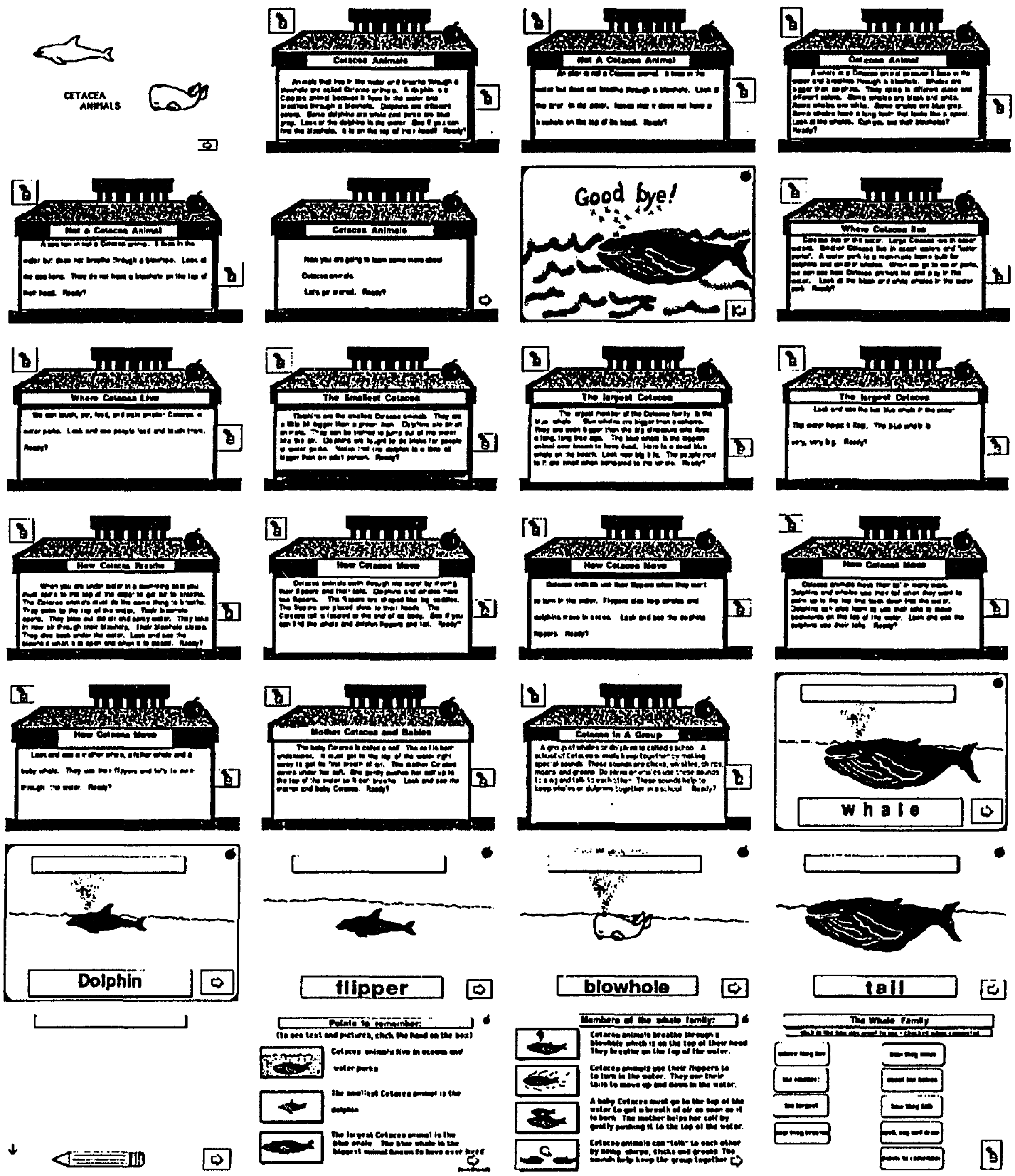
16. Say, "Ready" and read the text on the computer screen to the student.

17. Say to the student, "Ready? Please, position the computer cursor over the picture button that looks like a picture of an arrow, press the mouse button, and count to one before releasing the mouse button."

18. Say to the student, "Please, place the computer cursor over the picture button that looks like a bear waving good-by, press the mouse button, and count to one before releasing the mouse button."

19. The last screen on the computer is a graphic of a whale saying, "Good-by." After the last screen, say to the student, "Thank-you for your time and attention. Now, I want to ask you some questions about what you have just heard and seen."

The post-test was administered to the student and after the post-test, the student was thanked for his or her participation and rewarded with a sticker and a piece of candy.


CETACEA ANIMALS
Good bye!
whale
Dolphin
flipper
blowhole
tail

APPENDIX D
TIME LOG FOR STILL FRAME AND REAL-TIME MOTION VIDEODISC SEQUENCES

TIME LOG FOR STILL FRAME AND REAL-TIME MOTION VIDEODISC SEQUENCES

CONTENT	STILL FRAME PICTURES		REAL-TIME MOTION SEQUENCES	
Introduction	Still frame	Seconds	Real-time	Seconds
Dolphin	1	4	1	4
Otter	5	20	1	20
Whale	6	24	3	24
Sea Lion	3	12	1	12
Lessons				
Habitat A	3	12	1	12
Habitat B	2	8	1	8
Smallest	3	12	3	12
Largest A	1	8	2	8
Largest B	4	16	2	16
Breathe	2	8	2	8
Move A	5	20	1	20
Move B	2	8	1	8
Move C	2	8	2	8
Move D	7	28	1	28
Calves	3	12	1	12
Talk	3	12	1	12
Totals	52	212	24	212

APPENDIX E
ITEM ANALYSIS ON PILOT AND MAIN STUDY PRE-TEST AND POSTTEST SAMPLES

ITEM ANALYSIS ON PILOT PRE-TEST SAMPLE

Item No.	Difficulty	Item/Total Correl.	Alpha If Item Del.	Freq. of Choice A	B	C	D
1	.4667	.1958	.6578		7 *		
2	**.6667**	**-.3068**	**.7036**	**10 ***	**4**	**1**	**0**
3	.5333	.5150	.6234		8 *		
4	.0667	.2984	.6531	1 *			
5	.3333	.3889	.6382		5 *		
6	.4000	.3637	.6403		6 *		
7	.8000	.5039	.6309	12*			
8	.3333	.4745	.6294	5 *			
9	**.8667**	**-.3450**	**.6935**	**13 ***	**0**	**2**	**0**
10	.8667	.2305	.6550		13*		
11	.6000	.1275	.6646	9 *			
12	.6000	.5299	.6223			9 *	
13	.3333	.0643	.6701		5 *		
14	.8667	.0141	.6700		13*		
15	.5333	.5150	.6234	8 *			
16	.9333	.5266	.6411	14*			
18	**.2000**	**-.1506**	**.6848**	**3**	**9**	**0**	**3 ***
19	.2667	.2119	.6559	4 *			
20	.6000	.4045	.6359		9 *		
21	**.8000**	**-.0626**	**.6780**	**12 ***	**1**	**2**	**0**
22	.4000	.2437	.6528			6 *	
23	**.7333**	**-.0781**	**.6816**	**2**	**11 ***	**0**	**2**
24	.6667	.3052	.6467	10*			
25	.9333	.5266	.6411		14*		
26	.6667	.2232	.6548			10*	
27	.4667	.2342	.6538	7 *			
28	**.0667**	**-.0668**	**.6717**	**1 ***	**14**	**0**	**0**
17	1.0000			15*			

*Correct Answer

ITEM ANALYSIS ON PILOT POSTTEST SAMPLE

Item No.	Difficulty	Item/Total Correl.	Alpha If Item Del.	Freq. of Choice A	B	C	D
2	**.9333**	**-.2121**	**.7631**	**14***	**1**	**0**	**0**
3	.9333	.0270	.7527		14*		
4	.7333	.7136	.7036	11*			
6	.9333	.0270	.7527		14*		
7	.9333	.2751	.7416	14*			
8	.8667	.6212	.7183	13*			
9	.9333	.1078	.7491	14*			
11	.9333	.0270	.7527	14*			
12	.8000	.7424	.7045			12*	
13	.6667	.0434	.7616		10*		
14	.8667	.5539	.7228		13*		
15	.8667	.1694	.7474	13*			
17	.9333	.6212	.7253	14*			
18	.8000	.1234	.7521				12*
19	**.2000**	**-.0603**	**.7649**	**3 ***	**6**	**6**	**0**
20	.5333	.5851	.7128		8 *		
21	**.8667**	**-.2435**	**.7717**	**13***	**0**	**2**	**0**
22	**.8667**	**-.0119**	**.7583**	**3**	**0**	**0**	**13***
23	.9333	.2751	.7416		14*		
24	.7333	.0119	.7274	11*			
25	.9333	.6212	.7253		14*		
26	.7333	.7698	.6984			11*	
27	.6000	.1269	.7556	9 *			
28	.7333	.4970	.7229	11*			
01	1.0000				15*		
05	1.0000				15*		
10	1.0000					15*	
16	1.0000			15*			

*Correct Answer

ITEM ANALYSIS ON MAIN STUDY PRE-TEST SAMPLE

Item No.	Difficulty	Item/Total Correl.	Alpha If Item Del.	Freq. of Choice A	B	C	D
1	.1875	.1266	.5129			15*	
2	.4750	.1082	.5168	38*			
3	.2875	.0216	.5290			23*	
4	.0375	.0881	.5175	3*			
5	.3125	.2337	.4962			25*	
6	.3375	.0487	.5257				27*
7	.6125	.3282	.4792		49*		
8	.6125	.2467	.4934	49*			
9	.8667	.0487	.5214		71*		
10	.9375	.3364	.4968				75*
11	.5375	.0380	.5284		43*		
12	.7375	.3562	.4779				59*
13	**.4125**	**-.1181**	**.5528**	**7**	**33***	**40**	**0**
14	.9625	.1922	.5109			77*	
15	.2875	.1031	.5168	23*			
16	.9250	.3586	.4938	74*			
17	.8500	.2132	.5024	68*			
18	.2500	.3482	.4796				20*
19	**.2375**	**-.1246**	**.5479**	**19***	**10**	**51**	**0**
20	.4625	.0699	.5232			37*	
21	**.8875**	**-.0776**	**.5344**	**71***	**9**	**0**	**0**
22	.6875	.1025	.5170				55*
23	.8250	.2707	.4941		66*		
24	.6625	.2069	.5004				53*
25	**.8250**	**-.0018**	**.5291**	**0**	**66***	**10**	**4**
26	.5500	.2483	.4928			44*	
27	.2875	.1771	.5054	23*			
28	.2375	.1996	.5024	19*			

*Correct Answer

ITEM ANALYSIS ON MAIN STUDY POSTTEST SAMPLE

Item No.	Difficulty	Item/Total Correl.	Alpha If Item Del.	Freq. of Choice A	B	C	D
1	.8875	.3729	.7302			71*	
2	.9250	.3148	.7344	74*			
3	.9250	.4726	.7270			74*	
4	.6625	.6085	.7073	53*			
5	.8500	.5653	.7168			68*	
6	.8625	.0579	.7483				69*
7	.8750	.4236	.7268		70*		
8	.7000	.4422	.7222	56*			
9	.9000	.3450	.7321		72*		
11	.8500	.2082	.7396		68*		
12	.8875	.3971	.7288				71*
13	**.5750**	**-.0350**	**.7621**	**15**	**46***	**19**	**0**
14	.9875	.3413	.7387			79*	
15	**.9125**	**-.0193**	**.7501**	**73***	**7**	**0**	**0**
17	.9500	.1051	.7434	76*			
18	.7750	.6170	.7095				62*
19	.2125	.1175	.7466	17*			
20	.5500	.0508	.7554			44*	
21	.9750	.0719	.7440	78*			
22	.8625	.0058	.7512				69*
23	.8625	.2610	.7363		69*		
24	.7500	.1773	.7430				60*
25	.8625	.1318	.7440		69*		
26	.6125	.2599	.7376			49*	
27	.5500	.3967	.7257	44*			
28	.7875	.6399	.7083	62*			
10	1.0000						80*
16	1.0000			80*			

*Correct Answer

APPENDIX F
TEST INSTRUMENT

CETACEA ANIMALS KNOWLEDGE TEST

<u>Directions for Administration of Practice Questions and Test</u>

Read the question to the child. Present the child with four pictures, three distracters and the answer. Show the child the pictures while simultaneously saying what each picture depicts. Example: "it is a bear; it is a cat; it is a dog; it is a mouse". Say to the child, "I would like you to point to the answer or say the answer to me". Record the answer (A, B, C, or D) on the answer sheet. Tell the child "thank-you" at the end of each question. If the child answers the practice questions correctly, go on to the test questions.

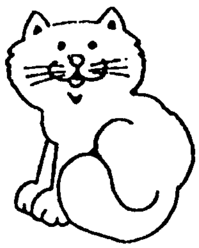
If the child does not respond to the test question, repeat the question one time. If the child does not respond after the second time, say to the child, "Let's try another question". If the child does not respond to three consecutive test questions, then discontinue the testing. If the child cannot respond to the test question within one minute, record an "out of time" (OOT) notation and go to the next question. If the child scores OT on three consecutive questions, than discontinue the testing procedure.

If there is inconsistency between what the student says and what the student points to say, "Is that a ____"? Point to the answer picture while you ask the question. If the child does not recognize the inconsistency, record no credit (NC) and go on to the next test question.

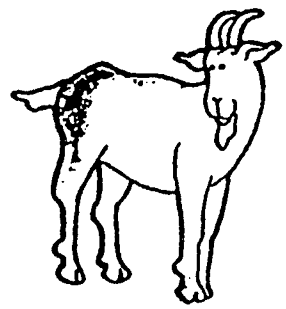
If the child gives a multiple response either verbally or by pointing and one response is correct, say to the child, "What is your best answer"? If it is the right answer, give the child credit and continue testing. If it is the wrong answer, record it and continue testing.

At the conclusion of testing, if it is the pre-test, tell the child that he/she did fine. Say, "You did a good job, thank you". If it is the post-test, tell the child that he/she did fine. Say, "You did a good job, thank you". At the conclusion of the post-test, give the children a sticker and a piece of candy as a reward for their participation in the study.

Point to the animal that meows?

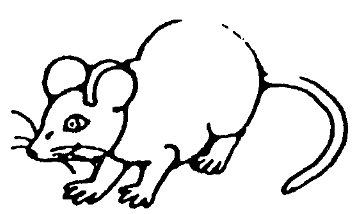


A. cat



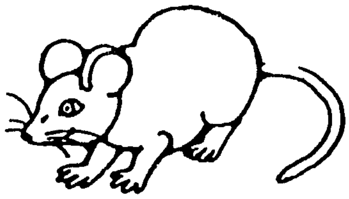
B. goat

C. bear

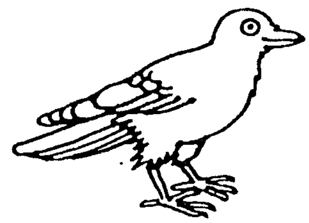


D. mouse

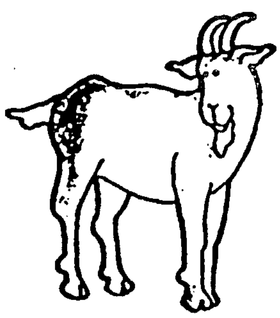
Point to the creatures that flies?



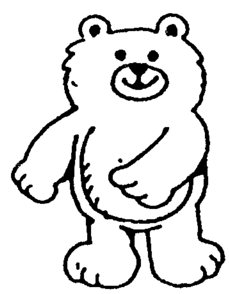
A. mouse



B. bird

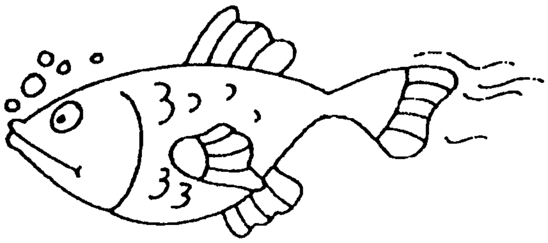


C. goat

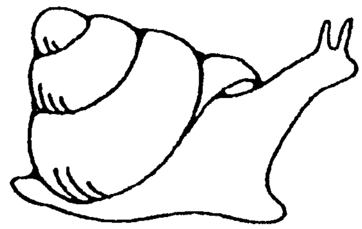


D. bear

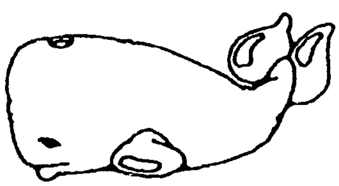
Point to a Cetacea animal.
Is it a:



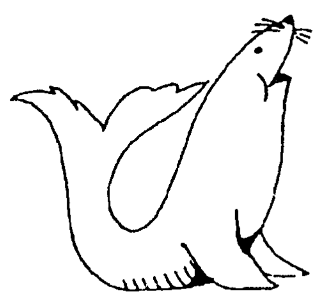
A. fish



B. snail

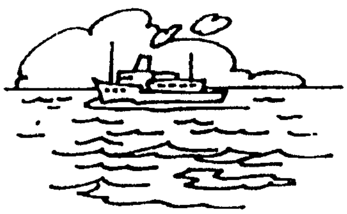


C. whale

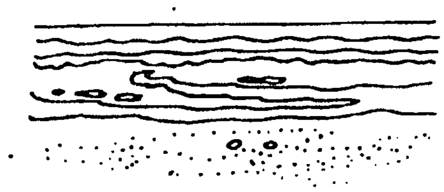


D. seal

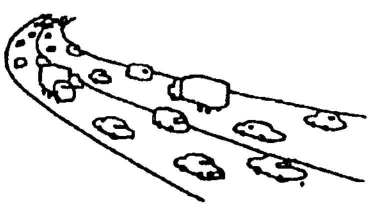
Point to where Cetacea animals live.
Do they live:



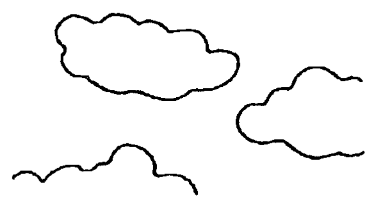
A. in the sea



B. both on land and in the sea

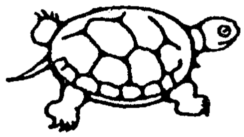


C. on the land

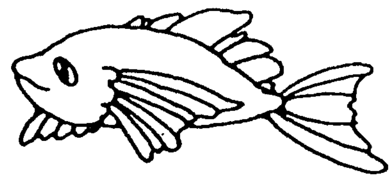


D. in the sky

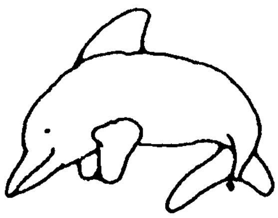
Point to a Cetacea animal.
Is it a:



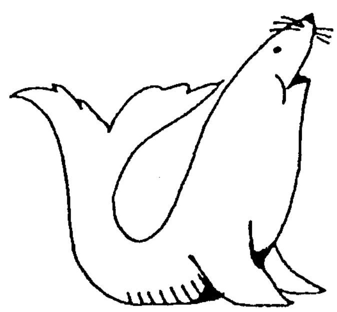
A. turtle



B. fish

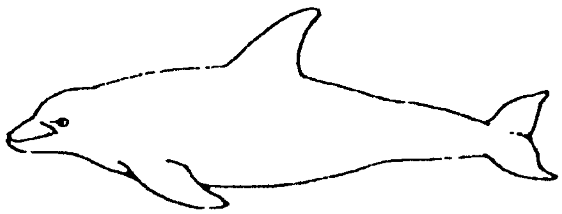


C. dolphin

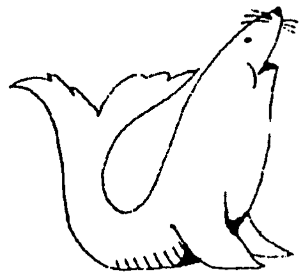


D. seal

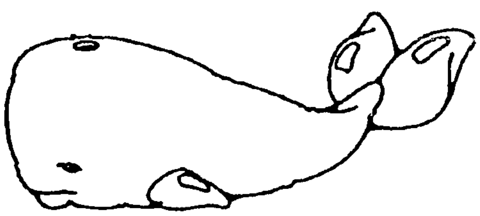
Point to the smallest Cetacea animal.
Is it a:



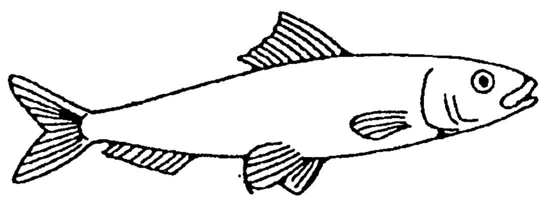
A. dolphin



B. seal



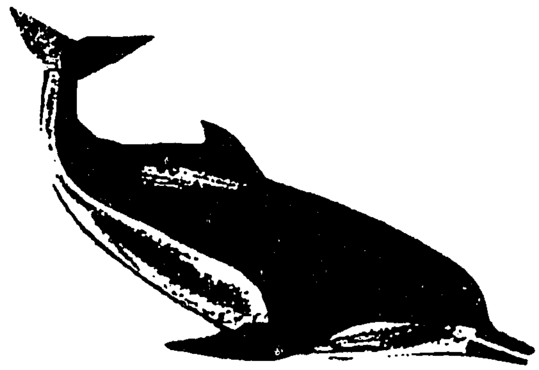
C. whale



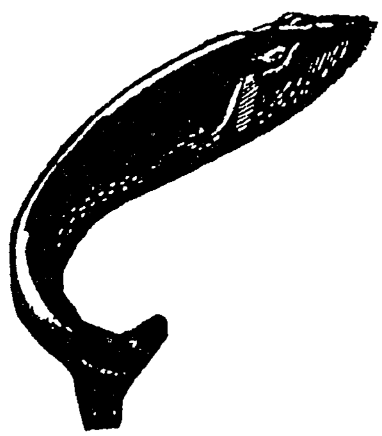
D. fish

Point to the largest Cetacea animal.
Is it a:

A. dinosaur



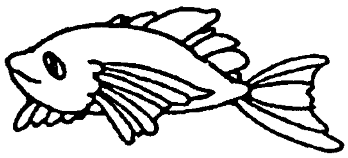
B. dolphin



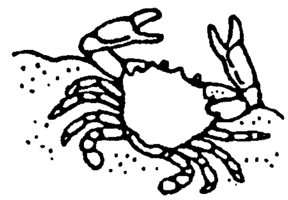
C. blue whale

D. seal

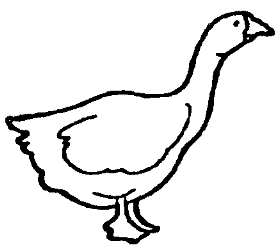
Point to the animal that has a flipper.



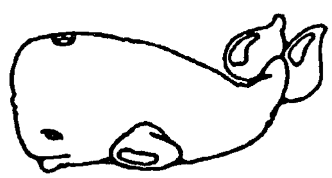
A. fish



B. crab

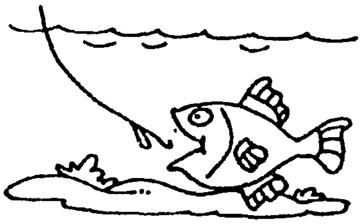


C. duck

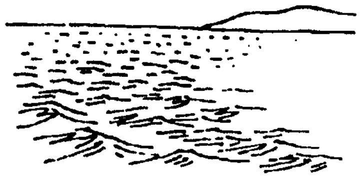


D. whale

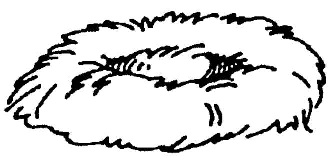
Point to the place where dolphin and whale babies breathe.
Do the babies breathe:



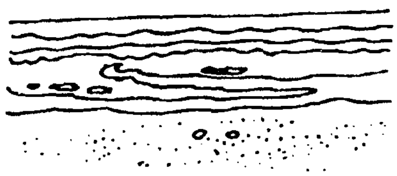
A. under the water



B. on top of the water

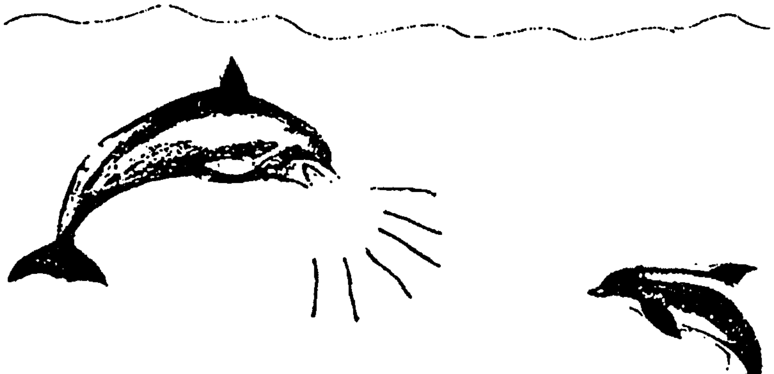


C. in the nest



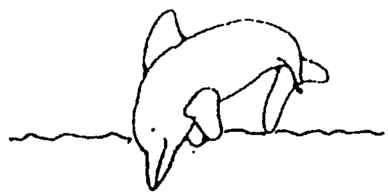
D. on the sand

Point to the example that tell how the dolphins and the whales keep together as a group. They keep together as a group by:



A. making sounds

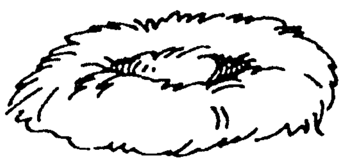
B. floating on top of the water



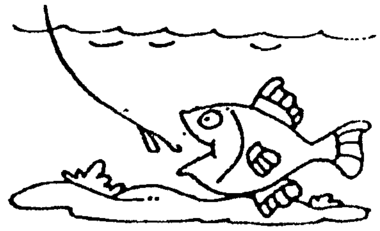
C. diving into the water

D. touching each other

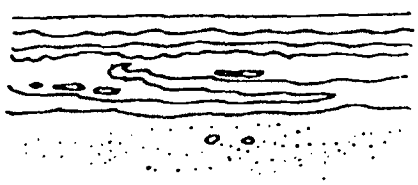
Point to where baby whales and dolphins are born.
The babies are born:



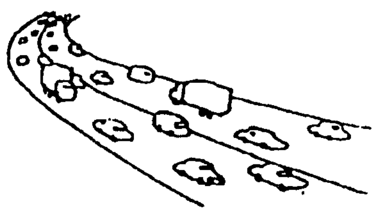
A. in a nest



B. in the water

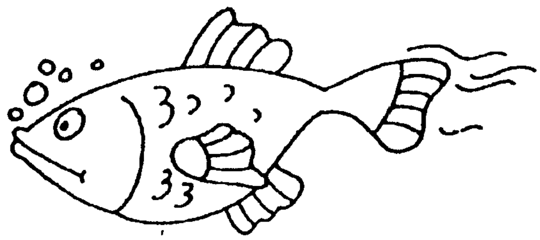


C. on the sand

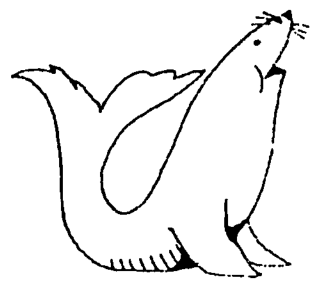


D. on the land

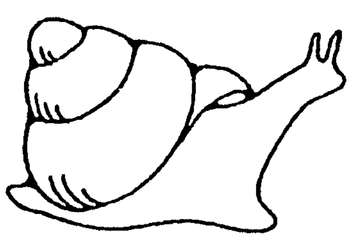
Point to the animal that breathes through a blowhole.



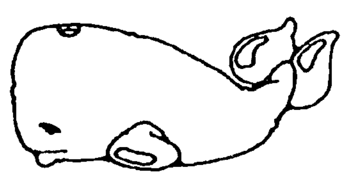
A. fish



B. seal

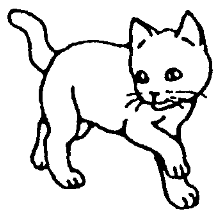


C. snail

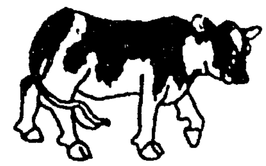


D. whale

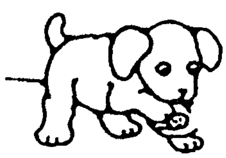
Point to another name baby dolphins and whales are called.
Baby dolphins and whales are called:



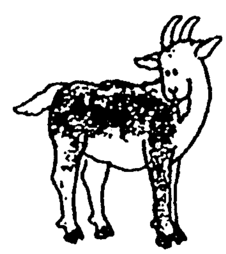
A. kittens



B. calves



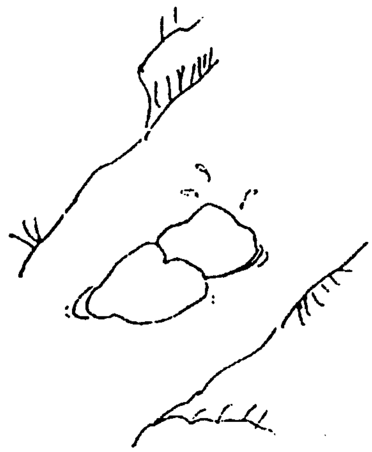
C. puppies



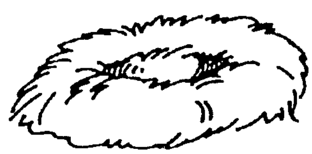
D. kids

Point to where dolphins live.
Do they live in:

A. lakes



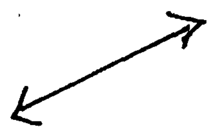
B. streams



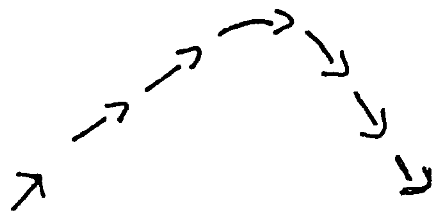
C. nests

D. water parks

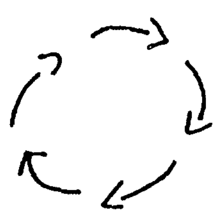
If the whale and the dolphin only used their tail, which way would they move in the water?
They would use their tails to move:



A. sideways

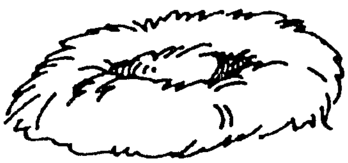


B. up and down



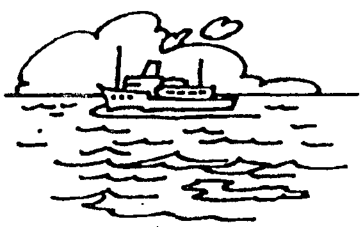
C. round in circles

Point to where whales live.
Do they live in:

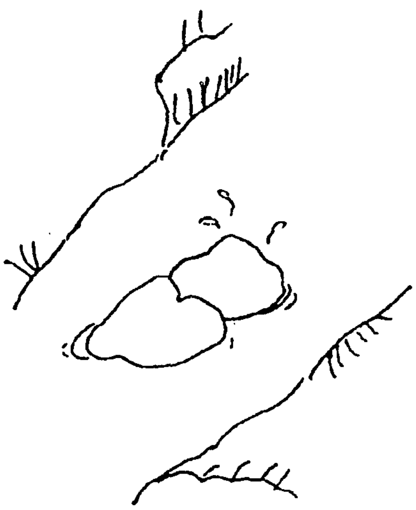


A. nests

B. lakes



C. oceans



D. streams

Now let's look at this model of the whale.
Put your finger on the whale's flipper.

A. right

B. wrong

Now let's look at this model of the whale.
Put your finger on the whale's blowhole.

A. right

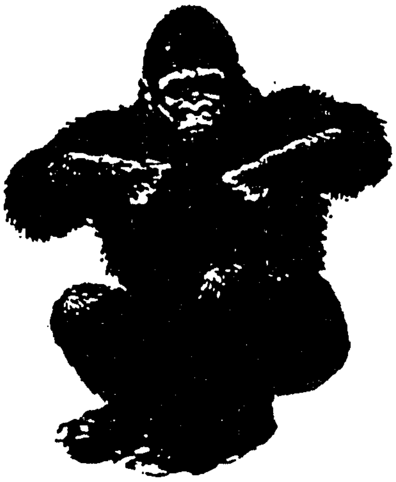
B. wrong

Now let's look at this model of the whale.
Put your finger on the whale's tail.

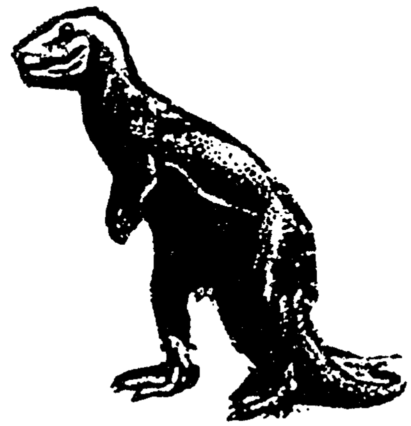
A. right

B. wrong

Point to the largest animal ever known to have lived.
Is it a:

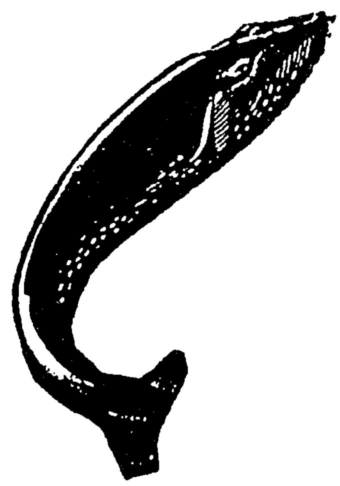


A. gorilla



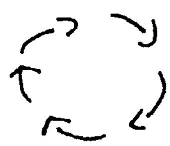
B. dinosaur

C. panda

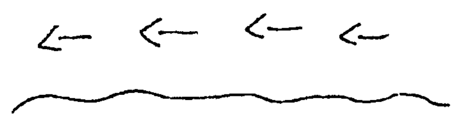


D. blue whale

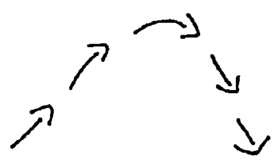
If the whale and the dolphin only used their flipper, point to which way would they move in the water?
They would use their flippers to move:



A. round in circles

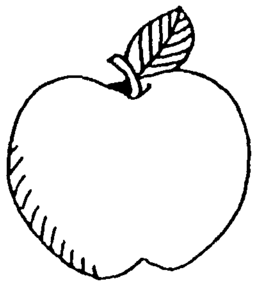


B. move backwards on top of the water

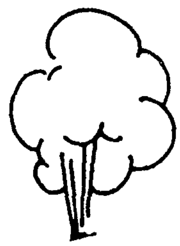


C. up and down

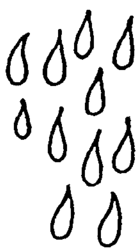
Point to the example that tells what Cetacea animals spray when they blow out their blowhole.
They spray:



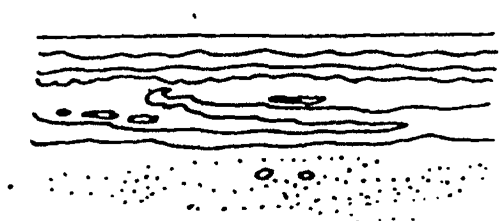
A. food



B. air

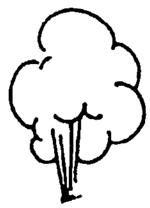


C. water

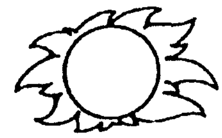


D. sand

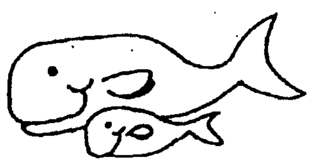
Point to what Cetacea animals need to do to stay alive.
Do they need:



A. air to breathe



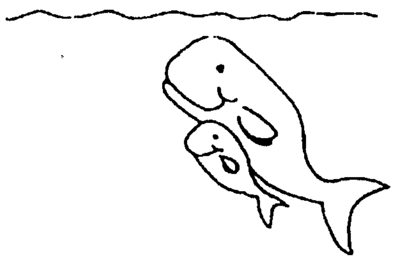
B. sun to keep warm



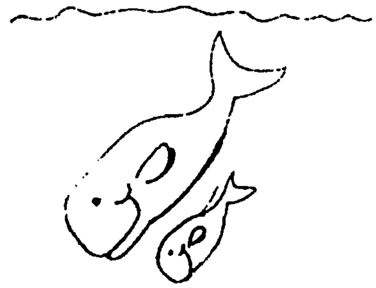
C. to have babies

D. to play with each other

Point to the example that tells how the mother whales and dolphins help their baby get its first breath of air.
The mother helps by:

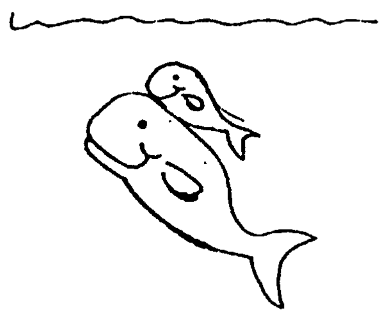


A. swimming over the top of her baby



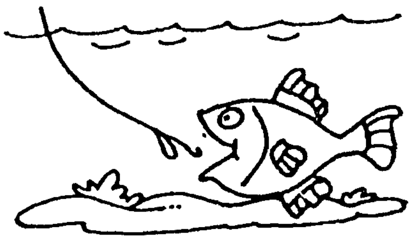
B. diving in the water with her baby

C. playing on top of the water with her baby

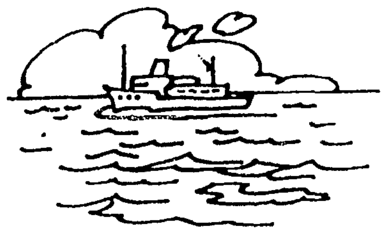


D. swimming under her baby

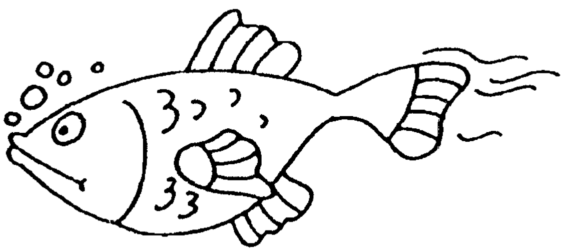
Point to the example that tell where whales and dolphins get their air for breathing.
Do they get their air from:



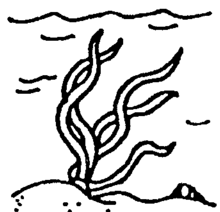
A. under the water



B. on top of the water

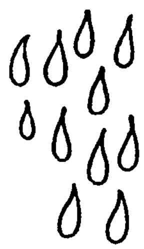


C. from fish

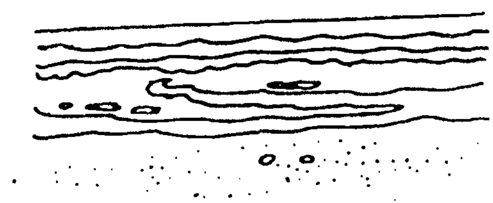


D. from the seaweed

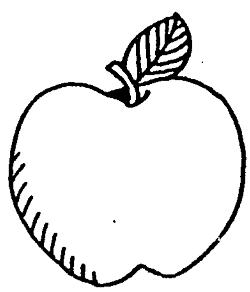
Point to the example that tells what the whales and the dolphins suck into their blowhole. Do they suck into their blowhole:



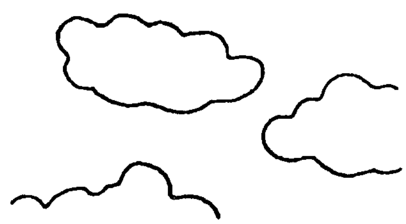
A. water



B. sand

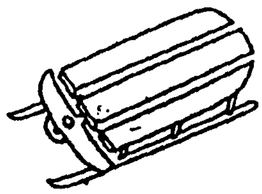


C. food

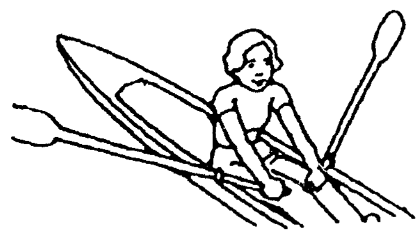


D. air

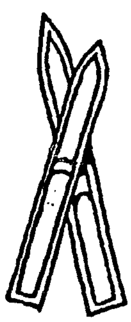
Point to an example of what the whales and the dolphins flippers work like. Do their flippers work like:



A. sled



B. boat paddles



C. skis

D. legs

Point to the example that tells what the whales and dolphins blowhole does after it sucks in new air.
After their blowhole sucks in new air, it:

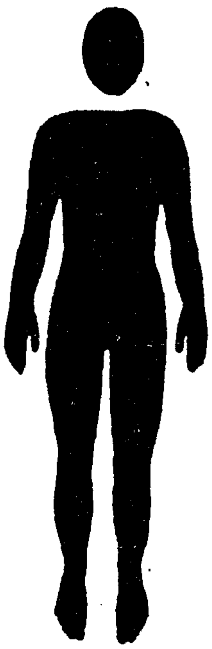
A. sprays

B. opens

C. closes

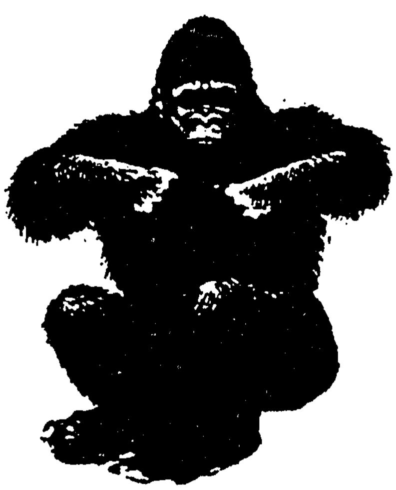
D. bubbles

Point to another creature that is about the size of a dolphin.
Is it a:

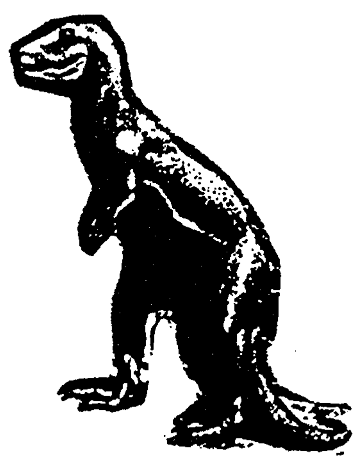


A. grown-up man

B. kangaroo



C. gorilla



D. dinosaur

Now let's look at this model of a porpoise. Is it a Cetacea animal? Please answer yes or no.

A. yes

B. no

You answered yes. What makes a porpoise a Cetacea animal?

A. blowhole

B. any other answer

You answered no. What makes a porpoise not a Cetacea animal?

A. any answer