

Story Comprehension and Academic Deficits in Children With Attention Deficit Hyperactivity Disorder: What Is the Connection?

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Abstract. Based on the reliable findings that children with attention deficit hyperactivity disorder (ADHD) have both attentional and academic difficulties, it is assumed that the attentional deficit contributes to the academic problems. In this article, existing support for a link between the attentional and academic difficulties experienced by children with ADHD is reviewed, and questions for future research are identified. This article goes beyond a discussion of visual attention problems to an investigation of the more complex processing deficits that may contribute to academic difficulties. It is suggested that current interventions for children with ADHD that focus on decreasing disruptive behavior and increasing simple attention to tasks may not address deficits in story comprehension skills such as those required for many school tasks. This article draws from the educational literature to explore possibilities for creating academic interventions that are more effective at remedying the story comprehension deficits experienced by children with ADHD.

The combined type of attention deficit hyperactivity disorder (ADHD) is one of the most common behavioral disorders among children of elementary school age (Barkley, 1997). Core symptoms include inattention, hyperactivity, and impulsivity (American Psychiatric Association, 1994), and each of these can have a significant impact on children's academic functioning. Stimulant medications and behavior management have proven efficacious in treating the core symptoms of ADHD; however, at the present time, there is little evidence suggesting that these treatments positively influence academic achievement. Thus,

it is imperative that we identify why children with ADHD exhibit academic problems so we can create interventions that more specifically address those areas of difficulty.

Currently, there are three subtypes of ADHD recognized by the American Psychiatric Association (1994). The predominantly inattentive type is characterized by significant inattention and distractibility but fewer than six symptoms of hyperactivity or impulsivity. Children with the predominantly hyperactive-impulsive type of the disorder experience considerable difficulty inhibiting excessive behaviors but do not have substantial attentional

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problems. The combined type of ADHD differs from the other subtypes in that significant levels of hyperactivity, impulsivity, and inattention are all present (American Psychiatric Association, 1994). Recent research suggests that the combined type diagnosis also may be associated with a different set of cognitive deficits (Milich, Balentine, & Lynam, 2001). This article will focus on children with the combined type of the disorder and it is likely that the findings reviewed here do not apply to children with ADHD, predominantly inattentive or predominantly hyperactive types. Because relatively little is known about how symptom presentation differs for males and females with ADHD, gender effects in the ADHD samples are discussed when possible. However, ADHD is less commonly diagnosed in girls and many studies have not examined gender differences.

ADHD Symptoms and Associated Difficulties

Because of the disruptive nature of the disorder, children with the combined type of ADHD experience a variety of difficulties in multiple settings. One area where the symptoms of ADHD are likely to have a significant impact is in the classroom. Evidence suggests that children with ADHD typically experience chronic underachievement and have high rates of school failure and grade retention (Barkley, 2006). Once thought to decline after childhood, difficulties associated with ADHD have been shown to continue into adulthood and have long-lasting repercussions (Barkley, 2006). Clearly, early academic intervention is a necessary step towards improving the prognoses of children with ADHD. To determine the areas most crucial for intervention, the nature of the academic problems these children experience must be explored.

ADHD consists of many intercorrelated symptoms, each of which may contribute to the academic difficulties these children experience. Failing to inhibit responses and hyperactivity both could be problematic in the classroom. However, behavioral problems might not fully explain this group's academic difficulties. As yet, connections between specific

symptoms of ADHD and the particular aspects of academic performance they affect have not received a great deal of research focus. Some evidence indicates a link between attention and academic achievement. In a longitudinal study of attentional problems and reading, Rabiner and Coie (2000) followed 387 children from kindergarten through fifth grade and collected several standardized measures of attention and reading achievement. Attentional difficulties were found to predict later reading achievement even when prior reading achievement, IQ, and behavioral problems were controlled.

The emphasis in the ADHD literature on the attentional deficit makes sense given the performance-oriented nature of many of the associated problems (e.g., being off task, requiring frequent redirection). However, the main measure of attention has often been whether a child was looking at a task or stimulus when it was presented. Thus, this research has yielded findings about only the *initial* phases of information processing by children with ADHD (i.e., visual attention; Sergeant & van der Meer, 1990) and has often left more complex capabilities unmeasured. In particular, we know little about how children with ADHD perform on cognitive processing skills required for many academic tasks like applying, analyzing, synthesizing, and evaluating information.

Recently, researchers have begun studying story comprehension to gauge how children with ADHD perform on tasks requiring simple visual attention as well as more complex cognitive skills. This line of research might help us connect the cognitive difficulties exhibited by children with ADHD to some of the academic problems they experience. Through this process, it is hypothesized that more effective interventions can be created. Reviewing the development of these skills in nonreferred children is a crucial step towards identifying specific deficits present in the story comprehension skills of children with ADHD.

Story Comprehension Research

Story comprehension tasks make up a significant component of school performance

(e.g., reading and writing tasks) and involve many cognitive skills in addition to simple visual attention (Lorch, Diener et al., 1999; Sanchez, Lorch, & Milich, 1999). Thus, examining them provides us with the opportunity to evaluate children's understanding of complex events (van den Broek, Bauer, & Bourg, 1997) like those they encounter in many school tasks. As such, story comprehension is a powerful gauge of both cognitive processing and cognitive development. Investigating story comprehension skills provides us insight into many aspects of children's cognitive functioning, which include 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 interpretation of presented information; the monitoring of comprehension; and the use of retrieval skills (Lorch, Milich, & Sanchez, 1998). Thus, the investigation of children's story comprehension offers insight into many aspects of their comprehension in general (Lorch et al., 1998).

Current story comprehension research emphasizes the importance of the causal connections that exist among story events (Graesser & Clark, 1985) and their role in maintaining a coherent understanding of the story (Lorch, Diener et al., 1999; Sanchez et al., 1999). One important structural property of stories is a focus on the *goals* arising from story events that in turn lead to other actions and outcomes (Stein & Glenn, 1979). Because of their central role in maintaining story structure, a thorough understanding of story goals is crucial for effective story comprehension. Another particularly important aspect of story comprehension is the number of causal connections that events have to one another. Events with many causal connections are linked to several other events in the story through antecedents and/or consequences, and are most important to story coherence. Research findings suggest that the number of causal connections that goals and other story events have to previous and subsequent events can influence the way in which stories are

comprehended and remembered (Trabasso, Secco, & van den Broek, 1984; van den Broek, 1989).

As nonreferred children age, they become more sensitive to causal relations among story events and better able to integrate them into a coherent whole (van den Broek, 1989). These improvements may be the mechanisms through which children become better able to use causal relations to guide comprehension and recall as they get older (Ackerman, Paine, & Silver, 1991). Children with ADHD are believed to exhibit a lag in developing many important academic and social skills; thus, their performance on story comprehension tasks may more closely resemble that of younger, nonreferred peers. By examining how children with ADHD comprehend story events and represent the relations among them, we can gain new insight into their cognitive processing abilities (Lorch et al., 1998). Ultimately, investigation of story comprehension in children with ADHD may shed light on many of their academic difficulties and inform the creation of effective academic interventions for these children.

Story Comprehension in Children With ADHD

Research employing televised stories has found that school-aged children with ADHD do not produce deficient recall of factual story information, regardless of whether salient distracters (e.g., toys) are present during viewing (Landau, Lorch, & Milich, 1992; Lorch et al., 2000; Lorch, Sanchez et al., 1999). Children with ADHD and their nonreferred peers have better recall of factual events that are high in importance (e.g., many causal connections to other events; Sanchez, Milich, Hooks, & Welsh, 1997). Thus, these children can recall factual information from stories as well as their nonreferred peers, even when their attention is divided. In addition, their recall is similarly influenced by event importance, as is that of nonreferred children.

However, a different pattern emerges for questions regarding causal relations (Lorch et al., 2000; Sanchez et al., 1999). The extant

literature indicates that school-aged children with ADHD are less sensitive to the causal structure of stories and show poorer performance on causal relations questions than non-referred peers when salient distracters are present (Lorch et al., 2000; Sanchez et al., 1999). This finding indicates that children with ADHD have a more tentative grasp of causal connections than do nonreferred children. Thus, they may have more difficulty understanding how story events are related when their attention is divided. Not surprisingly, children with ADHD appear to have more trouble organizing causal connections among story events into a coherent representation (Sanchez et al., 1999). Specifically, they may have difficulty identifying and understanding causal relations, effectively encoding them, and/or using them to guide later retrieval of story information (Lorch et al., 1998).

Lorch, Diener et al. (1999) used folktales to examine the extent to which the number of causal connections that events had to other events was predictive of later recall. Seventy-one 7- to 11-year-old boys and girls with confirmed diagnoses of combined type ADHD, along with 64 of their peers, were invited to participate in the study. Children with only learning disability diagnoses or significantly low IQ scores were not included. Each story event was coded for the number of causal connections it had to other story events, and transcriptions from sessions were coded for which story events participants recalled. The number of causal connections that events had to other events was predictive of recall for all children, but nonreferred children were found to be more sensitive to story structure. That is, as the number of causal connections to a story event increased, the increase in recall for that event was *steeper* for nonreferred children than for children with ADHD.

Findings from this study suggest that academic interventions placing emphasis on *connections* in text might be a way of sensitizing children with ADHD to the overall structure of a story. Daily instruction of children of elementary school age too often focuses primarily on helping children gain fac-

tual information from lectures or stories, ignoring the importance of how story events are related to one another. Instruction emphasizing causal relations among events might help sensitize children with ADHD to the organizing structure of stories and lectures, and assist them in building more effective representations to guide understanding and recall. One way of sensitizing children with ADHD to the connections among story events might be for teachers to systematically ask students *why* story events occur as information is being presented. These questions of causal relations should help students with ADHD to appreciate that story events have an underlying coherence and are not merely a series of discrete facts.

Using the same folktales and participant recruitment methods as Lorch, Diener et al. (1999), Lorch et al. (2004) examined the effect that studying has on story comprehension and recall among children with ADHD. Thirty-six 7- to 11-year-old children with ADHD and 43 of their nonreferred peers listened to one of two folktales and recalled the story both before and after studying a written version for up to 10 min. Events were presented on separate pages of the study booklet so time spent on each event could be recorded. For both groups, recall increased as the number of causal connections that events had to other events increased, but this effect was stronger for non-referred children than for children with ADHD. Findings indicated that groups did not differ in terms of their observable study behavior. However, when children with ADHD and their nonreferred peers with similar IQ scores were compared on the amount of new information they gained from studying, the former group performed more poorly, especially at the highest levels of causal connections.

The results suggest that simply encouraging children with ADHD to “study more” or relying solely on interventions that facilitate study behaviors (e.g., stimulant medication) may not sufficiently increase the effectiveness of their studying to identify and remember causal relations among events. A more effective strategy might be to teach children with ADHD to study the *connections* among story

events. Study aids could be created that require students to outline the material to be learned in such a fashion that causal connections are highlighted. For example, a guide like a story map that requires the student to fill in major events in sequence could assist him or her in connecting the events and solidifying the overall causal structure of the story. Research employing story maps to help children with ADHD understand causal connections is currently underway by Lorch and colleagues (Lorch et al., 2006). Given that the studying behavior of children with ADHD was similar to that of their nonreferred peers in the Lorch et al. (2004) research, an examination of group differences in cognitive processing while the study period is ongoing might be another fruitful avenue of future research.

Measures of Ongoing Story Comprehension

Only a handful of studies have employed methodologies that measure comprehension of ongoing printed or audiotaped stories by children with ADHD. In one investigation (Milch-Reich, Campbell, Pelham, Connelly, & Geva, 1999), 79 boys, 5–10 years old, with and without combined type ADHD, were asked to tell the story represented by a series of pictures. Narrations were coded for the kinds of events represented in the stories and the causal relations among events. Findings revealed that, regardless of diagnostic group, stories represented a similar number of events. However, children with ADHD employed fewer causal relations in their narratives, indicating poorer understanding of how story events were connected to one another.

In a similar study, Renz et al. (2003) asked 22 boys, 9–11 years old, with confirmed diagnoses of ADHD, and 44 of their nonreferred peers to narrate a wordless picture book. Boys with ADHD were able to produce narratives equal in length to those of nonreferred boys but had difficulties representing some important aspects of the story. Specifically, stories produced by boys in the ADHD group were deficient in two major story grammar categories: completion of the main char-

acter's overall goal and specific attempts made by the main character to reach the overall goal.

Flory et al. (2004) used the same activity employed by Renz et al. (2003) to examine group differences in story narrations of 116 boys and girls, 7–9 years old, with and without ADHD. In addition to narrating the wordless picture books, children completed three tasks assessing the core deficits of ADHD. Results revealed that, although containing as many words as those of nonreferred children, the narratives of children with ADHD included fewer elements relating to causal structure and goal plan. No effects were found for gender.

Character goals and the subgoals that result from unsuccessful attempts to achieve overall goals are aspects of stories that have special importance in understanding causal relations among events. Research has found that children need to comprehend how goals and subgoals lead to actions and story outcomes so they can develop a coherent narrative representation (Trabasso & Stein, 1997). Renz et al. (2003) and Flory et al. (2004) demonstrated that children with ADHD have difficulty maintaining focus on characters' goals as they build a story representation. To remedy this deficiency, instruction should focus on helping these children relate ongoing events to what characters are attempting to accomplish and how characters must change their behavior in response to outcomes that result from unsuccessful attempts to achieve goals. Story maps and similar tools help children understand goals by identifying causes, character actions, and outcomes. Teachers can help students focus on goals by asking questions about character goals, attempts to reach those goals, and the outcomes of those attempts.

The study by Flory et al. (2004) found that the differences in understanding goal structure between children with ADHD and their nonreferred peers could best be accounted for by deficits in ability to sustain attention. To examine how the sustained attentional deficit might relate to the difficulty children with ADHD have in understanding causal relations and goal-attempt-outcome sequences, a technique for gauging ongoing engagement with highly important, plot-relevant informa-

tion is needed. The secondary task provides such a measurement tool.

Secondary Task Paradigm

The secondary task paradigm requires the child to divide cognitive resources between a primary task like television viewing and a secondary task like reacting to an auditory probe. The assumption underlying this methodology is that because mental processing requires time and central processing capacity is limited, the more resources one devotes to the primary task, the fewer that will be available for the secondary task (Lorch & Castle, 1997). Thus, slower or increased reaction times to the secondary task are assumed to reflect deeper processing of or greater cognitive engagement with the primary task. As such, the secondary task contrasts with commonly used measures of sustained attention (e.g., the Continuous Performance Task) that merely require simple reactions to discrete visual stimuli. The secondary task is an especially sensitive measure that can pick up more subtle variations in cognitive engagement and link them directly to changes in the importance of story events.

Findings from research employing the secondary task paradigm with nonreferred children suggest that the developing causal structure of the ongoing story guides the allocation of cognitive resources (Lorch & Castle, 1997). Listeners create mental representations of stories by strategically allocating their attention to highly important, plot-relevant story information. To effectively comprehend a story, listeners must allocate greater engagement with central information and filter out incidental information. The probe task is a secondary task paradigm in which the child's primary activity is to watch a televised story that he or she will later be asked questions about, and his or her secondary task is to turn off auditory probes as quickly as possible while the story is ongoing (Lorch & Castle, 1997). Engagement can be measured at various points within a given segment of central or incidental information through reaction times to auditory probes.

Whirley, Lorch, Lemberger, and Milich (2003) used the probe task to examine the role attentional problems might play in accounting for the story comprehension difficulties experienced by boys with ADHD. Specifically, the study investigated whether ongoing variations in cognitive engagement with a televised story were related to the continuity of central or incidental information. Reaction-time probes were placed at preselected points throughout sequences of central, plot-relevant information. Recruitment and screening procedures similar to those used by Lorch, Diener et al. (1999) were used; 22 boys, 9–11 years old, with ADHD and 36 of their nonreferred peers participated. Findings revealed that nonreferred boys showed the expected linear increase in cognitive engagement (i.e., probe reaction times became slower) as additional important information was provided in the story. In contrast, boys with ADHD did not show the expected slowing in reaction time until relatively late into the central sequences (i.e., after 12 s), and actually exhibited a slight decrease in reaction time as central sequences continued from 7 to 12 s. Thus, as the central information progressed and necessitated deeper engagement, boys with ADHD actually became less engaged. This delay in increasing engagement may have caused the boys with ADHD to miss important connections between events, which might explain the comprehension problems children with ADHD have shown in previous studies and the difficulties they experience in many complex academic tasks.

It is unclear why children with ADHD show a delay in becoming engaged with important story material. One possibility is that they are unable to filter story information quickly enough to determine what is important in time to increase their engagement. Another explanation is that these children do not notice cues that signal the significance of an event. Either way, intervention strategies should focus on helping these children learn what makes an event central versus incidental to a story. Teachers might collect from students'

Table 1
Story Comprehension Research

Study	Groups	Measures	Group Differences	Effect Size r^a
Lorch, Diener et al. (1999)	71 ADHD 64 NR Ages 7–11 Boys & girls	Free recall of folktales	Number of casual connections predicted recall less strongly for ADHD group	.31
Lorch et al. (2004)	36 ADHD 43 NR Ages 7–11 Boys & girls	Free recall of folktales after studying them	For higher IQ group, ADHD group gained less new information from studying	.33
Milch-Reich et al. (1999)	41 ADHD 38 NR Ages 5–10 Boys	Tell a story represented by series of pictures	ADHD group included fewer causal relations in narratives	.36
Renz et al. (2003)	22 ADHD 44 NR Ages 9–11 Boys	Narrate a wordless picture book	ADHD group less likely to include completion of overall goal & specific attempts to reach goal	.41 .41
Flory et al. (2004)	49 ADHD 67 NR Ages 7–9 Boys & girls	Narrate a wordless picture book	ADHD group less likely to include initiating events & completion of overall goal	.25 .15
Whirley et al. (2003)	22 ADHD 36 NR Ages 9–11 Boys	Watch TV show & turn off audio probes	ADHD group failed to become engaged with centrally important information until late into sequences	.40
Walczyk & Hall (1989)	29 reflective 30 impulsive Third- & fifth-graders Boys & girls	Detect inconsistent information in texts	Impulsive readers had more difficulty detecting text inconsistencies	.36

Note. ADHD = attention deficit hyperactivity disorder; NR = nonreferred.

^a F values used to calculate effect size r (Rosenthal, 1994). Large effect, $r = .50$; medium effect, $r = .30$; small effect, $r = .10$.

evidence that a given event is central to the plot of the story by asking questions about how the event is connected with other story events and, more importantly, whether it is related to the main character's overall goal. Asking students to predict future story events based on previous ones may also help prime students to engage with important information.

Story Comprehension Review

Based on this review of the story comprehension literature (see Table 1), it appears that the difficulties exhibited by children with ADHD are particularly evident in regard to their sensitivity to the causal structure of stories (Lorch et al., 1999; Lorch et al., 2004),

their understanding of and sensitivity to causal connections between goals and subsequent action–outcome sequences in stories (Flory et al., 2004; Renz et al., 2003), and their patterns of engagement with continuing, plot-relevant story information (Whirley et al., 2003).

Many of the studies considered found similar levels of visual attention between ADHD and nonreferred samples (Lorch et al., 2000; Whirley et al., 2003), suggesting that the deficits the former group has in understanding causal relations are not because of difficulty in visually attending to the story. Further, school-aged children with ADHD are able to remember a similar amount of factual information as well as their nonreferred peers. In addition, tasks like story narration and secondary task methodologies limit the impact memory deficits have on performance, yet story comprehension difficulties are noted for children with ADHD even when those tasks are employed. Thus, the problems these children have on measures of story comprehension are perhaps because of factors other than deficits in visual attention or memory.

Intervention strategies designed only to overcome deficits in visual attention or to increase the amount of time children spend working on tasks may be insufficient for remedying the story comprehension difficulties children with ADHD have. Although treatment approaches aimed at improving the attending and studying behaviors of children with ADHD might prime them to better understand and remember stories, these methods may not sensitize them to the causal relations among story events. Thus, research is needed to guide the creation of interventions effective at remedying the difficulties in story comprehension experienced by children with ADHD.

To design more effective academic interventions for these children, it is necessary that we examine the skills identified by the educational literature as crucial for success on academic tasks. It might also be beneficial to examine how empirically supported treatments for children with ADHD differ from those interventions found to benefit nonreferred children experiencing academic difficulty, and how future research might guide a

convergence of clinical, cognitive, and educational literatures.

Reading Comprehension

Comprehension instruction researchers (e.g., Brown, 1980) have identified several cognitive processes in which active, thoughtful readers engage, including (a) activating prior knowledge and connecting it to new information, (b) predicting consequences of an action or event, (c) asking questions about the text, (d) monitoring comprehension and taking corrective action when comprehension failures are detected, and (e) recovering from disruptions and distractions. Poor comprehenders might have deficits in their current knowledge base, show difficulty understanding new information they are reading, or have problems connecting the two sources of information. They might fail to ask themselves questions about the text that would aid in understanding and recall. Finally, these children may be less skilled at connecting and integrating story or text information into a mental representation to guide comprehension and recall.

Although not specifically focused on children with ADHD, one study did examine the role impulsivity, a core feature of the disorder, may play in the effective application of comprehension skills. Walczyk and Hall (1989) assessed the comprehension-monitoring abilities of 48 third-graders and 48 fifth-graders classified as “impulsive” versus “reflective” readers based on their Matching Familiar Figures Test performance. Findings revealed that reflective children were better able to detect text inconsistencies than were impulsive children, but there were no group differences in terms of information recall. However, reflective readers did recall more of the information necessary for identifying inconsistencies in the text. The authors argue that the difficulty impulsive readers had monitoring their comprehension is partially owing to their failure to employ any effective strategies for analyzing reading materials. Although the comprehension-monitoring skills of children with ADHD have not yet been subjected to a great deal of research, findings from the

educational literature suggest this could be a fruitful next step toward improving metacognitive awareness in these children.

A number of techniques have been created and studied for their use in improving the reading comprehension of students identified as poor comprehenders. In their research, Cain and Oakhill (1998) discuss three specific processes that account for many of the difficulties poor comprehenders experience: inferencing ability, use of text structure, and comprehension monitoring. Inferencing ability and understanding of text structure are both crucial for creating mental representations of stories because they guide the allocation of cognitive resources and promote comprehension of text information. Monitoring comprehension is a critical step towards ensuring that all important story information is incorporated into the ongoing mental representation used to guide recall and understanding of a story.

Strategy Training in Reading Comprehension

Training students with ADHD to use inference-making and self-questioning strategies may be a way to remedy the story comprehension difficulties they experience. These two approaches appear to directly target many of the complex cognitive processes involved in reading comprehension because they focus on causal connections among story events and the overall causal structure of stories.

Training in inference making. Inferential processing allows students to make sense of information implied in text, and often requires making connections between previous knowledge and new information, or among text events. Inference making helps not only with understanding of text but also with recall of text information (Yuill & Oakhill, 1991). Consequently, it is an important process for connecting events in text and integrating text information to form a mental representation.

McGee and Johnson (2003) examined the effects of training 75 children, 6–9 years old, classified as “skilled” versus “less-skilled” comprehenders in inference-making techniques. The findings revealed that training

in inference making was superior to standard comprehension strategies for helping less-skilled comprehenders understand the story. This study and others suggest that, given appropriate instruction, children with deficits in understanding connections among story events may learn how to use context and prior knowledge to improve their comprehension and recall skills.

Another approach for helping students with ADHD learn to emphasize causal relations is to provide them with the opportunity to practice drawing inferences from text. From any given event, causal relations can connect backward to explain past occurrences or lead forward to produce future events, and anticipating consequences of events has been shown to be a better predictor of overall story recall than making backward connections (van den Broek et al., 1997). Thus, teaching and encouraging students with ADHD to predict later story events may be particularly critical in helping children grasp causal relations. To train students with ADHD in metacognitive awareness about predictions, teachers could engage them in evidence-gathering processes. Following the formation of a prediction, teachers might ask students to list the evidence based on previous events and prior knowledge that the predicted event will occur. If the expected event does not occur, students should reexamine their evidence to determine why their prediction was not confirmed.

Training in self-questioning. A second strategy that helps to promote in-depth processing of texts is self-questioning. Skilled readers ask themselves questions about texts and about their own understanding of texts. Answering those questions helps the reader develop a richer, more in-depth understanding of story events and the connections among them. In addition, self-questioning assists the reader in identifying where comprehension has failed, allowing him or her to remedy the difficulties before more confusion occurs. Asking questions about text propels the reader forward and makes discontinuation of reading less likely.

Research has supported the use of self-

questioning strategies to improve the reading comprehension of school-aged children classified as poor comprehenders (Hansen, 1981). A meta-analysis of 68 studies designed to improve reading comprehension in students with learning disabilities (Mastropieri, Scruggs, Bakken, & Whedon, 1996) found that interventions including a self-questioning component resulted in greater improvement than instructional approaches that did not include self-questioning. Consequently, Mastropieri and Scruggs (1997) identified self-questioning strategies as among the best practices for facilitating reading comprehension of students with learning difficulties.

Learning to use effective comprehension-monitoring strategies might help children with ADHD recognize the gaps in their understanding of how text and lecture events are connected to one another. Explicit training in strategies for filling in those gaps, once identified, will further aid these children in creating more complete story representations. Self-questioning about comprehension is one strategy found effective at promoting comprehension monitoring. Teacher modeling of simple, comprehension-related questions might help students with ADHD learn to recognize when comprehension failures occur. Training in strategies like rereading, note taking, and summarizing will assist children in repairing gaps in comprehension.

Multiple strategy training. Several studies have supported the use of multiple strategy training for improving reading comprehension. For example, Hansen (1981) trained 24 second-graders to use inference-making and self-questioning strategies. Findings revealed that students who received training exhibited superior understanding of the story, as evidenced by their performance on comprehension questions. In a series of studies, Palinscar and Brown (1984) included self-questioning and inference-making training in a multiple strategy approach taught to seventh-graders identified as poor comprehenders. Compared to a typical classroom teaching method, the experimental approach led to improvement in children's ability to summarize

important information from the story and to ask relevant questions to help with comprehension and recall.

Integration of Clinical, Cognitive, and Educational Literatures

Although a good deal of research has demonstrated the positive impact of training in comprehension strategies for nonreferred, less-skilled readers, very few strategies have been studied specifically for use with an ADHD population. As mentioned previously, current empirically validated treatments for children with ADHD are stimulant medication and behavior modification. Such interventions have demonstrated efficacy for improving some of the academic problems these children experience. For example, these treatments have been found to decrease disruptive behavior and increase the quantity of academic work produced. However, the impact of medication on performance of complex academic skills like comprehension of complex texts and skill acquisition has not been established.

In an early study, Conrad, Dworkin, Shai, and Tobiesson (1971) found that neither treatment with a stimulant medication (i.e., dextroamphetamine) alone nor in combination with perceptual-cognitive tutoring had any effect on the academic achievement of children with ADHD. More recently, the Multimodal Treatment Study of Children with Attention Deficit Hyperactivity Disorder (The MTA Cooperative Group, 1999), a 14-month randomized clinical trial of treatment strategies for children with ADHD, compared medication management, behavioral treatment, medication and behavioral treatment together, and standard community care in 579 children with the combined type of the disorder. Findings revealed that even the best-practices combination of stimulant medication and behavioral modification did not normalize the functioning of these children. According to the consensus statement issued by this group, stimulant medication is effective in improving the core symptoms of ADHD but has limited effects on academic achievement.

Table 2
Proposed Academic Interventions for Children With ADHD

Area of Deficit	Proposed Intervention
Using causal connections to guide recall of stories & understanding causal structure of stories (Lorch et al., 2000; Lorch, Diener et al., 1999; Milch-Reich et al., 1999; Whirley et al., 2003)	Ask students <i>why</i> events occur as story information is presented Train students in inferencing to help them use prior knowledge & text information in understanding stories Teach students prereading, listening, & studying strategies to prepare them for upcoming important story events & connections among events
Using causal connections to guide recall of story information while studying (Lorch et al., 2004)	Have students complete causal relations comprehension questions while studying
Understanding importance of goals & subgoals in stories (Renz et al., 2003; Flory et al., 2003)	Guide student practice in identifying & focusing on goal–action–outcome sequences in stories
Creating & understanding inferences	Give students practice drawing inferences & engaging in evidence gathering to support them
Monitoring comprehension & recognizing when comprehension has failed (Berthiaume, 2005; Walczyk & Hall, 1989)	Train students in self-questioning to gauge understanding during task Instruct students in using self-questioning strategies to monitor ongoing comprehension
Practicing & employing comprehension strategies	Reinforce student effort in learning & using comprehension strategies Give students meaningful texts to read & present information as to the purposes of reading

More specifically related to story comprehension, Francis, Fine, and Tannock (2001) asked 50 children with confirmed diagnoses of combined type ADHD to retell stories they had heard and seen as wordless picture books, both on and off stimulant medication. Findings revealed that although children more often reported story characters' internal responses and attempts while on methylphenidate, the medication had no effect on their inferential comprehension performance. Thus, stimulant medications and behavioral modification programs may *prime* children with ADHD to perform complex cognitive tasks by helping them focus and attend. However, there is research to suggest that children with ADHD exhibit academic and story comprehension deficits that are not remedied by stimulant medication or behavior

modification. As Rabiner and Coie (2000) hypothesized in their study of reading achievement, children with attentional problems may have trouble acquiring new reading skills and catching up on reading skills they have failed to acquire. This may be the case even when visual attention and on-task behavior have improved.

New academic intervention strategies may need to be created to assist children with ADHD in making connections among events and using those connections to form coherent representations of lectures and texts. Many of the comprehension strategies used successfully for nonreferred children with academic difficulty emphasize integrating information from text and from previous knowledge into mental representations of story and text events. Unfortunately, despite the obvious ac-

ademic difficulties children with ADHD exhibit, very little research has examined use of interventions supported in the educational research literature with this group.

Academic Intervention for Children With ADHD

Children with ADHD are typically treated with interventions aimed at improving their behavior and visual attention, but not their story comprehension skills. Also, academic skill remediation strategies are generally not implemented in the regular classroom (Pressley, 2002). Thus, it appears that many of the cognitive deficits exhibited by children with ADHD in studies of their story comprehension are not being adequately addressed at this time. The significant impact of comprehension strategy training on nonreferred, less-skilled comprehenders suggests that the difficulties children with ADHD have in these areas also might be improved through remediation. Table 2 presents many of the story comprehension difficulties children with ADHD appear to exhibit, the studies documenting those findings, and proposed interventions for remedying the deficits.

Unfortunately, the treatment literature rarely, if ever, recommends interventions that focus on training children with ADHD to enhance their representation of story information by using causal relations. This omission is explained by the fact that very little research has tied together findings from the clinical, cognitive, and educational research literatures to examine how the cognitive-processing skills of children with ADHD differ from those of their classmates. Further, research has not investigated how children with ADHD might benefit from receiving strategy instruction that emphasizes understanding causal relations. Research suggests that current empirically validated treatments for children with ADHD may not improve some aspects of academic performance (Conrad et al., 1971; Francis et al., 2001; The MTA Cooperative Group, 1999). Thus, a move toward use of strategies that target deficits in story comprehension skills could be a crucial next step. Educational intervention will work best in con-

junction with the treatments currently recommended for children with ADHD, as the symptoms of the disorder are likely to interfere with children's ability to attend to, retain, and practice techniques for improving comprehension skills.

Reinforcing Comprehension Strategies for Children With ADHD

Given that many children with ADHD experience low frustration tolerance and motivational difficulties, it will be important to enlist their cooperation if strategy training is to be undertaken in addition to their regular schoolwork. A number of methods may help children with ADHD "buy into" these interventions. Applying a reinforcement system for promoting the use of comprehension and comprehension-monitoring strategies is a necessary step. In addition, several researchers suggest that children will be more motivated to improve their performance *outcomes* (i.e., test scores, and so on) if teachers praise them for engaging in learning *processes* like metacognitive strategies (Gaskins & Gaskins, 1997). For example, a student who asks himself *why* a story event occurred following strategy training should be reinforced for attempting to make connections between events. Similarly, a student who looks back to an earlier part of a story to understand something she has just read should be reinforced for using effective comprehension-monitoring skills. To make the intervention rewarding, students with ADHD should be reinforced both for improvements in performance and for effectively *engaging* in strategy training. Explaining to these students the purpose of a task may be a key step toward increasing motivation and task persistence. Students will be more likely to put effort into comprehending texts that are relevant to their lives and interests, and will be better able to understand texts when they already hold some relevant knowledge.

Future Directions in Academic Intervention for Children With ADHD

An important area of future research is determining the causes of and contributing factors to the difficulties children with ADHD

exhibit in tasks like story comprehension. Specifically, strong evidence indicates that these children have deficits in their executive functioning abilities like planning, directing behavior towards a goal, and mentally manipulating information (i.e., working memory). Several researchers have identified problems with working memory as a central deficit of ADHD (Barkley, 1997; Rapport, Chung, Shore, & Isaacs, 2001), and the educational research literature suggests that working memory limitations contribute to the comprehension problems experienced by less-skilled, nonreferred children (Yuill & Oakhill, 1991). Given that skills involved in story and text comprehension place great demand on children's working memory, working memory deficits are certain to have a negative impact on reading and listening comprehension (Lorch et al., 1998; Lorch, Diener et al., 1999). Additional research is needed to examine whether strategy training in nonreferred populations works to improve text comprehension through reduction of the burden placed on working memory (Yuill & Oakhill, 1991). If so, future studies should consider ways to reduce the constraints placed on story or text comprehension by working memory limitations in children with ADHD.

It has been argued elsewhere that children with the predominantly inattentive type of ADHD have a different set of deficits from their counterparts exhibiting both inattention and hyperactivity-impulsivity (Milich et al., 2001). Thus, it is not clear whether these two conditions should be considered subtypes of the same disorder. This article has focused on children with the combined type of the disorder and it is possible that findings reviewed here do not apply to children with the predominantly inattentive type of ADHD. Examining gender differences in story comprehension and academic skills of children with ADHD is another important avenue for research. At the current time, relatively little is known about girls with ADHD and how their cognitive deficits might differ from those of their male peers. Children with combined type ADHD often have diagnoses of learning disability as well, and it is unclear to what extent story

comprehension deficits may be caused by comorbid learning problems. Future research should attempt to further distinguish between the problems associated with the two disorders. On a more practical note, children exhibiting difficulty in understanding causal relations would greatly benefit from academic intervention, regardless of which diagnosis is most prominent.

Future research is critical for better understanding the effects that current ADHD treatments have on reading comprehension, and for clarifying how interventions from the educational research literature will transfer to an ADHD population. First, we need to identify the reading comprehension skills on which children with ADHD exhibit deficits. Specifically, researchers should consider how these children perform on tasks like creating inferences and using self-questioning strategies to monitor ongoing comprehension. One next step would be to examine how specific components of story comprehension relate to these deficits. Investigating these connections can allow for the creation of assessment measures that specifically pinpoint the comprehension difficulties experienced by children with ADHD. Measures employed to diagnose ADHD might begin to evaluate skill in making connections among events, creating inferences, and monitoring comprehension. It will also be important to explore how story comprehension predicts aspects of academic achievement at different developmental periods.

Once research has identified ways children with ADHD differ from their same-aged, nonreferred peers in terms of academic and story comprehension skills, strategies that promote understanding of causal relations and comprehension of stories can be modified for this population. The next step is for research to examine whether children with ADHD can be trained successfully to use those strategies. Special attention should be paid to interventions that reduce the working memory demands made by story comprehension tasks, as these are likely to have the best success. Positive reinforcement may facilitate instruction in and promote the use of comprehension strategies.

Conclusion

Even under optimal conditions in which visual attention is high and comparable to that of nonreferred children (e.g., one-on-one testing) children with ADHD have difficulty with certain story comprehension tasks. Findings from this literature review suggest that we may not be able to account for all of the academic problems experienced by children with ADHD simply by examining whether they appear to be attending (e.g., looking at TV). Current empirically validated treatments are aimed at increasing simple attention and decreasing problematic behavior. However, these methods do not appear to positively influence academic achievement in children with ADHD and we must be open to other types of intervention. The educational research literature offers numerous strategies shown to improve reading comprehension in less-skilled, nonreferred children. To the extent the story comprehension difficulties experienced by children with ADHD (e.g., understanding causal relations) are related to reading comprehension skills like creating inferences and monitoring comprehension, training in comprehension strategies may prove useful and result in academic performance improvements. Once problem areas are identified, research should focus on examining the potential benefits of strategy training with the ADHD population.

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