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THE SCRIPT SCHEMA IN CHILDREN'S COMPREHENSION AND MEMORY

City University of New York

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THE SCRIPT SCHEMA IN CHILDREN'S
COMPREHENSION AND MEMORY

by

JOEL A. SELTZER

A dissertation submitted to the Graduate Faculty
in Educational Psychology in partial fulfillment
of the requirements for the degree of Doctor of
Philosophy, The City University of New York.

1985

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1985

This manuscript has been read and accepted for the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

THE SCRIPT SCHEMA IN CHILDREN'S
COMPREHENSION AND MEMORY

by

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This study examined how script strength, prior scriptal knowledge, and age differences affect children's comprehension and memory, and relate to reading skill. A script schema represents stereotypical action sequences of familiar events that are goal-oriented, for example, going-to-a-restaurant. Script strength refers to a script's ability to evoke a familiar temporal-causal sequence of events. Strong--canonical--schemata facilitate story recall. Prior knowledge and experience affect performance as measured by inference-making ability, recall, and errors in recall with words, sentences, and text. Skilled readers spontaneously use strategies that facilitate comprehension and recall.

A strong script was predicted to facilitate comprehension and recall of a picture series. Prior scriptal knowledge was expected to facilitate performance, and older children were predicted to have higher comprehension and recall than their younger counterparts.

The subjects were 139 second- and fourth-grade children. They were shown a picture series evoking the script getting-ready-for-school-in-the-morning. Within each grade, children were randomly assigned to one of six conditions in which a script-header--or title--was presented before or after exposure to the stimuli and varied by three levels of canonical strength. The children were asked to generate a story as a measure of their comprehension and were given traditional memory tasks to measure verbal recall, visual recognition, and serial reconstruction of the pictures.

As predicted, the strong script-header was found to facilitate comprehension and serial reconstruction ability. Children in the weak script-header condition produced more intrusions in their stories. Prior knowledge facilitated only the ability to produce more detailed information. Recall and recognition were not affected by the treatments. Fourth graders performed better than second graders on most tasks. A modest relationship between second grade task performance and reading ability was noted.

It was concluded the children's level of information processing must be consistent throughout a task to facilitate comprehension and recall. Scripts that organize new information to fit the learner's knowledge base may be a useful pedagogical tool.

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This dissertation is dedicated to my parents, my wife and daughter for the sacrifices made and encouragement offered.

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CHAPTER I
INTRODUCTION

"The matter of a phenomenon is given to us entirely a posteriori, but its form must be a priori in the mind, and hence must be capable of being considered by itself apart from sensation" (Kant, 1781/1968, p. 445).

Background of the Problem

Psychologists as well as philosophers have been intrigued over the years by how the mind works. How we perceive, organize, store, and recall information has been of interest to all those who have considered the problem of human memory. The current paper takes the position that human learners are actively involved in processing information that may be obtained from their environment. Increased understanding of this process, especially as it is related to school-age children, is a primary concern of the present study.

The idea that we actively process information has its roots in Heraclitus' view (circa 500 B.C.) of the world being in a state of flux and that active events are perceived (Heidbreder, 1933). It is the human observer who organizes such events as Kant's rationalism explains: Knowledge exists in the mind a priori so that we come to understand the world through our power of reason (Hilgard & Bower, 1975). But how does knowledge exist in the mind?

The psychological construct of schema (Bartlett, 1932; Rumelhart, 1980) has been used to explain this phenomenon. Schemata are cognitive structures that provide organized representations in the mind of the common experiences of individuals. A schema may represent the relationships between events, objects, or situations that become part of the individual's memory, and it can be modified by new information (Rumelhart, 1980).

Schema-based notions of internal cognitive representation have gained widespread support as adequate models for explaining knowledge acquisition and its organization in memory and tests of recall. A review by di Sibio (1982) of these issues reveals that although evidence has accumulated that adults actively engage in various cognitive manipulations of information, empirical support for the presence of children's schematic organizational skills is scant.

As recently discussed by Glaser (1984), understanding the young learner's ability to organize information in memory is important for developing pedagogical techniques that address higher order thinking and reasoning skills; this approach must complement the current emphasis on teaching the basic skills. The present research focused on the role schema-based knowledge has in young children's comprehension and storytelling performance as it relates to such higher order cognitive functioning.

The general trend in theorizing, as represented by cognitive psychology (cf. Neisser, 1982), has been to examine more closely the phenomena that relate to covert mental events. Associationist theories have failed to explain findings from more naturalistic, cognitively

complex experimental tasks that use, for example, familiar scenes, recall of text, or generation of stories (Bransford, 1979).

Tasks tapping higher order memory processes have replaced nonsense syllable and digit span paradigms for the study of these more complex pictorial, verbal, and meaningful stimuli. Bartlett (1932) made the first break with the associationist tradition by using connected discourse as his experimental stimuli. Since then researchers have used text (Blachowicz, 1977; Bransford, Barclay, & Franks, 1972; Kintsch, 1974; Spiro & Tirre, 1980), instructions to induce imagery in subjects (Anderson & Hidde, 1971; Bender & Levin, 1978; Paivio, 1971; Pressley, 1976), and pictures (Arnold & Brooks, 1976; Baggett, 1975; Guttman, Levin, & Pressley, 1977; Royer & Cable, 1976) in order to better understand cognitive processing. The results of these studies in general have supported theories of active cognitive learning and processing of information.

Another related development is of models of human learning and memory reliant on concepts from modern computer technology (Atkinson & Schiffrin, 1968; Miller, Galanter, & Pribam, 1960). However, these early computer models of memory such as established by Miller have been viewed as rigid in their use of box-like memory store conceptualizations. Craik and Lockhart (1972) proposed a theory of information processing extending the use of the computer analogy. It sparked interest of several theorists (Frederiksen, 1979; Kintsch, 1974; Rumelhart & Ortony, 1977) who challenged the memory store models with one using Craik and Lockhart's depth of processing concept. These latter theorists incorporate the use of schemata in their formulations, a notion at

the heart of current attempts to further describe memory processes and structure.

The "elaboration problem" is one empirical finding such theories attempt to resolve. This problem harks back to Bartlett's (1932) finding that subjects embellish stimuli in their minds, using schemata, in order to aid recall. Bartlett called this process their effort after meaning and measured it by distortions and intrusions in recall. Craik and Lockhart's (1972) hierarchical model of information processing considers such elaboration to involve deep processing; that is, stimuli are processed at a deeper, higher level of abstraction than mere associative linkage of stimulus bonds. Instead, stimuli are embedded and organized into highly meaningful units and exist as schematic structures in memory.

Script theory (Abelson, 1981; Schank & Abelson, 1977) is another outgrowth of the application of computer models to cognitive science. Scripts are defined as cognitive representations of stereotypical events that occur in a temporal sequence. The script provides causal connectivity and generates linking inferences between a set of objects, events, or situations (Graesser et al., 1979). For example, the script-header, or title, "The Restaurant," may suggest that the reader use specific knowledge and predict events to occur when being at a restaurant. The internally called-up script includes actors, roles, props, and actions instantiating the restaurant theme in memory (Abelson, 1981; Rumelhart, 1980; Schank & Abelson, 1977).

Scriptal knowledge can guide the learner in processing current information by providing cognitive scaffolding necessary to facilitate

memory organization (Bransford, 1979; Mandler, 1984). Script-headers provide advanced information for temporally ordering the incoming data into a causal chain; this advanced organizing function allows bits of data to fit particular niches in the script's framework.

Computers have been successfully programmed to use and organize information using scripts as guides (Schank & Abelson, 1977), and a few experimental studies (Bower, Black, & Turner, 1979; Graesser et al., 1979) have tested the script concept and found it to be a viable process in adults. Among the few studies using children, Nelson and Gruendel (1979) found that 3-year-olds readily produced a familiar script if given the script-header that instantiated a trip to a popular hamburger restaurant. School-age children were shown to be even more facile than 3-year-olds at producing and recalling the main events of scripts (McCartney & Nelson, 1981).

Although tests of script theory are very recent, the study of general schema usage and inferential processing in both children and adults has received intensive attention. The evidence for the presence of such inferential processes has been found in studies using sentences (Blachowicz, 1977; Bransford, Barclay, & Franks, 1973; Bransford & Franks, 1971; Doctorow, Wittrock, & Marks, 1978), pictures (Bartlett, 1932; Bransford & Johnson, 1972; Carpenter & Just, 1977; Guttman, Levin, & Pressley, 1977; Mandler & Parker, 1976), and by inducing imagery in subjects (Levin, 1973; Paivio, 1971; Pierce, 1980; Pressley, 1976). Paris and Lindauer (1976) have shown that even 6-year-olds can make inferences when given explicit strategies to organize information. Their subjects were able to imagine a situation when given a strategy to aid recall; older children made inferences spontaneously.

These studies indicate that rather than associations between stimuli, inferred, higher order aspects of objects and events are readily learned. Cognitive psychology has come full circle to arrive at the issues investigated by Bartlett over 50 years ago--questions of how memory is affected by higher order strategies.

This most critical issue, as it relates to the present study, involves the processes used by individuals to make new information meaningful. Comprehension and recall of stimuli, as illustrated by the studies cited above, are influenced by the induction of higher level processing in subjects. Providing the appropriate event schema (Bransford & Johnson, 1972), or script schema (McCartney & Nelson, 1981) helps adults and children organize incoming information into meaningful units. Comprehension and recall of the new information is dependent on the subject's proper instantiation of the schema. The schema operates as a guide or theory (Rumelhart, 1980) for matching, testing, and predicting where bits of data best fit.

Without the appropriate schema, however, individuals are often at a loss to comprehend certain material especially ambiguous stimuli (Bransford & Johnson, 1972). Adults may readily recall familiar scripts (Bower et al., 1979) but very young children cannot fill in the details of a script as well as older children (McCartney & Nelson, 1981). Age appears as one important factor mediating schema usage. Of course, older children and adults have more experience and prior knowledge available to them; yet as Glaser (1984) noted, the appropriate knowledge base can facilitate recall irrespective of age. The present study examines to what extent prior knowledge due to experience and age facilitates script schema usage by children.

Bransford and Johnson (1972) also revealed that when the experimenter controls the amount of knowledge available to subjects by manipulating the information necessary for understanding highly ambiguous material (text), prior knowledge facilitates comprehension and recall of that material. They found that the "placement" of the organizing information in relation to the material presented to the subjects is critical to comprehension. Does scriptal knowledge have a similar effect depending on where it is positioned in the presentation of a task? The current investigation addresses this question of when during a task schema-based knowledge is most influential in aiding the comprehension of new information.

Script schemata, like scene or story schemata, vary in their capacity to organize information in memory. Abelson (1981) described the "strength" of scripts according to their power to instantiate a causally-connected temporal sequence of events. For example, a restaurant script--or the script-header The Restaurant--evokes a more highly ordered temporal sequence than a going-to-the-circus script. He predicted the organizational properties of strong scripts are more likely to facilitate recall than weaker scripts. Similarly, Mandler (1984) recognized the issue of script strength in her discussion of canonical, or ordered, versus un-ordered scripts, calling for empirical investigation of the notion. The present study examines the merits of canonical form and script strength in relation to how it affects children's comprehension, storytelling and memory skills.

Traditional memory tasks using serial recall and visual recognition techniques have been criticized, as noted above, for their narrow

definition of human learning. However, schema-based studies have used text recall, story generation and recall as measures of memory skills. These tasks are viewed as being more appropriate for examining higher order abilities since they replicate more natural learning experiences. The present study uses both storytelling and several traditional recall and recognition paradigms to test the effects of script schemata across different levels of cognitive processing. By comparing traditional memory task performance with comprehension and storytelling skills, the issue of depth of processing is addressed (Craik & Lockhart, 1972).

Schema-based models of learning have been applied to such higher order skills as text comprehension and other reading processes (Kintsch, 1977; Mandler, 1984; Rumelhart, 1980; Spiro, 1980; Stein & Glenn, 1977). Mandler (1984), for example, cites evidence that the inferential processes of schema usage facilitate text comprehension in that a canonical text--like a canonical script--is recalled better than unordered text. The relationship between script schemata and reading skill is explored in the present investigation by comparing the subjects' memory and storytelling performance with their reading ability. In this manner, the role of script schemata in task performance at various levels of information processing is compared to the higher order processes presumed to be used during reading (Adams, 1980; Spiro, 1980).

Statement of the Problem

The problem presently investigated may be summarized by five major questions of concern:

1. How does a script schema affect the comprehension, storytelling, and memory performance of school children from two different age groups?

2. Does the relative position of scriptal knowledge to the presentation of new information affect performance?

3. How do the canonical aspects of a script, or script strength, affect storytelling and memory performance?

4. What is the relative efficacy of scriptal knowledge in facilitating story generation versus traditional memory performance?

5. Do the effects of a script schema on storytelling and memory skills relate to reading achievement?

CHAPTER II
REVIEW OF THE LITERATURE

This review begins with a brief summary of the historical antecedents to schema theory and modern cognitive science. Early experimental studies challenging psychology's reliance on associationism are discussed, as well as the development of computer models of human learning. Current schema-based notions of information processing are then introduced. Finally, several recent experimental studies of schema usage, including script schemata, are discussed in detail and related to the questions raised by the present research.

Early Schema Models

Bartlett (1932), in a radical attempt at challenging the then current psychological model of memory, borrowed the term schema from Head and Holmes (c. 1911-1912) hoping to provide experimental evidence of its usefulness (di Sibio, 1982). Bartlett's criticism of the associationist Ebbinghaus memory paradigm was threefold: (a) one cannot remove meaning from a system without destroying it; (b) the laboratory's artificiality does not reproduce the usual conditions of human learning; and (c) the sole manipulation of stimulus conditions ignores subject variables.

The thrust of Bartlett's position was the investigation of the "social conditions" of remembering. He attempted to blend into his experimental studies the consideration of subject and environmental variables and the interaction of these variables. In one experiment

Bartlett (1932) presented subjects with pen-and-ink portraits of various types of British military officers and asked them to recall details of the pictures such as facial features or characteristics. He noted especially when delay between acquisition and recall was increased how subjects sharpened, flattened, imported or generally transformed their verbal descriptions of the pictures over time. A similar result was obtained when he provided subjects with connected discourse to be remembered. Subjects read a text entitled the War of the ghosts derived from Indian folklore. His British subjects, when asked to recall the story over many days, produced an increasing number of errors in recall which Bartlett referred to as their effort after meaning. The subjects' reconstructions of the stories were molded into familiar English themes lacking reproductive detail while retaining the gist of the story.

Bartlett's methodology lacked the necessary controls to draw valid conclusions from his findings. Nonetheless, his work raised several issues regarding remembering and comprehension: How do we process meaningful material? What are the effects of prior knowledge on recall? Is remembering a reconstructive process requiring strategies to reactivate memories and build a meaningful response? In other words, if the subject is involved in actively constructing meaning for the stimuli during acquisition, then a separate process of reconstruction appears during memory recall.

Bartlett's work introduced both the schema concept and the evidence for both constructive and reconstructive efforts after meaning to the psychological literature. However, few researchers immediately followed Bartlett's interests although one study clearly duplicated his findings

regarding subjective distortion in reconstructive memory (Carmichael, Hogan, & Walter, 1932). This study was one of the earliest to examine the effects of error-induction with pictures. Carmichael et al. presented their subjects with 12 ambiguous figures under three conditions, including a control group. One experimental group was told just prior to the presentation of the figure that the figure resembled some familiar object. The other experimental condition received the same introduction but with a different familiar object named. For example, some subjects were told, "the next figure resembles (eyeglasses/dumbbell) . . . " before seeing the ambiguous stimulus. The control group did not receive this introduction.

When asked to reproduce the figures, the subjects distorted the original stimulus so that in 74% of the cases, it closely resembled the figure suggested by the experimenter's introductory label. The distortions of recall indicated the power of the experimenter's labelling statement heard during acquisition. Bartlett obtained similar results with subjects given various ambiguously-labelled symbols to be reproduced. Subjective distortion is thus easily induced, especially under ambiguous experimental conditions. Although Carmichael et al.'s early experimental evidence of some type of covert mental reorganization was supportive of Bartlett's findings, interest in internal cognitive representation and organization lay dormant some 20 years.

Information Processing Theory

The following section will introduce theoretical models of human information processing that place Bartlett's concerns into a more recent

framework of cognitive science. Bartlett's reconstructive aspects of memory established remembering as a problem-solving activity. The presumed mental events preceding human responses to stimuli suggest complex strategic activity to account for the sorting, classifying, and general processing of incoming stimuli. Computer programs that could solve complex mathematical and logical problems provided an interesting analog of how humans might process information (e.g., Newell, Shaw, & Simon, 1958).

Information processing (IP) initially dealt with the operation of computers. However, for cognitive scientists and, in particular, for psychologists interested in learning, IP theory provided a powerful tool replacing homunculi-like constructs of how the mind works. Unlike other mechanistic models, such as S-R theory, IP is concerned with behavioral process and not solely behavioral product. Essentially, human problem-solving behavior is seen to function through a series of activities analogous to that of a computer program. Data are read in, manipulated and analyzed by subroutines and read out in the form of behavioral or problem-solving responses. Miller, Galanter, and Pribram's (1960) TOTE (test-operate-test-exit) system epitomizes the process. In this system, problem-solving activity is schematized by using boxes and arrows to devise a hierarchical model of the reasoning process. The next step in such Artificial Intelligence (AI) research was to program a computer to solve problems of a logical or mathematical nature as accomplished by such programs as Newell et al.'s (1958) Logic theorist.

Within this type of conception comprehension may be seen as a problem-solving activity. In order to extract meaning from text or

other stimuli the reader, or the advanced computational machine, must be able to select important information from the material and connect it appropriately to prior knowledge or information. Bartlett had called such mental activity effort after meaning. Recently, Adams (1980) recognized this skill as the "reader's ability to organize the concepts of the text into a coherent structure . . . ," and added that "somehow [beginning readers] must acquire the notion that reading is a thinking game--that they should always try to figure out what they are looking for as they are reading a passage" (p. 27). Adams suggested that at certain levels of information processing, reading is a constructive problem-solving activity; the reader must know how to retrieve or construct that meaning the text implies.

The levels of processing view introduced by Craik and Lockhart (1972) initiated a shift away from earlier box-like IP models such as espoused by Newell et al. or Atkinson and Schifffrin (1968).

This newer view suggested that information is abstracted from raw stimuli and organized hierarchically. This process of abstraction is the job of the active learner, one who applies some organizing system, such as a schema, to the material. It will be shown later several studies support the contention that individuals do indeed apply some organizing rules or system facilitating memory performance. What schemata may consist of is the basis of the present study's focus on processing strategies.

Depth of Processing Models

The concept of depth of processing used by recent theorists of cognitive functioning (Craik & Lockhart, 1972; Frederiksen, 1979; Kintsch, 1974; Rumelhart, 1980) has revived Bartlett's contention that a subject's effort after meaning influences recall of material. In addition, traditional experimental memory tasks, such as serial recall of words, have demonstrated that as the meaningfulness of the task increases so does the recall of the initial stimulus items (Deese & Kaufman, 1957). The result is a primacy effect evidenced in the serial recall curve. The relationship between memory and comprehension is therefore empirically linked by a subject's reproductions or recall. Carmichael's et al. (1932) study provided early evidence of this link. The more recent IP models have attempted to explain these phenomena.

Craik and Lockhart (1972) introduced depth of processing as a hierarchy of processing stages in which the learner actively elaborates on a perceived stimulus. At its most elementary level perception consists of a superficial analysis of stimuli while at later stages of perception stimuli are matched with past memories and meaning is extracted. In the model perception is an ongoing process of hierarchical stages of analysis; the more elaborate the learner's analysis the deeper the processing. The elaboration provided by the learner is reminiscent of Bartlett's observation of subjects' active search for abstracting meaning from stimuli.

Perception of even simple stimuli is highly influenced by task context and instructions to subject, for example, whether an "A" or an "H" is perceived given a particular context (Neisser, 1967, p. 47).

Similarly, memory for simple stimuli is related to a subject's effort to actively organize the material. Torgesen (1978), for example, found the difference between fourth-grade good and poor readers on a digit span test was due to the mnemonic encoding strategies used by subjects and not to visual-spatial or cross-modal transfer deficiencies. He presented 60 children with six variations of a digit span recall test varying the modality (auditory or visual) and the task structure (simultaneous or sequential presentation of the digits). It was hypothesized that a simultaneous presentation of the digits visually would provide a greater burden on the subjects to use some mnemonic strategy and poor readers would be less likely to spontaneously apply a useful strategy. Torgesen's results confirmed the expectation that the structure of task presentation was the differentiating variable. Sequential presentation of digits--either auditorily or visually--revealed no differences in good versus poor readers' recall while simultaneous presentation revealed that poor readers did not use efficient processing strategies to aid their recall. Informal inquiry of subjects showed the use of rehearsal and chunking strategies by good readers, and other examples of elaborative encoding such as imagery. Results such as Torgesen's suggest that specific processing strategies aid memory. Recall of digits, however, involves strategies early in the depth of processing hierarchy; more complex stimuli may require deeper processing in order to be retained in memory.

Frederiksen's (1979) hierarchical model of processing levels in discourse comprehension closely resembles the Craik and Lockhart (1972) IP formulation, although it is clearly adapted to reading. The model

describes five levels of processing which are each supported by some internal representation. For instance, the first level is called Feature Analysis because of the "neural processes that operate on a graphic (or acoustic) input and encode the input information as a set of abstract visual (or auditory) features" (p. 157). The levels of processing continue up the hierarchy in complexity and are called, respectively, Graphic (acoustic) Decoding, Syntactic Analysis, Semantic Interpretation, and Inference. The highest level of processing, Inference, is of central concern to the current investigation. The Inference level "operates entirely on propositions, generating new propositions from propositions that are given, for example, from prior discourse, from discourse context, or from previously acquired knowledge about the world" (p. 159). During discourse processing, Frederiksen considers the higher level inferential processes to be in control of lower level processes, that is, the levels are interactive in nature.

Interaction of the component levels of processing have developed theoretically into two conceptions of discourse comprehension, according to Frederiksen. One, the bottom-up conception, refers to the more-or-less automatic processing which starts with lower-level processes which then proceed sequentially upward to build comprehension from textual material. Psycholinguists of the Chomsky tradition and early models of reading that emphasized perceptual skills (e.g., Gibson) used similar models to explain comprehension. The alternate top-down conception of comprehension is what Frederiksen and the present author perceive as a viable model requiring further investigation. According to this model higher-level inferential processes control lower-level components of the

system. Propositional networks, or schema, and prior knowledge work in concert together to help one construct meaning for incoming information. Bartlett's effort after meaning and his use of the construct schema to define inferential processes in comprehension has appeared in the framework of IP theory.

Schema Theory

Rumelhart (1980) considers schemata to be at the heart of any theory about comprehension. Like Frederiksen, he regards schemata as malleable structures that can be conceptually-driven (top-down) and data-driven (bottom-up). Thus, feature detection consists of activation of low-level schemata that, in turn, trigger higher-level schemata. For example, Rumelhart illustrated how an "eye" symbol can activate one's conception of a face. Top-down or conceptually-driven schemata would, in this example, allow a person's conception of "face" to activate sub-schemata of "eye," "nose," etc.

A schema for Rumelhart is a unit of knowledge and is not unlike Bartlett's definition. Schemata can interact with and imbed upon another. They "represent knowledge at all levels of abstraction" (p. 40) and like theories they allow one to test and predict. Schema therefore serves as a useful construct to help explain how we construct reality and remember. Within an IP framework, the concept can be tested through the development of computer simulations in artificial intelligence. For example, Schank and Abelson's (1977) computer programs that answer questions and can "understand" text depend on schemata or higher-level semantic and propositional rules to operate. Experimentally, schema explanations have

been used to describe subjective distortions in recall of stories, as seen in Bartlett's (1932) The war of the ghosts and Bransford and Johnson's (1973) "washing clothes" text. The next section examines such studies linking the theoretical constructs of schemata and levels of processing to empirical findings involving inferential and reconstructive knowledge used by subjects to comprehend material.

Empirical Evidence of Schema Usage

A basic tenet of schema research has been that in order to assess subjects' schema usage the experimenter must provide stimuli eliciting inference-making skills. When a subject is provided an ambiguous situation and asked to both understand and remember the presented stimuli, schema theory proposes that the subject uses prior knowledge to construct meaning for the material. To construct meaning he or she may use any available schema such as those provided by the experimenter in the Carmichael et al. study.

Bransford (1979) considered inference-making an active constructive process. The subject uses prior knowledge, or existing schemata, to organize incoming information. Bransford contrasts processing at the time of input with reconstructive processing at the time of recall. Subjects employ additional organizing information available in the course of remembering previously learned material. This view stemmed from a series of studies that led to the current understanding of comprehension and memory processes discussed below.

In one study (Bransford & Johnson, 1972), subjects' prior knowledge was controlled for by the experimenter. An ambiguous passage was

constructed relating a story about a man serenading a woman high up in an apartment building from street level. The relational aspects of the story were omitted from the passage but provided for in a picture of the scene. Another picture had the elements of the scene partially related. The picture therefore provided a context for understanding the passage.

Bransford and Johnson randomly assigned each of their subjects to one of five conditions: (a) a group with no contextual pictures to view before reading the passage; (b) a context-(picture) before group; (c) a context-after group; (d) a partial-context--nonrelated elemental picture--before group; and (e) a partial-context after group. Subjects were shown the organizing picture in the Context Before and Partial-Context Before conditions and then read the passage. After a 2-minute delay subjects were asked to recall the passage verbatim, or to produce as many ideas as they could remember about the story.

The experimenter found subjects who viewed the thematically-relating picture context, presented before the acquisition passage, yielded the greatest comprehension and recall scores. The Context After, Partial Context, and No Context groups of subjects had significantly poorer scores although the No Context group performed lowest in comprehension. For the novel text presented to subjects in this experiment, an organizing schema in the form of a thematic picture provided subjects with the information necessary to fill the gaps in knowledge missing in the acquisition phase passage. Subjects benefited most from the schema when it preceded the text.

In another instance of inferential comprehension Johnson, Bransford, and Solomon (1973) used short stories to test for recognition of implied

versus factual information. In this study, semantic knowledge and causal inferences were tapped in subjects. Their college-age subjects read 20 short 2- or 3-sentence stories during the acquisition phase. A recognition phase followed immediately consisting of 38 sentences read to subjects. Subjects were required to respond whether the sentence was old (heard previously during acquisition) or new (never heard before). The researchers found that subjects given statements such as "the boy hit the baseball and watched as it flew into the picture window in the house" were more likely (as compared to a control group) to believe an inferential recognition sentence--such as "the baseball shattered the picture window in the house"--was previously heard.

Similarly, Barnsford, Barclay, and Franks (1972) found that sentences including words relaying spatial information during acquisition aided subjects to make inferences in a test of recall of the sentences. Blachowicz (1977-1978), using a similar experimental paradigm with 40 second- and fifth-grade children, found that subjects demonstrated a significant tendency to recognize as old, sentences inferentially similar to acquisition phase sentences.

The ability of children to make inferences and actively construct meaning for stimuli was demonstrated in several other studies that support Blachowicz' finding. Paris and Mahoney (1974) assigned children from second- and fourth-grade classes to one of three experimental groups. One group verbally received an acquisition phase sentence and a recognition-phase test sentence. Another group saw pictures in both phases, and a third saw pictures and was given verbal recognition sentences. Sentences consisted of relational propositions, such as "The box is to the right

of the tree," "The chair is on top of the box." An inferential test sentence would then be "The chair is to the right of the tree." Children were given the sentences orally and asked to respond true or false to the recognition test items.

Paris and Mahoney found generally all children exhibited the tendency to recognize the congruent true inferences as previously heard sentences. In addition, the older subjects performed better. In an extension of this study, Paris and Upton (1976) found that children demonstrated similar tendencies with sentences suggesting logical consequences. For example, children were told a story about a boy raiding a cookie jar with the implication that he was caught in the act. Prior knowledge--in this case some logical rule known by the children--was applied by the subjects to understand the test sentence involving the consequences of the story. However, a previously cited study by Bransford and Johnson (1972) controlled for prior knowledge of their adult subjects. How would children benefit from contextual organizers preceding presentation of ambiguous material? Arnold and Brooks (1976) investigated this problem by adapting the Bransford and Johnson study for second- and fifth-grade children. Arnold and Brooks presented their subjects with an ambiguous, apparently disconnected, tape recorded fairytale-like story. A verbal or pictorial organizer was given, respective of assigned experimental group, to subjects prior to the recorded passage. Subjects were then asked to tell what the story was about, and two judges independently scored responses for comprehension of the story.

The results of the study replicated Bransford and Johnson's (1972) finding that the nature of the contextual information can affect recall

and comprehension. The second graders benefited more from the pictorial organizer than the fifth graders while the latter group used the verbal organizer (a story title) to their advantage and made many more inferences. In addition, the older subjects made more incorrect inferences, suggesting their attempts at building familiarity into the materials. This finding is similar to the results Bartlett obtained with adults' recall of stories.

Luftig (1982) recognized Bartlett's findings using connected discourse as containing the type of stimuli especially susceptible to memory change. Recall of lengthy text, especially after prolonged delay, provided subjects with time to contaminate the originally perceived material with their private schemata. For highly familiar themes, incoming information may be easily distorted to fit the subjects' own perception of the material in order to match the theme. Luftig used college subjects' familiarity with the life and history surrounding Adolph Hitler. Luftig was particularly interested in how subjects' depth of processing during task acquisition would affect recall. He presented 96 college students, assigned to three different conditions, a text of 16 sentences about Hitler. One group of subjects was given the same text as the "Hitler" group except "Gerald Martin" was substituted as the name of the main subject.

After the sentences were presented, subjects either copied the sentences verbatim (copy condition) or paraphrased (paraphrase condition), keeping the semantic content intact. Subjects were asked to recall the sentences either immediately or after 48 hours' time. Judges scored the recalled sentences for accuracy in general meaning.

As Luftig predicted, for the Hitler condition there was a significantly marked tendency to err in recall revealing normalizations (conforming information to fit historical data) and intrusions (additional information to conform to historical fact). The Martin conditions produced few distortions in recall. Subjects who were asked to paraphrase the acquisition sentences received better recall scores than those in the Copy condition. Apparently, the Paraphrase subjects processed the material at deeper levels and placed the familiar material in a private schematic context that facilitated recall.

Kintsch (1974) proposed a propositional theory of the representation of meaning in memory in which semantic concepts are processed at deeper levels and are therefore well-retained in memory. For example, Keenan and Kintsch (1974) gave college subjects short paragraphs to read and then asked them to verify the accuracy of several test sentences. Inferential statements were included in the recognition test phase and were used as a measure of error rate for recognition of "old" information. The researchers found a negligible error rate for subjects given an immediate recognition test, as measured by reaction time (RT) to test sentences. That is, subjects made few errors in discriminating previously seen sentences from inferential statements, but were about 1/2 second faster at recognizing (matching) the test sentences repeated verbatim. However, after a 20-minute delay, the RT difference disappeared and subjects made more errors in discrimination. Thus, subjects were faster in calling a test sentence true when they had actually seen it than when it had to be inferred, but this difference disappeared after a 20-minute delay. Kintsch hypothesized that a surface memory

for prose exists temporarily and that memory for meaning is more stable over time. Subjects in this experiment were able to gain access to the representative of the sentences only after 20 minutes as was observed in the lack of discriminative power between actual versus inferred statements after delay. The memory for surface form is lost but the deeply processed meaning is retained in memory. This idea is consonant with the depth of processing formulations and finds support in the studies cited above revealing inference-making abilities and other constructive strategies by subjects.

Such strategies are also evident in studies examining the underlying structures in text and finding reading comprehension either related to organizational factors in the text or applied by the reader (e.g., Kintsch, 1977; Spiro, 1980; Stein & Glenn, 1977). The experimental paradigm used by Bransford et al. (1972) with ambiguous passages of text best exemplifies this finding. As described above, Bransford et al. found that an appropriate organizational framework or schema facilitates comprehension and recall of the otherwise incomprehensible text.

Schema Usage and Reading Skill

By providing subjects with organizational strategies to facilitate understanding of material, researchers have demonstrated the importance of the schema concept. When subjects are given the appropriate schema to use in an ambiguous situation (e.g., Bransford & Johnson, 1972), they readily comprehend that material. However, individual differences in schema usage, prior knowledge, and ability to use organizing strategies

should also affect performance on the various tasks reviewed above. For example, Torgesen's (1978) study revealed that "good" readers were more likely to employ the appropriate cognitive strategies necessary for successful recall of digits. Similarly, Adams (1980) theorized skilled readers pay close attention to organizational structure in text and make use of top-down processing strategies to better comprehend what is read. Several experimental studies support this view. In one (Levin, 1973), organizational strategies were induced in subjects of varied reading proficiency. The researcher divided 54 fourth graders into three groups: (a) good readers, (b) poor comprehenders, and (c) good comprehenders. The subjects were randomly assigned to either of two tasks consisting of a 12-sentence story or a corresponding 12-frame cartoon-like presentation of the story. For both sets of materials two instructional conditions were given. One group of subjects was asked to read--or view in the case of the cartoon picture story--the story, and the other was told to generate images for each sentence--or for each picture with the cartoons--in the story. A short comprehension test followed the task.

Levin found that poor comprehenders (as measured by a test of reading comprehension) benefited more from the organizational strategy than either good readers or the poor readers (as measured by a test of general decoding and vocabulary skills). Since Levin was testing for overall comprehension of the concrete passages read by his subjects, those subjects using a higher level information processing strategy, spontaneously or with experimental induction, showed better comprehension.

In studies later replicating Levin's research there was general trend for skilled readers to possess both decoding and higher order comprehension skills. Perfetti and Hogaboam (1975) found third- and fourth-grade children who were skilled comprehenders to be able to automatically concentrate on inference-making while reading a passage. In a study by Pressley (1976) skilled third-grade readers were better able to integrate sentences in a passage than less-skilled readers using imagery. In addition, Smiley, Oakley, Worthen, Campione, and Brown (1977) found that their junior high school subjects differed in ability to recall stories and comprehend the theme of the stories depending on their reading skills. Further, in a study in which 500 elementary school children were given elaboration strategies to generate meaning for stories (Doctorow, Wittrock, & Marks, 1978), less-skilled readers benefited more than those with higher skills as measured by their comprehension and recall of the stories.

The use of pictures and imagery to induce schema-usage by subjects may be equally powerful in how they convey and depict spatial configurations in text. By inducing such strategies, experimenters instructed subjects to actively engage and interact with the text. In the studies cited above, the reader learned to connect presented information in the text with ideas outside of the text through organizational strategies. Mayer (1982) called such a process building external connections. This notion is similar to Glaser's (1984) view that the educational process requires the learner to build a knowledge base of increasingly complex schemata.

The types of schemata guiding memory processes so far reviewed include spatial, logical, propositional and semantic information. Deep processing of information, using a variety of these cognitive guides, appears to explain why memory for meaning extends beyond surface memory for stimuli in a particular sensory modality. For example, Torgesen (1977, 1978) demonstrated memory for digits is more dependent on strategic processes than on specific sensory modality abilities. For simple stimuli such as digits, subjects can employ cognitive strategies to aid recall. The analysis of complex stimuli such as text or pictures also appears to require more complex strategies to allow subjects to abstract meaning for comprehending and remembering the material.

Schema Usage in Serial Organization

Baggett (1975) proposed a picture series to relay a coherent story or message would be processed at a deeper level than merely in its visual surface form if viewed for later recall. Using the basic methodology established in the Keenan and Kintsch (1974) study with text, Baggett confirmed the hypothesis that subjects abstract information from material's surface form and process it for storage at a deeper more meaningful level, especially when such storage is for extended periods of time. She hypothesized that subjects who viewed a picture story implying a probable consequence would, after a specified delay, be unable to discriminate an explicit from an implicit test picture containing information about the story.

Baggett used a four-picture sequence depicting a long-haired man going to the barber to get a haircut. In her explicit version of the

story college students actually viewed a frame showing the man seated in a barber's chair getting his hair clipped. The implicit version, given to a separate group of subjects, merely showed the man seated in the barber's chair, but the actual haircutting was not explicitly shown in any picture. Two other conditions, closely resembling the Keenan and Kintsch (1974) study, were included. Baggett displayed her test slides during the recognition phase either immediately after acquisition or after a 72-hour delay; RT was recorded for recognition. A 72-hour delay was used for the delay condition because Shepard (1967) had found that immediate surface recognition of pictures was about 98% accurate.

The major results of the Baggett study replicated Keenan and Kintsch's (1974) findings. With no delay, subjects easily responded with a shorter RT to the actual pictures than the implicit pictures. However, after a 72-hour delay, RT for the explicit pictures increased and equalled RT for implicit pictures. Memory for the gist of the picture story apparently was all that was retained after three days.

Baggett wished to test her subjects' ability to infer information from the pictures after immediate recall. In an additional experiment, she presented a series of written yes or no questions regarding events of the picture series shown to subjects in her first experiment. Although these questions were presented immediately after the acquisition phase, subjects given explicit or implicit questions showed no significant differences in RT (pressing a button for yes or no).

The representation of meaning in memory as a semantic network of propositions, as espoused by Kintsch (1974), was the basis of explanation in Baggett's (1975) study. The common memory representation for

the meaning of the pictures was probably tapped by the yes or no question format. Memory for implicit propositions was presumably stored at a conceptual level and thus more deeply entrenched in memory. Yet the picture series used by Baggett also appeared to elicit a set of expectations in the viewer regarding a stereotypical, temporally- and sequentially-ordered phenomenon--getting a haircut. Is it possible her subjects' memory for the picture story was guided by expectations fitting a commonplace scenario and by searching their memory for prior knowledge regarding this haircutting vignette they were able to make inferences regarding the stimuli? This possibility gains validity in light of script theory, which will be discussed in the next section.

The Role of Scripts in Memory

Organizing schemata allowing for deeper processing of information have been shown to facilitate comprehension and recall (e.g., Arnold & Brooks, 1974; Bransford & Johnson, 1972). Schemata appear to organize stimuli spatially, temporally and semantically. But what about mental representations of real-world events in a stereotypical sequence? Baggett's (1975) haircutting sequence represents an example of a typical script--she does not use this term--in which actors (barber, man receiving haircut), props (barber shop, chair, scissors, etc.) and actions (walking in door, sitting down, etc.) exist as easily recognized elements representing a getting-a-haircut script.

The script concept was developed from work done in artificial intelligence by Schank and Abelson (1977). They programmed computers to understand

simple text. More recently, Abelson (1981) has placed the concept within the framework of psychological theorizing about comprehension. He considers the script, much like schemata, to be a cognitive structure, serving to organize information about stereotypical events. For instance, a restaurant script organizes our long-term memory representation of the events surrounding a visit to any restaurant. Our knowledge of the world is organized around enumerable scripts of typical activities such as seeing the dentist, washing clothes, or getting a haircut.

The script, according to Abelson, provides a powerful means of filling in gaps in knowledge, allowing us to make inferences about a situation where major details are left out or where portions remain incomplete. Our understanding of a situation requires the retrieval of a script that instantiates a situation and allows us to make inferences based on our stored knowledge of that given situation. The script is therefore like Rumelhart's (1980) view of conceptually-driven schemata, but different in that it is an abstraction of some action and not just a representation of some static concept such as "face." In constructing a face schema we may be able to fill in the missing nose, mouth, eyes, etc., in order to recreate our conception of a face. But with a script, we reconstruct the sequence of actions based on some recalled instance of the situation; that is, we fill in the missing actions necessary to complete the sequence--similar to how Bartlett's subjects reconstructed his Ghost story.

Script theory provides an explanation for the elaborative process in the phenomenon of comprehension presumed by investigators since Bartlett's day. Bower, Black, and Turner (1979) conducted a series of seven

experiments in an attempt to identify some common scripts, and tested recall and comprehension of them. They were particularly interested in defining specific scripts and examining subjects' gap-filling processes--Bartlett's effort after meaning. Gap-filling, or inferential, activities are evident in texts where the author suggests more than is explicated as in this Restaurant script (Bower, 1979, p. 178):

John went to a restaurant.
He ordered lasagna.
Later, he paid and left.

The reader can easily fill in the implied actions indicated by questions such as, Did John eat? Did he receive a bill? Did he talk to a waiter or a waitress? Indeed, the script-header, or title, alone (e.g., The Restaurant), may trigger a number of elaborative processes instantiating the situation, as Bower et al. point out. These investigations initially sought to establish whether people create scripts for stereotypic events. Asking 161 undergraduate students to write a simple script for such sequences as going to the restaurant, visiting the doctor, and getting up, the researchers found a highly consistent sample of typical events. They scored the frequency with which subjects mentioned particular actions in the script and found close agreement between the subjects' scores, $r = .80$ or greater.

Bower et al. (1979) followed up on their first experiment with several manipulations designed to test other aspects of script theory. Briefly, they attained the following results with their undergraduate college subjects: (a) scripts seemed to be naturally segmented (cf. Mandler & Johnson, 1977); (b) some implied actions were recalled as explicit details and may be falsely recognized as factual statements

from text; (c) scrambled text was recalled in a reordered, more logical sequence; (d) prior script expectations decreased comprehension time; and (e) interruptions in scripts were recalled better than other details. Several of these results not only concur with the predictions of script theory but also with other investigations of pictorial and text comprehension and inference-making. For example, Baggett demonstrated that inferential questions about implicit information in her picture story were recognized by subjects as containing factual information. Graesser, Gordon, and Sawyer (1979) found college-age subjects able to discriminate between atypical script sequences better than typical script events. This latter finding is similar to Luftig's (1982) discovery that subjects spontaneously normalize atypical schemata fitting incoming information neatly into preexisting knowledge schemata. In addition computers, when programmed to use scripted information such as a typical newspaper story about a train crash, can more quickly process the information and print a "news story" if the main concepts of the script are available in its program (Schank & Abelson, 1977).

Abelson (1981) makes a distinction between strong and weak scripts. In the strong version, a script name (script-header) will instantiate a set of expectations about a typical sequence of events. For example, getting-ready-for-school-in-the-morning allows the subject to construct a set of expectations of what might typically follow the event of an alarm clock ringing. The weak script is one lacking the serial organization and is similar to other schemata representing typical events without sequential order, e.g., going to the circus. Elaborating on this concept, Mandler (1984) compared a canonically-ordered script such

as visiting a doctor, to idiosyncratic, unordered scripts such as cleaning the house. There has been no empirical study to date on the relative efficacy of the strong, canonical script versus unordered scripts on comprehension or memory performance.

Studies of preschool children's use of scriptal knowledge have been limited to observational case investigations of verbal discourse (Nelson & Gruendel, 1979; Schank & Abelson, 1977). For example, in one study (Nelson & Gruendel, 1979), the researchers sought to identify how 4- and 5-year-olds use scriptal knowledge in their spontaneous communications as recorded in a nursery school setting. They found evidence these children made use of simple scripts--such as going on a trip, a day at school--in which common knowledge, in the form of a mutually-shared understanding of a sequence of events, allowed the young subjects to enter verbal dialogue. Although the Nelson and Gruendel study explored the use of scripts in young children, it did not clearly relate script usage and knowledge to memory or information processing. However, the study did identify the presence of script schema usage in very young children and set the stage for extending the study of script models to such populations.

A recent study by McCartney and Nelson (1981) examined more precisely the relationship between script knowledge in children and their comprehension and memory for a story. In this study, both kindergarten and second-grade children were used to determine whether age differences existed in script usage when recalling an aurally-presented story. McCartney and Nelson, by extending their work with preschoolers, hoped to clearly demonstrate the presence of scripts in school-age children and show this type of schema would affect recall.

Similar to the methodology developed by Bower et al. (1979), McCartney and Nelson constructed two stories based on adult response to a typical series of events--an evening in the life of a young child--recorded and played to the subjects. Furthermore, the emphasis of the script varied for the two stories heard by the subjects, one having a dinner script, the other a bed script. The subjects were assigned to one of the two versions of this evening script. In this study, each script consisted of seven events in temporal sequence in the story. The most salient events were called core events by the researchers; the less significant events providing logical and consistent gap-filling information were called filler events. These categorizations reflected the issues of thematic gist and gap-filling details originally raised by Bartlett. The subjects listened individually to the recorded story and were asked to recall the story verbally. Two judges scored the children's stories for number of core and filler events present, and in addition for number of event inventions, i.e., novel intrusions, present in the story.

The major finding of McCartney and Nelson's study was that the main, or core, events were recalled better than the filler events, the recall of filler events being better for the older children. All the children were able to correctly sequence these events in their stories. Few event inventions were noted, with no differences between grades even with varied emphasis in the assigned scripts. The findings support the notion that several stereotypic scripts were well established in children's knowledge representation--they were in Bower et al.'s adult sample--and that they related to comprehension and recall. However,

McCartney and Nelson's study did not address the issue of how scripts, by themselves, directly affect comprehension and recall. We know from this study children were able to recognize the evening script in the recorded story and therefore could recall with relative ease the gist, or core events, of the story. What is less understood is to what extent prior scriptal knowledge, that is, the manner in which prior information interacts with task information, is influential in the recall task.

Bransford et al. (1972) showed prior knowledge to be influenced by the context in which the material is presented, especially if that context is manipulated to suggest a specific theme. The question then becomes: How does prior scriptal knowledge interact with current stimulus information to affect comprehension and recall of that information?

As Abelson (1981) noted, it may be the strength of a script, as it instantiates a set of expectations about a current situation or task, that determines the direction comprehension and recall will take. The degree to which scriptal knowledge interacts with current information, the strength of the fit between past and present knowledge, may reveal the basis to memory performance.

Raising a similar issue, Mandler (1984) made note of the paucity of research on the canonical order of scripts, or script strength. Canonical order addresses the problem of organizational factors in memory performance with complex material such as pictures or text. Stories with strong canonical order have been shown to be easier to comprehend and recall than unordered text (e.g., Spiro, 1980; Stein & Glenn, 1977).

However, what has not been clearly shown is how the effects of various types of organizing schemata used in text facilitate recall and comprehension or relate to overall reading achievement.

Summary of the Literature

This review examined the theories and empirical evidence supporting schema-based models of human information processing. Early studies of memory were discussed in regard to how associationist theories were challenged and later replaced by those of modern cognitive science.

Computer models of intellectual functioning and depth of processing theories were introduced as recent contributions to the study of human learning. It was shown that inference-making by children and adults can be explained by models using schema-based constructs to describe comprehension and recall of pictures, words, or text. Empirical findings relating prior knowledge, inference-making, recall, and errors in memory were linked to these current schema models.

These findings suggested the need for refinement of schema theorizing regarding the different types of schemata individuals use in processing information. The script schema was described as one useful construct in building a general schema theory. Scripts were shown in several studies to be highly salient in both children and adults, and to provide the temporal-causal, canonical order often present at higher levels of information processing.

Testing the effects of canonical order, that is, script strength, and the role of prior scriptal knowledge in information processing by children were viewed as valid empirical issues by researchers currently concerned with the organizational aspects of knowledge in memory.

Rationale of the Study

The research reviewed in this chapter provided substantial evidence that schema-based models of human learning are a viable alternative to associationist memory paradigms. From Bartlett's (1932) criticism of the narrow laboratory methodology of his era to the more recent theories of cognitive science (Atkinson & Schifffrin, 1968; Newell et al., 1958), psychologists have accepted the mediational, covert, and structural explanations of human cognition built upon the primary units of knowledge termed schemata (Neisser, 1982; Rumelhart, 1980).

In an attempt to clarify the schema concept, theorists have identified variations in this primary organizational unit of cognition. Examples reviewed include story, event, and scene schemata (Bransford et al., 1972; Mandler, 1984), as well as scripts (Abelson, 1981). The script schema holds promise as a most useful construct to test because of its amenability to experimental manipulation: Scripts are readily produced by both adults and children and appear to be an early form of higher order cognitive organizational ability (Nelson & Gruendel, 1979).

The paucity of research in this area, especially in regard to specific aspects of scriptal-knowledge usage, was cited in the review (Mandler, 1984). These aspects include lack of empirical investigation of (a) the differential effects of age on script schema usage; (b) the effects of the position of scriptal knowledge in relation to the acquisition of new information; and (c) the effects of script strength or canonical order on memory and comprehension.

In addition, several studies reviewed have indirectly linked schema usage to reading ability (e.g., Kintsch, 1977; Rumelhart, 1980; Stein &

Glenn, 1977). Skilled readers tend to spontaneously use cognitive organizational strategies on comprehension and memory tasks (Perfetti & Hogaboam, 1975; Smiley et al., 1977) while to perform well less skilled readers depended on the external induction of schema usage (Doctorow et al., 1978; Levin, 1973; Pressley, 1976; Torgesen, 1978).

There has been no test to date of the interaction between script schema usage and memory performance or higher order cognitive skills as used by children. Consequently, the present research addressed these issues by examining the role of prior scriptal knowledge in memory and testing the effects of script strength on comprehension. Both memory and comprehension ability were related to reading skill.

Design of the Study

Independent Variables

The two subject variables used in the present study included grade level (second and fourth) and reading achievement score (April 1983 California Achievement Test scores). Script-header strength and script-header position were the two experimental variables.

Dependent Variables

The dependent measures in the experiment were used in two phases. In the first storytelling or story generation phase, subjects were asked to create their own story in order to measure their comprehension of the experimental stimuli. Three variables based on McCartney and Nelson's (1981) scoring system were derived from the children's stories: (a) core, or main, events of the story; (b) filler, or minor, events; and (c) event inventions incongruent with the script suggested by the

experimental material. Five core events were identified; however, the title getting-ready-for-school was not counted as an event in the present script. In addition, 20 filler events as well as several examples of event inventions were outlined in the scoring key. The scoring system used in the present study is shown in Appendix A, pp. 97-99.

In addition to the story generation variables, three traditional memory variables were obtained. These included verbal recall, visual recognition, and serial reconstruction of the experimental stimuli. Intrusions in recall were scored during the verbal recall task.

Hypotheses Regarding Storytelling Performance

Based on the evidence reviewed regarding schema theory, in particular, recent script models of information processing, it was predicted that:

1. Subjects given a strong, canonically-ordered script-header show greater comprehension (as measured by their storytelling performance) than those not given this script.
2. Subjects given a weak, unordered script-header produce more incongruous stories revealing less comprehension than those not given this script.
3. Subjects given prior scriptal knowledge demonstrate greater comprehension than subjects not given prior organizing information.
4. Fourth-grade children demonstrate greater comprehension than their younger, second-grade counterparts.

Hypotheses Regarding Memory Task Performance

The results of traditional memory task paradigms provided evidence to predict that:

1. Subjects given a strong, canonically-ordered script-header reveal greater verbal recall, visual recognition, and serial reconstruction ability than those who are not.
2. Subjects given a weak, unordered script-header produce more intrusions in recall than those who are not.
3. Subjects given prior scriptal knowledge have greater recall, recognition, and serial reconstruction ability than those who are not.
4. Fourth-grade children reveal greater memory performance than second graders.
5. There is a primacy effect in the serial recall of the experimental material.

Hypotheses Regarding Reading Skill and Schema Usage

Theoretical and empirical considerations regarding the role of schema-based knowledge in text comprehension suggested the expectations that:

1. Storytelling performance is related to the children's reading skills.
2. Performance on memory tasks is related to reading skills.

CHAPTER III

METHOD

SubjectsDescription of Sample

The sample consisted of 139 second- and fourth-grade students of varied socioeconomic and ethnic backgrounds attending three New York City public elementary schools. Students were drawn from four second-grade classes and four fourth-grade classes. A breakdown of the chronological age of the students by sex and grade level is presented in Table 1.

Approval for conducting the study was provided for by the New York City Board of Education's Office of Educational Evaluation. School principals' and teachers' involvement in the study was obtained, and parental permission was secured for the students who participated.

Reading Scores of Sample

April 1983 California Achievement Test (CAT) scores were obtained with school and parental permission. Table 2 displays the CAT grade equivalent (GE) scores of the students who took the examination. Scores were divided into two subtest areas of reading ability--Vocabulary and Comprehension--and a total reading achievement score. National percentile rank scores of the students were also reported for the CAT and are presented in Table 3. For these scores, no significant sex differences were found; $t(133) = 0.56$, $p = .58$.

Table 1

Means and Standard Deviations for Chronological Age of Students

Group	Grade	
	Second	Fourth
Girls		
<u>n</u>	32	39
<u>M</u>	7.98	9.88
<u>SD</u>	0.62	0.44
Boys		
<u>n</u>	36	32
<u>M</u>	7.94	9.88
<u>SD</u>	0.57	0.36
Total		
<u>n</u>	68	71
<u>M</u>	7.96	9.88
<u>SD</u>	0.59	0.40

Table 2

Means and Standard Deviations for California Achievement TestGrade Equivalent Scores

Reading Subtest	Grade	
	Second ^a	Fourth ^b
Vocabulary		
<u>M</u>	3.04	5.68
<u>SD</u>	0.92	1.82
Comprehension		
<u>M</u>	3.22	5.68
<u>SD</u>	1.14	2.08
Total Reading		
<u>M</u>	3.53	5.61
<u>SD</u>	1.26	1.83

^an = 65.

^bn = 64.

Table 3

Means and Standard Deviations for California Achievement Test Percentile Rank Scores

Group	Reading Subtest						
	<u>n</u>	Vocabulary		Comprehension		Total Reading	
		<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Fourth Grade							
Girls	35	59.77	26.08	58.25	27.40	59.85	26.82
Boys	29	61.14	26.41	60.03	27.39	60.89	26.89
Second Grade							
Girls	31	61.68	25.81	61.35	26.04	69.71	26.99
Boys	34	54.21	26.91	54.88	28.58	62.15	27.97

Note. Means are not significantly different.

Students were randomly assigned to the experimental conditions by obtaining a class list from each teacher and assigning a code number to each of the students' names. These numbers were then randomly drawn from a bowl and consecutively assigned to one of six treatments for each grade.

Experimenters

In each condition, a male and female graduate student alternately administered the experimental tasks to the students. The sample was equally distributed between the experimenters by grade, sex, and treatment.

Materials

The experimental stimuli consisted of an array of pictures, each picture bordered to make a 2 by 2 inch box. These were displayed horizontally as a single rigid strip (26 by 6 inches) of 12 pictures which were read by the students from left to right. The array had an opaque heavy cardboard flap attached and used as a covering shield.

The pictures used for the array were selected as a result of a pilot investigation that found these objects to be highly salient for second and fourth graders in representing the script getting-ready-for-school-in-the-morning. In the pilot study, 23 second-grade students and 36 fourth graders viewed an array of 20 pictures. At least 75% of the subjects selected 12 items representing objects typically seen while getting ready for school in the morning and 61% sequenced the items in the order used in the present investigation. When asked to

arrange the same items to tell a story about cleaning the house, only 7% of the subjects constructed a similar series. In the present study, the pictured objects were arranged in sequential order using Bower et al.'s (1979) adult norms for the getting-ready-in-the-morning script but modified based on the pilot testing. The pictures appeared from left to right sequence as: Clock, bed, toilet, faucet, towel, pajamas, chest, milk carton, cereal, toothbrush, hairbrush, and shoe. Appendix B, p. 101, displays the picture sequence.

A set of 12 visual recognition task cards, composed of 24 paired pictures, were presented on five by seven inch index cards. The picture pairs were created by randomly matching each of the 12 script pictures to a low-salient picture. These pairs were presented in this order: Chest-glass, briefcase-pajamas, hairbrush-television, faucet-pencil, door-shoe, toilet-window, toothbrush-key, telephone-clock, milk carton-fork, umbrella-bed, cereal-chair, book-towel (see Appendix B, p. 101).

During the acquisition phase of the experiment, an electronic stopwatch, accurate to 0.01 seconds, was used to time the stimulus presentation. A tape recorder with a remote-controlled microphone was used by the children in the story generation phase. A special data form was used by the experimenters to record the students' responses in the memory phase of the experiment.

For the serial reconstruction task, a three-item sample picture sequence was used to train the students. These sample pictures, also shown in Appendix B, represented a story about a child who was playing baseball and accidentally broke a window. The actual serial reconstruction task consisted of the 12 original picture-sequence items individually

mounted on two by two inch plasticized cards. They were presented to each student in the following randomized order: Faucet, towel, cereal, shoe, milk carton, pajamas, clock, hairbrush, bed, toothbrush, chest, toilet. Code letters on the back of each card were recorded by the experimenter on the data sheet following the exact arrangement of the student.

Procedure

Children from each grade were randomly assigned to one of six experimental conditions. A 3 x 2 x 2 (Script Strength x Script Position x Grade) factorial design was employed with the between-subjects variables partitioned by script-header level (strong, weak, and control), script-header position (before and after), and by grade (second and fourth).

The experimental tasks were administered individually in a quiet room within close proximity to the child's classroom in each of the schools. The child sat opposite the experimenter with the material displayed on a low student's desk. The experimenter familiarized the child with the tape recorder, use of the remote-control microphone, and made certain the student was comfortable. A pleasant, game-like atmosphere was established before presenting the experimental stimuli.

The covered stimulus array board was placed before the student and the instructions were read by the experimenter verbatim from index cards. Depending on the assigned treatment, the students were given the appropriate instructions as outlined below.

Instructions to Subjects

Strong Script-header Before

Prior to viewing stimuli. I'm going to show you some pictures that tell a story about a girl [boy for male subject] who is getting ready to go to school in the morning. You will have only a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

Strong Script-header After

Prior to viewing stimuli. I'm going to show you some pictures. You will have only a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

After viewing stimuli. The pictures you just saw told a story about a girl [boy] who is getting ready to go to school in the morning.

Weak Script-header Before

Prior to viewing stimuli. I'm going to show you some pictures that tell a story about a girl [boy] who is cleaning the house. You will have only a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

Weak Script-header After

Prior to viewing stimuli. I'm going to show you some pictures. You will have only a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

After viewing stimuli. The pictures you just saw told a story about a girl [boy] who is cleaning the house.

Non-Script-header (Control) Before

Prior to viewing stimuli. I'm going to show you some pictures that tell a story. You will only have a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

Non-Script-header (Control) After

Prior to viewing stimuli. I'm going to show you some pictures. You will have only a little time to look at the pictures. Be careful to look at all the pictures because I'm going to ask you about them later.

After viewing stimuli. The pictures you just saw told a story.

Immediately after reciting the instructions, the experimenter pointed to the right side of the covered apparatus and said, "Start here." The covering flap over the picture series was lifted while simultaneously starting the stopwatch. The stimuli were exposed for exactly 12 seconds with the experimenter reminding the student to "be careful to look at all the pictures" after the 5-second mark was past. At the end of the 12-second exposure period, the stimuli was again concealed by simply dropping the flap. The picture board apparatus was then removed and placed aside.

The microphone was then given to the student and the experimenter continued with the appropriate instructions for each child. The experimental tasks were presented to the children in four consecutive phases as outlined below.

Experimental Tasks

Story Generation Task

With the remote-controlled microphone in the child's hand, the subject was told, "Now tell me a story about the pictures you just saw." Gentle coaxing was given to the few children who did not immediately respond. At the completion of their story, the experimenter said, "That was very good, _____" [child's name]. The tape recorder and microphone were then put aside.

Verbal Recall Task

The experimenter, holding the data recording sheet out of the student's sight, said, "Tell me the name of all the pictures you just saw." The items were checked off on the data sheet as they were mentioned by the child. Any items not on the experimenter's list were also recorded as intrusions in recall.

Visual Recognition Task

The set of 12 paired-stimulus cards were placed face down before the student, and the experimenter said, "Now let's look at some more pictures. I want you to point to the pictures that you just saw before. Choose one of the pictures even though you might not be sure which is the right one. Now point to the picture that I showed you before." The experimenter then exposed each of the picture-pair cards consecutively while recording the student's choice on the data sheet.

Serial Reconstruction Task

Each student was given the three-item sample task initially. These pictures were placed on the desk before the student in randomized order (ball, broken window, bat) and then told, "These pictures tell a story about a girl [boy] who was playing baseball, but they are in the wrong order now. See if you can put them in the right order so they tell a story that makes sense." All the students were able to correctly sequence the sample item.

The sample was removed, and the 12 individual plasticized picture cards were then placed on the desk in randomized order as coded on the back of each card. The students were told, "These pictures are in the

wrong order now. Put them in the right order so they tell a story that makes sense." After the student completed arranging the series, the picture cards were collected by the experimenter and the letter codes on the back of each card was used to record the actual serial order produced by the student.

Confidentiality and Debriefing

The entire session required approximately 15 minutes to complete for each child. The students were told not to discuss the tasks with their classmates and that the tasks would be explained after all the children had participated. A brief class discussion was held in each school before and after the experiment to explain the study.

Upon completion of each session with a child, the experimenter thanked the child and presented her/him with a sticker prize of their choice. The pupil was then escorted back to the classroom.

CHAPTER IV

RESULTS

The data are presented below in three sections. Results from the storytelling, or story generation task, are discussed first. This section is followed by data on the traditional memory tasks. The last section presents regression data involving reading achievement scores and the children's performance on the experimental tasks. In addition, supplementary data on serial recall of the task items are reported.

Story Generation DataScoring and Interrater Reliability

To test the primary hypotheses regarding the effects of a script on comprehension and memory, two graduate students were trained by the researcher as independent raters of the children's story generation protocols. A scoring system similar to McCartney and Nelson's (1981) was used in order to obtain six measures of story production.

Agreement between the judges' scores was high as indicated by their Pearson correlation coefficients for each measure: number of core events $r(134) = .95$, filler events $r(134) = .84$, total events $r(134) = .93$, event inventions $r(134) = .95$, and word production $r(134) = .99$; $p < .001$ for each variable.

Multivariate Effects

A three-way multivariate analysis of variance (MANOVA) was performed to test the experimental effects on the story generation variables core

events, filler events and event inventions. These three variables, used by McCartney and Nelson (1981) in story recall, were chosen for the multivariate tests because of their related contribution to the children's story production. As shown in Table 4, the hypothesized main effect of script strength and grade on these combined story generation variables was significant at $p < .05$ and $p < .01$, respectively. A significant main effect was approached, $p = .064$, for the script-header position treatment. No significant interactions were found.

Univariate Effects

For each of the story generation variables analyses of variance (ANOVAs) were performed to further explore the significant MANOVA results. Table 5 displays the three-way ANOVA for the core events variable revealing a highly significant main effect, $F(2,121) = 20.99$, $p < .001$, for the script strength condition. A post hoc Scheffé comparison of the means for the core events variable indicated that children in the strong script group generated significantly more ($p < .05$) core events than those in the weak script or control groups, in support of the primary hypothesis.

A three-way ANOVA of the filler events variable yielded significant main effects for the script strength, $F(2,121) = 5.08$, $p < .01$, script-header position, $F(1,121) = 7.79$, $p < .01$, and the grade level, $F(1,121) = 5.67$, $p < .02$, conditions. The ANOVA for the filler events variable is summarized in Table 6.

Similar to the core events variable findings, no interactions were found for filler events, as can be seen in Table 6. Additional post hoc Scheffé comparisons of the filler events variable supported the hypothesis

Table 4

Multivariate Analysis of Variance of Story Generation Variables

Source	Hotelling's \underline{T}^2	Hypoth. <u>df</u>	Error <u>df</u>	<u>F</u>
Script Strength (A)	0.430	6	238	8.53**
Script-header Position (B)	0.062	3	120	2.49
Grade (C)	0.075	3	120	2.99*
A X B	0.042	6	238	0.83
A X C	0.081	6	238	1.61
B X C	0.014	3	120	0.56
A X B X C	0.042	6	238	0.84

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

Table 5

Analysis of Variance for the Core Events Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	77.74	2	38.87	20.99*
Script-header Position (B)	1.77	1	1.77	0.96
Grade (C)	1.37	1	1.37	0.74
A X B	10.02	5	2.00	1.08
A X C	3.43	2	1.72	0.93
B X C	0.64	1	0.64	0.35
A X B X C	6.62	2	3.31	1.79
Error	224.02	121	1.85	

* $p < .001$.

Table 6

Analysis of Variance for the Filler Events Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	28.80	2	14.40	5.08**
Script-header Position (B)	22.05	1	22.05	7.79**
Grade (C)	16.07	1	16.07	5.67*
A X B	2.76	2	1.38	0.49
A X C	5.94	2	2.97	1.05
B X C	4.01	1	4.01	1.42
A X B X C	5.07	2	2.53	0.89
Error	342.75	121	2.83	

* $p < .02$.

** $p < .01$.

that children in the strong script condition would generate significantly more ($p < .05$) filler events than those in the weak script group. However, control group children, in contrast to the relatively small number of core events that they produced, generated only slightly more ($p > .05$) filler events than their weak script-header group counterparts.

The number of event inventions generated by the children were also examined by a three-way ANOVA. As summarized in Table 7, this ANOVA revealed a significant main effect for the script strength treatment $F(1,121) = 3.06, p < .05$. No additional main effects or treatment interactions were found for the event inventions variable.

The examination of the mean scores shown in Table 8 indicates that children in the weak script group generated significantly more event inventions, as predicted, than those in the strong script group ($p < .05$) but not more than the control group, as found by post hoc Scheffé tests. Core and filler events mean scores are also presented in Table 8.

As noted in the ANOVA results, the filler events variable yielded significant main effects for the script-header position and grade level conditions. Table 9 shows the script-header position mean scores for the filler events variable; the scores for the core events variable and event inventions variable are also presented. As hypothesized, children who received the script-header before viewing the picture series generated significantly more ($p < .05$) filler events than children given the script-header afterwards. In addition, grade differences were found only for the filler events variable, $F(1,122) = 5.67, p < .02$, as shown in the summary of story generation scores by grade level in Table 10. Fourth-grade students, as predicted, generated significantly more filler events than the second graders.

Table 7

Analysis of Variance for the Event Inventions Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	182.56	2	91.28	3.06*
Script-header Position (B)	10.03	1	10.03	0.34
Grade (C)	39.64	1	39.54	1.33
A X B	12.92	2	6.46	0.22
A X C	132.23	2	66.11	2.22
B X C	4.46	1	4.46	0.16
A X B X C	28.87	2	14.43	0.48
Error	3609.43	121	29.83	

* $p < .05$.

Table 8

Means and Standard Deviations for Story Generation Variables by
Script Strength Condition

Variable	Script Strength					
	Strong ^a		Weak ^b		Control ^c	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Core Events	2.48	1.55	0.79	1.21	0.93	1.32
Filler Events	2.41	1.68	1.28	1.50	2.00	2.01
Event Inventions	4.87	5.77	8.65	8.94	6.91	4.76

^an = 46.

^bn = 43.

^cn = 45.

Table 9

Means and Standard Deviations for Story Generation Variables
by Script-header Position

Variable	Script-header Position			
	Before ^a		After ^b	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Core Events	1.55	1.55	1.28	1.56
Filler Events ^c	2.33	1.90	1.50	1.60
Event Inventions	6.83	8.32	6.71	4.99

^an = 66.

^bn = 68.

^cMeans differ significantly at $p < .05$.

Table 10

Means and Standard Deviations for Story Generation Variablesby Grade Level

Variable	Grade			
	Fourth ^a		Second ^b	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Core Events	1.71	1.58	1.29	1.14
Filler Events ^c	2.16	2.17	1.33	1.38
Event Inventions	7.60	7.51	5.86	5.87

^an = 70.

^bn = 64.

^cMeans differ significantly at $p < .02$.

A summary of the story generation ANOVA results is presented in Table 11. As shown by this table, the script strength treatment yielded significant effects as measured by all story generation variables. Children's story production, measured as the number of core events, filler events and event inventions generated, was significantly influenced by the strength of the script schema suggested to them by the script-header or title.

Furthermore, a main effect was found for each of the experimental conditions for the filler events variable with the direction of the effects as predicted. This finding indicated that the children's ability to produce details of a story, i.e., their ability to fill in the gaps of information linking the major events of a script, was affected by the strength or position of a script-header as well as their respective grade level.

Traditional Memory Tasks Data

Memory Variables

In addition to examining the effects of scriptal knowledge on children's ability to generate a story, four traditional measures of memory for the picture series were obtained: recall, intrusions in recall, visual recognition, and serial reconstruction of the picture series.

Multivariate Effects

The results of the three-way MANOVA, for the combined effect on the four memory variables, are presented in Table 12. A significant main effect for grade level was obtained for these variables; no other significant main effects or interaction were found.

Table 11

Summary Table for Analyses of Variance of Story Generation Variables^a

Source	Variable		
	Core Events	Filler Events	Event Inventions
Script Strength (A)	20.99 ^{**}	5.08 ^{**}	3.06 [*]
Script-header Position (B)	0.96	7.79 ^{**}	0.34
Grade (C)	0.74	5.67 [*]	1.33
A X B	1.08	0.49	0.22
A X C	0.93	1.05	2.22
B X C	0.35	1.42	0.16
A X B X C	1.79	0.89	0.48

Note. Degrees of freedom for effects with script strength (A) treatment are 2, 121; all other effects are 1, 121.

^aAll F ratios are reported.

^{*}p < .05.

^{**}p < .01.

^{***}p < .001.

Table 12

Multivariate Analysis of Variance of Memory Variables^a

Source	Hotelling's T^2	Hypoth. <u>df</u>	Error <u>df</u>	<u>F</u>
Script Strength (A)	0.139	8	248	1.49
Script-header Position (B)	0.023	4	123	0.71
Grade (C)	0.262	4	123	8.05*
A X B	0.086	8	244	1.31
A X C	0.085	8	244	1.29
B X C	0.021	4	123	0.65
A X B X C	0.046	8	244	0.73

^aVariables in analysis include recall, intrusions, visual recognition and serial reconstruction.

* $p < .001$.

Univariate Effects

Separate three-way ANOVAs were performed on each of the memory variables. An ANOVA for the recall variable, as shown in Table 13, yielded a significant grade level effect consistent with the multivariate findings, $F(1,126) = 22.77$, $p < .001$. There were no other significant effects at $p < .05$ for the recall variable.

An ANOVA of the intrusions in recall variable revealed no significant effects at $p < .05$. Table 14 displays the ANOVA results for the intrusions variable indicating the predicted script strength effect was not found; that is, children in the weak script condition did not produce more intrusions than those in the other groups.

Table 15 shows the three-way ANOVA for the visual recognition variable. As can be seen in this table, a significant main effect of grade level was found, $F(1,126) = 10.32$, $p = .002$, and a significant two-way interaction (Script Strength x Grade) was also found, $F(2,126) = 4.67$, $p = .011$.

The serial reconstruction variable yielded a main effect for both script strength, $F(2,126) = 3.40$, $p < .05$, and grade level, $F(1,126) = 7.79$, $p < .01$, as indicated by the ANOVA results shown in Table 16. As was hypothesized, the children in the strong script condition were better able to reconstruct the original sequence of the picture series than those given a weak script-header. Table 17 shows the serial reconstruction mean scores by script strength and indicates the strong script group was able to reconstruct the original picture sequence with significant accuracy, $\rho(12) = 0.54$, $p < .05$.

Table 13

Analysis of Variance for the Recall Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	2.78	2	1.39	0.61
Script-header Position (B)	4.81	1	4.81	2.12
Grade (C)	51.69	1	51.69	22.77*
A X B	6.50	2	3.25	1.43
A X C	6.37	2	3.19	1.40
B X C	0.68	1	0.68	0.29
A X B X C	6.41	2	3.20	1.41
Error	286.06	126	2.27	

* $p < .001$.

Table 14

Analysis of Variance for the Intrusions in Recall Variable

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	3.45	2	1.73	1.10
Script-header Position (B)	0.06	1	0.06	0.04
Grade (C)	1.15	1	1.15	0.74
A X B	4.89	2	2.45	1.57
A X C	0.49	2	0.24	0.16
B X C	0.33	1	0.33	0.21
A X B X C	0.38	2	0.19	0.12
Error	196.85	126	1.56	

Note. All F ratios are not significant at $p < .05$.

Table 15

Analysis of Variance for the Visual Recognition Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	4.57	2	2.23	0.97
Script-header Position (B)	0.28	1	0.28	0.12
Grade (C)	24.28	1	24.28	10.32 ^{**}
A X B	4.09	2	2.05	0.87
A X C	21.96	2	10.98	4.67 [*]
B X C	1.52	1	1.52	0.65
A X B X C	4.28	2	2.14	0.91
Error	296.40	126	2.35	

^{*} $p = .011.$

^{**} $p = .002.$

Table 16

Analysis of Variance for the Serial Reconstruction Variable

Source	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Script Strength (A)	0.70	2	0.35	3.40*
Script-header Position (B)	0.03	1	0.03	0.33
Grade (C)	0.80	1	0.80	7.79**
A X B	0.13	2	0.07	0.64
A X C	0.004	2	0.002	0.02
B X C	0.08	1	0.08	0.82
A X B X C	0.08	2	0.04	0.39
Error	9.14	126	0.10	

* $p < .05$.

** $p < .01$.

Table 17

Means and Standard Deviations of Memory Variables by ScriptStrength Condition

Variable	Script Strength		
	Strong ^a	Weak ^b	Control ^c
Recall			
<u>M</u>	3.67	4.07	4.00
<u>SD</u>	1.55	1.50	1.85
Intrusions			
<u>M</u>	1.08	0.94	1.30
<u>SD</u>	1.24	1.14	1.29
Visual Recognition			
<u>M</u>	10.18	10.27	9.83
<u>SD</u>	1.52	1.55	1.76
Serial Reconstruction ^d			
<u>M</u>	0.54	0.32	0.46
<u>SD</u>	0.26	0.39	0.29

^a $\underline{n} = 49$. ^b $\underline{n} = 44$. ^c $\underline{n} = 46$. ^d Means for strong and weak conditions differ significantly at $p < .05$.

Mean scores for the other memory variables are also presented in Table 17, revealing no significant script strength effects; script-header position effect mean scores for the memory variable are shown in Table 18. An examination of Table 18 reveals somewhat higher visual recognition mean scores for the children receiving a script-header versus those in the control group.

Table 19 reveals the significantly higher fourth-grade recall scores for all but the intrusions in recall variable. In addition, Table 19 indicates that the visual recognition scores for the fourth graders were significantly higher ($p < .01$) than the second-grade scores. Fourth-grade children given a script-header (regardless of its strength) benefited in being better able to recognize the stimulus items as compared to second-grade children or all children given no script-header or title.

A summary of the ANOVA results for the memory variables is presented in Table 20. Grade level main effects were found for all the memory variables; that is, fourth-grade students performed significantly better on all measures than the second graders. A script strength effect was found only for the serial reconstruction variable with children given a strong script-header being better able to reconstruct the original picture sequence than those given a weak script-header. In addition, a significant two-way interaction of script strength by grade for the visual recognition variable indicated that fourth graders given any type of script-header recognized more of the picture series items than children given no script-header.

Table 18

Means and Standard Deviations of Memory Variables by Script-header Position

Variable	Script-header Position	
	Before ^a	After ^b
Recall		
<u>M</u>	4.14	3.65
<u>SD</u>	1.51	1.14
Intrusions		
<u>M</u>	1.07	1.12
<u>SD</u>	1.32	1.14
Visual Recognition		
<u>M</u>	10.14	10.04
<u>SD</u>	1.70	1.54
Serial Reconstruction		
<u>M</u>	0.46	0.42
<u>SD</u>	0.37	0.29

Note. There are no significant differences between the means of any variable.

^an = 69.

^bn = 69.

Table 19

Means and Standard Deviations of Memory Variables by Grade Level

Variable	Grade	
	Fourth ^a	Second ^b
Recall ^d		
<u>M</u>	4.52	3.26
<u>SD</u>	1.61	1.41
Intrusions		
<u>M</u>	1.00	1.21
<u>SD</u>	1.17	1.29
Visual Recognition ^c		
<u>M</u>	10.51	9.66
<u>SD</u>	1.40	1.70
Serial Reconstruction ^d		
<u>M</u>	0.53	0.34
<u>SD</u>	0.28	0.35

^an = 71.

^bn = 68.

^cMeans differ significantly at $p < .01$.

^dMeans differ significantly at $p < .001$.

Table 20

Summary Table for Analyses of Variance of Memory Variables

Source	Variable			
	Recall	Intrusions	Visual Recognition	Serial Reconstruction
Script Strength. (A)	0.61	1.10	0.97	3.40*
Script-header Position (B)	2.12	0.04	0.12	0.33
Grade (C)	22.77***	0.74	10.32**	7.79**
A X B	1.43	1.57	0.87	0.64
A X C	1.40	0.16	4.67*	0.02
B X C	0.29	0.21	0.65	0.82
A X B X C	1.41	0.12	0.91	0.39

Note. Degrees of freedom for effects with script strength (A) treatment are 2, 126; all other effects are 1, 126.

^aAll F ratios are reported.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Scripts and Reading Achievement

It was noted that similar processes are believed to be at work during the use of schematic knowledge and the comprehension of written material (cf. Kintsch, 1977; Rumelhart, 1980). It was hypothesized that the cognitive processes used by the students to comprehend and remember the picture series were similar to those used while reading. A series of multiple regression analyses were performed using the children's story generation and memory scores as predictors of their CAT reading scores. The analyses were performed separately for each grade level.

Story Generation Variables

A forward-inclusive, hierarchical regression analysis of the story generation variables on total CAT reading achievement scores was performed. It was hypothesized that the core events, filler events, and event inventions variables would contribute significantly to the prediction of the children's reading achievement scores. MANOVA results using these story generation variables, as well as the basic design of the scoring system modeled after McCartney and Nelson's (1981) study, indicated the relationship between these variables would best be examined by means of a hierarchical regression. The relative importance of the variables was determined by these two factors.

Table 21 shows the results of this regression analysis with each variable entered in predetermined order. These data indicate the variance in the second-grade children's reading achievement scores due to regression (R^2) on the story generation variables core events, filler events, and event inventions is 0.0804. As can be seen by examining

Table 21

Summary Table for Hierarchical Multiple Regression Analysis of
Story Generation Variables on Total Reading Achievement Scores

Variable	Multiple <u>R</u>	<u>R</u> ²	<u>R</u> ² Change	<u>B</u>	<u>Beta</u>
Second Grade ^a					
Core Events	0.2692	0.0725	0.0725*	5.1895	0.2929
Filler Events	0.2771	0.0768	0.0043	-1.4152	-0.0704
Event Inventions	0.2835	0.0804	0.0036	0.2876	0.0611
Constant				60.8625	
Fourth Grade ^b					
Core Events	0.0543	0.0029	0.0029	-0.2885	-0.0169
Filler Events	0.1381	0.0191	0.0161	-1.9022	-0.1462
Event Inventions	0.1540	0.0237	0.0046	-0.2491	-0.0701
Constant				66.9110	

Note. Variables are in order of entry into regression equation.

^an = 61.

^bn = 67.

*p < .05.

the R^2 change values, only the core events variable contributed significantly to the prediction of the CAT scores, $F(1,59) = 4.61$, $p < .05$.

A hierarchical regression analysis of the story generation variables with fourth-grade children's total CAT reading scores yielded extremely small correlations. As shown in Table 21, the final R^2 value is 0.0237; there were no significant R^2 change values. Therefore, the fourth-grade children's performance on the story generation tasks could not be used to explain their reading achievement scores.

Memory Variables

A hierarchical regression analysis performed on the second graders' total reading achievement scores is summarized in Table 22. The visual recognition and serial reconstruction variables contributed significantly to the regression equation as shown by their significant R^2 change values, $F(1,63) = 5.46$, $p = .02$, and $F(1,63) = 4.36$, $p < .05$, respectively, for each variable.

The fourth graders' memory task scores, using the serial reconstruction, recall, visual recognition, and intrusions in recall variables in a forward-inclusive, hierarchical regression model, revealed a significant correlation between the intrusions in recall and reading achievement scores, $F(1,63) = 11.71$, $p = .001$. All other R^2 values were small and did not contribute significantly to the regression equation. The negative correlation for the intrusions variable was as expected, indicating the children with higher reading scores produced fewer intrusions in recall. Table 22 displays a summary of the memory variables for the fourth graders entered hierarchically into the equation.

Table 22

Summary Table of Hierarchical Multiple Regression Analysis of Memory Variables on Total Reading Achievement Scores

Variable	Multiple <u>R</u>	<u>R</u> ²	<u>R</u> ² Change	<u>B</u>	<u>Beta</u>
Second Grade ^a					
Serial Reconstruction	0.2544	0.0647	0.0647 *	19.1964	0.2486
Recall	0.3232	0.1045	0.0398	0.8349	0.0404
Visual Recognition	0.4220	0.1781	0.0736 *	5.0005	2.3137
Intrusions	0.4220	0.1781	0.0000	-0.0626	-0.0034
Constant				30.7948	
Fourth Grade ^b					
Serial Reconstruction	0.0019	0.0000	0.0000	-6.2179	-0.0662
Recall	0.1115	0.0124	0.0124	0.2028	0.0120
Visual Recognition	0.1419	0.0201	0.0077	0.5043	0.0267
Intrusions	0.4168	0.1737	0.1536 **	-9.2020	-0.4111
Constant				66.4505	

Note. Variables are in order of entry into regression equation.

^an = 65. ^bn = 67.

* p < .05. ** p = .001.

Supplementary Data Analyses

Consistent with previous findings regarding the serial recall of meaningful material (e.g., Deese & Kaufman, 1957), a primacy effect for verbal recall of the picture series was found. Figure 1 illustrates the percentage of children recalling each of the 12 stimulus items. The pupils were able to recall significantly more of the items presented from the beginning third of the picture series than those items from the middle, $t(139) = 8.67$, $p < .001$, or end, $t(139) = 8.84$, $p < .001$, of the series.

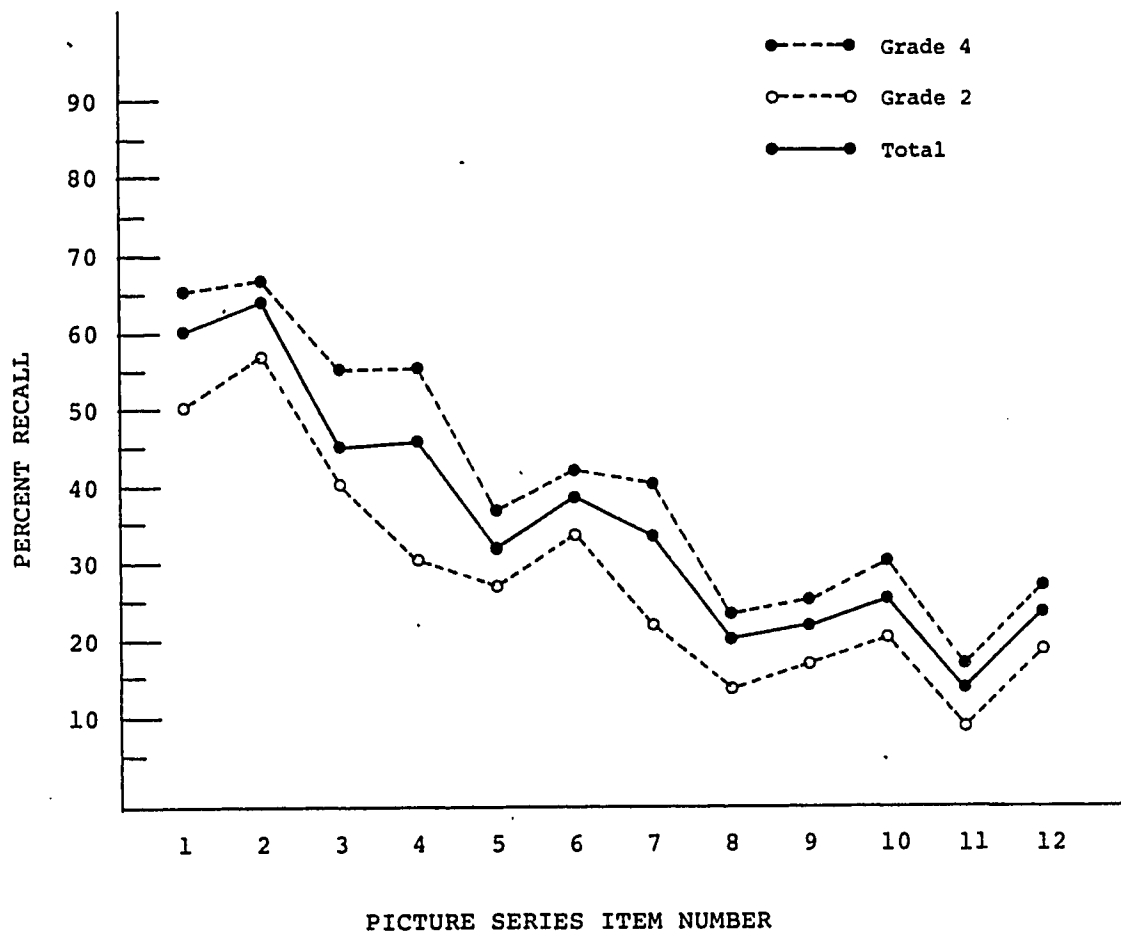


Figure 1. Percentage of recall of picture series items by second grade, fourth grade and total subject samples.

CHAPTER V
DISCUSSION

One of the primary goals of the present research was to determine the effects of scriptal knowledge on memory performance. Scripts were viewed as an essential part of schema theory, especially in relation to how experiential knowledge influences comprehension and recall in children. In addressing the issue of script strength (Abelson, 1981), the present research focused on one of the more pressing theoretical questions regarding schema usage: how does the strength or ordered aspects of a script relate to memory (Mandler, 1984)? As demonstrated by the present results, children's ability to invoke the use of familiar prior knowledge in the processing of incoming stimuli varied according to the level at which that knowledge may facilitate comprehension and confirm expectations of new information.

Mandler (1984), particularly concerned with the lack of empirical study of script strength, drew the distinction between canonical scripts--scripts evoking a strong temporal-causal sequence--and unordered scripts, much like Schank and Abelson (1977) theorized. The stronger canonical script--e.g., getting ready for school in the morning--was hypothesized to facilitate recall to a greater extent than an unordered script--e.g., cleaning one's house. The present study confirmed that script strength affects the comprehension and recall of familiar material given a specific level of processing (Craik & Lockhart, 1972). A closer examination of the story generation results revealed the importance of script strength theorizing.

Role of Script Strength

It was initially proposed that script strength would influence comprehension and recall. Specifically, a story script-header presented to children before or after viewing a sequence of familiar pictures was hypothesized to invoke the use of the appropriate schema needed to comprehend that picture series. Comprehension was measured as the children's ability to construct a story based on the picture shown them.

Although similar to the Bransford and Johnson (1972) paradigm of providing various levels of cues in an ambiguous situation and asking subjects to reconstruct a story, the current experiment focused on how children make use of existing knowledge to comprehend and produce a story. The present results indicated that, given a story title suggesting a strong, canonical script congruous with current information, children were able to produce a story fitting that conventional script.

It was concluded from the Bower et al. (1979) study on adults' script knowledge, as well as from Nelson's work with children (Nelson & Gruendel, 1979; McCartney & Nelson, 1981), that the organization of memory around familiar events has a powerful effect on recall. However, these studies did not systematically examine the differential effects on memory of various levels of schema organization. The use of the script strength concept in the present investigation addresses this particular problem.

McCartney and Nelson (1981) employed the terms core events and filler events to specify levels of recall in the stories produced by their young subjects. Core events were defined as the main events occurring in the story sequence while filler events were specific

detailed happenings serving to fill the gaps between these main events. Core events were more likely to be recalled by McCartney and Nelson's subjects than the filler events. Older children, however, produced significantly more filler events than their younger counterparts.

Similarly the present research, using the scoring system based on McCartney and Nelson's design, revealed that the filler events variable yielded significant age differences. The older subjects in the present study, fourth-grade students, generated significantly more filler events than the second graders, as was hypothesized. But the core events variable yielded no significant differences between the two grades. This finding is consistent with the McCartney and Nelson results which suggest that the main theme of a script exists for even the youngest subjects and that increasing age relates to improvements in children's ability to fill in the details of a schema.

The examination of age differences, although important, does not address the issue of the organizational properties of scripts (Mandler, 1984). In the present research, children given a strong script-header were found to be able to generate significantly more core and filler events than control subjects. The canonical script invoked by the title getting-ready-for-school-in-the-morning was therefore more likely to be produced by those subjects given such an organizing schema than by those given a weak, unordered script-header or no title at all.

The power of the script-header in aiding the subjects in the generation of the main theme or core events of the script can be demonstrated by comparing the core events and filler events generated across experimental conditions. Significantly more core events were found in the

stories of subjects given the strong script-header than by those given a weak script-header or by those in the control group. However, the number of filler events generated was greatest among those in the strong script-header group, their production being significantly higher than the weak script-header group but not more than the number produced by the control group.

In extending the McCartney and Nelson findings, the present results revealed the organizing aspects of a script are quite powerful in facilitating the comprehension and recall of main events but less powerful for the production of the fine details in a script. Furthermore, given a script-header suggesting a weak, non-canonical script, i.e., cleaning one's house, subjects were more at a loss to produce the gap-filling details of the script suggested by the picture series than those control subjects given no experimenter-provided organizing schema.

It was in this weak script-header condition, which was both incongruous with the script suggested by the picture series and unordered in its temporal-causal sequence, that subjects produced significantly more event inventions. A term again introduced by McCartney and Nelson, event inventions are similar to the intrusions in recall studied by Bartlett (1932) and Luftig (1982) using stories. With increasing delay, recall of factual information in these stories more closely resembled the subjects' knowledge of historical data than the information presented in the story. Details were therefore "leveled" by subjects to yield a story resembling the expectations of the main themes in text, a finding similar to earlier experimental data with pictures (Carmichael et al., 1932; Neisser, 1967). Inventions and intrusions

were introduced by subjects to meet contextual expectations.

In the present experiment, subjects given an unordered, weak script-header were also confronted with incongruous information in the picture series. The series evoked a causal sequence of events by portraying objects encountered while preparing for school in the morning. But experimenter-provided information suggested to this group an unordered organizational schema for comprehending the stimuli. The result was confusion and a need to import unrelated information.

Several subjects in this experimental group told stories illustrating this effect; e.g., "There once was a girl who wanted to clean the house and so she moved the clock off the table and dusted the table . . . ," or "One day I came home from school. My friend was walking with me. Then I went in the house and the water faucet started running and I called the plumber" Script strength therefore affected the direction in which subjects attempted to make sense of the task. Non-canonical script knowledge produced more extraneous filler information.

Additional research is needed to examine the effects of a weak script-header on comprehension and to ascertain whether--for all tasks--inventions or intrusions are necessarily inappropriate responses. To explore the relative power of the verbal script-header versus visual stimuli, the effects of a weak script-header and a picture series that evokes a weak script--such as cleaning-the-house--should be compared. In addition, the delayed recall and recognition effects found by Baggett (1975), Bartlett (1932), Kintsch (1974), and Luftig (1982) suggested memory for specific details would decrease over time. Future investigations

should examine the effects of incongruent information, contextual demands, and weak scripts on immediate and delayed memory performance.

Role of Script-header Position

Bransford and Johnson (1972) provided evidence that organizing information shown prior to the presentation of ambiguous stimuli facilitates comprehension and recall. Such an effect was also demonstrated in the current research, but only for the filler events variable. Subjects given an organizing script-header prior to exposure of the picture series generated significantly more filler events than those subjects receiving the script-header information afterwards. It appeared that the power of the script-header to invoke a useful schema was again observed in the production of core events, with the script-header position having no effect on this variable. However, prior knowledge did aid subjects in filling the details of their stories.

A script, once invoked in memory, will guide comprehension and recall, especially in regard to the major events present in the script. When present prior to the acquisition of new information, a script sets up powerful expectations allowing for the development of sub-schemata or details regarding the actors, actions, props and other elements of a script that play such a crucial role in comprehension.

Scripts and Theories of Memory

Traditional memory theory placed emphasis on the contiguity of stimulus and response resulting in the formation of associative bonds. Following the Ebbinghaus experimental paradigm, it had been repeatedly

shown in the memory laboratories that amount of recall is dependent on the strength of the associative links in memory (Kintsch, 1977).

In the highly controlled environment of the psychological laboratory, the non-meaningful nonsense syllable provided the experimenter with the ideal stimulus to explore the human mind. However, this tradition was constantly challenged by structural views of human cognition, even among its own ranks (e.g., Neisser, 1967). The need to entertain the concept of cognitive structure was deemed quite important.

The development of information processing theory, borne out of modern cognitive science, directed students of memory and cognition to further explore the process of thinking as opposed to the products of S-R connections. Twentieth-century technology, particularly the invention of the computer, led such researchers as Miller, Galanter, and Pribram (1960), and Newell, Shaw, and Simon (1958) to develop theories of cognition and intelligence based on the computer model. Rumelhart (1980) and Spiro (1980) best exemplify theorists who carried such thinking into educational and psychological research. Schema theory, as espoused by Rumelhart and Spiro, attempted to explain comprehension and memory in terms of structural organization while retaining the experimental rigor of the traditional psychological laboratory. The present study used several traditional recall and recognition paradigms to explore the effects of script schemata on these familiar memory variables.

As expected, age and experience played a major role in performance on the memory tests used in this study. Fourth-grade children were able to perform significantly better than second graders on all three memory variables: verbal recall, visual recognition, and serial reconstruction.

However, grade level was the only variable yielding any discernible differences between subjects. The expected experimental main effects due to the script conditions were not found except for a script strength effect for the serial reconstruction variable.

This finding, in which children given a strong script-header reconstructed the picture series more accurately than those given a weak script-header ($p < .05$), lent support to the notion that contextual aspects are influential in any experimental study. Of the three memory variables, serial reconstruction most closely resembled the experimental set established by the task instructions. Like the story generation task, serial reconstruction required the students to process the information as a temporal-causal sequence. Children provided with a strong script-header, invoking a canonical script, were better able than subjects in the other condition to recreate the original picture series and match it to the script schema. In essence, the children were processing the information in this phase of the task at a level of abstraction (Craik & Lockhart, 1972) similar to that when first viewing the stimuli. The ordered script provided the students with a top-down, schema-guided organizing framework.

It was shown earlier that subjects in Bransford and Johnson's (1972) classic clothes washing story experiment also varied in their comprehension and recall according to the direction in which they were forced to process new information. Given schema-relevant information, subjects were able to make sense of the ambiguous passage and therefore to comprehend and recall most of it. However, without the relevant schema subjects were forced to rely on data driven information processing

techniques, which proved to be ineffective for success at the task.

The present investigation, which examined verbal recall and visual recognition of the original picture stimuli by the students, revealed no facilitation in memory performance despite the provision of schema-relevant information. Although superficially in contradiction with the Bransford and Johnson results, a closer examination of the findings may help explain the discrepancy and reveal some consistencies.

In the Bransford and Johnson study, subjects were asked to recall an ambiguous, albeit intact, passage. Incoming information was perceived by the subjects at a high order level of information processing, i.e., expectations were set so as to prepare the reader for meaningful text. Recall of the passage, however, was at a lower level of processing, the requirements of recall being that the data be perceived as unrelated sentences by the control subjects. Only with schema-relevant information did the text gain coherence. Subjects given the appropriate schema were able to process the text at this more abstract level, and reveal superior comprehension and recall.

In the present study, students were presented with an apparently disconnected picture sequence similar to Bransford and Johnson's (1972) ambiguous text and "balloon" passage in which pictures with varying degrees of thematic relations between objects were presented prior to reading text. Prior knowledge, provided by the thematically-relevant picture, facilitated comprehension and recall of the text read by their subjects. This finding is consistent with the present results in which a strong script-header provided one group the schema-relevant information with which to organize the picture series and generate significantly

more core and filler events for their stories.

However, the children were initially given a lower level processing set with the recall and recognition tasks that did not so much require comprehension by them as did it place demands upon short-term memory. For such memory tasks, the most efficient method of improving memory performance is to organize the information at an associative or categorical level (Deese & Hulse, 1967; Mandler, 1984). In fact, the recall of the picture series resembled the serial recall curves of traditional verbal memory experiments as studied by Deese and Kaufman (1957).

Yet when this same group of children was instructed to arrange the stimuli in a serial reconstruction task so as to "tell a story that makes sense," schema-relevant information significantly improved memory performance. The children, using the same stimuli but at different levels of information processing, performed as was hypothesized when given a "higher order" processing set. Furthermore, no differences in the number of intrusions in recall were found between students in the strong versus weak script-header conditions. But at the schema-driven, story generation level of processing in which students were asked to produce a story, the weak script-header group produced significantly ($p < .05$) more event inventions than the strong script-header group.

Information processing levels, both at the time of stimulus presentation and during output (comprehension and recall) were more closely matched when schema-relevant information proved to be influential in task performance. If Bransford and Johnson's subjects had been asked to memorize a list of unrelated sentences, in lieu of being instructed to read text, perhaps memory performance would have improved. The

results of both the Bransford and Johnson study and the current investigation suggest that for a relevant schema to facilitate comprehension and recall, the level of processing must remain consistent throughout all phases of the task.

Scripts and Reading Achievement

Kintsch (1977) has pioneered the study of schema models in the processing of text. He is one of a growing theoretical constituency (Mandler, 1984; Rumelhart, 1980; Spiro, 1980; Stein & Glenn, 1977) exploring the role of schemata in text processing.

The modest relationship found between the children's reading scores and their scores on the story generation and memory tasks suggests much more needs to be understood about the schema concept before it can be used to explain reading ability. The strongest relationship found between the reading scores and the experimental task scores were among the second-grade children. Although the core events variable was alone in its contribution in explaining CAT reading performance for this group, this variable yielded significant script strength treatment results for the story generation task; core events was also most evident in McCartney and Nelson's (1981) findings.

As these concurrent data suggest, early reading skills may be related to the children's ability to identify and comprehend the main theme and core events of a story, with the youngest children being most dependent on familiar schema-related information such as provided by a script.

The results of the memory variables' regression on the CAT scores buttress this argument. Again, only the second graders revealed significant correlations between their serial reconstruction scores and performance on the CAT. In addition, the ANOVA results indicated a strong script-header facilitated serial reconstruction of the picture series. Perhaps the better readers among the younger children benefited most from the scriptal knowledge while the unskilled readers were less able to make use of the organization of information provided by the strong, canonical script schema.

A body of evidence now exists (cf. Mandler, 1983) indicating a canonical text, similar to a canonical script, is better comprehended and recalled than unordered text. However, as Mandler noted, the subtle differences between story schemata and the schemata found in scripts or familiar scenes have yet to be investigated. The schemata facilitating CAT performance may include story grammars (Kintsch, 1977) and propositional knowledge (Kintsch et al., 1975), as well as the short-term memory skills and scriptal knowledge studied in the present investigation.

Educational Implications

Schema theory provides cognitive scientists with a useful framework for understanding our internal representation of knowledge. Historically, psychologists have consistently sought to apply theories to pedagogical concerns, especially in the areas of human learning and cognition. It has recently been noted by long-term students of psychological and educational research (Sternberg & Powell, 1983) that schema-based theorizing complements not only bottom-up, perceptual and

verbal-skills research in cognition and intelligence, but also knowledge-based approaches.

Sternberg and Powell suggested that current studies using these approaches may be likened to an elaboration of the concept of fluid and crystallized intelligence (Horn & Cattell, 1966). Schema-based approaches are concerned primarily with the fluid, contextual aspects of cognition, the problem-solving skills necessary for processing information. Educators have frequently lamented over this neglected area of school learning.

However, recent theories of cognition have contributed to our understanding of how learners approach a problem or task using their fluid intelligence and then apply their prior knowledge, or crystallized intelligence, towards solutions. Intelligence, often an ambiguous term, has attained more specific meaning within the framework of schema theories which explain cognitive performance in terms of information processing skills.

At the base of schema theory's structuralist foundation is the hypothesis that human memory and knowledge is highly organized (Mandler, 1984). In the classroom, educators have continually sought methods to better organize pedagogical material so as to facilitate learning. The plethora of studies on advance organizers, of which Ausubel (1960) was chief proponent, exemplifies this research area. The present study, in its examination of the organizing aspects of a script schema, continues in this tradition.

Ausubel (1960) proposed that by providing students with some general, abstract overview of the material to be learned, they will be

better able to comprehend that material. His hypothesis was similar to the present position regarding the effects of an organizing script schema on comprehension and memory for the picture series.

Barnes and Clawson (1975) had noted that most researchers investigating the effects of advance organizers failed to replicate Ausubel's positive findings. Lack of an operational definition of the term advance organizer was a primary factor. In addition, these researchers cited by Barnes and Clawson used recognition tests as opposed to tests of recall of the material. As the results of the present study suggest, facilitative effects for comprehension and memory performance appear to be related to consistency between the information processing levels expected by students during acquisition and recall; the recognition tasks may have varied significantly from the level of abstraction set up by the advance organizer.

In order to aid the learner's comprehension and memory for the material, Mandler (1984) concluded the structure of the material must potentially fit the mental structures of the learner. As shown by the current research, a strong script-header will facilitate comprehension of a canonical script, but only at an appropriate level of information processing for the learner. The development of effective classroom materials and teaching methods will depend, in part, on greater understanding of the role script schemata play in the organization of the learner's knowledge base.

Addressing this issue, in his article discussing the pedagogical aspects of schema theory, Glaser (1984) suggested that the educational process recapitulates schema usage by the human learner. Referring to

Rumelhart's (1980) notion of a schema as being like a theory, possessing the ability to test and modify data as well as make predictions, Glaser noted that learners rely on schemata to adapt their present knowledge base to new information. Therefore, the teacher's task is to identify this knowledge base and help those students lacking adequate schemata to integrate new material by providing them with the appropriate organizational framework. Once this organizational structure is acquired, the student can then continue to use it to facilitate learning.

As demonstrated in the present study, by tapping the student's store of scriptal knowledge, educators can identify the familiar knowledge base available to the learner during problem-solving tasks. As an extension to Glaser's reasoning, the current research indicates the teacher should also elicit the appropriate level of information processing from the student and use material matching that organizational structure--schema--to facilitate learning. The closer the mesh between the structure of new material and the schemata activated in the learner to fill in gaps in the information presented, the more likely learning will take place.

APPENDIX A
SCORING SYSTEM

Scoring Key

A. Core Events

- I. getting up in the morning
getting up / got up
wake up in the morning
in the morning
- II. go to the bathroom
went to the bathroom
used the bathroom
- III. got dressed
put on . . . clothes
changed
- IV. eat breakfast / ate breakfast
have breakfast
made / make breakfast
- V. leave the house
left for school
went to school

B. Filler Events

- the alarm clock rang
- got out of bed
- sleeping in bed
- was in bed
- turned off alarm

- take a bath
- used / went to toilet
- wash up / washed hands / face

dried hands / face

cleaned up

use towel

took off pajamas

went to dresser

opened dresser / chest

got clothes out of . . .

had milk and cereal

went to kitchen

drink milk / eat cereal

brush hair / teeth

put on shoes / sneakers

C. Sample Event Inventions

got coat

went to sleep

cleaned house / bathroom

answered telephone

went out to play

Story Generation Scoring Sheet

Subject No.: _____

Judge: _____

A. Core Events

(Place the number that represents the order of appearance of an event next to its Roman No. as indicated in the KEY.)

I. _____
 II. _____
 III. _____
 IV. _____
 V. _____

Number of core events generated: _____

B. Filler Events

(Tally the frequency of filler events found using the appropriate KEY.)

Number of filler events generated: _____

C. Total Events generated

Find total of (A) and (B) above: _____

D. Event Inventions

(Tally the number of idea units generated that do not match, or paraphrase, acceptable responses on either KEY.)

Number of event inventions generated: _____

E. Word Production

(Tally total number of words used in story.)

Total words: _____

F. Item Recall

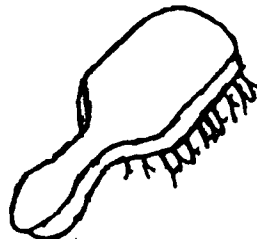
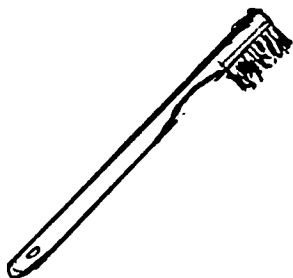
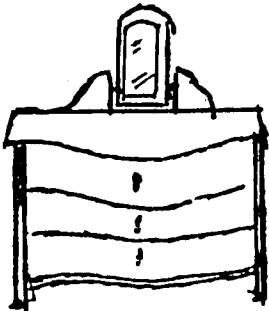
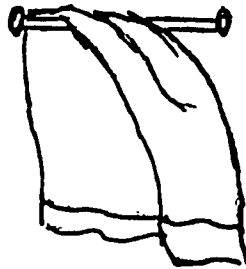
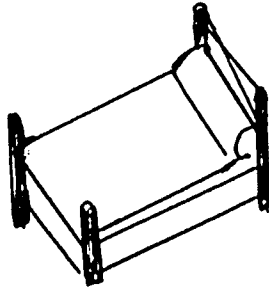
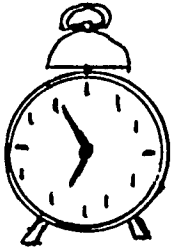
(Did subject name items only?): Yes _____ No _____

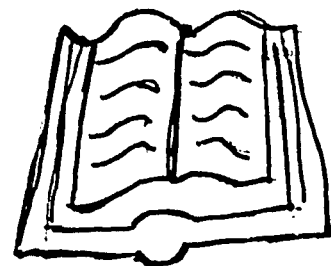
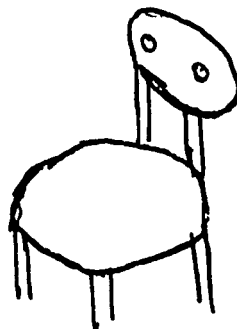
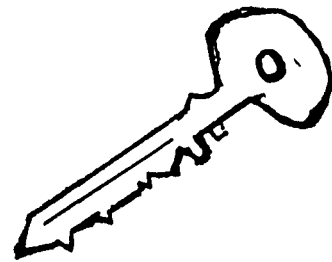
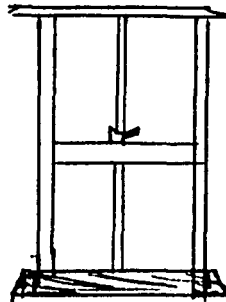
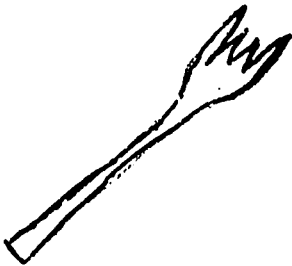
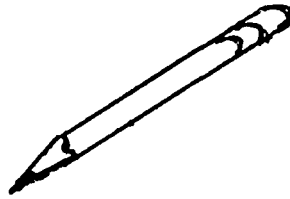
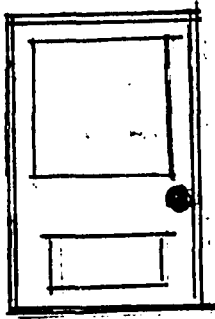
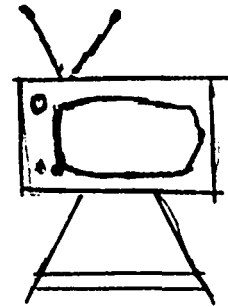
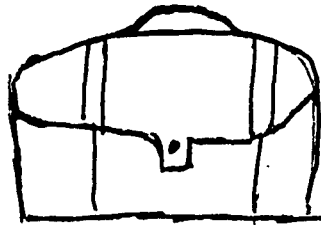
Total number of items named: _____

APPENDIX B

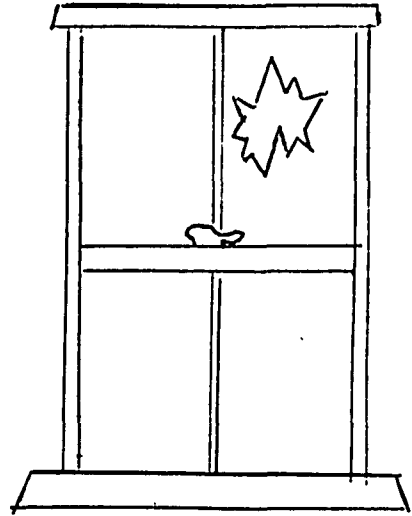
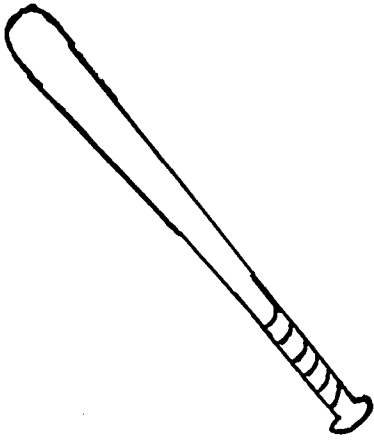
STIMULUS ITEMS

Picture Series Items



Visual Recognition Task Items

Serial Reconstruction Task Items
(Sample)



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