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A Developmental Examination of Story Recall and Coherence Among Children with ADHD

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Abstract

This study investigated developmental differences in story recall in children with attention-deficit/hyperactivity disorder (ADHD), *N*=57 (77.2% male) and their comparison peers, *N*=98 (61.2% male). Children at the ages of 4–6 or 7–9 completed a free recall immediately after viewing each of two televised stories, once in the presence of toys during viewing and once in their absence. This procedure was repeated with new stories 21 months later. Comparison children recalled more story events and showed a greater sensitivity to the thematic importance of the story events than did children with ADHD, a pattern that remained stable over time. Older comparison children showed a dramatic increase over time in the global coherence of their narrations, whereas the older children with ADHD showed limited improvement over time. The implications of these findings for academic performance and the possible need for remediation are discussed.

Keywords

ADHD; Longitudinal; Story recall; Story coherence

Attention-deficit/hyperactivity disorder (ADHD) is one of the most commonly diagnosed and widely studied behavioral disorders in children. As the disorder is mainly characterized by the presence of developmentally inappropriate levels of inattention, hyperactivity, and impulsivity, it is not surprising that the majority of past research has focused on these broad areas of impairment. In addition, it has been well documented that children with ADHD frequently experience academic deficits. Despite the extensive documentation of academic problems, many questions remain unanswered. For example we have little knowledge of the developmental course of cognitive processes that may contribute to academic difficulties among children with ADHD. At the most basic level the question becomes, what are these children doing differently from their peers that causes their academic performance to suffer?

One promising direction in emerging research is an examination of the development of story comprehension (Lorch et al. 2007). It is now recognized that successful academic performance depends on more than basic literacy skills, such as decoding and word

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recognition. Several models of reading development propose that narrative comprehension and word decoding represent separate processes and that each makes an independent and unique contribution to the development of reading comprehension (Shatil and Share 2003; Storch and Whitehurst 2002). For example, Kendeou et al. (2005) tracked children from ages 6 to 8 and found that early comprehension of stories presented on television or audiotape predicted later reading comprehension beyond the contributions of traditional indicators of literacy, such as word identification and vocabulary. Further, Feagans and Applebaum (1986) reported that relatively strong first grade narrative skills, beyond syntactic and semantic skills, predicted fewer academic problems three years later.

Given the documented importance of narrative comprehension, it is desirable to understand the skills required for effective comprehension. Certainly, sustained and focused attention are necessary (Flory et al. 2006), but many other higher-order cognitive processes are needed as well. The ability to form a good story representation directly reflects a person's ability to select, encode, interpret, and retrieve relevant information, use story structure and background information, and draw inferences from the information presented (Lorch et al. 2007). As the cognitive demands needed to form a complete and cohesive story representation are complex, evaluating story comprehension is a relatively direct way to gain insight into higher-order functioning required for the most central academic tasks such as reading and writing.

As indicated above, most theories of comprehension stress the importance of building a complete and coherent story representation. A number of factors have been identified as being important in this process. In the story comprehension literature, many theories emphasize the importance of causal relations among story events (Ackerman et al. 1990; Trabasso and Nickels 1992). To achieve a coherent understanding of a story, individuals must determine the *causes* of a given event and the *effects* of that event on subsequent events. In addition to the central role of causal relations, a second important feature is a focus on the *goals* arising from certain story events that in turn motivate other actions and outcomes (Mandler and Johnson 1977; Stein and Glenn 1979). Goals and other events with many causal connections are likely to represent the information in a story judged to be most important by mature comprehenders (Trabasso and Sperry 1985). Thus, in order to demonstrate effective story comprehension, children's recall must focus on these events with many causal connections.

Story Comprehension and Production Among Children with ADHD

Studies examining the story comprehension and production skills of children with ADHD show that these children experience significant impairments that correspond closely to the major components of story processing reviewed above. In a review of the relevant literature, Lorch et al. (2007) report reliable evidence documenting three main areas of impairment in story comprehension and story production. Specifically, children diagnosed with ADHD experience: 1) problems understanding causal relations between events, which seem to be linked to difficulty sustaining cognitive engagement (Bailey et al. 2009; Lorch et al. 2000, 2004a); 2) difficulty utilizing the goal structure of the story to build and produce an effective story representation (Flory et al. 2006; Leonard et al. 2009; Renz et al. 2003); and 3) problems recognizing and using important information to guide their recall (Flake et al. 2007; Lorch et al. 1999a, b, 2004b).

As the review by Lorch et al. (2007) indicates, we have a good deal of evidence about components that are deficient in the narration and recall of stories among children with ADHD. However, there are two important questions that have received very little attention in investigations of story comprehension of children with ADHD. First, although research has identified important deficiencies in components of story comprehension and production, these components do not provide a complete picture of effective story representation. In order for children to succeed in story processing tasks that are relevant to academic performance (e.g., writing book reports, summarizing stories), they must be able to integrate these components into a coherent whole (van den Broek 1997). However, little is known about the coherence of story narrations or recalls of children with ADHD.

The construct of coherence occupies a central place in the literatures on text comprehension (Lorch and O'Brien 1995) and story recall and narration (Goldman et al. 1999). It also is recognized as being a complex construct with multiple facets and widely varying operational definitions (Habermas and de Silveira 2008). Two of the accepted definitions are particularly relevant for the current study. The first type of coherence assessed in the present study is what has been called *temporal coherence* (Habermas and de Silveira 2008) or coherence/chronology (Voss et al. 1999). This construct refers to the temporal sequencing of story events. When focused on story narrations, stories are seen as more coherent and thus easier to comprehend and recall if the events follow a logical temporal sequence. For example, Voss et al. found that disrupting the chronology of a narrative significantly reduced judgments of that narrative's quality. When focused on the recall of stories, temporal coherence often is measured by the correlation between the order of the story events and the order of events as recalled (Lorch and Lorch 1995; Lorch et al. 1993).

The second type of coherence assessed in the present study is known as *global coherence*. Although this term has meant different things to different investigators, we are using the construct as proposed by Habermas and de Silveira (2008), which focuses on the subjective judgment of coherence as made by listeners/readers. Ratings of global coherence are made using the entire story recall or narration, and reflect the degree to which the narration is understandable to a reader or listener. Consistent with theories of the development of story representation, Habermas and de Silveira found that the global coherence ratings of narratives produced by 8- to 20-year olds increased significantly with age. These authors argue that assessments of coherence are most effective when global subjective ratings are combined with more objective, text-based indicators. Thus, one of the primary purposes of the present study is to examine the temporal and global coherence of story recalls provided by children with ADHD and their comparison peers.

The second important question that has received little investigation concerns developmental changes in story recall among children with ADHD. Given the reliable deficiencies identified among these children, it is important to determine the developmental course of these deficiencies. Three major patterns of developmental change in group differences should be considered. First, from the perspective of a developmental delay, early group differences may attenuate or even disappear as the children mature. A second possibility is that early group differences persist and remain stable throughout childhood. Finally, consistent with the reading literature, early deficits in basic skills may limit mastery of more complex processes as children mature, leading to greater group differences over time (Torgesen and Burgess 1998).

To date, only one study has examined developmental changes in story recall among children with ADHD. Bailey et al. (2009) examined changes in visual attention and story comprehension for children with ADHD and comparison peers. The children were between the ages of 7 and 9 at time one and seen again approximately 21 months later. At each session children viewed two televised stories, one in the presence of toys and one in their absence. Although both groups of children showed developmental increases in visual attention, initial group differences were stable over time. In contrast, deficits in cued recall among children with ADHD increased over time. Whereas comparison children's recall of factual and causal information increased over time in both viewing conditions, children with ADHD showed no developmental improvement in recall of factual information in the toys-present condition, and no improvement in recall of causal relations in either viewing condition.

The findings of Bailey et al. (2009) suggest that a developmental perspective offers new and important insights into the story comprehension deficits of children with ADHD. Specifically, for none of the dependent variables did children with ADHD narrow the gap with respect to comparison children. For some measures the deficits persisted whereas for others the group differences increased. Particularly important was the widening gap between the two groups in their understanding of causal relations, given the critical nature of this skill as academic work becomes more demanding.

As important as the findings of Bailey et al. (2009) are to understanding the development of story comprehension among children with ADHD, there is one key limitation to the information provided by this study. The use of a cued-recall methodology provides considerable structure to the children's recall and thus cannot assess their ability to form and communicate a coherent story representation. In contrast, a free-recall methodology requires children to structure their own recalls and thereby allows for examination of the coherence of the story representation.

A study by Flake et al. (2007) utilized a free-recall methodology to examine the effects of thematic importance on story recall and provided an initial investigation of the coherence of story recalls by children with ADHD. These children recalled less information overall and their recall was less influenced by thematic importance than was the case for comparison children. Flake et al. also included a measure of recall coherence, which was operationalized as the correspondence between the order of events in the original story and the order of events in the child's recall. If toys were present during viewing, children with ADHD scored lower on this measure than comparison children, but there was no significant group difference if toys were absent during viewing. However, one limitation of this study is that coherence only is assessed in terms of the order of recall of story events. Although this coherence measure does capture information about the sequence in which events are recalled, it does not necessarily reflect the integration of these events into a coherent story. Thus, the first purpose of the current study is to capture children's ability to communicate an integrated story representation by including a more global measure of story coherence. A second purpose of the current study is to build on the findings of Bailey et al. (2009) and Flake et al. (2007) by examining developmental changes in free recall as a function of the thematic importance of story events and in the coherence of story recalls.

The Present Study

The present study is an extension of the study conducted by Flake et al. (2007), examining the free recalls of children with ADHD and their comparison peers. Children in both diagnostic groups began the study separated into younger (4–6 years) and older (7–9 years) groups and then were seen again approximately 21 months later.[1] At both time periods children viewed two television programs, once in the presence of toys and once in their absence. After viewing each program children were asked to recall as much of the story as they could. Dependent measures included the story events recalled and two measures of story coherence. The first corresponded to the measure used by Flake et al., consisting of the correlation between the original order of story events and the order of the events in the child's recall. The second was a more global measure of coherence, in which each recall protocol was rated on a scale from not at all coherent to very coherent.

Method

Participants

A total of 155 children participated at both Phase 1 and Phase 2 of this study, with an average period of 21 months between the two phases. Fifty-seven children had been diagnosed with ADHD (77.2% male) and the remaining 98 children served as a comparison group (61.2% male). The groups did not differ significantly in terms of gender composition, $\chi^2(1)=1.82$.

Both groups were split into older (ADHD *n*=30, comparison *n*=55) and younger (ADHD *n*=27, comparison *n*=43) age groups; children in the younger age group were between 4 and 6 years of age at Phase 1, and children in the older group were between 7 and 9 years of age at Phase 1. An additional 32 children (13 comparison children, 19 ADHD) were seen at Phase 1 but not seen again at Phase 2. Of these 32 children, 11 families had moved away, 6 no longer wanted to participate, and 15 could not be scheduled. Analyses comparing children who remained in the study and those who dropped out revealed no significant differences in symptom levels and story recall performance for either the comparison or ADHD groups.

The children with ADHD were recruited from the Hyperactive Children's Clinic in the School of Medicine at the University of Kentucky. A three-step process was developed to ensure that each child had an appropriate diagnosis of ADHD. First, children were only

[1]The free recall data from Phase 1 are reported in Flake et al. (2007). The free recall data from Phase 2 and the global coherence ratings from both phases are new to this study. The older cohort in the current study was obtained from the same sample as the children who participated in Bailey et al. (2009).

considered if they had been assessed at the psychiatric clinic and received a diagnosis of ADHD based on the *DSM-IV* criteria (APA 1994). The diagnosticians were a team consisting of a child psychiatrist and another mental health professional. The diagnosis was made by the team using standard measures, including child and parent interviews, child observations, Conners (1997) Parent and Teacher Rating Scales, and when possible, psychological test results. The clinic diagnosed the children based on a convergence of evidence from these data, ensuring that the child was significantly impaired in at least two settings.

From the clinic diagnoses, a pool of potential participants was identified. In the second step of the diagnostic process, parents of identified children were asked for consent for the research team to review their children's files. If consent was granted, clinic files were examined by one of the authors to assess eligibility for participation in the study. This process allowed the research team to obtain additional information concerning potential exclusionary criteria, such as children who had an IQ below 80, significant sensory impairment, epilepsy, or a psychotic disorder. Children who were prescribed a medication that could not be suspended for testing sessions were excluded from the study but children being treated with a psychostimulant medication were eligible to participate. Children were not excluded if they had comorbid psychological disorders or learning disability. Children who met criteria for ADHD/Inattentive subtype were excluded from the study due to increasing evidence that impulsivity/hyperactivity is a core deficit of ADHD and that the ADHD/Inattentive subtype may be a distinct disorder and not a subtype of ADHD (Barkley 2001; Milich et al. 2001).

Finally, if the above criteria were met, the parent and child were invited to participate in the study. The third step in the diagnostic process was an on-site standardized interview with the parent to confirm the diagnosis of ADHD. The interview was similar to the Children's Interview for Psychiatric Syndromes- Parent Version (P-ChIPS; Weller et al. 1999), but was limited to verbatim *DSM-IV* criteria for ADHD and ODD. In this interview, parents were asked to respond whether each *DSM-IV* criterion was true for their child, give behavioral examples, and indicate whether they thought the behavior was age inappropriate and how it affected their child's academic and social functioning. A symptom was considered present if the parent's response indicated both age-inappropriate behavior and impairment in functioning criteria. This interview procedure has been used successfully by this research group previously and has achieved inter-rater reliabilities for the number of ADHD symptoms endorsed by the parent to be above 95% (e.g. Lorch et al. 1999b). Only children whose parental interviews supported a diagnosis of ADHD were retained and contributed data for this study.

The group of comparison children was recruited using advertisements in a local newspaper. The eligibility of each child began with a screening during a telephone interview with a parent to ascertain that the child was free from any referrals for behavioral problems or learning disabilities, but the child did not have to be symptom free. 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. Data for comparison children who met criteria for three or more symptoms of inattention, hyperactivity/impulsivity, or ODD were excluded from the study. As previously stated, comparison children were not required to be symptom free but, as indicated in Table 1, they exhibited significantly less symptomatology than children with ADHD for inattentive, hyperactivity/impulsivity, and oppositional defiant disorder symptoms. Both groups of parents further rated their children using the Child Behavior Checklist (CBCL; Achenbach 1991). As indicated in Table 1, the children with ADHD were rated significantly higher on the CBCL attention problems scale than were the comparison children. As further validation of the diagnostic categories, scores from the Conners Parent Rating Scale-Revised (CPRS-R: S; Conners 1997) were available from Phase 2 conducted approximately 21 months later. Children with ADHD scored significantly higher than comparison children on all scales from this measure, providing evidence of the stability of the diagnostic categories (see Table 1).

In addition to diagnostic measures, all children completed the Vocabulary subtest of the *Wechsler Preschool and Primary Scale of Intelligence-III* (*WPPSI-III*; Wechsler 2002) or *Wechsler Intelligence Scale for Children-III* (*WISC-III*; Wechsler 1991), as appropriate for their age, to provide an estimate of verbal intelligence. As indicated in Table 1, children with ADHD had significantly lower scores than did comparison children. Effects involving group did not differ regardless of whether IQ was included as a covariate in analyses, so the analyses reported below do not include vocabulary IQ as a covariate. Similarly, although the two groups did differ significantly in terms of years of maternal education, this variable was not a significant covariate.

At Phase 2 all children were administered the Listening Comprehension (LC) and Oral Expression (OE) subtests of the *Oral and Written Language Scales (OWLS;* Carrow-Woolfolk 1995). The LC subtest measures the ability to understand spoken language whereas the OE subtest measures the ability to use spoken language. As is evident in Table 1, the children with ADHD scored significantly below the comparison group on both subtests. In terms of oral language impairment, 19% of the children with ADHD scored greater than 1 *SD* below the mean (i.e. <85) for the OE test, whereas 4% of the comparison children did so. In order to examine whether any group differences could be accounted for by differential rates of language impairment across groups, all analyses were repeated excluding children whose OE score was less than 85. The pattern of results was the same for both sets of analyses except for one variable as noted in the "Results" section.

For those children with ADHD who were prescribed psychostimulant medication, they did not receive any psychostimulant medication on the day of the study. This provided an acceptable period of time for the drug to be passed out of the children's system (Greenhill 2001). Children received two small toys and $15.00 for participating in this phase of the study.

Materials

During each phase of the study children viewed two different 13-minute episodes of the *Rugrats* cartoon television program, one with toys present and one with toys absent. For each child, four of six possible episodes were randomly selected and counterbalanced across phases and viewing conditions. *Rugrats* episodes were chosen both because of the wide appeal of this animated program across the age range tested in this study and because episodes could be identified that followed a goal-driven story structure; that is, a protagonist is presented with a problem that gives rise to a goal that leads to attempts to achieve the goal, often encountering obstacles that create subgoals. Selection of *Rugrats* episodes also is justified by findings reported by Kendeou et al (2005), who demonstrated that early comprehension of *Rugrats* episodes successfully predicted later reading comprehension.

Each *Rugrats* story was 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. These importance ratings were collected so that the children's recall protocols could be examined to determine if they were recalling information that adult raters, or those skilled at story comprehension, had indicated was central to the overall meaning of the story. For each idea unit a mean importance rating was calculated, and quartiles of importance ratings were determined for each story. These quartiles defined the four levels of importance used in recall analyses. This ensured that the importance level variable was standardized for the different *Rugrats* programs.

Procedure

Children were brought to the home-like laboratory at the university by a parent for the first time in Phase 1 and a second time in Phase 2, approximately 21 months later. The procedure for both phases was the same. The child spent about five minutes getting acquainted with the experimenter and picking out a toy he or she would receive at the end of the session. During Phase 1 informed consent was obtained from the parent and assent from the child.

The viewing room contained a 121.92 cm×77.47 cm table on which were placed the toys during the toys-present viewing condition. A 91.44 cm cart was situated at a 45-degree angle to the right edge of the table. The camera was located in the left upper corner of the room, which allowed for recording the child's attention toward and away from the television.

An experimenter blind to group status and the specific purposes of the study (i.e., ADHD vs. comparison children) tested the child. The child was seated at the table (with or without toys, depending on the viewing condition) and told that a television program would be coming on to watch. The child was told that he or she would be asked about the program when it was over. If toys were present, the child was told that he or she could play with the toys during the program. Before leaving, the experimenter reminded the child that he or she would be asked about the program when it was over. The experimenter started the program and then left the room. The viewing session was videotaped.

When the program ended, the experimenter came back into the room and removed the toys (if necessary). The experimenter then reviewed the names of the characters from the program with the child. This was done using a picture showing the characters, and the picture was left on the table in front of the child. The child was asked to give a complete free recall of the story he or she had just viewed, followed by two standard prompts to encourage the child to provide as much information as she or he could remember. The child was allowed a short break before viewing and recalling the next program.

Approximately 21 months after a participant completed Phase 1, he or she was contacted to complete Phase 2 of the study. This phase was identical to the first, following the procedures above. The toy condition (with or without toys present) was counterbalanced within each phase, with participants viewing one program with toys present and one without. Participants never watched the same program twice within or between phases. At the end of Phase 2, each child had viewed a total of four different episodes.

Each child's free recall protocol was transcribed verbatim by a coder blind to group status and study hypotheses. Transcriptions were based on audiotaped recalls unless portions were inaudible in which case videotape recordings were consulted. Transcriptions were checked for accuracy and corrected when necessary. These protocols were then parsed into information units and compared to the idea units obtained from the script of the program, 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. To estimate interrater reliability for coding, a subset of the protocols was scored twice, producing a kappa value of 0.76.

Two measures were used to compare the coherence of recall protocols by children with ADHD to those of the comparison children. First, consistent with the procedure of Flake et al. (2007), the order of units as stated in each child's recall was correlated with the correct order sequence, with the individual child's correlation serving as the dependent variable (temporal coherence) in the analyses of variance (Myers and Well 1991). This measure is similar to indices of concordance used in previous studies of the coherence of children's story recall (Oakhill and Cain 2007; Stein and Glenn 1979). Data were dropped for these analyses for children whose total recall was less than three story units. At Phase 1 this resulted in dropping 10% of recall protocols but no protocols needed to be dropped at Phase 2. In addition, material recalled after each of the two prompts was not used in these analyses.

For the second measure of coherence, global coherence, each protocol was rated on a scale of 1–4 (1 = Not at all coherent, 4 = Very coherent). The criteria for the four levels were as follows: a score of ‘1’ reflected poor transitions from one idea to the next, poor connections while talking about the same idea, poor overall flow (choppy), significant difficulty explaining the sequence of events, and little or no story line maintained; a score of ‘2’ signified some appropriate transitions to new ideas and connections within an idea, but difficulty explaining the sequence of events, some parts of storyline maintained but little substance; a score of ‘3’ reflected appropriate transitions to new ideas and connections within an idea with good overall flow, only minor problems with transitions or connections, explains the sequence of events clearly but with some ambiguities; and a score of ‘4’ signified appropriate transitions to new ideas and connections within an idea with good overall flow, explains the sequence of events clearly with no or very few ambiguities. A random sample of 30 recall protocols was independently coded by a second rater, producing an interrater reliability correlation of 0.98.

Results

As noted in the “Methods” section, all analyses were undertaken twice, once including all children and once excluding children whose Oral Expression language score was less than 85. The pattern of results was the same for both sets of analyses except for one variable, temporal coherence. Thus, this is the only variable for which the second set of analyses is reported.

Developmental Changes in Free Recall

The initial focus of data analysis concerned developmental changes in the degree to which importance ratings predicted recall as a function of group status. The between-participant variables consisted of age group (younger vs. older) and diagnostic group (ADHD vs. comparison), and the within-participant variables consisted of phase (Phase 1 vs. Phase 2), viewing condition (toys-present vs. toys-absent), and importance level (the four quartiles).

Overall, the percentage of story units that children recalled increased from Phase 1 (M=13.5%) to Phase 2 (M=19.3%), F (1, 151)=63.52, p<0.001, effect size d=1.18 and comparison children (M=19.8%) recalled more than children with ADHD (M=13.1%), F (1, 151)=29.43, p<0.001, d=0.87. However, there was no significant interaction of phase and diagnostic group, F (1, 151)<1, indicating that group differences present at Phase 1 remained stable across the 21 months of the study.

All children's recall increased as importance level increased (Ms=9.9%, 13.1%, 16.4%, and 26.3%), F (3, 453)=416.7, p<0.001. Consistent with previous findings (Flake et al. 2007; Lorch et al. 1999a, b, 2004a, b), a significant importance level × diagnostic group interaction was obtained, F (3, 453)=12.39, p<0.001. Comparison children showed a significantly greater linear increase in recall as importance increased than did children with ADHD, F (1, 151)=19.74, p<0.001, d=0.72 (see Fig. 1). The three-way interaction involving diagnostic group, phase, and importance was not significant, F (1, 151)= 1.07, p>0.10

Older children (M=22.0%) recalled a significantly greater percentage of story units than did younger children (M=10.9%), F (1, 151)=81.31, p<0.001, d=1.46, and the effect of importance level on recall was greater for older children than for younger children, F (3, 453)=27.93, p< 0.001. Finally, although diagnostic group differences in recall were significant both for the older children (Ms= 26.9% vs. 17.1%), F (1, 83)=31.21, p<0.001, d=1.22. and for the younger children (Ms=12.6% vs. 9.1%), F (1, 68)= 4.40, p<0.05, d=0.52, a significant interaction indicated that the diagnostic group difference was greater for the older children, F (1, 151)=6.50, p<0.05, d=0.41. There was no significant interaction of diagnostic group, age, and phase, F (1, 151)=1.53, p>0.10

Children recalled significantly less information in the toys-present viewing condition (M=15.1%) compared to the toys-absent condition (M=17.7%), F (1, 151)=19.45, p< 0.001, d=0.70, but diagnostic group never interacted with viewing condition.

Measures of Recall Coherence

The two measures of recall coherence were the global coherence ratings and the correlational measure of temporal coherence. Analyses of both measures included the between-participants variables of age group and diagnostic group, and the within-participants variables of phase and viewing condition.

Temporal Coherence—For this measure of coherence the results differed depending on whether children with an oral expressive impairment were included in the analyses. With these children included, the correlations of recall order with story order were significantly greater for comparison children (M=0.81) than for children with ADHD (M= 0.69), F (1, 126)=8.39, p<0.01, d=0.52. This main effect was qualified by a significant interaction of group and viewing condition, F (1, 126)=4.42, p<0.05, d=0.37, such that the group difference was significant in the toys-present condition (Ms=0.84 vs. 0.67), F (1, 130)=11.49, p<0.001, d=0.58, but not in the toys-absent condition (Ms=0.77 vs. 0.72), F (1, 139)=1.74, p>0.10. When children with an oral expressive language impairment were excluded, neither the group difference, F (1, 114)=1.45, p>0.10, nor the group × viewing condition interaction, F (1, 114)=1.41, p> 0.10, was significant. For both sets of analyses, the correlations were higher at Phase 2 (M=0.81) than at Phase 1 (M=0.69), F (1, 126)=13.42, p<0.001, d=0.58, and for older children (M=0.87) than for younger children (M= 0.63), F (1, 126)=37.11, p<0.001, d=1.09, but there were no significant interaction of these variables with diagnostic group.

Global Coherence Ratings—Coherence ratings were greater for comparison children than for children with ADHD, F (1, 151)=39.82, p<0.001, d=1.18, for older children than for younger children, F (1, 151)=35.57, p<0.001, d=0.90, in the toys-absent condition than in the toys-present condition, F (1, 151)=17.26, p<0.001, d=0.67, and at Phase 2 than at Phase 1, F (1, 151)=67.52, p<0.001, d= 1.35. Significant interactions of diagnostic group and phase, F (1, 151)=9.32, p<0.01, d=0.49, and diagnostic group and age, F (1, 151)=13.04, p<0.001, d=0.58, were qualified by a significant diagnostic group × age × phase interaction, F (1, 151)=6.90, p=0.01, d=0.43. As shown in Fig. 2, the most dramatic improvement in coherence ratings from Phase 1 to Phase 2 were for the older comparison children (Ms=1.78, 2.70), F (1, 54)=111.87 p<0.001, d= 2.88. In contrast, the younger children with ADHD did not improve significantly over time (Ms=1.14, 1.32), F (1, 26)= 3.00, p=0.10. Improvements from Phase 1 to Phase 2 were intermediate for older children with ADHD (Ms= 1.25, 1.60), F (1, 29)=12.43, p=0.001, d=1.29, and younger comparison children (Ms=1.35, 1.56), F (1, 42)= 4.76, p<0.05, d=0.65.

Covariation Between the Two Coherence Measures—Correlations between the two coherence measures were computed for each diagnostic group, separately for each phase and viewing condition. Most correlations were significant but none exceeded r=0.40 (mean r=0.31, range = 0.21–0.39). This pattern suggests reasonable construct validity for the two measures but also that they are not redundant.

Discussion

A major goal of the present study was to investigate and compare patterns of developmental change in story comprehension among children with ADHD and comparison children, with a special focus on the children's ability to include important information in their story recalls and to construct and communicate a coherent story representation. As noted earlier, three major patterns of developmental change are possible. First, early group differences may attenuate or even disappear as the children mature. Second, early group differences may persist and remain stable throughout childhood. Finally, early deficits in basic skills may limit mastery of more complex processes as children mature, leading to greater group differences over time.

The results of the present study can be discussed with respect to each of these three possible patterns of developmental change. For no measures were initial group differences reduced across phases, thus providing no support for the hypothesis of a developmental delay in story comprehension among children with ADHD. The results for the effects of thematic importance on recall were consistent with the hypothesis that early group differences persist and remain stable throughout the elementary-school years. Although children's recall of story events increased for both groups of children across phases, the group difference in the impact of thematic importance on recall remained constant. The patterns of effects over time were somewhat different for the two coherence measures. For the correlations of recall order with story order, the initial advantage of the comparison group in the toys-present viewing condition remained stable over time, although this difference may have been accounted for by a group difference in oral expressive language impairment. In contrast, for the global coherence measure, older comparison children showed a significant and dramatic improvement over time, whereas older children with ADHD and younger comparison children showed very limited improvement.

In terms of understanding the development of story comprehension in children with ADHD, the most encouraging aspects of the findings are that, over time these children increased the total number of story events they recalled, and continued to demonstrate some sensitivity to thematic importance in their recall. These findings indicate that children with ADHD at least implicitly recognize some of the most important information in a story, which then guides encoding and recall of story information. Further, this skill is maintained over time. Unfortunately, there also are some discouraging aspects of the findings. Over time comparison children continued to recall more story events than did children with ADHD, and continued to show greater influence of thematic importance on their recall. Thus, these group differences in recall are unlikely to reflect a developmental delay that will disappear over time. Instead, to close this gap it may be necessary to develop interventions that train these children in recognizing the most important story events, in encoding and expressing sequences of story events, and in using such information to guide retrieval of story events.

More serious problems for children with ADHD are suggested by the results for the global coherence measure. Unlike the pattern for the older comparison children, older children with ADHD showed very limited improvement over time and their performance was indistinguishable from that of the younger comparison children. The limited improvement in global coherence is consistent with the Bailey et al. (2009) finding that this older group of children with ADHD showed no improvement in their performance on questions that explicitly tested the causal relations among story events. These group differences cannot be attributed to problems of inattention because in both studies the presence of a competing activity (i.e., toys) lowered visual attention but did not affect differences between diagnostic groups on the comprehension measures. The implications of these findings are especially dire, because the older children in the study were on average progressing from 3rd to 5th grade, a developmental phase when tasks increasingly require the production of coherent narratives, whether it be writing book reports or making oral presentations. In addition, during this age range such tasks span a variety of academic disciplines, including history, science, and language instruction. In order for work to be positively evaluated by teachers, children need to do more than just produce the necessary pieces, but they also need to incorporate logical connections among events. Interventions addressing these deficits are necessary but likely to be more difficult than those recommended to address deficiencies in recalling important information among children with ADHD. Unlike the sensitivity to thematic importance shown by children with ADHD, there is only limited evidence that these children are progressing in the ability to form logical connections or coherent representations. Without concerted intervention, the gap between comparison children and children with ADHD may continue to widen.

The importance of the developmental transition from primary (i.e., 1st to 3rd) to intermediate (i.e., 4th to 5th) elementary school grades is supported by the dramatic increase in coherence ratings seen among the older comparison children, in contrast to the limited improvement seen in the younger comparison group. As argued by Bourg et al. (1997), this is a period during which there is rapid change in children's ability to link events and to begin to include global, interepisode relations in their story representations. Both the dramatic increase in global coherence ratings among the older comparison children and the limited improvement shown by the younger comparison children are consistent with this interpretation. Thus, absence of improvement in global coherence ratings among the younger children with ADHD is not in itself a cause for concern. In contrast, limited improvement among the older children with ADHD may signal an important deficit in an expected developmental progression that forms the foundation for many tasks needed for academic success.

One of the purposes of the present study was to compare groups on two different measures of coherence, one emphasizing text-based sequences of information (i.e., temporal coherence) and the other reflecting coherence from a listener's perspective (i.e., global coherence). As discussed above, the pattern of results for the global coherence ratings suggests a potentially serious deficit over time for the older children with ADHD. In contrast, group differences for the temporal coherence measure are less dramatic and may be accounted for by differences in oral expressive language impairment. It is not entirely clear why group differences on the temporal measure, but not on the global measure, would be affected by oral language impairments. It is possible that the global coherence measure requires meta-cognitive skills (e.g., perspective taking, higher level organization) that go well beyond the influence of language abilities, whereas the temporal coherence measure reflects a more local processing and production of story information that is more dependent on basic language skills. Future research can investigate in greater detail the construct of story coherence as it relates to the deficits associated with ADHD.

Limitations

One potential limitation of the current study concerns the television programs used. The *Rugrats* program was selected because of its appeal across a wide age range and because the episodes chosen contained strong goal-based story structures. However, two characteristics of the *Rugrats* program may have influenced the nature of the story representations that children were likely to construct. First, the production features used in the program may have strongly signaled that the program's purpose is entertainment, which may have led to more superficial processing than for programming that also signals educational value (Fisch 2000). Second, although the local action sequences are comprehensible and entertaining for a wide age range, the goal structures of the entire episodes may have been too complex for the younger children, who recalled very little at phase 1. Nevertheless, the consistent patterns of performance across groups, ages, and thematic importance suggest that these program characteristics did not prevent reliable and valid information about children's story recall and representations from being obtained. Future studies should carefully evaluate programming formats and include diverse programming to ensure the generalizability of conclusions drawn.

A second potential limitation of the present study is the question of how well story comprehension and recall performance relate to achievement on academic tasks. Although many of the higher order cognitive processes required for story recall tasks are required for academic success, it is not known the degree to which performance on the present tasks generalize to tasks assigned in school. However, it is important to note that the findings of Kendeou et al. (2005) demonstrated that early recall of televised stories does predict later reading achievement beyond the contributions of traditional indicators of literacy, such as word identification and vocabulary. Nevertheless, the degree to which laboratory story comprehension tasks relate to actual school performance requires further investigation.

A further potential limitation concerns the possible role of comorbid language impairments or learning disabilities in accounting for group differences. Systematic assessment data were not available to permit formal diagnoses of language or learning disabilities. The language measures that were available at Phase 2 indicated that the children with ADHD were more likely to experience expressive language difficulties than were comparison children. However, with one exception the pattern of results was unchanged when children with significant language impairment were excluded from analyses. This suggests that language impairment is unlikely to be the sole factor accounting for group differences on recall measures, but future research needs to address this issue more thoroughly.

The final limitation concerns the exclusion of the inattentive subtype from the sample of children with ADHD. This decision was based on emerging evidence that the inattentive subtype may be a distinct disorder rather than a subtype of ADHD (Barkley 2001; Milich et al. 2001). Given that the focus of the original longitudinal study was on the combined subtype, recruitment was designed to produce a homogeneous sample. Future research can investigate the degree to which the findings for the combined subtype may hold for the inattentive subtype.

In conclusion, the results of this study extend past evidence of impaired story comprehension skills in children with ADHD. Their recall, as compared to that of their peers, continues to show less sensitivity to information that is important to the overall theme of a story. In addition to this disparity in story comprehension that is stable across time, children with ADHD appear to lose ground in the ability to develop and communicate a coherent story representation. These persistent story comprehension difficulties highlight the need for intervention strategies designed to target the development of story comprehension skills before children with ADHD fall even further behind their classmates in academic performance.

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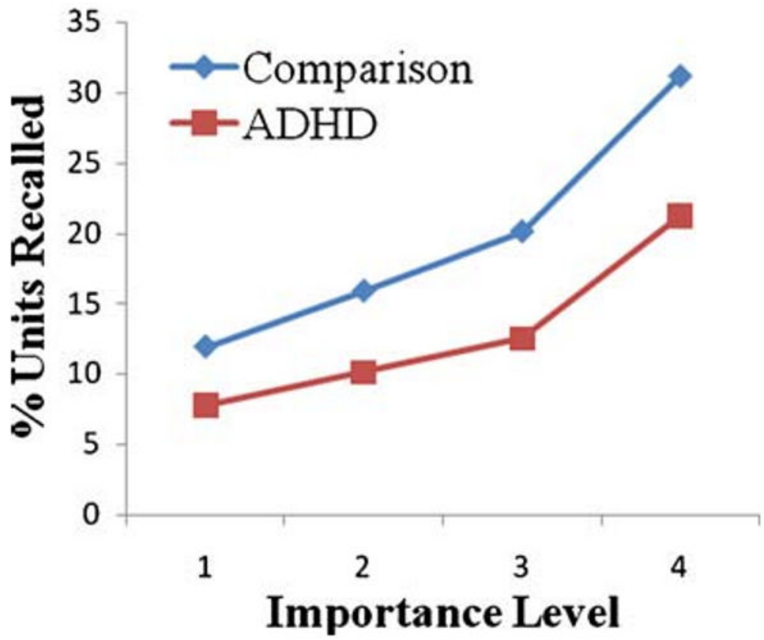

Fig. 1.
Mean percentage of units recalled as a function of diagnostic group and importance level

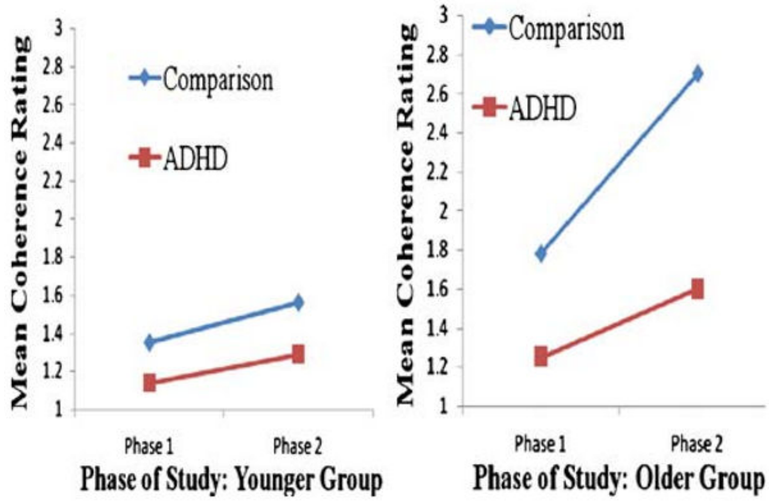

Fig. 2.
Mean coherence rating as a function of diagnostic group, age, and phase

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Table 1

Comparison of Two Diagnostic Groups on Relevant Demographic Variables

Factor	ADHD (n=57)		Comparison (n=98)		*t*	*p*
	M	*(SD)*	*M*	*(SD)*		
Phase 1 Age (years)	7.17	(1.66)	7.23	(1.59)	0.22	0.83
Phase 2 Age (years)	8.91	(1.77)	8.94	(1.61)	0.11	0.92
DSM-IV interview						
Inattention	6.07	(2.41)	0.14	(0.43)	23.74	<0.001
Hyp/Imp	5.98	(2.08)	0.19	(0.49)	26.30	<0.001
Oppositionality	3.29	(2.31)	0.28	(0.72)	11.96	<0.001
Mother's education	14.39	(2.18)	15.59	(2.27)	3.16	<0.01
Vocabulary scaled score	10.28	(3.77)	12.77	(3.40)	4.21	<0.001
OWLS Language Assessment						
Listening Comprehension	96.5	(15.5)	103.1	(12.1)	2.86	< 0.005
Oral Expression	95.0	(13.4)	108.6	(15.3)	5.43	< 0.001
Conners Parent Rating Scale						
Oppositional	66.07	(12.15)	48.35	(6.88)	11.26	<0.001
Inattention	69.70	(10.85)	47.63	(5.70)	16.1	<0.001
Hyperactivity	76.78	(10.43)	49.53	(6.08)	19.96	<0.001
ADHD Index	72.22	(8.97)	47.83	(5.74)	20.05	<0.001

Hyp/Imp hyperactivity/impulsivity

[a]The Conners Parent Ratings and the OWLS language assessment were obtained at Phase 2 of data collection