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The development in children of future time perspective.

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THE DEVELOPMENT IN CHILDREN OF FUTURE TIME PERSPECTIVE

A Dissertation Presented

by

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ABSTRACT

THE DEVELOPMENT IN CHILDREN OF FUTURE TIME PERSPECTIVE

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Little is known about how children develop their concepts of the future. However, future time perspective (FTP) is considered important in the development of abilities such as planning, goal setting, and the delay of gratification. FTP has also been related to mental health in adults and academic achievement in adolescents. This study explored FTP, defined as the ability to temporally locate and organize future events, and compared participants' ability to locate and organize the same events with respect to their past occurrences. There were 167 participants from four grade levels with average ages of the groups ranging from 7.4 to 10.5 years of age. Participants located five recurrent events on four timelines representing; a past(day), a past(year), a future(day), and a future(year). Participants also took tests to assess their knowledge of conventional time (i.e., clocks and calendars). Hypotheses were proposed that: a) participants would show a general developmental improvement on all tasks, b) participants would perform better on day-scale than year-scale timelines, c) participants would perform better on past than future timelines, and

d) knowledge of conventional time would be used by older participants to structure year-scale, but not day-scale, timelines. Results supported the first two hypotheses but, contrary to expectations, participants performed better on future than past timelines. The author proposed that location of sequences in the past is more cognitively challenging because it moves counter to the unidirectional flow of time; events that are more distant from the present are earlier in the sequence. Results supported the hypothesis that more sophisticated representations of conventional time are needed for location of events in longer durations, and that such representations are developmentally acquired, but a causal relationship could not be established. Participants relied heavily on event schemas in locating events; these schemas helped participants produce a correct sequence but often with the incorrect start of the sequence given the instructions regarding use of the present as a reference point. Results also suggested that children might have a different concept of the relationship between the present and the past and future than that of adults.

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CHAPTER 1

INTRODUCTION

The concept of time is best thought of as a multi-dimensional, rather than a unitary, construct (Friedman, 1990a; Levin, 1982). Whereas other dimensions of children's understanding of time (e.g., duration, conventional time) have received considerable research attention, children's understanding of the temporal features of the future has been relatively overlooked. However, the future is a concept of considerable importance in human development. The development in children of representations of the future has been theoretically related to such fundamental processes as the ability to: a) delay gratification (Mischel, Shoda, & Rodriguez, 1989); b) plan behaviors and realize goals (Kreitler & Kreitler, 1987; Miller, Galanter, & Pribram, 1960); and c) establish a sense of self-identity that is stable over time (Damon & Hart, 1988; Guardo & Bohan, 1971; Mohr, 1978). In addition, the maintenance of a time perspective that integrates the future has been related to mental health in adults (Melges, 1982; Rappaport, 1990) and academic achievement in adolescents (Gjesme, 1979). But little is known about the processes by which children develop their concepts of the future and this topic has received little theoretical formulation and scant research attention.

Although linguistic concepts of time are relatively late in developing, due to their syntactic and semantic complexity, children under 5 years of age understand future tense and use future-reference terms (Harner, 1982). Numerous

studies have shown that, between the ages 5 and 10, children show tremendous growth in their understanding of temporal concepts (for review see Friedman, 1982; Levin & Zakay, 1989). During this period of development, children learn to a) distinguish temporal from spatial factors, b) use the symbols of *conventional time* (i.e., clocks and calendars), c) measure time quantitatively, and d) locate past events temporally. But the few studies of future time perspective (FTP) that used young children as participants are of limited value in understanding the process of development because:

1) The methodologies used for measuring FTP are of questionable reliability and validity. The primary methodology used has been projective instruments such as TAT cards and sentence completion tasks. These techniques, while possibly having a clinical use, are of questionable value when used as objective measures of personality factors, and their utility is even more questionable when they are used to measure a poorly defined concept such as FTP. Other studies used a questionnaire format (e.g., Sandham & Hicks, 1982, 1984), but children who do not have a coherent FTP are not apt to answer questions about their cognition of the future in a reliable manner.

2) The aspect of FTP usually measured is that of *extension*--defined as the span in chronological time that the individual thinks about. A long extension signifies that the individual thinks of the distant future, a short extension signifies that the individual is more occupied with near events. Lewin (1951) felt that FTP would become extended, covering broader spans of chronological time, as children

age, but this proved to be an overly simplified formulation. Lessing (1972) and Klineberg (1968) showed that children often have a greater extension than adolescents, perhaps because they are more prone to fantasy. Furthermore, measures of extension do not inform us about *how* children are representing the future, the degree of structure they employ, or the realism of their content.

3) The studies on children's FTP (e.g., Klineberg, 1968; Lessing, 1968, 1972) are not helpful in explaining the cognitive processing that children employ with FTP nor the development of that processing. These studies, rather than explaining the cognitive development of FTP, used FTP as the dependent variable in distinguishing between special populations of children: a) low vs. high SES, b) emotionally disturbed vs. non-emotionally disturbed, or c) boys vs. girls.

In summary, a literature search has revealed a significant absence of research which can inform us about the cognitive processes by which latency aged children come to understand the temporal aspects of the future. Given this lack of prior research, a study that uses some of the methodological and conceptual components of research in three related areas will be conducted. The relevant research literatures are: a) research on adolescents and adults regarding FTP; b) research on children's understanding of other time-related concepts, such as duration and temporal location of events in the past; and c) children's understanding of related concepts, such as spatial perspective.

CHAPTER 2

DEFINITION OF FTP

The literature on FTP contains a great deal of conceptual inconsistency and confusion. Different authors use different terms to refer to a similar construct or refer to the same construct with different terms. In summarizing this literature, Nuttin (1985) stated that, "scores of very heterogeneous studies on various aspects of psychological time, and using very different measurement instruments, are grouped under the heading *time perspective*...therefore, the comparability of their data is highly questionable" (pp. 15-16).

One of the first formulations of the importance of the future on human behavior was proposed by Lewin (1935), although the phrase, future time perspective, was first used by Frank (1939). Lewin felt that during development, aspects of the past and the future that are more distant from the present become integrated within the present; thus young children would have a short extension of FTP which would become longer as they age. It was this theoretical construct that led to the focus on extension in early FTP research with children. However, studies (Klineberg, 1968; Lessing, 1972) with emotionally disturbed children found that younger children with emotional problems have a longer extension as compared to children without such problems, while delinquent or disturbed adolescents have shorter FTP as compared with normal adolescents. And so, Lessing (1972) reframed Lewin's hypothesis to state that, "development is from an

egocentrically foreshortened to a culturally realistic view rather than from a short to a long prospective span" (p.467).

Extensive work on FTP has been carried out from the perspective of motivational psychology by Nuttin (1985) and his associates. According to Nuttin, time perspective consists of the objects which the individual has established as goals or events to be desired or avoided. From this perspective, FTP cannot be considered independent of its contents--it is not an empty space waiting to be filled. In addition, all of the contents of time perspective have an inherent temporal sign (i.e., location in chronological time). Therefore, in Nuttin's conceptualization, there are two aspects of FTP to be investigated: a) the contents of FTP, consisting of mental representations of future events or goals and b) the temporal dimension, which locates those events or goals within a temporal framework.

Nuttin (1985) further conceptualized time perspective as analogous to spatial perspective. Spatial perspective is created when there are two or more objects in the visual field and the sense of perspective is created by the relationship between the objects; this happens when one object is nearer the viewer than the other. Likewise, temporal perspective only comes into play when there are two or more objects located in a temporal field, and the sense of perspective comes from perceiving the relationship between the objects.

This study will focus on the temporal dimension of FTP. Nuttin's work was organized from a motivational psychology perspective, which is more focused on content, but the

content of conceptions of the future are not as relevant from an information processing perspective, in which the *how* of future perspective is more relevant than the *what*. However, it is also possible that an individual's FTP will vary across content areas (Trommsdorff, Bruger, & Füchsle, 1982). For example, a child might have a more densely structured and extended FTP in regard to family matters as compared with school-life, but the situation could be reversed for another child. This complicates the research process, particularly studies using projective techniques, because extraneous factors could result in subjects responding within one content area to the exclusion of others.

In a general way, FTP "refers to the ways in which people conceive of, organize, and feel about their future" (Lomranz, Shmotkin, & Katznelson,1983, p. 407). FTP will be defined in this study as those aspects of an individual's cognitions of the future which are structured within a time frame. Pure fantasy, for example, would not be a part of FTP because it does not have a temporal location. Events in the future can be temporally located by: a) placing them into a sequence relative to other events; b) reference to conventional time units (e.g., "it will happen in two months"); or c) terms, either specific or general, which refer to distance from the present (e.g., "a long time from now"). Furthermore, the analogy that Nuttin (1985) makes between temporal and spatial perspectives will be considered central to this conceptualization, that the relative distance between events creates the sense of perspective.

Components of FTP

Nuttin (1985) breaks time perspective into 4 measurable constructs: a) it's *extension* or length; b) the *density* with which objects are distributed within the time periods (past and future); c) the degree of *structuration* among those dispersed objects, such as the presence or absence of ties between objects or groups of objects; and d) the degree of *realism* with which the objects are perceived by the subject.

Density, as used by Nuttin, refers to a comparison between the quantity of past and future objects, and so it is not relevant for a discussion of FTP. Extension will be used here as it has been used in previous research, as indicating the furthest distance from the present of the temporal horizon. The two components of FTP discussed will be structuration and realism.

Structuration

Structuration will be used to refer to the organized pattern between events in the future. Comparisons have been made (e.g., Michon, 1985; Riegel, 1977) between development of the concept of time and the scales of measurement; nominal, ordinal, interval, and ratio. Development of structuration of FTP can be viewed as moving from an ordinal to an interval mode of organization. Ordinal relationships organize events in a linear sequence according to factors of before and after. Interval relationships, while maintaining ordinal positions, organize events with measurable intervals between events. An example of an ordinal relationship would be a child knowing that a trip to grandmother's will come after a birthday party. But knowledge of an interval

relationship would be the child knowing that the trip to grandmother's is in five days, which is three days after the birthday party in two days.

Using the metaphor of the measurement scales, we might say that young children understand future events initially by names or categories, such as bath-time or breakfast. As children develop, an ordinal relationship between events is used and the future becomes organized according to sequences of what comes before and what comes after. An interval scale is used when children come to know about the proportional relationship between durations and the standardized metric of clocks and calendars that can be used to calculate those relationships. A ratio scale comes about when children are able to use a true zero of arbitrary temporal reference points to perform calculations of time intervals.

Event-Schemas

There is also a large body of research on *event-schemas* (see Mandler, 1984; Nelson 1986) that has relevance for structuration of FTP. Schemas are organized and unconscious mental structures that are used to comprehend new information (Bartlett, 1932). Developmental research on schema theory has followed the ideas of Schank and Abelson (1977) on *scripts*; scripts are schemas for events that contain temporal and causal sequences in specific contexts (e.g., grocery shopping, going to a restaurant). For example, Fivush (1984) found that children, after just their first day of kindergarten, developed scripts with temporal sequence. Event-schemas, according to the measurement-scales metaphor, are an ordinal organization of FTP.

Schemas are thought to guide attention, retention, and retrieval. Because they direct attention towards the abstract or general knowledge of the schema, there can be a distortion of perception or memory when the specifics of an event violate some of the facts of a schema (Farrar & Goodman, 1990). "Distortions in recalling specific episodes occur as what *actually* happened is confused with what *typically* happens based on script knowledge" (Hudson, 1993, p. 157).

The development of event-schemas can be understood as an extension of children's perception of the temporal property of succession. Nelson (1986) concluded that event-schemas are the basic building block of cognition from which more complex cognitive skills develop. Perception of succession appears to be intuitive; infants perceive stimuli sequentially (Bauer & Mandler, 1992) and a review of cross-cultural data does not reveal evidence that any other culture perceives time nonsequentially (Friedman, 1990a).

Research on event-schemas have shown that children construct temporal sequences of events fairly automatically. However, Friedman (1992) suggested that when longer periods of time are involved, memory for events in the past resembles "islands of time;" specific details are recalled, but the relationship between these islands of memories is not developed. Specifically, children as old as eight years had some difficulty in ordering the sequence of events, despite being able to verbalize a unique feature for each event.

The schematic organization of events is likely to be a major component of the structuration of FTP. It is also likely that children's event-schemas represent time in

patterns that follow natural intervals, such as the daily cycle. Friedman (1977) asked children to order cards showing daily events, and they started the events with the beginning of the day when they woke up. They had more difficulty ordering the cards correctly when they used a different starting point. He found that children's ability to order the cards with different starting points came about 2 years after their ability to order the cards starting with the beginning of the day, with age of mastery ranging from about 8 to 8 1/2 years.

Realism

Realism of FTP is a complex construct that probably incorporates several distinct abilities. It can be operationally defined as the presence of a meaningful relationship among knowledge of the past, present conditions, and representations of the future. Realism can be understood by looking at two cognitive processes, *forecasting* and *planning*, that demand that the child have a relatively complex and accurate representation of the future.

One important component of children's FTP involves their ability to predict, or forecast, what will happen in the future. In some instances, the prediction will not be precise but the child will need to establish some probabilities of an event's likelihood of occurrence. A critical aspect of forecasting is the ability to see the present in relationship to the past and to use that information to realistically project into the future. At times forecasting entails the recognition of a causal sequence (e.g., predicting growth of a plant based on a linear pattern of past and present states)

while, at other times, forecasting will be based upon recognition of repeated events (e.g., predicting events at a birthday party based on events at previous parties). Forecasting of repeated events will probably rely upon event-schemas for that content area.

Forecasting also requires that the child understand the relationship between change and constancy and, for those features that are changing, the child also needs to know something about the rate of change. For example, a child who thinks about family relationships in the future needs to take into account many different factors. Self-identity is a constant and will not change. Physical appearance changes in some ways (e.g., height), but not in others (e.g., eye color). Age changes in a linear and predictable fashion, but relative ages do not (e.g., an older brother will always be the same amount older). And some changes seem to happen faster than others. And so, the child who contemplates a date in the future needs to coordinate many levels of change and constancy.

The other cognitive process that requires realism of FTP is planning. Planning involves the capacity to represent a future goal and then create a strategy of behavior for reaching that goal. Planning organizes future behavior with a specific purpose and it can be compared to the creation of a cognitive map. Plans vary in the degree to which the goal is known in advance; plans with a clearer goal will have a more stable and detailed representation. All planning involves goals that are located in the future, but the degree to which the temporal element becomes an important feature of the plan

will vary with the particular goal being sought. Goals which require several distinct steps to be reached, and where those steps have different durations and rates of change, will require a greater degree of realism of FTP.

In their study on the cognitive development of planning, Kreitler and Kreitler (1987) asked 4 groups of children (N = 200; ages 5, 7, 9, and 11); "When will you carry out the things you plan?" The results showed a clear developmental progression in extension, which seemed to support Lewin's (1951) conception of FTP. The youngest children mentioned plans for acts expected to occur in the immediate future (defined as within minutes to a week) but older children were more likely to have plans for the near (one to four weeks) or far (more than 2 months) futures. The largest shift from plans for the immediate future to plans for the near future occurred between 7 and 9 years of age; while the shift toward including the far future into plans occurred between 9 and 11 years of age. There was also a steady developmental increase in the percentage of children who considered plans for different points in time. The authors concluded that "one of the implications of these findings is that in order to train children's ability to plan, one should first increase their time perspective" (p. 219); and by time perspective they seemed to be referring to extension.

Another term which is sometimes used in the FTP literature is *temporal dominance*. This refers to the degree to which an individual has the majority of his/her thoughts located within one of the *time zones*, either the past or the future. For example, it has been hypothesized that adults who

are depressed are dominated by thoughts of the past (e.g., Melges, 1982; Rappaport, 1990) and this trait has been referred to as *past orientation*.

The term *future orientation* will refer to the tendency of children to think about the future and to integrate information about future consequences into present behavior, cognition, and attitudes. This construct would be theoretically linked to abilities such as the capacity to delay gratification. There is likely to be individual differences in the degree of past or future orientation among children, but this has not been researched. FTP can be conceptually distinguished from future orientation. For example, it is possible that a child might have the cognitive tools to conceptualize the future in a structured and realistic sense (i.e., a high FTP) but, by nature of personality or conditioning, might not be inclined to act in a manner that takes into account future consequences (i.e., a low future orientation).

CHAPTER 3

DEVELOPMENT OF FTP

The earliest stages of children's ability to comprehend the future probably comes with object constancy. Children less than one year of age are able to maintain a visual image of an object which is not perceptually present; they are able to use that image as a goal and direct their behaviors to reach that goal (Gratch, 1972; Piaget, 1954). Fraisse (1982) proposed that children have biological temporal processes that become adapted to periodic durations in the environment, and this conditioning provides information about temporal phenomena that the child gradually becomes aware of and utilizes.

The development of language clearly aids in the process of understanding the future (Harner, 1982). Children between the ages of 3 and 5 are able to separate past, present, and future in their expressive language and children understand references to action in the past or the future even earlier (Crain, 1982; Harner, 1982; Stevenson & Pollitt, 1987). However, for young children the past and future are mostly undifferentiated; for example, children under five years of age will often speak of yesterday as referring to anything in the past. Development of a FTP requires that children become decentered from the egocentric position that focuses on their present needs.

Another critical aspect of the development of FTP is the role played by the socio-cultural environment. FTP, and related concepts such as the capacity to delay gratification,

have been correlated with social class (e.g., Lomranz, Shmotkin, & Katznelson, 1983). Other research has shown that planning strategies improve when future goals are worked on cooperatively by more than one child (Rogoff, Gauvain, & Gardner, 1987). And significant correlations were found between the number of statements mothers made to their children containing a reference to time and scores of children at age three on seriation tasks of the McCarthy Scales (Norton, 1993). This research shows that the development of FTP will be affected by the beliefs and attitudes of the people and the culture in which children are raised.

CHAPTER 4

INFORMATION PROCESSING OF FTP

The Past and the Future

The role played by representations of the past in children's FTP has been almost completely ignored, yet the past probably plays a critical role in those representations. It can be assumed that children (and adults) initially look to the past, or event-schemas built out of past experience, for meaningful information when thinking about expectations for the future. A child in the third grade knows roughly what to expect of going to school on a Monday based on previous experience. But the same child will likely have a very different affective response to taking a plane trip for the first time because there is no previous experience from which a representation of that future can be created. The ways in which children use the past to build representations of the future will vary, based upon factors such as how frequently the past experience has been repeated and how salient the memory for the relevant past experience is. One important difference between the past and the future, as noted by Melges (1990), is that whereas the past is built on perceptions, and reconstruction in memory of those perceptions, the future is a more purely cognitive process.

The temporal relationship between the past and the future has both linear and cyclic aspects, and different tasks will elicit either a linear or a cyclic problem-solving approach. At times, the future will be seen as one section of a timeline which runs from the past and through the present.

For example, events which are located by chronological age encourage the use of a linear model to conceptualize dates in the future. At other times, the future is seen, not as a continuous line, but as a series of cycles or *chunks* of time. Children who measure future time by what grade they will be in are using a cyclic model of FTP.

Conventional Time and FTP

Another neglected aspect of children's FTP is the role played by their knowledge of conventional time. Children below the age of 6 have memories for events in the past but are rarely able to locate the events, or link events to each other, using long-scale conventional time markers (Friedman, 1992). In an experiment that looked at children's memory for the timing of past events, Friedman (1991) found that children as young as four years of age could judge the relative recency of events in the past, and remember the time of day of an event even after a long delay, however they could not locate the event within other time patterns, such as month or day of the week. Children who were six years old were able to make use of time systems longer than a day to locate an event. Friedman concluded that there are two, relatively independent, ways in which humans locate events in the past; as a distance from the present and through location in time patterns. It is likely that, "children's ability to localize past events in time is limited by the extent of their knowledge about particular time scales. Once they develop representations of a time pattern, children can use them to structure their past" (Friedman, 1991, p. 154). It is possible that knowledge of time scales is also needed for

structuration of events in the future, but this hypothesis has never been tested.

Location of events in the past is helpful for location of events in the future when the future event repeats a pattern; such as the knowledge that next Monday there will be an art class because many of the previous Mondays have had the art class. However, because the recency of events in the past is accessed through memory processes that are not available when projecting into the future, it is possible that the presence of an script or knowledge of conventional time is even more critical when locating future events.

Children are generally taught to read a clock and recite the days of the week or months of the year when they enter school. Friedman (1986, 1990b) has shown that children first learn about conventional time by verbal lists, such as reciting the days of the week in the proper sequence but, as they approach ages 8 or 9, they start to use spatial imagery to represent conventional time. Spatial imagery is more efficient for various kinds of problem solving--such as calculating backwards order and judging the relative distances between nonsequential elements. Friedman (1986) used reaction time as a measure of whether a problem was solved with verbal list or imagery representations because the latter allows for a faster solution of problems that relate elements when the coding is not dependent upon a unidirectional sequence of elements, as they are in verbal lists. Friedman also found that development of spatial imagery does not reach adult levels of competence until early- to mid-adolescence.

Representations of Durational Chunks

Some aspects of FTP require that a child project a specific duration into the future. The representation of *durational chunks* within a FTP requires an understanding of conventional time units as well as an internal experience that is calibrated in relation to certain chunks of chronological units. An example of this process would be when a parent tells a child that he or she will arrive home in 20 minutes. This answer is meaningful to the child when: a) there is an understanding of both the number 20 and the unit of a minute, and some integration of both concepts into a whole and b) when there is a representation of a reference event to which 20 minutes can be compared. For example, 20 minutes might be the same length as a piano lesson which has been repeated often enough for the child to have built a representation of that duration.

As children's understanding of the subjective perception of time becomes integrated with their FTP, they will understand that different classes of events will be experienced differently. For example, 20 minutes of driving in a car might feel longer than 20 minutes of a TV program. Children who understand this can adjust their expectations accordingly.

Conversion of Temporal into Spatial Images

One way in which the literature on time perspective is similar to that of other aspects of psychological time is in the close relationship between temporal and spatial concepts. The future is an abstract concept and cannot be conceptualized unless it is given some physical form. This

form could be a timeline, a mental image of a clock or a calendar, or some idiosyncratic image.

Clark (1973) theorized a developmental progression in which children first build a concept of space and then acquire language which expresses those concepts. The child then constructs a language about time which is analogous to that of space. Piaget believed that children's confusion about time came about due to their inability to separate the concept of time from its spatial properties (e.g., distance covered and velocity of motion). And Nuttin (1985), in his explanation of time perspective, compares the creation of time perspective, where events are placed sequentially into the temporal field, to the perception of spatial perspective, where different objects are viewed in relationship to each other in a visual field.

From the literature on children's development of spatial perspective comes the argument that this knowledge might be better viewed as a process rather than as a content. For example, Gauvain (1993) states that,

> Spatial knowledge may not be a general, underlying 'piece' of knowledge which exists inside the head and is externalized for use when needed. In other words, spatial understanding may not be separate from the activity in which the knowledge is used and, thus, may be less like a representation, such as a route or a map, and more like a problem solving process (p. 93).

FTP and Intelligence

A number of studies have linked FTP with academic achievement (e.g., Gjesme, 1979), and academic achievement is highly correlated with most measures of general intelligence. In their study on planning in children, Kreitler and Kreitler

(1987) identified eleven planning variables, and the variable that was most highly correlated with a measure of intelligence was the number of chronological orderings in children's plans. Several curriculum programs for gifted children explicitly teach future problem solving. It is likely that measures of FTP will correlate highly with intelligence, and perhaps the correlation is so large that FTP will not have relevance as an independent construct but would be better viewed as a, relatively unexplored, component of *g*.

CHAPTER 5

RESEARCH PROPOSAL

This study will attempt to identify some of the cognitive processes involved in children's development of FTP. The study will compare structuration of future and past zones and data will be collected and compared for two durations, the *day-scale* and the *year-scale*. The impact of children's knowledge of conventional time on the structuration of FTP will also be studied. Given the lack of prior research in this area, the primary focus of this study will be exploratory with goals of a) obtaining descriptive information about the development of FTP and b) developing useful hypotheses that will indicate directions for future research. In addition to these general goals, several more specific hypotheses will be tested.

Research Design

Two types of tasks will be administered to participants; a timeline task that will give scores on structuration and a test that will assess participants' knowledge of conventional time. Four trials of a timeline task will be given: a) *past(day)*, b) *future(day)*, c) *past(year)*, and d) *future(year)*. Results from the timelines will be used to compare participants' structuration of zones (i.e., past vs. future) and scales (i.e., day vs. year). On the two day-scale timelines, participants will be asked to locate five *event-cards* representing events from their typical school day schedule; Eat Breakfast, Morning Recess, School Lunch, School Is Out, and Go To Bed. On the year-scale timelines,

participants will locate five event-cards representing recurrent and notable yearly events; First Day of School, Halloween, Christmas, Birthday, and Last Day of School.

The first part of the test on conventional time will assess participants' knowledge about the clock times and calendar dates of the events represented on the event-cards; referred to as *event(day)* and *event(year)* respectively. The second part of the test will assess participants' general knowledge of conventional time for the two scales, and these will be referred to as *measured(day)* and *measured(year)*.

Conventional time scores will be analyzed for the purpose of clarifying the cognitive processing that participants used in their structuration of timelines. This analysis will attempt to chart the transition from an *ordinal* to an *interval* process in the location of event-cards. It will be assumed that spatial-image representations of conventional time are needed for interval locations, since verbal-lists and ordinal coding provide little information about measured intervals.

Various studies on children and the concept of time have shown that significant growth occurs between the ages of 6 and 10 (for review see Friedman, 1982, 1990a; Levin & Zakay, 1989). By age 10, most children have a general understanding of conventional time and are able to understand that time measures are separate from their subjective experience of time passing. However, their understanding of the concept of time is somewhat tenuous and there are levels of understanding which are not reached until adolescence; for example, understanding that time measures are arbitrary. As a

means of gaining information regarding the developmental sequence of FTP concepts, four groups of subjects; 7, 8, 9, and 10 years of age; will be used. By focusing on this transitional age, when understanding of FTP is starting but not complete, it is anticipated that an analysis of demonstrated abilities and error patterns will provide some clues regarding developmental processes.

Research Hypotheses

The hypotheses proposed are that:

1. There will be a general developmental trend across the four grade levels on both the timeline tasks and the conventional time tests. Timeline tasks will also show a developmental increase in the use of an interval strategy in the location of event-cards.

2. Structuration of the day-scale will be acquired before structuration of the year-scale due to the greater processing demands of the longer duration.

3. Structuration of the past will be acquired before structuration of the future, due to the facilitation of memory in performance of past timelines.

4. Knowledge of conventional time is needed for structuration of longer durations. The younger participants in this study, whose knowledge of conventional time is not as well developed as that of the older participants, will not use this information in their structuration of year-scale timelines, but the older participants will have started to do so.

CHAPTER 6

METHODS

Participants

Participants were 167 children selected from 3 of the 4 elementary schools in a small city of about 30,000 in the northeastern United States. The vast majority of participants were Caucasian with a minority of Latino- and Asian-Americans.

Permission slips were sent home with all children in the targeted grades (see Appendix A). The notice informed parents that the research had to do with children's understanding of the concept of time but asked them not to prepare their children by discussing this topic. Of the approximately 750 permission slips sent home, about 25-30% were returned, of which about 15% were refusals. Principals in each school were asked to go through the list of students for whom parental permission was received and exclude from the testing those students who had: a) an individualized education plan (IEP), b) a diagnosed attentional or emotional disorder, or c) limited English proficiency such that the student would have problems with understanding test directions and tasks. These exclusions eliminated about 10-15% of the students for whom parental permission had been received.

Testing started near the end of a school year with participants in grades 1, 2, 3, and 4. When testing resumed the following fall, the same cohort of participants were followed into the next grade, and so the grade levels tested in the fall were 2, 3, 4, and 5; therefore the same cohort

(but not grades) of participants were tested in the spring and the fall. This decision was based on a preliminary examination of results from the spring testing. Fourth graders had not reached the ceiling of performance on the timeline tasks and it was felt that beginning first grade students could be overwhelmed by the demands of this testing. The four groups of participants will be referred to henceforth as grades 1, 2, 3, and 4.

Sixty participants were tested in the first school during the two weeks prior to the end of an academic year. The testing of 62 participants in the second school was conducted between Oct. 12 and Nov. 2. The testing of 45 participants in the third school was completed between Nov. 9 and Nov. 30. No differences in the student population of the three schools in regards to SES and ethnic background were evident. All of the testing was done on a Tuesday, Wednesday, or Thursday to ensure that, for the timeline tasks, a day in the past and a day in the future would be school days with the same schedule of events.

Table 1 describes the sample by grade level, gender, and age. Grade 1 included a disproportionate number of female participants and gender differences were tested for in the data analysis.

Table 1: Number, Sex, and Age of Sample

Grade	Male	Female	Total	Mean Age
1	13	26	39	7.4
2	20	20	40	8.5
3	19	22	41	9.5
4	21	26	47	10.5
Total	73	94	167	9.0

Materials

Timelines were made from heavy matte board and measured 13 by 123 cm; they were constructed with two identical boards, each 13 by 61.5 cm, that were taped together to facilitate mobility. The timeline itself was a thick black line drawn to extend the horizontal length of the board. There were three short, black, vertical lines drawn slightly more than 1 cm above and below the timeline which denoted the *present*, *past*, and *future reference points* (see Figure 1, page 38). The distance from the reference points in the past and the future to the present reference point was 60 cm. The timeline used for teaching and demonstration had velcro extending the entire length of the board, but the four timelines used by participants had velcro only on the past or future half, depending on which time zone was being assessed. Thus, the velcro identified the side on which participants needed to place the event-cards. In addition, each timeline was labeled on the bottom for the scale and zone being assessed (e.g., Past Day, Future Year). The zone not being assessed was also identified by zone, but without mention of a scale (i.e., day or year). On the demonstration timeline, the present reference point was marked with the word "present" but on the timelines used by participants the reference point was marked with the word "now" to avoid confusion resulting from the multiple meanings of the word "present."

The pictures on the event-cards were selected from children's books and other sources. They were mounted on matte board with an arrow pointing down from the picture (see

Appendix B). Pictures were chosen based on the ease of identifying the chosen event and words were written on the top of each picture to further identify the event. The event-cards contained velcro on the back such that when they were attached to the velcro of the matte board, the arrows would point onto the timeline.

Participants' were given a test to assess their knowledge of conventional time. The questions were read aloud and a four page answer sheet with 33 items was used by each participant (see Appendix C) for marking their answers. The last two items were dropped from the study and two other questions were scored as halves of one item. And so, 30 scored items were used from participants' answers. The answer sheet was designed to provide a large number of visual cues, to complement the auditory reading of questions, while preventing participants from reading ahead and answering questions prematurely and also eliminating clues to answers of other questions (e.g., the name of a day of the week).

Procedures

Participants were tested in groups of four and, in almost all instances, members of each group were from the same grade. Participants were brought to a room in the school that had been set up for the purpose of conducting this research. The room was arranged with four chairs in a semi-circle around the demonstration timeline at one end of the room. In the middle of the room was a large rectangular table with wooden barriers, 38.5 cm (15 inches) in height, separating the table into four cubicles. The four timelines were placed, one in each cubicle, with the five event-cards for that

timeline stacked face down in the cubicles, next to the barrier.

Upon entering the room, participants were directed to the four seats facing the demonstration timeline. The clock in the room was covered and participants who had wristwatches were asked to remove them for the duration of the testing. Most of the children knew nothing about the testing. A minority had been told, by schoolmates who had been previously tested or by their parents based on the information in the permission slips, that the tasks had something to do with time.

Children were told that they would be taking part in a research experiment to find out what they knew about time. They were introduced to the demonstration timeline and shown the reference points for the present, future, and past. Participants were asked for a definition of the present and, after responses were briefly discussed, were told that:

> The present is what is happening now. Right now you are sitting here, looking at the timeline, and listening to me explain about the work we will be doing. Let's talk more about the present. What day is it? What is the date? What time is it?

Participants were engaged in a classroom-style instruction until all seemed to understand that the middle reference point of the timeline represented the present and each participant could state the current day of the week, date, and time. Participants were told that they would be:

> working with different timelines--timelines that represent a day in time and a year in time--but one important thing to remember about all the timelines is that the middle of all the timelines--this line-- is always the present; and the present right now is [for example] Wednesday, October 12th, 1994 at about 9:30 in the morning.

The word "future" on the demonstration timeline was pointed to, participants were prompted to read the word and were instructed that "everything on this side of the timeline is the future." Definitions of the future were solicited from participants and then they were told that:

> the future is everything that is going to happen but that hasn't happened yet. When you are finished working with me you will leave this room and go back to your classroom, and that will be the future; but that is a future that is fairly close to the present, so it might be represented on the timeline here, just a little away from the present. When you graduate from elementary school, that will be further away in the future, and we might say it would happen further down the timeline here. And when you get married, that will be way down here somewhere...

The word "past" on the demonstration timeline was pointed to, participants were prompted to read the word and were instructed that "everything on this side of the timeline is the past." Definitions of the past were solicited from participants and then they were told that:

> The past is everything that has already happened. When we walked into this room, just a few minutes ago, that is in the past. On the timeline we might say that that would be about here, on the side of the timeline showing things that have already happened in the past, but it would be close to the present because it was just a little while ago. When you started school in kindergarten that would be further into the past and when you were a baby first learning to talk or walk that might be all the way down here. So the further you go from now, either into the past or the future, the further you go down the line away from the present.

Then the timeline, with the location of event-cards, was demonstrated for a week scale. A picture of a man was put on the present reference point with the direction that that represented the experimenter, "right now." The reference points of a week in the past and the future were identified

with their day, date and time while reminding subjects that the present stays the same. Two events were used to model the process of locating event-cards, going for a jog and a family drive. Several concepts using those two event-cards for the week scale were demonstrated; events close to the present should be located near the present reference point on the timeline (e.g., "if I go jogging right after school, then I'll put the card soon after the present, on the side showing the future"), events close to each other in time should be near to each other on the timeline, and events that were further from the present should be located on the timeline further away from the present.

Children were then asked whether they had any questions about the timelines before they were allowed to randomly choose a cubicle. As each participant was seated, he or she was given a gender-appropriate picture of a child mounted on a matte board with an arrow, in the fashion of the event-cards. Participants were told that, even though the pictures didn't look very much like them, they were to pretend that the boy or girl was them. When they sat down at the timelines, they were told to put the boy or girl on the present reference point to represent them right now. The day, date, and time of the present was repeated again. Then participants were instructed to look at the timeline they were working on and they were asked:

> Was it a timeline for a day or for a year? Was it a timeline for the past or the future? And you should also think about what that other line in the past or the future represents before placing the cards on the timeline.

Some children commented that, unlike the demonstration timeline, there was velcro on only one side (i.e., zone) of the timeline. In response to these questions, they were told that some of them were locating events for the past and others for the future and the label identifying the zone and scale being assessed was pointed out for each participant. When children were ready, they took the five event-cards and started the task. On a few occasions, participants tried to put event-cards in the wrong zone, the one without velcro. This response was not accepted and participants were instructed to place the card where it belonged, again with the prompt regarding the reference points:

> Think about what the day, date, and time are for the present and then think about that other line in the past or future. What day, date or time would that represent? You need to locate the events where they belong between those two lines.

Participants were instructed to work carefully and to try and give their best answer. They were also encouraged to rearrange the cards until they were satisfied that the whole timeline seemed correct to them. When they were done they were to raise their hands and their responses were recorded. Locations of each event-card were recorded as distance in centimeters from the reference point, reading left to right; thus the zero-point of the ruler was set at the present reference point for the future trials and at the past reference point for the past trials.

After the answers for each participant were recorded, the event-cards were removed and stacked next to the barrier. When the productions of all four participants were recorded, participants were instructed to take their person-card and

move clockwise around the table to the next cubicle. Each time they moved, the instructions regarding the placement of the figure on the present, and the cuing regarding the reference points, was repeated. The procedure was repeated until all participants had completed all four timelines.

Participants stayed at the cubicles while taking the test that yielded scores of event and measured time (see Appendix D). They were each given a pencil and an answer sheet, on which they were to write their answers, while the questions were read aloud. Prior to starting, participants were instructed that they were not to skip ahead nor were they to go back and answer previous questions. Participants were also told that some of the questions had a time limit and they might not have enough time to figure out the answers. If they were not sure about an answer when the next question was started, they should take a guess or leave it blank. They were also told that spelling didn't count and they could use abbreviations.

The first five questions assessed knowledge of event(day). These questions asked participants to write the clock time of the five events pictured on the event-cards of the day-scale timelines. For the Go To Bed and Eat Breakfast event-cards, participants were told that, even though the time they did those actions might be different on different days, they were to write down the time of the events on a "typical school day."

The next five questions assessed knowledge of event(year). These questions asked participants to write the name of the month of the five events of the year-scale

timelines. Then they were asked to write the date of the event or, if they weren't sure about the exact date, they could circle the word beginning, middle, or end to indicate that the event in question comes at the beginning, middle, or end of the month they had written.

Questions 11 to 20 assessed participants' knowledge of measured(day) and questions 21 to 31, knowledge of measured(year). Some of these questions assessed factual knowledge (e.g., how many hours in a day), but most were designed to favor those who had spatial-image representations of the information. This was accomplished by asking questions which would be difficult to solve with a strictly verbal-list method of coding (e.g., calculating backwards order of elements) and by limiting the amount of time for responses, since verbal-list problem-solving is slower.

Questions 17 to 20 were introduced with specific instructions and an example. Participants were told that questions would be asked about which day is closer, such as; "Which day is closer to Sunday, Saturday or Wednesday?" Children volunteered that the answer was Saturday. They were told that:

> even though, if you say the days of the week starting with Sunday, you would come to Wednesday first, Saturday is closer to Sunday because it comes just before it. So, you should answer with the day that is closer, whether you figure forwards or backwards through the days of the week.

At question 28, participants were told that:

> we will be doing questions like we did before when we asked about which day was closer, but now we will be using months of the year. But again I will be asking about which month is closer, whether that means going forwards or backwards.

No other example was given. Answer sheets were scanned before participants left the room to make certain that the answers were legible. Participants were given stickers at the completion of testing.

Scoring

Timelines were scored by numbering event-cards from one to five in correspondence with the smallest to the largest distance from the left reference point produced during the testing. Then the correct order of event-cards, given the time (day-scale) and date (year-scale) of testing, was recorded next to the order produced by the participant. When the produced order was identical to the correct order, that timeline was scored with two points. This response will be referred to as *correct order*. If it was not identical, the produced order was examined to see if the five event-cards were in the correct sequence; if it was, the timeline trial was scored with one point. This response will be referred to as *correct sequence*. For example, on the day-scale timelines many participants placed the Eat Breakfast event-card first (i.e., furthest to the left and with the smallest recorded distance from the left reference point) followed by Morning Recess, School Lunch, School Is Out, and Go To Bed. This pattern follows a correct sequence and was scored with one point, although the *starting point* (i.e., the card on the left) should have been one of the school-based event-cards; such as School Lunch if testing was at 11:00 a.m. or School Is Out if testing was at 2:00 p.m.. If the produced order did not reflect a correct sequence of events, then the trial was given zero points and called *incorrect sequence*. This method

of scoring was used in most of the data analyses and will henceforth be referred to as *serial scoring*. Other methods of recoding the data, done to highlight different aspects of problem solving, will be described in the analysis section.

The four tests that measured knowledge of conventional time; event(day), event(year), measured(day), and measured(year); were each scored on a scale of 0 to 10 points. There were five questions each for event(day) and event(year) and each item was scored with either 0, 1, or 2 points. For event(day), the scoring of the event-cards Morning Recess, School Lunch, and School Is Out was 2 points when participant answered with a time within 15 minutes of correct, 1 point for times between 15 and 30 minutes of correct, and 0 points for times more than 30 minutes from the correct time. For example, if school lunch for a grade 4 participant lasted from 12:00 to 12:20, any response between 11:45 and 12:35 was scored with 2 points. For event-cards Eating Breakfast and Go To Bed, 2 points were scored for responses that were reasonable (e.g., anytime between 7 and 8:30 a.m. for Eating Breakfast), 1 point for responses that were possible but unlikely (e.g., Eating Breakfast at 6 a.m.), and 0 points for responses that were blank or obviously wrong.

On the event(year) test, responses were given 1 point when the participant correctly identified the month of the event-card. If the month was identified correctly, the 2nd point for the item was awarded if the participant either: a) identified the correct date within one day or b) circled the correct qualifier of beginning, middle, or end of the month.

For Christmas and Last Day of School, either middle or end of the month was accepted as correct.

The measured(day) test had ten items and was scored as either correct or incorrect with one point apiece. The conventional(year) test had eleven items. Questions 24 and 25 asked about the four seasons and participants were given one-half point for identifying the four seasons and the other half for putting the seasons in the correct order. The rest of the questions were scored as either correct or incorrect with one point apiece.

Birthdays for participants were obtained from school records as were scores on the Gates-MacGinitie Reading Test (GMRT). Scores on the GMRT were used as a covariate in some of the data analyses. The GMRT was routinely given to all students in the school district once a year, and so this test was chosen due to its availability in the schools' files on each participant and the generally high correlation between reading ability and *g*.

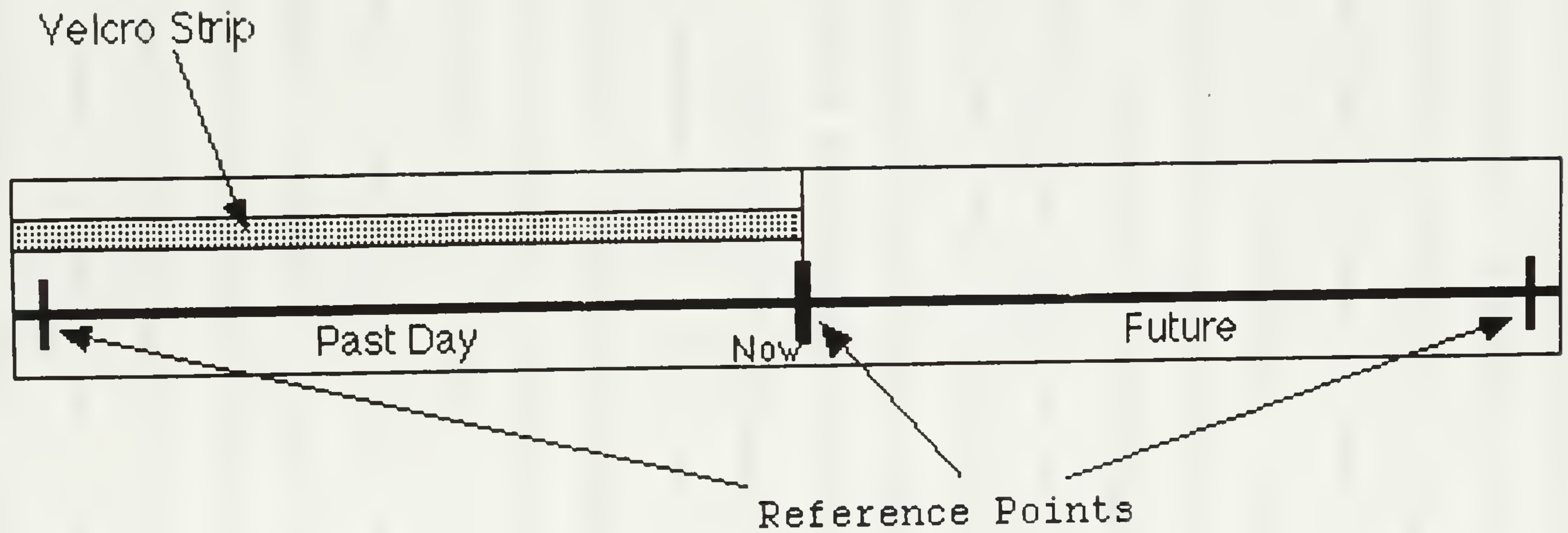


Figure 1. Timeline for the Past(Day)

CHAPTER 7

RESULTS

This study was designed to explore children's structuration of FTP with differences analyzed for factors of zone (i.e., past vs. future) and scale (i.e., day vs. year). Data was collected from four trials of the timeline task given to each participant: past(day), future(day), past(year), and future(year). In addition, a test yielding four scores was given to assess participants' knowledge of conventional time with the assumption that these scores would aid in understanding the kind of processing that the participants used when performing the timeline tasks. Several types of analyses were used to give different perspectives on problem-solving strategies used by participants.

Testing for Effects of Gender

It was assumed that there would be no difference between the performance of males and females on the timeline tasks. To test this assumption, a mixed design MANOVA was used with two repeated measures of scale (2 levels, day and year) and zone (2 levels, past and future) as dependent variables and two independent variables; grade and gender. Results showed that there was not a significant difference between scores by male and female participants ($F=.05$; $p=.827$) and there was not a significant interaction between grade and gender ($F=.14$, $p=.939$). As a result, gender will not be a variable in the remainder of the analyses.

Testing for Order Effects

The testing methods used in this study were designed to control for differences between participants resulting from the order in which they performed the four timeline trials. To determine whether there was an order effect, and to see whether there was a practice effect as participants progressed through the timeline testing, a series of sixteen chi square analyses were conducted--one analysis for each grade level on each timeline task. In each chi square, there were three rows for the serial scores on the timeline tasks (0, 1, or 2) and there were four columns representing the order in which that timeline trial was performed (first, second, third, or fourth). Of the sixteen analyses, only one yielded significant results; participants in the third grade had significant differences in the expected versus produced counts on the past(day) timeline. Participants in grade 3 who did the past(day) timeline first had a higher than expected number of correct sequence scores and participants who did that timeline third had more than expected incorrect sequences. These results indicate that there was not a practice effect in the performance of timelines; children did not learn the task such that later trials were easier than earlier trials. Given the lack of significance on other timelines, and on the past(day) by other grade levels, it is hard to know how to interpret these results. Order effects will not be factored into further analyses.

Analysis of Serial Scoring

In the serial scoring, timeline trials were scored as either 0, 1, or 2 points for incorrect sequence, correct

sequence, and correct order respectively. The statistical probability of producing correct order by chance is 1/120 while the probability of producing correct sequence by chance is 1/30--excluding correct order. Correct order is actually a subset of correct sequence but is treated here as a separate category. The probability of correct order or sequence is 1/24. Table 2 shows the distribution of serial scores for each grade level on the four timeline trials and Table 3 (page 42) shows the means and standard deviations resulting from those scores.

Table 2: Distribution of Serial Scores on Timeline Trials

Grade	Past(day)	Future(day)	Past(year)	Future(year)	Total
1					
score:0	19	8	31	22	80(51%)
1	18	28	7	13	66(42%)
2	2	3	1	4	10(6%)
2					
score:0	12	4	18	14	48(30%)
1	26	29	17	16	88(55%)
2	2	7	5	10	24(15%)
3					
score:0	13	1	19	13	46(28%)
1	22	34	13	15	84(51%)
2	6	6	9	13	34(21%)
4					
score:0	6	2	18	11	37(20%)
1	28	30	9	13	80(43%)
2	13	15	20	23	71(37%)
Total					
score: 0	50(30%)	15(9%)	86(51%)	60(36%)	
1	94(56%)	121(72%)	46(28%)	57(34%)	
2	23(14%)	31(19%)	35(21%)	50(30%)	

Table 3: Means (and Standard Deviations) of Serial Scores

Grade	Past(day)	Past(year)	Future(day)	Future(year)
1	.56(.60)	.87(.52)	.23(.48)	.54(.68)
2	.75(.54)	1.08(.53)	.68(.69)	.90(.78)
3	.83(.67)	1.12(.40)	.76(.80)	1.00(.81)
4	1.14(.62)	1.28(.54)	1.04(.91)	1.26(.82)
Total	.84(.64)	1.10(.52)	.68(.80)	.94(.81)

The preponderance of correct sequences, particularly in the day-scale trials, indicates that many participants were using event-schemas to solve the timeline tasks, often independent of the given reference points. Most of the participants who produced the correct sequence for past(day) and future(day) began with the Eating Breakfast event-card (65% on past[day], 77% on future[day]). The next most common starting point was Go To Bed, which was produced by 32% of those participants who produced a correct sequence on the past(day), 20% on future(day), timelines.

Of the participants who produced the correct sequence on past(year) and future(year) timelines, 80% and 75% respectively started with the First Day of School. The next most common starting point was Your Birthday, recorded by 11% of participants on past(year) and 12% on future(year).

Analysis of this data was conducted with a 2 X 2 X 4 mixed design MANOVA with scale (2 levels, year and day) and zone (2 levels, past and future) used as repeated measures of the dependent variables and grade (4 levels) as the independent variable (see Table 4, page 43).

Table 4: MANOVA of Serial Scores

	Sum of Squares	df	Mean Squares	F	*p*
Between Subjects	34.28	3	11.43	13.65	.000
Within Subjects					
Scale	3.99	1	3.99	8.91	.003
Zone	10.83	1	10.83	37.98	.000
Scale X Zone	.01	1	.01	.05	.826
Between X Within					
Scale X Grade	1.80	3	.60	1.34	.264
Zone X Grade	.47	3	.16	.55	.651
Scale X Zone X Grade	.20	3	.07	.31	.816

The results show highly significant main effects for scale and zone across levels of grade but there were no significant interactions between any of those factors. Participants scored significantly higher on the future than on the past zone and significantly higher on day than on year scale. Post-hoc analyses of grade differences showed significant differences between all grade levels ($p < .01$) with one exception. Participants in grades 2 and 3 did not differ significantly in their performance.

Another way of analyzing the data is to look at the development of children's ability to sequence events, independent of the correct starting point. This was done by collapsing the serial scores of correct order and correct sequence. This created a dichotomous score where children were given a 1 for correct sequence, which now includes correct order, and a 0 for incorrect sequence. Figure 2 (page 62) shows the proportion of participants at each grade level

who produced the correct sequence on the four timeline tasks, independent of starting point.

Figure 2 shows that by the second grade, 90% of participants were able to sequence the future(day) events correctly. For the other three timelines, there was a rise in scores between 1st and 2nd grade, a leveling off of scores between 2nd and 3rd, and then another rise in scores between 3rd and 4th grades. More than half of the participants in grade 1 were able to correctly sequence the day scales but not the year scales. By grade 2, more than half of the participants were able to correctly sequence event-cards on all four timelines.

Figure 2 also confirms the results of the previous analysis that children did better on the future than the past and better on the day than the year, except that children in the 3rd grade did equally well at sequencing the events in the past(day) and future(year) timelines.

Another way of examining the data is to look specifically at productions of correct order. In this recoding, scores initially coded as a 2 are recoded as 1 and scores initially coded as a 1 are recoded as 0. This again creates a dichotomous scoring scheme with a 1 for correct order and a 0 for everything else, including correct sequence. The scores of the Y axis of Figure 3 reflect the percentage of participants in each grade level who produced the correct order of event-cards.

Figure 3 (page 62) shows a few different patterns of performance than Figure 2. The most striking differences resulted from the large number of correct sequence scores on

day scales that have been recoded as 0. To produce a correct order, participants needed to adjust their event-schemas to start the sequence based on a starting point that took into account the date and time of testing, rather than the starting point that was central to their schema for that time scale.

The timeline mostly likely to produce a correct order at all four grade levels was future(year), although less than half of grade 4 participants produced correct order on this, or any other, timeline. Participants in grade 1 had great difficulty in producing correct order; no more than 10% of the participants produced the correct order on any of the four timelines. Figure 3 also shows a consistent rise in correct order across grades, with the exceptions of past(day) trials between grades 1 and 2 and future(day) trials between grades 2 and 3. In addition, the rise in scores between grades 3 and 4 is much steeper for correct order than it was on the previous graph for correct sequence. The participants in grade 2 had more success with the future than the past trials. For grades 3 and 4, the year scales were more likely to produce a correct order.

Analysis of Approximation-of-Sequence Scoring

An alternative method of coding the timeline data was used to further explore participants' abilities to sequence timeline events. Productions of the five event-cards in correct sequence, regardless of starting point, were scored a 10. Points were subtracted for each event-card that was out of sequence at the rate of one point for each position a card was misplaced. The reference point used for calculating this

score was the first card placed by the participant on the timeline in question. For example, if a participant started the past(day) timeline with Eat Breakfast, then the event-card that should have been in the second position was Morning Recess. If Morning Recess was in the third position, then one point was deducted; if it was in the fourth position, two points were deducted. The maximum points that could be deducted using this system was eight. In comparison with the serial scoring, all 2's and 1's are scored identically as 10 and the 0's received partial scores based on their approximation to a correct sequence.

Table 5 shows mean scores and standard deviations for grade levels on the four timeline tasks using the approximation-of-sequence scoring. The scores for future(day) show that, by the second grade, the vast majority of participants are sequencing events correctly. The other three timeline scores show a rise from grade 1 to grade 2 but then smaller differences between grades 2, 3, and 4. There is a slight drop in scores from 2nd to 3rd grades and then a rise in grade 4 scores.

Table 5: Means (and Standard Deviations) of Approximation-of-Sequence Scores

Grade	Past Day	Future Day	Past Year	Future Year
1	6.77 (3.6)	9.03 (2.2)	5.49 (3.0)	6.90 (3.2)
2	8.25 (3.0)	9.80 (0.6)	7.45 (3.1)	8.30 (2.7)
3	7.66 (3.5)	9.90 (0.6)	7.37 (3.1)	8.05 (3.0)
4	8.98 (2.7)	9.83 (0.8)	7.83 (3.0)	8.89 (2.2)
TOTAL	7.96 (3.3)	9.65 (1.3)	7.08 (3.2)	8.08 (2.9)

Another 2 X 2 X 4 mixed design MANOVA was carried out with zone and scale as repeated measures and grade as the independent variable (see Table 6).

Table 6: MANOVA of Approximation-of-Sequence Scores

	Sum of Squares	df	Mean Squares	F	*p*
Between Subjects	306.13	3	102.04	10.15	.000
Within Subjects					
Scale	256.57	1	256.57	35.06	.000
Zone	308.89	1	308.89	43.87	.000
Scale X Zone	21.75	1	21.75	4.68	.032
Between X Within					
Scale X Grade	11.72	3	3.91	.53	.660
Zone X Grade	17.78	3	5.93	.84	.473
Scale X Zone X Gr	17.59	3	5.86	1.26	.290

As with the serial scoring analysis, there are significant main effects between the two levels of zone and the two levels of scale as well as across grades, with a preference for future over past zones and day over year scales. However, with this system of coding, there is now a significant interaction between scale and zone. Post-hoc analysis shows that grade 1 is significantly different than the other 3 grades ($p < .001$), but there is no longer a significant difference between grades 2, 3, and 4; although the difference between grades 3 and 4 approaches significance ($p = .061$).

Analysis of Distance Scores

In addition to evaluating the development of sequencing and ordering abilities, this study tried to assess the development of children's ability to locate events on the

timeline with spatial distances that correspond to the appropriate temporal intervals. Riegel (1977) and Michon (1985) had proposed that the sequence of children's representations of time parallel the sequence of the scales of measurement; nominal, ordinal, interval, and ratio. This study assumed that participants' facility with the distance features of the timeline task would demonstrate the transition from an ordinal to an interval processing of temporal information.

Distance scores can be measured either between event-cards or between event-cards and reference points. The original intention was to analyze distance scores via the intervals between event-cards and reference points, however the prevalence of correct sequence scores, where participants ordered event-cards independent of the given reference points as defined by the time and date of testing, made distance scores hard to disentangle from sequencing factors. In addition, distance scores for day-scale timelines were a problem in that some of the events used in the day trials were not sufficiently fixed to allow accurate calculations, given the variations between--and even within-- participants in times of going to bed and eating breakfast.

Some initial analyses were run with two of the intervals from the year-scale timelines; the interval from the First Day of School to Halloween and the interval from Halloween to Christmas. However, distances between event-cards are also affected by the starting point used. For example, the timeline distance between Halloween and Christmas is 9 cm, which is the timeline equivalent of the 54 days between

October 31st and December 25th. But if one were to start at Christmas and move through the year to Halloween, the distance would be 311 days or 51 cm. At times it is not clear which starting point participants were using. In addition, participants who produced the correct sequence or order are more apt to have put events in a position that approximates the correct distance, and so distance scores might not add any new information to the data already available.

An alternative method of analyzing distance scores used the placement of event-cards at the ends of the timelines. For all four timelines, event-cards were marked that were located in the areas of the timelines less than 5 cm and greater than 55 cm. These areas will be referred to as the timeline *extremities*. The areas on either side of the present reference point will be called the *near(past* or *future)* and the areas furthest from the present, the *distant(past* or *future)* (see Figure 4, page 63).

For the day-scale, 4 cm of the 60 cm timeline correspond to 96 minutes of clock time and for the year-scale those 4 cm correspond to about 24 calendar days. Locations of event-cards in these extremities would have been correct, depending upon the time and date of testing. For example, participants tested in the early afternoon should have located the School Lunch event-card in the near(past) on the past(day) timeline, since lunch had recently occurred, and in the distant(future) in the future(day) timeline, because the next school lunch would not come until the following day. If all timelines were performed perfectly, the placement of event-cards for past and future trials of each scale would be identical. For

example, if a participant were tested at 2:00 p.m., the location of School Is Out would be at 2 cm, in the distant(past), on the past(day) timeline and also at 2 cm, in the near(future) of the future(day) timeline. Table 7 shows the locations of event-cards in the extremities of day-scale timelines for all participants across grades.

Table 7: Distribution of Event-Cards in the Extremities of Day-Scale Timelines

Event-Card	Distant(past)	Near(past)	Near(future)	Distant(future)
School is Out	13	12	0	18
Morn. Recess	7	2	5	1
Go To Bed	46	10	4	55
Eat Breakfast	47	5	25	14
School Lunch	6	1	4	4

Given the times of testing, there should have been many more locations within the extremities for event-cards of Morning Recess and School Lunch because most of the participants were tested within 96 minutes of one of those two events. It is probably significant that the two non-school event-cards, Eat Breakfast and Go To Bed, were most frequently located in the distant extremities, and the event-card that forms a boundary between school and home, School Is Out, received the next most frequent distant extremity location.

Table 7 also shows the effect of event-schemas in the location of event-cards and, based on the starting points used for these scripts, we would expect to see many locations of Eat Breakfast in the distant(past) and near(future), at

the beginning of timelines, and locations of Go To Bed in the near(past) and distant(future), at the end of timelines. The Eat Breakfast card is in the expected locations, except it occurs twice as frequently in the distant(past) as in the near(future). And Go To Bed has many locations in the distant(future) but nearly as many in the distant(past). These results reflect an overall pattern in which participants located event-cards in the distant extremities more so than would have been expected given the times of testing and the patterns generated by event-schemas.

Results also show a strong reluctance by participants to placing event-cards in the near extremities, close to the present reference point, when it would have been correct to do so. For example, many participants were tested soon after their school lunch, but only one participant put the School Lunch event-card within 4 cm of the present on the past(day) timeline. And twenty-eight participants were tested within 75 minutes of school being dismissed but none of them located the School Is Out event-card in the near(future).

Table 8 (page 52) shows the location of event-cards in the extremities of the year-scale timelines, and groups the data based upon the dates of spring (N =60) and fall (N =107) testing. This grouping of the distribution was done because the appropriateness of locations in the extremities varies with the date of testing.

Table 8: Distribution of Event-Cards in Extremities of Year-Scale Timelines for Fall and Spring Testings

Event-Card	Distant(past)	Near(past)	Near(fut)	Distant(fut)
Halloween				
fall	5	6	5	20
spring	1	0	0	0
First Day of School				
fall	32	2	7	24
spring	19	2	5	8
Christmas				
fall	19	1	0	9
spring	7	0	0	7
Birthday				
fall	15	0	1	6
spring	0	0	1	4
Last Day of School				
fall	13	4	1	30
spring	16	6	5	18

Although the past and future locations should be parallel, they almost look like mirror images. As was the case for the day-scale, the distant extremities are more highly represented than the near-extremities. Some of event-card locations are appropriate, given the dates of testing, but many are not. Fifteen participants put the Birthday event-card in the distant(past) and ten participants put that event-card in the distant(future), but that was a correct placement for only one participant in each group. Eighteen of the 20 participants who put the Halloween event-card in the distant(future), and all 6 who put it in the near(past), were tested in November--which means that that was an appropriate location. But it is interesting that participants were three times more likely to locate the next Halloween in the

distant(future) than they were to locate the recent Halloween in the near(past).

Based on the starting points used in year-scale event-schemas, we might expect to see many locations of the First Day of School event-card in the distant(past) and near(future), at the beginning of timelines, and the Last Day of School event-card in the near(past) and distant(future), at the end of timelines. Both fall and spring participants located First Day of School many times in the distant(past) but there were fewer locations in the near(future). The large number of locations in the distant(future) for First Day of School was a somewhat appropriate location for those tested in early October--although no participant was tested within 24 days of the First Day of School. However, as was the case for Halloween, the same participants who put First Day of School in the distant(future), did not locate that card in the near(past). That is, participants tested in October were reasonably accurate to view the next first day of school as far in the future, but it is curious that they didn't also locate the first day of school that happened the previous month in the near(past). The pattern of locating event-cards in the distant extremities, but not the near extremities, persisted for the other event-cards of the year-scale as it did for the day-scale.

Effect of Time and Date of Testing

An additional analysis looked for scoring differences between groups based upon the *time-of-testing* and *date-of-testing*. For the day-scale, data was coded for two groups, those tested before (N =110) and after (N =57) lunch. Because

School Lunch was one of the five event-cards, participants who produced a correct order and were tested before lunch needed to use a different starting point than participants who were tested after lunch.

However, a chi square analysis found that there were significant differences (p <.001) between the representation of grade levels in the two groups; there were a higher percentage of 4th grade participants in the group tested before lunch and a higher percentage of 1st grade participants in the group tested after lunch. Two separate ANOVA's were conducted, one each for past(day) and future(day), with serial scores as the dependent variable and an independent variable of time-of-testing (two levels, before and after lunch). To correct for differences in grade representation in the two levels of the independent variable, ages of participants was used as a covariate. Results in Table 9 show that there was no significant difference between the time-of-testing groups for the future(day) timeline, but there was a significant difference for the past(day) timeline.

Table 9: Effects of Time-of-Testing on Day-Scale Timelines with Age as a Covariate

	Sum of Squares	df	Mean Squares	F	p
Future(day)	.05	1	.05	.19	.663
Past(day)	2.27	1	2.27	6.14	.014

A followup analysis of past(day) timeline scores showed that the two time-of-testing groups produced an equal percentage of correct order responses, but participants tested after lunch were more likely to produce a correct sequence than those tested before lunch (63.2% to 52.7%) and less likely to produce an incorrect sequence (22.8% to 33.6%), despite the greater percentage of older participants in the before lunch group.

For the year-scale events, participants were placed into three groups: a) those tested before the end of one school year (i.e., June, N =60); b) those tested after school started in September but before Halloween (N =43); and c) those tested after Halloween (N =64). A chi square analysis was used to determine whether any of these groups was over-represented by particular grades, but no significant differences were found (p =.332). A 2 X 4 X 3 ANOVA was conducted with year-scale (two levels, past and future zones) as the dependent variable and independent variables of grade (four levels) and date-of-testing (three levels) to assess for differences between the dates-of-testing groups on the year-scale timelines. Results showed that there were no significant differences in performance on the year-scale among the three date-of-testing groups (F= 1.35, p =.262) and there was no significant interaction between zone (past vs. future) and date-of-testing (F=.84, p =.432).

Knowledge of Conventional Time

Participants' knowledge of conventional time was assessed with the scores for event and measured time for the day- and year-scales. The hypothesis was proposed that as children

develop their increased familiarity with the language of conventional time facilitates the solving of more complex temporal tasks, such as the year-scale timelines used here. If this hypothesis is true, we would expect to see: a) greater correlations between conventional time measures and year-scale timeline scores, as compared with day-scale scores; b) greater correlations between conventional time measures and timelines scores for older, as compared with younger, participants; and c) significant differences in conventional time scores between high scorers and low scorers on the year-scale timeline tasks.

Four measures of conventional time were taken; event(day), event(year), measured(day) and measured(year). Table 10 shows the means and standard deviations of the four tests for each grade level. There is a general rise in scores throughout the grade levels with the exception of a slight drop in scores between grades 3 and 4 for the event(year) score. The largest rise in scores occurs between grades 1 and 2 with more gradual increases in scores between higher grades, with the exception of the largest increase for measured(year) scores occurring between grades 2 and 3.

Table 10: Means (and Standard Deviations) on Event and Measured Time Tests for Day- and Year-Scales

Grade	Event(day)	Measured(day)	Event(year)	Measured(year)
1	5.85(2.73)	5.51(2.22)	6.46(2.65)	5.01(2.40)
2	7.83(1.95)	7.15(1.78)	7.95(1.87)	5.49(2.15)
3	8.27(1.48)	7.95(1.34)	8.68(1.47)	7.05(1.63)
4	9.26(0.94)	8.83(1.20)	8.53(1.95)	7.89(1.62)
Total	7.87(2.22)	7.44(2.05)	7.95(2.18)	6.44(2.27)

The relationship between participants' scores on the timelines tasks and their scores on event and measured time tests was submitted to correlational analyses. Event and measured time scores were combined into *conventional(day)* and *conventional(year)* scores because, although the tests were designed to assess different, but related, knowledge bases, both require familiarity with the language and concepts of conventional time.

If it is true that the older participants in the study were using their knowledge of conventional time to help solve the timeline tasks, and that representations of conventional time are needed for the greater processing demands of longer durations, we would expect to see greater correlations between the year-scale timelines and conventional(year) scores than between the day-scale timelines and conventional(day) scores, as well as higher correlations for the older grade levels. Table 11 supports the hypothesis; there are five significant correlations for the eight year-scale timelines and no significant correlations between conventional and timeline scores for the day-scale. In addition, the highest correlations were for grade 4 participants.

Table 11: Correlations Between Conventional Time Tests and Timelines Scores of the Respective Scale

	Day-Scale		Year-Scale	
Grade	Past	Future	Past	Future
1	.13	.23	.14	.35*
2	.15	.26	.41**	.30
3	.28	.15	.19	.35*
4	.17	.11	.37**	.63**

*= $p \leq .05$; **= $p \leq .01$.

The hypothesis regarding participants' use of conventional time representations for solving year-scale, but not day-scale, timelines was further analyzed with a series of 2-way ANOVA's using conventional time scores as the dependent variable and independent variables of serial scores of the corresponding timeline and grade. These analyses tested for differences in knowledge of conventional-time between groups of participants who produced correct order, correct sequence, and incorrect sequence on each of the four timeline trials. For example, the first analysis used the conventional(day) score as the dependent variable and past(day) and grade as independent variables. In addition, a measure of cognitive functioning, the Gates-MacGinitie Reading Test (GMRT), was used as a covariate.

The GMRT was used for the purpose of factoring out differences between participants in cognitive functioning. Scores were available on all but five of the participants and, for these participants, the average for the sample was substituted. The total score on the GMRT, a composite of vocabulary and comprehension components, was used. A oneway ANOVA was conducted with the Gates-MacGinities Reading scores as the dependent variable and grade level as the independent variable to verify that there were no differences between grade levels in this measure of cognitive functioning, and no significant differences were found ($F=1.16, p=.326$).

Table 12 (page 59) shows that the results of these analyses support the hypothesis. There were highly significant differences in conventional(year) scores between the three groups of serial scorers on the future(year)

timeline (*p* <.001) and significant differences between groups of serial scorers on the past(year) timeline (*p* <.05). There were no significant differences in conventional(day) scores between groups of serial scorers of either day-scale timeline.

Table 12: Analysis of Differences Between Groups of Serial Scorers on Conventional Time Scores with a Covariate

	Sum of Squares	df	Mean Squares	F	*p*
Past(day)	14.76	2	7.38	1.00	.370
Grade	979.91	3	326.64	44.30	.000**
Grade X Past(day)	29.62	6	4.94	.67	.674
Future(day)	16.35	2	8.17	1.14	.324
Grade	979.91	3	326.64	45.39	.000**
Grade X Future(day)	55.17	6	9.20	1.29	.271
Past(year)	75.44	2	37.72	3.93	.022*
Grade	632.49	3	210.83	21.97	.000**
Grade X Past(year)	37.32	6	6.22	.65	.692
Future(year)	154.95	2	77.48	8.56	.000**
Grade	632.49	3	210.83	23.28	.000**
Grade X Future(year)	41.15	6	6.86	.76	.604

*=*p* <.05; **=*p* <.01

Table 13 (page 60) shows that participants who produced correct order on year-scale timelines scored higher on conventional(year) tests than those who produced correct sequence, and participants who produced correct sequence had higher conventional time scores than those who produced incorrect sequence. This pattern holds true for both past(year) and future(year) timelines. The one exception to this pattern, a low conventional time score for the correct

order group in grade 1 on the past(year) timeline, is not meaningful because there was only one participant in this group.

Table 13: Means (and N) of Conventional(year) Scores for Each Grade Level and Group of Serial Scorers on Past(a) and Future(b) Year Timelines

(a) Past(year)

Grade	Serial Score 0	1	2	Total
1	11.08 (31)	13.29 (7)	11.00 (1)	11.47 (39)
2	12.19 (18)	13.82 (17)	16.60 (5)	13.44 (40)
3	15.39 (19)	15.58 (13)	16.67 (9)	15.73 (41)
4	15.17 (18)	15.89 (9)	17.80 (20)	16.43 (47)
Total	13.12 (86)	14.64 (46)	17.14 (35)	14.38 (167)

(b) Future(year)

Grade	Serial Score 0	1	2	Total
1	10.32 (22)	12.27 (13)	15.25 (4)	11.47 (39)
2	11.89 (14)	14.19 (16)	14.40 (10)	13.44 (40)
3	14.96 (13)	15.23 (15)	17.08 (13)	15.73 (41)
4	13.18 (11)	16.00 (13)	18.22 (23)	16.43 (47)
Total	12.22 (60)	14.44 (57)	16.92 (50)	14.38(167)

The hypothesis regarding grade level differences in knowledge of conventional time was analyzed with a series of sixteen oneway ANOVA's, one analysis for each grade level on each timeline. The dependent variable was the conventional-time score and the independent variable was the three groups of serial scorers on the timeline trials. The GMRT was again used as a covariate. The hypothesis would predict that more significant differences between groups of serial scorers would exist for older participants than for younger

participants. Table 14 gives some support for this hypothesis. The only significant difference emerged for grade 4 participants on the future(year) timeline.

Table 14: Analysis of Conventional Time Scores for Timelines and Grade Levels with Covariate of Reading Test

	Sum of Squares	df	Mean Squares	F	*p*
Grade 1					
Past(day)	17.30	2	8.65	.50	.613
Future(day)	39.21	2	19.60	1.17	.324
Past(year)	18.87	2	9.44	.56	.578
Future(year)	23.24	2	11.62	.69	.508
Grade 2					
Past(day)	4.66	2	2.33	.33	.725
Future(day)	11.26	2	5.63	.81	.454
Past(year)	49.42	2	24.71	2.73	.079
Future(year)	33.09	2	16.54	1.74	.190
Grade 3					
Past(day)	13.99	2	7.00	1.71	.190
Future(day)	5.97	2	2.99	.69	.507
Past(year)	8.49	2	4.25	.89	.420
Future(year)	14.21	2	7.11	1.54	.229
Grade 4					
Past(day)	1.13	2	.57	.28	.761
Future(day)	.58	2	.29	.14	.870
Past(year)	37.45	2	18.72	2.18	.125
Future(year)	132.10	2	66.05	10.34	.000**

$^{**}p < .001$

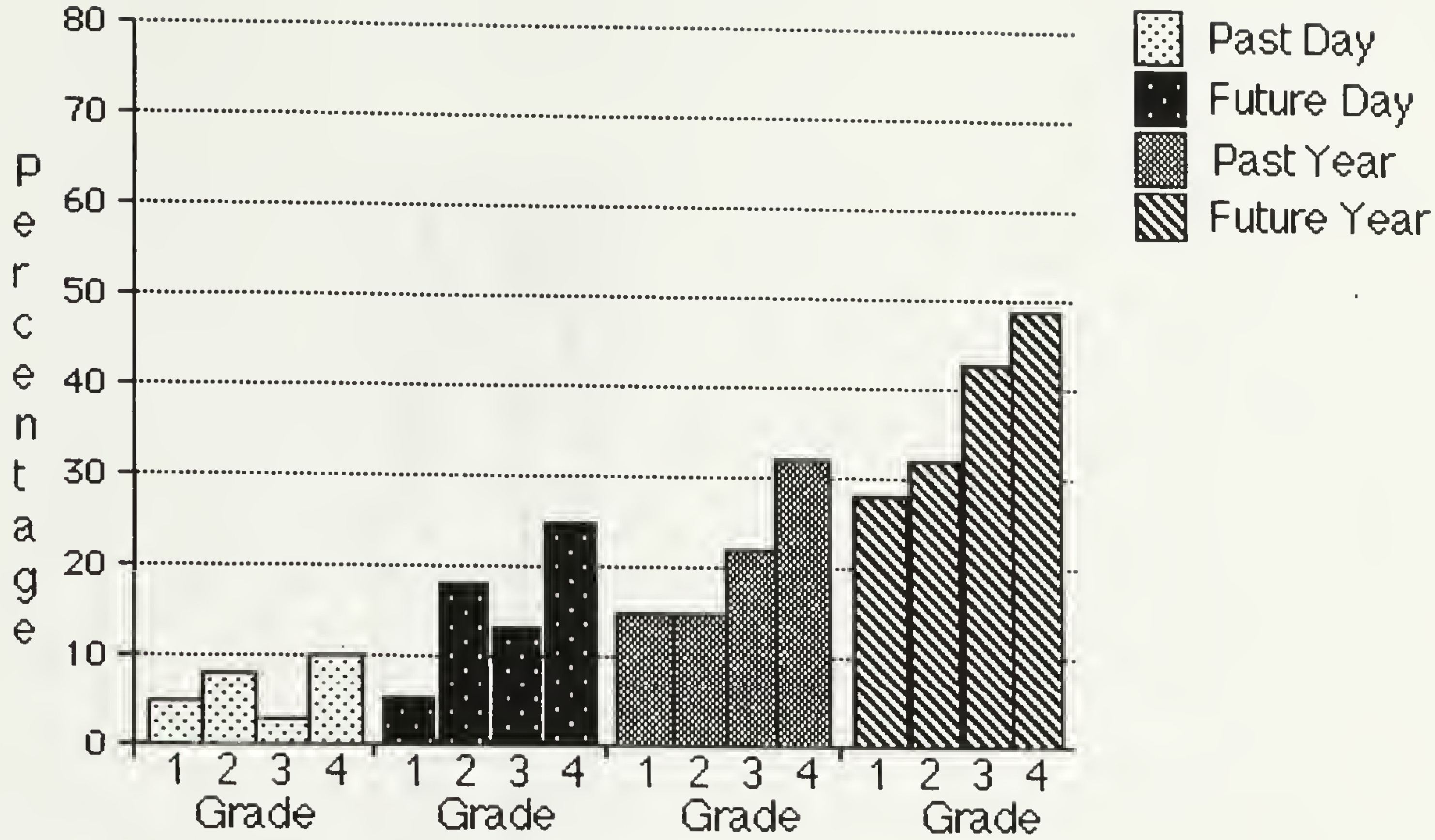


Figure 2. Percentage of Participants at Each Grade Level Producing Correct Sequence

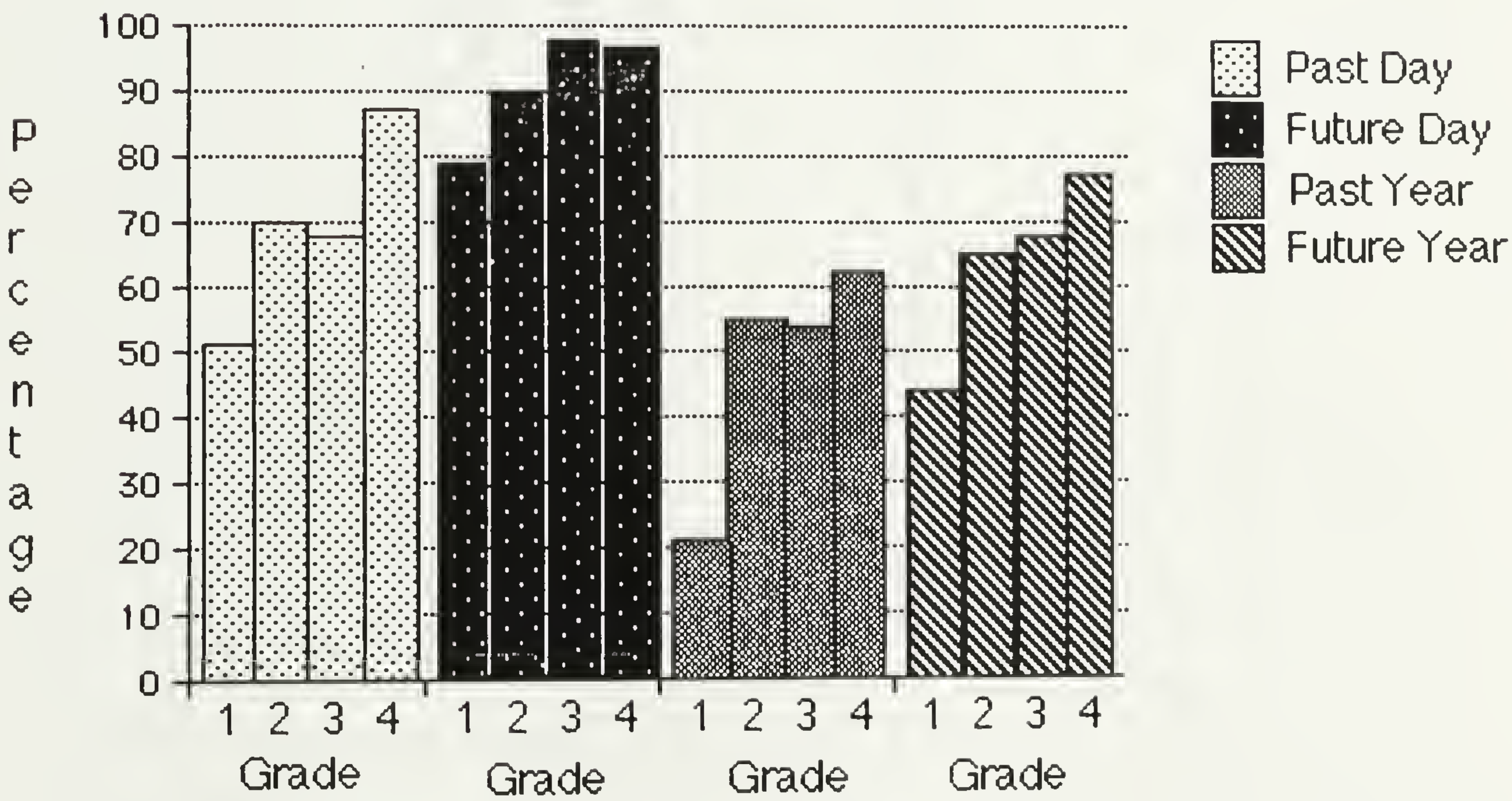


Figure 3. Percentage of Participants at Each Grade Level Producing Correct Order

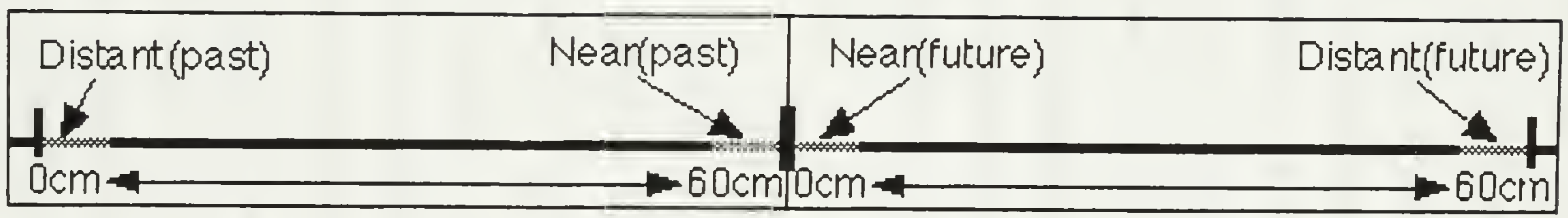


Figure 4. Timeline Showing Extremities

CHAPTER 8

DISCUSSION

There has been very little theory or research on the development of future time perspective (FTP) in young children. This study explored structuration of FTP, defined as the ability to temporally locate and organize future events, and compared children's structuration of the past and the future for two scales, a day and a year. Attempts were also made to understand the development of structuration as it relates to the acquisition of representations of conventional time measures (i.e., clocks and calendars). Four groups of participants were used with groups ranging in ages from 7.4 to 10.5.

Development of FTP

The first hypothesis proposed that there would be a developmental increase in participants' structuration of timelines and their knowledge of conventional time. This hypothesis was strongly supported by the results. Most of the studies on FTP have used older children and adolescents as participants. This is probably due to the notion that younger children are unable to realistically conceive of the future, perhaps because they have not reached the stage of formal operations. This study showed that children as young as 7 years of age are able to build realistic and structured expectations of future events, largely through the use of event-schemas. But the study also found that development of these skills follows an extended course, and the ages used here did not reach their ceiling on the timeline tasks.

Participants' ability to put both daily and yearly events into a correct sequence showed a significant increase between grades 1 and 2, but this knowledge seemed to reach its ceiling at about grade 2--as shown by the analysis of the approximation-of-sequence scores. There were few changes between grades 2 and 3, but then grade 4 participants showed significant growth in the ability to adjust their event-schemas to use flexible reference points, although their capacity to do so was still not at the level of mastery.

Even the youngest group tested (average age 7.4 years) showed some understanding of temporal sequence for yearly durations. On the year-scale timelines (past and future), grade 1 participants put the five event-cards into correct order or sequence twenty-five times where chance would predict slightly more than three successful productions. And yet the oldest group tested had difficulty with those tasks, as shown by the 21% of grade 4 participants who produced neither the correct order nor sequence on the year-scale timelines.

It was also hypothesized that there would be a developmental increase in the use of an interval organization of events, with the assumption that knowledge of conventional time would be an important factor in that development. However, due to the nature of the tasks used and the ages of the participants selected, participants relied largely upon ordinal event-schemas in their problem-solving; and so information on the use of intervals was not available.

The design of this research encouraged the use of event-schemas, which made it difficult to disentangle distance

scores from sequencing strategies. An alternative approach could have had participants locating one event at a time on timelines, which would have shown distance factors as independent of sequence.

Children's Use of Event-Schemas

The most pervasive cognitive process demonstrated in this study was participants' reliance on event-schemas. This study seems to lend support to the contention of Nelson (1986) that event-schemas are a basic building block of cognition. Representations of temporal sequence might be an unconscious and intuitive process that can be viewed as an extension of the basic perception of succession.

Event-schemas for temporal periods have two characteristics, a sequence of events and a relatively fixed starting point. Friedman (1986) stated that, "the initial encoding and processing of order preserves part of the formal structure but shows certain rigidities that are not present at later ages" (p. 1386). This conclusion was supported in this study by the large number of participants who ignored the instructions about reference points and relied heavily upon their event-schemas for starting points. The timeline tasks used, although simulating real-world circumstance of locating events using the present as a frame of reference, clearly challenged children to use starting points that violated their schemas for the time periods involved. Many children were not able to effectively do so.

It is interesting to note that; even though the "logical" starting point for daily events, waking up in the morning, was not included in the set of event-cards, participants were

able to start the schema with the earliest appearing event, Eat Breakfast. Further testing would need to assess the limits of such a flexibility in producing event-schemas for different time scales. It is possible that the large number of sequences that started with the Go To Bed event-card can be related to the absence of a card for waking up.

Adults start the year-scale with January but, although the verbal-list of months is taught in schools, it has no particular meaning in the experience of children. It is not surprising that children started their year with the First Day of School but interesting that none started with January 1st. A significant minority started with their birthday. It seems that children, ages 7 to 10, tell yearly time by their grade, and to a lesser degree by their age, but not by the calendar year. Some of the difficulty that participants had with the year-scale timelines, in addition to the greater processing demands of a longer and less frequent duration, might have been due to this inconsistency regarding a starting point.

It is also possible that the frequent production of event-schemas was an outgrowth of participants' confusion regarding task expectations. There is an inherent ambiguity in the (English) language of time; the term "day" can refer to any duration of 24 hours but "day" also refers to a day of the week. Despite the explicit instructions that participants were to locate events for the 24 hour duration before and after the present reference point, the labels on the timelines (e.g., "Past Day") might have prompted participants to locate events for "yesterday" or "tomorrow." Although this

might serve to explain the prevalence of Eat Breakfast and First Day of School starting-points on day- and year-scale timelines respectively, this confusion probably does not account for the differences between performances on past and future timelines.

Participants' reliance on event-schemas can also be considered a consequence of the use of recurrent events. It is not clear how these results would hold up with the location of novel events.

Scale Differences

Results clearly supported the second hypothesis; participants found it easier to structure the day than the year scale, probably due to the greater processing demands of organizing the longer duration. In addition, participants relied more strongly on event-schemas for day-scale, as opposed to year-scale, timelines. This difference can be accounted for by the frequent repetition of daily events which results in greater familiarity with that sequence.

Past vs. Future

The third hypothesis predicted that participants would find it easier to structure the past than the future. Expectations were developed from Melges' (1982) ideas that processing of FTP is more purely cognitive because the past is inherently involved with memory and perceptual processes. It was thought that memory might aid in the location and organization of past events. The most surprising finding of this study was the significantly better performance on future than past zones, contrary to the proposed hypothesis.

Research on event-schemas have shown that children code recurrent events by their general schema knowledge and their knowledge of specific details of those recurrent events is not as reliable; specific details are recalled more effectively for novel events than for recurrent ones (Hudson, 1993). One way to explain the results of this study is that, in production of future timelines, participants relied more purely on event-schemas and that they experienced some interference from episodic memory of specific past events. If so, it is possible that memories for the events represented by the event-cards interfered with performance on past, but not future, timelines. Some support for this hypothesis came from the analysis of the time-of-testing effects, in which participants tested after lunch produced more correct sequence scores than those tested before lunch on past(day) timelines. This might have occurred because a specific memory for the start of the daily script, eating breakfast that morning, was more temporally distant and hence less salient for those tested after lunch. However, the role of memory on task performance was not tested for, and its impact on performance is unclear.

However, it is the contention of this author that participants were more successful on future than past timelines because the process of locating events in the past is inherently paradoxical; one is looking back at events that are ordered in a forward direction. It is possible that the process of locating past events reverses the fundamental property of time, its unidirectionality. Time moves inexorably forward from the past into the future. Determining

the relationship between events in the past moves counter to this flow because the events that are more distant from the present are earlier in the sequence.

Some of this confusion about directionality became apparent when recording participants' locations from the timelines. In an attempt to record past event-cards as distance from the present, it was necessary to put the ruler upside down--which made reading numbers off the ruler awkward. The approach used was to place the zero point of the ruler on the past reference point, which made it possible to read the numbers from left to right. It is possible that cognitive location of events in the past requires a similar process; "reading" sequences of events in the forward direction requires establishing an arbitrary reference point in the past. According to this hypothesis, the location of future events is easier because the reference point used is the present, and this is cognitively less challenging than identifying and using a past reference point.

In the literature on event-schemas in children, I have not found any specific reference to differences between script knowledge for past and future time zones. In fact, the process has been assumed to be identical whether event-schemas are being used to anticipate future events or remember past ones. This study would suggest that that assumption would need to be reevaluated and old research reexamined in light of this new information.

The finding of differences between future and past zones needs to be replicated while specifically testing for the variables that might account for these differences. The

possible interference of event-specific memory on production of event-schemas can be experimentally controlled, as well as the testing of the hypothesis that location of sequences in the past is more difficult because it reverses time's unidirectionality. Although the results of this study appear to be statistically robust, they could be an artifact of the methods used. The impact of the timeline methodology on children's productions is not clear. Similar tasks, with and without the timeline as a structuring device, could help determine the impact of this tool on differences between performance on past and future zones. Participants' understanding of the timeline could be tested by having them locate events in either zone; their ability to put event-cards in the correct zone would assess whether they have a basic understanding of how the timeline works in differentiating past and future events. In addition, a sample of adults could have helped determine what "optimal" performance on timeline tasks would have looked like.

The Impact of Conventional Time

The fourth hypothesis proposed that more sophisticated representations of conventional time are needed for structuration of longer durations, and that such representations are developmentally acquired. Elements of this hypothesis received support from the results of this study. There were more correlations between conventional time scores and structuration of the year, as compared with the day, scale, and these correlations were stronger for grade 4 than for younger participants. In addition, grade 4 subjects who performed well on the timelines for the year-scale also

had higher scores on measures of conventional time than those who did not do as well. While these results suggest a relationship between knowledge of conventional time and structuration, a causal relationship cannot be determined. There was also a steady developmental increase in participants' ability to answer questions about conventional time, and that increase seemed to parallel the growth in structuration. However, it is not clear the degree to which, if any, this information was used by participants when doing the timeline tasks.

Dense Boundaries Between Zones

Participants seemed to understand the basic concepts of past, present, and future. During the demonstration and teaching process, when definitions and examples for each were solicited, participants were almost unanimously able to show their understanding of these concepts. However, the location of event-cards in the extremities of the timeline suggests that participants had a concept of the relationship of past and future to the present that is different than that of adults.

All of the participants in this study were tested during the school day, and event-cards not associated with school (i.e., breakfast and bed) were often placed as far from the present as possible. Similarly, for the year trials, many events were seen as far away, perhaps because occasions like birthdays and Christmas are much anticipated and what was most salient for participants was the non-immediacy of those special events. But, in addition to the incorrect placement of event-cards far from the present, participants also showed

a strong tendency to *not* place event-cards near the present when it would have been correct to do so.

An adult concept of the present is that of a one-dimensional point; a transition moment between past and future. The boundaries between the present and the past and future are permeable; present circumstance is strongly affected by what has happened in the past and what could happen in the future and there is an integration of the present with information from the past and expectations of the future. However, results of this study suggest that, for children, the present is contained within boundaries that are more dense; the future and the past are more removed and the present is not as affected by them. This finding also has relevance for the literature on extension in FTP. The tendency of young children to view future events as distant might not mean that they think about an extended future, but rather that the future seems very removed from their present.

The results of this study do not reflect children's knowledge as much as their ability to convert what they know into the conceptual language and imagery of time. For example, children who took the test in the afternoon, and who put the School Is Out event-card in the distant(future) end of the timeline, might well have known that they would be going home soon. If so, it is likely that they could have answered a simple question demonstrating such knowledge. But that is not what was tested here. Orientation and navigation in our modern society requires the conversion of information into the particular language of time; and this language is needed for the performance of essential operations.

APPENDIX A

PARENT CONSENT LETTER

Dear Parent;

As some of you might know, I have been the co-president of the ---- PTO this year, but my interest in children is both professional and academic as well as personal. For the past few years, I have been working as a school psychologist in the ------- School District while working towards my PhD in School and Counseling Psychology at the University of Massachusetts. I am writing to you now to ask permission for using your child as a subject in my dissertation research.

The topic of my study is the cognitive development in children of the concept of time. Young children are often confused about time but their understanding of time concepts develop rapidly as they progress through elementary school. However, relatively little is known about this course of development.

I will be testing children in groups of four and they will be taken out of their classes for approximately 30-40 minutes. During that time I will give them a series of tasks to perform and questions to answer. I need to test approximately 40 children in each of four age groups; 7, 8, 9, and 10 years of age. Some children will be tested this year, others at the beginning of the next school year. I did a pilot study of these tasks with 12 children, and they generally enjoyed the testing. I also believe that the process of testing could be useful for children in prompting them to reflect upon what they do, and do not, understand about time.

No names will be used in the study. Due to the nature of the research, each individual child's performance is not considered significant and aggregates will be used to determine trends and differences between and within age groups. Thus, the risk of your child being identified is minimal. The score that your child received on the Gates Reading Scale, which is in his or her school file, will also be needed in my data analysis. After the test data is compiled, the list of names will be destroyed to protect confidentiality. Parents will be given the opportunity to request results.

The results of my study will be compiled for teachers of the --- School with a list of instructional strategies that teachers can use when they are teaching about time. I believe that this study will provide important information to teachers about the kinds of misunderstandings and confusions that children have about this important concept.

Please make your decision and send in the form below immediately indicating whether or not I have your permission to include your child in this research. Not much time is left in the school year for me to reach my goals. You also have the right to withdraw your child from participation in this study at any time. There will be no penalty or prejudice shown to those who choose not to participate.

Use your discretion as to whether or not you want to "prepare" your child by telling him/her what will be happening, but please, do not tell your child that he or she will be asked questions about time. I am interested in how children think about time, not how "smart" they are. As a school psychologist in two elementary schools, I am experienced in taking kids out of classes. It really is not a "big deal" and most kids get excited about doing something different in school. Not all students for whom I get permission will be selected for the study.

I might need to ask some brief followup questions of parents, but these questions will take no more than about 2 minutes of your time.

If you have any questions about this study please call me at ---. Thank you very much for your cooperation.

Sincerely,

Joe Silverman

☐ I give my permission for my child to participate in the research study being conducted by Joe Silverman.

☐ I do not want my child to participate in the research study being conducted by Joe Silverman.

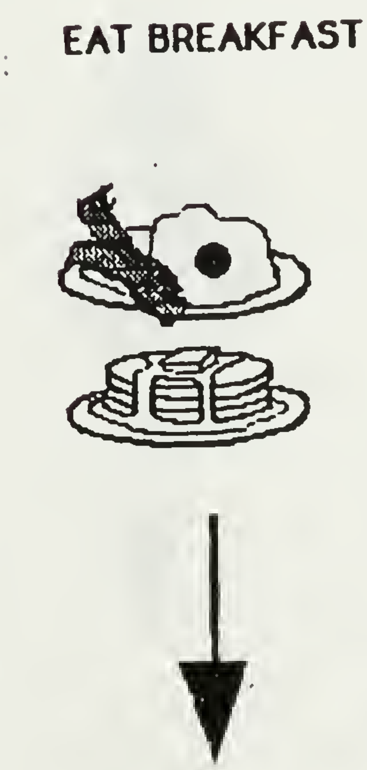
Child's Name: ____________________ Grade: ___

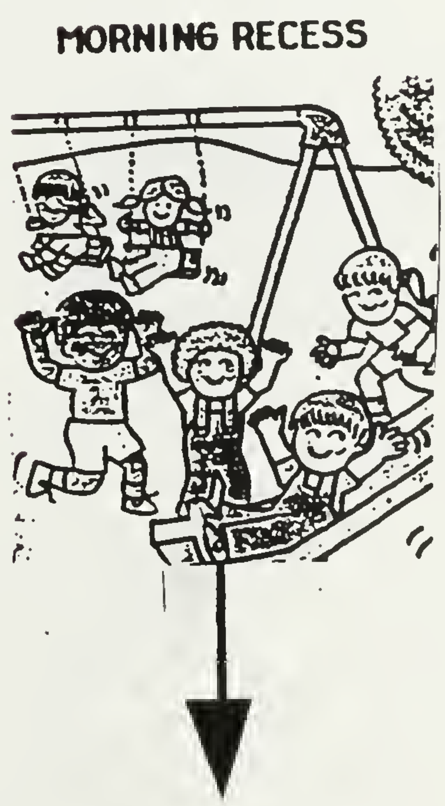
Teacher: ______________________

Parent Signature: ____________________________

EVENT-CARDS

Day-Scale





Year-Scale


LAST DAY OF SCHOOL


YOUR BIRTHDAY
Happy
Birthday


FIRST DAY
SCHOOL


CHRISTMAS


HALLOWEEN

APPENDIX C

PARTICIPANTS' RESPONSE SHEET

1. What time is it when?
   School lets out ________________

2. What time is it when you?
   Have morning recess at school ________________

3. What time is it when you?
   Go to bed ________________

4. What time is it when you?
   Eat breakfast ______________

5. What time is it when you?
   Have lunch at school ________________

6. What month is it when we have Halloween? __________
   Do you know the date? _____ or
   (circle one) Beginning - Middle - End

7. What month is it when we have the first day of school?
   ____
   Do you know the date? _____ or
   (circle one) Beginning - Middle - End

8. What month is it when we have Christmas? __________
   Do you know the date? _____ or
   (circle one) Beginning - Middle - End

9. What month is it when you have your birthday? ____________
   Do you know the date? _____ or
   (circle one) Beginning - Middle - End

10. What month is it when we have the last day of school?

____

Do you know the date? _____ or

(circle one) Beginning - Middle - End

11. ______

12. 10 in the evening............6 in the morning

_____ hours

13. 9 in the morning............3 in the afternoon

______ hours

14. __________

15. I will now say the days of the week, but one day will be left out. Write down the name of the day of the week that is missing. _______________

16. I will now say the days of the week backwards but one day will be left out. Write down the name of the day of the week that is missing. _______________

17. Friday or Sunday? (circle one)

18. Thursday or Saturday? (circle one)

19. Tuesday or Sunday? (circle one)

20. Wednesday or Monday? (circle one)

21. What month comes after the one we are in now?

____

22. I will now say the months of the year, but one month will be left out. Write down the name of the month of the year that is missing. _________________

23. I will now say the months of the year backwards, and again one month will be left out. Write down the name of the month of the year that is missing.

____

24. ___________

25. _____________
____
____

26. ____________

27. ___________

28. February or July? (circle one)

29. January or May? (circle one)

30. February or November? (circle one)

31. October or May? (circle one)

32. Halloween, Valentine's Day, or Christmas?

33. Thanksgiving, your next birthday, or the first day of school when you begin the next grade?

Name: __________________ Age: ___ Grade: ___
Phone #: ____________

APPENDIX D

TEST OF CONVENTIONAL TIME

Note: Questions with a time limit have the number of seconds allowed marked in parentheses.

1. What time is it when?
   School lets out ____________________

2. What time is it when you?
   Have morning recess at school ___________________

3. What time is it when you?
   Go to bed __________________

4. What time is it when you?
   Eat breakfast ________________

5. What time is it when you?
   Have lunch at school ___________________

6. What month is it when we have Halloween? ______________
   Do you know the date? ______________ or
   (circle one) Beginning - Middle - End

7. What month is it when we have the first day of school?
   ____
   Do you know the date? ______________ or
   (circle one) Beginning - Middle - End

8. What month is it when we have Christmas? ______________
   Do you know the date? ______________ or
   (circle one) Beginning - Middle - End

9. What month is it when you have your birthday?______________
   Do you know the date? ______________ or
   (circle one) Beginning - Middle - End

10. What month is it when we have the last day of school?
    ____
    Do you know the date? ______________ or
    (circle one) Beginning - Middle - End

11. How many hours are there in a day and night? ______ (4 s)

12. If a man went to bed at 10 in the evening and woke up at 6 in the morning, how many hours did he sleep? ______ (6 s)

13. If a woman left her house at 9 in the morning and returned at 3 in the afternoon, how many hours was she gone? ______ (6 s)

14. What day will the day after tomorrow be? ________ (6 s)

15. I will now say the days of the week, but one day will be left out. Write down the name of the day of the week that is missing.
Monday, Tuesday, Wednesday, Friday, Saturday, Sunday. (6 s)

16. I will now say the days of the week backwards but one day will be left out. Write down the name of the day of the week that is missing.
Sunday, Saturday, Friday, Thursday, Wednesday, Monday (6 s)

17. Which day is closer to Wednesday, Friday or Sunday? (5 s)

18. Which day is closer to Monday, Thursday or Saturday?(5 s)

19. Which day is closer to Thursday, Tuesday or Sunday? (5 s)

20. Which day is closer to Saturday, Wednesday or Monday? (5 s)

21. What month comes after the one we are in now?____________

22. I will now say the months of the year, but one month will be left out. Write down the name of the month of the year that is missing.
January, February, March, May, June, July, August, September, October, November, December. (6 sec.)

23. I will now say the months of the year backwards, and again one month will be left out. Write down the name of the month of the year that is missing.
December, November, October, September, August, June, May, April, March, February, January. (6 sec.)

24. What season is it now? __________

25. Can you name the other three seasons in the order in which they will come next?
______, _______, _______(15 s)

26. What is the 4th month after March? __________ (6 s)

27. What is the 2nd month before November? _________ (6 s)

28. Which month is closer to April, February or July? (4 s)

29. Which month is closer to October, January or May? (4 s)

30. Which month is closer to June, February or November? (4 s)

31. Which month is closer to January, October or May? (4 s)

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