Research Note

Reading Comprehension Deficits in Adolescents: Addressing Underlying Language Abilities

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Purpose: The purpose of this article is to discuss reading comprehension deficits in adolescents in relation to their word reading skills and lexical and syntactic development. Although reading comprehension strategies (e.g., “Find the main idea”) are often recommended, it is argued that before these can be effective, students’ underlying language deficits should be addressed.

Method: Data from a longitudinal study are analyzed to determine the relationship between reading comprehension, word reading, and lexical and syntactic development in adolescents.

Results: The findings indicate that poor reading comprehension in adolescents is predicted by concurrent deficits in word reading ability, lexical development, and syntactic development.

Conclusion: When poor comprehension is accompanied by deficits in word reading ability and/or lexical and syntactic development, intervention should target the underlying areas of deficiency. Studies designed to improve reading comprehension in adolescents are needed.

Many adolescents struggle to succeed in schools today because of underlying language impairments or weak language skills. This research note discusses the relationship between language development and academic success with respect to reading comprehension. Collaborative actions that could be taken to boost the level of reading comprehension in adolescents will be discussed, and an intervention study designed to evaluate those recommendations will be outlined.

Introduction

The ability to read and comprehend textbooks assigned in schools is essential for mastering the content of the curriculum in a wide range of subject areas. At the high school level, for example, adolescents are expected to read, analyze, and discuss challenging material in classes such as biology, chemistry, civics, economics, health, history, mathematics, and physics. Moreover, most textbooks at that level are written in the expository genre, often called the “language of the curriculum,” one of the most difficult genres for readers to comprehend (Ehren, 2010; Nippold & Scott, 2010; Snyder & Caccamise, 2010; Ward-Lonergan, 2010).

The complexity of this task is apparent in the following expository passage that describes air pollution, drawn from a textbook used to teach Earth science to high school students, ages 14–18 years. To facilitate analysis of the passage, all sentences have been coded for main and subordinate clauses as follows: main = [MC]; adverbial [ADV], gerundive [GER], infinitive [INF], participial [PRT], and nominal [NOM] (see Nippold, 2014).

Pollution can change [MC] the chemical composition of the atmosphere and disrupt [MC] its natural cycles and functions. Fossil-fuel combustion is [MC] the major source of air pollution. Most of this pollution comes [MC] from motor vehicles and coal or oil-burning power plants. Motor vehicles, like those in Figure 18, release [MC] carbon monoxide, nitrogen oxide, soot, and other pollutants. Some of the pollutants react [MC] to form [INF] smog. Power plants release [MC] sulfur dioxide and nitrogen oxides. These pollutants combine [MC] with water vapor in the air to create [INF] acid precipitation.... The burning [GER] of fossil fuels also produces [MC] carbon dioxide, an important greenhouse gas. The amount of carbon dioxide in the atmosphere has increased [MC] since industrialization began [ADV] in the nineteenth century. This increase has altered [MC] the carbon cycle and contributed [MC] to unnatural warming [GER] of the lower atmosphere, known [PRT] as global warming....

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Chlorofluorocarbons (CFCs) once used [PRT] in air conditioners and plastic foam production destroy [MC] ozone in the stratosphere layer of the atmosphere. Researchers say [MC] that a significant loss of ozone could result [NOM] in an increased incidence of health problems like cataracts and skin cancers because more of the sun's UV radiation would reach [ADV] Earth's surface. (Tarbuck & Lutgens, 2011, p. 110)

Word Reading Skills

To comprehend this passage independently, an adolescent would need to possess word reading skills sufficient to allow for accurate, efficient, and rapid recognition or decoding of numerous abstract and morphologically complex terms that occur in nearly every sentence (e.g., *chemical composition, fossil-fuel combustion, industrialization, chlorofluorocarbons*). The ability to read words fluently relies upon specific linguistic and metalinguistic skills, including phonological awareness and knowledge of the relationship between speech sounds and letters, known as the alphabetic principle. Most children acquire basic competence in phonological awareness and the alphabetic principle during the early school years (Aarnoutse, Van Leeuwe, Voeten, & Oud, 2001; Kamhi & Catts, 2012). However, further refinements occur beyond this point, especially in the ability to decode morphologically complex words, a skill that requires morphological awareness (Berninger, Abbott, Nagy, & Carlisle, 2010). An adolescent who struggles to read these types of words would have difficulty understanding the quoted science passage.

Lexical Development

In addition to being able to read the words in the science passage, the adolescent must know the meaning of those words or be able to discern their meanings through metalinguistic strategies (Nippold & Sun, 2008). Knowledge of words and the ability to learn new words constitutes lexical development. Key strategies for word learning when reading include attending to context clues (Carnine, Kameenui, & Coyle, 1984; Nagy, Herman, & Anderson, 1985; Sternberg, 1987) and performing a morphological analysis (Anglin, 1993; Nagy, Diakidoy, & Anderson, 1993; White, Power, & White, 1989). Although knowledge of word learning strategies begins in the early school years, proficiency in using them increases as students grow older and have more experience with them (Carnine et al., 1984; Nagy et al., 1993). Moreover, research has shown that explicit instruction in morphological analysis of words drawn from expository textbooks can improve the reading comprehension levels of adolescents who have poor reading skills (Vaughn et al., 2015).

Syntactic Development

In addition to lexical development, syntactic development plays a key role in reading comprehension (Poulsen & Gravgard, 2016). Syntax is a system of rules governing the ways in which words can be combined into phrases,

clauses, and sentences to express meaning (Kamhi & Catts, 2012). Inspection of the science passage indicates that many of the sentences are long and complex, containing numerous words and clauses that are organized to convey specific meanings. Yet the role of syntax in reading comprehension is often overlooked (Scott, 2009).

The importance of syntax becomes apparent upon realizing how each clause in the passage contributes unique information. In the final paragraph, for example, the sentence beginning with "Chlorofluorocarbons" contains a participial clause that tells why CFCs were used (to produce refrigerants and plastic foam), and the main clause tells why they are undesirable (they destroy ozone). In the sentence that follows, the main clause ("Researchers say that...") contains a metalinguistic verb (*say*) that introduces a nominal clause that explains why the loss of ozone is undesirable (i.e., it leads to health problems such as cataracts and cancer). This sentence concludes with an adverbial clause that explains how this happens (it allows the sun's UV radiation to reach the Earth's surface, implying that it also reaches human beings). A reader who cannot interpret these clauses will have difficulty comprehending these explanations.

Topic Knowledge

In addition to having solid word reading skills and sufficient lexical and syntactic development, to fully understand this passage, the reader would need to have knowledge of topics that are mentioned but not explained (e.g., industrialization in the 19th century and its relationship to air quality). This point is supported by a number of studies that have shown that topic knowledge makes a substantial contribution to reading comprehension in school-age children, adolescents, and adults, especially in relation to expository texts (e.g., Caillies, Denhière, & Kintsch, 2002; Cromley & Azevedo, 2007; McKeown, Beck, Sinatra, & Loxterman, 1992; McNamara & Kintsch, 1996; Rydland, Aukrust, & Fulland, 2012). According to Kintsch (1994), readers who are more knowledgeable about a topic can draw more inferences and create richer and more coherent mental representations, allowing better comprehension to occur.

Middle school and high school teachers expect their students to be able to read expository textbooks in order to learn the content of the curriculum and gain the necessary topic knowledge (Ehren, 2010). Given that topic knowledge is acquired largely through reading (Snyder & Caccamise, 2010), adolescents who avoid reading because they find it arduous and unrewarding are likely to know less about a range of topics. This limitation will compound their difficulties in comprehending books written in the expository genre, resulting in poor academic achievement.

Addressing Problems in Reading Comprehension

Educators frequently recommend that reading comprehension problems in adolescents be addressed by teaching students to use comprehension strategies. For an

expository text, these strategies may include previewing the passage for its likely content, monitoring comprehension by asking oneself questions about the passage, finding the main idea, and summarizing the key points in one's own words (Boardman, Scornavacca, & Klinger, 2013). According to Boardman et al., teachers are advised to introduce each strategy, one at a time, by modeling it for their students and providing guided practice in which the students, working in small groups, apply it to a passage of text they have just read. Students then engage in a discussion with their group members about the meaning of the passage. Although these strategies may be helpful to many adolescents, if some students have deficits in word reading ability or in lexical or syntactic development, it may be difficult for them to apply the strategies effectively. This is particularly the case with respect to finding the main idea or summarizing the key points because these two strategies assume the student can understand at the sentence level. However, the science passage on air pollution, discussed here, contains many long and complex sentences, dense with information, that would be difficult for students with language impairments to read and understand on an individual basis. Given that every word, clause, and sentence contributes to the overall meaning of the passage, it may be necessary to address the students' underlying word reading, lexical, and syntactic deficits before expecting them to use these strategies successfully.

The Iowa Project

What is the evidence for underlying deficits and their impact on reading comprehension in adolescents? To answer this question, I discuss the results of a longitudinal study of language development that was conducted with a large cohort of children who were living in the midwestern United States (Tomblin & Nippold, 2014). Participants originally had been recruited for the study from classrooms located in urban, suburban, and rural public school districts of Iowa and Illinois using epidemiological sampling techniques designed to represent the population of monolingual English-speaking kindergarten children in the United States. Known as the Iowa Project, the study identified each participating child at kindergarten (age 6) as having typical language development (TLD), specific language impairment (SLI), or nonspecific language impairment (NLI) using norm-referenced standardized tests. By definition, in children with TLD, nonverbal cognition and language development are average or above average; in children with SLI, nonverbal cognition is average or above average but language development is below average; and in children with NLI, both nonverbal cognition and language development are below average (Leonard, 2014; Tomblin & Nippold, 2014).

As a principal investigator on the Iowa Project, I was able to access and analyze data that had been collected on each participant over a 10-year period. In this longitudinal investigation, each child was reevaluated at Grades 2, 4, 8, and 10 (at ages 8, 10, 14, and 16 years, respectively) and given a battery of norm-referenced standardized tests that examined, among other things, language development

and reading. Here I report on the results of statistical analyses that I conducted using data from Grade 8 (age 14) for the three groups (TLD, $n = 247$; SLI, $n = 102$; and NLI, $n = 77$). At that point in time, participants in the study were 56% male and 44% female; and 85% White, 12% Black, and 3% other (Tomblin & Nippold, 2014).

The findings are examined for lexical (LEX) development, syntactic (SYN) development, word reading (WDR) ability, and reading comprehension (RDC). Each adolescent's performance in each area was based on a composite of standard scores from two norm-referenced measures. For LEX, those measures were the Peabody Picture Vocabulary Test, Revised Edition (PPVT-R; Dunn & Dunn, 1981) and the Expressive subtest of the Comprehensive Receptive and Expressive Vocabulary Test (CREVT; Wallace & Hammill, 1994); for SYN, they were the Concepts and Directions and Recalling Sentences subtests from the Clinical Evaluation of Language Fundamentals, Third Edition (CELF-III; Semel, Wiig, & Secord, 1995); for WDR, the measures were the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Tests, Revised (WRMT-R; Woodcock, 1987); and for RDC, they were the Passage Comprehension subtest of the WRMT-R and the Comprehension subtest of the Gray Oral Reading Tests, Third Edition (GORT-3; Wiederholt & Bryant, 1992). The results are reported in Table 1.

A series of one-way analyses of variance yielded statistically significant differences between groups for all four composites: LEX, $F(2, 423) = 115.84, p < .0001, \eta = .59$; SYN, $F(2, 423) = 138.52, p < .0001, \eta = .63$; WDR, $F(2, 423) = 64.44, p < .0001, \eta = .48$; and RDC, $F(2, 423) = 92.39, p < .0001, \eta = .55$, with large effect sizes (Cohen, 1969, p. 276). Tukey tests indicated that the TLD group outperformed the SLI and NLI groups and that the SLI group

Table 1. Means (and standard deviations) for each language group (TLD, SLI, NLI) on the lexical (LEX), syntactic (SYN), word reading (WDR), and reading comprehension (RDC) composites^a at Grade 8.

Composite	TLD	SLI	NLI
LEX	100.19 (11.60)	87.15 (08.35)	81.81 (09.42)
SYN	93.87 (24.25)	65.15 (21.12)	50.19 (16.63)
WDR	94.95 (10.78)	85.18 (14.81)	75.87 (18.64)
RDC	98.26 (23.58)	73.22 (21.87)	61.04 (25.07)

Note. All differences between groups were statistically significant. From *Later Language Development: School-Age Children, Adolescents, and Young Adults* by M. A. Nippold. Austin, TX: P-Ed. Copyright © 2016 by PRO-ED, Inc. Adapted with permission.

Composites: LEX = Peabody Picture Vocabulary Test—Revised Edition (PPVT-R; Dunn & Dunn, 1981) + Expressive subtest of the Comprehensive Receptive and Expressive Vocabulary Test (CREVT; Wallace & Hammill, 1994); SYN = Concepts and Directions and Recalling Sentences subtests of the Clinical Evaluation of Language Fundamentals, Third Edition (CELF-III; Semel, Wiig, & Secord, 1995); WDR = Word Identification and Word Attack subtests of the Woodcock Reading Mastery Tests, Revised (WRMT-R; Woodcock, 1987); RDC = Passage Comprehension subtest of the WRMT-R and Comprehension subtest of the Gray Oral Reading Tests, Third Edition (GORT-3; Wiederholt & Bryant, 1992).

outperformed the NLI group on all four composites. Thus, both the SLI and NLI groups showed deficits in lexical and syntactic development, word reading, and reading comprehension. It was also found that the NLI group performed significantly below the SLI group in all four areas.

To determine the associations between composites, correlation coefficients were calculated using standard scores from all participants combined ($N = 426$). The results were statistically significant, positive, and moderately strong in every case (see Table 2; Nippold, 2016, p. 31). This indicates that adolescents who were weak (or strong) in one area tended to be weak (or strong) in all other areas. Then, to determine the extent to which lexical and syntactic development and word reading ability predicted reading comprehension, regression analyses were conducted. All three factors (LEX, SYN, and WRD) individually and in combination of two and three factors predicted RDC (see Table 3; also reported in Nippold, 2016, p. 32).

Table 4 provides data on each composite for each of the three language groups, indicating the percent of participants in each group who performed at different levels. Although these data corroborate the main findings of the study, the table also shows that exceptions occurred. For example, some adolescents in the SLI and NLI groups performed at average or above-average levels on some composites, not evidencing deficits in those areas. It also shows that some adolescents in the TLD group performed below average in some areas, evidencing deficits.

These patterns indicate that in addition to examining group findings, it is important to consider individual differences within groups and not to make assumptions about how students will perform on the basis of prior labels. It also emphasizes the importance of evaluating each student carefully to determine individual strengths and weaknesses in language and reading ability.

Nevertheless, the findings of this study indicate that in general, children identified as having SLI or NLI as 6-year-olds continued to show language and reading deficits as 14-year-old adolescents. These results are consistent with other longitudinal studies of adolescents with an early history of language impairments (e.g., Conti-Ramsden, Durkin, Simkin, & Knox, 2009; Snowling, Bishop, & Stothard, 2000; Stothard, Snowling, Bishop, Chipchase, &

Table 2. Correlation coefficients calculated between word reading (WRD) ability, lexical (LEX) development, syntactic (SYN) development, and reading comprehension (RDC) at Grade 8 ($N = 426$).

Composite	WRD	LEX	SYN	RDC
WRD	—	0.60***	0.62***	0.61***
LEX		—	0.66***	0.71***
SYN			—	0.68***

Note. From *Later Language Development: School-Age Children, Adolescents, and Young Adults* by M. A. Nippold. Austin, TX: Pro-Ed. Copyright © 2016 by PRO-ED, Inc. Adapted with permission.

*** $p < .0001$.

Table 3. Multiple regression analysis for dependent variable Reading Comprehension (RDC) using R -square selection method at Grade 8 ($n = 426$).

Number in model	R -square	Variables in model
1	0.50	LEX
1	0.47	SYN
1	0.37	WRD
2	0.59	LEX SYN
2	0.56	WRD LEX
2	0.52	WRD SYN
3	0.60	WRD LEX SYN

Note. From *Later Language Development: School-Age Children, Adolescents, and Young Adults* by M. A. Nippold. Austin, TX: Pro-Ed. Copyright © 2016 by PRO-ED, Inc. Adapted with permission.

Kaplan, 1998). The study also shows that poor reading comprehension in adolescents is predicted by concurrent deficits in lexical development, syntactic development, and word reading ability. It is unfortunate that most participants in the Iowa Project with SLI or NLI did not receive the type of focused, intense, and explicit intervention that would be necessary to remediate their language and reading problems. A key message is that children whose language development is poor at age 6 (kindergarten) are at high risk for continuing to experience language deficits as they progress through school and are likely to struggle to become fluent readers who can comprehend challenging material. Moreover, it is unreasonable to expect that language deficits in a 6-year-old child will go away on their own or that they will not restrict the child's ability to become a proficient and independent reader. Thus, it is important to monitor children's progress as they grow older, become adolescents, and transition to high school (Conti-Ramsden et al., 2009).

Table 4. The percent of adolescents in each language group with above average (> 115), average ($85-115$), or below average (< 85) standard scores on each composite at Grade 8.

Composite	TLD	SLI	NLI
LEX			
Above average	10.53		
Average	78.13	57.84	32.47
Below average	11.34	42.16	67.53
SYN			
Above average	17.41	00.98	
Average	46.96	23.53	06.49
Below average	35.63	75.49	93.51
WRD			
Above average	00.81		
Average	79.35	51.96	32.47
Below average	19.84	48.04	67.53
RDC			
Above average	21.46	02.94	
Average	53.03	27.45	15.58
Below average	25.51	69.61	84.42

Note. TLD, $n = 247$; SLI, $n = 102$; NLI, $n = 77$. Categories are based on $M = 100$ and $SD = 15$.

Future Research

Intervention studies that target reading comprehension deficits in adolescents are sorely needed. When reading comprehension deficits are accompanied by weaknesses in word reading ability and in lexical and syntactic development, treatment should be designed to target each student's area(s) of deficiency. For example, although many adolescents with poor reading comprehension also have deficits in syntactic development, as reported in this article, their syntactic deficits are rarely addressed during intervention (Scott, 2009). Yet if a particular adolescent is struggling to comprehend at the sentence level and is unable to understand how clauses modify a sentence, how can we expect that student to grasp the main idea or to summarize the key points of an entire passage, or even the paragraph in which the sentence occurs?

In an ideal situation, each adolescent who demonstrates a reading comprehension deficit would receive a thorough evaluation, carried out by a speech-language pathologist (SLP) who examines all relevant areas, including word reading ability and lexical and syntactic development, using age-appropriate, norm-referenced, standardized measures. Then, when deficits are found, the SLP would design an intervention program, in collaboration with other school professionals, that targets the student's weaknesses while simultaneously helping to build the student's background knowledge in various subject areas. Intervention should be carried out in a systematic, intense, focused, and explicit manner that targets each student's underlying weaknesses, with the goal of improving the student's ability to read independently and comprehend expository textbooks.

Consider a hypothetical group of high school students who have deficits in all key areas and have been assigned to read the passage on air pollution in the Earth science textbook, described earlier. Working collaboratively with the science teacher, who bears most of the responsibility for building topic knowledge, the SLP could create a list of key terms that are essential for comprehending the passage. Students could be taught the meanings of those terms and also be taught to use strategies to figure out the meanings of other difficult words they encounter when reading. Indeed, there is evidence from research that students can be taught to use the strategies of attending to context clues (Fukkink & de Glopper, 1998) and analyzing the morphological structure of words (Baumann et al., 2002) to build their vocabularies.

To address syntax, the SLP could teach the students the functions of various clauses and how they modify the meaning of a sentence and could explain how certain types of words and clauses are connected. This would include, for example, the fact that metalinguistic (*say, argue, tell*) and metacognitive (*know, think, believe*) verbs commonly co-occur with nominal clauses to complete a statement or thought (e.g., Scientists *know* that *fossil-fuel combustion causes air pollution*); that morphologically complex and abstract nouns (e.g., *industrialization*) often are defined using relative clauses (e.g., ...is a process *that involves*

making goods with machines); and that adverbial clauses provide information about time, manner, reason, or condition (e.g., *When textile machines were invented*, cloth could be made more quickly). There is evidence from research that metalinguistic activities that heighten students' awareness of different types of clauses and sentences can build their knowledge of complex syntax (Hirschman, 2000).

Some adolescents will also require systematic instruction in word reading ability and its linguistic and metalinguistic underpinnings, including phonological awareness and letter-sound correspondences. To remediate deficits in these areas, the SLP may wish to collaborate with a reading specialist to ensure success. It is encouraging to know that research has shown that interventions designed to address students' underlying deficits in phonological awareness and letter-sound knowledge can improve their word reading skills (Snowling & Hulme, 2012).

Once students demonstrate gains in these basic areas and can comprehend individual sentences, the next step is to assist the students to comprehend two, three, and four sentences in a passage. Once students are successful at this level, the SLP could introduce the use of traditional reading comprehension strategies (e.g., "find the main idea") one at a time. Teaching students to use these strategies could potentially improve their reading comprehension even more. However, without building a strong foundation in the underlying language skills, including the linguistic and metalinguistic underpinnings of word reading ability, students are likely to experience frustration and discouragement if they are expected to use traditional comprehension strategies too soon.

To examine the effectiveness of intervention for reading comprehension that systematically addresses adolescents' underlying deficits in word reading ability, lexical development, and/or syntactic development, studies could be carried out that compare this approach to the more standard approach of teaching reading comprehension strategies without building the underlying language skills. The goal would be to determine which group makes greater progress over time. Studies of this nature would provide useful information for SLPs who work with adolescents, offering direction on how best to remediate reading comprehension deficits. The long-range goal would be to enhance students' chances of graduating from high school and completing the necessary postsecondary education to achieve success in life.

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