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## THE EFFECTS OF THEMATIC IMPORTANCE ON RECALL OF CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER AND COMPARISON CHILDREN

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## ABSTRACT OF THESIS

### THE EFFECTS OF THEMATIC IMPORTANCE ON RECALL OF CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER AND COMPARISON CHILDREN

This study examined the recall of televised stories for younger (4-6 years) and older (7-9 years) children with and without ADHD under two different viewing conditions (toys present/toys absent). Each child watched two *Rugrats* television programs, once with toys present and once with toys absent. Immediately after viewing a program, the child completed a free recall of the observed story. Nonreferred children's recall increased more than ADHD children's as importance level increased, and older nonreferred children recalled more information overall than older children with ADHD. For the toys condition, children with ADHD had smaller correlations between the story units recalled and the order of these units in the story than did nonreferred children. Children with ADHD demonstrated multiple difficulties in story comprehension. They were less sensitive to thematic importance and they produced less coherent recalls than their nonreferred peers.

**KEYWORDS:** Story Recall, Attention Deficit Hyperactivity Disorder, Story Comprehension, Thematic Importance, Story Coherence

Rebecca Alycson Flake

August 29, 2005

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THE EFFECTS OF THEMATIC IMPORTANCE ON RECALL OF CHILDREN WITH  
ATTENTION DEFICIT HYPERACTIVITY DISORDER AND COMPARISON  
CHILDREN

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THESIS

Rebecca Alycson Flake

The Graduate School  
University of Kentucky  
2005

THE EFFECTS OF THEMATIC IMPORTANCE ON RECALL OF CHILDREN WITH  
ATTENTION DEFICIT HYPERACTIVITY DISORDER AND COMPARISON  
CHILDREN

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THESIS

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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

Rebecca Alycson Flake

Lexington, Kentucky

Director: Dr. Richard Milich, Professor of Clinical Psychology

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2005

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## Chapter 1: Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most common behavior disorders in children, with prevalence estimates between 2 and 9.5 percent (Barkley, 1998). ADHD is characterized by developmentally inappropriate levels of inattention, impulsivity, and hyperactivity (Diagnostic and Statistical Manual of Mental Disorders-4<sup>th</sup> ed., American Psychiatric Association, 1994). These deficiencies place children with ADHD at a greater risk for academic problems. Children with ADHD are more likely to have had histories of learning disabilities, repeated grades, placement in special classes, and academic tutoring than their nonreferred peers (Faraone et al., 1993). This is of particular concern because in addition to stifling future success and opportunities, academic problems can lead to both social and emotional difficulties. Until recently, much of the research on cognitive difficulties in children with ADHD has focused on attention. Few studies have looked at higher-order components of cognitive processing. However, in order to better understand the academic problems faced by children with ADHD, more needs to be known about the differences between higher-order cognitive processing abilities of children with and without ADHD.

One way to assess higher-order cognitive functioning in children with ADHD is to study their ability to comprehend stories or understand complex events. These comprehension abilities are important early on in school performance for children. Effective story comprehension requires the usage of a number of different cognitive functions, including the following: “the strategic allocation of attention, the selection, encoding and interpretation of important information, the use of story structure, the retrieval of relevant background information, the generation of inferences that allow an interpretation of the presented information, the monitoring of comprehension, and the use of retrieval skills.” (Lorch, Milich, & Sanchez, 1998, p. 164). Therefore, in assessing higher-order cognitive abilities, it is useful to study story comprehension because it is relevant to school performance for children and it allows us to gain insight into many different aspects of children’s cognitive functioning.

Early research on story comprehension in children with ADHD applied global measures of recall to assess group differences (O’Neill & Douglas, 1991; Zentall, 1988).

O'Neill and Douglas used a memory task involving the retelling of stories; although the primary purpose of their study was to evaluate the study strategies of children with ADHD. They found that children with ADHD did not differ from their nonreferred peers in the number of main ideas recalled; however they did use less effective study strategies to aid recall. In the study by Zentall, a story retelling task was also used, and results showed that children with ADHD produced as many descriptions of events and major relevant points as their nonreferred peers; however, overall, children with ADHD recalled less of the stories. They also produced shorter protocols when asked to make up their own stories, although no group differences were found when the children were asked to tell a story from pictures in a book.

As illustrated above, few reliable group differences were found in the first two studies on story comprehension in children with ADHD; however, because only global measures of recall were used, other aspects of recall that may be more indicative of story comprehension abilities could not be addressed. One aspect that was not addressed was the effect of variations among story events on recall. Thus, these early studies may indicate that children with ADHD are able to recall the same number of story events as their nonreferred peers, but they do not provide information about the types of story events that children recall and whether children with ADHD differ from their nonreferred peers in the type of events they recall.

Previous research among nonreferred children, that has looked more closely at which story events children recall, has identified several particular changes as important in understanding how story comprehension abilities develop. One developmental change that has been identified involves children's sensitivity to the thematic importance of individual story events. As children mature, they become better at distinguishing between story events that are more important to the overall theme of the story and events that are less important or extraneous to the overall theme (Brown & Smiley, 1977; Brown, Day, & Jones, 1983). In the study by Brown et al., seventh graders, eleventh graders, and first year college students showed a clear effect of thematic importance in their recall, while children in the fifth grade did not show this effect. Thus, not only are older children able to recall more information from stories, but they also recall information that is more important to the overall meaning of the story, indicating a better

understanding of the story. Since sensitivity to thematic importance is a skill that develops with age and increases story comprehension, it would be useful to include this component when evaluating story comprehension in children with ADHD.

Tannock, Purvis, and Schachar (1993) offered one of the first investigations to address this issue by examining the recall of story events by children with ADHD as a function of the level of thematic importance. In this study, thirty boys with ADHD and 30 nonreferred boys (ages 7 to 11 years) listened to two audiotaped stories and retold the stories in their own words. Both stories had been previously rated by adults for the thematic importance of each story unit. Results indicated that overall boys with ADHD recalled fewer story events than nonreferred boys; however both groups of children were equally sensitive to the level of importance of the events. Additionally, when the boys with ADHD retold the stories, they made more ambiguous referents and semantically inappropriate word substitutions, and gave more incorrect or misinterpreted information than their nonreferred peers. In a comparable study, Purvis and Tannock (1997) obtained similar findings; however the statistical power of group comparisons was limited by a small sample size. Together, these studies suggest that children with ADHD may have poorer recall than comparison children; however, they are influenced similarly by the perceived importance of story events. Additionally, the errors children with ADHD make when retelling a story suggest they may have difficulty in producing an organized account of story events.

A more recent study by Lorch, Diener, et al. (1999) used the same procedure as Tannock et al. (1993) to examine the extent to which perceived importance and two story structure properties (the number of causal connections a story event has to other events and whether an event is on the causal chain linking events from the beginning to the end of the story) predicted the recall of children with and without ADHD. Seventy-four children with ADHD and 62 nonreferred children, ages 7 to 11 years, participated in this study. The results showed that nonreferred children remembered significantly more story units than did children with ADHD. Additionally, nonreferred children showed more sensitivity to the importance level and the number of causal connections in their recall than did children with ADHD. These findings differ from those of Tannock et al. (1993) and Purvis and Tannock (1997) in suggesting that there is a group difference in

sensitivity to thematic importance. Thus, one purpose of the present study is to build on the findings of these previous studies to determine whether children with ADHD differ from their nonreferred peers in sensitivity to thematic importance.

The studies discussed thus far have all used a single methodology. In fact, most research on story comprehension has used methods in which stories are presented either orally or through pictures/writing. These methods are useful, but they make it difficult to study story comprehension in preschool age children due to the requirement of reading skills or the difficulties involved in processing linguistic information. Lorch and Sanchez (1997) discuss several advantages of using a television viewing methodology to study story comprehension. One advantage is the potential in the television methodology of examining the comprehension of more complicated stories without taxing children, due to the presence of both auditory and visual modalities. A second advantage is that children are familiar with this methodology, so it may be a more natural way to assess their comprehension abilities. Additionally, television is engaging, again having both auditory and visual components, so it may capture children's attention better and allow for a more accurate assessment of their comprehension abilities. This methodology does not require reading skills, which also is an advantage because children who are younger or have learning disabilities/poor reading skills can be assessed through this methodology. Finally, the television methodology allows for attention to be linked with story comprehension. This is an important advantage when studying children with ADHD because one can evaluate the relation between attention and story comprehension. Previous research has done this by manipulating attention through having children watch television both in the presence and absence of toys (see for example Lorch et al., 2000).

A study by Sanchez, Lorch, Milich, and Welsh (1999) demonstrates the usefulness of the television viewing methodology. In this study, children, ages 4 and 6, with and without ADHD watched a televised program (*Sesame Street*). For half of the children toys were present during the program, and for the other half toys were absent. Story comprehension was assessed in this study by performance on cued recall questions. Both groups of children were found to attend significantly less to the program when toys were present; however, this effect was larger for children with ADHD. In the toys-absent viewing condition, no differences were found in the recall of factual information between

children with and without ADHD. In the toys-present viewing condition, when attention was reduced, the factual recall of children with ADHD decreased; however, the recall of comparison children was not affected. Children with ADHD performed worse on causal recall questions than the comparison children regardless of whether toys were present. These findings suggest that when distracter stimuli are not present and attention is maximized, children with ADHD can perform equally well to their nonreferred peers in obtaining factual information from stories; however their difficulties in obtaining causal information persist across viewing conditions, suggesting greater deficits in this area. This study demonstrates that the television viewing methodology can be used to effectively link attention with story comprehension. In this study however, story comprehension was assessed through a cued recall task in which children completed questions testing comprehension. It is important to understand, not only how children perform on this type of recall task, but also how children perform on free recall tasks in which they select what information to include when recalling the story.

A companion study by Lorch, Sanchez, et al. (1999) examined memory for televised stories in children, ages four to six, with and without ADHD. Specifically, this study looked at whether children's free recall of story events was predicted by several story structure properties (number of causal connections, whether an event is on or off the story's causal chain, story-grammar category, and position in the story's hierarchical structure). It was found that both groups of children were sensitive to the causal structure of stories; however, when attention was reduced by the presence of distracter stimuli, the children with ADHD were less sensitive to the causal properties of stories. Although this study looked at sensitivity to casual properties and not thematic importance, these two variables are related in that story events that are judged to be more important also have more causal connections to other events and are more likely to be on the causal chain (Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985). Thus, if group differences are found in sensitivity to causal properties than it is likely that group differences would also be found in sensitivity to thematic importance.

The purpose of the present research is to build on previous findings by examining the story recall of two different age groups of children (4-6 and 7-9 years of age, rather than just an older or younger group of children) with and without ADHD under a two

different viewing conditions (toys present/toys absent) design to manipulate the visual attention of the children. In this study, more demanding and complex stories will be used than in the study by Lorch, Sanchez, et al. in order to assess a wider age range of children. The primary focus of this study will be to assess differences in story recall of children with and without ADHD by analyzing the amount of information recalled as a function of the level of thematic importance. Additionally, the coherence of the recalled stories (or sequence the child recalls the story events in) and the number of recall errors made will be evaluated. Although group differences in recall errors have been observed in previous studies, differences in story coherence have not been evaluated.

Several outcomes are possible for this study. One possible outcome is that children with ADHD recall similar amounts of information as their nonreferred peers, but show less sensitivity to thematic importance. This would suggest that children with ADHD are able to absorb and reproduce similar amounts of information as their peers, but struggle with focusing their recall on the information that is most important to the meaning of the story. Another possible outcome is that children with ADHD recall less information than their nonreferred peers, but show the same sensitivity to thematic importance. This would suggest that children with ADHD do have the skills to identify information important to understanding the meaning of the story, but have difficulties with memory. A third possibility is that children with ADHD recall less information and show less sensitivity to thematic importance than their nonreferred peers. This would suggest that children with ADHD have both difficulties in focusing on important information in their recall and difficulties with memory (although these difficulties might be related to the fact that they are trying to recall information that is less meaningful). These three outcomes could also vary according to age and viewing condition. For example, it could be that differences are seen between younger children with and without ADHD, however the discrepancies are resolved over time, and so the older groups of children perform equally well; or differences are observed in the toys-present condition only, suggesting that the reduction in attention is responsible for decreased abilities.

## Chapter 2: Methods

### *Participants*

A total of 99 children with ADHD and 144 nonreferred children participated in this study. The data for 49 children were excluded because of a low IQ or a number of ADHD or Oppositional Defiant Disorder (ODD) symptoms that were inconsistent with group placement. Additionally, data for three children could not be included due to experimental malfunctions. The final sample consisted of 80 children with ADHD and 111 nonreferred children. Approximately half of the children in each diagnostic group were between the ages of 4-6 years ( $n = 78$ ;  $M = 5.72$  years;  $SD = .79$  years), and half were between the ages of 7-9 years ( $n = 113$ ;  $M = 8.46$  years;  $SD = .94$  years). Approximately 85% of the children were Caucasian, 10% were African American, and 5% were from other groups.

The children with ADHD were recruited from a hyperactive children's clinic at a local university medical center. To ensure that children in the ADHD group had appropriate symptomatology for a diagnosis of ADHD and were relatively free of confounding factors, a two-phase screening process was implemented in this study. First, after a thorough assessment at the clinic, all children were diagnosed with ADHD based on the DSM-IV criteria (American Psychiatric Association, 1994). This diagnosis was made by a team, including a child psychiatrist and another mental health professional. It was based on child and parent interviews, child observations, and other measures. Also, additional information was obtained when feasible from teachers, referring physicians, and/or psychological test results. Second, if parents indicated interest in the study by signing a consent to be contacted sheet, then the children's files at the clinic were reviewed by the investigators. In doing this, additional information was obtained on factors like children's scores on ADHD rating scales, IQ, medications, additional diagnoses, or reasons for clinical referral.

Children were not contacted for participation in this study if it was found that they had a low IQ, overly complicated clinical picture (for example, many symptoms of an autistic disorder), or took medications including antidepressants or antihypertensives. Children were not excluded from participation in this study based on the presence of comorbid psychological disorders. However, children with ADHD who had

predominately inattentive symptoms and few impulsive/hyperactive symptoms were not contacted for participation in this study.

If the above criteria were met, then the parent of the child with ADHD was contacted and invited to participate in this study. During the testing session, a semi-structured interview was conducted with the parent. This interview consisted of verbatim DSM-IV criteria for ADHD and ODD. In this interview, the parent was asked whether each diagnostic criterion was true for his/her child. If the criterion was true for the child, then the parent was asked whether this behavior was age appropriate for the child. The parent was also asked for examples when he/she indicated a criterion was true for the child. The data for children whose parental interviews supported an ADHD diagnosis was retained for analysis in this study. The interviews were audiotaped and 20% were coded by a second independent judge. Interrater reliability of the presence of ADHD based on the interview was calculated.

The nonreferred group, children without ADHD, was recruited through an advertisement in a local newspaper. They were screened before participation to ensure the absence of learning and behavior problems. Parental reports from the semi-structured interview showed that nonreferred children were less symptomatic than children with ADHD in terms of the DSM-IV criteria for inattentive symptoms ( $M = .14$ ,  $SD = .44$ , and  $M = 5.99$ ,  $SD = 2.26$ , respectively); hyperactive symptoms ( $M = .18$ ,  $SD = .47$ , and  $M = 6.01$ ,  $SD = 1.98$ , respectively); and oppositional behavior ( $M = .28$ ,  $SD = .73$ , and  $M = 3.48$ ,  $SD = 2.35$ , respectively). These data document further the assignment to the two groups.

Children with ADHD did not receive any psychostimulant medication on the day of the study. This provided an acceptable period of time to occur for the drug to be passed out of the children's system. All children received two small toys and \$10.00 for their participation in this study.

### *Materials*

The principal materials in this study consisted of six "Rugrats" cartoons. All of the cartoons had conventional story structures. In each cartoon, a problem arose, and then the story centered on the protagonist's attempts to solve the problem. The stories for these cartoons were parsed into idea units, where each unit expressed a single event.

Importance ratings were collected for each story unit by having college students ( $n = 193$ ) rate the units (1 = not important to the overall meaning of the story; 7 = extremely important to the overall meaning of the story) after viewing the televised program. College students watched two televised programs each and received class credit for their participation.

### *Procedure*

Upon arrival to the testing session, which took place in a home-like university laboratory, the child first spent about 5 minutes getting to know the experimenter. A graduate student explained the study to the parent during this time and obtained consent. After this, the child was taken to the testing room by the experimenter. The child sat at a small table facing a television. Toys were either present or absent, depending on the appropriate toy condition. In the toys present condition, several age-appropriate toys were positioned on a table in front of the child. The child was told that a television program was coming on for them to watch, and that he/she would be asked about what he/she saw when the program was over. Additionally, if toys were present, the child was told that he/she could play with the toys during the program. The experimenter reminded the child that he/she would be asked questions when the program was over before leaving the room. The experimenter started the television program (one of the six “Rugrats” videos) and then left the room. While the child watched the television program, the experimenter observed the child, who was being videotaped, in a separate room. When the television program finished, the experimenter re-entered the testing room and had the child complete a free recall of the observed story. The free recall was cued by a picture of the story characters. After this, the child completed a cued recall, which consisted of answering 35-38 factual and causal relations questions about what they saw. Both free recall and cued recall were audiotaped. Following the free and cued recall, the child was given a short break. During the break, the appropriate toy condition for viewing the next television program was set up, and then the procedure described above was repeated. The order of the television programs and the toy conditions was counterbalanced, where each child watched a program once with toys present and a different program with toys absent. While the child completed the testing session, the parent filled out several forms and completed the DSM-IV interview with a graduate student.

Each child's free recall protocol was transcribed verbatim. The protocols were then analyzed into units of information corresponding to main clauses. These units were compared with the idea units from the original scripts, and a score of 0/1 (not recalled/recalled) was assigned for each unit. The child was not required to recall the unit verbatim, just to capture the gist of the unit. A unit was coded as an error if the information was recalled incorrectly (i.e. attributing a behavior done by one story character to a different story character) or if it included information that had never occurred in the story. To estimate interrater reliability for coding, a subset of the protocols were scored twice, producing a kappa value of .76.

### Chapter 3: Results

#### *Effects of importance on recall*

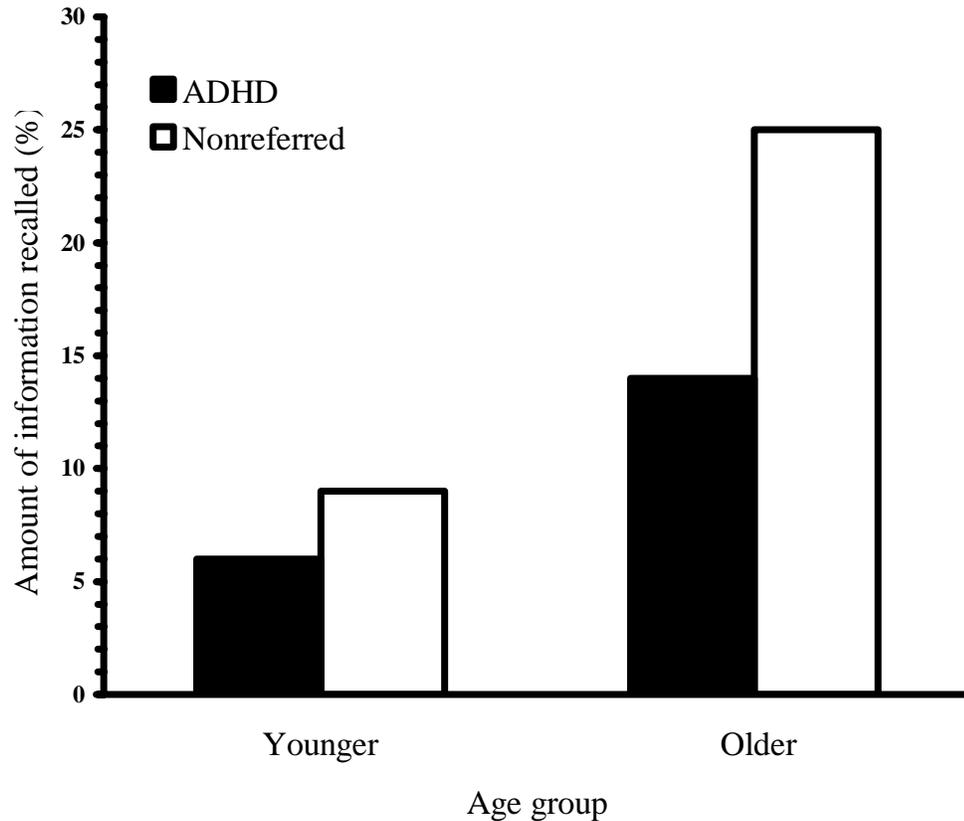
The initial focus of data analysis concerned the degree to which importance ratings predicted recall as a function of group status. General linear model regression analyses were conducted following the procedures recommended by Lorch and Myers (1990) for unbiased tests of repeated measures variables in regression analyses. As stipulated by Lorch and Myers, appropriate error terms for these analyses consist of the respective Participant x Linear Factor effects, rather than the often used pooled residual error term. In the first analysis, the between-participant variables consisted of age group (younger vs. older) and referral status (ADHD vs. comparison), and the within-participant variables consisted of viewing condition (toys vs. no toys) and importance level. "Importance level" was determined by first calculating the mean importance rating for each story event (from college students' ratings), and then constructing four levels of importance based on the quartiles of the ratings for each "Rugrats" program. This ensured that the importance level variable was standardized for the six different "Rugrats" programs.

#### *Group differences*

Results showed that nonreferred children ( $M = 19\%$ ) recalled significantly more than children with ADHD ( $M = 11\%$ ),  $F(1, 187) = 44.63, p < .01, r = .44$ . This finding was qualified by a significant age group x referral status interaction,  $F(1, 187) = 13.40, p < .01, r = .26$  (see Figure 1). Younger nonreferred children ( $M = 9\%$ ) and younger children with ADHD ( $M = 6\%$ ) recalled similar amounts of information, while older

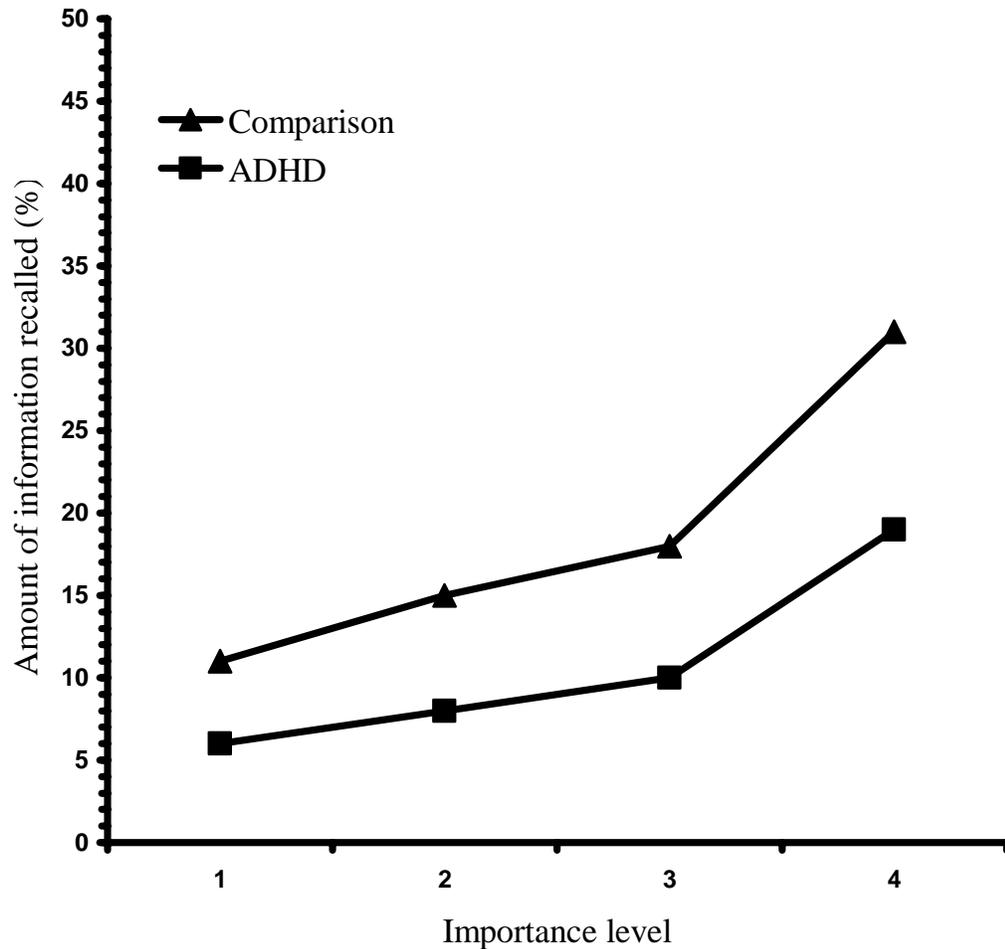
nonreferred children ( $M = 25\%$ ) recalled a larger percentage of information than older children with ADHD ( $M = 14\%$ ).

Figure 1. Percentage of information recalled from "Rugrats" program for younger and older children with and without ADHD.



Although all children's recall was found to increase as the importance level increased ( $M_s = 9\%$ ,  $12\%$ ,  $15\%$ , and  $26\%$ , respectively),  $F(1, 187) = 479.31$ ,  $p < .01$ ,  $r = .85$ , this finding was qualified by a significant importance level x referral status interaction,  $F(1, 187) = 13.80$ ,  $p < .01$ ,  $r = .26$ . Nonreferred children's recall increased more than the recall of children with ADHD as importance level increased (see Figure 2). Thus, children with ADHD show some sensitivity to the importance of the information they recall, but they do not show the same degree of sensitivity as do nonreferred children.

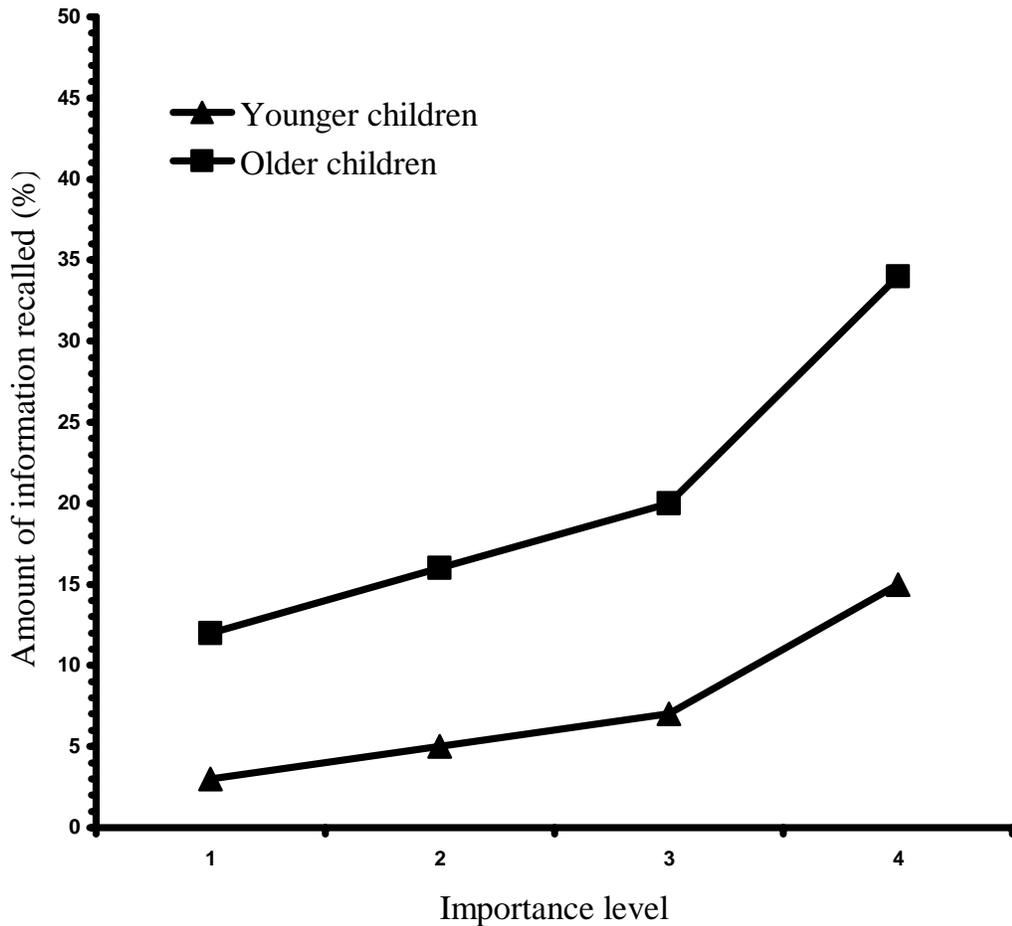
Figure 2 . Percentage of information recalled at four different importance levels for children with and without ADHD.



#### *Age differences*

Results showed that older children ( $M = 21\%$ ) recalled significantly more than younger children ( $M = 8\%$ ),  $F(1, 187) = 125.12, p < .01, r = .63$ . A significant importance level x age group interaction,  $F(1, 187) = 38.44, p < .01, r = .41$ , indicated that older children's recall increased more than younger children's recall as importance level increased (see Figure 3).

Figure 3 . Percentage of information recalled at four different importance levels for younger and older children.

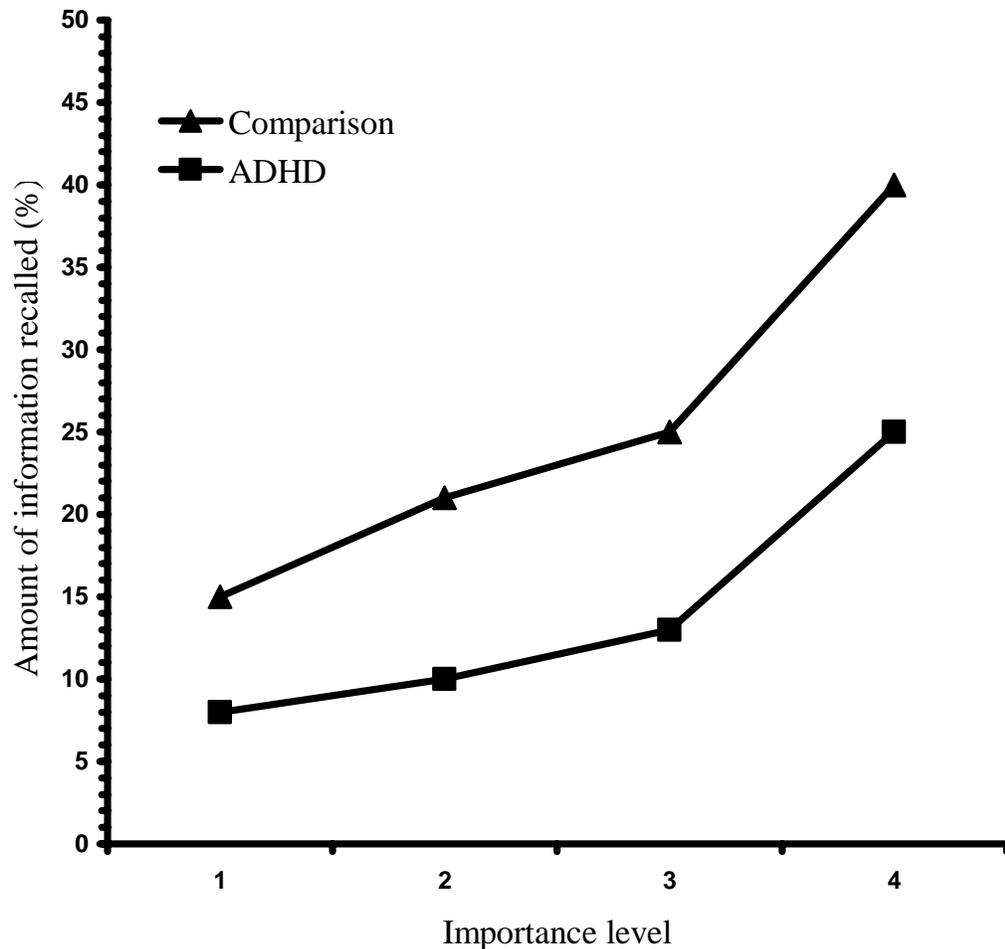


Although children recalled slightly more information in the no toys condition ( $M = 16\%$ ) than in the toys condition ( $M = 14\%$ ),  $F(1, 187) = 8.87, p < .01, r = .21$ , no significant viewing condition interactions were found in this analysis.

The above analysis was repeated separately for each age group due to the presence of a floor effect in the younger children's recall. Results for the older group showed that older nonreferred children ( $M = 25\%$ ) recalled significantly more than older children with ADHD ( $M = 14\%$ ),  $F(1, 110) = 43.11, p < .01, r = .53$ . Although the recall

for both groups of older children increased as importance level increased ( $M_s = 12\%$ ,  $16\%$ ,  $19\%$ , and  $32\%$ , respectively),  $F(1, 110) = 379.89$ ,  $p < .01$ ,  $r = .88$ , this finding was qualified by a significant importance level x referral status interaction,  $F(1, 110) = 12.71$ ,  $p < .01$ ,  $r = .32$ . Older nonreferred children's recall increased more so as importance level increased than the recall of older children with ADHD (see Figure 4). No other significant main effects or interactions were found.

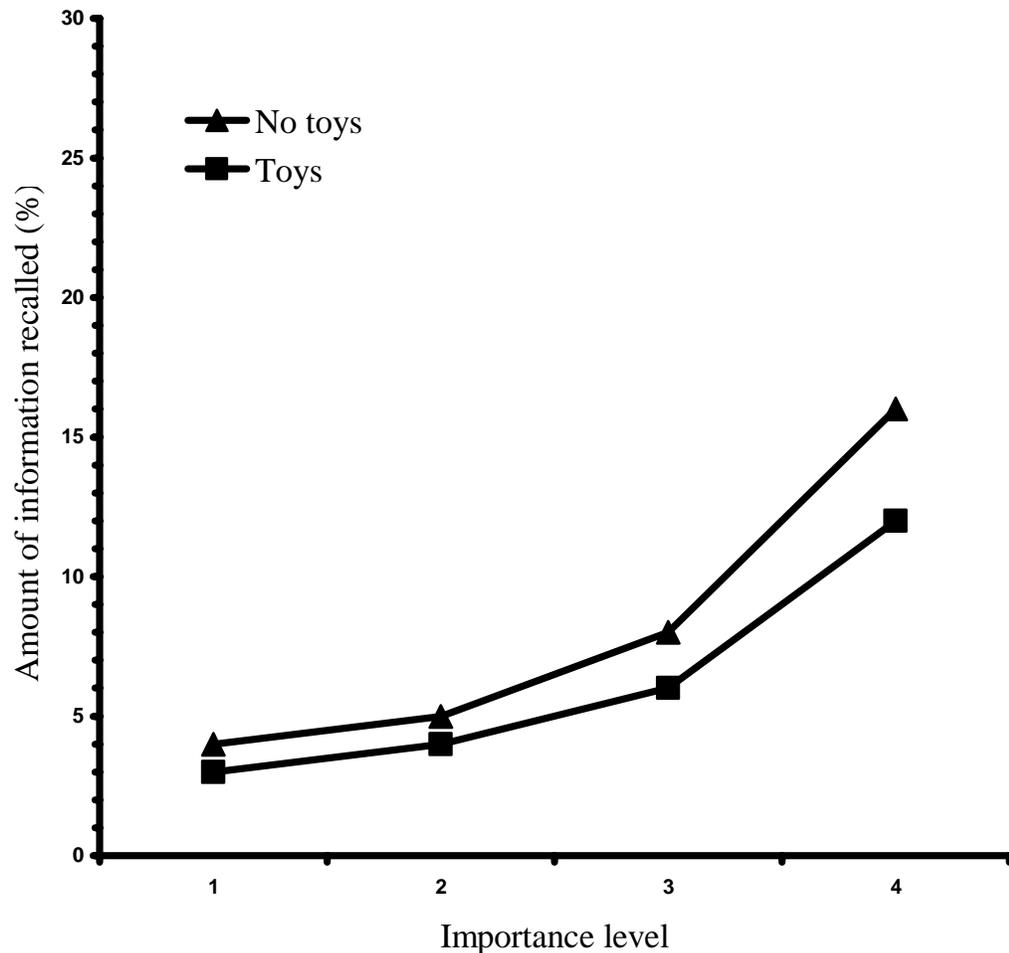
Figure 4. Percentage of information recalled at four different importance levels for older children with and without ADHD.



Results for the younger group showed that younger children recalled more in the no toys condition ( $M = 8\%$ ) than in the toys condition ( $M = 6\%$ ),  $F(1, 77) = 11.10$ ,  $p <$

.01,  $r = .35$ . Although younger children recalled more information as importance level increased ( $M_s = 3\%$ ,  $5\%$ ,  $7\%$ , and  $14\%$ , respectively),  $F(1, 77) = 107.06$ ,  $p < .01$ ,  $r = .76$ , this finding was qualified by a significant viewing condition x importance level interaction,  $F(1, 77) = 4.35$ ,  $p < .05$ ,  $r = .23$ . Younger children's recall increased as importance level increased more so in the no toys condition than the toys condition (see Figure 5). No other significant main effects or interactions were found.

Figure 5. Percentage of information recalled at four different importance levels for younger children in the toys and no toys conditions.



The analyses conducted thus far were repeated with the scores dropped for the children who did not recall any information ( $n = 57$  ADHD,  $99$  nonreferred retained for

these analyses) to determine if including these children in the analyses altered the above results. Findings did not differ from the above results indicating that the analyses were not affected by including these children. Additionally, follow-up analyses considered the following variables as covariates: intelligence, gender, ethnicity, years of completed education for the mother, the percentage of time spent attending to the “Rugrats” program for both viewing conditions, and the total amount of time spent in looks at the “Rugrats” program that are greater than fifteen seconds for both of the viewing conditions. The only variables that were found to be significant covariates were intelligence, percentage of time attending for both viewing conditions, and the total amount of time spent in long looks for the toys condition. Findings did not differ when these variables were included in the analyses, indicating that results cannot be attributed to these covariates.

### Story Coherence

The second focus of data analysis concerned group differences in the coherence of the stories children recalled. First, the order of units each child recalled the story in was correlated with the correct order sequence. Data were dropped for these analyses for children whose total recall was less than three story units. Separate analyses of variance were then conducted for each viewing condition since there were different numbers of children in the viewing conditions. For each analysis, there were two between-participant factors of referral status and age group.

For the toys-present viewing condition, results showed that children with ADHD ( $M = .69$ ) had significantly smaller correlations between the story units they recalled and the correct sequence than nonreferred children ( $M = .79$ ),  $F(1, 159) = 4.72, p < .05, r = .17$ . Additionally, younger children ( $M = .63$ ) had significantly smaller correlations than older children ( $M = .85$ ),  $F(1, 159) = 20.84, p < .01, r = .34$ . There was no significant referral status x age group interaction.

For the toys-absent viewing condition, results showed that older children ( $M = .83$ ) had significantly greater correlations than younger children ( $M = .51$ ),  $F(1, 170) = 22.34, p < .01, r = .34$ . There was no main effect of referral status or referral status x age group interaction for the toys-absent viewing condition.

### Recall Errors

The third focus of data analysis concerned group differences in errors made during recall. Analyses of variance were conducted to investigate the total number of errors children made in their free recalls as a function of group status. Data were dropped for these analyses for children who did not recall any information. Separate analyses of variance were conducted for each viewing condition since there were different numbers of children in the viewing conditions. For the toys-present viewing condition, results showed that younger children ( $M = .85$ ) made significantly more errors than older children ( $M = .45$ ),  $F(1, 177) = 4.82, p < .05, r = .16$ . There was no main effect for referral group or referral group x age group interaction. Additionally, no significant effects were found in the analysis of variance for the toys-absent viewing condition.

### Chapter 4: Discussion

The first purpose of this study was to assess group differences in story recall, between two different age groups of children with and without ADHD, by analyzing the free recall of televised stories as a function of thematic importance. Results showed that nonreferred children were able to recall more information from the stories than children with ADHD; however this effect was specific to the older group of children (7-9 years), due to either a floor effect or to the free recall task being too difficult for the younger group (4-6 years). In addition to recalling less information than their nonreferred peers, children with ADHD were also found to be less sensitive to the importance of the information they recalled. In other words, although their recall did increase as the importance of the material to the overall meaning of the story increased, the rate of increase was not as steep for the children with ADHD. These group differences were found regardless of the viewing condition (toys present or toys absent), which was used to manipulate the visual attention of the children. Further, the group differences in story recall cannot be attributed to group differences in the total percentage of time spent attending to the televised program or the total amount of time spent in long looks at the televised program, because the results did not change when these variables were included as covariates in the analysis. This indicates that something other than reduced attention caused the children with ADHD to be less sensitive to the importance of the information they recalled from televised stories.

The finding of group differences in recall as a function of importance differs from previous findings by Tannock et al. (1993) and Purvis and Tannock (1997), where children with ADHD were found to be equally sensitive as their nonreferred peers to thematic importance. The present study, however, used stories that were more complex and lengthy (stories ranged from 182 units to 241 units in length) than did the previous studies (stories around 60 units long). Additionally, findings from this study are consistent with the findings of Lorch, Diener et al. (1999) and Lorch, Sanchez et al. (1999), which found that children with ADHD are less sensitive to the causal properties of stories than their nonreferred peers. As discussed previously, decreased sensitivity to the causal properties of stories is linked with decreased sensitivity to thematic importance because story events that are judged more important also have more causal connections and are more likely to be on the causal chain. Thus, the findings of this study provide further support to the findings of Lorch, Diener et al. and Lorch, Sanchez et al. that children with ADHD do differ from their nonreferred peers in sensitivity to several indicators of story comprehension.

There are several possible reasons why children with ADHD may be less sensitive to thematic importance, and thus show poorer story recall, than their nonreferred peers. In order to effectively recall a story, information from the story must first be accurately encoded and stored in memory, and then later, this information must be successfully retrieved from memory in order to reproduce the story. Thus, problems at the encoding and retrieval levels must both be considered in order to understand why children with ADHD have poorer story recall.

One possibility is that children with ADHD show less sensitivity to thematic importance and poorer story recall, because they have difficulties retrieving previously encoded information. Although this seems like a plausible explanation for the findings of this study, because children with ADHD showed a consistent deficiency in story recall across viewing conditions, previous studies suggest otherwise (Lorch, Sanchez, et al., 1999; Sanchez et al., 1999). These two studies showed that children with ADHD were able to perform as well as their nonreferred peers on free and cued recall tasks when distracter stimuli were not present during the viewing of the stories. The fact that children with ADHD were able to perform as well as their peers under this condition

suggests that they do not have problems with retrieving previously encoded information. If this was the cause of their difficulties in story recall, then they would likely show poorer story recall even when distracter stimuli were not present, as the presence or absence of these stimuli during the viewing of the televised story should not interact with the ability to recall previously encoded information. Thus, although problems with retrieval cannot be ruled out as a possible explanation for why the children with ADHD were less sensitive to thematic importance in this study (because no differences in recall were found between the viewing conditions), previous findings suggest that other explanations may be more plausible.

One more plausible reason for why children with ADHD are less sensitive to thematic importance is they have difficulties with encoding information from stories due to a limited working memory capacity. Research has shown that children with ADHD have deficits in multiple components of working memory (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005). These deficits may be linked with difficulties encoding information from stories because they limit the amount of available cognitive resources that can be allocated to this task. Additionally, deficits in working memory limit the ability to encode a coherent story representation in memory, because they cause one to be less able to maintain activation of antecedents as new information is processed (Just & Carpenter, 1992). Thus, difficulties may occur for children with ADHD at the encoding level because they have fewer cognitive resources to devote to encoding information and the activation of early important story events in memory cannot be maintained as new events are processed.

Another reason why children with ADHD may show less sensitivity to thematic importance in their story recall is they have difficulties in distinguishing between events that are unimportant from those that are important to the overall meaning of the story. When trying to comprehend and remember a story, it is useful to focus one's attention on encoding the more important story events, because everything cannot be remembered and these events account for the main points or gist of the story. Additionally, these events may be easier and less time consuming to encode than unimportant events, because they have a greater number of links or ties to other important story events. Thus, the connections between these events, which allow for a cohesive story representation to be

constructed in memory, have already been provided by the story, and so additional cognitive resources do not have to be allocated to this task. Research with nonreferred children has shown that as children age they become better at identifying the information that is more important to the overall meaning of a story (Brown & Smiley, 1977; Brown, Day, & Jones, 1983). Older children are thus able to identify and focus on the important story material, which leads them to recall more information from a story and show more sensitivity to thematic importance in their story recall than younger children. If children with ADHD cannot identify important story events, then they will not be able to direct their attention to understanding and recalling this information. The problem then occurs at the encoding level, because the children with ADHD cannot focus on encoding the information that is most important to the story, and instead focus on encoding more random or extraneous story events.

The ability to identify important information was not directly tested in this study or in studies in the past for children with ADHD. Although importance ratings were not collected from children for the “Rugrats” programs, a similar task was completed by the children in this study (during another testing session), in which they divided story events from “Growing Pains” videos into three groups (low, medium, and high) according to their importance to the overall meaning of the story. A preliminary analysis showed that children with ADHD made more gross errors (classifying events of high importance as low or events of low importance as high) than their nonreferred peers, indicating that children with ADHD have difficulty identifying important information. Additionally, a group difference in recall of the “Growing Pains” program was eliminated when the number of gross errors was entered as a covariate. This preliminary finding provides some support for the idea that children with ADHD have poorer story recall due to difficulties with identifying and encoding important information.

The second purpose of this study was to evaluate group differences in the coherence of the recalled stories. Results showed that children with ADHD were able to recall equally coherent stories as their nonreferred peers when no distracter stimuli were present; however, when distracter stimuli were present, children with ADHD recalled stories that were significantly less coherent than those of their peers. This finding suggests that, unlike encoding and recalling important story material, reproducing a story

in the sequence in which it was originally presented is a task that children with ADHD are able to perform, but only under optimal conditions (when distractions are minimized). This finding also provides additional support for the idea that the difficulties in story comprehension that children with ADHD have occur at the encoding level, because when a distracter stimuli is present and attention is reduced, children with ADHD are no longer able to produce stories that are as coherent as their peers. Thus, difficulties in story coherence only occur for children with ADHD when they are distracted from observing the televised story and are not able to devote as many cognitive resources into encoding story information in its correct sequence.

The third purpose of this study was to evaluate group differences in the number of recall errors children made. Results showed that children with ADHD did not differ from their nonreferred peers in the number of errors they made in their story recall. Thus, although children with ADHD have difficulties in the amount of information and the type of information they encode from televised stories, they do not have difficulties in encoding or recalling information from the story correctly. One reason why group differences in errors may not have been found in this study, as they have been found in other studies (eg., Tannock et al., 1993), is that the overall rate of errors was very low for all children. When completing the free recall task in this study, children reported everything they could remember and then stopped. They did not report things they were not sure happened. This could be due to differences between the directions given to the child for the free recall task in this study and the directions provided in other studies. For example, in this study the free recall task was cued by first showing the child a picture of all of the story characters. This likely helped the child remember the different characters in the story, which would lead to a decrease in the number of ambiguous referent errors. Additionally, in this study more complicated story materials were used than in other studies, and because of the increased complexity of the stories, children may have been less comfortable with making guesses or bringing up points from the story they were unsure about.

This study had several limitations that suggest possible directions for future research. First, because of the floor effect or the task being too difficult for the younger group of children, group differences for the four- to six-year-olds could not be adequately

evaluated. In future studies, it would be useful to include children in this younger age range again and have them complete a task that is more age-appropriate (less lengthy or complex stories), so that we can better understand how story comprehension abilities develop and differ over time between children with and without ADHD.

A second limitation of this study was that it did not apply the causal network model by evaluating recall as a function of the various properties provided by this model. Previous research has indicated that these properties are related to story comprehension in both children and adults (see for example van den Broek, Lorch, & Thurlow, 1996). As a result, the network model provides a useful framework for understanding developmental trends in children's story comprehension and a valuable theoretical foundation for studying story comprehension abilities in children with ADHD. In the future, story network analyses will be completed for the "Rugrats" programs, so that group differences in recall as a function of the causal properties can be addressed.

Another limitation of this study, and a possible direction for future studies to address, was that it did not test directly whether children with ADHD differed from their nonreferred peers in the ability to identify important story information. As discussed previously, preliminary work provides some evidence that differences in the ability to identify important information may be linked with story recall abilities; however, it would be useful to directly test the children's abilities by having them rate the importance of the story events from the "Rugrats" programs. One final direction that future research may take is to evaluate the utility of story comprehension interventions. Once problem areas in story comprehension have been identified for children with ADHD, then interventions that address these areas will need to be examined to determine if they do in fact help children with ADHD and reduce group discrepancies in story comprehension.

The findings from this study have several important implications for children with ADHD. Research has shown that children with ADHD have more academic difficulties than their nonreferred peers. One of the factors that may be contributing to these academic problems is the difficulties children with ADHD have in identifying important story information, and thus using this information to guide their story building. This ability to identify and focus on important information is crucial in the school setting, where children must sift through information regularly, while completing reading or other

assignments, preparing for an exam, or just taking notes in class. Time limits them from being able to process and thus recall all of the information that is presented, as does memory capacity, so in order to succeed in school and retain useful material for the future, they need to be able to identify and focus on the information that is the most important. When trying to recall a story, focusing on the most important information also leads to greater recall abilities, as this information has more ties to other story events, and thus activates memory for these events. This relates to the recall of material in the school setting as well, because if children are able to identify and focus on the information that ties the presented material together, then they are likely to have greater recall than if they spend their time trying to memorize random or unrelated information.

Research has also indicated that children with ADHD have more social difficulties than their nonreferred peers. Difficulty with identifying important information could be contributing to their problems with social interactions as well. When a child has a disagreement with a peer, he or she needs to be able to identify the important information from this interaction, to prevent further problems (i.e. what he/she did to upset the peer; what not to do in the future; how to make amends). In addition to understanding and working through disagreements, identifying and attending to important information is part of having positive interactions with peers. Children do not have to be able to recall every word that a peer says to maintain a positive relationship; however they do need to be able to recall the information that their peer feels is most important. Being able to identify which information is important from a conversation is likely related to being able to identify the important information from a story.

In order to address the academic and social problems that children with ADHD face, treatment interventions are typically applied in the school setting. The results of this study suggest several important components that these interventions may want to include. First, they could incorporate teaching sessions or activities for children with ADHD that directly target increasing their ability to identify important information. For example, an activity could be used that teaches skills for summarizing or outlining short reading passages. Another component that may be useful for interventions is simply providing additional resources to children with ADHD to help compensate for their difficulties in identifying important information (i.e. an outline or summary sheet of the

class lecture). Finally, since the performance of children with ADHD is maximized when no distracting stimuli are present, efforts could be made to provide an environment that is relatively free of distracters.

In summary, the findings from this study provide further support that children with ADHD have difficulties in multiple aspects of story comprehension in comparison to their nonreferred peers of the same age. Specifically, children with ADHD show less sensitivity to the thematic importance of the information they recall from stories, and they are able to recall less information overall. Additionally, children with ADHD produce less coherent stories than their nonreferred peers, but only when distracter stimuli are present while the televised story is viewed. This suggests that children with ADHD have consistent weaknesses in certain aspects of story comprehension, like sensitivity to thematic importance; however they are able to perform as well as their peers on other aspects, like recalling a coherent story, unless their attention to the story is reduced by distracter stimuli. Group differences in story comprehension may be attributed to difficulties in encoding information due to limited working memory and problems identifying the information that is most important to the overall theme of the story. These findings add to our knowledge on differences in higher-order cognitive processing abilities of children with ADHD and their nonreferred peers, and they have multiple implications for more effective treatment interventions.

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<i>Years</i>	<i>Institution</i>	<i>Degree or Title</i>
1999-2002	University of Arkansas at Little Rock	B.A. in Psychology, May 2002
1995-1999	Tufts University Medford, MA	B.A. in Child Development, May 1999
1992-1995	The Baylor School Chattanooga, TN	High School Diploma, May 1995

**Clinical Experience**

2003-present	Therapist at the Jesse G. Harris, Jr. Psychological Services Center.
2004-2005	Volunteer placement at the Jesse G. Harris, Jr. Psychological Services Center.
2003-2004	Volunteer placement with Ed Amend, Psy.D.
2001-2002	Volunteer for Mark Edwards, Ph.D. and Eldon Schultz, M.D. at the Dennis Developmental Center.
2000-2002	Volunteer for Charles Feild, M.D. at the Dennis Developmental Center.
1999-2000	Mental Health Technician at the Elizabeth Mitchell Adolescent Center at the Centers for Youth and Families.

**Research Experience**

2002-present	Research assistant for Rich Milich, Ph.D. and Betty Lorch, Ph.D. at the University of Kentucky. Conducting research on ADHD and story comprehension in children. 20 hours weekly.
2000-2002	Research assistant to John Chelonis, Ph.D. in laboratories at both the Arkansas Children's Hospital and the University of Arkansas at Little Rock. Conducting research on learning, memory, decision making, and

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### **Publications**

Baldwin, R. L., Chelonis, J. J., Flake, R. A., Edwards, M. C., Feild, C. R., Meaux, J. B., & Paule, M. G. (2004). Effect of methylphenidate on time perception in children with attention-deficit/hyperactivity disorder. *Experimental and Clinical Psychopharmacology*, 12 (1), 57-64.

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