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Association Between Story Recall and Other Language Abilities in Schoolchildren With ADHD

Christina F. Papaeliou[1], Katerina Maniadaki[2], and Efthymios Kakouros[2]

Abstract

Objective: The present study aimed to investigate the effect of working memory, vocabulary, and grammar on narrative comprehension in children with ADHD. **Method:** Participants were 25 schoolchildren with ADHD and 25 typically developing (TD) children matched for chronological age and performance IQ. Children were assessed with the Wechsler Intelligence Scale for Children-Third Edition (WISC-III), a verbal IQ test, and a story recall task. **Results:** It was shown that children with ADHD recall less information from the stories than did TD children, while they are less sensitive to the importance of the information they recall. Moreover, it was found that children with ADHD experience problems in answering factual questions. Further analysis revealed that deficiencies in narrative comprehension may be accounted for by problems in working memory. **Conclusion:** The discussion focuses on the role of working memory in narrative comprehension and the implications of these findings for intervention approaches. *(J. of Att. Dis. 2015; 19(1) 53-62)*

Keywords

vocabulary, grammar comprehension, grammar production, story recall, ADHD

ADHD is the most common psychiatric disorder diagnosed in childhood (American Psychiatric Association [APA], 2000; Kakouros, Tzima-Tsitsika, Tsitsika, & Balourdos, 1996; Polanczyk et al., 2007). The prevalence of ADHD in Greece is estimated between 5% and 11% (Kalantzi-Azizi, Ageli, & Efstathiou, 2005), falling into the range observed in children from diverse cultures (APA, 2000; Szatmari, Offord, & Boyle, 1989a). The core symptoms of ADHD include difficulties in sustaining attention, inhibiting activity levels, and maintaining impulse control that are more frequent and severe than is typically observed in individuals of a particular developmental level. It is strongly suggested that the core symptoms of ADHD may be accounted for by deficits in the neurological mechanisms regulating executive functions (Castellanos et al., 1996; Schneider et al., 2010).

In addition to the primary deficits, children with ADHD exhibit a number of accompanying problems in language development and academic functioning. They exhibit 50% deficiencies in language, and they are found to be approximately 5 times more likely to be delayed in the onset of language (as assessed by the appearance of first words and short sentences) compared with typically developing (TD) children (Hartsough & Lambert, 1985; Ornoy, Uriel, & Tennenbaum, 1993; Szatmari, Offord, & Boyle, 1989b; Tirosh & Cohen, 1998). Moreover, most children with ADHD may experience difficulties of several degrees of severity throughout their school years in the acquisition of reading, writing, and mathematics, and have an increased risk to underachieve at school, fail to complete high school, or be placed in special education classes (Barkley, Fischer, Smallish, & Fletcher, 2006; Cantwell & Baker, 1991; DeShazo-Barry, Lyman, & Grofer-Klinger, 2002; Fischer, Barkley, Edelbrock, & Smallish, 1990; Maniadaki & Kakouros, 2011; Maniadaki, Kakouros, & Karaba, 2010; Murphy, Barkley, & Bush, 2002; Weiss & Hechtman, 1993). In Greece, learning disabilities are the primary reason for referral during school years among children diagnosed with ADHD (Kakouros et al., 1996).

It is now well documented that successful academic performance depends highly on the development of certain language domains such as vocabulary knowledge, comprehension of complex sentences, and comprehension of narratives. Numerous studies have demonstrated the importance of word knowledge in reading comprehension (Baker et al., 1995; Nagy, 1988; Nelson-Herber, 1986). Activation of the

[1]University of the Aegean, Rhodes, Dodecanese, Greece
[2]Technological Educational Institute of Athens, Greece

Corresponding Author:
Christina F. Papaeliou, Miltiadou St., 39, 175-63, P. Faliro Athens, Greece.
Email: papailiou@rhodes.aegean.gr

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meaning of a word may give a feedback to orthography, thus, facilitating word recognition (Assink, Van Bergen, Van Teeseling, & Knuijt, 2004; Seidenberg & McClelland, 1989). Comprehension of increasingly complex instructions and rules, which govern all domains of academic knowledge and are expressed through complex sentences, constitutes another prerequisite for successful academic performance (Wassenberg et al., 2010). Other studies demonstrate that early comprehension of narratives is a predictive factor for later academic performance beyond semantic and syntactic skills (Feagans & Applebaum, 1986; Shatil & Share, 2003; Storch & Whitehurst, 2002). The ability to build a complete and coherent story representation requires, apart from sustained and focused attention, higher order cognitive processes such as selection, encoding, interpretation, and retrieval of relevant information, utilization of story structure and background information, drawing inferences from the information presented as well as determining the causes, goals, and effects of certain story events (Ackerman, Silver, & Glickman, 1990; Lorch, Berthiaume, Milich, & van den Broek, 2007; Trabasso & Nickels, 1992).

Thus, the nature and extent of the deficiencies exhibited by children with ADHD in vocabulary knowledge, comprehension of complex sentences, and comprehension of narratives may, at least partly, account for their difficulties in academic functioning. Some studies have examined each of these domains of language development separately. Kim and Kaiser (2000) investigated semantic and syntactic abilities, among other variables, in 11 children with ADHD, in comparison with 11 TD children aged 6 to 8 years. Their findings showed that children with ADHD performed worse than TD children on sentence imitation and word articulation as measured by the Test of Language Development–2 Primary (TOLD-2). Moreover, children with ADHD received significantly lower scores than TD children on the composite quotients of spoken language (including picture vocabulary, oral vocabulary, sentence imitation, grammatical understanding, grammatical completion, word discrimination, and word articulation) and speaking (including oral vocabulary, sentence imitation, grammatical completion, and word articulation). However, the two groups did not differ significantly in receptive vocabulary skills, as measured by the Peabody Picture Vocabulary Test–Revised (PPVT-R) and the TOLD-2, oral vocabulary, word discrimination, grammatical understanding, grammatical completion, and the composite quotients of listening, semantics, and syntax. The authors conclude that children with ADHD are more likely to have problems with expressive language rather than receptive language.

Korkman, Kirk, and Kemp (1998) administered the subtest "Comprehension of Instructions" of the NEPSY (A Developmental NeuroPsychological Assessment) in 50 schoolchildren with ADHD (*M* age = 8.7 years). The subtest asks children to point to desired objects, for example, "a shape that is not a circle, but is yellow or black." The results revealed that children with ADHD performed significantly less accurately than their matched peers on the comprehension of these sentences. However, a more recent study by Wassenberg and colleagues (2010) showed that children and adolescents with ADHD understand complex sentences as accurately as TD children, but they are impaired in the speed of complex sentence comprehension.

Comprehension of narratives has been studied more than semantics and syntax in children with ADHD. A review of the relevant literature reveals that children with ADHD show deficits in several aspects of story comprehension. Specifically, children with ADHD experience problems in understanding causal relations, difficulties in using the goal structure to form a representation of the story, and deficiencies in global coherence, defined as the degree to which the narration is understandable to the listener as well as problems in making inferences and monitoring ongoing comprehension (Bailey, Lorch, Milich, & Charnigo, 2009; Berthiaume, Lorch, & Milich, 2010; Lorch et al., 2000; Lorch et al., 2007; Renz et al., 2003). One aspect that has particularly attracted researchers' interest is the effect of thematic importance of story events in recall. Thematic importance is conceptually and empirically related to sensitivity to the causal structure of the story. Trabasso and Sperry (1985) suggested that judgments of thematic importance are affected by the number of direct causal connections and the appearance of an event in the causal chain from the opening to the closing of the story.

One of the first studies addressing this issue was carried out by Tannock, Purvis, and Schachar (1993) in 30 boys with ADHD aged 7 to 11 years, compared with a control group. Although the sample was not divided by ADHD subtype, the authors report that 6 participants received concurrent diagnosis of oppositional defiant disorder and 6 received a concurrent diagnosis of conduct disorder. Participants listened to two audiotaped stories without having the opportunity to read them. The thematic importance of each event in each story had been previously rated by adults. Results indicated that although boys with ADHD recalled fewer story events compared with the TD group, they did not differ in the ability to comprehend and extract the main ideas from the stories. Nevertheless, different results are reported by Lorch et al. (1999) who used the same methodology to examine recall as a function of perceived importance in 69 children with ADHD–combined type and 62 children in the comparison group aged 7 to 11 years. ADHD children showed significantly less sensitivity to the importance level and remembered less story events than did TD children. These findings were replicated in a study by Lorch and colleagues (2004), where children were asked to recall a story in two successive conditions: after listening to it and after reading it. Using a different methodology, Flake et al. (2007) investigated the recall of televised stories in preschoolers (4-6 years) and schoolchildren (7-9 years) with ADHD–combined type under two different viewing conditions: in

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one condition the child was told that a TV program was coming on for them to watch and that he or she would be asked about what he or she saw, when the program was over. In addition, the child was told that he or she could play with toys placed in front of him or her during the program. In the other condition, no toys were presented. According to the relevant literature, this methodology has been shown to be an effective way to manipulate attention (Flake et al., 2007). Children with ADHD recalled less information from the stories than did children in the comparison group and they were found to be less sensitive to the importance of the information they recalled. Although their recall did increase as the importance of the material to the overall meaning of the story increased, the rate of increase was not as steep for the children with ADHD as for the TD children.

Another factor that was examined in this study was verbal working memory. Working memory constitutes one aspect of executive functioning, which has been shown to be impaired in ADHD. Current models specify two functional components of working memory: one for short-term maintenance of information and the other for manipulation of information during complex cognitive tasks. The maintenance component is further separated into the phonological loop, which maintains verbal information and the visuospatial sketchpad, which maintains visuospatial information. Current studies on normal discourse processing emphasize the role of working memory in narrative comprehension (Zwaan & Radvansky, 1998). However, there are relatively few studies examining this relationship in children with ADHD. McInnes, Humphries, Hogg-Johnson, and Tannock (2003) investigated listening comprehension and working memory abilities in children with ADHD, with and without language impairment. Children completed tests of basic language and cognitive skills, verbal, and spatial working memory. Narrative comprehension was assessed in a task where children listened to a standardized narrative and an expository passage. An important finding of this study was that children with ADHD show impairments in narrative comprehension irrespective of language impairments.

Despite the fact that comprehension of narratives plays a crucial role in children's academic performance, studies so far focused on the description of the deficiencies exhibited by children with ADHD, whereas they have not systematically examined the role of working memory as well as more fundamental aspects of language, such as semantics and grammar on narrative comprehension. The authors suggest that addressing this issue may further highlight the linguistic and cognitive processes that may contribute to the academic difficulties exhibited by children with ADHD, thus, facilitating the planning of more effective intervention strategies.

Taking into account the previously mentioned considerations, the present study has a twofold purpose: (a) to contribute to the literature on vocabulary production, comprehension, and production of grammar and story recall in schoolchildren with ADHD and (b) to examine the influence of working memory and semantic and grammatical abilities on story recall in this population.

Method

Participants

Participants in this study were 25 primary schoolchildren with ADHD–combined type (17 boys and 8 girls) and 25 TD primary schoolchildren (16 boys and 9 girls). Children in the ADHD group were selected from private and public centers for developmental disabilities in Athens, Greece, where they were attending an individual intervention program for less than 3 months. Children of the TD group were selected from public schools in different areas of Athens, so as to be representative of different socioeconomic backgrounds (professional middle class, middle class, working class). Only children who were Greek speakers from monolingual homes were included in this study. None of the participants had a diagnosis of any medical problem. Moreover, participants were selected so as not to have a medication history, to avoid any effects medication might have in their performance. The two groups were matched for chronological age ($t = 1.19$, $p = .237$, $df = 48$) and performance IQ ($t = 1.23$, $p = .256$, $df = 48$; Table 1). The performance IQ was assessed using the Greek version of the WISC-III (Georgas, Paraskevopoulos, Bezevegis, & Giannitsas, 1997). Written permission was obtained from the parents before the children's participation in the study.

The diagnosis of ADHD was made by experienced clinicians, based on structured interviews with parents and child, clinical examination of the child, and information provided by parents with the completion of the ADHD Rating Scale–IV (DuPaul, Power, Anastopoulos, & Reid, 1998). Clinicians interviewed the child and the parent(s) to note whether children met the criteria for ADHD–combined type according to the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; APA, 1994), that is, if six criteria for inattention and six criteria for hyperactivity/impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level. The ADHD Rating Scale-IV is a standardized behavior checklist for diagnosing ADHD in children and adolescents based on the *DSM-IV* diagnostic criteria. It has been translated into Greek and standardized for use with Greek population (Kalantzi-Azizi et al., 2005). The ADHD Rating Scale–IV can be completed in 5 to 10 min by parents or teachers. In the present study, it was completed by the parents and the two groups showed significant differences in ADHD quotients ($t = 8.3$, $p < .001$, $df = 48$). According to the clinical examination, children with ADHD did not meet the criteria for any other developmental disorder.

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Table 1. Data on Chronological Age, Performance IQ, and ADHD Quotient for the ADHD Group and the TD Group.

	Age			PIQ			ADHD Rating Scale–IV		
	M	Range	*SD*	*M*	Range	*SD*	*M*	Range	*SD*
ADHD (*n* = 25)	8.5	6.1-11.4	1.4	99.0	81-119	16.6	25.1	4-42	8.9
TD (*n* = 25)	9.1	6.1-11.1	1.4	106.6	83-127	11.9	7.3	0-20	6.6

Note: TD = typically developing.

Measures

Working memory. The Freedom for Distractibility Index (FDI) is a measure of attention, concentration, and working memory. It was originally defined by Sattler (1988), and it includes Arithmetic and Digit Span. These tasks require working memory processes applied to the manipulation of orally presented verbal sequences.

Verbal IQ Test (VIQ). The VIQ (Stavrakaki & Tsimpli, 2000) is a standardized measure used to assess receptive and expressive language abilities in individuals aged 3 to 15 years. The VIQ was used instead of the language scales of the WISC-III, because the latter focuses on the semantic aspects of language, whereas the VIQ also includes morpho-syntactic aspects. The VIQ uses black-and-white pictures and consists of the following subtests:

- Vocabulary Production (VP): assesses the ability to name objects or actions presented in pictures (maximum score 27)
- Grammar Comprehension (GC): assesses the ability to understand sentences by choosing which picture from three options represents a spoken sentence (maximum score 56)
- Grammar Production (GP): assesses the ability to complete a partially formed sentence by supplying a final word that has a proper morphological form, according to a previously presented paradigm (maximum score 24)
- Recall of Syntactic Structures (RSS): assesses the ability to repeat complex sentences accurately (maximum score 51)

Story recall. The stimulus material for this task was the folktale *The Father, His Son, and Their Donkey*. This story contains 376 words, multiple characters, and sequences of events that make it too detailed to be recalled verbatim. The story was unfamiliar to the children in the study but it had been used in prior studies on story recall in TD children (Brown, Day, & Jones, 1983; Brown & Smiley, 1977) as well as in children with ADHD (Purvis & Tannock, 1997). The story was read by a female researcher and was audio-recorded. The recording lasted 2 min and 40 secs. At the beginning of the session, the researcher gave the child the following instructions: "Now you will listen to a story. Pay attention because, when it finishes, I will ask you to tell me the story and answer some questions." In the presence of the researcher, the child listened to the recorded story, but he or she did not have the opportunity to see any pictures related to the story or to read the story. Following a procedure described in Brown and Smiley (1977), the story was divided into individual units. An individual unit was defined as one that contains an idea and/or represents a pausal unit, that is, a place where a reader might pause. Ten graduate psychology students were asked to read the story thoroughly and then divide it into individual units by placing a vertical line at a division point. Cohen's kappa for intrarater reliability was .85 and for interrater reliability was .80.

At a following stage, the students rated each unit on a 4-point scale for its importance to the structure at the theme of the story as a whole. In this procedure, intrarater reliability was .81 and interrater reliability was .75. The story was divided into 56 individual units that were distributed at the importance levels as follows: (a) 13 individual units in Importance Level 1 (maximum score: 13), (b) 13 individual units in Importance Level 2 (maximum score: 26), (c) 14 individual units in Importance Level 3 (maximum score: 42), and (d) 16 individual units in Importance Level 4 (maximum score: 64). Story retelling was assessed using two measures: (a) Selective recall: This was defined as the proportion of idea units correctly recalled at each of the four levels of importance. This measure reveals the pattern of recall rather than the absolute amount and represents the ability to focus on important aspects of the story rather than on nonessential material. (b) Responses to Factual Questions: Children were asked to respond to five factual questions that were derived from units of information central to the theme of the story. Each question was rated as correct (score 2), partially correct (score 1), or incorrect (score 0), yielding a maximum score of 10.

Results

Group differences in the FDI, the VIQ, and the story recall task were calculated using MANOVA. The MANOVA examines the effect of one or more independent variables

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Table 2. Performance of the ADHD Group and the TD Group on the VIQ Test and the Story Recall Task.

	ADHD		TD				
	M	*SD*	*M*	*SD*	*F*	*p*	η^2
FDI	22.9	2.9	19.3	3.6	5.54	.023*	0.102
Vocabulary production	19.5	2.6	19.5	2.2	0.02	.891	<0.000
Grammar-comprehension	48.2	4.4	52.9	1.6	16.9	<.00**	0.256
Grammar-production	16.9	2.7	16.3	3.0	0.20	.653	0.004
Sentence recall	49.9	1.4	51.3	0.5	5.13	.028*	0.095
Importance Level 1	2.2	2.4	2.3	1.7	0.11	.742	0.002
Importance Level 2	5.5	4.7	7.3	4.4	2.06	.156	0.041
Importance Level 3	14.7	10.6	19.9	9.0	3.73	.059	0.071
Importance Level 4	15.4	13.3	27.2	13.8	9.86	.003**	0.168

Note: TD = typically developing; VIQ = Verbal IQ Test. *df* = 1.
*$p \leq .05$. **$p \leq .01$.

on more than one dependent variables controlling for Type I error. Results are presented in Table 2.

FDI and VIQ

Compared with the TD group, the ADHD group performed significantly lower in the FDI, the GC Test and the Sentence Recall test. However, the two groups did not show any significant differences in the subscales of VP and GP (Table 2).

Story Recall

As regards group differences, the MANOVA revealed that children with ADHD recall significantly less story units of Importance Level 4 than TD children. Although children with ADHD tended to recall less story units of Importance Levels 2 and 3 compared with TD children, these differences were not statistically significant.

The analysis for the recall pattern showed that in the ADHD and the TD groups, the amount of information recalled increased as the importance level increased, $F(1, 48) = 64.2$, $p < .001$. Differences in the amount of units recalled between importance levels were calculated using a paired-samples *t* test controlling for repeated measures. Results showed that the ADHD group recalled significantly more units of Importance Level 4 than units of Importance Levels 1 and 2, $t = -6.39$, $p < .001$, and $t = -5.53$, $p < .001$, respectively, significantly more units of Importance Level 3 than units of Importance Levels 1 and 2, $t = -8.14$, $p < .001$, and $t = -6.69$, $p < .001$, respectively, and significantly more units of Importance Level 2 than units of Importance Level 1, $t = -6.16$, $p < .001$. However, there was no significant difference in the recall between units of Importance Levels 3 and 4, $t = -0.24$, $p = .815$. Similarly, the TD group recalled significantly more units of Importance Level 4 than units of Importance Levels 1, 2, and 3, $t = -7.60$, $p < .001$; $t = -6.49$, $p < .001$; and $t = -3.12$, $p = .007$, respectively, significantly more units of Importance Level 3 than units of Importance Levels 1 and 2, $t = -8.26$, $p < .001$, and $t = -8.71$, $p < .001$, respectively, and significantly more units of Importance Level 2 than units of Importance Level 1, $t = -5.05$, $p < .001$. However, there was a significant interaction between the group and the linear component of importance level, $F(1, 48) = 6.26$, $p = .006$, which shows that as importance level increases recall increases less in children with ADHD compared with TD children (Figure 1).

Children's total scores on the five factual and inferential questions were classified in three groups: 0-3 = low, 4-6 = moderate, and 7-10 = high. The findings revealed that 8 (32%) children with ADHD compared with 2 (8%) TD children received low scores, 12 (48%) children with ADHD compared with 11 (44%) TD children received moderate scores, and 5 (20%) children with ADHD compared with 12 (48%) TD children received high scores. These differences were statistically significant ($\chi^2 = 6.53$, $df = 2$, $p = .038$).

The effects of working memory, semantics, and syntax on story recall were investigated. As a first step, the correlation of each importance level with the FDI and the subscales of VP, GC, GP, and Sentence Recall was calculated using the Pearson *r* (Table 3). The results showed that all importance levels were significantly positively correlated with GC and GP. Moreover, Importance Levels 2, 3, and 4 were significantly positively correlated with Sentence Recall. In addition, Importance Level 4 was significantly positively correlated with the FDI (Table 3).

Then a stepwise multiple regression analysis was conducted, with dependent variable Importance Level 4 (where the two groups demonstrated significant differences) and independent variables (the measures that correlated significantly with this importance level). According to the findings, the recall of units of Importance Level 4 was predicted by GP ($\beta = .471$, $p < .001$) and the FDI ($\beta = .376$, $p = .002$).

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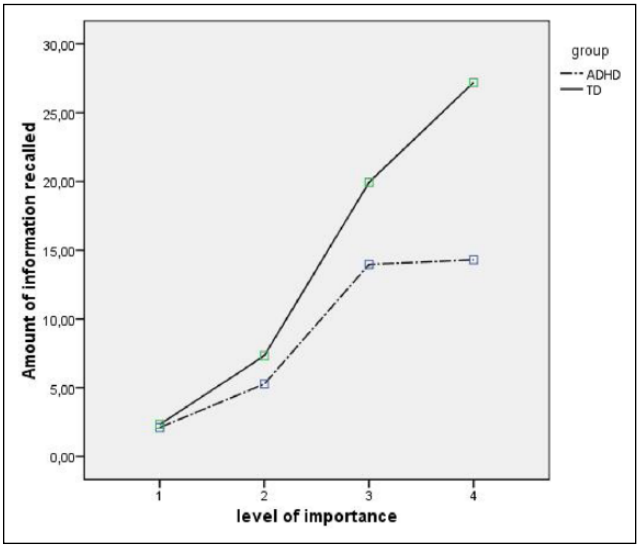

Figure 1. Amount of information recalled at four different importance levels for children with ADHD and TD children
Note: TD = typically developing.

Given that the two groups differed significantly only in the FDI, it seems that their difference in the ability to recall units of Importance Level 4 may be explained by this factor.

Moreover, the correlation of Factual Questions with the FDI, the subscales of VP, GC, GP and Sentence Recall, and each importance level were calculated (Table 4). Results demonstrated that the Factual Questions were significantly positively correlated with GC, GP, Sentence Recall as well as with all importance levels. However, the stepwise multiple regression analysis revealed that the score on Factual Questions was predicted only by the recall of Importance Level 4 ($\beta = .489$, $p < .001$).

Discussion

The present study investigated aspects of working memory, semantics, and syntax as well as their effect on narrative comprehension in schoolchildren with ADHD, in comparison with TD children. Participants were assessed on the Working Memory Index of the WISC-IV, a VIQ, and a story recall task. An important finding of this study was that children with ADHD exhibit deficiencies in verbal working memory, GC, and sentence recall. However, expressive vocabulary and the ability to produce grammatically correct sentences is relatively spared in this sample of children with ADHD.

It is well documented in the literature that children with ADHD show poor skills in manipulation of verbal information and working memory deficits are a consistent cognitive correlate of ADHD (Barkley, 1997; Cohen et al., 2000; McInnes et al., 2003). Nevertheless, findings from other studies addressing the issue of complex sentence comprehension in children with ADHD are inconsistent. Using similar material to that of the present study, Korkman and colleagues (1998) found that schoolchildren with ADHD were less accurate than their matched peers on comprehension of complex sentences. However, Kim and Kaiser (2000) showed no significant differences between 6- and 8-year-old children with ADHD and TD children in a task assessing the ability to comprehend sentences having different syntactic structures. In a study with older children and adolescents, Wassenberg and colleagues (2010) observed that although participants with ADHD appear to understand complex sentences as accurately as TD participants, they need considerably more time to provide the correct answers. The speed of comprehension was not measured in this study. In any case, it is necessary to take this parameter into account in any assessment of language comprehension in children with ADHD.

Moreover, an important finding of this study was that schoolchildren with ADHD recall less information from a story compared with TD children, and they are also less sensitive to the importance of the information they recall. Although the information recalled by children with ADHD did increase as the importance of the material to the overall meaning of the story increased, the rate of increase was lower compared with the rate of increase observed in TD children. Decreased sensitivity to the thematic importance of the story is associated with decreased sensitivity to the causal properties of the story, as events that are judged as more important also have more causal connections and are more likely to be on the causal chain (Trabasso & Sperry, 1985). Thus, it may be implied that children with ADHD are less sensitive to the causal properties of narratives compared with TD children. Also, children with ADHD exhibit problems in answering factual and inferential questions. These findings are in accordance with previous studies that span a wide age range (i.e., ages 4-12 years), different modalities of presentation (audiotape vs. videotape), and stories varying in content, length, and complexity (Flake et al., 2007; Lorch et al., 1999, 2004).

In an attempt to explain the deficiencies exhibited by children with ADHD in the sensitivity to the thematic importance of story units and the ability to make inferences from a narrative, these variables were correlated with working memory, vocabulary, and grammar. The findings demonstrated that the ability to recall thematically important information is positively correlated with verbal working memory, comprehension, and recall of complex sentences as well as spontaneous production of complex sentences. However, further examination showed that only verbal working memory has a direct effect in the recall of thematically important information.

This finding is in accordance with findings reported by McInnes and colleagues (2003), which show that children

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Table 3. Correlations Between Each Important Level With the FDI and the VIQ Test.

	Importance Level 1	Importance Level 2	Importance Level 3	Importance Level 4
FDI	0.132	0.152	0.194	0.345*
VIQ-VP	0.107	0.170	0.233	0.124
VIQ-GC	0.345*	0.441**	0.482**	0.443**
VIQ-GP	0.421**	0.454**	0.468**	0.446**
VIQ-RSS	0.198	0.280*	0.289*	0.323*

Note: VIQ = Verbal IQ Test; VP = Vocabulary Production; GC = Grammar Comprehension; GP = Grammar Production; RSS = Recall of Syntactic Structures.
*$p \leq .05$. **$p \leq .01$.

Table 4. Correlations Between Factual Questions With the FDI, the VIQ Test, and Each Important Level.

	Factual questions
FDI	0.154
VIQ-VP	0.093
VIQ-GC	0.300*
VIQ-GP	0.367*
VIQ-RSS	0.313*
Importance Level 1	0.365*
Importance Level 2	0.477**
Importance Level 3	0.479**
Importance Level 4	0.489**

Note: VIQ = Verbal IQ Test; VP = Vocabulary Production; GC = Grammar Comprehension; GP = Grammar Production; RSS = Recall of Syntactic Structures.
*$p \leq .05$. **$p \leq .01$.

with ADHD have difficulties in comprehending subtle aspects of information contained in standardized narrative and expository passages. In addition, the authors demonstrated that this ability is significantly positively correlated with working memory. Working memory constitutes a key cognitive resource in comprehension, as it facilitates the ability to form on-line and maintain mental representations of information presented as well as to modify these representations as new information is processed (Kintsch, 1998; Zwaan & Radvansky, 1998).

The results of the present study also support Tannock's (Tannock & Schachar, 1966; Tannock et al., 2000) proposal that narrative processing relies on aspects of executive functioning, such as working memory, which are impaired in ADHD. Thus, it may be hypothesized that difficulties in story recall originate from the primary symptoms of the disorder. Nevertheless, further studies are required to investigate whether other aspects of executive functioning also affect the ability for story comprehension.

Relevant literature proposes that children with ADHD are more likely to have problems with expressive rather than receptive language (Baker & Cantwell, 1992; Beitchman, Tuckett, & Bath, 1987; Berry, Shaywitz, & Shaywitz, 1985; Kim & Kaiser, 2000). Expressive language usually includes word articulation, sentence imitation, and narrative production. Receptive language usually includes word discrimination, vocabulary comprehension, and GC. However, the present data do not support this argument. Rather, they suggest that children with ADHD may show weaknesses in some aspects of receptive and expressive language, but not in others. In particular, children with ADHD seem to experience difficulties in aspects of expressive language that require working memory such as sentence recall. However, children with ADHD do not seem to have problems in recalling words representing objects or actions or in producing the correct morphological or syntactic forms. Moreover, children with ADHD seem to exhibit deficiencies in complex sentence comprehension and narrative comprehension.

The findings of the present study suggest that the problems exhibited by this population in the ability for narrative comprehension may stem from deficits in working memory. These findings may have certain implications for the formulation of effective intervention programs for children with ADHD. Language problems are common developmental concerns and often lead parents or teachers to refer children to health services. However, in cases that language problems coexist with symptoms of ADHD, specialists should not focus on the restriction of the language problems, but on the restriction of the primary symptoms of ADHD, because these symptoms may constitute causal factors of language problems.

Limitations

First, the ADHD group consisted of children who were referred to the specialist. Usually, the referred cases, apart from the primary symptoms of ADHD, exhibit more serious accompanying behavioral problems, which may affect their performance in the linguistic tasks. It would be interesting in a future study to examine the effect of primary ADHD symptoms on story recall in a community sample.

The ADHD and TD groups showed very low levels of recall, especially for the Importance Levels 1 and 2, where

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the performance was below 25%. This finding suggests that the particular task may have been too difficult, thus, obscuring group differences. The story presented was the folktale *The Father, His Son, and Their Donkey,* which was unfamiliar to the participants, but it had been used in prior studies on story recall in TD children (Brown et al., 1983; Brown & Smiley, 1977) as well as in children with ADHD (Purvis & Tannock, 1997). The story was divided into 56 units and each unit was rated on a 4-point scale for its importance to the thematic structure of the whole story. In future studies, it would be useful to standardize this task to TD children and make any necessary adaptations before administering it to atypical populations.

It is demonstrated that phonological processing is fundamental for a variety of language abilities related to semantics, syntax, and narratives (for a review, see Baddeley, 2003). However, such a measure was not included in the present study. The examination of phonological processing may allow to further highlight the underlying processes involved in comprehension of narratives in children with ADHD.

In this article, it is suggested that the deficiencies demonstrated by children with ADHD in story recall may be accounted for by deficits in working memory, which is part of executive functioning. However, the present study did not investigate the effect of other aspects of executive functioning (i.e., response inhibition, flexibility shifting, planning, and verbal fluency) on different language domains. Future studies should address this issue, to provide a better understanding of language development in children with ADHD.

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Author Biographies

Christina F. Papaeliou completed her PhD at the University of Edinburgh and is now assistant professor of developmental psychopathology and language disorders at the University of the Aegean, Greece. Her research concerns language development in typical and atypical populations. Her published journal articles and her book focus on these topics.

Katerina Maniadaki completed her PhD at the University of Southampton and is now assistant professor of psychology in the Department of Social Work, Technological Educational Institute of Athens and head of the Center of Developmental and Learning Disabilities "Arsi." Her research concerns ADHD as well as other developmental disorders. Her published journal articles and her books focus on these topics.

Efthymios Kakouros is professor of psychology in the Department of Preschool Education, Technological Educational Institute of Athens, and head of the Center of Developmental and Learning Disabilities "Arsi." His research concerns ADHD as well as other developmental disorders. His published journal articles and his books focus on these topics.

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