ABSTRACT OF THESIS

DEVELOPMENTAL CHANGES IN ATTENTION AND COMPREHENSION AMONG CHILDREN WITH ADHD AND COMPARISON CHILDREN

Children with ADHD have significant attentional problems that affect their academic performance. Because many of the typical symptoms of ADHD manifest themselves in classrooms, these attentional problems may have an impact on comprehension and its course of development. This is a significant area of interest because the academic success of a child requires being able to recall and comprehend information. Effective comprehension requires being able to understand both causal ("*why*?") and factual ("*what*?") questions.

The purposes of this study are use the television viewing methodology and 1) to employ a longitudinal investigation and compare patterns of developmental change among children with ADHD and comparison children in attention and comprehension, 2) examine if cognitive engagement, as indexed by long looks, increases with age for each group, and 3) investigate how look lengths relate to comprehension for each group.

Participants were 59 children with ADHD and 101 comparison children. Children viewed two 12-minute episodes of the *Rugrats* television program at time one and two episodes at time two, approximately 18-months later. Each of the children viewed the television program in one of two viewing conditions, toys-present and toys-absent.

Results provide insight into the problems in attention and comprehension experienced by children with ADHD. First, the preciously observed difficulties in sustaining attention with toys-present for children with ADHD are stable across time and a wide age range. Second, as they got older children with ADHD did not exhibit the same increase in time spent in long looks as comparison children. Third, the older high IQ children with ADHD fell behind comparison children in their recall of factual information as they got older. Fourth, as they became older, high IQ children with ADHD did not show improvement in their causal recall with toys present, in contrast to comparison children. Finally, although there was some support for the hypothesis that time spent in long looks is associated with comprehension of the televised material, it did not account for group differences in recall. Several implications and directions for future research are discussed.

KEYWORDS: ADHD, Children, Stories, Attention, Comprehension

Ursula L. Bailey________________________

July, 10, 2006__________________________

DEVELOPMENTAL CHANGES IN ATTENTION AND COMPREHENSION
AMONG CHILDREN WITH ADHD AND COMPARISON CHILDREN

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DEVELOPMENTAL CHANGES IN ATTENTION AND COMPREHENSION AMONG CHILDREN WITH ADHD AND COMPARISON CHILDREN

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Arts and Sciences at the University of Kentucky

By

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2006

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ACKNOWLEDGMENTS

The following thesis, while an individual work, benefited from the insights and direction of several people. First, my advisors and Thesis Chairs, Drs. Elizabeth P. Lorch and Richard Milich, offered invaluable guidance and patience throughout the entire learning process. In addition, Dr. Larry Gottlob provided timely and instructive comments that challenged my thinking and improved the quality of the finished product.

In addition to the technical and instrumental assistance above there are many personal instances of gratitude that cannot go unmentioned. Above all, I am thankful to God for the wonderful opportunities afforded me and for His Sovereign and gentle hand that orchestrates my life. None of this would have been possible without the love and support of family and my friends. My mother, Mildred Bailey and father, Wendell Bailey, have been constant sources of encouragement for me. Thank for being a truly soft place to fall and a compassionate sounding board throughout this whole process. My brothers, Wendell Bailey and Ralph Bailey, have always been my biggest cheering section. I can always count on them for their unwavering love and supportive guidance. You guys have really been the wind in my sails! Thank you for having always seen in me what is only now coming to fruition. My aunt, Mary Grayson, has been encouraging during this process and is a tireless prayer warrior. Thank you for

I truly believe that no one should walk through this life without knowing the love of a friend. Without the day-to-day support from Melinda Leonard, Andrea Smith, Leslie-Ann Toney, Dr. Rashada Alexander, Tia Stokes, and Taja Brown here in Lexington, my graduate experience would have been much more taxing. Thank you guys for reminding me to stay well-rounded and for the much needed respite. I would like to thank my loving and loyal circle of friends: Sharnise Wilson, Evita Smith, Nicole Brooks, Ayanna Peake, Martina Puryear, Shernieka Stephenson, Keisha Boone, Malia Gibson, and Jason Coffey. Every single one of them has enhanced my life in immeasurable ways. I love you guys for so many reasons! God has planted your friendships as seeds in my heart; I marvel at they flourish.

Next, I would like to thank the women of Delta Sigma Theta Sorority, Incorporated for being a constant source of support and inspiration for me. I would like to thank Dr. Peggy Enochs for her pool of wisdom and well of mentorship that I draw from even today. I would like to thank Drs. Peter Millet and Prem Kahlon for taking so much time with me as an undergraduate and for introducing me to research. Thank you for providing the kind of advisement that so many people dream of having and for your support that has continued long after my graduation from Tennessee State University. I would like to thank Bishop J.W. Walker for his challenging instruction and the tremendous growth that I experienced while in Nashville as well as the Shiloh church family for their encouragement and kind regards.

Finally, I wish to thank the anonymous participants of this multi-year longitudinal study and their families. Without their dedication, this project would not have come to fruition.

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Chapter One

Introduction

It is well established that children with attention deficit hyperactivity disorder (ADHD) have significant attentional problems (Douglass, 1999). There is also converging evidence that attentional problems these children with ADHD exhibit may be reflected in school performance via grade retentions and other academic difficulties. Typical symptoms of the disorder include difficulty sustaining attention, failure to complete tasks, forgetfulness, excessive fidgeting, and excessive physical activity (American Psychiatric Association, 1994). Because many of these symptoms manifest themselves in a classroom setting, these attentional problems affect school performance and may have an impact on comprehension and its course of development. However, there is much to be learned in terms of how attention impacts comprehension, especially in children with ADHD.

Many methods have been employed to measure attention. Such tasks as reaction time, continuous performance or vigilance tasks, as well as measures of on-task behavior, represent a few of the methods that are commonly used. However, none of these tasks provides a structure that links attention to comprehension. For example, on-task behavior is often employed in classrooms as a measure of attention, but monitoring on-task behavior alone does not provide information regarding whether the child is actually comprehending. This is a significant area of interest because the academic success of a child necessitates being able to comprehend, remember, and recall information.

Television Viewing Methodology

One task that effectively links attention to comprehension is the television viewing methodology. A laboratory study by Lorch, Anderson & Levin (1979) provided evidence that toys reduced attention to television in 5 year olds from 87.1% to 44.5%. Thus, the TV viewing method manipulates attention to television as children watch two programs, one in the presence of toy distracters and one in the absence of toy distracters. The children are continuously videotaped in order to code attention and at the end of each program, free recall and cued recall questions are recorded.

There are benefits to using the TV viewing method, especially among children with ADHD. First, TV viewing provides a familiar and enjoyable setting for children while presenting complex story structures. Also, literacy is not a requirement in this task, thus younger children and children with reading problems may be included in the sample. Most importantly, the TV viewing methodology permits a closer look at the relation between attention and comprehension.

Attention and Comprehension in Elementary School Aged Children

There have been some consistent TV viewing results in studies examining attention and comprehension in children with ADHD and comparison children at the elementary school age (Landau, Lorch, & Milich, 1992; Lorch et al., 2000, Lorch et al., 2004).

Landau et al. (1992) compared visual attention patterns and comprehension of boys with ADHD and comparison boys when viewing the PBS program, *3-2-1 Contact*. Each child watched two different segments of the television program under two conditions; in the presence of toys and with toys absent. At the conclusion of each program, all of the boys were asked cued recall questions pertaining to factual information.

The results indicated that when toy distracters were present, boys with ADHD and comparison boys differed significantly in percent visual attention to the television. Conversely, when toy distracters were absent, percent visual attention to the television was similarly high for both groups. Despite the differences in attention, there were no significant differences in recall of factual information, even in the toys-present condition.

Lorch et al. (2000) replicated the procedures of Landau et al. (1992) in Study 1 of their experiment, and added *Growing Pains* as one of the stimuli used. The results for attention were similar to those of Landau et al. (1992), but the comprehension results differed. Lorch et al. (2000) found no significant difference when toy distracters were absent, but when toy distracters were present, comparison boys significantly recalled more than boys with ADHD. In an attempt to reconcile the conflicting findings between the two studies, an exploratory analysis was conducted that distinguished between factual and causal recall questions. The questions that were factual in nature asked the children to tell "what" happened. Conversely, the questions that were causal in nature asked the children "why" events took place. The results revealed no group difference in factual or causal questions when toy distracters were absent. However, with toy distracters present, comparison boys significantly outperformed boys with ADHD in causal questions. Study 2 presented evidence supporting the exploratory analysis and concluded further that when visual attention is accounted for, differences in recall of causal questions between the groups disappears. The evidence suggests that children with ADHD are capable of answering causal questions when distracters are absent, but that visual attention accounts for some of the difference between them and comparison children with toys present.

Cognitive Engagement

Lorch et al. (2004) replicated the previous research and suggested that the differences in look lengths and cognitive engagement mediate attention and comprehension. Attentional inertia has been described as a phenomenon in which the longer a continuous look is maintained, the probability of it continuing increases, and there is a concomitant decrease in distractibility. The effect plateaus at 15 seconds (Anderson, Choi, & Lorch, 1987). Attentional inertia, the increase of the probability of a look continuing the longer it has been maintained, appears to be the mechanism that links look length to cognitive engagement (Anderson, Choi, & Lorch, 1987). Lorch et al. (2004), replicating the design of Lorch et al. (2000), examined attention and found results consistent with those of the earlier study in terms of visual attention and comprehension of factual and causal questions. The study also revealed that boys with ADHD spent more time in short looks to the television in contrast to comparison boys who spent more time in longs looks ($\geq$15sec) to the television. To support the hypothesis that cognitive engagement accounted for the group differences in comprehension with toy distracters present, three pieces of evidence converged that long looks ($\geq$15 sec) result in deeper processing and comprehension. The first evidence demonstrated that the group difference in causal questions disappeared when time spent in long looks, but not time spent in short looks, was controlled for. Also, when information necessary to answer the causal questions was presented, children with ADHD were less likely than comparison children to be in long looks to the television. Finally, when children with ADHD were in long looks at a point where information necessary to answer the causal questions was presented, their performance was comparable to comparison children. Thus, long looks, as an indicator of cognitive engagement, appear to account for group differences in comprehension of causal questions.

Attention and Comprehension in Preschool Aged Children

There has been little investigation into the story comprehension of preschool aged children with ADHD and their nonreferred peers. Comparing the abilities of these children may add insight into what developmental differences, if any, are present in recall of causal and factual information.

In addition to the previous research with elementary school aged children, there has been investigation using TV viewing and comprehension in preschool aged children with ADHD and their nonreferred peers. Using the children's television program *Sesame Street*, Sanchez, Lorch, Milich, & Welsh (1999) found that preschool aged children with ADHD performed differently than their nonreferred peers in attention and comprehension. Like previous studies with elementary school aged children, visual attention was consistently high when toy distracters were absent; however, when toy distracters were present, visual attention of children with ADHD was significantly lower than that of their nonreferred peers. In factual recall, comparison children significantly outperformed children with ADHD when toys were present, but not when toys were absent. For causal relation questions, comparison children answered more causal questions correctly and outperformed children with ADHD regardless of the presence of toy distracters. It appears that preschool children perform comparably to their nonreferred peers in factual recall, so long as they are not in the presence of distracters. However, preschool children with ADHD appear to fall behind comparison children in their abilities to recall causal information, which is essential to effective story comprehension.

Developmental Conclusions and Longitudinal Design in ADHD

There are problems associated with making developmental conclusions in children with ADHD. Most of the available data are cross-sectional and reflect age differences and developmental changes can only be inferred. Also, very few children under four are diagnosed with ADHD due to the sometimes age appropriate variability in their behavior (American Psychiatric Association, 1994). For the younger children who are diagnosed, there is a question regarding the similarity of their referral patterns as well as the severity of the disorder (i.e. children diagnosed at age 4 may be more severely impaired compared to a child diagnosed at age 8).

The previous research relating attention to comprehension using the TV viewing methodology spans preschool and elementary school aged children as well as those with ADHD and their nonreferred peers. Some of the diverse findings may be due to differences in viewing materials (i.e. TV stimuli), age cohorts (i.e. preschool vs. elementary school), or gender of participants included. Because of the different approaches taken in previous studies, it is difficult to draw developmental conclusions based on prior findings. In order to get a reliable picture of the development of attention and comprehension in children with ADHD, it is important that the methodology be able to compare the same children at different points in time, as well as use the same stimuli for each child. There have been few uses of the longitudinal design that examine attention. Milich (1984) examined sustained attention and activity level in a normative sample of boys across two years, finding that the behavior of boys improves, with an increase in age leading to more on-task behavior, less activity, and fewer attention shifts. Milich, Loney, and Roberts (1986) conducted a similar longitudinal study using a sample of boys clinically referred for hyperactive behaviors. The results revealed that as age increased over the 2 years, there was improvement in gross motor activity in the free play condition and attention in the academic condition.

Thus, the primary purpose of the current study is to use the TV viewing method and a longitudinal design to investigate and compare patterns of developmental change in attention and comprehension among children with ADHD and comparison children. Specifically, we examined if long looks increase with age for each group. In addition, we investigated how long looks and short looks relate to comprehension for each group. We expect that the pattern of attention, comprehension, and cognitive engagement, may differ from prior findings due to cross-sectional nature of previous research in contrast to the longitudinal design of the current study.

Chapter Two

Methodology

Participants

A total of 160 children participated in the study. Of those children, 59 had a diagnoses of ADHD, 101 were comparison peers. All of the children were categorized in either a younger group (N= 71) (age 4-6 at time of recruitment in Phase One) or an older group (N= 89) (age 7-9 at time of recruitment in one). There were a total of 44 younger comparison children and 27 younger children with ADHD. There were a total of 57 older comparison children and 32 older children with ADHD.

The children with ADHD were recruited from an outpatient psychiatric clinic in the area. Each child's information was examined to ensure that they were of appropriate age, have a DSM-IV (American Psychiatric Association, 1994) diagnosis of ADHD, and an IQ score that is not below seventy. On-site parent interviews were structured to confirm the ADHD diagnosis. In this interview, the DSM-IV criteria were used and parents responded whether each criterion was true for his or her child. To rule out possible effects of medication, many efforts were made to make sure that children normally on stimulant medication were free from it the day of testing. Parents received a reminder call the day prior to the study and on the day of testing to verify that the child's medication was suspended. Children that exhibited problems of only inattention were not allowed to participate in the study as Barkley (1997) has illustrated that impulsivity/hyperactivity is a core deficit in ADHD. Children with comorbid diagnoses, such as oppositional defiant disorder, conduct disorder, and learning disabilities were allowed to participate in the study.

The group of comparison children was recruited using advertisements in a local newspaper. The eligibility of each child was assessed via a telephone interview with a parent to ascertain that the child was free from any behavioral problems or learning disabilities. An on site structured interview with the parent confirmed the results of the phone interview such that only children free of behavioral problems and learning disabilities were included in the study. All of the children were paid for their participation in the study.

Children with ADHD were rated by parents as having significantly more inattentive symptoms (*M*= 5.9) than comparison children (*M*=.15), $F(1, 156)=1227.2$, $p<.001$, $r= .94$. Older children were also rated as having more inattentive symptoms (*M*=3.53) than younger children (*M*=2.55), $F(1, 156)= 35.51$, $p< .001$, $r= .43$. These main effects were qualified by a significant Group x Age interaction $F(1, 156)=27.38$, $p<.001$, $r= .39$, such that older children with ADHD were rated as having significantly more inattentive symptoms (*M*= 6.84) than younger children with ADHD (*M*= 5.0), $F(1,57)= 10.13$, $p< .05$, $r= .39$. There was no difference between older (*M*= .21) and younger (*M*= .009) comparison children $F(1,99)= 1.67$, $p = .200$, $r= .95$. Children with ADHD were rated as having significantly more hyperactive symptoms (*M*= 5.89) than comparison children (*M*= .193), $F(1, 155)= 1185.59$, $p< .001$, $r= .94$, as well as having more oppositional-defiant disorder symptoms (*M*= 3.40) than comparison children (*M*=.271), $F(1, 155)=356.50$, $p< .001$, $r= .83$.

Mothers of children with ADHD reported having significantly fewer years of education (*M*=14.36) than mothers of comparison children (*M*= 15.59), $F(1, 152)=53.65$, $p< .001$, $r= .51$.

During separate phases of the longitudinal study, measures of intelligence were collected. Younger children with ADHD had significantly lower scores on the *WPPSI-3* vocabulary subtest (*M*= 10.22) than younger comparison children (*M*= 11.86), $F(1,69)= 4.58$, $p< .05$, $r= .25$. In addition, older children with ADHD had significantly lower scores on the *WISC-III* vocabulary subtest (*M*= 9.21) than older comparison children (*M*= 13.37), $F(1,87)= 25.67$, $p< .001$, $r= .48$. Because of the group differences that emerged significant on measures of intelligence, the current study will follow the suggestion of Barkley, Edwards, Laneri, Fletcher, & Metevia (2001), and include IQ as a between-subjects factor in all remaining analyses except those of visual attention.

The participants in the current study were recruited as part of a larger longitudinal study. The children included in the present analyses were first seen in Phase One and then seen a second time in Phase Two, approximately 18 months later. As with most longitudinal studies, attrition did occur in our sample. Of the 191 participants originally recruited, there were a total of 31 participants who did not return for Phase Two. The primary causes of attrition were due to 1) not being able to reach the participants' parent,

2) the family moving away, and 3) dropping out of the study. To ensure that those participants lost to attrition did not differ significantly from those retained, we compared them on diagnostic measures, mother's education, child's IQ and attention and comprehension outcome measures. There were no significant differences on any of these measures between those who remained in the study at Phase 2 and those who did not, and in only 1 out of 10 variables did diagnostic group interact significantly with attrition status. The mothers of children in the ADHD group who dropped out had fewer years of education than the mothers in the other groups. Based on these limited findings, it does not appear that attrition is affecting the results.

Materials

The children viewed four of six 12-minute episodes of the *Rugrats* television program. The current study was a part of a larger longitudinal study in which all children viewed all six episodes of *Rugrats* over the course of a three-year period of time. The order of the episodes viewed was random and the selections were counterbalanced.

Each of the children viewed the television program in each of two viewing conditions, once with toys present and once with toys absent. The order of the viewing condition was counterbalanced. The toys included in Phase One of the study were two handheld video games, a *Magna Doodle*, a remote control car, a *Buzz Lightyear* action figure, a Transformer robot, and a *Nerf* basketball and hoop. The toys included in Phase Two of the study were a dart board with magnetic darts, remote control car, handheld tic-tac-toe game, *Spectra Color*, dinosaur figurine, and a bendable figurine with a dog.

The number of each set of cued recall questions ranged from 28 to 40. The questions tested factual information and causal relations among events in the stories.

Procedure

Children were brought to the laboratory by a parent for the first time in Phase One and a second time in Phase Two, approximately 18 months later. The procedure for both phases was the same. Upon arrival, the child spent about five minutes getting familiar with the experimenter and picking out which toys he or she would receive at the end of the session. Consent was obtained from the parent during this time, in Phase One. Afterwards, the child was taken to the viewing room set up with toys present or absent and was seated at a 121.92 cm x 77.47 cm table. A 91.44 centimeter cart was placed at a

45-degree angle to the right edge of the table. The video camera was located in the left upper corner of the room. This arrangement allows the child's attention, evidenced by distinct head movement, toward and away from the television to be recorded. The experimenter, blind to group status (i.e. ADHD vs. comparison children), tested the child.

Toys-present Condition

The toys were arranged on the table in a standard order prior to the child's entrance in the room. Each child was given directions as follows:

> There will be a TV program coming on in a minute for you to watch. There are some toys here too, and you can play with them if you want while the program is on. When I come back into the room, I'll ask you some questions about what you saw on TV. (Turn on TV) Remember, I'll ask you some questions about what you saw when the show is over.

Toys-absent Condition

The child was seated at the empty table. Each child was given directions as follows:

> There will be a TV program coming on in a minute for you to watch. When I come back into the room, I'll ask you some questions about what you saw on TV. (Turn on TV) Remember, I'll ask you some questions about what you saw when the show is over.

At the conclusion of the program, the experimenter returned, turned off the television, and removed the toys (if present). Each child was shown a picture card with all the major characters of the *Rugrats* program. Then the child was asked to give a free recall of the events of the story and then was asked the series of cued recall questions. The cued recall tests followed the sequence of the show and the child's answers were recorded on audiotape, transcribed, and scored as correct or incorrect. In order to obtain an estimate of inter-rater reliability for coding, 20% of the recall responses were scored twice, with Pearson correlations of .99 for Phase One responses. The reliability achieved during Phase Two responses for factual recall with toys absent was .92, and with toys present was .98. .The reliability during Phase Two responses for causal recall with toys absent was .94, and with toys present was .94.

The videotapes were reviewed by coders to determine the child's percent visual attention to the television. Visual attention ratings were done using a synchronization of the *Rugrats* episode with a computer program which allows raters to code a child's onset and offset looks toward the television. In order to obtain an estimate of inter-rater reliability for coding, 20% of the tapes were scored twice, with Pearson correlations of .98 for Phase One and .95 for the toys-absent condition and .95 for the toys-present condition during Phase Two. The same format was followed for Phase Two number of long looks with toys present .94, with toys absent .89, and time spent in long looks with toys present .99 and with toys absent .96.

Chapter Three

Results

The primary purpose of the current study is to use the television viewing methodology and a longitudinal design to investigate and compare patterns of developmental change in attention and comprehension among children with ADHD and comparison children. As mentioned previously, all analyses include IQ as a factor with the exception of the analyses involving visual attention, because this variable is not significantly correlated with IQ. Complete ANOVA tables for visual attention and comprehension are included in Appendix A. The following results will only include effects involving diagnostic group.

Percent Attention. In order to investigate patterns of developmental change in visual attention, a 2x2x2x2 repeated measures ANOVA was employed with diagnostic group (ADHD or comparison) and age group (younger or older) as the between-participants variables and viewing condition (toys present or toys absent) and time period (Phase 1 or Phase 2) as the within-participants variables. Main effects of group, $F(1, 140) = 22.74$, $p < .001$, $r = .37$, and viewing condition, $F(1, 140) = 764.74$, $p < .001$, $r = .85$, were qualified by a significant group x viewing condition interaction, $F(1, 140) = 15.67$, $p < .001$, $r = .32$. Although a very small difference of means (comparison $M = 95.07$, ADHD $M = 91.91$) emerged significant with toys absent, $F(1,144) = 3.94$, $p < .05$, $r = .16$, the difference between comparison children ($M = 47.05$) and children with ADHD ($M = 28.28$) groups was more pronounced with toys present, $F(1,144) = 19.74$, $p < .001$, $r = .35$, (see Figure 1). Although significant, the former finding is most likely an artifact of limited variability because the restricted range of the both means is above 90%. There were no other significant interactions involving diagnostic group.

Number of looks. Comparison children ($M = 21.04$) made fewer looks toward the television than did children with ADHD ($M = 24.93$), $F(1, 140) = 5.86$, $p < .05$, $r = .20$. There were no significant interactions involving diagnostic group.

Time spent in long looks (>15 sec). Comparison children spent significantly more time in long looks toward the television ($M = 435.36$) than children with ADHD ($M = 338.69$), $F(1, 140) = 32.56$, $p < .001$, $r = .43$. There was a significant group x viewing condition interaction, $F(1, 140) = 13.73$, $p < .001$, $r = .30$, which was qualified by a significant group x phase x viewing condition interaction, $F(1, 140) = 5.05$, $p < .05$, $r = .19$ (see Figure 2). With toys absent during Phase One, comparison children spent significantly more time in long looks ($M = 637.60$) than children with ADHD ($M = 567.18$), $F(1,143) = 22.12$, $p < .001$, $r = .39$. At Phase Two, however, this difference in the toys-absent condition disappeared and both comparison children ($M = 619.59$) and children with ADHD ($M = 596.88$) spent comparable amounts of time in long looks to the television, $F(1,143) = 1.94$, $p = .166$, $r = .12$. With toys present during Phase One, comparison children ($M = 198.25$) spent significantly more time in long looks to the television than children with ADHD ($M = 80.29$), $F(1,144) = 14.22$, $p < .001$, $r = .30$. Unlike the results for toys absent during Phase One, during Phase Two with toys present, comparison children ($M = 282.56$) continue to spend significantly more time in long looks to the television than children with ADHD ($M = 112.62$), $F(1,144) = 22.18$, $p < .001$, $r = .37$. A compelling finding emerged when we examined each group's time spent in long looks during Phase One in comparison to their long looks during Phase Two. Comparison children significantly increased their time spent in long looks from Phase One to Phase Two, $t(93) = 3.29$, $p < .001$, $r = .32$, with toys present. Strikingly, children with ADHD failed to show a significant increase in their time spent in long looks from Phase One to Phase Two, $t(53) = 1.46$, $p = .151$, $r = .20$, with toys present. There were no other interactions involving diagnostic group.

Time spent in short looks (<15 sec). There was no significant main effect of diagnostic group or any significant interactions.

Factual Recall. In order to investigate patterns of developmental change in comprehension, causal and factual recall were explored. To assess factual recall, a 2x2x2x2x2 repeated measures ANOVA was employed, with group (ADHD or comparison), age group (younger or older), viewing condition (toys present or toys absent), time period (Phase One or Phase Two), and IQ (Low or High), with total percent correct of factual questions as the dependent variable. A group x age group x IQ interaction was obtained, $F(1, 145) = 4.95$, $p < .05$, $r = .18$ (see Figure 3). Despite apparently similar differences between group means, only for the older, high IQ group, $F(1,45) = 5.41$, $p < .05$, $r = .33$, did comparison children ($M = 78.98$) recall significantly more factual information than children with ADHD (*M*= 71.12). There were no other significant interactions involving diagnostic group.

<u>*Causal Recall.*</u> To assess causal recall, a 2x2x2x2x2 repeated measures ANOVA was employed with total percent correct of causal questions as the dependent variable. Unlike the results for factual recall, comparison children correctly answered significantly more causal questions (*M*= 51.29) than children with ADHD (*M*= 45.59), *F*(1, 145)= 7.30, *p*< .05, *r*= .22. There was also a significant phase x viewing condition x group x IQ interaction, *F*(1, 145)= 7.75, *p*< .05, *r*= .23 (see Figure 4). Regardless of viewing condition and IQ classification, children generally increased in the amount of causal information recalled from Phase One to Phase Two. The one exception to this was the group of children with ADHD classified in the high IQ group. Interestingly, with toys present, this group failed to show a significant increase in the amount of causal information recalled from Phase One to Phase Two, *F*(1,14)= .023, *p*= .882, *r*= .04. Moreover, when the increases in causal recall from Phase One to Phase Two were compared, the only significant difference that emerged was in the high IQ children with toys present [Comparison (Phase One *M*= 46.45, Phase Two *M*= 59.87); ADHD (Phase One *M*= 47.43, Phase Two *M*= 48.52)]. In this condition, comparison children gained 13.42 percentage points compared to the nonsignificant 1.1 percentage point increase of children with ADHD, *F*(1, 78)= 5.15, *p*< .05, *r*= .25.

Furthermore, we examined the effect of group on every combination of IQ, viewing condition, and phase. The results indicate that for low IQ children with toys absent, a significant group difference emerged during Phase Two whereby comparison children (*M*= 60.25) recalled significantly more causal information than children with ADHD (*M*= 45.34), *F*(1, 67)= 14.42, *p*< .001, *r*= .42. This effect was not present during Phase One, *F*(1, 72)= 1.46, *p*= .241, *r*= .14. In the low IQ children with toys present, a trend toward comparison children (*M*= 46.18) recalling more causal information than children with ADHD (*M*= 38.05) emerged during Phase Two, *F*(1, 69)= 3.33, *p*= .07, *r*= .21, that was not significant during Phase One, *F*(1, 72)= 2.74, *p*= .102, *r*= .19. In the high IQ children with toys absent, there were no group effects during either Phase One, *F*(1, 80)= .157, *p*= .643, *r*= .04 or Phase Two, *F*(1, 78)= 1.34, *p*= .250, *r*= .13. For the high IQ children with toys present, a significant group difference emerged during Phase

Two whereby comparison children (*M*= 59.87) recalled significantly more causal information than children with ADHD (*M*= 48.52), $F(1, 78)= 7.88$, $p< .05$, $r= .30$. This effect was not present during Phase One, $F(1, 80)= .015$, $p= .901$, $r= .01$.

Cognitive Engagement

A final purpose of the current study is to investigate how cognitive engagement, as indexed by long looks, relates to comprehension for each group. In previous research (Lorch et al., 2004), longer looks appear to be indicative of increased cognitive engagement toward the television, resulting in a deeper processing of the story information. To determine whether time spent in long looks accounted for any group differences in recall, 2x2 ANCOVAs were run separately by phase with diagnostic group and age group as between-participants variables and time spent in long looks as a covariate. In order to determine that long looks specifically attenuate the differences in comprehension, additional analyses were run with short looks in order to rule out that the differences could be accounted for by overall attention. Analyses were only run on the Phase Two data and the toys-present viewing condition because there were no significant group effects on comprehension during Phase One and the toys-present viewing condition was the only condition in which we find variations in visual attention.

Factual Recall

Phase Two time spent in long looks. The only significant group difference occurred for older children in the high IQ classification. At Phase Two, the effect of group was significant, $F(1, 45)= 5.07$, $p< .05$, $r= .32$. Time spent in long looks was not a significant covariate, $F(1, 43)= 2.00$, $p= .164$, $r= .21$. However, with long looks covaried, the effect of group failed to reach significance, $F(1, 43)= 3.49$, $p= .069$, $r= .27$.

Phase Two time spent in short looks. Time spent in short looks was not a significant covariate, $F(1, 43)= .221$, $p= .641$, $r= .07$. However, with short looks covaried, the effect of group was also failed to reach significance, $F(1, 43)= 3.77$, $p= .059$, $r= .28$.

Causal Recall

Phase Two time spent in long looks. The only significant group difference occurred for children in the high IQ classification. At Phase Two, the effect of group was significant, $F(1, 80) = 8.76$, $p < .05$, $r = .31$. There was a trend toward time spent in long looks emerging as a significant covariate, $F(1, 77) = 3.73$, $p = .057$, $r = .19$. With long looks covaried, however, the effect of group remained significant, $F(1, 77) = 5.09$, $p < .05$, $r = .25$.

Phase Two time spent in short looks. Time spent in short looks was not a significant covariate, $F(1, 77) = .291$, $p = .591$, $r = .06$.

Visual Attention and Comprehension Correlations. In order to determine the strength of relations among the visual attention and comprehension variables, Pearson correlations were employed separately by group and phase (See Tables 5 and 6). Specifically, we determined if there were any group differences between the independent correlations. The analyses were only run on the toys-present viewing condition as this was the only condition in which we find variations in visual attention. The results of the correlational data provide a deeper understanding of how the attention variables (i.e. long or short looks and percent attention) relate to both factual and causal recall for children with ADHD and comparison children. Specifically, for comparison children, percent attention was positively related to long looks. In addition, both attention and long looks were positively related to their recall. This pattern persists from Phase One to Phase Two. A quite different pattern emerged for children with ADHD, however. For these children, only at Phase Two were percent attention, long looks, and short looks positively related to their recall.

Taken together, these results appear to indicate that for children with ADHD, short looks are an important facet comprising their visual attention. Primarily, more time in short looks does not mean less time in long looks, as with comparison children. Secondly, for children with ADHD, short looks actually have a positive relation with causal recall, in contrast to the lack of relationship shown with comparison children.

Table 1

ANOVA Table for Percentage Attention

Source of Variance	*F* Value	Significance (*p*)
	Between Subjects	
Group (G)	22.74	.000**
Age (A)	3.56	.061
G x A	.057	.811
	Within Subjects	
Phase (P)	18.34	.000**
P x G	.38	.539
P x A	.00	.994
P x G x A	.07	.791
View (V)	764.74	.000**
V x G	15.67	.000**
V x A	3.81	.053
V x G x A	.315	.575
P x V	5.97	.016*
P x V x G	1.74	.189
P x V x A	3.06	.082
P x V x G x A	.133	.716

*$p < .05$, **$p < .001$

Table 2

ANOVA Table for Number of Looks

Source of Variance	*F* Value	Significance (*p*)
	Between Subjects	
Group (G)	5.86	.017*
Age (A)	1.57	.213
G x A	2.72	.101
	Within Subjects	
Phase (P)	1.21	.273
P x G	.00	.988
P x A	.04	.844
P x G x A	.01	.934
View (V)	277.52	.000**
V x G	.06	.809
V x A	.00	.983
V x G x A	2.54	.113
P x V	.254	.615
P x V x G	.01	.908
P x V x A	.28	.600
P x V x G x A	.08	.780

*$p < .05$, **$p < .001$

Table 3

ANOVA Table for Time Spent in Long Looks

Source of Variance	*F* Value	Significance (*p*)
	Between Subjects	
Group (G)	32.56	.000**
Age (A)	2.13	.147
G x A	.34	.563
	Within Subjects	
Phase (P)	7.64	.006*
P x G	.00	.960
P x A	.02	.886
P x G x A	.36	.548
View (V)	1077.52	.000**
V x G	13.73	.000**
V x A	.79	.377
V x G x A	.70	.403
P x V	5.14	.025*
P x V x G	5.05	.026*
P x V x A	1.44	.232
P x V x G x A	.96	.329

*$p < .05$, **$p < .001$

Table 4

ANOVA Table for Time Spent in Short Looks

Source of Variance	*F* Value	Significance (*p*)
	Between Subjects	
Group (G)	3.53	.063
Age (A)	.19	.666
G x A `	.92	.340
	Within Subjects	
Phase (P)	.03	.865
P x G	.00	.983
P x A	.06	.806
P x G x A	.00	.982
View (V)	122.17	.000**
V x G	1.22	.271
V x A	.07	.789
V x G x A	1.16	.283
P x V	.759	.385
P x V x G	.58	.449
P x V x A	.19	.661
P x V x G x A	.67	.413

*$p < .05$, **$p < .001$

Table 5

ANOVA Table for Factual Recall

Source of Variance	*F* Value	Significance (*p*)
	Between Subjects	
Group (G)	3.43	.066
Age (A)	59.27	.000**
IQ	38.52	.000**
G x A	2.47	.118
G x IQ	2.02	.157
A x IQ	.34	.563
G x A x IQ	4.95	.028*
	Within Subjects	
Phase (P)	64.11	.000**
P x G	3.85	.052
P x A	14.45	.000**
P x IQ	8.94	.003*
P x G x A	.02	.892
P x G x IQ	.42	.516
P x A x IQ	1.62	.205
P x G x A x IQ	.15	.702
View (V)	79.12	.000**
V x G	1.21	.274
V x A	.02	.899
V x IQ	3.59	.060
V x G x A	.47	.492
V x G x IQ	.23	.632
V x A x IQ	.02	.892
V x G x A x IQ	.40	.527
P x V	.00	.979
P x V x G	.45	.503
P x V x A	.81	.371
P x V x IQ	2.14	.145
P x V x G x A	1.69	.196
P x V x G x IQ	.69	.409
P x V x A x IQ	.03	.865
P x V x G x A x IQ	2.18	.142

NOTE- Factual recall percentage correct. $*p < .05$, $**p < .001$.

Table 6

ANOVA Table for Causal Recall

Source of Variance	*F* Value	Significance (*p*)
Between Subjects		
Group (G)	7.30	.008*
Age (A)	87.51	.000**
IQ	57.32	.000**
G x A	1.32	.252
G x IQ	3.08	.082
A x IQ	.29	.592
G x A x IQ	.75	.389
Within Subjects		
Phase (P)	86.73	.000**
P x G	1.96	.164
P x A	19.37	.000**
P x IQ	.57	.451
P x G x A	3.48	.064
P x G x IQ	.09	.760
P x A x IQ	1.49	.224
P x G x A x IQ	.03	.854
View (V)	57.12	.000**
V x G	.57	.452
V x A	.19	.666
V x IQ	1.62	.205
V x G x A	2.60	.109
V x G x IQ	2.70	.102
V x A x IQ	.13	.721
V x G x A x IQ	.14	.705
P x V	8.53	.004*
P x V x G	1.20	.276
P x V x A	2.63	.107
P x V x IQ	.27	.603
P x V x G x A	.87	.354
P x V x G x IQ	7.75	.006*
P x V x A x IQ	.11	.740
P x V x G x A x IQ	.00	.987

NOTE- Causal recall percentage correct. *$p < .05$, **$p < .001$.

Table 7

Factual Recall as a Function of Group, Age, and IQ

	Low IQ (n = 71)		High IQ (n = 82)	
	Comparison (n = 31)	ADHD (n = 40)	Comparison (n = 66)	ADHD (n = 16)
	M (SD)	M (SD)	M (SD)	M (SD)
Younger	46.94 (20.51)[a]	36.91 (20.80)[a]	55.32 (17.73)[a]	63.06 (18.67)[a]
Older	66.12 (16.28)[a]	59.41 (20.32)[a]	78.98 (11.75)*	71.12 (17.65)*

NOTE—Standard deviations in parentheses.
*= $p < .05$
[a] = NS group difference

Table 8

Causal Recall as a Function of Group, Phase, IQ and Viewing condition Toys Absent

	Low IQ (n = 71)		High IQ (n = 82)	
	Comparison (n = 31)	ADHD (n = 40)	Comparison (n = 66)	ADHD (n = 16)
	M (SD)	M (SD)	M (SD)	M (SD)
Phase One	39.57 (16.80)	33.31 (17.56)	55.52 (16.68)	53.46 (12.55)
Phase Two	60.25 (13.41)*	45.34 (17.88)*	67.88 (13.25)*	72.30 (15.71)*
Toys Present				
Phase One	35.01 (20.16)	27.01 (18.50)	46.45 (17.18)	47.43 (20.02)
Phase Two	45.78 (18.28)*	37.32 (18.22)*	59.87 (14.46)*	48.52 (15.20)

NOTE—Standard deviations in parentheses.
* = Significant increase in causal recall from Phase One to Phase Two

Table 9

Factual Recall during Phase Two with Toys Present in Older, High IQ Children, Controlling for Long and Short Look Lengths

	F value	Significance *(p)*	Effect Size *(r)*
Original Group Effect during P2	5.07	.029*	.32
Group Effect w/Long Looks covaried+	3.49	.069	.27
Group Effect w/Short Looks covaried+	3.77	.059	.28

*$p < .05$, **$p < .001$
P2= Phase Two
\+ = Long Looks not a significant covariate ($p = .164$)
Short Looks not a significant covariate ($p = .641$)

Table 10

Causal Recall during Phase Two with Toys Present in High IQ Children, Controlling for Long and Short Look Lengths

	F value	Significance *(p)*	Effect Size *(r)*
Original Effect during P2	8.76	.004*	.31
Group Effect w/Long Looks covaried $^{+}$	5.09	.027*	.25
Group Effect w/Short Looks covaried^{+}	8.42	.005*	.31

*$p < .05$, **$p < .001$
P2= Phase Two
$^{+}$ = Long Looks not a significant covariate (p= .057)
Short Looks not a significant covariate (p= .591)

Table 11

Correlations between Visual Attention and Comprehension for Comparison Children

		1	2	3	4	5
			Phase One			
1.	Percent Attention	1.00	.057+	.925**+	.294**	.242*
2.	Short Looks		1.00	-.233*	.035	-.052
3.	Long Looks			1.00	.254*	.242*
4.	Factual Recall				1.00	.699**
5.	Causal Recall					1.00
			Phase Two			
1.	Percent Attention	1.00	-.242*+	.917**+	.268**	.395**
2.	Short Looks		1.00	-.510**+	.018	.068+
3.	Long Looks			1.00	.240*	.319**
4.	Factual Recall				1.00	.745**
5.	Causal Recall					1.00

*= Correlation significant at .05 level
**= Correlation significant at .01 level
+= significant group difference exceeding Zcrit ± 1.96

Table 12

Correlations between Visual Attention and Comprehension for Children with ADHD

		1	2	3	4	5
			Phase One			
1.	Percent Attention	1.00	.550**+	.840**+	.189	.217
2.	Short Looks		1.00	.105	.169	.196
3.	Long Looks			1.00	.068	.061
4.	Factual Recall				1.00	.763**
5.	Causal Recall					1.00

		1	2	3	4	5
			Phase Two			
1.	Percent Attention	1.00	.334*	.843**+	.360**	.367**
2.	Short Looks		1.00	.166+	.286*	.537**+
3.	Long Looks			1.00	.413**	.385**
4.	Factual Recall				1.00	.693**
5.	Causal Recall					1.00

*= Correlation significant at .05 level
**= Correlation significant at .01 level
+= significant group difference exceeding Zcrit ± 1.96

Figure 1. **Percentage attention to television for comparison children and children with ADHD as a function of viewing condition.**

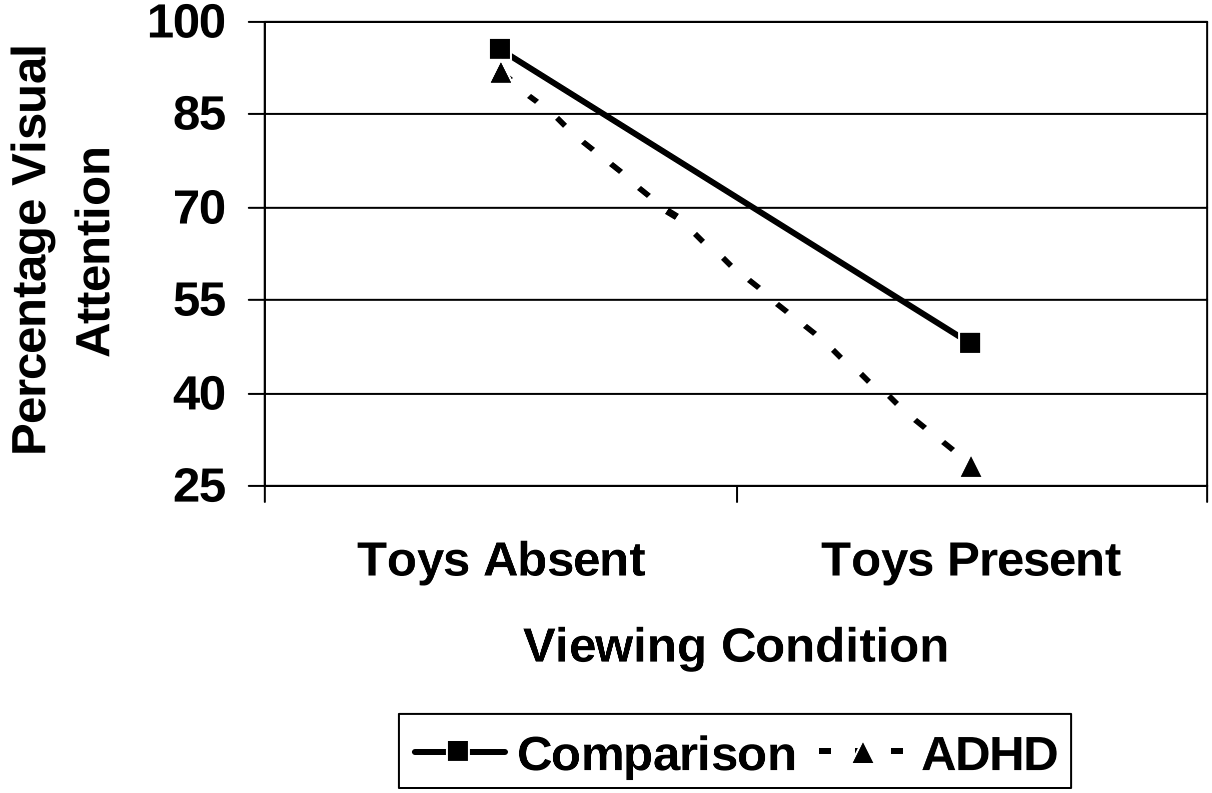
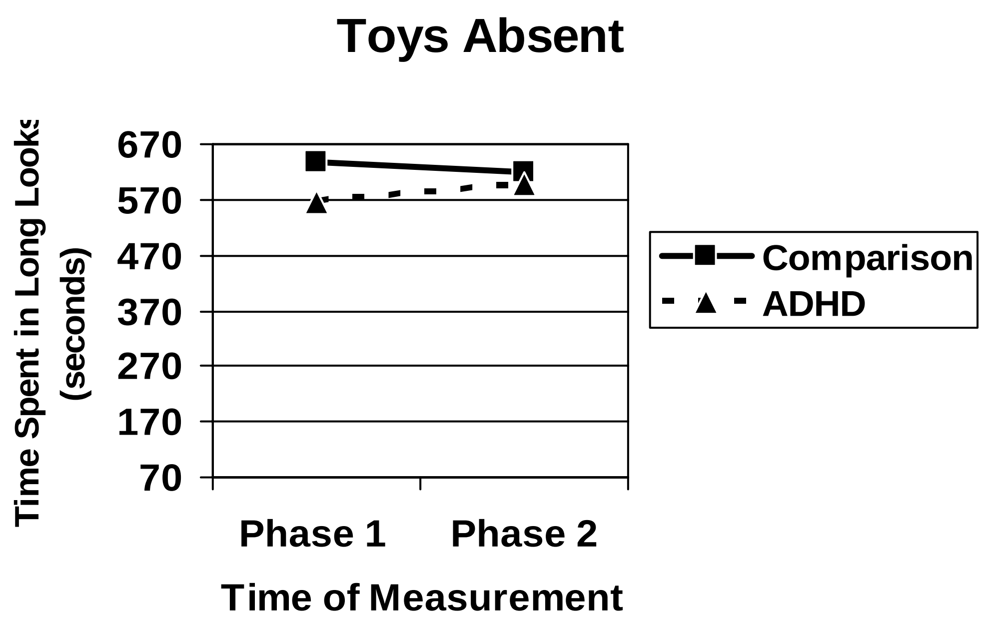


Figure 2. **Time spent in long looks by diagnostic group and viewing condition as a function of time of measurement.**



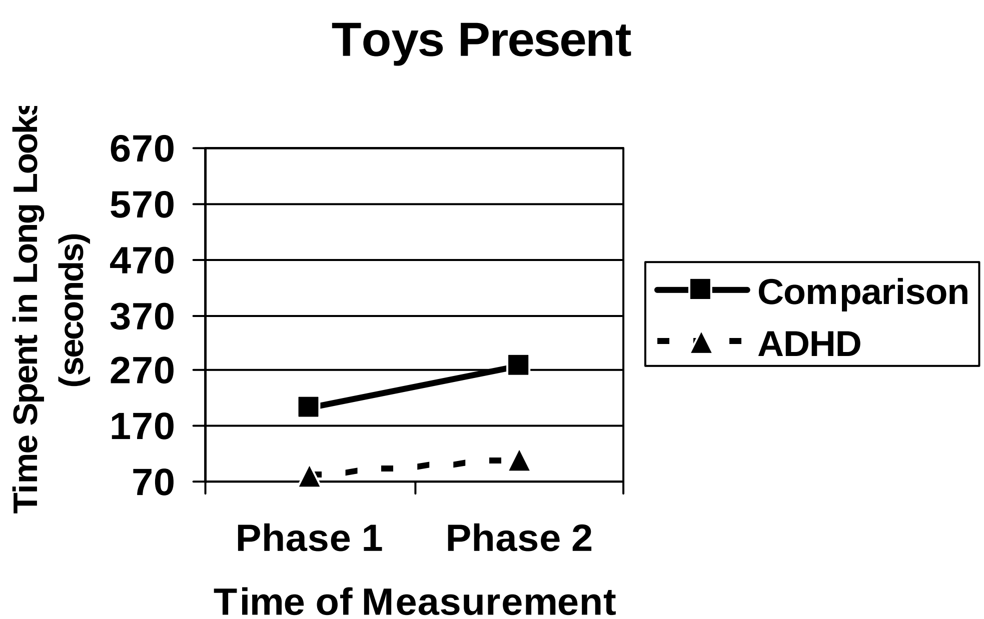
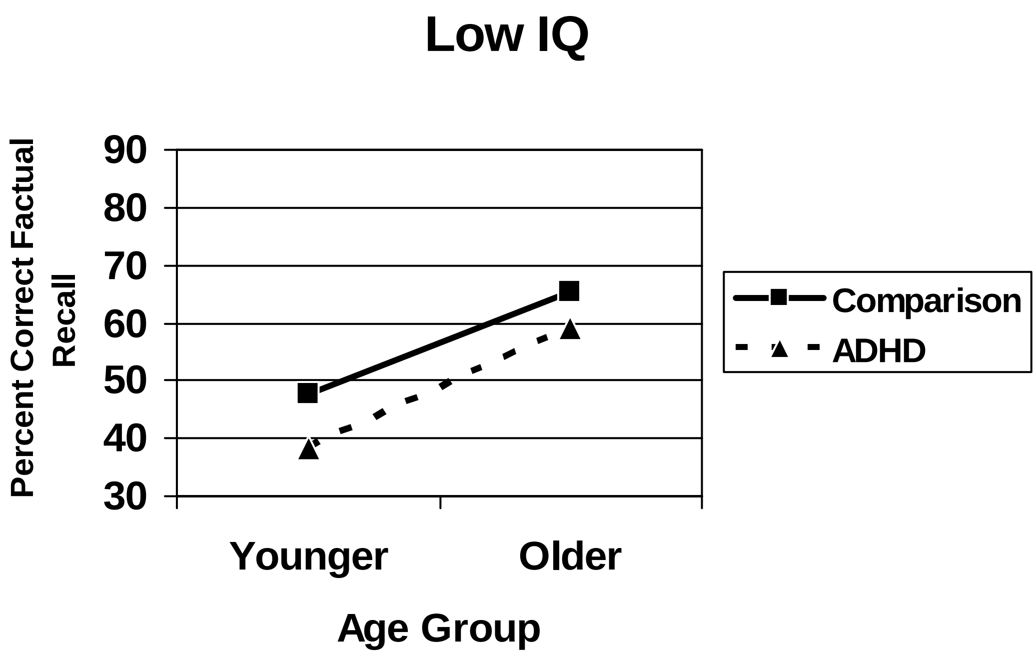


Figure 3. **Percent correct factual recall by diagnostic group and IQ group as a function of age group.**



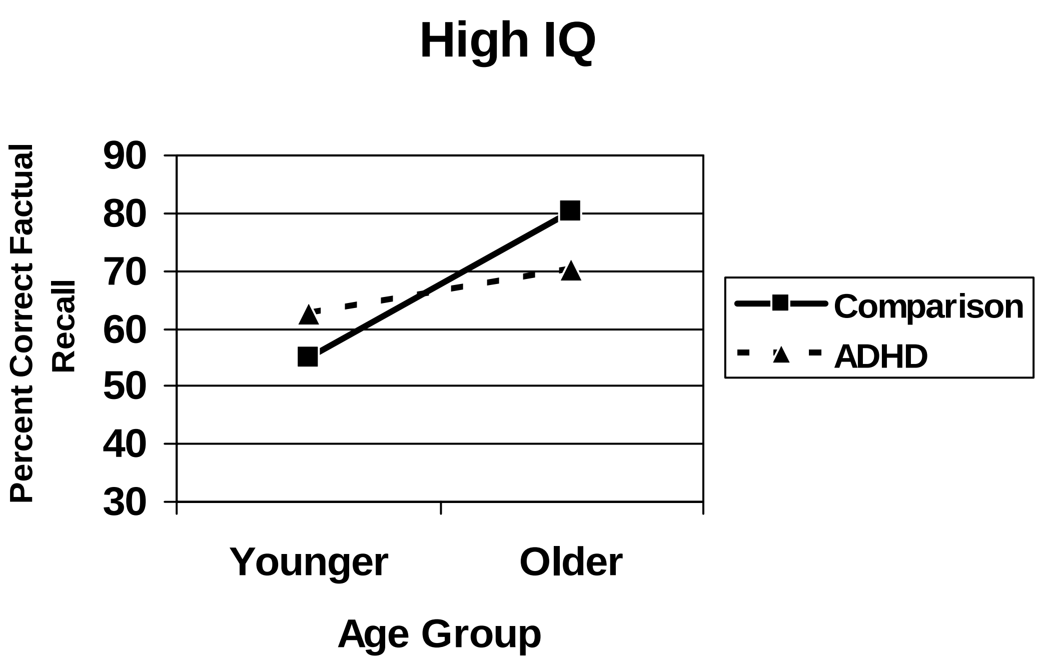
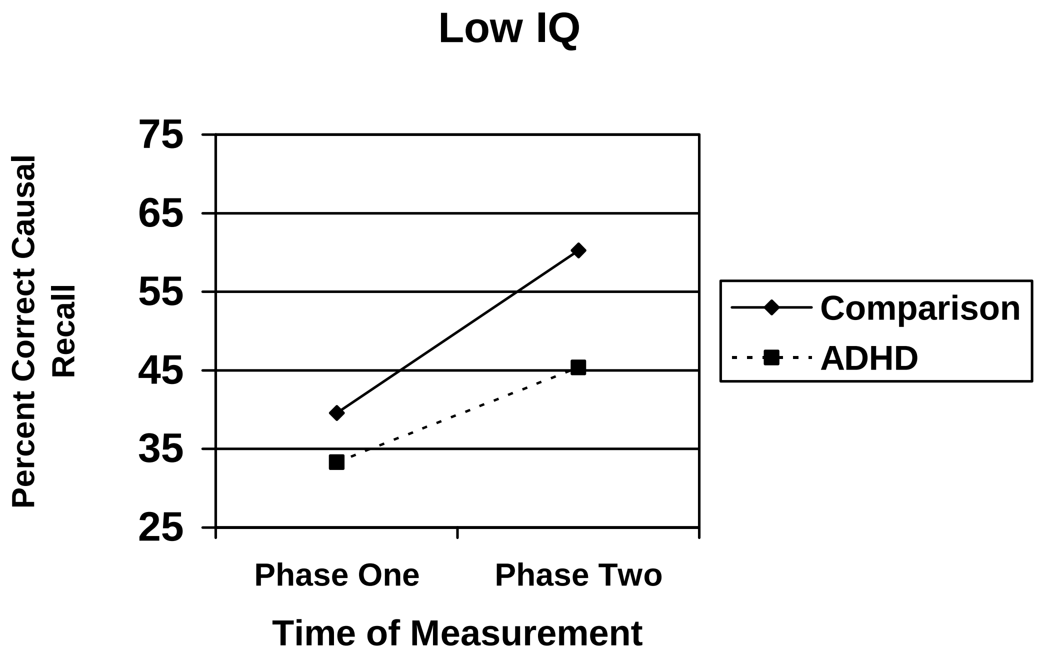


Figure 4. **Percent correct causal recall by diagnostic group, IQ group, and viewing condition as a function of time of measurement.**

Toys Absent



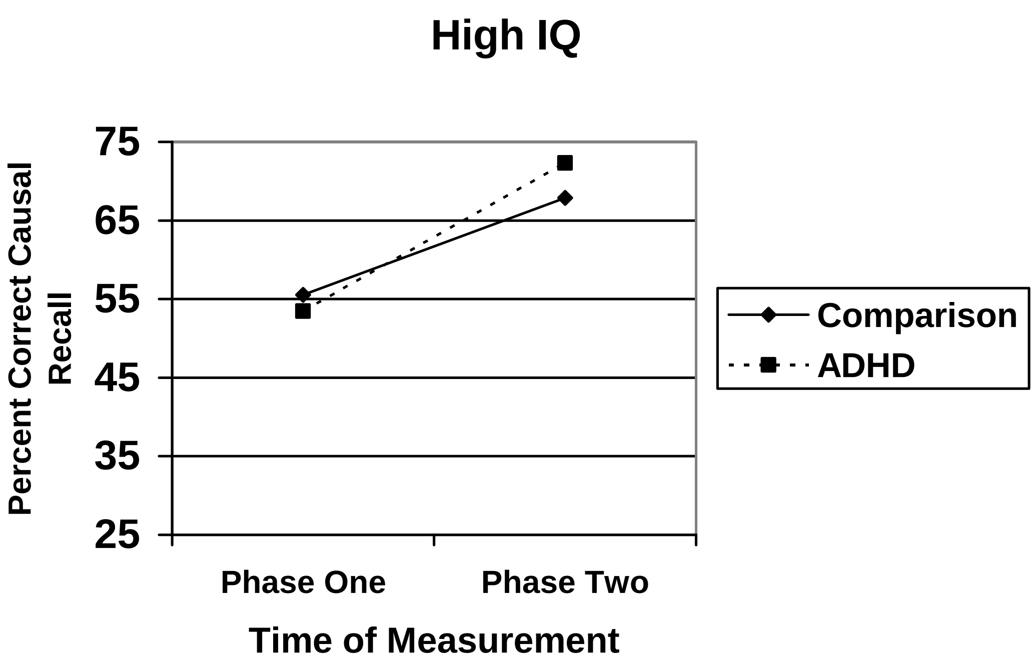
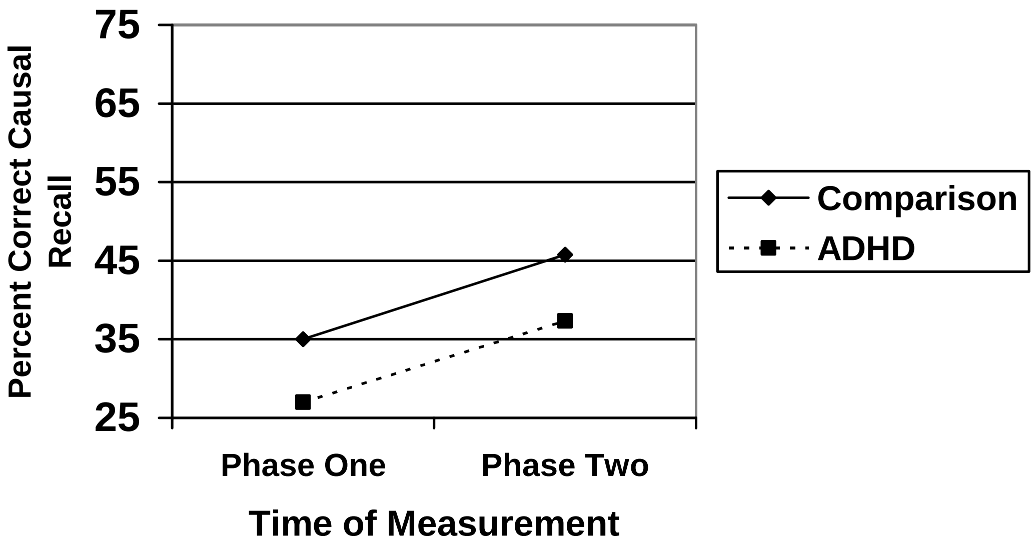


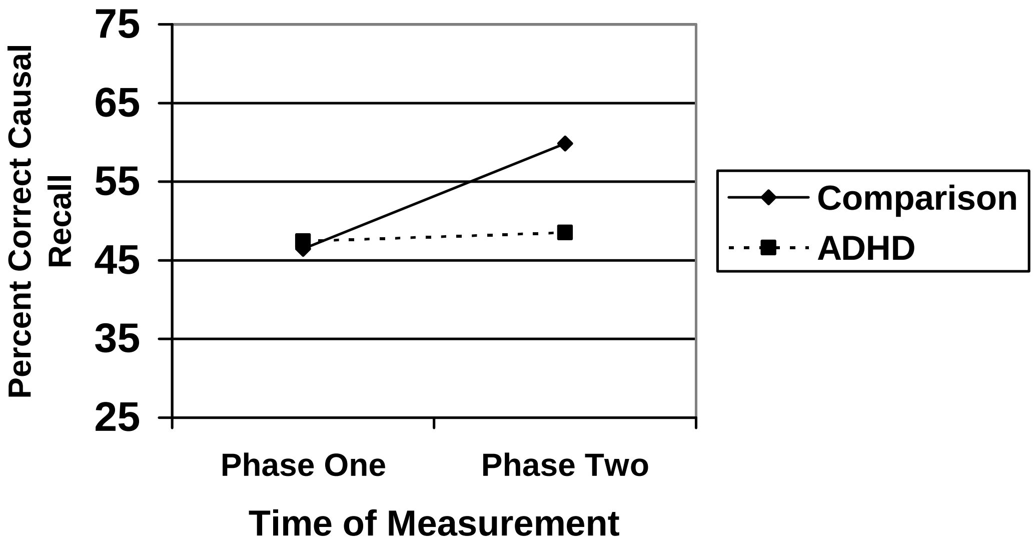
Figure 4 continued. **Percent correct causal recall by diagnostic group, IQ group, and viewing condition as a function of time of measurement continued.**

Toys Present

Low IQ



High IQ



Chapter Four

Discussion

Review of findings. A major goal of the present study was to investigate and compare patterns of developmental change in attention and comprehension among children with ADHD and comparison children. The results revealed several important findings that provide insight into the problems in attention and recall experienced by children with ADHD. First, the results provide the first evidence that the previously observed difficulties in sustaining attention in the toys-present condition for children with ADHD are stable across time and across a wide age range. Second, as they got older children with ADHD did not exhibit the same increase in time spent in long looks as did comparison children. Time spent in long looks is considered an important index of the degree of cognitive engagement with the presented material. Third, in terms of recall the older high IQ children with ADHD fell behind comparison children in their recall of factual information as they got older. Fourth, as they became older, high IQ children with ADHD did not show improvement in their causal recall when toys were present, in contrast to comparison children. Finally, although there was some support for the hypothesis that time spent in long looks is associated with comprehension of the televised material, time spent in long looks did not account for group differences in recall of either factual or causal information.

Percent Attention. Regarding percentage of visual attention, the results of the present study provide further support for the group differences that exist in attention that have been reported in previous studies- specifically, few if any differences between the groups during the toys-absent condition but a greater decrease in attention during the toys-present condition for the ADHD group than for the comparison group (Landau, Lorch, & Milich, 1992; Sanchez, Lorch, Milich, & Welsh, & 1999; Lorch et al., 2000; Lorch et al., 2004). Moreover, the results of the present study provide the first evidence that this pattern of findings is stable across time and age. One possible explanation for the dramatic difference between children with ADHD and comparison children's percent attention with toys present is that children with ADHD are exhibiting difficulty with distractibility, making them less able to inhibit looks at toys. When these children are given the option of distributing their attention between the task and toy play, they appear to be more willing to allocate attention to toy play than comparison children. This would not necessarily present a problem except for the fact that the results provide evidence that children with ADHD are not recalling as much information as comparison children, especially in the toys-present condition.

To further support the notion of children with ADHD exhibiting problems with inhibition, it is important to keep in mind that by Phase Two of the study, all children had experience with the procedure of coming in to watch the television program (with toys present and toys absent) and answer questions immediately afterwards. It appears to be the case that children with ADHD are able to use their prior experience with the TV viewing paradigm during Phase One to govern their behavior and answer more questions correctly in Phase Two so long as toys are absent. However, despite that their prior experience with the paradigm should inform the behavior of children with ADHD with toys present; they seem to be unable to resist the appeal of the toys.

Long Looks. With regard to long looks in the present study, children as a whole actually spent very little time in long looks. It is interesting to note that the children in the Lorch et al. (2004), study spent substantially more time in long looks in the toys-present viewing condition (Comparison = 52%; ADHD = 32%) than children in the toys-present condition (Comparison = 34%; ADHD = 13%) of the present study. Spending less time in long looks in the present study, could be due to differences in the stimuli presented; the present study used a cartoon program whereas Lorch et al. (2004), used a situational comedy. Cartoon programs in general may signal to children that viewing is simply a fun activity, not requiring substantial cognitive effort. Specifically, the present study's use of the program, *Rugrats,* (which has talking babies as its main characters) may signal to children that the purpose of the activity at hand is entertainment, not necessarily attention to the story elements. Furthermore, cartoon programs generally use certain formal features (i.e. peculiar voices, sound effects) that have been found (Anderson, Alwitt, Lorch, & Levin, 1980), to have varying effects on the initiation and termination of children's visual attention. Specifically, Anderson et al. found that peculiar voices and sound effects tended to elicit looks from children who were not already looking, but had no effect on children who were already looking during their onset. Thus the *Rugrats* program may have many features that would elicit looks from children, but these features may not necessarily maintain those looks. This type of program, in contrast to a situational comedy, may signal to children that superficial looks are all that are needed for viewing and consequently, may not maintain children's attention unless they began processing the story. Despite the stimuli and the relatively low levels of time spent in long looks in the present study, comparison children still spent nearly two and a half times more time in long looks than did children with ADHD.

Beyond the finding that children with ADHD in the present study spent very little time in long looks, they demonstrated an interesting pattern involving viewing condition. The results indicate that during Phase One, in terms of time spent in long looks, children with ADHD lag behind comparison children in both the toys-present and the toys-absent conditions. However, children with ADHD catch up to their comparison peers during Phase Two in the toys-absent condition. In this viewing condition, there is very little variation between groups and this finding could be attributed to the observation that most children will spend relatively high amounts of time engaged in long looks to the television in the absence of competing stimuli. For this reason, it is apparent that children with ADHD are not demonstrating a generalized deficit in spending time in long looks.

Unlike the pattern of results children with ADHD demonstrated with toys absent during Phase Two, with toys present children with ADHD start out behind and did not catch up to their peers. Moreover, while comparison children increased their time spent in long looks with toys present across phases, children with ADHD did not. It appears that with toy distracters present, children with ADHD are exhibiting effects of the disorder's core deficits, specifically, inhibition, distractibility, and executive functioning. The lack of progress on their part could be a function of 1) difficulties with inhibition, resulting in their inability to appropriately allocate their attention between a primary and alternate activity, and 2) executive functioning, whereby children with ADHD are unable to use their prior experience in the TV viewing situation and strategically plan to divide their attention in an effort to be better able to answer the questions that they understand will follow.

An alternate explanation of this finding links the differences in the way children with ADHD divide their attention with toys present to their ongoing construction of story representations. The suggestion that the way in which children attend has an effect on how they comprehend is straightforward and tenable. However, this suggestion implies that the relation between attention and comprehension is unidirectional; it could be the case that the relation is best described as a reciprocal one. In this explanation, not only does the way in which children attend influence comprehension, but the way in which children build their story representations affects the way in which they attend. If children with ADHD are building fragmented story representations with toy distracters present, this impoverished understanding of the story could drive their time spent in long looks to in turn be impoverished. Considering that long looks, but not percent attention, are indicative of cognitive engagement, it seems plausible that this aspect of visual attention would be affected by a disjointed understanding of the story.

Comprehension. With respect to comprehension of factual information, when the data during Phase One are analyzed alone, very few group differences in factual recall emerge, and that pattern persisted during Phase Two. The present results reveal that in general, there are no group differences in factual recall unless Phase One and Phase Two data are analyzed together. In this case, there was no group difference in factual recall in the low IQ classification. The present results of no group difference fall in line with previous findings reported for factual comprehension. Specifically, Landau et al., (1992), Lorch et al. (2000), and Lorch et al. (2004), similarly reported no group difference in factual recall regardless of viewing condition.

The only group difference that did emerge was for older children within the high IQ classification. Here, we observe that children with ADHD fall behind their comparison counterparts and fail to attain the level of factual comprehension that older high IQ comparison children reached, and this effect was true regardless of viewing condition. One explanation of this finding could be that older high IQ comparison children have developed the skills necessary for comprehension more proficiently than is typical. This group of older high IQ comparison children may perform well in school, have more experience with stories and may seek out more practice with stories. Although the older high IQ children with ADHD appear deficient when measured against their comparison counterparts, they have the capability to recall similarly, but due to their problems with attention and inhibition, they fail to profit as much as their comparison peers.

Causal comprehension also revealed an interesting pattern of results. During Phase One, there was no group difference for low IQ or high IQ classifications regardless of viewing condition. The previously reported effect of little time being spent in long looks may shed some light on this finding. Because all children spent relatively little time in long looks, particularly during Phase One, there may not have been enough time to affect any group differences in this phase.

During Phase Two, all comparison children, regardless of IQ classification or viewing condition, demonstrated an increase in their causal comprehension. Low IQ children with ADHD also increased in their causal comprehension regardless of viewing condition, although they did not gain as much as their comparison counterparts. These children with ADHD may already have an impoverished representation of the causal structure underlying televised stories due to some identified cognitive processing deficits associated with ADHD (e.g. inhibition, working memory, and sustained attention), (Lorch, Diener, Sanchez, Milich, Welsh, van den Broek, 1999). When this is coupled with low IQ, the children may exhibit increasing difficulty with comprehension of causal information.

In the toys-absent viewing condition, both groups of high IQ children performed similarly. It appears that with toys absent, the high IQ of the children with ADHD has some protective benefit for casual recall that may work to compensate for some of the previously mentioned cognitive processing deficits (i.e. inhibition, working memory, and sustained attention) commonly associated with ADHD diagnoses.

The only group that did not gain in their recall of causal information from Phase One to Phase Two was the high IQ children with ADHD when toys were present. In this case, it appears that the presence of distracters outweighs any potential benefits of high IQ. This then raises the question of what could be responsible for high IQ children with ADHD lagging behind their comparison counterparts. One possible explanation of this occurrence deals with increasing problems with working memory. High IQ children with ADHD may be experiencing increased difficulty over time deselecting attention between toy distracters and the television program as well as with keeping up with pieces of information at various points in time. This could lead to deficient encoding of causal connections within the program. This is a compounding problem because if these children are in fact having difficulties encoding causal information, this will also make them less apt than their peers to be in position to use complex strategies for recall, such as using cues from the questions to help them formulate correct answers. An alternate explanation is related to the previously reported finding that in time spent in long looks, children with ADHD failed to increase their time across the two points of measurement. Possibly, because children with ADHD already spend less time then their comparison counterparts in long looks with toy distracters present, they may have missed information critical to connecting causal relations. Because long looks are understood to be indicative of deeper processing, without them, it becomes difficult to construct a tightly woven comprehension of the causal events.

Cognitive Engagement. The results of the present study lends some support to the hypothesis that long looks are associated with comprehension, however, long looks did not account for the group differences reported for either factual or causal recall. The cognitive engagement analyses for factual recall of the older high IQ children revealed a trend that with both long and short looks covaried, the effect of group was reduced but not eliminated. The cognitive engagement results of the present study suggest that long looks alone may not be a reliable measure of cognitive engagement for all the children in the present study. Supporting evidence for this suggestion comes from 1) the previously reported effects that children with ADHD did not increase time spent in long looks and 2) the compelling correlational data that demonstrated that comparison children showed a pattern of long and short looks being negatively related; a finding that was not present in children with ADHD, and 3) for children with ADHD, long looks and short looks were both positively related to causal recall. Taken together, the evidence suggests that while long looks may be a very effective measure of cognitive engagement for comparison children, it appears that it is not the only indicator of cognitive engagement for children with ADHD.

The present study also examined how aspects of visual attention relate to each other and comprehension. It has been reported in previous research (Lorch et al. 2004) that long looks, but not short looks, have been shown to attenuate group differences in causal relations. However, the results of the present study expand on that finding and suggest that both long and short looks have an impact on other aspects of visual attention such as percentage visual attention and comprehension of causal relations for children with ADHD.

Conclusions. The results of the present study appear to point toward differences in the way children with ADHD and comparison children may be approaching televised stories. Building on the reported differences in visual attention and comprehension, there may be differences in the way that information is organized. As noted by Trabasso, Secco, & van den Broek, (1984), events within a story can be organized into episodes that are causally related. Perhaps in some cases, children with ADHD successfully comprehend each of these "mini" episodes, but over time they are not able to relate each individual episode to the next to construct an entire representation of the story. It would follow that if a child has difficulties building a representation of the story among the related "mini" episodes or does not understand that the "mini" episodes are related, then they would find no need to make adjustments to their viewing behavior (i.e. increased long looks) that would facilitate a more coherent representation.

Limitations. One potential limitation in the present study was choice of stimuli. The use of the 12-minute *Rugrats* episodes that the children viewed may not have been a long enough stimulus to elicit much time in long looks or to establish motivation to begin to process for comprehension. Finally, the present study's use of the cartoon program, *Rugrats*, may not be comparable to other types of programming e.g. situational comedy, drama etc, although the time spent in long looks was sufficient to demonstrate an effect of group.

An additional limitation of the present study was the small sample of children with ADHD, particularly those also classified in the high IQ group. To begin, there were almost twice as many comparison children than children with ADHD. As for the cell sizes when IQ was included, there were only 16 high IQ children with ADHD compared to 66 high IQ comparison children.

Finally, although the results of the present study have implications for the classroom, generalization may be limited. Due to the structured testing environment created to control for unwanted factors or distractions, the present study may have made this context of television viewing unlike the context of a classroom, whereby distractions are ever present. Further, classroom activities and curricula may not be considered as entertaining as the testing environment in the present study. For example, cartoons and toys may not be readily available for children at school at the same time that stories are presented.

Future Directions. One area of future research concerns the present study's limited generalizability to classroom environments. Because the present study's necessarily structured environment precludes many of the potential day-to-day distractions experienced in classrooms, one starting point would to examine children's comprehension in environments that are closer to actual classrooms (i.e. other children, other distractions). This would allow an in-depth look into comprehension and allow the laboratory results to be compared to actual classroom data. It would be interesting to determine if the laboratory results of comprehension mimic those of the classroom or if children's comprehension is more impaired in actual classroom settings due to their less rigid structure.

Also related to the generalizability to classroom settings is the issue of the use of other media that are often presented to children at school; specifically the presentation of auditory passages and reading passages. The use of these types of stimuli may closely approximate the way that children are used to encountering stories yet they allow for systematic investigations of what children actually comprehend. Undertaking investigations of this vein will allow researchers to piece together a more global picture of what children with ADHD's comprehension looks like and in which situations it is most impaired.

Another possible line of research involves children with ADHD's use of televised media in the home. It would be interesting to examine and compare the use of televised media at home (including amount), the context in which it is viewed, and the content of the programming. These factors may have some impact on the comprehension skills that the children demonstrate in the laboratory and the academic motivation (i.e. mastery- or goal-) orientations possessed by the children. An investigation of this nature may have implications for the academic outcomes of these children (Acevedo-Polakovich, Lorch, Milich, & Ashby, 2000).

Finally, more research needs to be directed toward a developmental understanding of cognitive processes such as those involved in story representation, generation, and comprehension. It will be beneficial to continue to investigate the developmental pattern of cognitive engagement in children with ADHD, specifically the finding that multiple facets of attention (i.e. short and long looks) were positively related for them and not comparison children.

In closing, the present study has built on previous research by examining the attention and comprehension of children with ADHD and has expanded upon the literature by providing a developmental perspective. It is well established that children with ADHD have significant academic difficulties; however the present study has attempted to provide some evidence that sheds light on the patterns that children with ADHD exhibit in their attention, comprehension, and cognitive engagement. This line of investigation may have implications for their academic difficulties, and because of its developmental approach, the present study may provide insight into when interventions may be most beneficial.

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EDUCATION

Developmental Psychology 2008 (Expected Graduation)	*University of Kentucky*, Lexington, KY Chairs: Elizabeth P. Lorch and Richard Milich
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PROFESSIONAL EXPERIENCE

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Multicultural Programming Coordinator — June 2006- Present
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Summer Research Intern

Laboratory of Psychological and Brain Science — 2002
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SERVICE

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Professional

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ACADEMIC HONORS & AWARDS

Phi Kappa Phi National Honor Society Induction	2002
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Who's Who Among Students in American Colleges and Universities	1999-2003
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SCHOLARLY WORK

<u>Conference Presentations</u>

Bailey, Ursula L., Millet, Peter. (2003, April). A Test of the Ultimate Attribution Error. Tennessee Academy of Sciences. Tennessee State University, TN.

Bailey, Ursula L. & Millet, Peter. (2002, April). An Examination of Gender Conceptualizations of Mental Illness in College Students. Tennessee Academy of Sciences. Austin Peay University, TN.

<u>Posters</u>

Karantzoulis, S., Rich, J., **Bailey, U.L**., & Maki, P.M. (2005, August). Modality manipulations to classify perceptual and conceptual implicit memory tests. American Psychological Association, Washington, D.C.

Bailey, U. L., Lorch, E.P., Milich, R., Estis, M.F., Colby, C. (2005, April). Atlanta, G.A. Developmental Changes in Attention and Comprehension among Children with ADHD and Comparison Children. Society for Research in Child Development (SRCD).

Bailey, U. L., Lorch, E.P., Milich, R., Estis, M.F., Colby, C. (2004, October). Predicting Causal and Factual Recall in Children with Attention Deficit Hyperactivity Disorder. 16th Annual International Conference on Attention Deficit/Hyperactivity Disorder. (CHADD). Nashville, TN.

Bailey, U. L., Juleus, Wensa; Snyder, Elizabeth; Bright, Cheryl; Davis, Deborah; Burns, Barbara. (2002, November). Temperament and Attentional Processes in Children Born Prematurely. Annual Biomedical Research Conference for Minority Students. New Orleans, LA.

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