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Time perception a function of sex and age

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TIME PERCEPTION:
A FUNCTION OF SEX AND AGE

A Thesis

Presented to the

Faculty of

California State College

San Bernardino

In Partial Fulfillment of

the Requirements for the Degree

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in

Psychology

Tina Podell Wein

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by

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ABSTRACT

Past, present and future time perceptions are compared among six, eight and ten year old boys and girls using the story-line procedure. Twenty subjects from each age group, ten boys and ten girls, were granted parental permission to participate at a public elementary school. The subjects were interviewed individually and asked to complete three stories. Each story characterized a different time tense frame of reference. The subjects were also asked to estimate a given lapsed time interval of five minutes. The results suggest that age, not sex significantly determines time perception development. Significant age differences were found in the child's perception of past and future time as well as estimates of the five minute time interval. The older the child, the more complete and comprehensive the time perception. Specifically, past and future are defined significantly more distally, and the five minute estimations closer approximate the true value. Additionally, those children who perceive a more distant past also project a more distant future. The results of this study have implications for education and cognitive processes, and are discussed herein. This discussion stresses the need to update and continue developmental time perception research.

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DEDICATION

This research is dedicated, with love, to my children-in order of their births- Joseph David, Marci Dana, and Max Steven Wein. May this research help in the effort to understand "your world."

I love you,

Mom

1/13/80

ACKNOWLEDGMENTS

There are many thanks to give for many different reasons; I hope each person will understand, without elaboration, the love and thanks I am extending now.

To my Husband, Ron Steven Wein;

To my Mother and Father, Lee and Bill Podell;

To my Mother and Father, Revella and Bud Wein;

To my Friend, Sandra Tsuneyoshi-Pawling;

To my committee, Chuck Hoffman and Bob Cramer; and

To my committee chairperson, Marsha Liss;

To the children and parents of Cahuilla Elementary School, their principal Andy Belomo, and their secretary Wanda Scholl.

Without all of you, this never would have been.

Thank you,

Tina Podell Wein

1/13/80

Time -- it surrounds us, it dominates our daily routine, it haunts us with its quickness, it teases us with its slowness. It seems to have a beginning in the birth of a life and an ending in death, or is that just an illusion.

INTRODUCTION

For generations, philosophers have attempted to define what time is or whether time really is. A precise and accurate definition of time might be found in the dictionary which states:

> Time 1 a: the measured or measurable period during which an action, process, or condition exists or continues: DURATION...
> (Merrian-Webster, 1963)

The present research studied the developmental aspects associated with acquisition of time perception as defined by 'a unit of time' as well as 'a sense of time'. Previous research and observation suggested by Erikson (1959) and Marquis (1941) noted that although time permeates all human experience the newborn infant lacks the awareness of the flow of time. The child lives in a series of present moments, unaware of the quantities of time which govern human existence.

Cottle (1974) suggests that not until the age of four or five does time recognition drastically change resulting from expanding language and symbolic potentialities. Now the child is not only concerned with the here and now, but s/he has a grasp towards a tomorrow.

In order to better understand the development which succeeds this initial grasp of time, this study is designed

to examine the differences between six, eight, and ten year old children as they perceive past, present, and future time as well as estimate a five-minute time interval.

There is a scarcity of information contained within the existing literature, however some research on time perception combined with comprehensive theory was initially accomplished by Piaget.

Piaget

Time perception is developed when the progressive understanding of succession, duration, and simultaneity is attained during three developmental stages. These stages are based on children's responses to causal observations, and are classified as Stage 1 (Intuitive), Stage 2 (Articulative) and Stage 3 (Operational) (Piaget, 1970).

More specifically, each of Piaget's stages can be conceptualized by the events that symbolize it. Piaget suggests that Stage 1 (Intuitial/Pre-operational) is defined by the egocentric and distorting intuitions the child has of time. It is also characteristic of this stage for the child to confuse space with time. For example, when asking a child to expain which is older, a shorter older seven-year-old, or a taller younger six-year-old, the child will explain that the taller six-year-old is older because s/he is bigger (s/he takes up more space). The child also lacks a perception of events in succession and durations of time. These concepts are confused with space perceptions.

Additionally, Piaget suggests that Stage 2 (Articulated/ Intuition) exhibits an emergence of articulated intuitions, either of succession or of duration, but never both, and not in any specific order. For example, the child will understand either the order of births of two friends (succession, that is one was born before the other) or s/he will understand the permanence of their age differences (duration, that one is always two years older than the other), but s/he will not be able to coordinate these seemingly related realisms.

Piaget concluded that Stage 3 (Operational) completes the coordination between succession and duration. The simultaneous use of these two types of articulated intuitions helps transform the operation into a coherent deductive system. Now, the child not only knows the difference in ages of the two friends, s/he knows which was born first (who is older).

Piaget set up three experiments of causal relationships to illustrate his theory. To illustrate succession, children observed colored water drained from one jar to a second jar, the jars stacked one on top of the other. The upper jar was filled and, at designated intervals precise amounts of water were released from the upper to lower jar. After "each release" the children were directed to draw the water levels they observed onto a series of drawings representing the two empty jars. When all the water had been transferred, the completed drawings (six to eight) were shuffled, and the child

was asked to put them in order; ultimately, the drawings were cut horizontally and the child was asked to order the top jar from full to empty, and the bottom jar from empty to full.

Piaget's results suggest that first stage children are unable to arrange the shuffled, uncut drawings in correct order due to the failure to grasp the process of succession. During second stage, the children are able to arrange the uncut drawings correctly, but, when the drawings are cut, they are confused. At this stage, they have a coherent intuition of succession, but are unable to extract it. The stage three children complete the cycle by correctly ordering the uncut and cut drawings, maintaining a complete understanding of succession.

To illustrate duration, the top jar was shorter and wider in appearance than a tall, thin bottom one, although they were both equal in volume. Consequently, when a child was asked if the time it takes the water to run from jar 'one' to jar 'two' is longer, shorter, or equal for the two jars, the stage one child fails to realize that the two are equal because s/he sees the level in 'two' rising more rapidly than the level drops in 'one'. During stage two, the child does discover this relationship and begins to appreciate it, but s/he is still unable to coordinate these intervals, continuing to hold that duration in jar 'one' is longer than duration in jar 'two'. Ultimately stage three children succeed in correctly analyzing the process and integrating duration for

accurate time perceptions.

To illustrate simultaneity, Piaget set up an experiment in which two figures (I and II) were set off together from a starting line and moved in the same direction and stopped together; however, 'I' was moving more quickly than 'II', with the result that they came to rest approximately three to four centimeters apart. The children were then asked to judge if the length of time it took 'I' to cover its distance was longer, shorter, or equal to 'II'.

Their answers suggested reinforcement for progressive development in the three stages. Stage one children fail to grasp the simultaneity of the end points. They argue that 'I' takes longer than 'II' because it goes farther or more quickly, and they think that 'II' stops first because it covers a smaller distance. At the beginning of stage two, the children deny the simultaneity and equality of the two durations, but contend that 'II' goes on for a longer time because it moves more quickly. It is also apparent that, in the beginning of stage two, some children discover the simultaneity of the motions but still deny the equality of the durations. Completing the process, at stage three, simultaneity and equality of synchronous durations are grasped and correlated immediately.

A literature survey suggested that Piaget's terminology, perceptional constructs and developmental processes had been supported by various methods.

Age-Related Research

Oaken and Sturt (1922) supported Piaget's conclusions by investigating seven groups of children and studying replies (vocabulary) to a 'questions' test. The groups were selected on the basis of age, starting with four year olds and concluding with ten year olds.

The 'questions' test consisted of 22 items ranging from: "What is your age? Is it morning or afternoon? Why? How long would it take you to walk around this room?" to: "How long have you been talking to me?" All of the Ss were administered the same test; however, the younger children were tested individually and orally, while the older children were tested in groups with pencil and paper.

Oaken and Sturt found that four-year-old children know very little about time, frequently providing absurd answers. Five-year-old Ss begin engaging in accurate time evaluation but have much more difficulty with 'duration'. After seven years of age, the absurdities have largely disappeared, showing a certain general knowledge of time, while the ten-year-old group closely approximates adult knowledge of time.

Ames (1946), traced the verbal expressions which follow the development of the sense of time (past, present, and future) in young children by using two methods. The first was the observation of children, 18 to 48 months old, as they indulged in spontaneous or directed play. All spontaneous

verbalizations involving time expressions were recorded. The children were observed throughout the school season during two consecutive school years. The second method directed a series of questions dealing with various aspects of time to children five through eight years of age.

Table 1 organizes Ames' results of children from 18 to

Insert Table 1 about here

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48 months. At first the child (18 months) is aware only of the present, while at 21 months the future becomes initially exhibited in phrases like "in a minute," and "pretty soon." Ames suggests that these remarks are the result of past experiences (adult/parent speech interaction). At 24 months, the recognition of the past is supported with remarks like "last night." Essentially, Ames suggests that the young child develops a time perception which begins with the present, advances towards a future, and completes development with the past.

Further, Ames questioned five, six, seven, and eight year old children directly about yesterday, today, and tomorrow. Basically, he found that five year olds can tell what day it is, they can correctly order days, and they can project their age at their next birthday. At six, an understanding of the seasons and of duration is conceptualized, while, at seven, the child can tell the season, the month, and the specific clock hour. At eight, the child can tell

Table 1

Number of Statements Dealing With Past, Present and Future In Spontaneous Nursery School Conversations.

Age	Present	Future	Past
18 months	100%		
21 months	87%	13%	
24 months	64%	26%	10%
30 months	59%	25%	14%
36 months	41%	36%	21%
42 months	34%	33%	32%
48 months	47%	33%	19%

clock time, the year, the day of the month, and s/he indicates an understanding of the more generalized concept in her/his ability to answer the question: "What does time mean?"

Bromberg (1938) suggests a similar phenomenon, observing that at about five or six years of age children's perceptions begin as objective experiences and develop slowly until about ten or twelve. He suggests that initially the child understands time as an 'egocentric now' established through concrete objects and life experiences.

Bromberg further suggests that the child has no obvious need for a past because his/her existence is dependent on the present, however the immediate future has a dim relationship to the present since the future may be a repetition of the present. In all, he concludes that the perception of younger children are related to the immediate present or the immediate future and that the past becomes cognizant between the fifth and eighth years.

Although the child verbalizes the past and future, it is not clear what these perceptions mean to him/her or how they are conceptualized. Research suggests that three procedures have been used successfully to determine developmental time perception differences.

Time Perception Procedures

Farnham-Diggory (1966) indicated that as a child grows older s/he regards the short-range future as less distant from the real events of the immediate present. Using the "time

line," she asked her subjects, age seven to 16, to indicate on a 197 millimeter line how far away various future times seemed to be. The times ranged between three hours and 80 years from the present. The distances that the children designed were significantly related to age, suggesting that the younger the child, the farther away the future events seemed to be.

Cottle and Pleck (1969) have used the "time line" with 180 subjects ranging in ages from 12 to 18 years. By instructing subjects to draw four marks on a line (20 centimeters long), the test generated six variables: (1) personal past; (2) present; (3) future; (4) life space (the total combination of personal past, present and future); (5) the time before birth (historical past); and (6) the time after death (historical future). These variables were then analyzed according to age, sex, and social class, suggesting that: (1) upper class subjects perceived shorter life cycles, they were more historicentric; (2) older persons (16-18 years) drew significantly shorter "present" time lines; (3) older subjects drew a significantly longer personal past; and (4) middle class boys show significantly longer personal futures (future extension) than any other sex-class group.

Another research method, which was developed by Ross (1965) is the Time Reference Inventory (TRI). This paper and pencil test consists of items that describe ten pleasant, ten unpleasant, and ten neutral events (e.g., "The happiest time

of my life is in the ..."). Subjects decide whether each item refers, for them, to their 'past,' 'present,' or 'future,' and mark it accordingly.

Webb and Mayers (1970) used the TRI to investigate developmental influences on temporal perceptions with four age grousp, 9-10; 12-13; 15-16; and 18-19. The test was administered in the classroom setting and suggested that 12-13 year old males projected their thoughts farther into the future than did their female counterparts. Age had a significant effect on future extension however there were no significant age differences for past extension. Younger groups projected thoughts farther into the future than the older group.

A final method employed to investigate time perceptions is the "Story Line." Von Wright and Von Wright (1977) used this technique to test whether future time perceptions are greater for 17 and 18 year old men or women. The subjects, 84 males and 125 females from Finland, were given the following task:

> Let's suppose that there is a seer, who can foretell the future with fair accuracy. When he concentrates his thought on some given point of time, he can see what things will be like then. Let's also suppose that you may ask him two questions, one about your own future and one about the world more generally, When you ask him about the matter

> in your own future which you are particularly keen about, what year do you choose? and what is your question? (p. 30)

The results of this study made the following suggestions. First, that for both sexes, the global future time perception tends to be more extended than the personal perception. For example, the subject asked, as a global question, "if life had been extinguished by some catastrophe at about the year 2000?" The personal perception was directed to "studies/job/vocation in the mean year 1986, for boys; and 1981, for girls." These results support Cottle and Pleck's (1969) research that personal future time extension was significantly longer for middle-class boys.

Rozek, Wessman and Gorman (1977) have also employed the story line to estimate time span for four, five, six, seven, and nine year old girls. Each subject was individually asked to give her ending to two stories which began: "Ten o'clock one morning, Jerry met his friend in front of his house..." "Susan is sitting at home, eating lunch. She is thinking of the time to come when..." After each story, the subject was asked to estimate how long the action was going on (the time duration in their story).

The subject also completed 25 questions relating to the three Piagetian cognitive time stages mentioned earlier. These questions assessed the child's grasp of duration, succession, and simultaneity. The subject concluded this

experiment by estimating on her own when one minute had passed after watching the interviewer demonstrate a minute interval on a timer.

The results of the Piagetian tasks suggest that none of the subjects was in Piaget's intuitive stage (stage 1); all had reached the articulated-intuition stage (stage 2) or attained the operational stage (stage 3). The results from the analysis of the stories (content duration estimates) suggested that all of the younger girls (four and five year olds) were unable to estimate duration associated with the content in their stories, while the two older groups (6-7 and 9 year olds) told stories with progressively longer estimated durations. The minute estimations also showed clear relationships to age, with almost all subjects greatly underestimating the interval, especially in the youngest group. In all, minute estimation and story duration were significantly related to Piaget's cognitive time staging, but the magnitudes of the relationships were not as great as when compared with age. This suggests that age may be a better predictor than Piagetian staging for time estimation. This study also suggests that conceptual abilities and judgments of time span as defined by Piaget are acquired earlier than previously suggested.

In summary, time sense is a function that develops rather late in childhood, at about four or five and is characterized by Piaget as Stage 1: Pre-operational or intuitive; Stage 2:

Articulated, and Stage 3: Operational. Most researchers agree that the developmental growth period is from approximately 4 to 12, with refinements occurring thereafter. The three methods of investigation used to understand the past, present, and future time extension have been the timeline, the TRI, and the story line. Most of this work has been with subjects age 10 and older, with researchers implying that the methods for measurement require a comprehension level greater than that of young children.

Research Hypotheses

This study examined three age groups to understand developmental perceptions of time tenses (past, present, and future), as well as a five minute time interval (estimations). The age groups (6, 8, and 10) fall within Piaget's stage 2 and 3.

Researchers have been previously discouraged by testing procedures when working with young children. It is demonstrated however, by Rozek, Wessman and Gorman (1977) that positive results can be sustained through their method. The present study expanded Rozek, et al. method by testing the child's perception of past, present, and future time. The child completed three time-related stories. Each child also estimated a five minute lapsed time interval while talking with the interviewer.

The data was analyzed according to sex and age. The literature research suggests sex differences with older

subjects (Von Wright and Von Wright, 1977; and Webb and Mayers, 1970), however there is no suggestion of this trend in younger subjects (Cattle, 1974; Piaget, 1970; Bromberg, 1938; Ames, 1946; and Farnham-Diggory, 1966).

More specifically, two main hypotheses were tested. It was expected that age but not sex differences would be represented by the extent (duration in story content) that subjects perceive each time tense (past, present, and future); also, it was expected that age, but not sex, would dictate the accuracy of children estimating the five minute interval.

These hypotheses are based on two assumptions. First, the perception of past and future time is determined by the understanding of succession and duration. Second, children develop a sense of time beginning with an all-encompassing 'present,' then slowly include the future and finally, the past. The child has her/his life ahead of her/him consequently future and past have been shown to have an inverse relationship to age; the past is a minor part of the young child's world, while it is a major part of the older person's world.

Therefore, no sex differences were expected on any of the measures. However, several significant age differences were predicted. It was hypothesized that as the child develops, their perception of the past becomes more completely understood and perceived, as measured by longer story content duration. However, since the past develops later in the development of 'time sense' it was hypothesized that younger

children would have confusion in distinguishing 'past time' and would perform significantly different from the other groups.

'Present' time perception would have the least amount of variability because the 'present' is primary and basic to the development of the time tenses. Therefore, no significant differences in the way that children perceive the present were predicted.

'Future' time perception was expected to show greatest variability. The older children were expected to have significantly more perceptions of the future, prompted by thoughts of 'what I want to be when I grow up.' The younger child would think of the future in an immediate time sense, based on their lack of comprehension of duration or succession. Consequently, the older the child, the longer the future time span.

The five minute time interval estimation involves an intuitive sense of time in order to estimate the elapsed time. The child has to have developed internalized perceptions of time. There are no visual cues involved. Therefore, a child matures and is involved with life s/he internalizes a 'sense of time' which enables him/her to estimate lengths of time involved in activities. Consequently, it was predicted that there would be significant age differences with the older group perceiving the five minute interval most accurately.

This investigation compared age and sex with present,

past, future time perceptions and an elapsed time estimation.

METHOD

Subjects

A total of 60 students from Cahuilla Elementary School served as subjects. Equal numbers of males and females within each age group were selected. The three age groups (6, 8, and 10) were selected on the basis of Piaget's stages (6, 8, and 10 year old children were observed to be in a 'stage' range from entering Stage 2 - Stage 3) and references in early research (Piaget, 1970; Oaken and Sturt, 1922; Bromberg, 1938; Ames, 1947; and Rozek, Wessman and Gorman, 1977). Subjects were randomly selected from the classes. Parental permission were obtained in advance; the parental consent form can be found in Appendix I.

Procedure

Each child was interviewed individually during school hours. The child was directed from her/his class to a separate section of the main office where the interviewer was seated behind a desk. Each interview was taped with the tape recorder hidden and the microphone camouflaged in books stacked at one side of the desk. The child sat in a chair facing the desk and interviewer. The interviewer hid a stop watch in her lap. The watch and tape recorder were engaged when the child entered the room.

The experimenter introduced herself to the subject and

then explained that she had made up the beginning to three stories. She asked the subject if s/he could use their imagination and make up the endings. The experimenter recorded the child's name and age during their initial conversation. Following this introduction, the experimenter presented the stories in random order for each subject. The stories were as follows:

PRESENT TIME: Sue/Steve is sitting in front of her/his house...

FUTURE TIME: Linda/Fred is sitting at the table thinking of the time to come when...

PAST TIME: Sarah/Sam is walking with her/his friend talking about a time in the past when...

The subjects were asked these questions, using same sex names to enhance children's identification with the stories. Also, after each story, the child was asked to identify the duration of the action in their story (e.g. the time Sue was sitting in front of her house until...their story completion).

The experimenter kept track on the stop watch on her lap, interrupting the interview after five minutes to ask the subject how long the two of them had been talking.

RESULTS

Plan of Analysis

The data consisted of four tasks (dependent variables): present, past, future time story estimates, and five minute time estimates. Each of these tasks represents each groups (six, eight, and ten year old boys and girls) perception of the varied aspects of time. The raw data, dependent on the children's answers, displayed a wide range in time estimates from minutes to years. Each of the measures were analyzed separately. Analyses of variance were done on the present, future, and five minute time estimates, while a chi-square test was appropriate for the past time estimations. The chi-square was necessary because the six year olds were not able to correctly identify past time durations.

Data Transcription

The relevant information on each of the tapes was transcribed for each subject. This information included sex, age, and four time sense scores. The latter represent the story estimation the subjects gave after each story, and the five minute estimation. Table 2 shows the means for each time

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Insert Table 2 about here

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measurement by cell.

Table 2

Means by Sex and Age on Present, Past, Future and Elapsed Time Perceptions

	PRESENT (Minutes)	PAST (Days)	FUTURE (Days)	TIME ESTIMATION (Minutes)
Six Year Olds				
Boys	34.4	*	928.1	20.25
Girls	33.2	-	36.7	12.44
Total	33.75	-	482.4	16.35
Eight Year Olds				
Boys	22.6	241.5	13.0	8.3
Girls	36.3	157.6	185.7	10.37
Total	29.45	199.55	99.35	9.34
Ten Year Olds				
Boys	175.3	499.15	1,770.9	5.2
Girls	42.5	700.5	865.25	7.2
Total	108.9	574.83	1,318.08	6.2

* The missing data is accounted for by this group's inability to correctly identify the past time variable.

Subjects answered questions in terms of minutes, hours, days, and years. To facilitate analysis, data for each measure were converted to time-equivalent bases. The conversions produced the following: the 'present' time data was transformed into 'minutes' (e.g., one hour equals 60 minutes); the 'past' time data was converted into 'days' (e.g., one years was equivalent to 365 days); the 'future' time was tabulated in terms of days, and the five minute estimates were converted to minutes.

Present Time Data

The analysis of variance computed for the present time story estimates is represented in Table 3. The analysis

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Insert Table 3 about here

---

failed to reveal any significant differences. This data suggests boys and girls, aged six, eight, and ten, perceive the present time similarly as represented by their means in column 1 of Table 2.

Past Time Data

Scanning the 'past time' data (column 2, Table 2) suggested that the youngest group as a whole were unable to substantiate their past time story endings with a 'past time' estimate. For example, the story was completed by the subject, but when asked, "How long ago did that happen?" the subject would state that "that story took place in two more days." There was clear confusion of past and future; therefore, a

Table 3

Analysis of Present Time Story Estimates

By Six, Eight, and Ten Year Old Boys and Girls

SOURCE	SS	DF	MS	F	P
Sex	24,080.06	1	24,080.06	.71	NS
Age	79,855.43	2	39,927.72	1.17	NS
Sex X Age	65,043.64	2	35,521,85	1.04	NS
Error	1,840,216.8	54	34,078.09	////	//
Total	2,009,195.9	59	/////////	////	//

chi-square for the observed and expected responses was used testing whether the six year olds were significantly different from the other groups in their ability to evaluate past time. Table 4 reveals that younger subjects inconsistently

Insert Table 4 about here

completed the 'past time' story (e.g. they combined past time story endings with future time estimates, or equated past time with prehistoric time), more often than they consistently completed them.

The chi-square results demonstrate that there is a significant difference ($\chi^2 = 14.94$, $p < .001$) between six year olds (11 inconsistencies) and eight year olds (3 inconsistencies) or ten year olds (1 inconsistency). Six year olds are significantly different in their inability to answer to past time therefore the group was dropped from the ANOVA performed between the eight and ten year olds.

The ANOVA illustrated in Table 5 demonstrated no sig-

Insert Table 5 about here

nificant difference between the eight and ten year olds, however they did approach significance in the predicted direction suggesting that 10 year olds have a more prominent past. Therefore, the past time tense develops with age such that six year olds cannot correctly evaluate it, while eight

Table 4

Chi Square Analysis of Past Time Story Discriminations By Six, Eight, and Ten Year Old Boys and Girls

	Consistent Responses	Inconsistent Responses
Six Year Olds	9	11
Eight Year Olds	17	3
Ten Year Olds	19	1

* $\chi^2 = (14.94)$ $p < .001$

Table 5

Analysis of Past Time Story Estimates by Eight and Ten Year Old Boys and Girls

SOURCE	SS	DF	MS	F	P
Sex	70,485.9	1	70,485.9	.12	NS
Age	1,408,700.4	1	1,408,700.4	2.42	NS
Sex X Age	280,594.2	1	280,594.2	.48	NS
Error	20,994,031	36	586,167.53	////	//
Total	22,753,811	39	//////////////	////	//

and ten year olds can differentiate it and approach significantly longer durations with maturity.

Future Time Data

The future time analysis represented in Table 6 suggests

Insert Table 6 about here

---

a significant age difference between groups ($p < .01$). The means shown in data column 3 of Table 2 suggests that older children extend farther into the future than younger ones. However the Post Hoc t-test using Dunn's critical value α/c, where $c = 3$ and critical value = 2.39, suggested that the significant difference was established between eight and ten year olds, ($t = 2.66$, $p < .01$). A logical explanation for the six year old behavior is that the six year olds are extending a profound future because, similar to 'their past time data' they are not clear in their conception of future time. They have a general idea of the meaning of future but are not realistic in their evaluations. On the other hand, as the child matures (8 years) s/he can make realistic evaluations for future and ultimately extends significantly longer future durations with greater maturity (10 yr. olds > 8 yr. olds). No sex differences were suggested, similarly no interactions.

Five Minute Estimation Data

The analysis of the five minute time period estimation represented in Table 7, shows a significant age difference

Table 6

Analysis of Future Time Story Estimates

By Six, Eight, and Ten Year Old Boys and Girls

SOURCE	SS	DF	MS	F	P
Sex	4,424,491	1	4,424,491	2.11	NS
Age	15,537,380	2	7,768,690	3.71	*
Sex X Age	3,796,643	2	1,898,321.5	1.81	NS
Error	113,074,900	54	2,093,979.6	////	//
Total	136,833,414	59	//////////	////	//

* Significant at the .01 level

Insert Table 7 about here

between the groups ($p < .025$). The means, as shown in column 4 of Table 2, suggests that, as the child matures, a more accurate approximation of the time intervals exists. This is supported by the Post Hoc t-test performed on the means, using Dunn's critical value α/c, where $c = 3$ and critical value = 2.39. Signficant age differences were found between six and ten year old children, $t = 2.80$ ($p < .01$). No sex differences or interactions were found.

It is suggested by the means that the younger subjects greatly overestimate the interval, however a detailed description of the range of scores they used to estimate this variable shows that these children answer in a bizzare and inconsistent way. They are just as inclined to estimate the period as one minute as they are to estimate it as 60 minutes. Therefore the mean of these durations is characteristically over-estimated. The important note here is that as the variability in estimations is reduced, the group mean more closely approximates the true value (5 minutes).

Correlation of Past and Future Data

The 'past time' and 'future time' data (columns 2 and 3, Table 2) suggested that perceiving a more distant past also meant perceiving a more distant future. The six year olds were excluded because of their previously suggested lack of 'past time' perception as well as their unrealistic

Table 7

Analysis of Five Minute Time Estimates

By Six-, Eight- And Ten-Year-Old Boys and Girls

SOURCE	SS	DF	MS	F	P
Sex	323.43	1	323.43	2.47	NS
Age	1079.39	2	539.70	4.12	*
Sex X Age	22.88	2	11.44	.09	NS
Error	7073.23	54	130.99	////	//
Total	8498.92	59	//////	////	//

* Significant at the .025 level

future time estimations, four other individuals were excluded because of their inappropriate future time score (zero time score). The Pearson Correlation Coefficient proved significant, $r = .45759$ ($p < .01$), showing that individually it is those children who gave more distal past references who also gave more distal future references. It appears then that once 'past' and 'future' are acknowledged they develop dependently.

DISCUSSION

The results from this research suggest that there are developmental differences in children's perception of past and future time, and their judgements of a five minute time interval. Generally, the older the child, the more complete and comprehensive the understanding of time. S/he not only defines past and future with more distant time estimations, but s/he is more accurate in her/his five minute estimate. The correlated results suggest, additionally, that it is those children (from eight to ten) who perceive a more distant past who also project a more distant future. More specifically, several hypotheses were tested in this research.

Research Hypotheses

Sex Differences. The results of this study confirm a lack of sex differences. In previous research, sex differences were evident with older subjects (Von Wright and Von Wright, 1977; and Webb and Mayers, 1970), but not with children (Cottle, 1975; Piaget, 1970; Bromberg, 1938; Ames, 1946; and Farnham-Diggory, 1966).

Past Time

Previous research (Cottle, 1974; Oaken and Sturt, 1922; Ames, 1946; and Bromberg, 1938) suggested that, as the child matured, the perception of past became more completely

developed. Therefore, it was hypothesized that younger children would have confusion in distinguishing 'what' past time was.

The results supported late acquisition of past time perception. Six year old children were confused in their definitions of past time. They frequently talked about "dinosaur time' (prehistoric time) when referring to the past time in their stories. Additionally, they referred to the past tense in their stories but scheduled the events in the future (e.g., E: "How long ago did that happen" S: "It'll happen in three more days.")

The discrepancies diminished with age when eight and ten year olds could clearly define the past, and began to approach developmental differences in their perceptions. Past time perceptions become defined at approximately eight years of age, and, henceforth, a rapid understanding and organization of this dimension is practiced. Eight and ten year olds differ, however in the extent to which they define past. The ten year olds consider past time at approximately two years while the eight year olds evaluate it at approximately 9 months.

Present Time

Previous research (Erikson, 1959; Marquis, 1941; Cottle, 1974; Ames, 1946; Bromberg, 1938; Farnham-Diggory, 1966; and Rozek, Wessman and Gorman, 1977) suggested that 'present' time would have the least variability. The present does not require

the understanding of succession, duration, and simultaneity to grasp its meaning. As Erikson and Marquis (1941) noted, the first awareness of time is a series of present moments, this study supports that assumption.

Future Time

It was expected that the future would have the greatest variability because it develops quickly (Ames, 1946; Bromberg, 1938; and Farnham-Diggory, 1966). All the children would understand this concept resulting in many developmental comparisons.

The present research found significant age differences with respect to the future. It is comprehended at all age levels, however six year old children are not yet realistic in their perceptions. Further, it is those children who project a greater future who consistently refer to a more distal past. Consequently, it is suggested that development of past time perceptions are inter-dependent. Specifically, I would infer that the future develops initially and opens the understanding for the past enabling the two to coordinate in a generalized perception of time.

Five Minute Time Estimation

Previous research (Piaget, 1970; Oaken and Strut, 1922; Ames, 1946; Bromberg, 1938; and Rozek, Wessman and Gorman, 1977) suggested that the five minute time lapse estimations would be judged most accurately by older children. It was hypothesized that the more mature child has internalized a

'sense' of time which enables her/him to estimate lengths of time involved in activities. This research emphasizes that as the child develops, the estimation is more accurate and the cognition of time has shifted from the view of objective experiences (concrete objects and life experiences) to subjective experiences (internalized experiences).

Developmental Conception of Time

Oaken and Strut (1922) suggested five year old children start to obtain a general perception of time, but persist in multiple absurdities concerning 'duration.' At about seven, these largely disappeared and by ten, children have a close approximation to the adult knowledge of time. The present research suggests that the child's (six year olds) absurdities are concentrated in the perception of past time and the estimation for the future, as well as their ability for internalizing time in estimating five minutes.

This research proposes that the past is the most confusing and least understood of the tenses to the child. "Past" is also the time period with which the child has had the least experience. The present, as Bromberg (1938) notes, is always there; life for the young child has been a series of present movements; the future is comprehensible to the child because s/he learns by experience that someone or something has had little time to experience the past. It is only with maturity and experience that the child builds up a cognitive process for a personal past.

More currently, Rozek, Wessman and Gorman (1977) compared Piagetian staging to age using time perception and time lapse estimation. Rozek, et. al., found that other children not only project longer time estimations but are more accurate in their approximation of time intervals. The time-tense related stories of the present study indicated past, present, and future perceptions, and made it possible to gain knowledge concerning the cognitive powers of the different age groups.

Along with the extension of the stories used by Rozek, et. al., the time estimation procedure was revised. Instead of having the children mimic a one minute time lapse instruction, children approximated a five minute time lapse using her/his own cognitive powers. The child's ability to approximate was dependent upon the child having an internal 'sense of time.' The present procedure established that the child gains a cognitive process which enables her/him to evaluate how much time has passed.

Rozek, et al., also suggest that it is not necessarily the Piagetian-Cognitive states that indicate how perceptive the child is, but that age seems to be a better determiner. If age is a better determiner, then Piaget may be excluding some valuable components in the development of time perception, however he has outlined the general principles which determine the acquisition of time perception.

Piaget

Piaget (1969) suggests that time perception is the product of a progressive understanding of succession, duration, and simultaneity through three cognitive-developmental stages. More specifically, succession and duration are constructs which, when developed, enhance perceptions of past and future. The child must understand that events happen in an order (succession) and that this order remains constant, consuming a given amount of time (duration) in order to perceive a flow of time (past to present to future). As the constructs are built, the construct of simultaneity is added. Simultaneity is the perception of comparing two events' durations. This can also mean one real event against a cognitively stored event (e.g., sitting and talking with the experimenter as compared to a stored experience of similar duration).

Duration and succession were both tested in the past and future story procedures. The child used memory storages of past/future experiences (succession) to complete the stories. The child also had to rely on cognitive processes when evaluating the length of time involved in their stories (duration). The comprehension of succession and duration was tested in each story.

It was found that six year olds had dufficulty in evaluating past time but not the present or future tenses. It is demonstrated then that by the age of six, the child is aware of duration and succession, but the meaning of past is not

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APPENDIX I.

Spring, 1979

Dear Parents:

We are researchers at California State College, San Bernardino, interested in early childhood development. At present we are examining how children understand time. In this study three age groups of children will participate. The children will be asked to make up endings to three stories, their answers being recorded. No evaluations of individual children will be made. A report of the results will be available later. This project is being carried out with the permission of your child's school. We hope you will be interested in having your child participate in this project. Please fill out the information requested below and return the slip to your child's teacher.

Thank you for your cooperation.

Sincerely,

Tina Wein
Graduate Student

Marsha B. Liss
Marsha Liss, Ph.D.
Assist. Professor

My child _____ age _____

does/does not (circle one) have my permission to talk with Tina Wein regarding the understanding of 'time'.

_____
Parent's signature

5500 STATE COLLEGE PARKWAY, SAN BERNARDINO, CALIFORNIA 92407

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