Literacy Studies: Perspectives from Cognitive Neurosciences, Linguistics, Psychology and Education

Kristi L. Santi
Deborah K. Reed *Editors*

Improving Reading Comprehension of Middle and High School Students

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While language defines humanity, literacy defines civilization. Understandably, illiteracy or difficulties in acquiring literacy skills have become a major concern of our technological society. A conservative estimate of the prevalence of literacy problems would put the figure at more than a billion people in the world. Because of the seriousness of the problem, research in literacy acquisition and its breakdown is pursued with enormous vigor and persistence by experts from diverse backgrounds such as cognitive psychology, neuroscience, linguistics and education. This, of course, has resulted in a plethora of data, and consequently it has become difficult to integrate this abundance of information into a coherent body because of the artificial barriers that exist among different professional specialties. The purpose of this series is to bring together the available research studies into a coherent body of knowledge. Publications in this series are of interest to educators, clinicians and research scientists in the above-mentioned specialties. Some of the titles suitable for the Series are: fMRI, brain imaging techniques and reading skills, orthography and literacy; and research based techniques for improving decoding, vocabulary, spelling, and comprehension skills.

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Improving Reading Comprehension of Middle and High School Students

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Abstract

The focus of this Springer Literacy Edition is to provide the most current research regarding instruction in the area of comprehension for middle and high school students. Each author of the first four chapters will focus on a core subject area in middle and high school and discuss the current research along with instructional implications for this particular population. Core subject areas are defined as social studies/history, science, English language arts, and mathematics. Three additional chapters on special education, English language learners, and assessment will describe the current practices to ensure academic achievement remains the central focus for all the learners.

Keywords Reading comprehension • Adolescents • Content areas • Assessment • Special populations

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What Do Models of Reading Comprehension and Its Development Have to Contribute to a Science of Comprehension Instruction and Assessment for Adolescents?

Marcia A. Barnes

Abstract Cognitive models of reading comprehension provide a starting point for asking theoretically-motivated and empirically-driven questions relevant to understanding the reading comprehension of adolescent students. This chapter provides an introduction to the volume by reviewing component skills approaches and process models of reading comprehension followed by a discussion of selected empirical work related to these models. Developmental and individual differences in key comprehension-related processes from these models are discussed with particular reference to adolescent readers. Characteristics of discipline-specific texts that affect comprehension in middle school and high school students are also examined. Implications of this research for informing reading comprehension assessment, instruction, and interventions through the adolescent years are provided, with reference to the other chapters in this volume.

Keywords Component reading skills • Process models of comprehension • Informational text

Models of academic skills are important for organizing what is known about skill development and performance as well as for guiding research on instruction, intervention, and assessment. This chapter presents an overview of cognitive models of reading comprehension and empirical work on the typical and atypical development of reading comprehension to provide a lens through which comprehension in adolescent students can be viewed. Because of considerable gaps in our knowledge of the development of comprehension skills—particularly in older students and for the types of texts that these students must read, understand, and use to learn—I pose a series of comments and questions in the chapter that might be fruitful to pursue in order to inform research in the domain of adolescents' reading comprehension.

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Reading comprehension is the product of processes that operate during reading to create a mental representation of the situation described by the text, referred to as a situation model (Kintsch, 1988). The resulting mental representation includes information provided by the propositional content of the text that is integrated with the reader's knowledge to provide an evolving understanding of what is read. There are several approaches to understanding and modeling reading comprehension, including those that focus more on describing *component skills* that contribute to text comprehension and those that describe the *process* of comprehension or how comprehension of text unfolds over time to result in the construction of the situation model. These approaches represent different levels of explanation and investigation. The aim of this chapter is not to compare these various approaches, but to use them as a starting point for asking theoretically-motivated and empirically-driven questions relevant to understanding the reading comprehension of adolescent students. Component skills approaches and process models of reading comprehension are reviewed briefly followed by a discussion of selected empirical work related to these models. Potential implications of this literature for understanding reading comprehension through the adolescent years are provided, with reference to the other chapters in this volume.

1 Process Models of Reading Comprehension

Process models such as the Construction-Integration model (Kintsch, 1988), the Landscape model (van den Broek, Rapp, & Kendeou, 2005; van den Broek, Young, Tzeng, & Linderholm, 1999) and the Structure-Building Framework (Gernsbacher, 1990) describe the iterative and dynamic processes used to construct representations of the text during reading. In these models, cognitive processes are engaged to maintain both local and global textual coherence through the linking of pronouns with their referents, the integration of information between sentences both adjacent in the text and across larger text distances, and the retrieval and integration of information from the text with one's store of general world knowledge or specific topic knowledge.

Process models, such as the Landscape Model (van den Broek et al., 2005), consider how reader characteristics and characteristics of the text interact to result in the construction of the situation model. These reader characteristics include: (a) limited capacity working memory, which is needed to integrate information within and between sentences; (b) relevant word and world knowledge stored in long-term memory, the lack of which will impose constraints on comprehension including the ability to make inferences and learn from text; and (c) the readers' purposes for reading (e.g., entertainment vs. study/learning) as well as their perspectives during reading (e.g., from one or another character's point of view), both of which can influence the reader's focus of attention and affect how the text is processed. Text characteristics that affect the cohesiveness of the text also affect

comprehension. Cohesiveness can differ across texts within a genre, between text genres, and between texts targeted for different grade levels (reviewed in McNamara, Graesser, & Louwerse, 2012). For example, science and history texts require the processing of many causal and temporal relations (van den Broek, 2010) and the cohesiveness of these texts depends on the presence of words and phrases that cue or signal these important relations (e.g., the use of *because* or as a *consequence* to cue causality). The extent to which there is repetition or overlap of important words and concepts throughout the text also contributes to text cohesion (review in Graesser, McNamara, & Louwerse, 2003).

In cognitive process models, some comprehension processes—particularly those important for maintaining local coherence—proceed in an automatic fashion using low effort, fast-acting memory retrieval processes (McKoon & Ratcliff, 1992) as the reader retrieves information from prior text that is still in working memory (Ericcson & Kintsch, 1995) or activates background knowledge that is easily accessible from semantic memory (Schmalhofer, McDaniel, & Keefe, 2002; Singer, 2013). The models also provide for more effortful or strategic processing to maintain global coherence and to repair breaks in coherence (e.g., van den Broek et al., 2005). More strategic processing may be required to integrate information across larger chunks of text when the to-be integrated sentences are no longer together in working memory, when semantic memory needs to be consciously searched for what is known about a topic because the information does not come immediately to mind, and when the reader's purpose is to learn from text. *Reading to learn* slows down processing as the reader focuses on explicitly integrating information in the text, updating knowledge, and possibly revising prior misconceptions in knowledge (Kendeou, Smith, & O'Brien, 2013; van den Broek et al., 2005).

Although these models can accommodate individual differences in reader characteristics, they are not developmental models. As such, the discussion of how reader characteristics affect text processing focuses on text-level comprehension skills and not on variations in word decoding. In contrast, component skills models explicitly include word decoding as a potential source of variability in explaining reading comprehension. This is important for understanding the sources of reading comprehension difficulty in school-age populations, including students in middle school and high school.

2 Component Skills Models of Reading Comprehension

In component skills models, the hypothesized component skills act as sources of variance in explaining performance on reading comprehension tasks. At the broadest level of component skills models is the Simple View of Reading or SVR in which reading comprehension is the product of decoding and language comprehension (Hoover & Gough, 1990). The original SVR neither specified what aspects of language are subsumed under the language comprehension component nor the

relative importance of any constituent skills for comprehension; however, it made explicit three important assumptions about reading comprehension. The first is that word decoding is necessary but not sufficient for reading comprehension. The second is that whatever knowledge and skills are involved in general language comprehension are those that overlap to a large extent with what is needed to understand text. And the third is that the multiplicative relation of the components means that lower levels of either word decoding and/or language comprehension will have large effects on reading comprehension (although similar results are produced from an additive components model, Joshi & Aaron, 2000). Implicit in the model is the idea is that the two components in the equation, and hence their product, reading comprehension, vary across development and individuals.

The SVR has provided a useful heuristic for guiding research and practice, but there is recognition that it does not capture the complexity of reading with respect to how word decoding (including fluency) and language comprehension are conceptualized; it may not account for some aspects of reading performance in particular subgroups, such as second language learners; and the relations of components to reading comprehension may vary as a function of the way in which reading comprehension is measured (review in Kirby & Savage, 2008; Cutting & Scarborough, 2006).

One component skills model that tests the relation of component skills to each other and to reading comprehension, specifically in adolescent students, is the Direct and Inferential Mediation or DIME model (Cromley & Azevedo, 2007). The DIME model incorporates some of the specific reader-level characteristics from the process models (e.g., word and world knowledge, inference-making, strategy-use) as well as word decoding to predict reading comprehension. The DIME model not only tests relations between these hypothesized component skills and reading comprehension, it also tests indirect relations; that is, that the relations of some component skills to comprehension are mediated by other component skills. The DIME model has been tested with ninth grade students' comprehension of informational and narrative text on a standardized measure of reading comprehension (Cromley & Azevedo, 2007), as well as with college students' comprehension of biology text (Cromley, Snyder-Hogan, & Luciw-Dubas, 2010). In these studies, world knowledge (general or topic-specific), word knowledge (vocabulary), and inference-making were directly related to reading comprehension and word and world knowledge were also indirectly related to reading comprehension through their impacts on inference-making. The effects of strategy use were smaller and indirect, also through inference. Word reading was directly related to comprehension, but only in ninth graders. Interestingly, the effects of prior topic knowledge and inference were particularly large for college students' understanding of biology texts. A recent test of the DIME model (Ahmed et al., 2014) measured component skills and reading comprehension at a latent level with a large sample of middle school and high school students. When method variance was taken into account (i.e., controlling for the fact that several of the tasks used reading to measure the component skills of reading comprehension), inference/integration had the largest direct effect on reading comprehension followed by word and world knowledge. In fact, word

and world knowledge were found to be so highly correlated at the latent level in adolescents as to be one construct. Word and world knowledge were also indirectly related to reading comprehension through inference and strategy-use.

In sum, process models of reading comprehension have been important for describing how representations of the text are constructed through a series of iterative cognitive processes that serve to maintain local and global coherence. They take into account how characteristics of the reader and the text influence comprehension. Component skills models include the influence of word decoding on reading comprehension and attempt to specify what other word- and text-level knowledge and skills account for variability in reading comprehension. They do not focus on how the text itself contributes to reading comprehension, but have been used to test whether the relation of component skills to comprehension might vary as a function of the type of text to be understood (e.g., Cromley et al., 2010).

A theme that emerges from considering these different types of models is that comprehension is related to several word-level, text-level, and memory skills as well as to one's background knowledge and to structural features of the text itself. But which of these are the most relevant for explaining developmental and individual differences in reading comprehension? We need to know not only that skills are related to comprehension, but also the size and nature of those relations. An effect that is significant but small will not have as much relevance for assessment and instruction as an effect that is both reliable and large. Perfetti and Adlof (2012) make a distinction between those components of comprehension that are intrinsic to comprehension and those that are simply cognitive correlates of comprehension. What types of evidence would help to identify skills that are integral for comprehension? Longitudinal studies of academic skill development provide one means for testing the direction and nature of the relationship between cognitive and academic skills (Barnes et al., 2014) as do experimental or intervention studies. Skills that consistently show substantial variation between individuals who differ in comprehension ability are also good candidates (Cain & Oakhill, 2007; Perfetti & Adlof, 2012). I now turn to a selected review of research on knowledge and skills that are likely of most relevance to reading comprehension as well as consider what is known about text characteristics that may particularly affect comprehension and learning from text in middle and high school students.

3 Typical and Atypical Development of Reading Comprehension

3.1 Word Reading Accuracy and Fluency

Word reading has been described as a constrained skill because it develops within a relatively short time window and consists of a relatively limited stimulus set that needs to be mastered (Paris, 2005). Although word decoding imposes constraints

on understanding what is read, the influence of decoding accuracy and reading fluency on reading comprehension decreases with increasing grade. Verhoeven and van Leeuwe's (2008) longitudinal study of component skills showed a decreasing influence of decoding on reading comprehension from grades 2 to 6. Cross-sectional research also shows that word reading and reading comprehension become less strongly correlated with age while listening comprehension and reading comprehension become more strongly correlated over this same time period (Gough, Hoover, & Peterson, 1996), such that for adults, correlations between listening comprehension and reading comprehension approach parity (Gernsbacher, Varner, & Faust, 1990). Similarly, studies that test the relative contributions of decoding and language comprehension to the prediction of performance on various reading comprehension measures at different ages show that, in contrast to performance at younger ages, listening comprehension accounts for significantly more of the variance across several different tests of reading comprehension in older students (Keenan, Betjemann, & Olson, 2008).

A recent dominance analysis of latent component skills, which rank orders the importance of component skills for reading comprehension at different grades, demonstrated that decoding fluency was the most important (dominant) predictor of reading comprehension in third grade, but not at seventh and tenth grades (Tighe & Schatschneider, 2014). In tests of the DIME model with middle school and high school students, word decoding continues to exert a significant direct effect on reading comprehension though this effect is smaller for word reading than it is for other component skills (Ahmed et al., 2014; Cromley & Azevedo, 2007).

Based on these studies it is tempting to think that we do not need to pay attention to the influence of decoding when understanding reading comprehension in adolescent students. However, even though decoding becomes less predictive of reading comprehension with increasing grade for the student population as a whole, difficulties in word decoding accuracy and speed continue to affect reading comprehension for some adolescents (chapter "Special Education in Middle and High School" on students with reading difficulties). Some proportion of adolescents who are low in comprehension have inaccurate and/or slow decoding often accompanied by difficulties in meaning-based skills, such as vocabulary knowledge, and those with basic word reading difficulties that emerge earlier in schooling may continue to struggle with decoding in the secondary school years (Brasseur-Hock, Hock, Kieffer, Biancarosa, & Deshler, 2011). Furthermore, there are some individuals whose difficulties in reading decoding only emerge later in schooling, after the early elementary school years. These adolescents struggle with decoding, reading comprehension, or both (Catts, Compton, Tomblin, Bridges, & Sittner, 2012; Leach, Scarborough, & Rescorla, 2003).

In sum, difficulties in decoding accuracy and fluency become less of a limiting factor for reading comprehension as basic decoding and fluency skills develop to levels sufficient to support the comprehension of grade-appropriate text. However, some adolescents still struggle with basic word-level reading skills, and a significant proportion of these also have difficulties with language comprehension. In relation to the SVR, those adolescents with lower levels of decoding and

language comprehension will be severely disadvantaged when it comes to reading comprehension. The implications are that adequate decoding cannot be taken for granted in adolescent students and may present significant constraints on reading comprehension for a minority of the adolescent school population. It is important to note that even when adolescent students have word decoding problems, interventions that focus solely on word-level skills yield relatively modest effect sizes on reading comprehension in comparison to interventions that explicitly focus on the teaching of reading comprehension (see meta-analysis of Edmonds et al., 2009). The implications for assessment and intervention are quite clear. Knowing whether word decoding problems are one source of a student's comprehension difficulties is important for appropriately tailoring intervention and accommodations. On the other hand, knowing that word decoding problems are *not* the source of a student's comprehension difficulties, as is the case for many language minority students (chapter "Reading Comprehension Skill Development and Instruction for Adolescent English Language Learners: A Focus on Academic Vocabulary Instruction"), is equally important. This will help ensure that interventions with these students are not wasted on teaching already acquired basic skills. Furthermore, simply working on improving decoding skills in adolescent readers with decoding problems is unlikely to yield strong positive effects on reading comprehension unless reading comprehension is also an explicit focus of intervention for these struggling readers.

3.2 Word and World Knowledge

Given the decreasing influence of word reading skills for explaining variability in reading comprehension in older students, what do we know about the leading sources of individual differences in reading comprehension in the secondary school years? In both process and component skills models such as the DIME model, knowledge—both word knowledge (vocabulary) and world knowledge (general knowledge or topic-specific knowledge)—are presumed to be critical for comprehension. Word and world knowledge are examples of what Paris (2005) calls unconstrained skills, which start to develop before and continue to develop during and after learning how to read words. Because research with adolescents shows that word and world knowledge are largely overlapping constructs at the latent level, they are discussed together in this section.

Longitudinal studies of the role of vocabulary in the development of reading comprehension are few and are limited to the elementary grades. A study by de Jong and van der Leij (2002) found that early vocabulary skills (at age 7) predicted reading comprehension 3 years later, even after controlling for prior reading comprehension and decoding (also see Oakhill & Cain, 2012; Storch & Whitehurst, 2002). In a cross-sectional study of students from the seventh to twelfth grades, the effects of word and world knowledge on reading comprehension were direct and substantial (Ahmed et al., 2014).

In studies of children and adults with lower levels of comprehension whose word reading is intact, vocabulary difficulties extend beyond simply not knowing the meanings of words. Even when these readers know something about word meanings, they may still have difficulties rapidly and effortlessly accessing a broad range of semantic connections about and between words. For example, low comprehenders may struggle with the ability to quickly relate not only the highly associated words *brother-sister*, but also the semantically related words *brother-father* (Nation & Snowling, 1999).[1] In Evoked Response Potential (ERP) studies, Perfetti and colleagues have found that adults who are good decoders but less skilled comprehenders show a smaller neural effect of semantic relatedness between words, which is consistent with the idea that lexical representations for and between words are of lower quality for these individuals than they are for more skilled comprehenders (e.g. Landi & Perfetti, 2007; Perfetti & Stafura, 2014). Similarly, even when good decoders who are less skilled comprehenders have the world knowledge needed to make inferences they are less likely than their skilled peers to integrate that knowledge with text to maintain coherence (Cain, Oakhill, Barnes, & Bryant, 2001). In relation to cognitive models of comprehension, difficulties in the rapid access or activation of networks of word and world knowledge during reading will reduce the reader's ability to fluently establish and maintain local semantic coherence.

What do we know about the importance of word and world knowledge for the types of texts that adolescent students must understand and use to learn? For comprehension of disciplinary texts (e.g., biology), the effect of topic knowledge is particularly strong (Cromley et al., 2010). Social studies texts and science texts in the secondary grades have higher levels of lexical difficulty (low frequency words and more specialized vocabulary) than more narrative texts at the same grade level (McNamara et al., 2012). Because it is estimated that readers need to know the meanings of at least 90 % of the words in text in order to understand what they are reading (Nagy & Scott, 2000), this high degree of lexical complexity in informational texts will have significant effects on comprehension in subjects such as science, social studies, and math for middle and high school students.

In summary, because knowledge (word and world) must be integrated with propositions in the text in order to form the situation model, lack of knowledge or inefficient access to knowledge will have significant implications for the construction of the situation model. This is the level of text representation associated with a deep level of understanding and learning from text. The texts that must be comprehended and used to learn new information in the secondary school years become increasingly informational and discipline-specific with specialized vocabulary and specific topic knowledge, making comprehension particularly challenging for lower knowledge students who must simultaneously deal with unknown words in the text as they are trying to learn new mathematical, scientific, or social science concepts

[1] Also see Henderson, Snowling, and Clarke (2013) for an example of difficulties in rapidly accessing less frequent word meanings, such as the *river* meaning of *bank*.

from the same text (van den Broek, 2010). Texts that provide relevant background knowledge to low knowledge students lead to better comprehension and recall of the central ideas in a text (Miller & Keenan, 2009); however, informational texts often assume (and do not provide) the background knowledge and meanings of difficult lexical items required to construct an adequate situation model of the text (van den Broek, 2010).

Because the direct and indirect effects of knowledge on reading comprehension in adolescents vary reliably with comprehension level—and are significant and large—we would consider word/world knowledge to be an integral component of comprehension rather than merely a cognitive correlate of comprehension. What are the implications of this view for instruction, intervention, and assessment for adolescent students?

In terms of assessment, it might be helpful to know to what extent an individual's difficulties in comprehension are associated with lack of knowledge. There is some evidence that individuals who have generally good comprehension skills may be better able to compensate for lack of knowledge during reading than readers with generally lower reading abilities (O'Reilly & McNamara, 2007). However, the compensatory mechanisms used by better readers when knowledge is lacking are not well understood. New approaches to measuring comprehension such as those described in chapter "Improving Comprehension Assessment for Middle and High School Students: Challenges and Opportunities" on assessment, sometimes provide background knowledge as well as the meanings of important words in the text as part of the assessment process. The appeal of such an approach is that it provides an assessment of comprehension when knowledge is equated between individuals or is, at least, less of a factor in test performance (see Barnes, Dennis, & Haefele-Kalvaitis, 1996). However, if word and world knowledge are integral components of comprehension, then we also have to be aware that a reading comprehension test that provides word and world knowledge is going to tell us something different about comprehension from tests that do not have these design features. Apart from norm-referenced assessments, teachers will need to know what word and world knowledge their students do and do not have so that instruction of word and world knowledge important to understanding disciplinary-based text can be provided. One question to ask about disciplinary-based instruction and interventions (e.g., literacy instruction embedded in social studies) is whether their success ought to be based on students acquiring disciplinary-specific knowledge rather than on any existing benefits for comprehension more generally.

The instructional message in chapter "Reading Comprehension Skill Development and Instruction for Adolescent English Language Learners: A Focus on Academic Vocabulary Instruction" on English Language Learners is aligned with what is known about the importance of word and world knowledge for comprehension. The teaching of academic language is likely necessary for improving comprehension of adolescent English learners as well as for students with low knowledge related to socio-economic disadvantage (Lesaux, Kieffer, Kelley, & Harris, 2014). Vocabulary instruction may be particularly helpful for the reading comprehension of students with learning difficulties. Larger effects sizes for these

students were found in a meta-analysis of the impact of vocabulary instruction on reading comprehension among school-age children in comparison to the relatively modest effect sizes of vocabulary instruction found for the student population as a whole (Elleman, Lindo, Morphy, & Compton, 2009).

Attempts to increase content specific knowledge have also resulted in improvements in reading comprehension. Two recent experimental studies of classroom-wide interventions in social studies that focused on content-specific knowledge acquisition using a team based-learning approach found significant effects for content knowledge acquisition and comprehension of disciplinary-specific history text. In the first study, eighth grade students also significantly improved their comprehension on a standardized reading comprehension measure (Vaughn et al., 2013). In the second study, eleventh grade students demonstrated significant acquisition of content knowledge; however, the effects (and growth in the treatment group) were largest for those students who had some content specific knowledge prior to the research-based instruction (Wanzek et al., 2014). Such findings are important because they suggest that students may need a basic level of domain-specific knowledge in order to benefit from on grade-level disciplinary-specific instruction.

Compton, Miller, Elleman, and Steacy (2014) have argued that because the relation of knowledge and comprehension is so strong, the next generation of reading comprehension interventions ought to be primarily concerned with building specific topic knowledge prior to reading and making judicious use of diverse texts that cluster around a theme in order to promote the acquisition and use of broader knowledge bases. Word and world knowledge could be considered integral components of adolescents' reading comprehension. Given this and some of the positive findings from intervention studies that explicitly focused instruction on building academic language and content knowledge for typically developing adolescent readers, English Language Learners, and adolescents with learning difficulties, it would seem that knowledge interventions of the type suggested by Compton et al. (2014) may hold promise for future intervention research with adolescents implemented across content areas.

3.3 Discourse-Level Skills

Discourse-level skills, including inference/integration and comprehension monitoring, qualify as additional integral skills for reading comprehension based on evidence from longitudinal studies, robust variation with comprehension skill level, and experimental intervention studies. The studies discussed below focus primarily on inference and integration.

In a longitudinal study conducted by Oakhill and Cain (2012) the predictors of growth in word reading and reading comprehension from ages 7–8 to ages 10–11 were measured. The developmental precursors of word reading differed from those for reading comprehension. Taking into account reading comprehension from previous time points, inference and monitoring skills contributed unique

variance to later reading comprehension outcomes over and above that explained by word reading, vocabulary knowledge, and other cognitive measures (also see Cain, Oakhill, & Bryant, 2004). These discourse-level skills are aspects of reading identified as important in the process models of reading comprehension discussed above, and overlap with two of the component skills represented in the DIME model—inference and strategy use.

In process models of reading comprehension, inference and integration skills are needed to maintain local and global coherence. Inferences made between parts of text and between knowledge and text are important for learning, particularly from informational texts (van den Broek, 2010). The importance of inference and integration for reading comprehension in adolescent students receives additional support from recent modeling of comprehension in middle and high school students which showed that a latent inference factor, consisting of inferences between sentences within a text as well as rapid integration of knowledge and text during reading, was the strongest direct predictor of reading comprehension after accounting for method variance (Ahmed et al., 2014). Inference also emerges as a strong predictor of reading comprehension in other tests of the DIME model and mediates some of the relation of word and world knowledge to comprehension (Cromley & Azevedo, 2007; Cromley et al., 2010).

Longitudinal and cross-sectional studies of inference suggest that inference-making improves over the elementary school years (Barnes et al., 1996; Oakhill & Cain, 2012; Pike, Barnes, & Barron, 2010), but little work has been conducted on whether there are age-related changes in inference and text integration in the middle and high school years. A recent cross-sectional study of adolescents suggests that there is considerable change from the middle school to high school years in the ability to make inferences that integrate consecutive sentences in a text in order to maintain local semantic coherence; high school students are more skilled than middle school students at making these types of inferences (Barth, Barnes, Francis, York, & Vaughn, 2015). Although lack of knowledge has negative consequences for making inferences that integrate knowledge and text, it is worth noting that difficulties in inference-making in struggling comprehenders persist even when they have the requisite knowledge needed to make inferences (Cain et al., 2001). Thus, difficulties in inference and text integration are not simply due to lack of knowledge

In terms of comprehension monitoring, struggling comprehenders are less likely than their more skilled peers to detect inconsistencies in text and, therefore, are less likely to attempt to repair breaks in coherence (Oakhill, Hartt, & Samols, 2005). What is unclear is whether difficulties in comprehension monitoring reflect a problem with comprehension monitoring skill, per se, or reflect the adoption of lower standards of coherence for text (van den Broek et al., 2005). That is, struggling comprehenders may not expect text to always make sense (Perfetti & Adlof, 2012) and, therefore, they may not notice breaks in coherence and/or may not employ effortful strategies to repair breaks in coherence.

Reading comprehension assessments vary in the component skills and processes that they tap (Francis, Fletcher, Catts, & Tomblin, 2005; Keenan et al., 2008); for example, some explicitly assess inferential aspects of comprehension, some

are more closely related to variation in word decoding than others, and some rely more or less on prior knowledge to answer questions (Keenan et al., 2008). More recent adaptive measures such as those described in the assessment chapter (chapter "Improving Comprehension Assessment for Middle and High School Students: Challenges and Opportunities") tend to have a greater proportion of inferential questions (e.g., *Why* questions) at higher levels of the test, which is consistent with the types of reading and analysis that are part of the Common Core State Standards. Tighe and Schatschneider (2014) suggested the dominant relationship of nonverbal problem solving with reading comprehension in their cross-sectional study at tenth grade might be due to the increased requirement for inferential processing at higher levels of the particular reading comprehension test used in their study. Given the importance of inference and text integration for reading comprehension, the assessment of inferential aspects of comprehension would seem to be an important component of reading comprehension measures for secondary school students.

Discourse-level skills are malleable based on experimental (i.e., intervention) studies with children with and without comprehension difficulties. Although intervention research on inference-making is relatively sparse and most studies were conducted several years ago (but see Elbro & Buch-Iversen, 2013 and Fritschmann, Deshler, & Schumaker, 2007), several of these studies report improvements in both inference-making and reading comprehension (see synthesis in Hall, 2015 for struggling comprehenders). Although strategy use, when in the presence of other factors such as knowledge and inference, has relatively small effects on reading comprehension that are mediated by inference (Ahmed et al., 2014; Cromley & Azevedo, 2007), strategy instruction aimed at improving comprehension monitoring through the use of question asking, summarization, and the like has been associated with positive treatment effects for individuals with and without disabilities (e.g., National Reading Panel (US), National Institute of Child Health, & Human Development (US), 2000; Solis et al., 2012), particularly for adolescent students (e.g., Edmonds et al., 2009) and for the learning of disciplinary-based content (e.g., science, social studies, English language arts) in adolescents with learning difficulties (Scruggs, Mastropieri, Berkeley, & Graetz, 2010).

Knowing that adolescent readers have limitations in their inference capacity (Barth et al., 2015) and that informational texts often strain this capacity (van den Broek, 2010), texts to promote learning need to be chosen with care. Teacher scaffolding of such text may also be required in order for students to draw accurate inferences between key ideas in the text and between knowledge and text. In light of the emerging pattern of findings about the strength of relations of component skills to reading comprehension, it is interesting to note that interventions that focus on strategy use are far more plentiful than those that focus on teaching and practicing inference and integration skills. Interventions that serve to improve inference-making might also affect reading comprehension. One potentially fruitful avenue for research with adolescent readers might be to develop and test inference/integration interventions, perhaps using technology (not available when the majority of earlier studies was conducted) to provide sufficient practice with making inferences that support both local and global coherence.

4 Text Characteristics That Affect Comprehension for Adolescent Readers

Process models of comprehension consider how text structure and characteristics of the text affect how text is processed as well as how these text characteristics interact with reader characteristics. Most of the research that has been done on knowledge and use of text structure involves narrative text. Understanding and use of text structure is a significant unique predictor of reading comprehension in longitudinal studies of younger children (Oakhill & Cain, 2012). However, the texts that middle and high school students must understand and use to learn become increasingly informational and discipline- or content- specific (See Chapters in this volume on math, science, and social studies). Text structures for informational text and the types of relations that are common in these texts (e.g., causal, logical, temporal) are often less familiar to students than those found for narrative text. Informational text structures can be taught and used to promote comprehension of informational text even for young elementary school children (e.g., see Williams et al., 2005, 2014), and there is some evidence that text strategy instruction for informational text may be particularly helpful for individuals with learning difficulties (Hebert, Bohaty, & Nelson, 2014).

What is known about the text characteristics in discipline-specific domains that can affect adolescents' reading comprehension? McNamara et al. (2012) analyzed narrative, social studies, and science texts by sampling from materials appropriate for students from the early primary to the late secondary grades. Narrative texts had the least challenging words but the most challenging sentences, so, in narrative text, lexical complexity compensated for increasing sentence complexity with increasing grade. Furthermore, narrative texts in the higher grades were more cohesive at a global level, which likely contributes to the ability to construct an accurate situation model for this type of text. In contrast, social studies texts were found to have high lexical difficulty, high sentence complexity, and low cohesion. That is, cohesive devices to signal causal and temporal relations were often absent in such texts, making comprehension of and learning from social studies texts particularly challenging for secondary school students.

The ability to process, track, and remember temporal relations shows developmental change well into middle childhood and adolescence, which is believed to be related to capacity-based difficulties in revising situation models to accommodate events that are presented out of sequence (Pyykkönen & Järvikivi, 2012). So, the fact that these temporal relations are not always well-cued or clarified in social studies texts suggests that a significant proportion of the texts being read by adolescent students will exceed their developmental capacities if their reading of such texts is not supported by considerable scaffolding.

McNamara et al. (2012) also found that science texts had high lexical difficulty due to the use of many topic specific terms and concepts. In addition, they contained more causal and clarification cohesive devices than did social studies texts to cue important relations. But cues signaling the direction of causal relations were often absent, thus contributing to lower cohesion.

Reader characteristics (e.g., general reading skill, knowledge, working memory) and the reader's purpose for reading interact with complexity (lexical and syntactic) and text cohesiveness in relatively complex ways (e.g., Bohn-Getter & Kendeou, 2014; Ozuru, Dempsey, & McNamara, 2009). This contributes to low cohesion texts being particularly difficult for struggling readers to understand. However, on grade-level texts are rendered more comprehensible for these less skilled readers if the appropriate cohesive devices are added to text and text complexity is reduced (Reed & Kershaw-Herrera, in press). Overall, these findings on text complexity, cohesion, and their interactions with reading skill suggest that the choice of text will matter a great deal for promoting subject-specific learning in secondary school settings for many students, but perhaps particularly for less skilled readers.

In sum, informational texts pose challenges for comprehension in the secondary grades not only because of the number of unfamiliar words, but also because important causal and temporal relations are often not cued by cohesive devices such as words that denote causal connections and temporal relations. Van den Broek (2010) says of informational texts "Most texts outpace most readers' attentional resources" (p. 454) requiring that the reader employ considerable effortful *search after meaning* strategies. Therefore, instruction in these *search after meaning* strategies may be of greatest benefit when applied to students' comprehension of informational text.

5 Concluding Comments

Models of reading comprehension have been useful for guiding studies of typical and atypical development of reading comprehension. Enough is known to propose that a relatively small set of knowledge and skills are of particular importance for comprehension based on a convergence of findings from longitudinal, experimental, and model testing studies. Word and world knowledge, inference/integration, and—to a lesser extent—word reading and comprehension monitoring and strategy use emerge as knowledge and skills of greatest relevance for reading comprehension in adolescents. As well, characteristics of the text (e.g., lexical difficulty and the presence/absence of cohesive devices that cue important relations in text) likely affect comprehension in middle school and high school students. This research on developmental and individual differences in comprehension and text characteristics is sufficiently well-developed to inform assessment, instruction, and interventions for adolescents. Despite increasing agreement in the field about the skills that are necessary for comprehension, information about development and change in these skills over the adolescent years is sparse. Yet, such information would be informative for understanding reading comprehension, how to measure it, and how to improve it in adolescent students. Although intervention research that specifically addresses these important sources of variance in comprehension is emerging, the further development and testing of interventions in knowledge

building and inference-making/integration skills across content domains might be a fruitful avenue to pursue to improve literacy outcomes for middle and high school students.

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Reading History: Moving from Memorizing Facts to Critical Thinking

Dixie D. Massey

Abstract The task of reading and studying history in the K-12 setting has long been a memory task—knowing dates, places, and events. In contrast, historians use disciplinary-specific heuristics of sourcing, corroboration, and contextualization to understand not just what the text says, but when the text was written, who wrote it, and what may be missing from the text. "Doing history" is largely dependent on reading and studying texts (VanSledright, Read Res Q 39:342–346, 2004b) and it is the texts themselves, as well as the thinking about those texts that distinguishes history from other disciplines. This chapter explores what makes text in history different from texts in other disciplines. Identifying what makes historical texts unique suggests specific instruction that is needed to move students from novice readers to readers with growing levels of expertise in disciplinary reading.

Keywords History • Disciplinary literacy • Social studies

1 Introduction

Even before disciplinary literacy was popular, researchers were considering what is unique about reading history texts. Historians and history educators are at least partially responsible for the shift away from a content-area reading approach towards a discipline-specific oriented approach to reading instruction. Thanks to the work of Wineburg (1991), VanSledright (1995), and others (e.g., Afflerbach & VanSledright, 2001; Hynd-Shanahan, Holschuh, & Hubbard, 2004), we have work that considers how historians read as well as how novices read history—from elementary students all the way through graduate students. This foundational work has long provided a contrast to other approaches to reading, both general strategies and in other disciplines.

This chapter will give a broad overview of reading in history in relation to the current research on effective reading instruction. Historians know the importance

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of contextualizing information; thus, the chapter begins with a survey of reading history to trace the lineage of the disciplinary reading approach. Next, the chapter considers what makes text in history unique. This will then be compared to reading knowledge when considered as a developmental continuum. Based on the presented research, the chapter examines what kind of instruction is needed to develop students who are able to handle history texts thoughtfully and with at least some level of expertise. Finally, the chapter will conclude with a focus on ongoing issues that researchers and practitioners must address.

2 Contextualizing: Reading Instruction Then and Now

What counts as successful reading? The answer to that question has evolved over centuries of instruction in the United States. In the early 1800s, the focus of reading was on oral recitation and memorization (Mraz, Rickelman, & Vacca, 2009). Although this approach persisted into the twentieth century, some scholars began highlighting the importance of understanding and thinking about the meaning of text (e.g. Huey, 1908/1968; Thorndike, 1917).

Early reading instruction focused on young readers. The advent of World War I highlighted the problem of illiteracy among the soldiers in a way that raised the general public's awareness and focused attention on older readers. During the same time, child labor laws were implemented and children stayed in school longer. With more children continuing their education, more and more junior high schools were created. The result was a growing awareness of the need for different types of reading instruction for adolescents and in specific contents (Sears, n.d.; Tyack & Cuban, 1995).

William S. Gray, the editor of the popular *Dick and Jane* series, studied 250 teachers of fourth through sixth graders to better understand subject area instruction (as cited in Vacca, 2002). This is considered one of the first studies in what we now recognize as content area reading. Though researchers continued to look more closely at adolescent readers and reading in specific contents, it wasn't until the 1970s that content reading began to receive more scholarly and practitioner attention (Mraz et al., 2009). This paralleled Deloris Durkin's (1978/1979) monumental study highlighting the lack of comprehension instruction during classroom reading instruction. The result was a focus on helping students in content area courses learn a set of general reading strategies that could be applied to multiple content areas (Tierney, Readence, & Dishner, 1985), with an emphasis on what was similar, not unique, in the disciplines (Leinhardt, Stainton, & Virgi, 1994). Such strategy instruction was meant to "teach students how to approach content-area learning in a deliberate and critical manner" (Mraz et al., p. 83).

In recent decades, the content area reading approach that focuses on general strategies to be applied across disciplines has come under criticism (Conley, 2008; Shanahan & Shanahan, 2008). Shanahan and Shanahan wrote that general strategies become less generalizable as one moves into the complexities and specific nature

of disciplinary knowledge. Star, Strickland, and Hawkins (2008) went so far as to suggest that general strategies do not help students apply reading strategies to discipline-specific text.

Current reviews of adolescent literacy push researchers to look more deeply at the specificity of reading within each discipline and less at generalizable strategies (Conley, Freidhoff, Gritter, & Van Duinen, 2008; Moje, Stockdill, Kim, & Kim, 2011; Shanahan, 2009). Here it should be noted that discipline, as most commonly used in the literature reviewed for this chapter, refers to a broad subject area (Rouet, Favart, Britt, & Perfetti, 1997; Shanahan, 2009; Shanahan, Shanahan, & Misischia, 2011; Wineburg, 1998). History and mathematics are disciplines. Within the disciplines, most experts have an area of particular focus, typically referred to as domain-expertise. For example, a historian has studied within the discipline of history but might have domain-expertise in World War I.

A disciplinary emphasis suggests questions and patterns of focus. Howard Gardner (2000) wrote in *The Disciplined Mind,* "At any given moment the disciplines represent the most well-honed efforts of human beings to approach questions and concerns of importance in a systematic and reliable way" (p. 146). Chapman, Counsell, McConnell, and Woolley (2007) echoed Gardner's focus by noting that the disciplines push us to consider questions, evidence, causes, and issues of significance in patterns of thinking that are specific rather than general. Reading is the most common form of pursuing those questions. Shanahan (2009) wrote, "Reading in the disciplines requires disciplinary knowledge—knowledge of the way information is created, shared, and evaluated for quality" (p. 241). Specifically, history text, whether textbook or primary sources, is complex and differs from other disciplinary texts.

Although historians have been considering this for several decades (Wineburg, 1991), focus on the complexity and the specificity of disciplinary texts, such as history texts, is a relatively new focus of reading researchers. For example, the *Handbook of Reading Research, Vol. III,* (Kamil, Mosenthal, Pearson, & Barr, 2000) referred to integrated curriculum (Gavalek, Raphael, Biondo, & Wang, 2000) that wove subject areas together. Bean (2000) wrote a chapter in that volume on reading in the content areas where he observed that research had shifted from a cognitive approach focused on which strategies are most effective and generalizable across contents to a socially constructed focus. No mention was made of discipline-specific reading or text. This changed with the *Handbook of Reading Research, Vol. IV* (Kamil, Pearson, Moje, & Afflerbach, 2011) where specific needs of adolescents in disciplinary literacy were addressed (Alexander & Fox, 2011; Moje et al., 2011).

Much of the research reported in the present chapter considers how to close the divide between history at the university level and history as a subject in the K-12 setting. Here it should be specified that the bulk of research available focuses on reading in history, as opposed to reading in the other areas of social studies such as civics or economics. This chapter will continue that focus on history, while at the same time echoing Conley's and colleagues' et al., observations that we need to examine multiple sub-disciplines in depth in order to understand the complexities of the reading required in each discipline (Conley, 2008, 2009; Conley et al., 2008).

3 What's So Unique About History Text?

Early research in the discipline of history (e.g., Wineburg, 1991, 1998) focused on what historians do—the questions that guided their thinking, the actions taken when they read, and the stance that they took toward information: "History as practiced in the contemporary academy is suspicious, secular, public, qualified, and, to use Sir Karl Popper's lapidary term, 'falsifiable.' Unlike religion, in which faith cements belief, history requires evidence—tangible, verifiable, and open to scrutiny" (Wineburg, 2007, p. 7).

Historians' actions and inquiry methods have been in sharp contrast to K-12 practices when studying history. The task of reading and studying history in the K-12 setting has been a memory task—knowing dates, places, and events. Bain (2008/2009) described the dichotomy as follows:

> History at the university was a discipline, a unique way of knowing the world that professionals shared. In the high school, history was a subject students took and teachers taught, differing from other subjects only in the facts covered. Students claimed that they did in history exactly what they did in other courses—used texts, memorized facts, did homework, and took tests. In the minds of adolescents, there is little unique about history (p. 159).

Historians and educators currently argue that there is much unique about historical content. "Doing history" is largely dependent on reading and studying texts (VanSledright, 2004b) and it is the texts themselves, as well as the thinking about those texts that distinguish history from other disciplines.

3.1 What Counts as Text

The task of reading history is one of inquiry and interpretation (Bain, 2006; Shanahan, 2009; Wineburg, 1991, 2001). Simply deciding what counts as readable text is one of the first elements complicating the discussion of reading in history. For decades, the history textbook was the authoritative source that presented all of the history that students needed to know (Moje et al., 2011). More recently, the history textbook has come under increasing scrutiny and criticism for a variety of reasons. First, the textbook is problematic because students often perceive it as authoritative (Bain, 2006; Juel, Hebard, Haubner, & Moran, 2010; Moje et al., 2011; Paxton, 1999; Shanahan, 2009). Shanahan posited,

> The invisible author provides the typical reader with the perception that the causes are, indeed real. That is, because the author does not share his or her sources of information, analytic procedures, and determinations of reliability and validity, the cause and effect statements are not "checkable."(p. 251)

Further, treating the textbook as authoritative interferes with the process of examining multiple sources to create a plausible and coherent interpretation; that is, historical inquiry. Bain (2006) noted that if textbooks are accepted as authoritative,

then the act of "doing history" or inquiry is never really started because there is no question or problem to explore. Although historians do refer to secondary and tertiary sources, historians "do not accord [the textbooks] the authority given the textbook in a classroom" (Moje et al., 2011, p. 465).

Additionally, the organization of the textbook is ambiguous, with embedded texts and multiple text structures. The typical structure of history texts is narrative and descriptive. The persuasive structures that historians frequently notice (Wineburg, 1991) are embedded within the narrative structure and, thereby, are often hidden from students (Shanahan, 2009).

The response of history educators has been the inclusion of primary sources as text along with, and sometimes instead of, the traditional textbook (Bain, 2006; Wineburg, 1999, 2010; Wineburg & Martin, 1994; Wineburg, Smith, & Breakstone, 2012). Morgan and Rasinski (2012) noted, "Primary sources help students develop immediacy to the time period or event and allow for a natural compare–contrast that deepens understanding of the past as well as the present" (p. 585). However, the use of primary source text instead of, or in addition to, a textbook presents a set of unique challenges to readers, including a variety of genres and text structures, multiple points of view, historical references, specialized vocabulary, and the specificity of language, as described in the following sections.

3.2 Variety of Genres and Text Structures

One of the significant challenges students face when reading primary text or textbooks with excerpts from primary sources is the variety of genres presented in each text (Ogle, 2010). Wyman (2005) listed five broad categories of primary sources:

- Written documents (e.g., letter, diaries, manuscripts)
- Government Documents (e.g., census records, government reports, birth certificates)
- Printed documents (e.g., newspaper articles, books, magazine articles)
- Visual Artifacts (e.g., maps, photographs, drawings, posters)
- Oral Artifacts (e.g., audio files)

Each genre might contain multiple text structures. For example, written documents might contain descriptive text structures as well as cause-effect text structures. Diaries and letters might contain more narrative text structures. Visual artifacts might be part of a printed document, requiring interpretation of both printed and visual text.

Lack of experience reading a variety of genres and text structures contributes to students' novice reading of history texts (Afflerbach & VanSledright, 2001; Perfetti, Britt, & Georgi, 1995; Wineburg, 1991). Although textbooks frequently include both embedded primary source quotes as well as references to additional primary sources, there is little research that guides how even embedded work might be used to further

students' understanding of genre and text structure (Afflerbach and VanSledright 1998). Afflerbach and VanSledright (2001) noted that although students enjoyed the information presented in the primary source excerpts, they were unable to evaluate it and use it to deepen their understanding.

Understanding multiple genres and text structures comes only from purposeful instruction using a variety of texts. Though students as young as primary grades have experienced success reading primary documents when carefully scaffolded (Morgan & Rasinski, 2012; VanSledright, 2004a), it is much more typical for primary sources to be completely neglected in the elementary grades (Morgan & Rasinski, 2012). By the time students enter middle and high school where entire courses are devoted to the study of history are required, typically students have limited background with the numerous genres and text structures they will be required to read.

3.3 Multiple Points of View

Although a single textbook may represent multiple authors, it generally presents a shared point of view. However, collections of primary sources can represent multiple points of view: rich or poor, opposing political parties, expert or novice. Researchers and practitioners currently argue that in order to understand history, students need to do historical inquiry, which requires them to examine multiple sources. These sources help students evaluate the credibility and reliability of the information (Shanahan, 2009; Wyman, 2005). However, multiple sources about a topic typically present conflicting information. Although this is beneficial in gaining deeper understanding about an issue, it can also present a challenge to students.

Discrepancies in texts are frequently overlooked by students without careful instruction from teachers (Dutt-Doner, Cook-Cottone, & Allen, 2007; Foster & Yeager, 1999; Lee & Ashby, 2000; Shanahan, 2009; VanSledright & Kelly, 1998). Instead of noticing the differences in points of view and evaluating accordingly, students frequently take a more passive view, approaching each text as a set of facts to be remembered (Paxton, 1999; VanSledright, 2002b; VanSledright & Kelly, 1998). Hynd-Shanahan et al. (2004) noted that when students were asked to read multiple documents they used mostly general reading strategies such as memorizing dates. Just as with the textbook, students frequently assign authority to the source and fail to consider the reliability of the author (Moje et al., 2011; Wineburg, 2001). Instead, students may use primary sources to support a previously held idea rather than develop deeper historical understanding.

3.4 Historical References

A typical text in history frequently requires the reader to have extensive background knowledge (Buehl, 2011; Moje et al., 2011). The simple use of proper names presents the reader with multiple components: decoding words, understanding the

meaning of the words in isolation as well as within a phrase, and identifying references. For example, a text about the United States' treatment of Native Americans may only reference the Sand Creek Massacre one time, but understanding the reference requires understanding that Sand Creek implies a location, knowing the meaning of massacre, and realizing that together the words refer to a specific killing of Native Americans. Or consider a single paragraph describing Israeli-Palestinian relations. A single paragraph from a newspaper account might require knowledge of historical and current geography, historical and current political systems, regional culture, and the religions of Islam and Judaism as well as an understanding of the role World War II played in the creation of Israel (Buehl, 2011). Students need the context to understand the significance and interpretation of historical references, while at the same time they need a basic understanding of historical reference to understand the context.

3.5 Specialized Vocabulary

Every discipline requires specialized vocabulary. Social studies has been referred to as an overloaded content (Bailey, 2007; Ogle, Klemp, & McBride, 2007) that is actually a composite of multiple subdisciplines. Bailey posited that students encounter more than 600 discipline-specific words in a single secondary social studies course. To further complicate the issue, many of those words may be antiquated and used in ways that are presently obsolete (Moje et al., 2011). For example, Bryson (1990) offered examples of words that have evolved to mean the opposite of what they originally meant:

> *Counterfeit* once meant a legitimate copy. *Brave* once implied cowardice—as indeed *bravado* still does. *Crafty*, now a disparaging term, originally was a word of praise, while *enthusiasm* which is now a word of praise, was once a term of mild abuse. *Zeal* has lost its original pejorative sense, but *zealot* curiously has not (pp. 77–78).

These few examples emphasize the complexity of the vocabulary present, particularly in primary sources. Present-day meanings may not be the same meanings intended when the source was written, even if students recognize the word.

Academic vocabulary is required not only to understand the texts, but also to communicate effectively (Heafner & Massey, 2012). Knowing specialized vocabulary opens doors for students to become insiders (Moore, Readence, & Rickelman, 1989). Researchers have documented two clear benefits of vocabulary knowledge:

1. There is a positive relationship between vocabulary knowledge and comprehension (Beck, McKeown, & Kucan, 2013; Elleman, Lindo, Morphy, & Compton, 2009; Graham, 2013; Graves, 2009). Stahl and Nagy (2006) noted that possessing larger vocabulary makes students better readers.
2. Vocabulary knowledge is cumulative and generative (Flanigan, Templeton, & Hayes, 2012; Stahl & Nagy, 2006). The more words students know, the better they are able to approximate a definition of new words and assimilate new

meanings. This frequently occurs because of the knowledge of base words and the multiple forms they take with the addition of affixes as well as an understanding of Latin and Greek roots.

Traditional means of learning vocabulary in history classes have included lengthy lists of words that students memorized (VanSledright, 2011). Yet what we know about vocabulary learning has shown the ineffectiveness of this method. Heafner and Massey (2012) wrote,

> Comprehension derived from a rich vocabulary base requires more than definitional learning or phonetic usage; it demands understanding of discipline-specific word meanings in authentic reading and visual context. Proficient use of, and control over, the academic language of social studies becomes central to student learning (p. 7).

This level of knowledge requires multiple exposures to the words. Stahl and Nagy (2006) estimated that it takes anywhere from 4 to 12 exposures in order to truly understand the meaning of a word. This exposure to words cannot occur as merely references or memory reviews but, instead, should accompany focused reading of content texts and instruction that supports comprehension of the text (Beck et al., 2013; Blachowicz, Ogle, Fisher, & Watts-Taffe, 2013; Graham, 2013; Heafner & Massey, 2012; Stahl & Nagy, 2006).

3.6 Specificity of Language

In addition to specific vocabulary, texts in the social studies are written using specific patterns of language. These patterns of language differ from conversational language and from the patterns of other disciplines (Fang & Schleppegrell, 2010; Scheleppegrell 2004; Schleppegrell, Greer, & Taylor, 2008). Three common patterns specific to history texts are abstraction, interaction of time and cause, and interpretation (Schleppegree & de Oliveira, 2006). Consider just one of those patterns—abstraction. History texts typically use nominalizations to describe events. Nominalizations are nouns which are derived from verbs or adjectives. The result is an increasingly abstract text that both differs significantly from the typically patterns of conversation, as well as makes it difficult to understand who or about what the authors of the text are writing.

History texts further use abstraction to give a sense of authority. For example, most textbooks are written in the third person. A phrase might state that the army was "hopelessly inadequate." The authors do not state that "they believe the army was hopelessly inadequate" or that their interpretation of primary sources leads them to conclude that the army was hopelessly inadequate. Without careful instruction, students frequently accept textbooks as authoritative, in part because of the patterns of language in which they are written.

4 Reading and Thinking About Text

Research has focused not only on what is unique about the history text, but also what the reader must do as they read the history text. Some work refers to reading like a historian (Wineburg, Martin, & Monte-Sana, 2011), while other refers to thinking like a historian (James & McVay, 2009; VanSledright, 2002b; Wineburg, 1999), and still other work references both reading and thinking like a historian (VanSledright, 2004b). It must be emphasized that reading and thinking are not separate. In the contexts of the research, reading is not merely identifying words; reading must be accompanied by thinking.

Historians read and think about the text in certain ways. Historians view history as an account that differs from other accounts (Bain, 2006) and take an inquiry approach to the texts that asks complex questions about why and how (Wineburg, 1991). Conversely, history in school has been viewed as a chronology of events to be learned from a "truthful and unexamined master" (Lee & Spratley, 2010, p. 7). Theories presented in the following sections emphasize how to make the inquiry processes used by historians explicit and useable for K-12 teachers and students.

4.1 Heuristics for Reading

Reading and thinking like a historian is sometimes described as being able to think critically, guided by discipline-specific processes (Afflerbach & VanSledright, 2001; Sandwell, 2005; Wineburg et al., 2012). Expert-reader studies suggest that disciplinary experts have a protocol of decisions that they make when reading (Wineburg, 1991, 1998). Wineburg (1991, 1998) identified three history-specific reading/thinking processes that he labeled heuristics: sourcing, corroboration, and contextualization. These heuristics guide the decisions that experts use to examine history.

4.1.1 Sourcing

Sourcing is the process of identifying where texts came from, who wrote them, and evaluating how reliable the authors are. This can be as simple as noting and making evaluations about texts based on if the story appears in *Time* magazine, a popular blog, or the opinion page of a newspaper. If the author is known, the reader may also evaluate the text based on the author's reputation or his position. Martin and Wineburg (2008) emphasized the importance of sourcing: "Sourcing is key to understanding how knowledge is made in many disciplines, but it is especially important in history" (p. 305).

4.1.2 Contextualizing

Contextualizing is the process of identifying other events that may have influenced the author of the text such as particular policies, institutions, and circumstances (Reisman & Wineburg, 2008). Wineburg (1998) emphasized, "The creation of context lies at the heart of historical expertise, forming the foundation upon which sound historical readings must rest" (p. 337). For example, some of Abraham Lincoln's words can be viewed as racist when it comes to issues of slavery. Wineburg explained, "Modern readers tend to view Lincoln's statements as contradictory and inconsistent, or worse—hypocritical and self-serving" (p. 330). However, experts who are able to contextualize his comments understand the mid-nineteenth century views on racism and the institution of slavery. Words that now appear racist were then a liberal position based in the context. Teaching activities that support contextual knowledge include providing background knowledge, asking guiding questions, and explicitly modeling contextualized thinking (Reisman & Wineburg, 2008).

4.1.3 Corroboration

Wineburg (1991) described corroboration as "check[ing] important details against each other before accepting them as plausible or likely" (p. 77). In other words, using one document to check and verify the accounts offered in other documents helps historians judge authority and reliability. Additionally, corroboration requires intertextual reading which further complicates the reading process (Hynd-Shanahan et al., 2004; Wineburg, 1991). When corroborating evidence, the reader might notice discrepancies between accounts or a lack of details in accounts, and judge the plausibility of accounts based on the presented information (Wineburg, 1991).

4.2 Habits of Mind

Effective use of sourcing, contextualizing, and corroboration are only part of historical thinking. The College Board's (2011) recent publication titled *Historical Thinking Skills* noted, "The redefined historical thinking skills and their components provide an essential framework for developing historical habits of mind" (p. 3). The authors listed the following historical thinking skills:

1. Crafting Historical Arguments from Historical Evidence: "Historical thinking involves the ability to define and frame a question about the past and to address that question by constructing an argument" (College Board, 2011, p. 1).
2. Chronological Reasoning: This skill is comprised of three components: evaluating historical causation, patterns of continuity and change over time, and periodization.

3. Comparison and Contextualization: This skill requires being able to compare and contextualize "developments across or between different societies, and in various chronological and geographical contexts" (College Board, 2011, p. 2).
4. Historical Interpretation and Synthesis: The final skill emphasizes the ability to create diverse interpretations in contrast to a single answer.

These historical habits of mind emphasize the specific nature of reading, writing, and thinking within a particular discipline. The focus of the habits of mind is to move students away from passivity and towards critical thinking by showing them what questions to ask (Martin & Wineburg, 2008; Paxton, 1999; Wineburg et al., 2012). What neither the heuristics nor the habits of mind indicate is the developmental nature of such thinking.

5 Development of Reading

Not everyone approaches historical text with the same level of expertise. The novice-expert continuum is a well-used paradigm when examining reading from a developmental perspective (See Shanahan et al., 2011, for a more detailed review of the novice-expert paradigm specific for literacy). Accompanying the focus of disciplinary literacy is research that suggests expertness is a function of the discipline; that is, expert readers of history differ from expert readers in mathematics or poetry (Massey & Riley, 2013; Shanahan et al., 2011).

5.1 Expert Readers

To better understand what occurs in an expert reading of history text, researchers have studied historians' reading of historical text (Rouet et al., 1997; Wineburg, 1991, 1994, 1998). Historians read across sources as they practice sourcing, contextualizing, and corroborating. They ask questions and make interpretations, but then continue to question their interpretations. They monitor their own confusion and doubt their own decisions (Wineburg, 1991, 1994, 1998). Wineburg (1998) noted that a historian with expertise in U.S. history, specifically with Abraham Lincoln, and a second historian with expertise in a separate historical era, differed in their reading of documents pertaining to Abraham Lincoln's stance on slavery. When asked to step outside of his specialization, the historian not specializing in U.S. history relied more on general problem solving strategies. Because of expertise in the discipline of history, the historian was able to "think like a historian" and to leverage his knowledge in such a way as to "develop new knowledge even when lacking many of the requisite tools to do so" (Wineburg, 1998, p. 336). Although this historian distrusted his own sense-making abilities, Wineburg wrote:

> His distrust in his own sense-making abilities may be thought of as a domain-specific form of metacognition, an imperative to read history differently from how we read ordinary

> expository or narrative text … It was what he didn't know that came to the fore: his way of asking questions, of reserving judgment, of monitoring affective responses and revisiting earlier assessments, his ability to stick with confusion long enough to let an interpretation emerge. It was how he responded in the face of what he didn't know that allowed him, in short, to learn something new. (pp. 338, 340)

Many things influence expertise. Rouet et al. (1997) noted that although graduate students in psychology demonstrated complex reading strategies because they were used to reading within their discipline, they still read historical documents differently than graduate students in history. In this study as well as others (Wineburg, 1991, 1998), general reading strategies that are common across disciplines (e.g., rereading, summarizing, asking questions) are demonstrated, although more nuanced strategies associated with background in the discipline as well as prior knowledge of specific topics contributed to differences in what was labeled *expert reading*.

5.2 Novice and Developing Readers

The level of expertise required to think like a historian and leverage knowledge from one context into another requires a high degree of sophistication and metacognition. A historian less knowledgeable in a particular domain was able to leverage his knowledge to create understanding in a different domain. However, K-12 students do not possess this same level of expertise, experience with text, or contextual knowledge. Instead, they are novice and developing readers.

Novice readers in general, and novice readers of history specifically, are unaware of many of the features of the text and the discipline. VanSledright (2004b) specified that even though they are novices in the sense that they lack awareness, they are already partially educated because "when they enter school, they already possess a variety of collective memories regarding their own personal history and that of their country" (p. 344). Instead:

> The novices are novices because they are yet unaware of the unique applications of the heuristics that characterize expertise … Many of them are reasonably good readers … However, they know little about the structure of the domain, lack strategies for reading intertextually, and have little experience reading subtexts … . Perhaps most notably, their epistemology of text is often diametrically opposed to that of the experts. In other words, they believe that the meaning is in the text, it is unmediated by the author, and that it is their job to extract it correctly (VanSledright, 2004b, p. 344).

Not only are adolescent novices and developing readers unaware of discipline-specific strategies, they are also impacted by tremendous physiological and biological changes. Alexander and Fox (2011) described these changes:

> Inundated with discussions of high-stakes assessment, reading standards, or curricular innovations, reading researchers and practitioners can sometimes forget that adolescents face dramatic biological and physiological changes in their transition to adulthood. Those

> changes can relate directly to what adolescents choose to read, why they read, and how they read, as well as how they apply what is learned through their encounters with text. (p. 170)

The novice-expert paradigm offers a method for addressing such changes and inexperience. Unlike the physiological changes that will happen because of genetics, knowledge of reading history must be a focus of explicit instruction in order to develop.

5.3 Reading Development in History

A variety of research specific to history supports this developmental perspective (Dutt-Doner et al., 2007; Lee & Ashby, 2000; VanSledright, 2004b). Specifically, researchers mention two related processes that seem to develop over time with explicit instruction: the ability to read across sources and the ability to reconcile conflicting information (Dutt-Doner et al., 2007; Lee & Ashby, 2000; Martin & Wineburg, 2008). When presented with conflicting information, novice readers tend to disregard the new information that conflicts with what they already think. Martin and Wineburg referred to this approach as "solving the problem" of conflicting sources (p. 315), which is usually accomplished by ignoring some of the information. When conflicting information is ignored, novice readers typically make quick interpretations that they do not question (VanSledright, 2004b; Wineburg, 1991, 1994). Lee and Ashby (2000) found that not until sixth grade were students able to attribute differences in historical accounts to problems with sources (e.g., transmission, errors, or biases) or interpretations. Dutt-Doner et al. (2007) compared fifth graders and seventh graders as they read and analyzed primary source documents. They found that the seventh grade students were significantly stronger than fifth grade students in background knowledge, background use, and image analysis skills, resulting in an increased total document composite score for the seventh graders compared to the fifth graders. Fifth graders had little understanding of the analytic process and were much more likely to experience frustration when reading the primary source documents. Dutt-Doner and colleagues concluded that although both fifth and seventh graders struggled to understand conflicting information, "The middle school years may be the platform for this developmental shift in ability or a time of coming of age for independent historical reasoning with primary source documents" (p. 4). Additionally, they posited, "Fifth and seventh graders were different in many areas, and there may be a developmental trajectory of historical thinking. The middle school years, uniquely, may be a critical period for the development of independent, historical thought" (p. 14).

Shanahan and Shanahan (2008) proposed a developmental model of literacy progression, starting with *basic literacy skills*, followed by *intermediate literacy skills*, and eventually developing to more sophisticated *disciplinary literacy skills*. Basic literacy skills include decoding and knowledge of high frequency words. Intermediate literacy skills consist of things like generic comprehension skills

and general vocabulary knowledge. Disciplinary literacy skills are made up of specialized skills that may vary among specific disciplines. Important to this model is the well-researched notion that literacy progression is developmental. That is, one must progress from recognizing sight words and decoding text and applying general comprehension strategies before becoming adept with more sophisticated disciplinary literacy skills.

It is important to recognize that even though the emphasis of reading in history may involve specific strategies, what Wineburg referred to as heuristics, there is still benefit to teaching general strategies—what Shanahan and Shanahan (2008) referred to as intermediate literacy skills. These generic strategies should not be just the responsibility of language arts teachers or elementary teachers. Instead, Heller and Greenleaf (2007) emphasized:

> Research suggest that the teaching of generic reading comprehension strategies does have merit, and that students can learn a number of routines that can help them comprehend many different kinds of written documents … Moreover, numerous studies over the past few decades have demonstrated that it is most effective to teach comprehension strategies, text structures, and word-level strategies while students are engaged in reading challenging, content-rich texts. Such skills don't stick when practiced for their own sakes (p. 8).

Heller and Greenleaf (2007) suggested that these general strategies should include broad categories of pre-reading activities (e.g., reviewing vocabulary, making predictions, and identifying text features), during reading strategies (e.g., drawing visual representation, identifying arguments, asking questions), and post reading strategies (e.g., summarizing, comparison). However, they cautioned that exclusive emphasis on generic skills may lead students to conclude that all texts are basically the same. This is why practice of the intermediate skills is so important within particular disciplinary texts.

6 Instruction in History: Developing Expertise

Bain (2008/2009) expressed the question that we must answer:

> How can we help students move from surface or scholastic understanding to "deep" understanding? How do students learn to contextualize, corroborate, hear voice in text, and assess significance? To put it bluntly, does any of this research, theory, or scholarship really matter when a teacher teaches history? (p. 160)

We have a great deal of research about what experts do as they read history (Shanahan et al., 2011; Wineburg, 1991, 1998). We also have research about what grade school through high school novices do as they read (Afflerbach & VanSledright, 2001; Dutt-Doner et al., 2007; Lee & Ashby, 2000; VanSledright, 1995; VanSledright & Kelly, 1998; Wineburg, 1992). However, the work that exists could hardly be considered robust. Bruce VanSledright (2004a), one of the major contributors to what we know about novices reading history, was not responding directly to Bain's question but addressed the same issue when he wrote:

> To put it simply, we do not know exactly what it takes or what it looks like precisely to obtain shifts in epistemologies of text, shifts of the sort that appear crucial to development of historical thinking and understanding. At this point, as near as I can tell, we have a set of theories or ideas about producing such changes. But we need more research work, work done across disciplines (p. 345).

With that context in mind, the research that we do have offers foundational principles for effective instruction.

6.1 Knowing the Students

Knowing the students' capabilities, background knowledge, and literacy skills is a key component of effective practice (e.g., Afflerbach & Cho, 2009; Cunningham & Allington, 2007; Leslie & Caldwell, 2009). Knowing the students involves gathering data through informal and formal assessments; inventories; and observations about students' abilities, interests, and interactions. It includes knowing students' preconceptions of history as well as their reading abilities.

Reading research has shown that knowing students also should include understanding students' out-of-school literacies and discourses because out-of-school practices influence in-school reading and communicating. Some students' out-of-school literacy practices may position them to learn disciplinary literacy skills based on the home discourse or family background and experience more easily than others (Lemke, 1990; Lesh, 2011). Moje (2008) wrote that we need responsive literacy pedagogy in which teachers examine the texts and literacy practices of students beyond school "and then connect those texts and practices to the texts and literacy practices of the disciplines" (p. 60), elevating what students know and know how to do above the content to be covered.

Knowing the students allows the teacher to decide what is developmentally appropriate for the students. This also includes understanding students' current level of performance in the developmental progression of basic literacy skills, intermediate literacy skills, and discipline-specific skills (Shanahan & Shanahan, 2008). If students lack basic and intermediate literacy skills, starting points of instruction will be different than starting points for students who lack only discipline-specific literacy skills. VanSledright (2004a) described the process:

> The historians can serve as a benchmark in relationship to which we can understand what the less sophistical historical thinkers do. However, we must not unfairly hold novices to the standard set by the experts. The academic developmental distance between novices and experts is a gap that history teachers—through history education—can strive to close." (p. 230)

This developmental perspective focuses on starting instruction where the students are and moving them towards expertise without holding them to impossible standards.

6.2 Setting Clear Goals

Perhaps the most important goal is to understand that the overarching purpose of reading in the discipline of history at the K-12 level is not to develop historians; rather, the purpose is to develop critical thinkers (Afflerbach & VanSledright, 2001; Sandwell, 2005; VanSledright, 2002a, 2004a, 2004b; Wineburg, 1998). Afflerbach and VanSledright summarized, "Getting good at reading history may significantly contribute to students' general ability to read critically" (p. 697). This should help students sort through contradictory information to reach logical conclusions (Wineburg, 1998). VanSledright (2004b) reflected on his return to the K-12 classroom to teach after several years at the university. He wrote,

> Here I want to point out that my interest in teaching forms of expert reading in history has very little to do with raising the next generation of historians. On the contrary, I would maintain that reading expertise required in history needs to be prized for its critical literacy components (e.g., reading for subtext, corroborating accounts before drawing conclusions, developing a healthy skepticism about what texts claim), those that, in an information-dominated culture, become more necessary every day (p. 345).

Although developing historians who are expert readers may not be practical as a goal for the K-12 spectrum, VanSledright (2004b) argues that proficiency in reading as an attainable goal.

Common to most discussions about relevant and attainable goals for middle school and high school students are identifying arguments, evaluating source authority, understanding historical context and its bearing on the text, and identifying multiple interpretations. By specifying these objectives and teaching students to ask what historians would do, initial research suggests that students' read with increased metacognition (Hynd-Shanahan et al., 2004). Without the teacher setting and communicating clear goals, students do not typically understand that the task of reading history is "that of deciding what to believe" (Shanahan, 2009, p. 252).

These goals must be clearly separated from test-preparation goals. Barton and Levstik (2003) emphasized:

> In order for teachers to present history as an investigative, interpretive undertaking, they must have a purpose that cannot be served by focusing on coverage and control; their goal must be one that can be met only by having students work with primary sources, consider multiple perspectives, and so on (p. 359).

Further, these goals must be contextualized as discipline-specific, meaning that the goals and the reading required to satisfy the goals are both similar and different from other disciplines. For example, students need to understand how the purposes for reading in history vary from the purposes for reading in math and science. The desired outcome for reading in history is to ask questions of the text and arrive at multiple interpretations (The College Board, 2011; Lesh, 2011). In contrast, the purpose of reading in math and science texts is

frequently to find a single solution to questions already posed by the text (Lesh, 2011). However, there are still shared literacy components of reading in different disciplines. One of the cautions of discipline-specific literacy is the false division that can be created between subject areas as well as between intermediate and discipline-specific reading (Massey & Riley, 2013). Although expert readers across the social sciences, physical sciences, and mathematics do use unique strategies, they also use similar general reading strategies such as monitoring comprehension, rereading, and asking questions (Massey & Riley, 2013; Shanahan et al., 2011). At times, they apply these general strategies in ways that are unique to the discipline (Massey & Riley, 2013; Wineburg, 1991). For example, a historian asks questions—a general strategy that many other experts use—but then asks particular questions at particular points such as questions about the authority of the author and the context of writing. Instruction that allows students to compare and contrast the processes of reading in each discipline can help students develop metacognition about reading in general and disciplines specifically.

6.3 Modeling Explicit Thinking

In order to help students accomplish instructional goals, students must be given a clear model of how to meet those goals (Bain, 2008/2009; Buehl, 2011; Lesh, 2011; Martin & Wineburg, 2008).

Lesh (2011) observed,

> History and social studies are the only disciplines in which students are not explicitly taught the tools necessary to understand how knowledge is created . . . Instead of making the study of history's tools, vocabulary, and processes apparent to students, we present our discipline as one whose sole goal is to provide volumes of information (p. 11).

Think alouds are emphasized as one of the most important teaching activities in order to offer the explicit instruction needed to provide students with the tools of historical reading and thinking (Martin & Wineburg, 2008; Reisman & Wineburg, 2008). Think alouds make the experts' thinking audible and perhaps visible for students. Martin and Wineburg wrote:

> Our previous research led us to believe that simply presenting novice readers with powerful examples and expecting them to have some utility is the pedagogical equivalent of magical thinking. Just as the untutored eye looks at a Van Gogh and sees not a swirl of pulsating color and energy, but a simple tree, grass, and sun, so the novice watches Natalia and wonders "What's the big deal?" Novices not only need to "see thinking"—they also need to see it and then be guided in understanding what they saw (p. 310).

Thus, even when using think alouds, the teacher must be aware that students may be mimicking what the teacher is doing rather than truly understanding the process.

6.4 Teaching Word and Language Patterns

In every discipline, vocabulary is critical to understanding. Background knowledge is typically evidenced as vocabulary knowledge (Johnson, 1982). In other words, "The more words we have ... the more background knowledge we have" (Marzano, 2004, p. 33). The words serve as labels for a person's schema, or categories of knowledge.

Multiple texts offer practical ideas for teaching vocabulary, even vocabulary specific to history (e.g., Heafner & Massey, 2012; Marzano & Pickering, 2005; Stahl & Nagy, 2006; Tompkins & Blanchfield, 2004). Although the various activities and games vary, several shared elements are repeated in almost all vocabulary instruction. First, teachers need to acknowledge that not all words can be taught directly. Identifying which words should be taught explicitly and which words can be taught through more general exposure calls for a great deal of instructional expertise. Second, vocabulary instruction should be generative; that is, an emphasis should be given to words and word parts that will help students understand more words than just the words that are being taught. For example, instruction in Greek and Latin roots will typically generate knowledge about other words. Third, students need multiple exposures to words before they will be able to achieve the deepest levels of understanding.

In the same way, patterns of language are also important for helping students understand text. Knowledge of authorial choices in language and the patterns used in kinds of texts help students both understand and evaluate textual arguments and authority. Schleppegrell and de Oliveira (2006) described four key processes that are most useful for teachers to learn and then to use with students:

> Teachers have found it useful to ask students to identify the grammatical processes, participants, and circumstances, to see the meanings in time markers and connectors, to unpack complex nominal groups, and to link cohesive devices (referrers and synonyms) to their referents (p. 263).

The focus on language is applicable to written or spoken language, an important tool as more and more audio and video clips are being used as primary sources. Fang and Schleppegrell (2010) emphasized that all language "can be analyzed for to what it says about the world (the experiential meaning), for the social relationship it enacts (the interpersonal meaning), and for the way it weaves meanings into a coherent message (the textual meaning)" (p. 592). Teaching students to use language analysis processes helps them recognize patterns and be able to break down dense text into meaningful ways.

6.5 Providing Time and Texts They Can Read

Numerous reports on adolescent literacy portray a grim picture of adolescents' reading. Biancarosa and Snow (2006) noted: "Comparing the most recent NAEP results for all three grade levels (i.e., 4, 8, and 12) to those from 1992, the percentage

of students scoring proficient has significantly improved among fourth graders, but not among eighth and twelfth graders" (pp. 7–8). International comparisons are equally disturbing. Comparisons with adolescents in other countries through such assessments as the Program in International Student Assessment (PISA) have consistently ranked students from the United States much lower than their counterparts from other countries for multiple comparison years (Darling-Hammond & McCloskey, 2008; OECD 2008, 2012). These comparisons led authors such as Alexander and Fox (2011) to label adolescents as "endangered readers and thus, endangered learners" (p. 157).

Research on reading in general contexts supports the idea that students' reading improves when they spend the bulk of their time reading texts that are at their independent and instructional levels (see Allington, 2006, for a summary of research). Thoughtful planning can result in a collection of sources that offer not only different perspectives, but that are also written at different reading levels. The inclusion of audio and video clips as well as documents (such as political cartoons, which are heavy on visual information and light on actual text) can help struggling readers participate with the content.

An additional option is to modify primary sources. Wineburg and Martin (2009) recommended this approach for struggling readers as a way to provide them with text they can read but that offers access to multiple voices. They offered three principles for simplifying texts:

- Focusing the text: making it shorter to highlight most important components.
- Simplification: standardizing spelling, using simpler language
- Presentation: modifying font and size of print, providing ample white space to make text more visually appealing and easier to read

At a time when more and more focus will be given to complex text, Wineburg and Martin (2009) offered a final caution: "To deprive students of [complicated primary sources], regardless of income or skill, limits their horizons. It diminishes their chances to become fluent readers and thinkers, and ultimately informed citizens—which may be the greatest loss of all" (p. 216).

Modifying texts is not without criticism. Schleppegrell et al. (2008) believed that texts should not be simplified for students because doing so circumvents students' ability to learn complex concepts. Ultimately, we will need more research to better understand the outcome of modified compared to unmodified history texts for students.

6.6 Expecting Pushback

Teachers who have successfully implemented the aforementioned principles face an additional barrier in the form of students' attitudes (Barton, 1997; Sandwell, 2005). For example, Sandwell presented high school students with primary sources and a mystery. Students were asked to read a series of documents and make their own

interpretation about a murder. Instead of demonstrating excitement over the task, students were frustrated and requested something they could answer simply and specifically.

Numerous authors have noted decreasing motivation to read beginning in middle school (e.g., Biancorsa & Snow, 2004; Guthrie, 2008; Wigfield, 2004). Although some might dismiss this as simply a hallmark of teenagers, decreasing motivation is a problem for all teachers. When Guthrie, Schafer, and Huang (2001) conducted a detailed analysis of motivation and PISA reading scores, they found that student engagement had the largest correlation with achievement in literacy and that reading interest predicted reading comprehension in every country. Reading engagement was more important than students' family background, consisting of parents' education and income. Further, students with high reading engagement, but lower parental education and income, had higher reading achievement than students with lower reading engagement and the same background characteristics.

Although there is no easy fix for students' resistance, researchers offer concrete suggestions for countering students' decreasing motivation. Guthrie (2008) summarized what students need in order to engage with and stay engaged with content and text:

- Students need to be able to make choices. They need to have some control as opposed to full teacher control. This includes choice in assignments and choice in texts.
- Students need to be able to show competence with texts.
- Students need to believe they have the ability to understand and learn from the texts that they encounter.
- Students need to be socially engaged with text and with others.

Applied to the reading of history text, these principles suggest that even the most carefully crafted collection of primary documents may not be motivating for students if they do not know what they are supposed to do—and thus are unable to show competence. Additionally, if they are given no choice in what documents or texts to read and are asked to complete the work alone and present rationales only for the teacher, they are likely to not engage in the task of reading. Sandwell (2005) observed, "The problem is not simply that the skills need to be taught, but that even when students have learned how to engage with the materials, they still demonstrate a marked reluctance to do so" (p. 13).

6.7 The Criticality of the Teacher

In the discussion of effective instruction, the criticality of the teacher cannot be overlooked. Teachers must possess deep understanding of both historical interpretation and historical inquiry before they can engage their students in historical thinking (Bain, 2008/2009; Hover, Hicks, & Irwin, 2007). They must understand basic, intermediate, and disciplinary literacy skills as well as understand how to assess

students' knowledge of reading and knowledge of content. Unfortunately, this level of understanding is not always evident. Although pre-service and novice teachers can often articulate many ideas crucial to effective instruction in history, they do not yet possess a deep understanding of how to implement such instruction (Hover et al., 2007; Monte-Sano & Cochran, 2009). Hover et al. studied seven beginning teachers who struggled to translate what they could describe into actual instruction:

> The findings indicated that, when asked to talk about history and historical thinking, the seven beginning teachers elucidated rich and interesting conceptions congruent with much of the literature. However, when asked to talk beyond simple definitions—when asked to discuss their objectives for their history class, to describe their conception of best history practice, or to describe their typical instructional approach—historical thinking did not enter teachers' conversations in explicit ways (p. 108).

One common response to a lack of confidence or understanding is to revert to using the textbook exclusively. Teachers may cling to the authority of the textbook or continue to use the textbook exclusively because of testing pressure, textbook adoptions patterns, or other reasons outside disciplinary knowledge (Barton & Levstik, 2003; Paxton, 1999; VanSledright, 2004a). Barton and Levstik noted that even when teachers know how to conduct historical investigations, they do not always choose to engage their students in the process because the primary goals of instruction—as supported by administration and state and federal testing—is frequently content coverage.

As important as teachers' own content knowledge is, their ability to help broker students' understanding of text is also essential (Afflerbach & VanSledright, 2001; Bain, 2008/2009; Dutt-Doner et al., 2007). Without drawing students' attention to the goals, the text, and the thinking required, students may express enjoyment of the text (Afflerbach & VanSledright, 2001) but miss both content and process (Dutt-Doner et al., 2007). Bain (2008/2009) described:

> Engaging students in some legitimate disciplinary activity without restructuring the social interaction or challenging students' presuppositions may yield only ritualistic understanding. The problem for practitioners is to design activities that engage students in historical cognition without yielding to the tempting assumption that disciplinary tasks mechanically develop students' higher functions (p. 160).

Thus, the role of the teacher must not be glossed over or downplayed. If we want to develop knowledgeable readers of history, then we must also emphasize developing expert practitioners, or what Wineburg and Wilson (1988) referred to as *wise practitioners*.

7 Ongoing Issues

Even though we have more research about reading in history than we do about reading in other disciplines, it should be noted that we still have much to consider and learn about reading in history and the broader social studies. Among the many issues researchers and practitioners continue to grapple with are teaching methods and assessment.

7.1 More than One Method

There is some dissonance about the ways to teach a discipline. Promoting disciplinary understanding through students' historical inquiry or document analysis is the approach most frequently used and promoted by historians and other educators (Barton & Levstik, 2003; VanSledright, 2011; Wineburg et al., 2012). However, Peter Seixas (2000) described three ways of teaching history.

- A story approach with the object being to tell the "best story" about how something occurred in order to form group identity and group cohesion.
- A disciplinary approach through the examination of documents and sources in order to determine which account offers the most accurate interpretation.
- A postmodern approach, which examines how different groups use rhetoric and narrative to serve present purposes.

Gutek (2006) described the disciplinary approach as a search for truth.

> In the disciplinary-documentary approach, history, construed as disciplined knowledge, claims to be universal in that no one group has an exclusive claim to particular narratives or to the truth. Its truth claims rest on historical method and the historical method through (p. 414).

In contrast, the postmodern approach seeks to understand not truth but a relationship between power and history. Postmodernists hold all historical accounts, primary documents or otherwise, as politicized artifacts. Thus, the postmodernist also seeks to focus on the motives used to create the documents.

Again, it may be that we need to exercise the most caution in avoiding an either/or approach and instead focus on commonalities. The position of language and text in all three methods of teaching is of utmost importance. Additionally, being able to read critically is central to at least the disciplinary and postmodern approaches and, therefore, emphasizes the need to develop strong literacy skills.

7.2 What We Assess

The assessment of historical content is in flux and without clear ways of assessing the instruction given in ways that are understood by all of the stakeholders, history educators risk losing credibility at the state and national levels. Testing is certainly not a new issue, nor is testing in history specifically a challenging topic, considering what researchers have been saying for over 30 years. Howard and Mendenhall (1982) referenced the problem of "sacrific[ing] comprehension for coverage" (p. 52) in order to test knowledge, calling it a deadly sin. VanSledright (2002b) wrote, "The standard textbooks, combined with lectures delivered by teachers, are considered definitive. Tests measure the results. The obsession appears to be with the products of historical study, not with the practice of doing it" (p. 1091). Wineburg et al. (2012)

noted that such testing encourages memorization of isolated facts instead of helping students think more critically and form interpretations.

The Stanford History Education Group (n.d.) created a new assessment designed to assess not isolated facts, but the inquiry and thinking processes required to analyze documents. The History Assessments of Thinking (HATs) are formative assessments designed to help teachers assess what students can and cannot do through document analysis followed by short answer responses (Wineburg et al., 2012). The Stanford History Education Group wrote, "We need *formative* assessments in the history classroom—assessments that allow us to make daily changes in our instruction—not just end-of-course tests. What good are assessments if they don't help us become better teachers" (para. 4). Although this approach offers options for formative assessment for classroom teachers, whether such an option will be acceptable to state and federal stakeholders remains unclear.

8 Conclusion

The increased focus on disciplinary literacy allows us to focus on the specificity of language, texts, and tasks in each discipline. It also promotes a developmental approach where we must recognize that in order to be successful in a discipline, readers must have a foundation of basic and intermediate literacy skills that form a scaffold for more specific skills of disciplinary literacy (Shanahan & Shanahan, 2008). Generic (or intermediate) strategies, such as summarization and question asking, seem to be useful in multiple subject areas. We must help students build on these commonalities that function across disciplines and create nuanced, discipline-specific reading habits for thinking critically. Although searching for a "best" approach may be tempting, we must be careful not to set up false dichotomies. Further, disciplinary literacy underscores the idea that reading should not be separate from thinking and that experts in every field are able think critically about their discipline.

With an increased focus on disciplinary literacy comes a deeper need for historians, teacher educators, reading researchers, and practitioners to collaborate on effective practices for translating theory into practice for teachers and their students. Research in reading and research in teaching history inform each other. One area in need of more research is how the teachers read the texts that they use. The research that we have compares students of varying ages when reading primary sources (Afflerbach & VanSledright, 2001; Shanahan et al., 2011; VanSledright, 1995, 2002a) as well as examining the reading done by historians (Wineburg, 1991, 1998). However, teachers stand as mediators between practice and theory. It is up to them to provide explicit models, navigate learning purposes, and motivate students. Unfortunately, we know very little about how teachers of history read the texts that they ask students to read. This directly relates to what they are able to model, and

in turn, to what students are able to learn about the processes of reading. In sum, we have much more to learn about disciplinary literacy, expert reading, and best practices for translating experts' actions and thinking into teachable practices.

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Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page

Mary A. Avalos, Alain Bengochea, and Walter G. Secada

Abstract Reading comprehension research in mathematics has focused primarily on the teaching of generic content area reading strategies (Alvermann D, Moore D, Secondary school reading. In: Barr R, Kamil M, Mosenthal P, Person PD (eds) Handbook of reading research, vol II. Longman, New York, pp 951–983, 1991; Pearson PD, Fielding L, Comprehension instruction. In: Barr R, Kamil M, Mosenthal P, Pearson PD (eds) Handbook of reading research, vol II. Longman, New York, pp 815–860, 1991). In contrast, mathematics education research has focused on ensuring that students understand and can translate the symbols and register of mathematics (Crandall et al., 1989) to and from everyday language to solve problems. Both approaches have been used to support the treatment of mathematics as a fixed body of facts and procedures that are to be acquired by the learner. More recent thinking, however, views school mathematics as a "way of knowing" (National Council of Teachers of Mathematics, Professional standards for teaching mathematics. Author, Reston, 1991, Principles and standards for school mathematics. Author, Reston, 2000; Siegel M, Fonzi J, Read Res Q 30:635, 1995) and incorporates "mathematical texts" as affordances that can support students'

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development of mathematical literacy (Draper RJ, Siebert D, Rethinking texts, literacies, and literacy across the curriculum. In: Draper RJ, Broomhead P, Jensen AP, Nokes JD, Siebert D (eds) (Re)Imagining content area literacy instruction. Teachers College Press, New York, pp 20–39, 2010; Siegel M, Fonzi J, Read Res Q 30:632–673, 1995). From our work as an interdisciplinary team, we argue for an interdisciplinary perspective of reading comprehension as applied to reform-oriented mathematics-teaching practices. We begin by reviewing the literature on adolescents' reading comprehension of mathematics and then present a small study investigating how sixth and seventh grade students approached reading math textbooks. We end by proposing a revised definition of reading comprehension for mathematics grounded in the results of our study. In building on multiple theories we redefine reading comprehension in mathematics using the work of Rosenblatt (The reader, the text, the poem. Southern Illinois University Press, Carbondale, 1978, 1982), Kintsch (1988), and Halliday (Language as a social semiotic. Edward Arnold, London, 1978) to respectively incorporate the transactional, constructivist, and language-dependent nature of thinking and reasoning necessary to create meaning and successfully comprehend mathematical texts.

Keywords Mathematics • Textbook comprehension • Opportunity to learn

1 Introduction

Mathematics textbooks are densely packed with information, using more concepts per sentence and paragraph as compared to other texts that are used in school (Schell, 1982). To convey meaning, mathematics textbooks use technical vocabulary and symbols specific to math, everyday language in semantically different ways, specific genre structures and language features within written texts, and visual graphic representations (Halliday, 1978; Huang & Normandia, 2008; Schleppegrell, 2007; Spanos, Rhodes, Dale, & Crandall, 1988). These features contribute to the complexity of math textbooks that is common in elementary and middle school (Secada, Zisselsberger, Langer-Osuna, & Avalos, 2011; Zisselsberger, Avalos, & Secada, 2012). Often, students must engage in nonlinear reading patterns as they zigzag among written words, tables, graphics, and symbols to make sense of problems and other information found in the textbooks (Carter & Dean, 2006).

The organization of most U.S. mathematics textbooks follows an *exposition—examples—exercises* model, structuring tasks in a sequence intended to build students' conceptual understandings for each lesson (Love & Pimm, 1996). Expository text introduces a concept, generally within the problem setting; next, worked-out examples are introduced and are used to demonstrate how to apply problem solving methods. The lesson concludes with a set of exercises and problems that provide student practice. Generally, problem difficulty within a lesson or chapter flows from easier tasks towards increasingly complex tasks. Most mathematics textbooks contain sidebars and pictures that are both proximally and distally related to the lesson, along with a mixed review of problems from previous lessons, practice

problems, and vignettes that connect the mathematics lesson to other content areas or cultures; all of this can be confusing for students to navigate (Metsisto, 2005).

Mathematics textbooks usually include short, seemingly disconnected snippets of text on each page that are meant to provide students multiple examples and practice problems within different contexts, making the math textbook look, feel, and read differently than disciplines using more expository-like text structures (Barton & Heidema, 2000; Buehl, 2011). What is more, an analysis of mathematics problems used for the Third International Mathematics and Science Study (TIMSS) shows there is a gradual increase in the use of more expository-type mathematics texts as students advance through the grade levels (e.g., proofs; Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2002). Thus, as math content becomes more abstract in middle and high school, math problems and text increase in density. The need to explore how students approach reading their math texts is important, especially in light of the fact that all students are expected to meet the new and demanding expectations of the Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010) mathematical practices.

Österholm (2006, 2008) compared high school and college students' reading of mathematics and expository texts. Two groups of students with equivalent mathematical knowledge read (a) a math text with symbols or (b) an expository text without symbols describing the same construct. Expository math texts without symbols were approached and read differently than mathematics texts with symbols that denote relationships, constitute processes, and represent numerical values. Students who read the text with symbols scored lower on a comprehension post-test. Moore (1994) found that college students had difficulty with the mathematical language of notation, arguing that students' inability to restate definitions and concepts in their own words demonstrated limited comprehension. Not only do these studies indicate the need for secondary students to read mathematical texts differently than other content area texts, but they also point to the need for teachers to scaffold reading instruction and to support students when they are reading mathematical texts. This instructional imperative would seem to be particularly important for socially and culturally diverse learners who may not be familiar with problem contexts that are more typical of mainstream student experiences (Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013) or who may be more accustomed to different problem solving practices (Hoffert, 2009). Additionally, learning "the language of math" may be akin to learning an additional language in and of itself (Barbu & Beal, 2010; Kersaint, Thompson, & Petkova, 2009; Moschkovich, 2010; Wright & Li, 2008).

To better support students' reading across content areas, literacy experts have advocated the use of content area literacy instruction, which has been successful in assisting students' understandings of complex texts (Alvermann & Moore, 1991; Conley, 2008; Ogle, 2009; Pearson & Fielding, 1991; Van Garderen, 2004). Earlier work in content area literacy instruction typically involved the application of generic reading strategies to content texts. Hence, resistance to content area literacy instruction by secondary math teachers was not uncommon because it was

seen as disconnected from the domain knowledge that *mathematics* teachers were responsible to teach, and it was not seen as an essential component for understanding the domain (Draper, 2002; Olson & Truxaw, 2009; Siebert & Draper, 2008). This is particularly true for mathematics teachers who are primarily concerned with students' ability to translate symbols and the register of mathematics (Spanos et al., 1988) to and from everyday language for solving and describing problems (Siegel, Borasi, & Smith, 1989). Another issue with applying generic reading strategies to math texts is that this approach generally treats mathematics as a body of facts and procedures that are to be acquired by the learner rather than treating mathematics as a "way of knowing" (Siegel & Fonzi, 1995, p. 635), of which the former is the antithesis of mathematics reform efforts (National Council of Teachers of Mathematics [NCTM], 1991, 2000).

Content area reading instruction has evolved to promote multi-literacies beyond reading comprehension, thus moving instruction from the application of generic comprehension strategies to the promotion of discipline-specific knowledge and content-specific ways of knowing (Moje, 2008; Shanahan & Shanahan, 2012). A literacies-based approach to mathematics instruction focuses on the "performance of literacy" (Lerman, 2007, p. 755) which includes students' discourse practices and thinking processes, along with their reading, writing, and visual comprehension of mathematics texts so as to more closely reflect how knowledge is created, shared, and evaluated by experts in the field. Thus, making sense of texts shifts from the application of generic strategies to the use and construction of disciplinary-specific practices (Shanahan, Shanahan, & Misischia, 2011). As Heller and Greenleaf (2007) point out, reading in different subject areas requires varying approaches to reading the text that include the knowledge and reasoning processes found in the particular subject.

The discipline of mathematics values literacies that promote reasoning for quantitative situations, problem solving, creating and testing conjectures, communication and evaluation of mathematics solutions, and modeling/application to real life contexts (Siebert & Hendrickson, 2010). In reform-oriented mathematics instruction (NCTM, 1991, 2000), teachers become facilitators of student learning rather than practitioners of a 'pedagogy of telling' (Sizer, 1984, p. 109). The CCSS (2010) mathematical practices promote students' perseverance in problem solving, critical thinking, and sense-making of texts, among other disciplinary-like practices. With this expansion of literacies, the notion of *text* has expanded beyond words on a page to include multiple modes of viewing, organizing, and reading to make sense of information (Buehl, 2011; Draper, Broomhead, Jensen, Nokes, & Siebert, 2010; Langer, 2011; McKenna & Robinson, 1990; Parris, Fisher, & Headley, 2009). Mathematical texts include tables, graphs, diagrams, models, or graphics with data or information related to a problem, equations, proofs, written descriptions of a problem or solution, calculator readouts, and verbal mathematics discussions (Siebert & Hendrickson, 2010). Proficiency with this expanded notion of text is necessary for students to become active and engaged participants of math-practice communities, as called for by the CCSS. While the NCTM standards documents (1991, 2000) emphasize the importance of reading, writing, and communicating

in reform-oriented mathematics classrooms, specific strategies for helping students acquire mathematical literacies are not included or suggested for teachers to emulate or adapt (Draper & Siebert, 2004). This is also the case for the CCSS (2010).

With this relatively new and different way of looking at content area literacy, research is needed to inform pedagogy that will promote students' acquisition of mathematical literacies. Lerman (2007) calls for research that investigates how students from diverse backgrounds read what is required of them, and how their reading habits position them to sustain their identities when performing math or science literacies. This type of literacy research, according to Lerman, would inform pedagogy by indicating the degree to which teachers must be explicit in teaching students what is required for them to read texts for appropriate performance, and ultimately to foster equity in mathematics and science teaching.

This chapter provides baseline information on the purposes for which middle school students claim to read their math textbooks. Furthermore, we discuss how teachers might use this information for their own pedagogical practices in support of content area literacies specific to math textbooks. According to Bossé and Faulconer (2008), many who have examined reading mathematics fail to distinguish *reading about* vs. *reading in* mathematics. *Reading about* mathematics makes use of a variety of text types to learn about mathematics (i.e., picture or comic books, novels, biographies), while *reading in* mathematics makes use of mathematical texts to further domain knowledge. Our work addresses the issue of *reading in* mathematics; it is based on a study that explored how sixth through eighth grade students at various English language proficiency and math achievement levels reported using or reading their math textbooks when working independently. We begin by describing how students and teachers use math textbooks in secondary classrooms as demonstrated in previous studies. Next we briefly describe our study and findings to orient the reader for a discussion grounded in the CCSS (2010) and Shepherd's (2005) framework to advocate an active (as opposed to passive) reading of mathematics texts. We conclude with suggestions for teachers' pedagogy to support content area literacies while using mathematics textbooks.

2 How Students and Teachers Use Math Textbooks

According to Love and Pimm (1996), teachers are the mediators between students and their mathematics textbooks; therefore, teachers' interpretations of math textbooks for their students have bearing on how students perceive and ultimately use textbooks (Pepin & Haggarty, 2001). Moreover, teachers' instructional decisions as based on their textbook's curriculum ultimately influence students' opportunities to learn and the way instruction is carried out (Regis, Appova, Reys, & Townsend, 2006; Reys, Reys, Lapan, Holliday, & Wasman, 2003; Valverde et al., 2002).

Although the same mathematics textbooks can be used differently across classrooms, secondary teachers typically use their district-adopted texts as an organizer to make daily decisions about what and when to teach certain grade level content

(Ball & Feiman-Nemser, 1988; Chávez-López, 2003; Grouws & Smith, 2000; Regis et al., 2006). Regis et al. found that of 116 participating middle school mathematics teachers, 39 % of them used the district's mathematics textbook at least 90 % of the instructional days they documented, and over 70 % used the textbook 3 out of 4 days during the documented instructional period. Individual teachers also use the same mathematics textbook in different ways with different groups of students based on the students' learning characteristics (Chávez-López, 2003; Moren, 2000). Draper (1997) states that, in part, students avoid reading their math textbooks because they are unprepared to do so. She argues that since teachers are generally the main source of information in math classrooms, the need for students to read their textbooks for learning mathematics is eliminated. Draper (2002) also points out that methods textbooks for pre-service mathematics teachers rarely discuss reading mathematical texts, and at times when they do, reading in math class is generally given a negative spin by the authors because the approach is associated with more traditional, teacher directed teaching methods.

Shepherd (2005) noted that many of her struggling undergraduate students read mathematics texts as passive receivers of information. Building on the work of Exner (1996), she implemented an approach in her introductory/basic math courses that aimed to convince her students they could successfully read mathematical texts. Shepherd lectured very little during class, only outlining what she felt was important for the students to understand, thus forcing them to read mathematical texts. Specifically, she provided scaffolds to move students from a passive reading of mathematics (e.g., reading a literary text as receiver of information) to an active reading that required students to pause and think critically at certain points of assigned tasks. When students saw a designated symbol (i.e., happy face) in the mathematical text assigned by Shepherd, they were required to do something or take action on the information they were reading before moving on. The action to be taken was suggested by Shepherd as scaffolds for how to approach reading mathematics more actively. Suggested actions involved defining vocabulary, finding or creating examples that would demonstrate what was read, making connections to prior knowledge of mathematics or the context of the task, setting up an equation based on the information, or making notes in the margin. To measure the success of this intervention, Shepherd focused on her students' dispositions towards mathematics because she believed students' feelings about mathematics were a better indication of their success with the subject than passing the course. Students in Shepherd's classes with the reading mathematics text emphasis were generally more engaged learners of mathematics throughout the term and did not give up as easily as previous students in the same introductory course.

Rezat (2009) explored how and when German sixth and twelfth grade high-achieving students consulted their math textbooks when given problem solving tasks by teachers during class. He found that textbooks were primarily used while carrying out four activities termed "utilization scheme types" or USTs (p. 1,264). The first UST, called "solving tasks and problems," had three different UST patterns of use, including: (a) students looked to find worked examples or methods that would assist in solving similar tasks/problems; (b) the tasks students chose to examine more

closely in their textbooks showed similarities to the original task they were trying to solve (i.e., same images graphed or data in similar types of tables/organizers); and (c) students began to look for assistance at the start of the chapter, focusing on headers until useful information was found. Based on student observations, interviews, and student work, Rezat argued that students saw the examples at the beginning of the textbook's lesson to be the most helpful when looking for information to assist them with solving problems. Rezat also found that the students focused more on finding a solution to the problem rather than reading the textbook to develop understanding of the mathematics behind the problem's solution.

The second UST, called "consolidation," Rezat referred to as using the textbooks when students' wanted or needed to learn rules, review or repeat teacher mediated tasks, or solve problems similar (and usually adjacently placed) to teacher-mediated tasks. The overarching purpose for this UST was to go over mathematics already taught by the teacher. Many students in this study also made use of the review sections at the end of the chapter/lesson to consolidate their understanding of the lesson. These patterns of use indicate less dependence on the teacher for understanding and learning mathematics content as students utilized their textbooks independently.

The final two USTs, or "utilization scheme types" from Rezat's work were "acquiring mathematical knowledge" and "activities associated with interest in mathematics." The former was described as students going outside of the lesson or chapter studied during class to an adjacent part of the book that had not been introduced in order to find out about upcoming math lessons, and the latter focused on the images in the math textbook that appealed to the interests of the students. The students did not associate looking at the pictures with learning mathematics; rather, they looked at the pictures and read associated captions out of interest in the images displayed on the page. Rezat and colleagues (2009) state that the students' USTs of textbooks reflected how and what they felt was important when learning mathematics; student dispositions towards learning math were predominately "comprised of learning and applying rules and worked examples to tasks, and developing proficiency in tasks similar to teacher-mediated tasks" (p. 1,267).

More recently, Rezat (2013) reanalyzed his original data to report how students utilized textbooks for the purpose of self-regulated practice of mathematics. He identified three mathematic textbook USTs for the purpose of self-regulated practice (i.e., to improve understanding of concepts and procedures, how to carry out procedures, and grades). He termed these USTs as position-dependent, block-dependent, and salience-dependent. Position-dependent USTs referred to the relative position of the practice problem(s) in relation to the teacher-mediated sections; the positioning of the problems within the text guided the students' choices when determining which problems to focus upon for practice. One of the participating teachers did not mediate or provide worked examples from the textbook until the second week of a construct's instruction. Until this time, the position-dependent practicing scheme does not occur in the data. Only when the teacher mediated textbook problems did her students select adjacent problems for individual practice, indicating how teacher mediation impacts students' textbook use. Block-dependent practice occurred when

students chose specific blocks or sections from the textbook to practice. For example, students selected blocks at the chapter level with rules in boxes or tasks/problems created for students to self-regulate understanding of the chapter's content (e.g., sections entitled, *Practice*). Salience-dependent practice included practicing what was deemed to be salient based on surface level features of the tasks; that is, tasks that were similar in appearance to teacher-mediated tasks but not necessarily close in proximity to the actual problems focused on by teachers. Rezat concluded it was important to note the structure of the mathematics textbook in order to use it efficiently (i.e., for block-dependent USTs or specific sections), yet at the same time, position- (i.e., relative proximity of practice to teacher-mediated problems) and salient-dependent (i.e., tasks that look similar on a surface level) USTs indicated the students' conceptions of what was important for practice based on the focus of the teacher during classroom instruction.

In a study involving undergraduates, over 1,000 students in introductory mathematics classes were surveyed to describe their use of mathematics textbooks (Weinberg, Wiesner, Benesh, & Boester, 2012). Survey responses revealed that students used examples to build mathematical understanding, rather than using expository text for that purpose. The researchers speculated that the reported use of math textbooks may be a result of the textbook structure, along with students' dispositions about reading and their perspectives on the nature of mathematics. Weinberg and colleagues end by advocating that instructors carefully choose mathematics texts and materials to promote mathematical reasoning and to encourage students to read math textbooks to support their developmental reasoning.

In sum, though there are few studies on the comprehension of mathematical texts (and none that we could find focused on diverse secondary populations), the work that has been done indicates mathematics textbooks are heavily relied upon and used by teachers to serve as planning guides for instruction. Teachers tend to mediate the information in mathematics textbooks which effectively eliminates the need for students to critically read mathematics textbooks for understanding. How students perceive the nature of mathematics also has important repercussions for how they use and make sense of mathematical textbooks. When using example and practice problems from their textbooks, most students emphasize solving the problem over understanding how and why the problem is solved.

3 Overview of Our Study: Methods and Findings

The study reported here was part of a larger research and development project that sought to infuse explicit teaching of mathematics-academic language via reading, writing, listening, speaking, and viewing with instruction that developed English language learners' (ELLs') mathematical literacies (Secada & Avalos, 2010). We audio recorded interviews with ELLs and fluent English speakers at various math proficiency levels in the sixth through eighth grade classrooms of teachers,

who were participating in the larger development effort, to answer the following research questions:

- How do middle school students of varying mathematical and English proficiencies report that they read their math textbooks?
  - What text features and types of problems do middle school students report finding most and least helpful when using their math textbooks to solve problems independently (e.g., alone or for homework)?
  - What about these features and types of problems do middle school students report as providing them with support or help that indicates an active approach to reading mathematics textbooks?

3.1 Participants

Our student sample came from two culturally and linguistically diverse, Title I urban middle schools within a large district located in the southeastern U.S. The schools were similar in social/ethnic demographic make-up and at the time of data collection, both had recently implemented magnet school programs with science, technology, engineering, and mathematics (STEM) curricular emphases. We were specifically interested in how students of varying math achievement levels and English proficiencies reported that they used their math textbooks to determine if there were differences in use by achievement and/or English proficiency. Purposeful sampling was used to select students for lower-achieving or higher-achieving groups. Within the lower-achieving group, students were further sorted into ELLs or FES (fluent English speaking) categories.

The majority of participating students in sixth and seventh grades scored below the 32nd percentile on the Test of Mathematics Achievement-2 (TOMA-2; Brown, Cronin, & McEntire, 2009) administered in the spring of the year that they were interviewed; these students' interview data were grouped in a *lower achieving* (LA) category for the purpose of this study. Sixteen of the LA students in our sample were identified and receiving services as ELLs (hereafter referred to as LA-ELLs) by the district. These students primarily spoke Spanish as their first language (L1) and had intermediate proficiency in English; however, within this sample there were also a couple of L1 Haitian Creole speakers with early intermediate English proficiency, and one student who spoke Urdu (L1) with intermediate English proficiency. Most of the LA-ELLs ($n = 13$) were in remedial (intensive) math classes for 1.5 h each day, and the remaining LA-ELLs ($n = 3$) were placed in a STEM class that integrated math instruction with science, technology, and engineering content. The mean TOMA-2 score for the LA-ELL group was at the 6th percentile.

Twenty-one of the LA participants were fluent English speakers (hereafter referred to as LA-FES), meaning that they had never received ELL-related services or that they had exited from ELL designation based on passing the state test for this purpose. The majority of the 21 LA-FES students were in an intensive math

class ($n = 17$) and the rest in the STEM class ($n = 4$). The mean TOMA-2 score for LA-FES group was at the 3rd percentile.

Eight students in the sample were in an algebra class, which was considered to be advanced math for their grade/age ($n = 1$ in seventh grade; $n = 7$ in eighth grade). All of the participating algebra students were FES (ALG-FES with a mean TOMA-2 score at the 72nd percentile. Because there was only one ELL in the algebra class (i.e., considered higher-achieving), we excluded this student's interview data from our sample.

3.2 Procedure

A typical lesson was selected from a seventh grade textbook in the district's adopted math series, and a structured interview protocol was created based on the problem types and text features from the lesson. The sixth through eighth grade district-adopted math textbook series shared the same format and structure. Therefore, the students were not necessarily familiar with the math content of the selected lesson, but they were familiar with the way the lesson was structured; how it proceeded from page to page; and how sidebars, highlighted font, and other text features are used for each lesson. Although most texts in the U.S. follow the exposition—examples—exercises structure, the adopted textbook used by the participating teachers and students started with a worked-out word problem. Individual interviews were conducted with participating students using a structured protocol to ask if they paid attention to each text feature or revisited each problem on every page of the lesson when working independently using their textbook. As a follow up question, we asked the students why they thought they did or did not pay attention or would/would not revisit that text feature or problem type (i.e., *How is this helpful?*). The students were not asked to work out math problems or explain concepts during the interviews. Examples of questions/prompts from the protocol about the structure of the text (e.g., worked out problem, practice problem) include: *"Now let's look at a different section on this page. Do you read or look at X without your teacher asking you to do so?"* If so, the interviewer prompted with, *"When or why would you?"* If the student stated that the section was helpful, the interviewer asked, *"How does it help you?"* An example from the protocol asking about text features stated, *"Headers, bolded or highlighted font, pictures, and boxes with problems inside are all text features used in math books. Which of these text features help you when you are reading your math book without your teacher helping or asking your class to look at them?"* Then the interviewer would point out each feature individually, according to what was on each of the selected textbook pages (i.e., *"Does the highlighted text or words help you when you are working without your teacher or help from someone?"*). If the student responded positively, the interviewer prompted, *"How does that text feature help you?"*

Not all of the participating students articulated why the text features or problems were helpful or unhelpful, so our results report the responses that students clearly

articulated as helpful or not helpful. When possible, we included elaborations on those responses that explained why students stated they would or would not go back to the problem or did/did not pay attention to the text feature. A total of 45 students (as previously described) were interviewed, with each interview lasting approximately 35–40 min.

3.3 Data Analysis

After transcribing the interviews, two researchers worked together initially and then separately, coding line by line to develop and verify open codes that emerged from the students' responses (Glaser & Strauss, 1967). We then revisited and articulated more than half of each other's coded transcripts. Categories and themes emerged for the LA-ELL, LA-FES, and ALG-FES groups based on codes from students' elaborated responses for helpfulness (or unhelpfulness) for each problem type and text feature (Strauss & Corbin, 1998). Both researchers articulated their coded findings until agreement was reached to finalize the coding themes across and within groups.

3.3.1 Helpfulness and Active Versus. Passive Reading

Upon reviewing the analyzed data, we found it helpful to use Shepherd's (2005) work on active versus passive reading of mathematics as a framework to further analyze these data and present the results. We build on Shepherd's work and define *active reading* of mathematics as the reader actively attempting to make meaning from the text to build understanding of mathematics knowledge (e.g., reading that *furthers understanding* of lesson concept; *makes connections* across problems/problem types, real world applications). It is a far-sighted view of reading math that emphasizes creating meaning and building on prior knowledge to reason through problems. On the other hand, *passive reading* is a focus on getting through the mathematical text for the primary purpose of solving a task or problem (i.e., focus on a solution over understanding of the solution process) rather than actively making meaning from a text in a holistic way. It is a myopic or compartmentalized view of reading math by which the reader relies less on reading for meaning and understanding of mathematical concepts, which could result in plugging in numbers to an algorithm without much use of reasoning through problems. According to our definition of active and passive reading, we defined what this may look like for the text features and selected problem types based on Shepherd's work (Table 3). We then separated the themes for each text feature and problem type into two groups. For themes that indicated action was taken to promote understanding of

the mathematics concept while using their textbooks independently, we designated active characteristics. For themes that demonstrated a passive stance (recipient of information), we designated passive characteristics.

3.4 Results

A summary of results for selected text features[1] and themes indicating "helpfulness" can be found in subsequent tables. The selected text features and problem types are reflective of what was mentioned in the literature as utilized by students when working in their mathematics textbooks (i.e., headers, font variation, vocabulary definitions, example, and practice problems). Shepherd (2005) in particular mentions the need to write in order to promote understanding of mathematics, so we also included the single problem from the textbook that requests students to write a description of two approaches to solve a problem and explain which they prefer. There were many common themes across groups as to how students reported these text features or problem types helpful or unhelpful when working independently, but there were also important differences when framing the themes using an active versus passive reading stance. Table 1 provides helpful themes from selected text features across groups, and Table 2 lays out helpful themes from selected problem types across groups.

3.5 Reported Themes for Text Features

3.5.1 Font Variation

All groups saw the function of varying font as providing important information. LA student responses indicated they used bolded font to *direct* them, and the ALG-FES students indicated bolded font *guided* them. Only two LA-ELLs stated they did not pay attention to font variation when reading the math textbook; otherwise, the responses to questions concerning this text feature demonstrated it was helpful for all students when reading mathematics textbooks.

3.5.2 Headers

All three subgroups of students saw headers as important for reading math textbooks because the headers told what the section was about and what the reader would be

[1]Space limitations preclude us from presenting results for all text features and problem types of the lesson.

Table 1 Themes based on "Helpful" responses per selected text features across groups

Text feature and description of use in mathematics textbook	Algebra FES	LA-FES	LA-ELLs
Font Variation (Color, Size, Bold): Font variation was used to call attention to directions for completing different sections, example problems or tasks and steps used to solve them, headers for each section, sidebar information, and cross references to other textbook sections with similar problems	Tells important information;	Tells important information	Tells important information
	Serves as a guide	Important to learn what lesson is about	Tells you what to do (i.e., directions to follow)
		Bolded font indicates exact procedures and supports understanding	
Headers: Labeled each section of the textbook (i.e., Example, Practice, Real World Application)	Tells you what you'll be doing	Tells what you're going to learn/do, what section is about	Explains what you are learning
			Identifies examples
Highlighted Font:	Writes or reads vocab specifically to learn and use	Provides words for lesson	Vocabulary is important-it helps to understand what lesson is about
Vocabulary specific to understanding the math content for each lesson was highlighted and defined within the text	Helps understanding		Words we need to learn
	Must be important since highlighted		

Table 2 Themes based on "Helpful" responses per selected problem types across groups

Problem type and description	Algebra FES	LA-FES	LA-ELLs
Worked Examples	Reference for solving other problems	Reads repeatedly to better understand how to solve problems	Enhances understanding when unsure how to solve problems
	Helps independent problem-solving	Previews the lesson and test	Previews the lesson
	Copies methods in notes and refers to them	Reference for solving other problems independently	Provides practice
	Reviews often to further understanding	Shows how to solve the problems	Shows how to solve the problems
Semi-Worked Examples	Challenges you because requires independent set-up of equation	Provides reference for other problems	Helps understanding of real world applications of mathematics
		Relates to real world situations	
	Provides opportunity of real world application	Provides example for other problems	Provides an example
Procedural Practice Problems	Provides practice	Provides practice to deepen math understanding	Provides practice
	Checks understanding	Checks understanding	Supports/checks understanding
			Draws connections from examples to complete practice problems
Applied Practice Problems	Provides practice related to example	Provides more practice	Provides practice for test
	Checks understanding	Independent solving to check understanding in relation to other problems	Supports/checks understanding of the lesson
		Helps determine which method to use to solve	Helps determine which method to use to solve
		Deepens understanding of word problems and lesson	Draws connections from examples to complete the word problems
Write Math	ALG-FES students did not find this helpful overall	Deepens understanding when math told through statements and words	Prepares you for a test

doing. The LA-ELLs also reported headers as helpful because the headers identified examples. The only reports of headers not being helpful (i.e., did not pay attention to headers) came from the same LA-ELL students that did not find font variation helpful.

3.5.3 Highlighted Font-Vocabulary

All groups indicated they understood the importance of vocabulary in comprehending mathematics texts and concepts. There were no reports of highlighted vocabulary being unhelpful across groups (Table 2).

3.6 Reported Themes for Problem Types

3.6.1 Worked Examples

The *Worked Examples* were problems with explicit steps completed for worked solutions. These appeared to be most helpful for all students across groups, who reported the worked examples helped with understanding how to solve other problems in the chapter. Both FES groups reported these problems were used as a reference for others, and the ALG-FES group indicated they reviewed the worked examples often to help them understand the lesson. Both LA groups stated the problems provided a preview of the lesson, and FES students also added that the worked examples served as a preview of the test. Only a few students in each LA group did not find these problems to be helpful and reported they did not read them. Additionally, the LA-ELL group reported they would need teacher assistance to understand and did not find these problems helpful when working independently.

3.6.2 Semi-worked Example

When students were asked about a semi-worked out problem (partially worked solutions to scaffold parts of the solution) requiring them to set up the equation for solving (i.e., real world example), they all believed this type of problem supported their understanding for other parts of the chapter and provided opportunities to apply mathematics to real world situations. Interestingly, there were a couple in the ALG-FES group who reported reading this problem type but not finding these problems helpful. This was because the semi-worked examples required too much effort to set up the equation to solve, or the students simply disregarded the problem unless directed to it by their teacher.

3.6.3 Procedural and Applied Practice Problems

Procedural Problems had limited amounts of written words, were similar and adjacent to worked examples, or were provided in a section for students to practice and check content understanding. *Applied Practice Problems* were general word or story problems requiring students to apply procedures to a specific situation in order to solve the problem. All students across groups agreed that both kinds of practice problems provided practice and opportunities to check understanding. Some students also mentioned that both kinds of problems prepared them for tests (LA-ELL) or deepened students' understanding through independent problem solving opportunities (LA-FES). When explicitly asked about which problems students preferred (*Procedural* vs. *Applied or* word problems), all students preferred the *Procedural Problems* in this section but with different rationales. The LA-FES students stated that they relied on teacher assistance or an example to follow in order to solve word problems, and they felt more independently able to solve procedural problems. The LA-ELL students specifically mentioned that word problems were more difficult because they must "look at every word and detail" and, thus, preferred "less wordy" problems. A couple of the ALG-FES students reported they preferred procedural problems because these problems were more difficult to understand and, thus, challenged them. But, the majority of these students preferred procedural problems because word problems were more difficult to solve.

3.6.4 Write Math

The *Write Math* problem required students to describe two possible methods for solving problems in writing and explain which they prefer. The majority of students across all groups either did not find this problem type helpful (i.e., they did not read or pay attention to it) or did not articulate if it was helpful or not helpful. The LA-ELL group, who did report this problem to be helpful, stated that it prepared them for tests. A few of the LA-FES group stated that *Write Math* helped them better understand when math was told with words and statements. Most of the LA students in this sample were in participating Language in Math intervention classrooms and wrote more than the other students in the sample; this may have impacted their responses simply because most LA students (in the intensive classes) had more experience writing in math class than the other students. One ALG-FES student indicated that *Write Math* was helpful because it was good practice for using vocabulary in the explanation. Others who articulated why this problem wasn't helpful stated it was not reflective of real life to write in math or that they did not like to write (Table 3).

Students across groups demonstrated active and passive reading approaches in their responses (Table 4). The lower-achieving students had more themes categorized as a passive stance; however, when comparing the two lower-achieving student groups, overall the LA-FES students had fewer themes emerge in this category.

Table 3 Examples demonstrating active and passive reading characteristics of mathematics texts

Text feature or problem type	Active reading	Passive reading
Font Variation/Headers	Reads to understand what to do (directions)	Doesn't read or pay attention
Highlighted Font Vocabulary	Notices and pays attention to find examples and non-examples of the vocabulary word or concept;	Doesn't read or pay attention
	Makes connections to other math concepts or vocabulary	
Worked or	Reads actively (reads for understanding;	Plugs in steps from one problem without attempting to understand why steps make sense or are used
Semi-Worked Example, and Practice Problems	Copies example in notebook; writes notations;	
	Makes connections with other concepts/problems;	
	Constructs own examples	
Write Math	Writes to clarify or understand more about math problem/solution process	Doesn't see value or benefit of writing in math

The LA-FES students in our sample also appeared to understand the purpose of text features (font variations, headers, highlighted font) when comparing responses and themes in those categories. Though the data demonstrate there were active readers across groups, the ALG-FES students did not have any statements identified to indicate there were passive readers within that group.

4 Summary, Discussion, and Implications

To summarize our main results: the *Worked Examples* were helpful for most students. However, the entire low-achieving (LA) sample had themes that indicated teacher assistance would be necessary in order for this problem type to be helpful when working independently, indicating more of a passive approach to reading. The *Semi-worked Example* did not have any themes indicating students read these problem types passively. It could be that the structure of the problem required them to read actively in order to solve it, which in turn promoted understanding. Themes from the *Procedural Practice* problems indicate that LA-ELLs read both actively and passively, and the FES groups demonstrated themes of active reading characteristics. The *Applied Practice Problem* category indicates word problems were difficult for the entire LA sample who relied heavily on support from others to solve; the ALG-FES group did not articulate much concerning word problems—except for the theme indicating they preferred the problems for the challenge they

Table 4 Themes demonstrating active and passive reading characteristics across groups

Text feature or problem type	Algebra FES		LA-FES		LA-ELLs	
	Active	Passive	Active	Passive	Active	Passive
Font Variation	Tells important information;		Tells important information;		Tells important information	Doesn't Pay Attention
	Serves as a guide		Important to learn what lesson is about		Tells you what to do (i.e., directions to follow)	
			Bolded font indicates exact procedures and supports understanding			
Headers	Tells you what you'll be doing		Tells what you're going to learn/do, what section is about		Explains what you are learning;	Doesn't Pay Attention
					Identifies examples	
Highlighted Font	Writes or reads vocab specifically to learn and use		Provides words for lesson		Vocabulary is important-it helps to understand what lesson is about	
	Helps understanding;				Words we need to learn	
	Must be important since highlighted					
Worked Examples	References for solving other problems		Reads repeatedly to better understand how to solve problems	Doesn't pay attention or look at them	Enhances understanding when unsure how to solve problems	Doesn't read
	Helps independent problem-solving		Previews the lesson and test		Previews the lesson	Would do this with teacher assistance

Semi-Worked Examples	Provides practice		Provides reference for other problems		Helps understanding of real world applications of mathematics	
	Checks understanding		Relates to real world situations		Provides an example	
	Challenging; requires effort to set up equation		Provides example for other problems			
Procedural Practice Problems	Provides practice		Provides practice to deepen math understanding		Provides practice	Reviews answers with teacher
	Checks understanding		Checks understanding		Supports/checks understanding	Doesn't pay attention
					Draws connections from examples to complete practice problem	Wouldn't attempt without teacher
Applied Practice Problems	Provides practice related to example		Provides more practice	Relies on teacher	Supports/checks understanding of the lesson	Provides practice for test
	Checks understanding		Independent solving to check understanding in relation to other problems	Doesn't read or pay attention	Helps determine which method to use to solve	More difficult because must pay attention to every word and detail
	Prefers word problems for challenge		Helps determine which method to use to solve	Too difficult	Draws connections from examples to complete the word problems	Doesn't read or pay attention
			Deepens understanding of word problems and lesson	Reads only when assigned by teacher		Looks at it but doesn't read closely
						Too wordy

posed. Finally, results from the *Write Math* problem show that this problem type was not thought of as helpful to promote understanding of math by most students. Other than the LA-ELLs who used the problem to prepare for a test, students indicated they did not see the value of writing for mathematics understanding. There was one theme from the LA-FES group indicating they did see the value of writing for math, probably due to the fact that the majority of these students had more experience writing during math class.

Student self- reports across groups, particularly those in the LA groups, as to why certain problem types were helpful or unhelpful when working independently indicate that the students are unaccustomed to reading mathematics for meaning and persevering through problems to solve them. LA students found the *Applied Practice* word problems to be especially difficult, and as a result, they must rely on teacher support to solve the problems. In contrast, at least some of the ALG-FES group preferred the challenge of word problems over *Procedural Practice* problems. The student self-reports also reflect their dispositions towards mathematics and what they perceived to be the purpose for learning math (i.e., solving a problem for a test vs. developing reasoning skills to solve problems in general).

Student self-reports about how they use and read their textbooks, along with why students perceive certain text features and problem types as "helpful" or "unhelpful," point to the possibility that teacher mediation of the curriculum could be an important factor in assisting students' to adopt more active reading behaviors to comprehend mathematics textbooks. Teacher scaffolding of active-reading behaviors may also impact students' dispositions about the nature and purpose of learning mathematics as reported by Rezat (2009, 2013) and Weinberg et al. (2012). We use Rosenblatt's (1978, 1982), Kintsch's (1988), and Halliday's (1978) theories to discuss how reading with a more active stance could be helpful in comprehending mathematics texts for understanding.

Rosenblatt's (1978, 1982) theory treats reading as a two-way transactional process in which a reader and the text are central to the meaning-making process. According to Rosenblatt's (1978, 1982) theory, the reader is to be an active participant in making learning meaningful, filling in the missing pieces of text with a variety of responses. Kintsch's (1988) theory assumes that a given text is processed and represented at different levels: (a) at the propositional level, expressing semantic content (meaning) of the text, and (b) at the situational level, conceptualizing and creating a model of a situation based on explicit information with the support of prior knowledge. Textbase understanding is sometimes disjointed or incomprehensible, depending on linguistic complexity, and requires situational understanding to aid comprehension. Halliday's (1978) notion of social semiotics describes language as a social phenomenon that is rooted in social and cultural contexts where lexico-grammatical (linguistic and grammar) choices are made; thus, this theory explicitly deals with linguistic complexity.

These combined reading theories call for a change in the way teachers approach mathematics instruction, using textbooks to support reading comprehension of mathematical textbooks *while* fostering and developing mathematical understanding. The structure of most mathematics textbooks in the U.S.

(exposition—examples—exercises) lends itself to this combined theoretical approach. However, the focus of what is mediated by teachers during instruction, using the exposition and examples sections of the textbook, is what we feel should change in order to comprehend textbooks, increase mathematics understanding, and meet more rigorous learning standards. Rezat's (2013) and Weinberg et al.'s (2012) work demonstrates how students approach the exercises section of mathematics textbooks is dependent upon how teachers mediate the exposition and example sections. Based on student self-reports, our results support their findings.

The first part of the lesson, the exposition portion of the mathematics textbook, was designed to build students' background knowledge of the mathematics domain. Previous studies indicate students do not pay attention to the exposition portion of mathematics textbooks (Rezat, 2009, 2013; Weinberg et al., 2012). The textbook pages we selected for our study did not have an exposition section, which was typical for this textbook. Instead, the lesson began with a word problem that included a worked example. Although the students reported the worked example to be helpful, the header and sidebar information (lesson objective/main idea, undefined vocabulary words, and written state standard) were the only references indicating what the lesson would be about and triggering prior knowledge. Though not reported here, students in our study generally did not pay attention to the lesson objective/main idea, undefined words, or state standard in the sidebar. Moreover, even if students reported that they *did* pay attention to those sections, these features would be of little use to activating prior knowledge in a meaningful way without teacher mediation for those with limited or no prior experiences with the mathematics concept—in much the same way that simply stating what the lesson is about does not help students without some prior knowledge or schema to build upon (Kintsch, 1988).

A common recommendation for mainstream mathematics instruction is for teachers to mediate the textbook's lesson introduction in order to ascertain students' prior knowledge and experiences (both within and outside of school) with the concept and lesson objective to drive their instruction. More time can be spent on building students' prior knowledge and conceptual understandings of the math content if the teacher discovers students are not familiar with the concept. Our results expand that recommendation to incorporate teacher attention to and mediation of the language structures used by the author to convey mathematical meaning, which otherwise may constrain students' comprehension of the text. ELLs specifically need support with the language of mathematics and academic discourse as they generally do not learn this outside of school (Zwiers, 2008, 2009).

The examples section of the textbook should also be approached differently so that teachers no longer emphasize the solving of problems only to find answers; our results suggest that students will use their books for the same narrow purpose. Instead, we recommend that teachers focus student attention on understanding the problem solving process in the hopes of expanding the reading practices of their students. If teachers would approach examples in mathematics textbooks as providing opportunities for students to use and develop their conceptual understanding and reasoning, we hypothesize that teachers would be more likely to scaffold how

students read examples and encourage reading more meaningfully rather than solely looking for the steps and procedures to follow in order to solve problems.

5 Conclusion

When coupled with previous research on how teachers mediate and how students use mathematics textbooks, our study's findings suggest that mathematics textbooks should be used differently than what seems to be regular classroom practice in order to better support all students' understandings of mathematics texts, particularly lower-achieving FES students and ELLs (Regis et al., 2006). We advocate a more active stance for reading mathematics in conjunction with instruction that meaningfully makes connections to students' previous experiences with the mathematics content and language features specific to mathematics texts. In so doing, we proposed the merging of three language comprehension theories (Halliday, 1978; Kintsch, 1988; Rosenblatt, 1978, 1982) to guide instruction using mathematics texts.

The combined theories emphasize the two-way transactional processing of texts at different levels (semantic and situational), based on lexico-grammatical choices of the author. Although more research in this area is needed, we hypothesize that a dual focus on reading for meaning and the comprehension of language used to convey meaning in and for mathematics could be scaffolded by teachers' mediation of the textbook to promote an active reading stance. This would help to build students' reasoning skills and develop dispositions that seek to understand and approach mathematics textbooks and problems for reasons beyond tests, graded assignments, and "school-related" motives. Ultimately, the mediation of mathematics textbooks by teachers using such an approach could enable communication of mathematics while developing disciplinary literacies and practices for deep understandings of the content that CCSS and other rigorous learning standards expect.

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Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension

Jose A. León and Inmaculada Escudero

Abstract Reading comprehension involves a reader developing a mental representation of a text through the establishment of causal relations based on the ideas and events in the text. This is especially relevant to scientific text comprehension. Causal relations are fundamental to the process of comprehension as they provide a framework or scaffolding to order information in a logical way that is consistent with the argument. The most common method of assessing comprehension is based on the reader answering a series of multiple choice questions. It is unusual for comprehension measures to use an open task such as a summary. However, summaries require the reader to use writing skills as well as those of comprehension, thus revealing wide individual differences among students. This gives rise to two questions: (a) up to what point is a summary a reflection of the causal structure of a text, and (b) what—if any—is the influence of the causal relations on the comprehension of more competent and less competent readers? In this chapter we analyze the causal structure of scientific texts, as opposed to that of narratives, and explore how high school students process and comprehend these causal relations. We also examine how students' comprehension of causal relations can be evaluated by multiple choice tasks or open tasks such as summaries. Finally, we discuss some educational implications for improving comprehension in science.

Keywords Causality • Summarizing • Science discourse

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1 Science Textbooks, Strategies, and Cognitive Processes

It is a common fact that students, especially those in middle and high school, find many science texts very difficult to comprehend. Science texts frequently contain conceptualizations of ideas, explicitly specified rhetorical organization, jargon, context-bound terminology, and technical uses of terms. Furthermore, science writers frequently use abstract concepts and mathematical language (with symbols and formulas) that are difficult to ground in everyday experience and often require extreme precision. Hence, understanding what the text is about demands considerable effort. A direct consequence of these difficulties is comprehension problems, especially in those readers with poor scientific knowledge. In fact, all of these difficulties are exacerbated by the fact that most students have minimal background knowledge of science and, therefore, need to build an understanding nearly from scratch (Otero, 2002; Chambliss, 2002). An alternative scenario is that the knowledge students do possess is incorrect in some way, and it is this incorrect or mistaken knowledge that interferes with the scientific concepts and principles presented in textbooks (Graesser & McMahen, 1993; Otero & Kintsch, 1992). A consequence of all this is that students frequently develop negative epistemic attitudes toward science texts and think of them as containing incomprehensible information (Chinn & Brewer, 1993; Harp & Mayer, 1998; Otero & Campanario, 1990). These attitudes negatively influence their text processing strategies that, in turn, further limit their understanding and result in a continuing downward spiral of low motivation and even truancy (Mayer, 1999; Otero, 2009). All of these factors explain why reading science textbooks is hard and why it has become difficult to entice students to pursue a higher education in science disciplines.

2 Reading Science Texts and Writing a Summary: Some Data

Reading, regardless of whether it is understood to be a process or a skill, is generally recognized as being extraordinarily complex. It requires drawing on multiple operations whose coordinated activity enables the reader to extract, interpret, judge, and understand what has been read (Chiapetta, Sethna, & Fillman, 1991; Lemke, 1990). Far from being merely a passive and receptive subject limited to decoding, the reader takes an active role, applying knowledge and schemata as well as skills and experience to the search for meaning. It is the reader who generates what is understood, although this is based on the text.

The text itself, or rather the writer of the text, leaves clues about what is important and how the text is structured and organized. The author also illustrates particular points with good examples. All of these aspects facilitate the extraction of meaning and help the reader make sense of what he or she is reading. Thus reading involves an interaction between the reader's knowledge and the strategies

he or she applies with the information in the text. Analyzing what a text means, synthesizing, answering general or specific questions, relating one section of text to another, predicting possible outcomes, judging, evaluating, detecting and repairing inconsistencies, and completing ideas where information is lacking are all just some of the multiple operations involved in this interaction between the text and the reader that result in comprehension. Reading is of such importance that many developed and developing nations are dedicating considerable amounts of time and energy into researching reading and how it can be assessed.

One fairly recent initiative is the Program for International Student Assessment (PISA), which has been in operation since the year 2000 in all the countries of the Organization for Economic Cooperation and Development (OECD, 2010). Its aim is to establish common criteria for evaluating the performance of 15-year-olds in three areas: science, math, and reading. Thirty-two countries participated in the first year, and by 2009 this number had nearly doubled to sixty-five. With respect to reading, students are required to carryout a number of different tasks such as reading for global comprehension, reading for specific information, and interpreting or reflecting on the content or structure of a text. Not only school textbooks are used, but also personal letters, fiction, biographies, web pages, and documents in the public domain (e.g., official reports, news items). This variety of texts is included in order to monitor students' reading of different kinds of materials or for different purposes.

The PISA is a standardized test that is administered in many countries, and consistently the performance of students from the U.S. or Spain (relative to the ranking of other Western nations) is below the average. Only 4 % of Spanish and U.S. teenage readers achieve the highest scores while the average for the rest of Europe is 10 %. And the situation for math and science performance is broadly similar. Thus, for the last 10 years, we have known that: (a) 15-year-old students from Spain or the U.S. do not read much and that, when they do, they are not efficient readers; (b) this negative situation has remained constant for the past 10 years; and (c) the low marks obtained in reading correlate with a comparably negative picture in math and science.

An equally interesting question is how students perform in applying their knowledge and reading strategies to a written task, such as a summary, over the course of their school lives. To address this, we carried out a large-scale study that assessed how well students at different stages of education completed a summary task (León, Olmos, Escudero, Cañas, & Salmerón, 2006). A total of 786 students took part in this study, all from schools and a university in the Madrid area. The ages included were 12 years (sixth grade), 14 years (middle school), 16 years (high school), and >21 years (third year of university). The participants were asked to read an extract of no more than 500 words taken from an encyclopedia (a general knowledge text) and, afterwards, write a summary. Evaluation was based on two criteria. The first took into account the content, paying special attention to those features showing that the original text had been simply paraphrased or synthesized in a more or less superficial way. In other words, what was assessed was the surface structure and the textbase—two mental representation levels. Thus, a summary

consisting of paraphrases of the original source text or which, perhaps, included an idea expressed literally (i.e., as in the original) would be included in this type of analysis. The second method of evaluation paid more attention to coherence; that is, to the way ideas were presented, the causal connections between them, any development of the argument, the degree of synthesis, and any evidence of background knowledge used by the reader.

One of the most interesting things shown by this research was the relationship between the students' age or grade level and the kind of summary made, with differences between content and coherence being much greater at the earlier stages of education. We would expect that a child of 10 would have much fewer resources upon which to draw than a university student. Noteworthy among the results was a lack of fundamental differences between the summaries written by the 12-, 14-, and 16-year-old students. Significant improvement in summary writing was only shown by the university students. One reason for this lack of improvement in summary writing between the ages of 12 and 16 could be that students in this age range maintained the explicit ideas and the original wording of the text rather than elaborating richer and more synthesized summaries. This tendency disappeared among the university students. This could also be seen when we analyzed for type of summary (i.e., content-based or coherence-based). Students of school age tended to write summaries that closely followed the surface structure and the textbase rather than focusing on coherence. Put another way, although Spanish school-age students may have tried at some limited degree of synthesis in their written summaries, they tended to follow the structure of the source text and repeated its contents.

Together, these results seem to show that the deficiencies in summary writing extend throughout the educational system, affecting the primary levels as much as the secondary levels. One cannot help feeling that our educational system fails to invest sufficient time and resources in developing reading comprehension, metacognitive awareness, or the skills needed to write good summaries. Even worse, our educational system seems to encourage a kind of *theoretical teaching* where excellence is measured (whether by an exam, a summary, or any other kind of answer) by the students' ability to merely reproduce, in more or less paraphrased form, what a text, teacher, or other source says. Perhaps we encourage the basic levels of reading, but not the most important; the basic levels of writing, but not the most reflective.

3 The Influence of Text Characteristics and Causal Relations on Reading Comprehension

Text characteristics and text genre can influence reading comprehension. The literature frequently distinguishes between narrative and expository (e.g., science) texts (Adam & Revaz, 1996; Brewer, 1980; Harris, Rogers, & Qualls, 1998; León, Escudero, & van den Broek, 2003). Narrative texts make particular connections

between facts and usually reflect reasons, the actions of a protagonist, and the problems of daily life or fiction. On the other hand, the primary purpose for reading expository texts, such as science or history, is often to search for true, universal conditions. The expository mode frequently features the conceptualization of ideas or ways to build knowledge, explicitly specified rhetorical organization, context-bound terminology, and technical uses of terms (Kucan & Beck, 1996).

Another important difference between narrative and expository texts is based on the degree of generalization and the number of observations that are needed to construct a causal explanation. Causal relation, as a basic organizational principle, is also an explanatory principle, telling us what, how, why, and when the causality occurs. Readers understand an event when they are capable of relating it to other events in a text. One of the most important links is causality. It is not surprising that those who first conducted research on comprehension suggested that causal relationships play an essential role in narrative understanding (Bartlett, 1932; Dewey, 1938; Piaget, 1927). Researchers of narrative comprehension in the 1970s shared the assumption that causal representations were central in the comprehension and memory of narratives (Mandler & Johnson, 1977; Rumelhart, 1975; Schank & Abelson, 1977; Stein & Glenn, 1979; Thorndyke, 1977). There is plenty of evidence that both the strength and the number of causal connections determine the probability of comprehension and recall of the information read as well as the level of importance assigned by the reader to the text information (Trabasso & Sperry, 1985; van den Broek, 1988). As a consequence, causal models have been prevalent in psychological studies of narrative comprehension (Graesser, Swamer, Baggett, & Sell, 1996; Langston & Trabasso, 1999; Trabasso, Secco, & van den Broek, 1984; van den Broek, 1989; van den Broek, Young, Tzeng, & Linderholm, 1999).

Some researchers have shown that establishing causality during reading can be the most important process involved in comprehension (León et al., 2003; León, Solari, Olmos, & Escudero, 2011; Sundermeier, van den Broek, & Zwaan, 2005). Through five experiments, Sundermeier et al. (2005) demonstrated how causal and spatial information is constantly coded and updated during reading, especially when this is necessary to establish causal coherence. Some authors consider causal inferences to play a fundamental role in comprehension and have given them greater attention (McKoon & Ratcliff, 1986; van den Broek, 1990), and it is causal criteria which mainly guide inferential processing (Díaz & de Vega, 2003; van den Broek, 1990). This idea arises from the fact that the reader constructs a text-based and a situational model that are very sensitive to the availability of causal information (Sundermeier et al., 2005). Given that this procedure is necessary to construct a coherent global representation, the search for causal relations becomes the key to comprehension as a process and as a result (León, 2004).

Usually, in the comprehension of daily events or simple narratives, chronological order is a main criterion to organize causality. As noted, we learn causality by discovering the co-occurrence between causes and effects in the real world, in that causes precede effects. However, in a scientific context, it is not always possible to organize causality chronologically. Understanding science often amounts to grasping the meaning of some scientific generalization and using it to explain a

specific situation in which the generalization figures (Newton, 1995). In addition, many scientific explanations reverse the order of causality. They start with the presentation of the problem and then try to answer the question of *why* the problem has occurred. The reasons why scientific explanations appear in this way could be connected with the complex conceptual analysis needed in order to interpret reality according to scientific principles.

Scientific explanations are often causal (León & Peñalba, 2002; Ohlsson, 2002; Salmon, 1998) and elicited by posing *why* questions. That is, when we give scientific explanations, we answer *why* a particular phenomenon occurs. For instance, it is common knowledge that all the living beings, animals or plants, are fighting for their survival and, in so doing, develop strategies of adaptation to the environment. These and many other beliefs make up our commonsense causal understanding of the natural world, including human beings and their interactions with nature. The characteristics of this system and the way it operates are a matter for scientific debate. That is, we produce scientific discourse with explanations of, for example, *why* adaptation occurs, *what* it means, *how* and *when* it takes place, and *what* the consequences are.

Given that global coherence relations are primarily of a causal nature, it is important to bear in mind that this coherence arises through the reader connecting broad segments of the text and re-organizing information derived from the text within a structured representation that is integrated into a global causal structure (Escudero & León, 2007; León, 2003). Global coherence is a representation of text comprehension that includes the mental model and the causal network generated by the reader from the information in the text. Causal information, then, is fundamental to the process of comprehension as it provides a framework or scaffolding on which to order in a logical way information consistent with the argument. There is some evidence that, compared to novel or inexpert readers, expert readers organize information on more abstract levels with general strategies, laws, and principles (León & Peñalba, 2002; León & Pérez, 2001).

Some models and theories in discourse psychology have focused on the psychological mechanisms that underlie the comprehension of causal relationships in these scientific contexts. There have been investigations of the inferences that explain, elaborate, or predict events in causal chains in science (Britton & Black, 1985; Graesser & Bertus, 1998; Millis & Graesser, 1994; van den Broek, Virtue, Gaddy, Tzeng, & Sung, 2002). Sometimes it is difficult to comprehend the text because of the lack of subject matter knowledge; whereas, at other times there is a lack of text coherence. These barriers make it difficult, if not impossible, to link the text causally (McKeown, Beck, Sinatra, & Loxterman, 1992). Therefore, science texts require more intense processing than narrative texts. Comprehending science discourse requires different kinds of knowledge to form an explanation (e.g., conceptual and abstract knowledge), mathematical and logical argumentation, and procedural or strategic action.

4 The Importance of Summaries in Comprehension Processes and Reading Competence

One area of text comprehension research that has most interested psychologists and discourse researchers concerns the processes that occur during the comprehension and summarizing phases of reading. Comprehension and summarizing are very closely related. In fact, some researchers (e.g., Palincsar & Brown, 1984) have suggested that if readers are not able to summarize a passage, then they have not understood it. A generally acknowledged practice consists of using a summary to organize and emphasize the most relevant content of the text. Although the summary concept is imprecise, summaries themselves hold a significant place in scientific texts, and their effectiveness in improving comprehension and recall is generally recognized (Hartley & Trueman, 1983; Kintsch, Steinhart, Stahl, & LSA Research Group, 2000; León & Carretero, 1995; Lemarié, Lorch, Eyrolle, & Virbel, 2008; Lorch & Lorch, 1986, 1996; Lorch, Lorch, Ritchey, McGovern, & Coleman, 2001). When readers summarize a passage, they tend to form a nucleus of information, a core concept that represents a general vision of the text in a coherent way. Synthesis and coherence are two key aspects of a good summary. In order to summarize a text, a reader must read and comprehend the material, isolate the main ideas, and convey those ideas succinctly. In general, we can assume that a summary is a concise statement of the most important information in a text. A summary should describe most of the main ideas (or main topics) in the text. The ability to be concise is very important in some instances such as when submitting a scientific article or a proposal for meetings or conferences that usually require an abstract of 100 words or fewer. Because this task involves deeper processing—including writing strategies such as generalization, synthesis, and maintaining coherence (e.g., Brown, Day, & Jones, 1983; van Dijk & Kintsch, 1983)—it is more complicated than simple reading. Summarizing is especially important in educational and professional contexts (e.g., training in reading and writing strategies and assessments and in e-learning assessment, respectively).

The nearness of a causal chain can be a strong predictor of how the events of a story are rememembered (Khoo, Chan, & Niu, 2002). Causal relations, and the density of these relations, affect the reader's perception regarding the importance of these events for the story. The events with more causal connections and which occur as part of a causal chain from the beginning to the end of a story are judged by the reader to be more important and can be used in open tasks such as summaries or reports. This gives rise to the question of whether the causal structure of a text can determine how or to what degree the layers of a text can be understood, remembered, and used in different tasks. Many cause-effect relations in a text are inferred by the reader using information in working memory and long-term memory. Furthermore, some researchers have suggested that the goal of narrative comprehension is to discover the order of causal links that connect the beginning and end of the text (Khoo et al., 2002). In a recent study we assessed reading comprehension, analyzing the causal network in a narrative text and comparing this to the causal networks

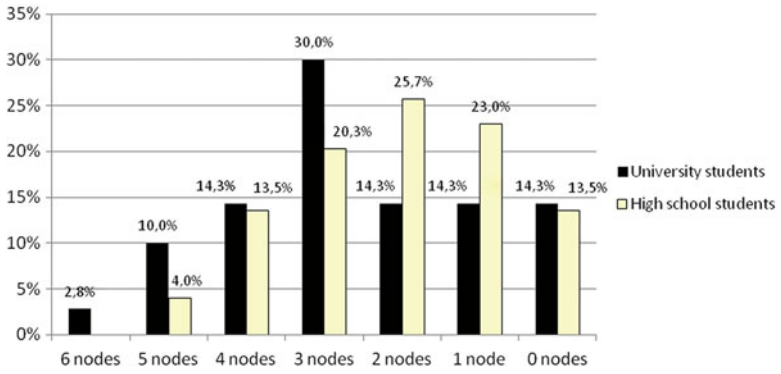

Fig. 1 Percentage of students using the key causal nodes in narrative text, by group (León et al., in press)

generated by the students in their written summaries of the original text and a multiple choice test (León, Escudero, & Olmos, in press). A total of 144 students (74 from high school [15–16 years old] and 70 undergraduate students) took part in this study. The main hypotheses behind this study were that causal density, or more specifically those nodes in a text that have a greater number of causal relationships, will have a greater effect on reading comprehension, and that the identification of the causal relationships in a text is one of the factors that distinguishes more competent from less competent readers. The results supported these hypotheses and, furthermore, enabled us to detect a predictive value between the recognition of causal nodes and types of reader (see Fig. 1).

Figure 1 shows the percentage of *key nodes* used by each group of students in their summaries. As can be seen, most of the university students based their summaries on three nodes while the high school students used between one and two. Only two university students (less than 3 % of that group) and no high school students seem to have identified all six key nodes. No high school students established six relations while three high school students used five nodes. Given these results, the correlations between each student's answers to the multiple choice comprehension questions and the number of points she or he had been awarded for the summary were compared. It was observed that the points awarded for the summary were moderately related to the representation of the textbase and to that of the mental model. As expected, this relation shows a slightly positive tendency. In other words, those students who can generate a good textbase and/or mental model tend to be good at summarizing the text.

A large number of experimental studies have also shown that writing a summary not only aids comprehension but also aids memory for the content of the source text (e.g., Anaya, 2005; Hidi & Anderson, 1986; Kintsch, 2000; Rinehart, Stahl, & Erickson, 1986). More specifically for our purposes, other studies have made clear that a summary is a good measure of comprehension (e.g., Al-Shabanah, 2005; Armbruster, Anderson, & Ostertag, 1987; Cordero-Ponce, 2000;

Jorge & Kreis, 2003; Kirkland & Saunders, 1991; León et al., 2006; Nelson & Smith, 1992; Taylor, 1983; Thomas & Bridge, 1980; Vadlapudi & Katragadda, 2010; Zipitria, Arruarte, Elorriaga, & Díaz de Llarraza, 2007). In their study, Thomas and Bridge (1980) obtained a very high correlation ($r = 0.80$) when they compared comprehension measured through a cloze test to comprehension measured through a summary. Nelson and Smith (1992) evaluated the quality of summaries in relation to the content, calculating the amount of important information included in each summary expressed as a percentage of all the main ideas in the text previously identified by expert judges. Research by Armbruster et al. (1987) and Cordero-Ponce (2000) follows similar lines. Furthermore, a number of studies conclude that comprehension ability shown by readers at an early age is a powerful predictor of comprehension in later years (Oakhill & Cain, 2007). In the final year of primary school, reading comprehension becomes especially important—above all because it establishes the basis for learning in high school. In fact, the academic progress of students who have poor reading comprehension or low motivation to read is severely limited (Guthrie et al., 2004).

Many research findings support the idea that coherence is central to discourse comprehension as well as to summarizing. Coherence is accepted as a main characteristic of a reader's mental representation of text content. Coherence relations are constructed in the reader's mind and depend on the skills and knowledge that the reader brings to the situation (Graesser, Singer, & Trabasso, 1994). A summary is considered to reflect how coherent (or incoherent) an understanding of the text the reader has. To summarize well, a reader must first perceive a text as coherent and then ensure that the ideas conveyed in the text hang together in a meaningful, organized, and synthetic manner. This analysis requires differing integrated levels of representation, including text-based models (based on topics and ideas from the text) and situational models (based on the reader's prior knowledge). As a result, summarizing is a highly effective means of constructing and integrating new knowledge. Many aspects of discourse contribute to coherence, including co-referencing, causal relations, connectives, and signals. These are highly correlated with other coherence factors such as causal relations found in the text (Trabasso et al., 1984). The potential for summarization to improve comprehension is high because it requires much more active meaning construction than choosing the best response from a set of choices or even writing short answers to isolated questions. Perhaps for this reason, as some authors suggest (e.g., Kintsch et al., 2000), summarizing may be a more authentic method for assessing what readers do and do not understand about a text than traditional comprehension tests.

5 The Representation of Scientific Text and Strategies for Summarizing

The content of scientific texts has multiple levels of representation, but the most important split is between shallow and deep knowledge. Shallow knowledge consists of explicitly mentioned ideas in a text. These can include lists of concepts, a handful of simple facts or properties of each concept, simple definitions of key terms, and major steps in a procedure (not the detailed steps). Deep knowledge consists of coherent explanations of the material that fortify the learner for generating inferences, solving problems, making decisions, integrating ideas, synthesizing new ideas, decomposing ideas into subparts, forecasting future occurrences in a system, and applying knowledge to practical situations (see Graesser, León, & Otero, 2002). Deep knowledge is essential for handling challenges and overcoming obstacles (when there is a need to understand how mechanisms work, for example), and for generating and implementing novel plans. Explanations are central to deep knowledge, whether the explanations consist of logical justifications, causal networks, or goal-plan-action hierarchies. It is well documented that the construction of coherent explanations is a robust predictor of an adult's ability to learn technical material from written texts (Chi, de Leeuw, Chiu, & LaVancher, 1994; Cote, Goldman, & Saul, 1998; León & Peñalba, 2002; Webb, Troper, & Fall, 1995). These different levels of mental representation also correspond to different ways of summarizing, each with their own appropriate strategies. These will be discussed in the next section.

5.1 Surface Code Level

This is the shallowest level, which preserves the exact wording and syntax of the explicit verbal material. Only the most recently read clauses are retained in memory and then only for a short time unless we make some effort to remember them. There are instances when this kind of mental representation is essential; for example, when we try to learn the lyrics of a song or recite poetry. In both these cases, words and syntactic organization are preserved in an identical way to the original. However, although memorizing a text allows us to recreate the superficial structure, it does not mean we have understood the text. Rather, it is a literal reproduction, a repetition that may not carry any meaning or bring us to an understanding of what is written.

The *copy-delete strategy*, proposed by Brown et al. (1983), occurs at this level and these authors found that it was relatively common among primary school students. Using this strategy, the ensuing summaries can be characterized by being shortened copies of the text. The important ideas and sentences are repeated more or less word for word and the surface structure of the text is maintained. Ideas are not combined with others, nor are they paraphrased; and if the summarizer runs out of space to write, he or she simply stops. For example, if a text to be summarized

contains 20 sentences, a student using this strategy might choose those sentences that he or she thought were the most important (say, sentences 3, 5, 6, 7, 12, 13, 15, and 20). These eight sentences would then be copied literally from the text while the remaining superfluous sentences would be ignored.

5.2 Textbase Level

The textbase is an interconnected network of the explicit propositions contained in the text. These may correspond to exact phrases but will also consist of abstract representations and paraphrases as well as a number of inferences necessary to establish coherence at the local level. The textbase preserves the meaning of the source text but not necessarily in the original words or syntax.

The textbase is useful in many comprehension tasks that require reference to explicit information in a text such as searching for or identifying specific details or connecting information across different sections of the text. For understanding to occur, the reader must build a mental representation made up of the meanings associated with the ideas and sentences contained in the text. For example, consider the following short text proposed by Otero, Caldeira, and Gomes (2004, p. 55):

> The water contained in a cloud is in the form of miniscule drops that reflect the light. It is this which gives clouds their characteristic white color.

A student who is asked to write this text from memory might begin in the following way: "The water in a cloud is made up of tiny drops ....". We can see that the text has been paraphrased and does not have an exact correspondence with the original; nevertheless, the meaning has been preserved.

With respect to the summary writing strategies associated with this level of representation, better readers usually focus only on relevant information, apply rules for condensing the information, and produce more succinct and coherent texts. The following steps were outlined by Brown et al. (1983): (a) delete unnecessary information; (b) delete redundant information; (c) substitute a list of names or events with a superordinate term; (d) substitute a number of subcomponents of an action or sequence of actions with a superordinate term; (e) select a topic sentence; and (f) if there is no topic sentence provided by the text, generate one.

5.3 Mental Model or Situation Model

At the deepest level, there is the mental model (or situation model) of what the text is about. This level of representation is more similar to our own experience of the situation or event described in the text than to the grammatical or structural characteristics of the text. To give an everyday example, the situation model of an internal combustion engine might include the electronic or mechanical components

of the system, the spatial arrangement of these components, the causal chain of events when the system is working, the mechanisms that explain each causal step, the functions of the components, and the plans of agents who manipulate the system for various purposes.

The mental model is more complex as it requires the reader to integrate propositions in the text with his or her own background knowledge and to generate inferences. Thus, evaluation of this level of comprehension is fundamental to our concerns because in order to achieve a good understanding of the text, the reader must supply a great deal of implicit information. This is achieved through making inferences, deductions, and abstractions; associating ideas; predicting; and so on. All of that may influence further processes after comprehension such as interpreting or judging. By evaluating the mental model, we can see whether a reader's comprehension is subject only to the explicit information contained in a text or, on the other hand, whether it is more reflective, efficient, and complete. For the purposes of evaluating reading, this level complements the previous levels as it can show us what problems might result from an inadequate understanding or even the causes of a poor understanding. We could say that it allows a measure of depth of comprehension as well as a measure of efficient reading competence.

To continue with our earlier example of the clouds, suppose that after reading the text, another hypothetical reader asks himself or herself the following: "If clouds are white because the sunlight is reflected by tiny drops (technically speaking, *droplets*), why do they sometimes look gray?" This raises the question of whether this reader's understanding of the text is identical to that of the reader who simply stores the meanings of the words in memory. The answer would seem to be: no. In the second case, the reader actively tries to relate the information in the text to his or her previous background knowledge. In fact, the reader finds that the information in the text (clouds are white) is incompatible with what he or she knows (some clouds are gray). In other words, this reader has generated a richer mental representation than the first reader—one that contains information from the text as well as what he or she already knows. The mental model, then, corresponds to a cognitive representation of actions, events, persons, or whatever the situation described in the text is, and to that is added information from the reader's own knowledge and experience.

As with the textbase, the summarizing strategies associated with the mental model include focusing on what is relevant and condensing the information to a more succinct yet coherent form by applying the following rules: (a) delete unnecessary information; (b) delete redundant information; (c) substitute a list of names or events with a superordinate term, or substitute a technical term whether this is in the text or not (*droplets* in our example above); (d) substitute a number of subcomponents of an action or sequence of actions with a superordinate term; (e) select a topic sentence; and (f) if there is no topic sentence provided by the text, generate one (based on background knowledge). Furthermore, at this level, students may review their summaries to check whether they contain sufficient information (Hare & Borchardt, 1984) as well as review them for coherence (León, 2004).

In conclusion, a summary is considered to be a highly complex task, requiring as it does metacognitive abilities not only to identify and select relevant information,

but also to organize, interpret and, ultimately, assimilate information in a critical and personal fashion. In all of these operations the reader must endow what he or she reads with meaning by relating it to what he or she already knows. Put another way, the reader endows his or her own representation of the text with meaning by, on the one hand, reducing and synthesizing the information contained there and, on the other, extending or deepening this further by adding his or her own knowledge and experience. The evaluation of summaries can be more effective if we take into account the use the reader or summarizer makes of the three levels of representation.

6 Using the Mental Representation as a Strategy of Improve a Summary

Some authors, such as Kirkland and Saunders (1991), suggested that summaries should be evaluated on the basis of four criteria that they claimed were appropriate for expository texts. The four criteria were: (a) the summary provides a general overview of the text and emphasizes the relations existing between the main ideas, (b) the information given is clarified by secondary ideas, (c) the vicarious character of the summary with respect to the source text is clear or even made explicit, and (d) the summarizer uses his or her own words. In their summary analysis model that draws on the work of several writers, Jorge and Kreis (2003) used five parameters to measure the quality of summaries: cohesion and coherence, inclusion of the main ideas contained in the source text, conciseness, information about the source text, and absence of personal opinion. A similar study was carried out by Zipitria et al. (2007) who developed a system based on observing and analyzing the processes used by expert evaluators of summaries. Zipitria and his colleagues identified variables (e.g., coherence and cohesion, appropriate and correct language, appropriate, correct and relevant content) and examined the overall contribution each of these made to the quality of the summary. The evaluators gave a global mark to the summary as well as marking each variable on a scale of 0–10. This study also reported a statistical analysis which showed a certain independence of the variables. A generalized conclusion of all these studies is that a summary task encourages deep understanding of the text because it requires active construction of the meaning as opposed to merely choosing one response from several alternatives or answering isolated questions. As such, writing summaries can be a valuable complementary instrument to traditional methods (i.e., multiple choice) of evaluating students' comprehension of science text.

We proposed that summaries should be evaluated on the basis of three criteria that were found to be appropriate for expository as well as narrative texts (León et al., in press). The three criteria were *content*, *coherence,* and *cohesion or written expression. Content* concerns the extent to which the summary reflects the essential content of the text. Evaluation is based principally on the textbase; that is, on whether the most relevant ideas have been included. *Coherence* is the main characteristic of a reader's mental representation of text content. Coherence relations are constructed

in the reader's mind and depend on the skills and knowledge that the reader brings to the situation. This analysis requires differing integrated levels of representation, including text-based models (based on topics and ideas from the text) and situational models (based on the reader's prior knowledge). As a result, summarizing is a highly effective means of constructing and integrating new knowledge as well as connecting causal relations between the relevant ideas, including reasons and consequences. These aspects should be clear and explicit in a good summary. Along with other details supplied by the reader, the aspects also give greater coherence to the summary. Finally, *cohesion or written expression* refers to the style and form of the summary. The characteristics that are evaluated positively are the use of paraphrasing, correct synthesis, and whether the summary is personalized; that is, whether the writer has used his or her own words. Characteristics that are evaluated negatively or even penalized are the inclusion of unnecessary or irrelevant information, the repetition of ideas, the use of the copy-paste strategy, and whether the summary is too long (and, hence, probably contains superfluous details).

The three criteria can be observed in a summary of the following science text sample:

Strangling Trees

A strange plant grows in some tropical forests. These are the *strangling trees*, one of the most curious examples of adaptation to the environment. When young, these trees are climbers; growing around the trunk or branches of other forest trees. As it climbs up its host, however, the strangling tree envelopes it in a mass of dense roots, suffocates it until it dies, and then lives as an independent tree.

The reason for this behavior is that, in the tropical forests, there is great competition for light and sun. A young plant just poking out of the dark forest floor, and not especially adapted to the conditions there, has little chance of survival unless it can reach the light it needs at the tops of the trees. The stranglers solve this problem by using other trees to reach their own "place in the sun" among the dense tangle of branches which makes up a tropical forest.

Some of the most common stranglers are certain fig trees from Brazil. The seeds of these strangling figs usually germinate in a high branch of an existing tree, probably carried there by birds or fruit-eating bats. The resulting plant produces two types of roots: one kind climbs up the trunk and branches of the host while the others reach down to the forest floor, either following the trunk or simply dangling in the air. The stem grows upwards toward the light. This young plant is an epiphyte; that is, a plant which lives on another but does not take anything from it.

Once the downward growing roots reach the forest floor, the strangler's growth accelerates. Its roots thicken rapidly and it can grow many leaves and branches. Viewed from the ground it is almost impossible to distinguish which parts of the tree belong to the strangler and which to the host. It is now when new roots are formed and begin to spread themselves over the host's trunk. After some time, these roots form a dense mesh around the host tree that gradually gets tighter and tighter.

This is when the strangler kills its host not only preventing its trunk from getting bigger, but also squeezing it, crushing it, so that the sap can no longer circulate and nourishment can no longer reach its branches or leaves.

While it is choking its host, the strangler's roots continue growing, getting more and more robust until they completely cover or nearly cover the trunk. When the host tree dies, the strangler becomes an independent tree with its own leafy canopy. Some stranglers are the biggest trees in the tropical forest.

> Strangler trees are not only common in Brazil. They can be found in the humid rain forests of Australia, New Zealand and several other countries (León, Escudero, & Olmos, 2012, p. 8, reprinted with permission).

A summary of this type of text could be as follows:

In humid rain forests (Brazil, New Zealand, Australia) the high density of vegetation means that very little light reaches the forest floor, so there is great competition for light and sun. In order to survive (adaptation to the environment, survival strategy) some trees (e.g., Brazilian fig tree; an epiphyte) adopt the curious strategy of climbing up a host tree, eventually smothering it in a mass of dense roots which, in the end, squeeze the host tree so tightly that the sap can no longer circulate. The host tree dies and the strangler tree occupies its place as an independent tree.

With regards to the **content** of the summary, the information included should explicitly mention the strangler tree and the host tree, as well as the strangling process described in the first paragraph of the text. Also important is the fact that the strangling tree and the host co-exist at first, but eventually the strangler chokes the host and ends up living as an independent tree. Analogies (e.g., *it is or acts like a vine*; *it is a kind of climbing plant but much bigger*; *it is a creeper*), are useful, as is describing the two possible routes: *one kind climbs up the trunk ... while the others reach down to the forest floor*. Other central ideas that should be mentioned are the reason for the strangler tree's behavior (the why), in particular the fight for survival (adaptation in general) or the competition for sunlight (adaptation to a specific condition).

Attending to **coherence**, there is a more or less clear causal thread running through our sample science text (general idea: *Strangler trees have a curious way of fighting for survival and in trying to reach the sunlight in dense tropical forests*) and a survival strategy (*Although at first they co-exist with a host tree, little by little they surround it from top to bottom with their own roots so that, in the end, they asphyxiate it and take its place as independent trees*). The order of the ideas follows the logical sequence (i.e., FIGHT FOR SURVIVAL – STRATEGY OF ADAPTATION). Although if it were the reverse (i.e., STRATEGY – FIGHT), it might also be acceptable, providing the essential ideas are included.

Finally, with respect to **written cohesion**, the ideas should be expressed clearly and flow easily from one sentence to another. This summary uses paraphrasing and correct synthesis, and the summary is personalized—the writer has used his or her own words.

This system of assessment permits us to compare other examples of poor or incomplete summaries of adolescents:

– *This text talks about how strangling trees kill people, these trees are found mainly in Brazil, New Zealand and other several countries, talks also about the roots and seeds of these trees.* (Middle School, 14 years old)

– *This talks about one of the strangest adaptations to the environment. In the beginning these plants grow like a creeper around the trunk and branches of an ordinary tree in the forest.* (High School, 16 years old)

Examples of acceptable (or nearly acceptable) summaries written by adolescents include the following:

– *This talks about trees which strangle other trees because they fight for the light. Birds take the seeds up to the highest branches of other trees. The roots grow downwards, surrounding the tree and strangling it.* (Middle School, 14 years old)
– *The text talks about a tree which slowly kills other trees in its search for light and in this way can survive. Little by little these trees surround their prey and then squeeze and squeeze until the sap can't circulate. The plant is called "Brazilian fig tree" but they also exist in New Zealand, Australia and Brazil.* (High School, 16 years old)
– *Strangling trees are plants which have adapted to the environment, they strangle another tree until it dies and then live as an independent tree. They do this because of the competition for light and sun.* (High School, 16 years old)

We can also apply the three criteria to identify adolescents' good or excellent summaries:

– *In some tropical forests in Brazil, Australia, New Zealand, etc., a strange type of tree grows, the stranglers. These trees grow like creepers around another typical forest tree, climbing up the trunk in search of sunlight. Once they have reached the top and their roots are in the ground, they begin to squeeze and crush the trunk of the trees they are living on to later occupy their places in the forest.* (Middle School, 14 years old)
– *For the vegetation in the forest, survival is a war to get light. The strangling tree is an example. It grows in several countries in different parts of the planet. Stranglers have adapted to the environment in order to survive. Like every plant they need light and their way to get it is by germinating their seeds, which most probably have been digested by fauna (birds) in the branches of a tree where they grow, surrounding the host tree until they kill it (through asphyxia) when they occupy its place.* (High School, 16 years old)

Academic texts like *Strangling Trees* as well as others, including narrative texts, have been analyzed recently in different studies using summary task and multiple choice tests (León et al., in press; León, Olmos, Perry, Jorge-Botana, & Escudero, 2013). These studies were designed around three main objectives. The first objective was to test whether a summary task would predict the reading comprehension ability of students at different education levels: middle school, high school, and university. The second objective was to determine whether symmetry/asymmetry of the summary task was a predictor of reading comprehension ability. The third objective was to examine whether a summary task would predict reading comprehension ability when using source texts of differing degrees of complexity.

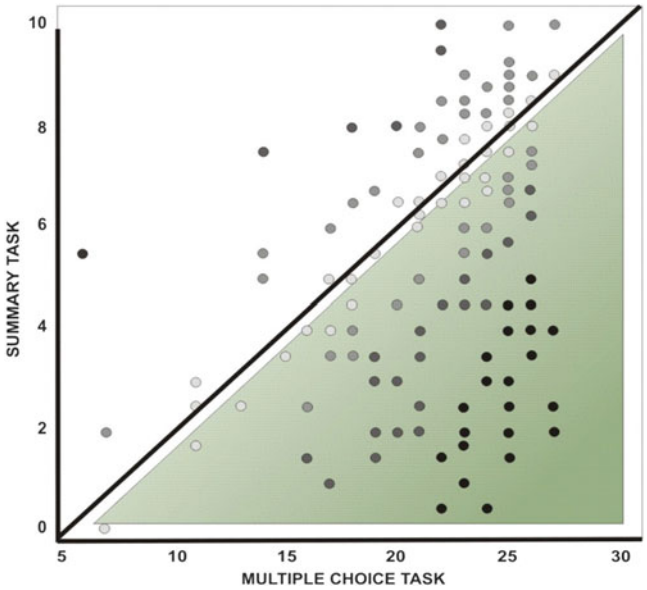

Fig. 2 Dispersion diagram showing the effect of the one-way asymmetry between the scores for the multiple choice test and the summary task for the *Candies* text for all groups (León et al., in press)

The results obtained suggest that summary writing can indeed be used as a predictor of reading comprehension, at least when this is measured using a multiple choice test. Furthermore, an examination of the data for both the expository and narrative text types used show that between the multiple choice reading test and the summary task there is a one-way asymmetrical effect, while in the reverse direction (from the summary to the multiple choice test) the effect is symmetrical. This is depicted in Fig. 2.

In practical terms, this indicates that although the result of a multiple choice reading test would not guarantee or predict the quality of a given student's summary, the quality of the summary could be used to predict the same student's performance on the reading test. We may conclude that a summary may be used to predict reading comprehension as measured by a multiple choice test. This has occurred with two distinct texts with different levels of difficulty and with participants at different stages of education (middle school, high school, and undergraduate students). The predictive nature of a written summary can be interpreted in the sense that a student who obtains a high mark for his or her summary will probably also obtain a high mark in more traditionally evaluated reading comprehension. Similarly, we would expect a student who achieved a low mark in the summary to not do very well in a multiple choice reading test. Therefore, summary writing can be said to have a predictive value for reading comprehension and, in turn, of reading competence.

One possible interpretation of this data is that a summary task is much more complex than a multiple choice test; apart from engaging the cognitive processes involved in reading comprehension, it also requires control over the processes used in written production. As discussed earlier, producing a written summary requires the writer to abstract the essential ideas, to establish coherent relations among them, to distinguish between relevant and irrelevant details, and to construct a logical internal mental representation of all these that is true to the semantic relations in the text. Moreover, it involves writing strategies and confronting an already existing text. These skills, in turn, imply the writer is actively evaluating the relative importance of text information. In short, writing a successful summary requires planning and control over one's own comprehension.

7 Conclusions

In this chapter we support the idea that the summary writing is a valuable learning activity because it helps readers build a coherent mental representation of the text, which is the foundation for adequate and consistent learning. This learning activity is special more relevant when reading and understanding science texts because it involves more time and effort than narratives to construct a mental model of an event and a causal explanation. It also takes more time to process the features of academic discourse: technicality, abstraction, complexity, and inclusion of expert knowledge.

Several characteristics of the summary writing may be important in this regard. First, a summary not only requires production of a written text, but also presupposes the skills and processes that are involved in comprehension. Currently, it is assumed that a summary writing task demands considerable effort on the part of the reader as he or she advances through the source text in order to differentiate between relevant and irrelevant ideas and concepts, decide on the ideas and details upon which a coherent internal mental representation of the semantic relations in the text will be built, and establish coherent relations between the ideas. Thus, a summary task encourages the reader to carryout a systematic exploration of stored information, encourages text structure strategies, and strengthens the connections between old and new information. Second, summary tasks require a degree of planning and control over one's comprehension. They stimulate the use of metacognitive skills and favor the development of self-regulation strategies, all of which have a positive impact on knowledge building and learning from written texts. Third, underlying the use of all these strategies is the basic idea that to summarize a text one must first understand it, and the better the understanding, the better the summary will be. Perhaps it is for this reason that asking readers to write a summary is considered by some researchers as one of the best methods of evaluating comprehension (Idris, Baba, & Abdullah, 2008).

The predictive nature of a written summary on text comprehension can be interpreted in the sense that a student who obtains a high mark for his or her

summary will probably also obtains a high mark in reading comprehension. Similarly, we would expect a student who achieved a low mark in the summary to not do very well in a multiple choice reading test. Therefore, summary writing can be said to have a predictive value for reading comprehension and, in turn, of reading competence (León et al., in press). The three criteria (i.e., content, coherence, and cohesion) are relevant to evaluating summary tasks adequately.

Summary writing tasks can help students learn higher level writing and comprehension strategies. Writing summaries is not only relevant to the study of comprehension, but also has other educational applications. For example, Hadwin, Kirby, and Woodhouse (1999) studied variables such as summary writing, working memory, verbal ability and background knowledge as predictors of both good summary writing and of memory for content. They found that the quality of written summaries was the best predictor of academic performance and of individual differences between students.

Finally, we highlight that summary writing is a valuable learning activity requiring more research. The education system in general needs to invest more time on developing the strategies required for writing good summaries. We might even say that the secondary educational system fosters a type of theoretical teaching where *excellence* means the capacity to reproduce a text, or whatever the original form was, regardless of whether this be on an exam, in writing a summary, or providing any other kind of answer. This would require a drastic change in current practice and present a challenge that must be met by educators in the near future.

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Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices

Michael F. Hock, Irma F. Brasseur-Hock, and Donald D. Deshler

Abstract Whether driven by individual state or national efforts, the desire by key stakeholder groups to make American students internationally competitive brings a renewed focus on reading comprehension instruction in middle and high schools. Such efforts push reading comprehension instruction beyond understanding text and the author's message to critical or "close" reading that integrates text-based information with the reader's prior knowledge resulting in new and expanded understanding of complex ideas. In order to ensure that students become proficient in the type of higher order comprehension expected by more rigorous standards, teachers need to be effective in teaching high impact reading comprehension strategies. In this chapter, we briefly highlight new expectations for English language arts at the middle and high school levels, review reading programs shown to be effective in rigorous research studies that measure reading comprehension or reading achievement outcomes with middle and high school students in core English language arts courses. Finally, we discuss specific reading strategies and vocabulary instruction that support close reading and suggest a model for teaching reading comprehension in middle and high schools.

Keywords Close reading • Adolescents • Language arts • Reading strategies

1 Introduction

For states that adopt either the Common Core State Standards (CCSS) or rigorous independent standards, a significant shift will be required in English language arts (ELA) instruction (Rothman, 2013). This shift will be required because of the standards' emphasis on college and career readiness. Such an emphasis will require

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that middle and high school teachers provide reading comprehension instruction that is vastly improved and far more rigorous than current instruction (National Governors Association Center for Best Practices [NGAC] & Council of Chief State School Officers [CCSSO], 2010).

2 Reading Comprehension Defined

For the purpose of this chapter, we define reading comprehension as a process in which the reader constructs meaning from text-based information. During this process, the reader creates a mental representation of the meaning of the text by using features of the text and the reader's knowledge of the world. When the reader integrates text-based knowledge with prior knowledge, deep comprehension occurs (Duke & Carlisle, 2011; Kintsch, 1998; Snow, 2002). Thus, reading comprehension is not limited to knowledge of textual information, but comprehension becomes the complex interaction of text, reader, and contextual factors (Duke & Carlisle, 2011; Duke, Pearson, Strachan, & Billman, 2011; Snow, 2002). Teaching students to be effective comprehenders of text who engage in the process described above will require a significant shift in how reading comprehension is taught in ELA classes.

In addition to changing the way reading comprehension is taught, changes will be required in curriculum materials, instructional strategies, assessments, instructional support systems, professional learning, and instructional coaching. For example, teachers will need to engineer instruction so that whole class, small group, cooperative learning groups, and individual support and feedback opportunities are available to students in order to personalize learning (Rothman, 2013; Snow & O'Connor, 2013). Teachers will need to identify research-based reading strategies that engage students in comprehension activities (Shanahan, 2013). More importantly, teachers will need to be prepared to explicitly teach the strategies to a diverse student population. Instruction will need to be explicit in order to meet the needs of students with disabilities, those living in poverty, and those whose first language is other than English (Allington, 2011; Archer & Hughes, 2011). In addition, schools may need to provide supplemental reading instruction through a framework of multi-tiered system of supports (MTSS). An MTSS framework will support students who are not yet proficient readers and those who have had insufficient response to reading comprehension instruction in the past (Lane, Oakes, Menzies, & Harris, 2013). Finally, all innovations must be anchored in quality professional learning if some level of implementation fidelity is expected.

Instructional coaches will play a critical role in the professional learning process (Knight, 2004). Instructional coaches are most often school-based personnel, usually experienced and highly effective teachers on special assignment, who act as on-site professional developers. The coaches support teachers as they implement proven innovations and/or programs. Instructional coaches use effective practices for adults to collaborate, identify practices that address teachers' needs, and coach

teachers through implementation of those practices. Often coaches will support and encourage teachers by helping teachers analyze the classroom environment and identify ways to address pressing concerns. In short, instructional coaches, working in partnership with teachers, identify goals, guide teachers through new instructional material, engage in collaborative planning, model new instructional practices in teachers' classrooms; and provide feedback to teachers (Knight, 2004).

In this chapter, we will discuss ways to include effective comprehension strategies in ELA instruction. Additionally, we will explore evidence-based practices and structures that support effective implementation and are aligned with the changing expectations for ELA middle and high school reading comprehension instruction.

3 The Continuing Challenge

Overall, the findings reported in the 2013 National Assessment of Educational Progress (NAEP) relative to reading outcomes for fourth and eighth grade students are modestly encouraging. For example, scores for eighth grade readers improved slightly. That is, scores increased from 265 points in 2011 to 268 points in 2013, a statistically significant difference. Fourth grade reading scores were relatively stable with a slight but not statistically significant change (National Center for Educational Statistics [NCES], 2013). In stark contrast, however, some subgroups of learners showed little or no improvement. The data for eighth grade students with disabilities show that these students continue to do poorly. Fully 63 % of students with disabilities read below the Basic Level on the NAEP reading assessment compared to 22 % of their peers without disabilities (National Center for Educational Statistics, 2012). Additionally, both African American and Latino 17-year-olds score 26 points below White students the same age (NCES, 2013). In a very real sense, students reading at the Basic or Below Basic Levels are currently unable to comprehend much of the written material they encounter in language arts classes.

The challenge is not solely related to subgroups of students within the U.S.. On an international measure of math, science, and reading literacy, U.S. students continue to be "average" when compared to 65 international education systems. Specifically, the Program for International Student Assessment (PISA; Buckley, 2013) shows no measurable change in scores for U.S. 15-year-olds in reading literacy. And *only 8 %* of 15-year-olds in the U.S. scored at the higher reading levels of the PISA (Buckley, 2013). The higher levels of reading comprehension are somewhat aligned to new measures of reading comprehension and standards found in the CCSS. Thus, English language arts teachers will, in all likelihood, encounter wide academic diversity in their classes and students with poor basic reading skills.

Although data on the reading performance of adolescent readers is helpful in general, it does not describe the nature of the specific reading challenges many students face in terms of reading comprehension and the skills that support

comprehension. To add clarity to the reading skill profile of adolescent readers and thus better inform teachers about the instructional needs of adolescent readers, Hock et al. (2009) conducted a descriptive study of adolescent readers in which multiple reading measures were administered to a stratified sample of exemplary, above average, average, below average, and unsatisfactory adolescent readers. Students were placed in the appropriate category based on their reading scores on the Kansas Reading Assessment (Kansas State Department of Education, 2005). Students were then administered 11 standardized reading tests across five reading domains: alphabetics, word level reading, fluency, vocabulary, and comprehension (Hock et al., 2009).

The study described differences across reading domains between proficient and adolescent struggling readers (ASRs). In all five reading domains, struggling readers were found to score statistically lower than their proficient reader counterparts. By and large, the struggling readers scored approximately one standard deviation below the mean in each reading domain and 20 or more standard score points lower than the proficient reader group. Although the areas of greatest deficit were in fluency and comprehension, many poor readers also demonstrated significant deficits with word level reading (word attack, decoding, word recognition, and rate). Specifically, the study found that 61 % of the struggling reader group scored low in all five domains. An additional 12 % scored low on all domains except word level. Thus, 73 % of the students had comprehension difficulties. These findings underscore the notion that improving reading proficiency is not a challenge to be taken lightly. We strongly believe that ELA teachers will need support to improve reading comprehension outcomes for all students. Such support will require instruction that is effective, supplemental, and aligned with the major reading domains.

Adolescent struggling readers are not a homogenous group. In a latent class analysis of the same struggling reader data set discussed above, researchers found five statistically unique subgroups of ASRs: readers with severe global weaknesses, readers with moderate global weaknesses, dysfluent readers, weak language comprehenders, and weak reading comprehenders (Brasseur-Hock et al., 2011). The profiles of these five subgroups demonstrate considerable diversity and are distinguished by their specific strengths and weaknesses. Two of the subgroups were similar with respect to component reading scores though dissimilar with respect to severity of the deficits: those with what were termed *severe global weaknesses* and those with *moderate global weaknesses*. These two groups scored from one to two standard deviations below the mean on almost all reading measures. *Dysfluent readers* showed weaknesses only on the measure of fluency. *Weak language comprehenders* were distinguished by average to above average performance on all component skills except comprehension, which was a half of a standard deviation below norms. Finally, *weak reading comprehenders* demonstrated strengths, performing at or above average on all components skills, but were still poor comprehenders. The weak reading comprehenders may lack skills that weren't assessed or have potential difficulties with strategic processing of extended text. They may also lack experience with particular genres of texts or have limited background knowledge necessary for comprehension.

Given the significant reading needs of adolescent struggling readers and the diversity of subgroups of poor comprehenders, increasing students' reading proficiency to the level required by more rigorous standards will be a significant challenge for teachers whose students lack basic reading skills. Again, we believe whole school efforts are required to improve reading proficiency for all adolescents, such as that offered in an MTSS framework (Lane et al., 2013), and instructional practices and strategies for teaching adolescents to be proficient readers in ELA classes.

4 Beyond the Comprehension Challenge: The Opportunity Gap

Low levels of reading achievement are related to poor school and life opportunity outcomes. For example, about 20 % of the lowest level readers will drop out of high school by the end of their sophomore year (Dalton, Glennie, Ingels, & Wirt, 2009). The consequences of not graduating have been well documented; dropouts have higher unemployment rates and earn lower wages (Lehr, Johnson, Bremer, Cosio, & Thompson, 2004). Thus, although reading proficiency matters in terms of school and life outcomes, many middle and high school students, including English language learners, African American and Hispanic students, students living in poverty, and students with disabilities, have a history of significantly limited educational success and overall life opportunities due, in part, to poor reading skills (Carnegie Council on Advancing Adolescent Literacy, 2010; Lichtenstein & Blackorby, 1995).

5 The Impact of the More Rigorous Learning Standards

In response to increasing the U.S.'s ability to compete internationally, states have worked to increase the rigor of educational standards. In turn, these rigorous standards are expected to significantly increase the U.S.'s academic competitiveness and to better prepare students for the growing knowledge-based global economy. Although the new standards may be theoretically sound, initial results from states that have administered reading measures more closely aligned with rigorous standards indicate that student performance will be well below desired outcomes. For example, student reading test scores in New York dropped about 35 % from the previous year's scores, and only 26 % of students in the third through eighth grade passed the test in English (Editorial Board New York Times, 2013). Similar findings can be found in other states (e.g., Kansas, Kentucky, and North Carolina). Given that many students scored below proficient on previous state tests and are now scoring even lower on more rigorous measures, it seems likely that many ELA teachers will need to alter their instructional practices and curriculum in order to respond to this new reality.

5.1 What We Know About Effective Reading Programs

Although limited in number, evidenced-based programs shown to significantly improve reading comprehension outcomes for middle and high school students do exist (e.g., http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2013456). In this chapter, we review *only* those reading programs shown to be effective in rigorous research studies and reviewed by the What Works Clearinghouse (WWC). Further, we review only those programs that measure reading comprehension or reading achievement outcomes with middle and high school students in core English language arts (ELA) courses. That is, the programs must have been delivered in ELA classrooms and not in supplemental or special courses. Information on instruction for English Language learners and students with disabilities and often provided in supplemental instruction settings are reviewed in Chapters "Reading Comprehension Skill Development and Instruction for Adolescent English Language Learners: A Focus on Academic Vocabulary Instruction" and "Special Education in Middle and High School" of this book. Because the majority of these students are served in general education language arts classes, ELA teachers will find that information helpful.

6 What Works Clearinghouse

The Institute for Education Sciences (IES) established the What Works Clearinghouse (WWC) to help educators determine the level and quality of evidence supporting interventions, practices, and programs. The stated goal of the WWC is to provide educators with the information they need to make evidence-based decisions. They do this through a systematic review process which applies rigorous research standards to identify high-quality research and summarize the findings. The WWC gathers studies through a comprehensive search of published and unpublished publicly available research literature. They also search relevant electronic databases and websites. Studies are screened for eligibility, and then each study is reviewed to determine if evidence standards have been met. Each study receives a study rating of: *Meets Evidence Standards without Reservations*, *Meets Evidence Standards with Reservations*, or *Does Not Meet Evidence Standards*, that relates to the amount of confidence WWC places in the ability of the study to demonstrate causal evidence of the effectiveness of an intervention. The WWC combines findings from individual studies into summary measures of effectiveness, including those describing the magnitude of findings, the amount of supporting evidence, and the ability to generalize findings. The WWC trains and certifies its reviewers to ensure that all reviews are accurate representations of whether studies meet WWC evidence standards. Additional information on the WWC and in-depth information on all studies reviewed can be found at http://ies.ed.gov/ncee/wwc/.

7 Evidenced-Based Reading Programs

First, we review **Project CRISS®**. The WWC found Project CRISS® to have potentially positive effects on reading comprehension for general education students in grades 4 through 6 (U.S. Department of Education, Institute of Education Sciences, 2010a, 2010b, 2010c). Given that some middle schools include students in grades 5 and 6, we believe this program to be appropriate for the chapter. Project CRISS is a professional development program for teachers of students in grades 3 through 12 and uses existing curricular materials to teach reading, writing, and learning in whole class settings. The main thrust of the program is to support teachers as they change instructional practices, not necessarily curricula. Teachers learn how to: teach their students comprehension monitoring strategies; integrate new knowledge with prior knowledge; and implement strategies for active engagement in learning activities by discussion, organization, and analysis of text structure. Teachers also learn how to support student application of these skills and strategies as they learn content.

Results of two randomized control trials (RCTs) that met WWC evidence standards are included in the WWC report on Project CRISS. One study (Horsfall & Santa, 1994) reported significantly greater gains on a developer-made measure of free recall of information for students in grades 4 (ES = 1.17) and 6 (ES = 0.96). These are very large effects obtained on developer-made measures that were closely aligned with the intervention. However, in another RCT study (James-Burdumy et al., 2009) no statistically significant effects for Project CRISS were found over a control condition using a standardized reading measure (The Group Reading And Diagnostic Evaluation; Williams, 2001) and measures of science and social studies reading comprehension. The WWC concluded that the evidence supporting Project CRISS, while mixed, was potentially positive.

Cooperative Integrated Reading and Comprehension® (CIRC; Stevens & Slavin, 1995) is a reading and writing program for students in grades 2 through 6. The key components of the program include story related activities, direct instruction for reading comprehension, and integrated language arts/writing instruction. Within the general education classrooms, students work in cooperative pairs or small groups of four reading to each other; using strategies for prediction and summarization; writing responses to questions; and practicing skills for spelling, decoding, and vocabulary. The CIRC is part of the *Success for All* school reform model and focuses on reading and writing skills. A Spanish version of the program is also available. Currently, CIRC has evolved into two reading programs: Reading Roots (beginning readers) and Reading Wings (upper elementary).

Based on two studies that meet the WWC evidence standards with reservations, the CIRC was found to have potentially positive effects on reading comprehension and general literacy achievement for younger adolescents (U.S. Department of Education, Institute of Education Sciences, 2010a, 2010b, 2010c). One of the studies (Stevens & Slavin, 1995) was conducted, in part, in grade 6 as an element of the language arts curriculum. This quasi-experimental design study found the overall

impact of the program to have an Improvement Index of 7 percentile points for the average student. In this case, percentile scores represent the number of scores below the reported percentile score. Thus, if the average score for the comparison group was, for example, at the 57th percentile, the CIRC group scored at the 64th percentile or 7 percentile points higher.

The researchers used standardized measures of reading comprehension and vocabulary. Another quasi-experimental study was conducted by Jewell (1994) in grades 2 through 6. Although there are potential confounds in this study (e.g., volunteer teachers in the experimental condition, non-volunteer teachers in the comparison) the results were promising if not limited. The impact of the CIRC program was 2 percentile points above the mean, which the WWC (2010) determined to be small with indeterminate effects.[1]

The Talent Development Middle Grades Program is a comprehensive school reform model designed to improve learning outcomes for students in urban middle schools (Herlihy & Kemple, 2004). Key features of the model include small learning communities, the use of an evidenced-based curriculum aligned with standards, teacher teams, and school-family-community connections. A key component of the model is a reading program called Student Team Reading. This program is a reading and language arts curriculum for middle school students that utilizes cooperative learning, high interest reading material, and explicit instruction to teach reading comprehension strategies, fluency in reading, and writing. The instructional model involves teacher explanation, team and independent practice, and peer and individual assessments.

One study met the WWC criteria for evidenced-based standards with reservations. The study was conducted with seventh and eighth grade middle school students in 29 urban schools (Herlihy & Kemple, 2004). The Student Team Reading Program was found to have potentially positive effects on reading comprehension for adolescents. The impact of those effects were determined to be an average of 3 percentile points above the average score for students in the study. The U.S. Department of Education, Institute of Education Sciences (2013) determined the effectiveness of The Talent Development Middle Grades Program to have potentially positive effects on comprehension for adolescent readers.

Reading Apprenticeship® is an instructional approach designed to improve engagement, fluency, and comprehension of content area materials. Reading Apprenticeship is intended for students in middle schools, high schools, and community colleges. In the program, the teacher assumes the role of expert reader who models and guides students through text-based problem solving activities. The course is embedded within content area classes (Corrin et al., 2008).

One study meets the WWC standard for evidence without reservations (Corrin et al., 2008). In this RCT study involving over 2,000 students in 10 school districts, students in the Reading Apprenticeship condition scored a statistically significant positive effect on the reading comprehension subtest of the Group Reading And

[1]The WWC does not report effect sizes that are less than 0.25.

Diagnostic Evaluation (Williams, 2001). There were no significant differences on subtests for vocabulary or overall test performance. The U.S. Department of Education, Institute of Education Sciences (2010a, 2010b, 2010c) found *Reading Apprenticeship*® to have potentially positive effects on comprehension for adolescent learners.

Read 180 is a widely used supplementary reading program designed for students in elementary through high school. Although Read 180 is not usually taught in ELA classes, it could provide more intensive reading instruction if needed. Read 180 is one example of how a school could utilize an MTSS framework for adolescent struggling readers.

Read 180 incorporates a computer program for reading practice, a high interest literature component, and direct instruction in reading skills. Students engage in whole group direct instruction, small group rotations, and whole group wrap-up sessions for 90 minutes each day. The program has a software component that can track student progress and provide progress monitoring data on each student and whole classes. The software component is adaptive as it tracks and adjusts the difficulty level of the material students read. Read 180 also includes an extensive classroom library of high interest books for independent reading. Audiobooks are also available and can provide modeled reading.

Seven studies met the WWC standards for effectiveness with reservations. The studies included over 10,000 students across seven states and with students in grades 4 to 9. The results across the seven studies were mixed, and the U.S. Department of Education, Institute of Education Sciences (2009) concluded that Read 180 had potentially positive effects in comprehension and general literacy achievement for adolescent learners.

Fuchs, Fuchs, Mathes, and Simmons (1997) examined the effects of **Peer-Assisted Learning Strategies** (PALS) students in grades two through six at 12 elementary and middle schools. Random assignment of 12 schools to the intervention or control condition was conducted for the study. These 12 schools were equally divided between the *Peer-Assisted Learning Strategies* and control conditions and among high-, middle-, and low-level achievement school designations. After schools were randomly assigned, teachers identified three students to participate in the study: a low achiever with a learning disability, a low achiever without a disability, and an average achiever. The resulting study sample included 60 students who received *Peer-Assisted Learning Strategies* and 60 comparison students who received regular reading instruction. The study reported student outcomes after 15 weeks of program implementation.

For the full sample of students in the study, researchers found a statistically significant positive effect of *Peer-Assisted Learning Strategies* on the questions correct measure of the Comprehension Reading Assessment Battery (CRAB) (Fuchs et al., 1997). According to WWC calculations, the effect was not statistically significant (when adjusted for clustering), but it was large enough to be considered substantively important (i.e., an effect size of at least 0.25). This results in a rating of potentially positive effects, with a small extent of evidence (U.S. Department of Education, Institute of Education Sciences, 2012).

Taken together, the six programs described above represent the current body of evidence-based practices that have been rigorously evaluated by a third party clearinghouse. Findings from research on the programs highlight several common instructional practices across the five models: (a) explicit instruction is the instructional model of choice–all studies reviewed included some variation of explicit instruction to teach students skills, strategies, or specific knowledge; (b) students are taught strategies for reading comprehension; (c) instructional approaches include cooperative learning activities; and (d) reading comprehension instruction may be embedded within the existing core curriculum.

Although all of the programs have demonstrated statistically significant positive gains on some measures of reading comprehension for students in the intervention condition of studies, the impact of the interventions on reading outcomes was somewhat limited and mixed. For example, in a Project CRISS RCT study (Horsfall & Santa, 1994), statistically significant gains on a developer-made measure were reported. In another Project CRISS RCT study (James-Burdumy et al., 2009), researchers found no statistically significant effects using a standardized reading measure. Further, in the Reading Apprenticeship study, statistically significant results were reported. However, the effect size was small (0.19), and most students were still reading two or more years below grade level after treatment (Corrin et al., 2008; Herlihy & Kemple, 2004). In other words, the reading comprehension achievement gap was not significantly narrowed to the extent that students could independently navigate the text-based demands of their core classes. Thus, although these interventions have been shown to have potentially positive effects on adolescent learners, more research and development seems warranted.

8 Research-Based Instructional Practices

In addition to the evidence-based programs described earlier, English language arts teachers can take some comfort in the evidence supporting *instructional practices* that can be implemented within existing curricula. In a review of more than 800 meta-analyses of general instructional practices, Hattie (2009) identified high impact instructional practices, some of which can be incorporated into middle and high school ELA classrooms: (a) teachers are among the most effective influences in learning; (b) teachers need to be directive, caring, influential, actively engaged in learning, and passionate about their work; (c) assessment that informs instruction and knowledge about what each students knows is critical; (d) teachers need to know about learning intentions, success criteria, and student progress toward intended outcomes; (e) teachers need to know how to teach students to construct knowledge; and (f) staff need to create schools and classrooms where learning and risk are welcome. The key finding, according to Hattie, was that gains in student learning were dependent upon teachers and their instructional practices. In 2004,

Nye, Konstantopoulos, and Hedges found that teacher effects are larger than school effects, thereby further supporting the notion that teachers play a critical role in student outcomes.

Hattie (2009, 2012) describes specific instructional practices that are highly effective. He defines highly effective as practices that have an effect size of 0.40 or higher. Many of these practices are not tied to a specific program or intervention but can be incorporated into core classes and existing curricula. These practices include: (a) having students regularly record progress and self-report grades (ES = 1.44); (b) creating a safe, structured, and welcoming learning environment that reduces disruptive behavior in the classroom (ES = 0.86); (c) providing students with immediate, positive, and corrective feedback after each practice effort (ES = 0.72); (d) establishing strong student-teacher relationships in which teachers have a growth mindset (ES = 0.72); (e) using direct or explicit instruction when teaching complex ideas, strategies, and skills (ES = 0.59); (f) structuring lessons to allow for high student engagement and time on task (ES = 0.59); (g) teaching student cognitive and meta cognitive strategies (ES = 0.67); and (h) providing explicit instruction in reading and vocabulary strategies (ES = 0.67). Although Hattie identified other effective practices, the ones identified above seem feasible for inclusion in the ELA classroom and all have desirable effect sizes. Again, the main influence on student achievement is the teacher (ES = 0.50) and the way she or he teaches (ES = 0.43).

Although Hattie identified instructional practices that are effective in any core class, other researchers have identified practices that are effective specifically for teaching reading comprehension. For example, Allington (2011) identified explicit instruction in reading as a practice that impacts all students. Explicit instruction usually involves teachers engaging in the following actions: offering clear explanations; providing a model of the cognitive and metacognitive thinking associated with expert problem solving and reading; guiding students through practice with partially worked examples; having students practice in cooperative groups and independently; providing immediate, individualized, positive, and corrective feedback; and ensuring that students have multiple opportunities to apply new skills, knowledge, and strategies to content area text-based materials (Kline, Schumaker, & Deshler, 1991).

Ensuring that instruction is responsive to student needs is another key factor in improving student reading comprehension (Allington & McGill-Franzen, 2013). In order to be responsive to student progress and specific needs, teachers need to routinely evaluate the impact of instruction on student growth. Given progress-monitoring data, teachers can adjust instruction, pace, intensity, and materials to better meet student needs. Central to making assessment useful, teachers must use the data to adjust instruction. Specifically, they must give students elaborated feedback so that misunderstandings can be corrected or additional instruction provided.

In sum, skilled and knowledgeable teachers attuned to the progress and needs of their students are critical factors in the instruction of reading comprehension.

Armed with knowledge of effective reading comprehension programs and instructional practices, teachers can impact student reading comprehension outcomes in dramatically significant ways.

9 Close Reading and Deeper Reading Comprehension

Regardless of whether the standards for literacy are part of a national movement or derived by individual states, reading comprehension, as defined earlier in this chapter, requires proficiency in a variety of reading skills and strategies. One increasingly popular strategy or approach to comprehension has been termed "close" reading (Boyles, 2013; Brown & Kappes, 2012; Shanahan, 2013; Snow & O'Connor, 2013). Close reading is sometimes characterized as expecting the reader to extract meaning from the text by careful and multiple examinations of the language in a passage or selection (Snow & O'Connor, 2013). This approach suggests that the reader should focus almost exclusively on the text and not on activities designed to anticipate elements of a story or explore the reader's existing world knowledge base. In short, this view holds that activities that distract the reader's focus from a deep examination of text impact comprehension in negative ways.

In stark contrast to this view is the notion that close reading can and should embrace other elements of comprehension. That is, enhancing the reader's background knowledge and or vocabulary related to the target selection aids comprehension. Hattie's research (2009) seems to support this point by the finding that prior knowledge (often measured by vocabulary) has an effect size of 0.67. Further, close reading is enhanced when teachers consider and surface other sources of information about a topic or subject such as social norms and moral judgment (Snow & O'Connor, 2013). Finally, a singular focus on text-based information seems contrary to the other standards that argue for the importance of discussion and argumentation. This view of close reading is more inclusive of the integration of a wide variety of targeted reading, language, and socially constructed strategies for comprehension.

Although some students will be able to successfully engage in close reading without extensive support, data indicates that many students may not possess the skills and strategies necessary for close reading or comprehension of grade level material (Brasseur-Hock, Hock, Biancarosa, Kiefer, & Deshler, 2011; Buckley, 2013; Hock et al., 2009; NCES, 2013). Thus, it becomes critical that ELA teachers provide direct instruction in research-based reading comprehension strategies. Toward that end, we offer a research-based strategy that is both responsive to the notion of close reading and inclusive of other reading comprehension strategies and instructional practices (Brasseur-Hock, Hock, & Deshler, 2012; Hock et al., 2012). First, we define close reading as reading challenging class material multiple times and for multiple purposes with the goal of integrating text-based information,

the author's interpretation of that information, and the reader's knowledge of the world (Duke & Carlisle, 2011; Kintsch, 1998; Snow, 2002). In the logic described above, the author presents text-based information and offers his or her interpretation of the information. The explanation is explicit and is not necessarily inferred by the reader. The reader, drawing upon his or her knowledge of the world, draws a conclusion about what the text-based information means and also evaluates or interprets the author's conclusion. This process is aligned with Kintsch's (1998) notion of construction integration and situated learning.

During close reading, readers establish a purpose for reading, looks for clues about the content of the reading selection, thinks about what he or she knows about the topic, and then reads the selection multiple times while pausing to think and reflect about ideas and content. In effect, the reader has a conversation with text by reading, pausing at points of interest, and reflecting on ideas.

The first interaction with the text involves reading a "chunk of information" contained in a single paragraph. This pass gives readers a general idea about the information contained in the paragraph. The second read involves finding and highlighting the core idea and most important supporting details and then paraphrasing that information into the reader's own words. The reader is encouraged to make comments or pose questions during this pass. This process is followed for each of the paragraphs in a selection until a section of text is completely read. The key outcome of this initial stage of close reading is to clearly understand the information presented in the text. In a sense, the reader identifies important information in the text and thinks about what the author believes about the ideas in text. Once all the important paragraphs are paraphrased, the reader engages in a third read of the material in which each paragraph is reviewed with the goal of pulling together a summary of the core ideas presented in the entire selection. During this final read, the reader continues to integrate text-based information with information possessed by the reader. Also, the reader answers questions previously posed, thereby creating new knowledge.

During this iterative process, the reader uses multiple skills and strategies that expert readers use as they read. For example, expert readers ask questions about the information or author's point of view, determine the meaning of unfamiliar vocabulary, make notes about key points, write summary statements, and link information to others sources of information. In effect, the reader acts like the "Good Information Processor" described by Pressley, Borkowski, and Schneider (1987). Good Information Processors are expert readers and thinkers who know a wide range of strategies for learning, self-regulate the use of those strategies, know much about the world, and are self-directed and motivated to learn. Thus, we view close reading as drawing upon multiple reading strategies, selecting and monitoring the use and effectiveness of those reading strategies, integrating what the reader already knows about the topic at hand with text-based information, and having the commitment to work hard to create new knowledge and understandings of complex topics.

10 Supporting Close Reading Comprehension with Vocabulary Instruction

Of particular importance for reading comprehension proficiency is academic vocabulary (Nagy & Townsend, 2012; National Institute of Child Health & Human Development, 2000; Snow & Kim, 2007). The relationship of academic vocabulary to comprehension has been well established (e.g., Anderson & Freebody, 1981; Baker, Simmons, & Kame'enui, 1998; Snow & Kim, 2007; Stahl & Fairbanks, 1986). In fact, researchers have found that if students encounter a passage in which they do not know some of the words, their ability to comprehend will be limited because adequate reading comprehension depends on the reader already knowing 90–95 % of the words in a text (Nagy & Scott, 2006). Thus, teaching students how to learn vocabulary within the context of ELA reading materials has the potential to impact reading comprehension in meaningful ways (e.g., Honig, 2010; Nagy & Townsend, 2012; Shanahan & Shanahan, 2008) and lack of word knowledge may very well make close reading a frustrating experience for students (Nagy & Scott, 2006). The good news is that ELA teachers have long recognized the power of vocabulary to impact learning in meaningful ways. However, we also know that typical instruction in vocabulary does not reflect what we know about effective practices for vocabulary instruction (Nagy & Townsend, 2012). Typical vocabulary instruction is often defined as instruction that involves the teacher assigning selected vocabulary from a content area and asking students to look up the definition and write the words in new sentences (Phythian & Wagner, 2007). Below we suggest a research based vocabulary strategy or process for learning vocabulary that direct supports close reading activities. This approach conceptualizes vocabulary instruction as a "tool" for reading comprehension (Nagy & Townsend, 2012) and not a standalone decontextualized activity.

11 Principles of Effective Vocabulary Instruction in English Language Arts

If academic vocabulary is strongly related to reading comprehension, what can ELA teachers do to teach vocabulary that is both effective *and* feasible? Although most of the research on vocabulary instruction has been done with preschool and early elementary students, research-based practices have been identified that lend themselves to instruction in secondary level ELA classes. Foundational to these practices is identifying and teaching a corpus of words that have high utility in a specific content area. There are generally two types of vocabulary words: (a) general academic words that are useful across discipline areas and (b) discipline- or content-specific vocabulary that are unique to a particular course or field of study. The latter are directly linked to core class materials (Shanahan & Shanahan, 2008). That is, the words are found in the context of ELA course materials.

One source of general academic words is the Academic Word List (Coxhead, 2000). Vocabulary interventions using the Academic Word List have found significant gains in student's vocabulary knowledge (Kelley, Lesaux, Kieffer, & Faller, 2010; Snow, Lawrence, & White, 2009). Interventions that focus on discipline-specific interventions have also been shown to be effective in improving vocabulary knowledge and reading comprehension (Vaughn et al., 2009).

Central to a comprehensive reading program for struggling middle and high school students is a research-based process for learning vocabulary. This process incorporates elements identified as being effective with adolescents across both middle and high schools (Hock, Brasseur, & Deshler, 2013) and relies upon the selection of words from the Academic Word List (Coxhead, 2000) or words identified from readings associated with the discipline under study. Then, students are guided through explicit learning activities. Specifically, the process includes the following seven steps:

1. The teacher selects a list of 6–10 high utility words. The teacher and students pronounce each word, and then students rate each word as "known," "heard of," or "never heard before." Words already known by most students are excluded from the list to be studied.
2. The word is presented and examined in context.
3. Either individually or in pairs, students further examine each word by looking at affixes, root word clues to meaning, and context.
4. Students write a draft definition of each word that fits its context and then share the definition with the class.
5. The teacher guides students through an extensive discussion of the draft definitions, helping students identify common features of the definitions, and asks students to share rationales for their draft definitions.
6. The teacher and class agree upon a final definition for each word that is written in student-friendly language and fits the given context.
7. Students independently write new sentences containing the target words. Students also write sentences containing words with affixes and/or roots from the target word. The learned vocabulary is highlighted in discipline-specific readings whenever encountered.

11.1 Necessary Structures and Supports

We mentioned earlier that teaching students to comprehend text at deeper levels will require a school-wide effort. Teachers in all core classes will need to teach students how to comprehend discipline-specific text. Given the diversity in adolescents' reading skills, supplemental support also may be necessary for some students. A framework that provides support for teachers and students and allows for personalization of instruction may be helpful in this effort. Two current frameworks for such support are response to intervention (RTI; Sugai, Horner, & Gresham, 2002)

and positive behavior support (PBIS; Sugai & Horner, 2006; Lewis & Sugai, 1999). These models differ in their area of focus (i.e., RTI on academic skills and PBIS on behavior), but each offers a multi-tiered system of screening and intervention that increases in intensity to address a student's particular area of need. Some researchers advocate for the use of an integrated, comprehensive three tiered model of prevention that combines the features of RTI and PBIS to meet students' multiple needs given that academic, social, and behavioral problems are likely to manifest concurrently (Lane, Kalberg, & Menzies, 2009; Lane, Oakes, Menzies, Oyer, & Jenkins, 2013; Lane & Wehby, 2002; Sugai & Horner, 2002). A comprehensive, integrated three tiered model can address each area and uses a variety of intervention tools to help students who have multiple needs. Conceptualizing reading comprehension in this way is one theme of this book and makes reading instruction the responsibility of all teachers. Moreover, tiered models can help clarify what supports may be available to teachers and students.

11.2 Concluding Thoughts

Reading comprehension instruction for adolescents takes on added importance in the wake of national and international reports of U.S. student performance on measures of reading and math. Recent attention to the 2013 NAEP and 2013 PISA reports in which U.S. student performance is mediocre for some subgroups or, at best, average when compared to 65 other international education entities has heightened concern.

In this chapter we provide reviews of evidence-based programs and instructional practices, thoughts about close reading and close reading strategies, highly effective instructional practices, a comprehensive framework for conceptualizing whole school response to teaching reading to a very diverse student population, and creating a classroom and school environment conducive to learning.

Central to success in improving reading comprehension for middle and high school students is a teacher who is passionate about teaching, passionate about the success of the students he or she teaches, and highly skilled in the delivery of effective instructional practices and programs. However, the burden of reading comprehension instruction does not rest solely on the shoulders of teachers. Teachers will need extensive professional learning and instructional coaching support to implement many of the practices suggested in this chapter. In addition, instructional support should be based on student data and provided within a framework for behavioral, academic, and social emotional needs. When these factors are in place, improving reading comprehension outcomes for middle and high school students can become a reality.

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Improving Comprehension Assessment for Middle and High School Students: Challenges and Opportunities

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Abstract For decades, standardized reading comprehension tests have consisted of a series of passages and associated multiple-choice questions. Although widely used in and out of the classroom, there continues to be considerable disagreement regarding how or whether such tests have net value in the service of advancing educational progress in reading. This chapter begins with a review of features that characterize standardized reading assessments. In particular, we discuss how assessment designs and analytics reflect a balance of practical and measurement constraints. We then discuss how advances in the learning sciences, measurement, and electronic technologies have opened up the design space for a new generation of reading assessments. Abstracting from this review, we end by presenting some examples of prototype assessments that reflect opportunities for enhancing the value and utility of reading assessments in the future.

Keywords Assessment • Measurement • Computer adaptive testing

If frequency and time spent administering assessments to students were criteria of success, then the current era in U.S. schooling could be considered a golden age of testing. For example, a recent report from the American Federation of Teachers (Nelson, 2013) provided some staggering facts about the volume of testing in two school districts in the U.S. In one, there were 34 test administrations and as many as 47 in the other. This translated to anywhere from three full school days to nearly 2 weeks of time dedicated to testing. Test preparation time varied from 16 full school days to approximately a month. If this study is even marginally representative of schools across the country, there is no shortage of testing in our schools.

Despite their ubiquity, the abundance and increasing prevalence of assessments in schools is not an end that is universally lauded, especially when the stakes

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are considered high (Minarechová, 2012). Even before the era of No Child Left Behind, researchers have argued over the amount of high stakes testing and its effect on driving the curriculum (Neill, 1997). High stakes tests have been criticized as negatively impacting construct validity, as well as increasing corruption, cheating, and affecting how cut score decisions are made (Berliner, 2011; Petress, 2006). These effects seem more pronounced in years and grades where high stakes tests are administered, as compared to grades and years in which they are not administered (Stecher & Barron, 2001), indicating the testing is driving the effects. High stakes testing also affects instruction time. After high-stakes testing is introduced, instructional time for the subjects that are tested (e.g., in English Language Arts (ELA) or mathematics) increases (Au, 2007). However, this comes at a cost to the instructional time devoted to other subjects that are not the focus of the high stakes testing, e.g., social studies (McMurrer, 2008). Clearly, high stakes testing has an impact on education, the curriculum, and instructional time.

The negative reaction to high stakes testing is not limited to academics and educators, but has spread to the general public as well. For instance, a recent poll of registered voters in New York showed that 52 % of respondents indicated there is too much testing, while only 12 % indicated there is not enough (Siena College Research Institute, 2013). This negative view on testing has led New York to consider revising its state's testing policies (Spector, 2013). At a national level, public opinion towards the Common Core State Standards and testing has even caused a "Don't Send Your Child To School Day" movement (Owens, 2013). Clearly at the public and academic level, there is broad concern about the amount, type, and use of testing in schools.

If assessments are to be useful for improving learning in applied contexts (such as improving comprehension in middle and high school students), then the science of assessment needs to respond to the critiques with solutions other than simply more types of tests, more frequently administered (Gordon Commission, 2013). Opportunely, the convergence of educational policy, the use of electronic technologies, empirical and theoretical research on comprehension, and advances in measurement theory in the twenty-first century provides a unique context for revisiting the traditional design and measurement techniques characteristic of literacy assessments (Sabatini, Albro, & O'Reilly, 2012; Sabatini, O'Reilly, & Albro, 2012).

In this chapter, we review and present ideas regarding the process of assessment construction. We discuss theoretical frameworks and principles used to structure assessments and guide item development, as well as psychometric models used to estimate scores. We begin with a selective review of some tenets that typify the state-of-the-art of standardized comprehension tests, highlighting strengths and weaknesses that create opportunities and challenges. We then discuss the future of comprehension assessment and some ideas for optimizing their use in enhancing learning and achievement in middle and high school students.

1 Modern Standardized Comprehension Testing

In this section, we describe some foundational concepts underlying canonical, standardized reading assessment designs that are in use today. An examination of these concepts can help us to understand which design elements serve or satisfy which content, use, or measurement purposes or constraints. This section can then serve as a preface for exploring the possibilities and consequences of innovating in assessment design and measurement models.

1.1 Assessments Reflect a Balance of Constraints

Both the form and the utility of assessments are a function of how well the design addresses and balances the multiple constraints that need to be considered in light of the purpose, use, and interests of stakeholders. While the effects of testing have been well documented over the past 100 years (Phelps, 2012), modern standardized tests represent years of optimizing the trade-offs between various technical and practical constraints imposed on design and statistical modeling.[1] It is beyond the scope of this chapter to address every key concept. Instead, we focus on the following design and implementation concepts: (a) the *construct*; (b) *standardization*; and (c) *cost and time efficiency*. We then address the following psychometrics concepts: (a) *classical test theory*, (b) *unidimensionality and item independence*, (c) *reliability*, and (d) *validity*. Below, we introduce each very briefly, then discuss a number of constraints that arise from traditional definitions or techniques used to operationalize the concepts in testing. In the subsequent section, we will introduce advances that are changing the landscape of limits and constraints in designing innovative assessments of comprehension.

1.2 Design and Implementation

1.2.1 Defining and Measuring the Construct of Reading Comprehension

There is no universally agreed upon, single theory of comprehension, and therefore, by implication, no unified reading comprehension construct definition (Cain & Parrila, 2014; Perfetti & Stafura, 2014). What is largely agreed upon is that the cognitive knowledge, skills, and dispositions that comprise an individuals' proficiency in comprehension are invisible (unobservable or latent, as some measurement

[1] For those interested in a more complete and technically sophisticated treatment of measurement concepts, issues of ethical design and use, and modern day advances, a library of measurement books are available (e.g., see AERA/APA/NCME, 1999; Brennan, 2006; ETS, 2002).

specialists prefer to say). We can only infer their presence from evidence collected as individuals perform comprehension tasks. A reading assessment is generally a collection of tasks (texts plus questions about those texts); the examinee's responses are the evidence. One of the primary challenges in assessment design is in defining the target construct, choosing tasks that represent that construct definition, and evaluating the evidence trail those tasks produce.

One aim of a strong assessment design is to measure broadly the target construct. The intent of broad construct coverage is to enhance the validity of the inference that an examinee (or group in some cases) possesses the knowledge and skills representative of proficiency in the target domain. Breadth of coverage would seem to increase the generalizability of the inference from observed performances to the construct. One would like to make a claim about an individual's (or groups') general ability in, for instance, reading comprehension, and not merely a claim that on a specific day the individual was able to read specific passages and answer specific questions.

As in other applied statistical sampling situations, the notion is that one defines the scope of the construct domain, usually categorized across several dimensions, then samples systematically across that domain to obtain a reliable estimate of an individual's ability. In reading, this typically has taken the form of a two dimensional matrix: the first dimension consisting of the spectrum of text types an individual might encounter; the second consisting of the skills that one is likely to apply when comprehending those texts. Curriculum skill standards can be used to describe priorities for instruction and learning within this construct space, thus, they often weigh heavily in constructing the matrix of valued knowledge and skills.

One trade-off that is often required to maximize the breadth of coverage, though, is depth, resulting in an assessment (or a curriculum) that is sometimes described as a "mile wide and an inch deep" (Schmidt, McKnight, & Raizen, 1997). Depth may be interpreted to mean reliable estimates of subskills. If test items are widely and unevenly sampled across the domain, precise inferences about specific subskills are not possible. Depth can also mean engaging the learner in deeper, more complex reading tasks. Deeper tasks often mean permitting the student more time with a selected set of texts to reason, reflect, and respond to complex problems. In order to ask deep questions, more time may be required to respond to a targeted set of questions; at the expense of broader coverage one might get from simpler questions that can be responded to quickly. For example, while one of the advantages of performance assessment is an increase in depth of skills tested, it is often at the expense of reduced generalizability in comparison to more traditional tests (Miller, 2002).

1.2.2 Standardization

Standardization concerns instantiating a test in a consistent fashion for all examinees. The intent of standardization of instructions, administration, and scoring is to maximize objectiveness and comparability of scores across a population,

which in turn impacts test reliability, validity, and fairness. Non-standardized procedures increase the risk that different individuals may have unfair advantages or disadvantages, resulting in scores that do not reflect their true ability on the targeted construct. Standardization does not prevent bias, but at least it systematizes it, making it easier to detect by other means – e.g., differential item functioning (DIF), which is used to detect items that function differently in subgroups of interest such as gender or ethnicity (Santelices & Wilson, 2012) – and it does preclude some kinds of overt bias.

While beneficial, standardization when taken to the extreme may constrain the inferences that can be made from test scores. This can occur when key aspects of the target construct are not measured, because the effort to standardize the administration and scoring is high (e.g., training scorers to objectively score essays). By neglecting to measure parts of the construct, the validity of the score as a measure of the construct is threatened.

Unprincipled standardization may also lead to unintended consequences. For example imposing time constraints in a reading comprehension test may shift the construct from measuring true reading ability to measuring individual differences in processing speed. Conversely, providing unlimited time on a measure designed with a fixed time limit (perhaps with the intent of taking into account variation in processing speed) would be similarly inappropriate. In any event, standardization involves making a set of choices that maximize the consistency of some administration features of the test to ensure the generalizability of the assessment. However, issues of construct coverage and standardization are often also balanced against more practical constraints, such as cost and efficiency, which are discussed next.

1.2.3 Cost and Efficiency

In balancing assessment design features, a practical constraint is often defined by the cost and efficiency of the test (Peng, Li, & Wan, 2012). In practice, this has resulted in the robust use of multiple choice items to measure reading ability (Rupp, Ferne, & Choi, 2006). The multiple-choice (MC) item format has become so widespread in standardized testing, perhaps, because of how it simultaneously helps to meet multiple design (and measurement) constraints. Often maligned and criticized, the MC format confers multiple benefits. MC items can be objectively and automatically scored, addressing the standardization constraint. Open-ended or constructed response (CR) items can also be scored objectively, however, historically, CR items have been costly to administer (students require more time to respond than typical MC items) and costly to score (after factoring in training and calibrating reliable scorers). The added time required to complete CRs also impacts on the breadth of construct coverage a test can accomplish.

MC items allow for more items to be administered per unit of time than many other alternatives, allowing wider breadth of sampling of the domain per unit time; consequently they are time efficient. In addition, until recently, a significant benefit of printed MC format tests was their cost effectiveness for large-scale,

group testing. More items could be printed per page, and with bubble-entry answer sheets, test booklets could be reused, while answers could be scored automatically. The advent of computer and web-administration of tests, however, is reducing the need for printed tests. Consequently, this benefit is diminishing (though MC items still confer the benefit of efficiencies associated with adaptive testing, which will be discussed later in the chapter). Finally, sophisticated, yet efficient statistical techniques and theories have been aligned with the dichotomous item score (i.e. correct vs. incorrect).[2]

While MC items have many benefits, an over reliance on traditional forms of MC may have other unintended consequences (see Rupp et al., 2006). For instance, MC items are useful for testing recognition processes, but not the recall of information or the ability of the individual to generate a response. In general, most applied settings of knowledge and skills do not resemble the context of choosing among prepared, alternative responses. Providing incorrect alternatives (distracters) in MC format can activate incorrect or irrelevant knowledge. Similarly, poorly constructed multiple choice assessments can be problematic because the correct answers can often be selected without reading the passages (Katz & Lautenschlager, 2001; Powers & Wilson-Leung, 1995). If poorly designed multiple choice questions can be answered without the passage, then the validity of the test is severely threatened.

In sum, while features that are designed to maximize efficiency and reduce costs are clearly important, there are trade-offs that can impact the validity of claims about individuals, and the utility of test results for different purposes.

1.3 Statistics and Psychometrics in Testing

A key feature of the modern standardized test is the technical, statistical machinery of psychometrics that has been developed to infer the quality, reliability, and validity of inferences from test scores. From its origins in the beginning of the nineteenth century through today, the methodologies associated with test development and analyses have become ever more sophisticated, yet precise. In this chapter, we focus on a select set of concepts that we view as undergoing a shift from past practice, as innovations in measurement theory are explored and implemented in applied contexts. The discussion is mostly non-technical, with the focus on explaining concepts versus technical detail.

1.3.1 Classical Test Theory

This theoretical approach represents the historical methodology for estimating the difficulty and discrimination of test items, as they appear on a specific test form.

[2]It is not that psychometrics cannot handle scores other than dichotomous; however, the complexity increases and efficiency in design and analyses typically decrease.

As indicated by the name of the theory, the classical approach is focused on the nature of total test scores, which can be expressed by the relation between an individual's achieved total score (X) at a given administration of the assessment, an unknown true score (T), and an unknown error score (E).

As an illustration, imagine a test consisting of three reading comprehension passages and 20 questions. If the assessment was administered each week over a period of 8 weeks, the distribution of scores would demonstrate that at some administrations, an individual's scores might be higher or lower than on other occasions. The best estimate of an individual's ability would not be any of the selected administrations, but rather the average across all the individual total scores. Additionally, if the reading comprehension measure was assumed to have no error (i.e., $E = 0$), then the total score X would be equal to the true score T, and the total test scores for the individuals would be considered perfectly reliable.[3] The separation of true versus observed score is in recognition of the unobserved or latent nature of constructs. We infer the construct based on the observations we make of student behavior and these observations are not without error. Understanding, controlling, or minimizing the error is a large part of the technical expertise that goes into test design and score modeling. However, as we will see later, deciding what is and what is not error is not trivial and may shape the nature of the construct and the inferences that can be made from the scores.

In classical test theory, two features of items are worth noting: item difficulty and level of discrimination. Item difficulty refers to the proportion of individuals who correctly respond to an item, and ranges from .00 to 1.00 with values closer to one indicating the item is easier. Item discrimination characterizes the strength of the relation between item and test performance, and in classical test theory is typically evaluated using the point-biserial, item-to-total correlation (Nunnally & Bernstein, 1994). Values for this index range from −1.00 to 1.00; negative estimates are not desirable as they indicate that an individual who correctly answers a question is likely to have a low total score, and item-to-total correlations from .00 to approximately .20 reflect non-existent or weak associations. Taken together, items which are considered to be "good" in classical test theory are those that do not demonstrate floor (i.e., <5 % get the item correct) or ceiling (i.e., >95 % get the item correct) effects, and where the item-to-test correlations are at least .20.

[3]It is worth noting that there are several assumptions made about the errors in classical test theory (Kline, 2005). First, it is expected that T and E are uncorrelated, meaning that an individuals' errors, either negative or positive will not maintain a systematic relation with the true score. Second, it is expected that an error score on one form of the assessment (e.g., the three reading comprehension passages) will be uncorrelated with the error on a parallel form of the assessment (e.g., a set of three different reading comprehension passages). Third, it is expected that the errors are normally distributed with the average of the random errors around the individual's score to be zero. This means that at times the reading comprehension score may be high such as when the student may have particularly high self-efficacy or recalls the information well from a prior testing, or low such as when the student skipped breakfast, but because the random errors are assumed to be normally distributed, the average across testing periods will be zero.

Classical test theory continues to be a commonly used framework in psychometrics. The advantage of classical test theory is that it is relatively simple and it accounts for item difficulty and discrimination parameters. However it does not simultaneously account for properties of the items and the ability of the test taker into the model. For instance in classical test theory, measurement error is assumed to be the same for all test takers. In reality this is not true, as we discuss later.

Another set of constraints also arise from the focus of the theory on the test form, rather than at an item level. The consequence is often that the assumptions of classical test theory only hold when forms are administered intact (i.e., the same items in the same sequence); a challenge when developing and validating, for example, multiple, parallel forms and adaptive testing programs. As we will discuss, IRT helps address some of these constraints, though others persist, and new challenges arise that also must be addressed.

1.3.2 Test Unidimensionality and Item Independence

Two other historical, psychometric assumptions/constraints are *unidimensionality* and *item independence*.[4] Unidimensionality refers to the assumption that all the items on a test measure a single, unitary construct – however that construct may be defined. So, if a test is designed to measure the construct of reading, then all the items should measure reading, not math, or science, or geography. Complexities arise as one considers whether sampling from different aspects of the construct constitute other independent constructs or dimensions. For example, statistics, geometry, and calculus could arguably be subdimensions of a unidimensional mathematics construct, or separate, unidimensional constructs on their own. Questions often arise concerning what is construct relevant versus irrelevant (or error) or pre-requisite skills, as well as whether there are sufficient items to warrant detecting psychometrically distinct subdimensions in a test. In general, exploring the dimensionality of a test is often a key step in understanding or establishing the validity of inferences from scores. Many options now exist for conducting dimensionality analyses, as discussed later.

Item independence concerns the relationship or dependence of getting an item correct based on other items in the test. The goal is to be able to treat every item as a random sampling from the construct domain. Item dependency typically occurs when an item might provide a key piece of information that is necessary to answering a subsequent item, thus, changing the probability of the response based on what one knows or learns during the test. In a strict sense, item independence is almost always violated when writing multiple questions to a single text passage in a reading comprehension test. The individual items may not directly cue each other, however, one's general understanding of the passage may have an influence on the

[4] In psychometrics, item independence is introduced as a purely statistical assumption, though it has practical implications for task design, as discussed later.

entire set of items. Recent innovations surrounding the notion of testlets has started to provide techniques for accounting for the variance associated with dependencies among test items (Wainer, Bradlow, & Wang, 2007).

Strict adherence to item independence can result in narrowing the construct. For example, research supports the importance of proficiency when reading in multiple text and digital environments, where students are expected to read a set of related sources on a similar topic (Britt & Rouet, 2012; Coiro, 2009). In this case, designs for adequately measuring the construct might warrant stronger item dependencies than would be deemed as appropriate under traditional assumptions. Fortunately, options for exploring item independence and managing violations are becoming available.

In summary, dimensionality and item independence shape how a test is analyzed, evaluated, and interpreted. However, without appropriate reliability, a test is typically not considered useful for any type of reporting about examinees – an issue addressed in the next section.

1.3.3 Reliability

Test *reliability* is sometimes represented in journal articles and other academic literature as the panacea for ensuring the technical adequacy of a test. Most statistics and psychometric textbooks note that test reliability is a necessary, but not sufficient pre-requisite to validity. Like validity (discussed next), reliability is a complex technical concept that is continually being formulated, contested, re-evaluated, and debated (Haertel, 2006). In classical test theory, the staple techniques used to evaluate the reliability of tests have been internal consistency (e.g., Cronbach's alpha), retest reliability, and alternate-form reliability; though there has been an increasing amount of criticism of Cronbach's alpha (Sijtsma, 2009). Each technique represents a unique history and perspectives on what aspects of reliability are essential, and they are not interchangeable. How reliability is conceptualized varies depending on whether the measurement framework is based on classical test theory or IRT (Embretson & Reise, 2000; Fan, 1998; Hambleton & Jones, 1993; Lord, 1980; Petscher & Schatschneider, 2012). Thus, this section focuses on the distinctions between the two theories as they pertain to reliability.

The basis of the classical test theory definition of reliability is the correlation of a test X and its parallel form X′; hence, reliability is often written as rho {X, X′}. A primary assumption that follows from this definition of reliability is that the standard error of measurement (i.e., a measure of uncertainty in a score; SEM) associated with any person's total score is constant across all individuals.[5] In practice, achieving this would require strong item to ability matching in a test form, so as to ensure that there is no floor or ceiling effects in item responses. However,

[5]It follows then that if tests are strictly parallel, we can replace the covariance of true scores T and T′ – COV (T, T′) – by the variance of true scores V(T), and the CTT assumption of uncorrelated errors COV (E, E′) = 0 = COV (T, E′) gives us what we need.

item-ability matching is quite difficult to achieve using classical test theory, because the theory is focused on the totality of items (i.e., a total test score).

IRT models have different assumption about errors[6] that allow for individuals to vary in how precise (or reliable) an individual's score might be. Precision is derived from what is termed *information*; a special property in item response theory that is calculated from an item's discrimination parameter and the probability of correctly answering an item given a person's ability score. The higher the discrimination parameter and the more closely matched an individual's ability score is to the difficulty of the item, the more information we have about the person's ability, and thus, more precisely their ability is estimated. In the same way that reliability in classical test theory is associated with measurement error, so is information in IRT associated with a standard error of the estimate (SEE). The advantage of using information in the context of IRT is that a more realistic estimate of the reliability of scores for all examinees can be achieved. Despite this advantage, the scoring algorithms used to obtain the ability scores and SEE are mathematically complex and require complex algorithms for deriving the scores. Thus, the lack of transparency in estimation may produce difficulty in explaining the results and how they were obtained to school and state officials.

1.3.4 Validity

While reliability is a key feature of any test, validity is paramount. The issue of validity has been treated extensively by others (e.g., American Educational Research Association et al., 1999; Baker, 2013; Kane, 1992, 2006; Messick, 1989; Mislevy, 2007, 2009). While it is beyond the scope of this chapter to provide a detailed explication, a few highlights are warranted. Prior evaluations of validity, in practice, were traditionally addressed primarily *after* a test was constructed. Test items and forms were created from blueprints, such as the matrix of dimensions described above, most often without any explicit cognitive theory or framework in mind (Mislevy, 2006, 2008). That the blueprint was considered by experts as descriptive of the domain, and that the items aligned with the blueprint, constituted an evaluation of content validity. Once the forms were assembled and piloted in a field test, various aspects of validity could be investigated statistically such as concurrent and predictive validity, dimensionality analyses, and in rare cases, consequential validity.

Criterion-related and predictive strength remain a high priority in establishing valid inferences from test scores, especially for tests used in large-scale, high stakes settings. However, in this traditional approach, less attention was often paid to

[6]Technically, IRT models do not contain an error variable as a component of the model equations. They are based on a probability model for item level variables and assume a latent variable. The standard error in IRT models is based on assumptions we make about the model, and on what is known as the Fisher information inequality or Cramer Rao lower bound.

the theoretical and empirical evidence for the construct (Baker, 2013; Messick, 1989). To the extent that theory influenced item and test design, that theory was often in the test developer's head, not in a more explicit set of claims set out in a predefined framework to be evaluated empirically. Using principled item and assessment development methods help fill the void of strictly empirically-driven test construction.

Conceptions of validity now emphasize the importance of constructing assessment arguments consisting of claims, and evidence in support of those claims, which may be evaluated using measurement techniques (Baker, 2013; Kane, 1992, 2006; Messick, 1989; Mislevy, 2006, 2008; Mislevy & Sabatini, 2012; Shephard, 2013). Mislevy and Sabatini (2012) note that the argument framework for assessment provides tools that go beyond traditional measurement approaches to validity, stating:

> The key is that the roles of psychological perspectives, evaluation procedures, and task features – all absent from the measurement framework – are now explicit in assessment argument structures, to be articulated with measurement machinery. (p. 121)

The goal is to validate the inferences made from test scores for specific purposes, uses, and target populations. This contrasts with the older practice of thinking of the validity of the test itself, independent of the scores, uses, or inferences drawn. This evidence trail may include the results of analyses typically done after the construction of a test, but more often begins much earlier during the design process. Evidence-centered design is a process developed to build assessments on cognitive and empirical evidence that enhances the claims of a validity argument as a consequence of a systematically conducted design process, as well as empirical field test data and analyses (Mislevy & Haertel, 2006; Mislevy, Steinberg, & Almond, 2003).

In summary, validity in not a property of the test itself; nor is it something that should be investigated only after a test has been built, but rather should be infused in all phases of assessment development. Even after a test has been built and has been shown to have adequate psychometric properties, evidence should be collected and accumulated over time to support specific claims about test score use. In the remainder of the chapter, we describe innovations in assessment design and in psychometric analysis and modeling that are opening up new types and applications of reading assessments.

2 Opportunities and Challenges in Enhancing Comprehension Assessments

The purpose or use of assessment results drives the interpretation of scores and should drive the construction of the assessment instrument itself (Mislevy, 2006, 2009; Mislevy & Haertel, 2006). Table 1 provides a typology of typical purposes or uses of assessment information in schools as associated with comprehension

Table 1 Purposes or uses of comprehension tests

Purpose	When typically administered	Example use cases	Typical level(s) of inference
Screening	Before instructional program begins	Identifying individual students at-risk in traditional classroom curriculum and instruction for potential other services or programs	Individual
Placement	Before instructional program begins	Place individual students into different levels or groups in a program	Individual
Diagnostic	Before (or as indicated based on other info)	Evaluate specific individual strengths and weaknesses that may be relevant to instructional objectives, intensity, or duration	Individual
Formative assessment	During: Daily, as appropriate	Make day to day instructional-decisions; provide actionable information for teachers or students	Individual, group, instruction, or classroom
Monitoring/benchmark	During: At appropriate intervals	Evaluate whether instruction is working towards outcome	Individual, group, instruction, or classroom
Outcome	After instructional program delivered	Provide accountability/program improvement information	Individual, group, instructional program, classroom, school, system

(though many of these types certainly also apply to other subject areas such as math and science). The table is roughly ordered from top to bottom with respect to when in the instructional program the assessment would characteristically and logically be administered, as well as the typical level of inference for the scores. For example, one would expect to screen students for pre-existing barriers to learning or place them into a level in an instructional program before starting the program; while one would administer outcome testing after students have completed a program. Formative and monitoring assessments logically occur during the learning program. We excluded from the table some special case assessment purposes including selection; certification (typically used with professionals such as teaching certifications); referrals (such as evidence used to refer an individual for special education services). We note that requiring students to pass high school graduation tests is also a special case of outcome assessment, with higher stakes.

2.1 Applied Comprehension Assessment in Middle and High School Contexts

Although outcome assessments and other high stakes tests are abundant in middle and high schools, use of assessment before and during instruction in these settings is limited, although some instrument options, with demonstrated reliability and validity, currently exist for addressing screening, progress monitoring, and other formative assessment purposes. The *Center on Response to Intervention* website (http://www.rti4success.org/) is a good resource to find instruments that have been reviewed by a Technical Review Committee of experts for technical rigor and use. Most reviewed assessments by the Center utilize curriculum-based measurement (CBM) with demonstration of use only up to grade 6 or 8, although a few computer-adaptive (i.e., IRT-based) assessments of reading comprehension up to grade 10 or grade 12 are available (e.g., Renaissance Learning's STAR and NWEA's Measures of Academic Progress). The measurement strengths and weaknesses of CBMs are described elsewhere (see Christ & Hintze, 2007) and further advancement of computer adaptive testing is discussed later in this chapter.

A majority of the research literature exploring assessment before and during instruction lies in the response to intervention (RTI) literature (e.g., Christo, 2005; Compton, Fuchs, Fuchs, & Bryant, 2006; Fuchs, Compton, Fuchs, Bryant, & Davis, 2008; Klingner & Edwards, 2006; O'Reilly, Sabatini, Bruce, Pillarisetti, & McCormick, 2012). Although there is some support for RTI assessment practices in middle and high schools, their use in elementary schools has undergone more rigorous evaluation (Jimerson, Burns, & VanDerHeyden, 2007). Barriers inherent to secondary settings tend to limit rigorous study with this population (Fuchs, Fuchs, & Compton, 2010).

Fuchs et al. (2010) point out three considerations unique to secondary settings that have implications for the uses of RTI-style assessments. First, screening assessments may be less critical, as students in need of intervention have mostly been previously identified. Secondly, since the gap in achievement may be very large, outcome assessments need a sufficient floor. One broad example of problems secondary schools face with inferences from data is highlighted by Fuchs et al.'s third consideration. Elementary schools use screening, diagnostic, and/or curriculum-embedded measures to match students to effective interventions. The increasingly broader range of skills involved in reading comprehension in struggling middle and high school students and dilution of responsibility for teaching certain skills in secondary settings, make it more challenging to match students to instruction and intervention appropriately. Without additional diagnostic assessment, effects from matched instruction may be limited.

In addition, the systematic review of data in secondary settings is impeded by a relative lack of "structured occasions to turn assessment information into actionable knowledge" (Halverson, 2010, p. 133). Regularly scheduled team meetings where

educators discuss instructional decisions based on data is one way to systematically ensure that assessment data is used appropriately for its designed purpose. Clarity in the intended claims, inferences, purposes and uses that assessment scores are intended to serve as the first step in addressing the multiple constraints that any applied assessment situation may entail.

2.2 Psychometric Advances

2.2.1 IRT & MIRT

Earlier in the chapter, we noted two specific utilities of IRT relative to classical test theory. First, IRT places items and individuals on the same metric, such that the likelihood of correctly answering an item can be related to varying levels of ability scores. Second, it relaxes classical test theory constraints on equal measurement error to allow for individual precision estimates of ability scores. In addition, there are multiple virtues of IRT, which help to address other complex measurement issues including invariance (Embretson & Reise, 2000; Messick, 1983), equating, and resolving multidimensional constructs.

Invariance in classical test theory depends on two assumptions: item parameters are statistically equivalent across different groups of individuals and the ability of the individuals is statistically equivalent across a set of items. Despite the importance of these assumptions to classical test theory, they are easily and frequently violated. A lack of item invariance across different groups of individuals precludes meaningful comparisons in total test scores.[7] Suppose that two classrooms' vocabulary ability is being measured, and a list of 20 words is developed to split across the two classrooms. The equality of students' scores is dependent on the equality, or invariance, of the item difficulty. Conversely, suppose that the same list of 20 words is given to two separate classrooms, one which has a high incidence of students eligible for free/reduced priced lunch, and another which has low incidence of free/reduced priced lunch. It is likely that the difficulties of the items will vary between classrooms. In both instances it is difficult to make meaningful interpretations of the resulting scores because they are confounded by item difficulty differences in the first example, and student ability differences in the second example. IRT overcomes such limitations because its theory rests on the idea that item parameters are not dependent on the sample, they are a property of the item. Thus, while an item with an IRT difficulty of 0 (i.e., average difficulty) will potentially be harder for the classroom with a high incidence of students eligible for free/reduced priced lunch compared to low incidence classrooms, the difficulty of the item remains approximately the same between the classrooms.

A related concern is equating. Because the assumption of item invariance is often violated, it is necessary to adjust scores such that a total test score based

[7] In classical test theory, methods of equating test forms are used to address these kinds of problem.

on a set of items means the same thing as another set of items from a parallel form. Several methodological designs are available in classical test theory (e.g., single group, common item nonequivalent group, and random group) as are multiple statistical procedures for converting scores (e.g., mean equating, linear equating, equipercentile equating; Kolen & Brennan, 2004). A limitation of equating methods is that it is useful for adjusting scores for a group of examinees, but not each individual (Livingston, 2004). IRT overcomes such limitations by using multiple-group item characteristic curve and test characteristic curve (Stocking & Lord, 1983) methodologies. These analyses are also used in the previously mentioned methodological designs for equating, but are especially useful from a theoretical perspective, when tests vary in the difficulty of items or the groups vary in ability. Further, IRT equating does not require extreme scores at the tails of the distribution in order to provide a meaningful translation of scores, and it requires fewer steps in execution when the items are on the same scale.

2.2.2 Dimensionality with Complex Structure

Notwithstanding the numerous benefits IRT maintains over classical test theory, a particular challenge surrounds assessing and addressing the assumption of unidimensionality of item responses. While measuring a singular construct is desirable, there are many instances which may preclude a unidimensional construct from emerging. The breadth of the construct being measured, the nature of item stimuli, the number of items written to reflect each dimension, and the knowledge required to complete the task each have bearing on the extent to which a test of unidimensionality yields a best fitting model for a single construct. Several statistical methods exist by which dimensionality can be evaluated. There are exploratory and confirmatory factor analyses which may be estimated using parametric and non-parametric estimations (Kim, Zhang, & Stout, 1995; Stout, Douglas, Junker, & Roussos, 1993; Tate, 2002), yet even with these options; a key question is how to resolve complex dimensionality issues. To guide the remainder of this discussion on IRT, we put forth the following scenario and discuss three possible solutions.

Suppose that a researcher has developed a new assessment of reading comprehension, which is comprised of two different reading comprehension passages, one of which is an informational passage and the other is narrative. Each passage has ten questions which require the reader to identify the main idea of the passage, draw an inference from the text, distinguish between fact and fiction in the passage, evaluate textual evidence to support conclusions, and demonstrate definitional knowledge of textual vocabulary.

The most common method for evaluating student ability on this type of assessment is to simply sum the scores of the 20 items as a representation of reading comprehension ability. Figure 1a represents this process, which assumes that the scores are indeed unidimensional. While convenient, it is possible that several other models may provide better fit to the data. Because each passage has ten items, it is plausible that the variances are best captured by two related factors; one for the

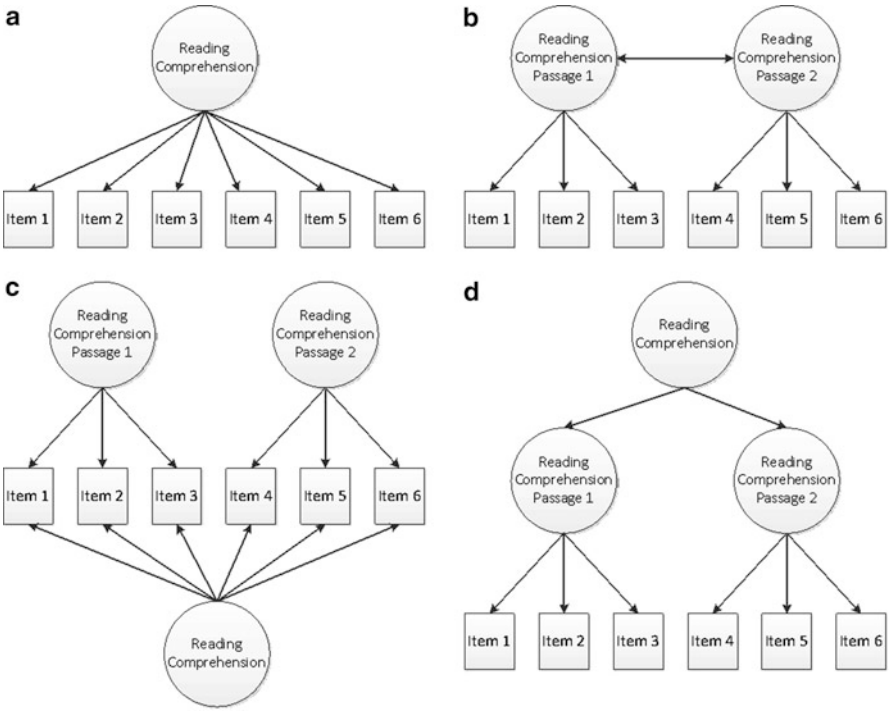

Fig. 1 Graphical representation of (**a**) unidimensional model, (**b**) multidimensional correlated factors model, (**c**) multidimensional bi-factor model, and (**d**) multidimensional second-order factor model

informational passage items, and one for the narrative passages items. Shown in Fig. 1b, this perspective would fit in the framework of a multidimensional factor analysis, where two latent factors, one for each passage, with factors that are correlated. More specifically, we refer to the model in Fig. 1b as a multidimensional item response (MIRT) model when the items are categorical; or modeled with a non-linear, multidimensional, confirmatory factor analysis.

MIRT models have gained popularity in recent years (Reckase, 1997), as they are able to capture distinct, yet related processes which influence item responses. Under circumstances where a correlated factor model yields the most appropriate fit to the data, it suggests that the processes used to answer questions for one construct, such as the informational passage, may also underlay or contribute to performance on the other construct (i.e., the narrative passage). In MIRT terminology, this is known as a compensatory item response model, because high ability in one domain provides useful information in understanding the performance on the second, correlated construct. At a broad, theoretical level, a compensatory MIRT model is no different from a logistic regression with multiple predictors. For any given value of one independent variable, the probability of $Y = 1$ will vary given a value on a second

independent variable. It is possible that a low value on variable 1 and high value on variable 2 yields the same probability of Y = 1 as a high value on variable 1 and low value on variable 2. Thus, the MIRT model leverages one's higher ability on one construct for lower ability on another construct. A primary question when fitting a MIRT model is the extent to which a correlated construct model, while fitting better than a unidimensional model, provides information on construct relevant skills. If not, then perhaps revisiting the assessment design might be most appropriate.

An alternative multidimensional specification for the data in this illustration is a bi-factor model (Fig. 1c). Bi-factor models seek to explain item correlations with a general factor of what is believed to be measured by the item responses, along with two or more specific factors which model the residual item variance not captured by the general factor. In the present example, a general factor of reading comprehension would best represented item variation across all 20 items, while two specific factors would represent the residual variance which could be differentially attributed to features of the narrative and informational passages.

In summary, there are a wide range of techniques available for modeling dimensionality of assessments, thus, relaxing some of the constraints that the assumptions of unidimensionality may have imposed on the design. These techniques help in designing assessments that are theoretically sound and more useful in applied settings.

2.2.3 Local Item Independence

Just as bi-factor models are useful in resolving dimensionality issues, they also have applicability to modeling violations of local item independence. The concept that the likelihood of an item response is independent of responses to other items has been closely linked to the assumption of unidimensionality (Stout, 1990), yet our presentation here is concerned with how to manage such violations. As we noted earlier, local item dependency (LID) often occurs in traditional tests of reading comprehension. One of the most frequently used methods to identify LID is via Yen's Q3 statistic (Yen, 1984), which is the correlation between two items after accounting for overall test performance; the larger the correlation, the greater the presence of LID. While this procedure is useful in identifying where LID may exist for an assessment, it does not explain why it might have occurred.

LID tends to occur when items are grouped under a shared stimulus, such as a reading comprehension passage, or a word problem in math, and we can term such groupings, or bundles of items, testlets (Wainer et al., 2007). The presence of LID would be expected to be higher within each testlet (e.g., the narrative or informational passage), than across testlets; thus, we could model the impact of LID via a bi-factor model. In this case, the bi-factor model is used to estimate the difficulty and discrimination of the items. Specific factors are identical to that in the dimensionality example where one factor is modeled for each passage, but the evaluation of the model is focused on how well the items are estimated on the general factor of reading comprehension. By using the bi-factor model for LID, an

individual can simultaneously evaluate the presence of LID via the specific factor variances, as well as obtain item parameter and examinee ability scores which are adjusted for testlet effects.

While bi-factor models are emerging more as a method for handling dimensionality and local item dependency in reading data (Kieffer & Petscher, 2013; Petscher, 2011; Rijmen, 2010; Rijmen, 2011; Yovanoff & Tindal, 2007), there are several limitations worth noting. Compared to the correlated factor multidimensional model shown in Fig. 1b, the bi-factor model in Fig. 1c represents a complex structure, whereby each item describes more than one factor, compared to the simple structure (i.e., each item describes one factor) in Fig. 1b. The bi-factor model estimates more parameters; thus, more examinees are required to ensure that items parameters are free from bias. Relatedly, the complexity of the model is such that it often takes longer to converge and may need more appropriate starting values compared to other model specifications.

2.2.4 Scaling and Estimation

A natural query which may emerge after having read through the prior sections might be, "Is there a tangible benefit to implementing such complex models?" After all, testing the models described here are helpful for methodologists and statisticians, but to what extent do such models assist in understanding student performance on the assessment? The answer is – there is a benefit. Selecting the appropriate factor model (i.e., unidimensional, simple multidimensional, or complex multidimensional), estimation model for item parameters (e.g., Rasch model or 2-parameter logistic model), or estimator (e.g., maximum likelihood or weighted least squares) are necessary processes to placing scores on a common scale (Gorin & Mislevy, 2013; Tong & Kolen, 2010). A common scale is critical so that scores can be used to track growth within and across academic years for individual students, and is important for ensuring that normative scores reflect accurate population achievement. Moreover, common scales are critical for selecting cut scores in standard setting such as the Bookmarking (Lewis, Green, Mitzel, Baum, & Patz, 1998) or Modified Angoff procedures. Further, when scores are empirically used to set benchmarks for interim assessments to make screening decisions, a common scale is critical to the process of ensuring that identification procedures are well validated. In sum, complex modeling creates scales and score estimates that align to specific purposes or uses, thus, enhance the validity of the inferences made from those scores.

3 Envisioning the Future of Reading Assessment

Traditional tests have been widely criticized for failing to incorporate the cognitive and learning science literature in designs (Mislevy, 2006, 2008; Pellegrino, Chudowsky, & Glaser, 2001; Snow & Lohman, 1989). Early attempts at opening

up the design space, such as the performance assessments of the 1990s, met with significant challenges concerning construct coverage, objectivity, and consistency of scoring, cost-effectiveness, and time-efficiency (Gearhart & Herman, 1998; Kafer, 2002; Koretz, Stecher, Klein, McCaffrey, & Deibert, 1993; Koretz, Stecher, Klein, & McCaffrey, 1994a, 1994b). Thus, their feasibility and utility was rightfully questioned.

However, several concurrent forces are changing the equation concerning what is feasible and useful. Specifically, the migration of so much of the educational (and reading literacy) construct domain to digital forms; the availability and sophistication of technology-based delivery and scoring platforms; and advances in measurement techniques are ushering in a new world of possibilities for assessment of any kind and especially for reading literacy (See O'Reilly & Sabatini, 2013; Sabatini, Albro, et al., 2012; Sabatini & O'Reilly, 2013; Sabatini, O'Reilly, et al., 2012; Sabatini, O'Reilly & Deane, 2013). Although the constraints described above still operate, there are new solutions for addressing and optimizing assessment designs to meet the constraints.

3.1 The Call for a New Generation of Reading Assessments

Previously, we discussed the foundational concepts that led to the development of traditional assessments. We framed that discussion in terms of the balancing act between the definition of the construct, the purpose of the assessment, the particular needs of the end users, and the constraints imposed by logistical, psychometric, economic, and practical issues. Despite these challenges, however, advances in technology and in particular, changes in theoretical, political, and social attitudes have begun to reshape how we think about assessment.

In recent years, a number of scholarly reforms have been proposed to argue for a new kind of assessment. Most notably, these include the Common Core State Standards (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010), the associated Race to the Top Funding (U.S. Department of Education, 2009), and the major consortia, the Smarter Balanced Assessment Consortium, and the Partnership for Assessment of Readiness of College and Careers. The movement also includes other progressive frameworks and standards such as the Partnership for 21st century skills (2004, 2008); panels and commissions on assessment reform (Gordon Commission, 2013); assessment reform initiatives at major testing companies (Bennett, 2011b; Bennett & Gitomer, 2009); framework innovations in international assessments of reading such as PISA (Organisation for Economic Co-operation and Development (OECD, 2009a), PIAAC (OECD, 2009b), PIRLS (Mullis, Martin, Kennedy, Trong, & Sainsbury, 2009), and ePIRLS (International Association for the Evaluation of Educational Achievement, 2013a, 2013b); and various publications on assessment reform (e.g., Pellegrino et al., 2001).

Collectively, these efforts call for a new generation of reading literacy assessments that reflect a broader conceptualization of the construct that goes beyond what traditional assessments have been designed to measure. In particular, these construct features include, but are not limited to: purpose-driven or goal-directed comprehension (McCrudden & Schraw, 2007; van den Broek, Lorch, Linderholm, & Gustafson, 2001), multiple text comprehension (Britt & Rouet, 2012; Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Goldman, 2004), disciplinary and content area reading (Goldman, 2012; Lee & Spratley, 2010; Shanahan, Shanahan, & Misischia, 2011; Shanahan & Shanahan, 2008), digital literacy, online reading or reading in technological environments (Coiro, 2009, 2011; Leu, Kinzer, Coiro, Castek, & Henry, 2013) and social interaction including collaboration and communication (NGACBP & CCSSO, 2010; Partnership for 21st Century Skills, 2004, 2008).

3.2 What Might These New Assessments Look Like?

Although there is great enthusiasm for progressive assessment reform, instantiating these ideas in a feasible, practical, and sound manner are not without challenges. For instance, while there is a growing research base in many of the areas described above, the cognitive and learning science literatures are new and many of these efforts have not been investigated when the primary purpose is the design of valid and reliable assessments – most extant research is focused on either basic research or the design of learning and instruction. In order for the pieces to fit together, a coherent synthesis of the literature needs to be constructed with assessment considerations and constraints in mind. That is, fragmented and separate literatures need to be integrated into coherent assessment frameworks. The frameworks, in turn, would be used to design items, tasks, and test forms. Then, associated claims can be formulated during the design process, and evaluated during and after test construction on the basis of cumulative evidence.

At the international level, several innovative reading frameworks have been developed including the aforementioned PISA (OECD, 2009a), PIRLS (Mullis et al., 2009), ePIRLS (IAEE, 2013a, 2013b), and PIAAC (OECD, 2009b). Collectively, these large-scale frameworks have been modernized to reflect issues such as multiple text understanding, digital and online reading, and even collaborative problem solving (OECD, 2013). Interested readers are encouraged to consult the reading frameworks of the national and international reading assessments.

Although the international assessments described above are innovative, they still have to work under a host of practical and operational constraints. As such, many "riskier" design features may have to wait for future administrations. So what will the future of reading assessment look like in 5–10 years? Predicting the future is always difficult, but it might be useful to look at some examples of large scale research projects that are currently underway.

The first is an ongoing research project that began in 2007 called Cognitively Based Assessment of, for, and as Learning or CBAL for short

(Bennett, 2011a, 2011b; Bennett & Gitomer, 2009).[8] CBAL is an innovative approach to assessment in k-12 settings and has been developing assessments in the English Language Arts (ELA), mathematics, and science. The CBAL ELA competency model, akin to an assessment framework (Deane, Sabatini, & O'Reilly, 2012) is based on a synthesis of the literature of reading, writing, thinking, and their connections. Multiple prototype ELA summative and formative assessments have been developed and evaluated (Bennett, 2011b). A key goal of CBAL is to integrate the research in the learning sciences to improve construct coverage and make the assessments meaningful for instruction.[9]

A similar research project, called Reading for Understanding (RfU) initiative was funded by the Institute of Education Sciences (Institute of Education Sciences, 2010). The purpose of this large-scale initiative is to improve reading outcomes though both intervention and assessment. Relevant to the current chapter is the work of the assessment team (see ETS, 2013) which includes research partners at multiple universities including Florida State University, Northern Illinois University, and the Arizona State University. The assessment team is charged with developing innovative assessments of reading comprehension and component skills for students in prek-12 settings. Key to this effort was the integration of the theoretical and empirical literature in the learning sciences including the areas of reading comprehension, reading components, reading strategies, measurement, metacognition and self-regulation, motivation, and the general cognitive science literature (O'Reilly & Sabatini, 2013; Sabatini & O'Reilly, 2013; Sabatini, O'Reilly, & Deane, 2013).

The confluence of findings from this body of work has informed the development of a reading framework that guides the design of items, tasks, and forms for multiple assessments developed under the RfU initiative, most notably, an assessment called the Global, Integrated Scenario-based Assessment (GISA). Moreover, specific findings from the National Reading Panel (National Institute of Child Health and Human Development, 2000) and the National Early Literacy Panel (Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, DHHS, 2010), as well as the reading framework developed by Sabatini and O'Reilly (2013) guided the development of a component skills assessment called the FCRR Reading Assessment (FRA; Foorman, Petscher, & Schatschneider, 2013) and SARA (Sabatini, Bruce, & Steinberg, 2013). For the goals of this chapter, we present a broad discussion of the purposes of each type of assessment. The GISA has been developed, in part, from the stand-point of construct coverage and supporting learning, while a goal of the FRA, a computer adaptive test (CAT), is focused on time efficiency. The proceeding sections on the two assessments underscore the point that the different designs represent different ways of balancing purposes

[8]Interested readers should visit the CBAL website at: http://www.ets.org/research/topics/cbal/initiative

[9]Due to space limitations, we only elaborate on the RfU assessment project in the paper. Both CBAL and RfU share many of the same underlying principles and both incorporate innovative design techniques including scenario-based tasks and assessments.

and constraints. In the cases below, the different assessments can be used to serve complementary goals (for empirical studies, see Mislevy & Sabatini, 2012; O'Reilly et al., 2012; Sabatini, O'Reilly, Halderman, & Bruce, 2014).

3.2.1 GISA

GISA designs are guided by a three-part framework. The first part of the framework outlines six principles for assessment design that were derived from the literature (Sabatini & O'Reilly, 2013). While some of the principles discuss empirical and theoretical issues, such as vocabulary, that are already covered on many existing reading tests, other principles cover issues that are not routinely addressed, such as goal-directed reading (or task-oriented reading), multiple source integration, and digital literacy. The second part of the framework provides a definition of reading, a position on development, the constructs to be assessed, and the two assessments designed to measure reading comprehension (Sabatini, O'Reilly, & Deane, 2013). In brief, reading comprehension is described as the set of knowledge, skills, and dispositions that enable readers to construct meaning from text. In particular, five dimensions of reading literacy are described: the writing (or print) system, language (or verbal) system, text and discourse, conceptual modeling/reasoning, and social modeling/reasoning. These dimensions serve as analytic categories for decomposing literacy tasks, such that one can describe or evaluate the relative contribution of skills necessary to perform the task successfully.

GISA utilizes several features that are not routinely found in existing off-the-shelf reading assessments (O'Reilly & Sabatini, 2013). These features include: the use of scenario-based assessment; task designs that model and support evidence-based instructional practice; the use of simulated peers; and the inclusion of performance moderators in the design. These ideas are briefly summarized below.

In many traditional reading assessments, test takers are presented with a collection of unrelated passages on a range of general topics. Students answer a set of discrete items on each passage and then move on to an unrelated passage. In this traditional design, students are effectively expected to "forget" what they read previously when answering questions on later passages. In other words, there is no overarching purpose for reading other than to answer discrete multiple choice questions (Rupp et al., 2006). In contrast to this approach, the GISA uses a scenario-based assessment approach to shape the way passages, tasks, and items are processed.

In a scenario-based assessment, students are given an overarching purpose for reading a collection of thematically related sources for the purposes of solving problems, making decisions, or completing a higher level task (e.g., make a presentation; edit a wiki). The reading purpose sets up a collection of goals, learning aims, or criteria that students use to evaluate sources, or decide what information is relevant. The collection of sources is often diverse and may include a selection from a textbook, e-mails, blogs, websites, policy documents, primary historical documents, and so forth. Students are asked a series of questions about the sources

ranging from traditional comprehension items (locate information, vocabulary, basic inference) to more complex tasks such as the synthesis and integration of multiple texts, perspective taking, evaluating web search results, completing graphic organizers, using a rubric to score given responses, or applying what they read to a new situation or context.

Tasks and activities in a scenario are sequenced to reveal what parts of a more complex task students can or cannot do. For instance, if a student has trouble writing a summary, thus limiting the evidence of their skills, other tasks are provided to determine whether the student can recognize a good summary, evaluate a given summary, complete a graphic organizer, or identify key ideas. Such a collection of graded tasks helps provide an evidence trail that can be used to infer the complexity of tasks a particular student can handle. In this way, complex tasks are not viewed as an "all or none activity", but rather as a way to help triangulate partial student knowledge in the larger context of development. Simulated "peer" students are also included into the assessment design to provide guidance, hints, and to serve as a way to identify student misconceptions or errors in understanding. For instance, a simulated peer may provide an incorrect explanation of a process described in a text and the test takers task is to identify and correct the error.

Other techniques are often incorporated in the test design to provide more information about test takers, including their level of background knowledge on the topic of assessment, or their level of engagement and motivation. In tandem, these "performance moderators" can be used to help interpret test scores. For instance, if a measure of background knowledge indicates that the student knew a lot about the topic, then the score could be qualified as possibly reflecting more about the student's knowledge level than their reading ability *per se*. In a similar vein, if measures of engagement indicate that the student was not putting their best effort forward, then the score might be qualified as not reflecting the student's true reading ability. Other performance moderators are included in the test design such as metacognition and self regulation, as well as reading strategies, to model and encourage good practice.

To illustrate these ideas, imagine a scenario in which students are asked whether hybrid cars are environmentally friendly. Before they read any texts, they are given a background knowledge test on related topics such as gasoline automobiles, hybrid cars, electricity, batteries, and so forth. Students are then given a preliminary set of passages that help build up their general understanding of what a hybrid car is and how it works. Successive sources outline the potential benefits (e.g., less fuel consumption, fewer emissions and pollutants released in the atmosphere) of hybrid cars, while other texts discuss potential problems (e.g., higher cost of the vehicles, environmental impact discarding the batteries). Students are asked to evaluate the creditability of the sources (Do the sources have a monetary stake accompanying their position?), as well as the reasoning and soundness of the arguments (Do the arguments go off on a tangent? Are source authors trying to convince by emotional appeal rather than a logical argument with supporting evidence?). Simulated peers might incorrectly summarize the texts or draw inappropriate inferences, and the test taker is asked to correct the summary or inferences, as supported by text evidence.

Tests takers might then be asked to make a brochure outlining the key issues on both sides of the argument and draw conclusions based on the available evidence.

The scenario-based assessment described above is designed to reflect the way an individual might interact and use literacy source material better than is reflected in traditional, decontextualized assessments. It presents real problems and issues for students to solve and it involves the use of higher level reading and reasoning skills that are demanded by many current initiatives. Despite these more demanding goals, the assessment also presents students an opportunity to develop their skills, as complex tasks are broken down into more manageable subtasks, while empirically supported practices, such as metacognition and reading strategies, are incorporated into the design. In this way, the assessment represents an opportunity to *support learning*, in addition to more traditional uses of measuring what is previously learned (in terms of content assessment) or understood during the assessment (reading assessment). Although the innovations described above are still in their infancy, preliminary data indicate they are feasible and worth considering, as new technology and data emerge. Although any and every assessment must work with a set of constraints such as those described earlier in the paper, evolution in design and in technology can often be integrated into a manageable, but innovative design space.

3.2.2 FRA – A Computer Adaptive Test

Time can often be a limiting factor, as many assessments use a static form with a fixed set of items in predetermined order. The item pool often consists of items which have a difficulty range, yet most items in a static assessment tend to be of a moderate difficulty, with relatively few easy or hard items included. This means that for a given group of individuals, low ability students will confront moderate or hard items that are too difficult relative to their ability (hence, yield little information), and high ability students will spend less time confronting items that are at their challenge level (hence, yielding less information than of their proficiency). A result of this assessment structure is that high performing and low performing students have less reliable scores, as well as inefficient tests of their abilities.

Recent innovations in psychometric and technological research, known as computer adaptive testing (CAT), allow for assessments to be more dynamic than many traditional forms that use a fixed set of items in a predetermined order. The intricacies of a CAT have been discussed at length in various sources (e.g., Thompson & Weiss, 2011; van der Linden & Glas, 2010; Wainer, Dorans, Flaugher, Green, & Mislevy, 2000; Wise & Kingsbury, 2000), but the essential operations occurs in the following four step process: (1) the examinee is administered an item where the difficulty is optimally matched to their ability; (2) the examinee responds to the item; (3) the ability score is estimated; and (4) steps 1–3 continue until the examinee meets one of several possible termination criteria established by the test developer (e.g., has an ability score with a standard error less than some value, or has taken a maximal allowed number of items). CATs could reduce testing time,

with some estimates as high as 50 % (Weiss, 1982; Weiss & Kingsbury, 1984), while maintaining strong reliability for most participants. Three particular benefits of CAT hold great promise for the next generation of assessments, and are emerging as important applications in education: (1) accounting for item dependency, (2) accounting for item response lag, and (3) empirical classification of students via item performance.

CAT can help improve the reliability of scores for all participants by taking into consideration the ability estimate of the student. The underlying concept of a CAT is that students should be optimally matched to items, rather than forced to take items which are too difficult or too easy relative to their ability level. Because CAT is rooted in IRT, computer algorithms are able to search an item pool and continually locate items which are closely matched to a person's ability. Recall that a hallmark of IRT is that the difficulty of the item and the ability of the person are both estimated and are on the same metric. In this way, CAT creates individual tests customized to the ability of the individual; low ability examinees will tend to receive easier items and high ability students will receive more difficult items.

While CAT has several advantages over static assessments, there are some potential drawbacks. One potential concern is construct coverage. If items are optimized to the ability level of the student, a particular test taker may not receive items that cover key aspects of the construct. This may be acceptable under the assumption of unidimensionality of the construct, in that any item might be considered indicative of overall ability. However, this assumption may be limiting if one wants to be assured that a variety of tasks representing a complex construct are attempted by the examinee. Furthermore, in some states, legislative measures require that all test takers take the same assessment. In a literal sense, CAT produces a different test for different groups of students. In any event, CAT continues to be an innovative way to help maintain reliability in light of time pressure and efficiency concerns, as illustrated in the following description of the FRA.

3.2.3 FRA

The development process of the computer adaptive FCRR Reading Assessment (FRA) carefully balances recent understanding of the critical constructs of reading development across the school years, multiple approaches to improving the efficiency of test items and calculation of scores, and translation of those scores to teachable skills in the classroom from pre-k to grade 12. Similar to the GISA, the FRA views reading comprehension as a complex, multidimensional construct. The student interface with FRA is such that they may be assessed on a variety of reading component skills relative to their development including: alphabet knowledge, phonological awareness, word reading, vocabulary, listening comprehension, spelling, syntax, and reading comprehension. FRA has overlap with many off-the-shelf measures in reading, but it differs in that it is delivered in a computer adaptive environment. This allows students to receive fewer items in each substantive area, without frustrating the student based on the difficulty of the item.

Construct measurement in the FRA is focused on narrow, teachable aspects of the intended constructs. For example, vocabulary is thought to be multidimensional (receptive/expressive); however measuring the skill more globally or comprehensively historically requires establishing a basal and ceiling in both receptive and expressive areas. Achieving a reliable and valid score requires many items and takes time away from instruction. As such, given the state of research on a subskill like vocabulary, which suggests the correlation between receptive and expressive skills is moderate to large, the FRA is focused on measuring receptive vocabulary skills in a CAT framework. What may be lost by not measuring expressive skills is gained in the efficiency and precision with which we can provide reliable diagnostic information on receptive vocabulary. In this way the teacher is able to evaluate vocabulary ability as measured by the FRA and determine if further instruction, intervention, or depth in diagnostic profiling within a skill is necessary.

The statistical models used in the FRA are designed to leverage the correlations among the constructs as potential sources of information. By using cross-construct information, it is possible to obtain information about an examinee's ability in a particular reading skill by measuring a different skill. Under circumstances where such models fit, the FRA leverages the information which, for example, knowledge of letter sounds might contribute to understanding student ability in a correlated trait such as phonological awareness.

In addition to the enhanced precision, reliability, and efficiency of the FRA, scores are more readily useable for teachers. The tasks in the FRA were deliberately chosen to answer specific questions in modern educational practice and to more intuitively guide appropriate instructional decision-making. For example, ability scores were chosen because teachers and other educators typically ask if students are progressing in their targeted reading skills. The ability score gives a precise and reliable estimate of student's abilities without the equivalent forms problems of more traditional assessment. An important practical utility of the FRA is that it gives scores for teachable skills (e.g., Syntactic Knowledge and manipulating word parts in the Vocabulary Knowledge task) that are aligned to highly emphasized, standards-based instruction (i.e., Common Core State Standards).

4 Conclusion

The goal of this chapter has been to provide a review of assessment design and analytic practices, which can be used to contextualize the implications of innovations in reading comprehension assessments. We have discussed how assessments reflect a balance of purposes and constraints that guide the development of tasks, items, and test forms. More specifically, we reviewed how construct definition, standardization, and cost and efficiency help shape and constrain practical, reliable, and feasible tests. We also reviewed key issues in measurement and psychometrics including classical test theory, unidimensionality, item independence, reliability, validity, and item response theory and how they contribute to test construction and the inferences that can be made from test scores.

Given this foundational review, we also discussed the future of reading assessment by drawing on recent innovations in measurement and cognitive theory. We provided examples of two complementary assessments that are designed to be used in tandem to provide a broader picture of reading achievement. In closing, we note that innovation is relative to the time period in which it was conceived. We anticipate future advances in theory and technology will continue to transform what was once considered constraints into opportunities for test designers to enhance the value and utility of comprehension assessments in applied settings.

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Reading Comprehension Skill Development and Instruction for Adolescent English Language Learners: A Focus on Academic Vocabulary Instruction

Emily Phillips Galloway and Nonie Lesaux

Abstract This chapter describes the reading comprehension development of adolescent ELLs, and the nature of their difficulties in this domain. We first describe the ELL population in U.S. secondary schools today—the diversity within the group and its academic achievement. We then discuss the elements and nature of the reading process itself to provide readers the foundational knowledge to understand the challenges faced by adolescent ELLs. We also highlight a series of research-based instructional practices that support the literacy development of adolescent ELLs. In particular, we focus on the importance of academic vocabulary instruction, as a key element of academic language instruction, for promoting these students' advanced literacy skills. We conclude this chapter by delineating a literacy research agenda that will address and answer many of the pressing questions posed by today's educators and policymakers.

Keywords English language learners • Academic language • Vocabulary

1 Introduction

Questions once posed by individual teachers concerned about a single student acquiring English as a second language at school—part of a relatively small group of struggling readers—are now asked by policymakers and practitioners alike as they attempt to support a sizeable (and growing) population of students to gain advanced literacy skills. Indeed, the rapid growth of the English language learner (ELL)[1] population, who, on average, appear to struggle with comprehending grade-

[1]We adopt 'English Language Learner,' rather than the term, 'emergent bilingual' (García, Kleifgen, & Falchi, 2008), throughout this manuscript given that this is the term used most widely in U.S. school districts and federal policy (Menken, Kleyn, & Chae, 2012).

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level texts, raises multiple questions for researchers, educators, and policymakers (for further discussion, see Lesaux, 2006, 2012). Many of these questions, which are this chapter's focus, relate to the development and instruction of this population's advanced literacy skills: Who are adolescent ELLs? Why is reading in middle school and beyond challenging for ELLs and their peers? What are some research-based practices that support ELLs' literacy development? And, what should the research program of tomorrow look like in light of the challenges faced by ELLs in our secondary schools today?

This chapter discusses the reading comprehension development of adolescent ELLs, and illuminates the potential sources of difficulty these students encounter as they are confronted with complex texts in middle school and beyond. Specifically, we begin the chapter by describing the ELL population in U.S. secondary schools today—the diversity within the population and its academic achievement. We then discuss the elements and nature of the reading process itself to provide readers with the foundational knowledge to understand the challenges faced by adolescent ELLs, as a population that have been traditionally 'overlooked and underserved' as a result of the focus in the extant literature on primary school English Language Learners (Ruiz-de-Velasco & Fix, 2000; Short & Fitzsimmons, 2007). We also highlight a series of research-based instructional practices that support the literacy development of adolescent ELLs. In particular, we focus on the relevance of academic vocabulary instruction, as a subset of academic language (AL) instruction, for promoting these students' advanced literacy skills. Whereas academic language instruction attends broadly to the numerous language features and text structures that are found in academic texts, we place particular emphasis in this chapter on the utility of developing adolescent ELLs' knowledge of academic words. We take this approach because there is much empirical evidence to inform the design of academic vocabulary instruction for secondary students and because the teaching of academic vocabulary serves as an entry point for educators into the teaching of AL (Nagy & Townsend, 2012). We conclude this chapter by delineating a literacy research agenda that will answer the pressing questions posed by educators and policymakers.

2 Who Are Adolescent English Language Learners (ELLs)?

2.1 ELLs in the U.S. Secondary School Context

In industrialized countries worldwide, the population of children growing up in linguistically diverse homes is increasing (UNICEF Innocenti Research Centre, 2009), and the U.S. is no exception. Here in the United States, the past several decades have seen a dramatic increase in the number of school-age children from homes where English is not the primary language. Between 1980 and 2009, this population of children rose from 4.7 to 11.2 million youths, or from 10 to 21 % of the school-age population (Aud et al., 2011), with the greatest growth occurring in our

secondary schools (Garcia & Cuellar, 2006). The term, *English language learner* or ELL, refers broadly to students in our schools who, because of their English proficiency levels, need specialized language support to access the curriculum. The design of these specialized language supports has been hindered, however, by the monolithic portrayal of this population in the literature coupled with the failure to acknowledge the staggering diversity in resources available to meet the needs of these students in different educational contexts (Menken, Kleyn, & Chae, 2012).

The ability of schools to serve these learners is likely variable given the noteworthy state-to-state and region-to-region differences that underlie these population trends. For example, while the vast majority of ELL youths live in California, Texas, New York, Florida, and Illinois, population growth rates of ELLs have been relatively stagnant in those states. In contrast, historically more linguistically homogeneous states—those where there is limited existing infrastructure within schools to meet this population's needs—are experiencing the greatest growth. For example, between 1995 and 2005, the school-age ELL population increased by 301 % in Nebraska, 295 % in Arkansas, and 208 % in Nevada (Batalova & McHugh, 2010).

Of particular relevance for efforts to craft educational programs and services, the degree of linguistic heterogeneity among non-English speaking homes differs across states. In homes where English is not the primary language spoken, the most common home language is Spanish within the overall ELL population (73 %) (Batalova & McHugh, 2010). The remainder of this school-age population of learners together speaks 1 of 440 other languages (Batalova & McHugh, 2010). For illustration, in seven states Spanish is not the predominant language spoken at home by ELL learners. In five of these states (i.e., Montana, North Dakota, South Dakota, Hawaii, and Alaska), the largest group of the non-English speaking population speaks an indigenous language. In the remaining two states, Maine and Vermont, the most common languages spoken are Somali and Bosnian, respectively, reflecting our recent geopolitical history (Batalova & McHugh, 2010). Thus, some schools serve large numbers of students with similar linguistic histories and are able to readily employ staff who, as speakers of the languages students speak at home, can leverage these learners' linguistic resources instructionally to promote literacy development; this is, however, not the case in all schooling contexts.

Schools today also face additional challenges in serving these learners and their monolingual peers—many of whom are growing up in homes where access to financial resources is limited. Poverty is linked poor reading outcomes in monolingual populations, who despite having a host of colloquial language resources, have been documented to have fewer opportunities to be exposed to and to practice using the language of school texts and of academic discourse (Corson, 1997; Heath, 2012). Today, poverty is on the rise in the U.S. where 22 % of all children live in poverty, up from 18 % in 2007 (Lopez & Velasco, 2011). Children of immigrants, however, are disproportionately impacted by this growing trend. Taking the case of the large and growing Latino population—a population that has accounted for 56 % of the nation's growth in the last two decades—approximately 1 in 3 Latino children is raised in poverty, and many of these students enter school with limited proficiency

in conversational English and, like their monolingual English peers, may rely on teachers and classrooms for exposure to academic English (Lopez & Velasco, 2011).

Schools, are positioned as powerful mechanisms in supporting these learners given that more than half of the population of ELLs in our schools have received all of their formal education in the U.S., most beginning in kindergarten (Capps et al., 2005); in fact, the two fastest growing subpopulations of ELLs in the United States are students who immigrated before kindergarten and U.S.-born children of immigrants (Batalova, Fix & Murray, 2007; Capps et al., 2005). Yet, our schools need additional guidance and support to meet the needs of these learners as evidenced by the numbers of students entering into our secondary schools with the designation of 'Long-Term ELLs (LTELLs)' despite having received all of their formal education in English (Menken et al., 2012; Olsen, 2010). These students, who have been educated in the U.S. schooling system for 7 years or more and continue to require language support, are often proficient oral conversationalists; but lack the advanced literacy skills needed to keep pace with their middle grade, monolingual English peers (Cosentino de Cohen, Deterding, & Clewell, 2005).[2] This paradox, often puzzling to secondary educators, has situated these LTELLs as a silent majority within the ELL student population at the secondary level in many states (Menken et al., 2012; Olsen, 2010).[3] In this chapter, while we acknowledge the challenges faced by teachers and by schools in supporting growing numbers of ELLs to acquire advanced literacy skills, we also remind ourselves of the promise of bilingualism in relation to cognitive and literacy development.

2.2 ELLs as Bilinguals and Multilinguals

Some adolescents are *simultaneous bilinguals*, meaning that they speak both English and Spanish or another language at homes and are in the process of learning both languages at once. Others are *sequential bilinguals*, in which case they are from homes where they and their families almost exclusively speak their native language and they are fluent in their first language and are learning English as a second or additional language. Regardless of whether English acquisition is occurring simultaneously or sequentially, it is important to remember that second language acquisition is an *uneven* process (Bialystok, 1991) and depends upon many contextual factors—personal (age, time in the U.S., parental language skills, exposure to English in informal settings) and academic (exposure to English at school, school quality) (Goldenberg, Rueda, & August, 2006; Páez, 2001).

[2]LTELL is an administrative term used by many districts nationwide.

[3]LTELLs comprised nearly 59 % of students in 40 school districts in California according to Olsen (2010), one-third of ELLs in secondary school in New York City, and 23 % of the ELL population ins Chicago's secondary schools (Menken et al., 2012).

In the latter half of this chapter, we place a particular emphasis on one academic factor known to impact bilingualism and to be malleable: exposure to and opportunities to use academic English within the social context of school (Jia & Aaronson, 2003; Valdés, 2001). Because bilingual adolescents navigate many social contexts (home, school, peer groups, etc.) and employ English as well as one or more additional languages in these settings, their relative proficiency in English and the other languages in their repertoire can fluctuate depending on the topic. For illustration, having learned about photosynthesis in science in English may support proficient discussion of this phenomenon in the language of instruction—but not in another language despite having a rich understanding of what photosynthesis entails. Analogously, some ELLs have participated in formal schooling in their sending countries and, so, bring developed background knowledge of curricular content and of the routines of schooling, albeit acquired in a language other than English. The task for these learners is to map the English words to content, some of which may have been taught in a previous school context, and to acquire an understanding of schooling in the U.S. classroom (Freeman, Freeman, & Mercuri, 2002). Learners from sending countries that lack educational infrastructure may have received very little formal education prior to enrolling in U.S. schools, so they face the three-fold challenge of acquiring English for social communication and academic learning as well as becoming acquainted with formal schooling's processes and routines. Given our focus on adolescent ELLs, we would be remiss in failing to acknowledge the role of learner agency in English exposure and usage in the school context (Jia & Aaronson, 2003). We situate adolescents as active (rather than passive) agents in the process of becoming bilingual (or multilingual) and suggest that this is an important developmental factor to consider when designing instruction.

3 Our Focus

It is beyond the scope of a single chapter to address the needs of the entire adolescent, school-aged ELL population given the incredible diversity that characterizes this group. Therefore, in this chapter focused on ELLs' reading comprehension, we use the term, *ELL*, to solely refer to the learners of English as an additional language in our middle and high school mainstream classrooms who (regardless of official English proficiency designation or classification) have acquired interpersonal English skills; but lack the English language knowledge to comprehend the complex texts from which they are expected learn (August, Carlo, Dressler, & Snow, 2005). We focus on these students because we believe that every educator in every secondary school classroom, regardless of content area, likely encounters adolescents who fit this profile each day and wonders how best to teach them. Furthermore, elucidating the struggles of these particular learners—many of whom have received their entire education in U.S. schools—helps us to set an instructional agenda to address the weaknesses in how we have structured learning opportunities

for these students to date. New approaches to the education of adolescent ELLs are necessary because prevailing models have led to reading comprehension outcomes for English Language Learners that persistently lag behind the national average.

4 Why Is Reading in Middle School and Beyond Challenging for ELLs and Their Peers?: Reading Comprehension Unpacked

For those reading this chapter, we define reading comprehension as a process through which a reader constructs a mental schema, or representation, by integrating the information presented in a text with her own prior world knowledge—of content and language (Duke & Carlisle, 2011; Hock, Brasseur-Hock, & Deshler, chapter, "Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices", this volume; Kintsch, 1998; Snow, 2002). While the other chapters in this book highlight the nuances of comprehending disciplinary texts; we focus in this chapter on the reading comprehension development of adolescent ELLs and elucidate the potential sources of difficulty these students encounter as they are confronted with complex texts in all content area classrooms. As in the other chapters of this text, we begin by describing generally the multiple skills that comprise reading as well as the nature of reading development to provide readers a context for understanding the particular challenges faced by adolescent ELLs as they attempt to make meaning from complex texts. Specifically, we suggest that for all students-regardless of English learner status-learning to read is a *dynamic* and *cumulative* activity. Building upon the foundations of early reading skill, readers in each successive grade must develop new *skills* and *knowledge* if they are to successfully make meaning of the increasingly challenging texts that comprise the core curricula. For ELLs, these challenges are compounded by the varying degrees of familiarity they may have with English as the language of instruction in our schools and, in particular, with the academic language found in the textbooks, novels, and newspaper articles from which students are tasked with learning in their classrooms.

4.1 Foundational Understanding 1: Reading as Dynamic and Cumulative

For all learners, including ELLs, the process of reading development is both *cumulative* and *dynamic* (RAND Reading Study Group, 2002). Never complete, reading development begins at birth and continues through adulthood. *Reading* at age 3 is not the same as reading at age 5; reading for a 9 year-old at school is different

from reading at age 14 in the content area classroom. It is only by accumulating skills, knowledge, and reading experiences that the adolescent reader is able to keep pace with the changing demands of the curriculum and the proliferation of purposes for reading, ultimately enabling continued academic success. The successful adolescent reader not only deciphers words on a page, but also draws on knowledge (sometimes referred to as *background knowledge* or the *reader's schema*) to assess, evaluate, and synthesize the information presented in the text (RAND Reading Study Group [RRSG], 2002). Often asked to respond orally and in writing to complex questions that can only be answered by integrating ideas from multiple sources (e.g., texts, media sources, the reader's relevant prior experience), successful readers access and apply knowledge from multiple disciplines that has been acquired over time and by reading a variety of texts. In secondary contexts in particular, reading is a central mechanism for acquiring knowledge of content and language. Reading skills are, in fact, the foundation for learning across all academic domains, including math, science, and social studies (Graves, Juel, & Graves, 1998).

By middle school, the numbers of opportunities that students have had to accumulate knowledge of how to read at school, of the topics that comprise the middle grade curriculum, and of the language through which these topics are communicated vary widely. As alluded to above, for ELLs, these differences are particularly salient. Whereas some ELLs have had few chances to participate in formal schooling before entering U.S. schools, other ELLs bring rich knowledge of school-relevant reading practices acquired in a first language (referred to as an L1) that may be transferable to the task of learning to read English texts. Knowledge of the purposes for which we read at school and of the strategic processes involved in reading acquired in a first language inform how learners approach texts and support ELLs in acquiring academic literacy skills in English. However, educators should be mindful of the reality that the majority of ELLs in our schools today are U.S.-born and have received all of their formal education in U.S. schools. If we conceptualize reading development as the sum total of a reader's experience transacting with text, the prevalence of long-term ELLs documented to struggle with understanding what they read in middle school provides urgency around the need to examine the cumulative instructional opportunities provided to these learners in our schools (Menken et al., 2012; Olsen, 2010).

4.2 Foundational Understanding 2: Reading Comprehension Draws on Skills-Based and Knowledge-Based Competencies

Reading comprehension is not a unitary skill; numerous separate but related competencies support the comprehension of text. Broadly speaking, we classify these competencies as either *skills-based competencies* or *knowledge-based competencies* (Paris, 2005; Snow & Uccelli, 2009). The mechanics of reading or *skills-based*

competencies are those that allow students to read words accurately and efficiently by mapping letters onto their respective sounds in combinations. For example, to read accurately students must know the full array of sound-symbol relations using the 26 letters and approximately 44 sounds in the English language. These skills are highly susceptible to instruction, learned in the primary grades by the average learner and, for the vast majority of students, are not a lasting source of difficulty after Grade 3 (Chall, Jacobs, & Baldwin, 1990). In contrast, *knowledge-based competencies* involve the range of skills and knowledge necessary for understanding what is being read. To make meaning from any text, the reader needs (at a minimum) relevant background knowledge related to the text's vocabulary, topic, and structure (Berninger & Abbott, 2010; Catts, Adlof, & Weismer, 2006; Mancilla-Martinez & Lesaux, 2011; Snow & Uccelli, 2009). In contrast to skills-based competencies, these knowledge-based competencies are much larger developmental- and instructional-"spaces" and include the constellation of skills more directly related to comprehension and, as such, comprehension difficulties (Chall et al., 1990; Paris, 2005; Snow & Kim, 2007). In fact, these knowledge-based competencies are key sources of lasting individual differences in reading ability and are fundamentally important to the comprehension of the texts students read in the secondary school context (Anderson & Freebody, 1983; Catts, Fey, Zhang, & Tomblin, 2001; Catts & Kamhi, 2005; Hock et al., 2009; Snow & Kim, 2007).

In particular, in this chapter, we place a heavy focus on students' knowledge of the academic vocabulary that appears in complex texts as an important knowledge-based competency that mediates text comprehension. While accelerating the literacy growth of ELLs requires a multifaceted approach, the research has coalesced on the notion that comprehension instruction should bolster students' knowledge of specialized vocabulary and language structures (both sentence and text structures) found in academic text and discourse, known as *academic language* (AL). Defined by Nagy and Townsend (2012) as the, 'specialized language, both oral and written, of academic settings that facilitates communication and thinking about disciplinary content (p. 92),' AL is a functional tool that allows for discussion and reflection on the types of complex ideas and phenomenon that comprise the middle grade curricula. Such language is an essential tool for reading, writing, and critical thinking, and one that presents a particular source of difficulty for many students, including ELLs.

4.3 Concretizing Skills- and Knowledge-Based Competencies: How Do We Read Academic Text?

To concretize the multi-componential nature of reading, we turn to an excerpt from the Common Core State Standard's exemplar texts (2010)—one that contains many of the features generally found in academic texts—and examine how an adolescent reader might brings to bear code- and meaning-based skills when reading this text.

> From the meanderings of a pond's edge to the branching of trees and the intricate forms of snowflakes, shapes in nature are often more complicated than geometrical shapes such as circles, spheres, angles, cones, rectangles, and cubes. Benoit Mandelbrot, a mathematics professor at Yale University and an IBM fellow, was the first person to recognize how amazingly common this type of structure is in nature. In 1975, he coined the term fractal for shapes that repeat themselves within an object. The word fractal comes from the Latin term for "broken." In 1904, long before Mandelbrot conceived of fractals, Swedish mathematician Helge von Koch created and intriguing but puzzling curve. It zigzags in such an odd pattern that it seems impossible to start at one point and follow the curve to reach another point. Like many figures now known to be fractals, Koch's curve is easy to generate by starting with a simple figure and turning it into an increasingly crinkly form.[4]

4.3.1 Skills-Based Competencies

To skillfully read even this short excerpt, an adolescent reader may make use of a host of skills-based competencies. Perhaps when this reader's eyes move across the words in this passage, many are known to her by sight. For this reader, little cognitive energy will be expended on the task of reading a word whose meaning, spelling, and pronunciation are already linked in the reader's memory (Ehri, 2005). For the majority of middle graders, words that are commonplace in the books read in primary school are automatically read as units. For instance in the passage above, *from* and *the* are sight words often mastered in kindergarten; but, words like *recognize* or *person* should not be assumed to be part of the typical middle grader's sight word repertoire (LaBerge & Samuels, 1974). We would expect that most adolescent readers may be unfamiliar with at least some of the words in the passage, and so, will need to make use of word reading strategies (i.e., decoding, analogizing, or predicting; Ehri, 1991). To decode, a reader must be able to map sounds onto letters (for example, /t/ /r/ /ee/ /s/) and blend these to form a word, or when reading longer words, manipulate chunks of letters and blend these syllabic units into familiar words (e.g., me · an · der · ings; Ehri, 1991). In a process referred to as *analogizing*, this reader may make use of a word she already knows to read a new word with the same spelling pattern (or rime). For instance, using the known word *wrinkly*, to read the unknown word *crinkly* in the text above (Goswami, 1986). Finally, this reader might use context and letter clues to guess an unfamiliar word (Tunmer & Chapman, 1998). With comprehension as the end goal, this student must also read the text quickly enough so that she is able to hold in mind the information read at the beginning of the text until she reaches the last sentence. At the end of eighth grade, it is documented that a student must correctly read at least 140 words a minute or be able to read this passage in a little over 60 seconds.

[4]Peterson, I., & Henderson, N. (2000). *Math Trek: Adventures in the Math Zone*. San Francisco: Jossey-Bass.

4.3.2 Knowledge-Based Competencies

Although necessary, skills-based competencies are not enough to glean meaning from text. Knowledge-based competencies, including understanding a word's meaning in the context of the passage and other relevant academic language skills also play a role in text comprehension. Adolescents, including many classified as ELLs, have command of conversational English. Nevertheless, these proficient conversationalists often have had few opportunities to acquire the more precise and succinct academic language found in school texts (Fang & Schleppegrell, 2010; Schleppegrell, 2004; Schleppegrell, Greer, & Taylor, 2008). For instance, the word *forms*, used here as a noun, may confuse this adolescent reader if she is only familiar with the verb *to form*, which is common in oral school discourse (as in "to form a group"). The disciplinary vocabulary found in content area writing also represents another stumbling block for the prototypical adolescent, words like *geometrical* and *fractal* in this excerpt (see chapters "Reading History: Moving from Memorizing Facts to Critical Thinking", "Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page", "Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension", and "Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices"; Phillips Galloway, Lawrence, & Moje, 2013). Knowledge of word meanings may certainly be augmented by knowledge of meaningful word parts (i.e., root words, suffixes, and affixes); for instance, this reader may draw her knowledge of *–ian* in *mathematician* to infer that this term means, "someone who does math" (Kieffer & Lesaux, 2010).

This adolescent reader may also use prior knowledge of how texts are constructed by writers and of the topic generally to make sense of this text. Knowledge of phrases commonly used by writers to signal how sentences and ideas relate, known as 'connectives' or 'discourse markers,' support a reader's comprehension of academic texts. However, when these phrases are unfamiliar, they do little to support text processing (e.g., "such as" in the phrase "geometrical shapes *such as* circles, spheres, angles" cues the reader to recognize that the author is enumerating examples) (Crosson & Lesaux, 2013b). This reader may also access her knowledge of sentence structures typical of academic texts. For instance, she may recognize the authors' use of a common strategy for embedding a definition of a newly introduced term within a text (e.g., "...he coined the term fractal for shapes that repeat themselves within an object."). This student may also recall and use relevant background knowledge, such as conceptual knowledge of the work of mathematicians or the visual image of a fractal, to fully understand the passage. Reading disciplinary texts, in particular, poses challenges to adolescent readers, who often do not bring the elaborate schema of background knowledge that an expert reader might, and so, must construct this understanding from scratch or by relying on incorrect knowledge, thus further impeding comprehension (Graesser & McMahen, 1993; León & Escudero, chapter, Understanding Causality in Science

Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension, this volume; Otero & Kintsch, 1992).

Finally, this excerpt is a very short segment of a much longer text. To read the entirety of this text, this adolescent reader must have the motivation and interest to persevere as well as the cognitive strategies to monitor her understanding of the text and to repair misunderstandings that arise when reading. The challenge of reading this passage is, of course, compounded by the need to carry out all of these reading processes simultaneously. Given the integrated nature of the reading process, in which skills-based and knowledge-based competencies operate in tandem, educators reading this chapter may question why we distinguish the two. However, readers of this chapter will find, that this distinction is meaningful for thinking about reading instruction as it relates to students from low-income and non-English-speaking homes for whom knowledge-based competencies tend to be the prevailing source of difficulty (Paris, 2005; Snow & Uccelli, 2009).

5 Unpacking Sources of Reading Comprehension Difficulty for Adolescent ELLs

5.1 Foundational Understanding 3: Knowledge-Based Competencies, Especially Academic Language, Are a Source of Difficulty for ELLs and Many of Their Classmates

A recent wave of developmental research clearly demonstrates the challenges faced by the growing population of students who enter school with limited proficiency in English (Carlisle, Beeman, Davis, & Spharim, 1999; Carlisle,Beeman, & Shah,1996; Leu, Kinzer, & Hinchman, 1996; Jiménez, García, & Pearson, 1996; Lesaux & Kieffer, 2010; Mancilla-Martinez & Lesaux, 2011; Proctor et al., 2005). However, code-based skills development does not appear to pose difficulty for most ELLs. That is, by the end of second grade, with adequate instructional opportunities, most of the school-age population has sufficient knowledge of letter-sound correspondences and, as a result, has the basic ability to decode printed words (Betts, Bolt, Decker, Muyskens, & Marston, 2009; Geva & Yaghoub Zadeh, 2006; Jean & Geva, 2009; Lesaux et al., 2006; Lesaux, Crosson, Kieffer, & Pierce, 2010; Lesaux, Rupp, & Siegel, 2007; Mancilla-Martinez & Lesaux, 2011). In fact, multiple developmental studies suggest that ELLs master these skills within the same time frame as their peers from middle-class, majority-culture backgrounds (August & Shanahan, 2006; Betts et al., 2009; Geva & Yaghoub Zadeh, 2006; Jean & Geva, 2009; Lesaux et al., 2007; Lesaux & Kieffer, 2010).

By contrast, knowledge-based competencies, those competencies more directly related to comprehension, appear to be persistent sources of difficulty for many

ELLs and their peers from low-income households (Betts et al., 2009; Geva & Yaghoub Zadeh, 2006; Hock et al., 2009; Lesaux & Kieffer, 2010). For example, a recent study of sixth grade readers enrolled in 26 classrooms in a large, urban district examined the nature of reading comprehension difficulties in adolescent populations. When comparing the sources of difficulty for struggling readers from non-English speaking homes to those from monolingual English speaking homes, the researchers found more similarities than differences. For the sample studied, low-vocabulary knowledge was a profound source of difficulty across linguistic groups, who both consistently evidenced reading comprehension abilities below the national average (Lesaux & Kieffer, 2010). Given these data, some educators reading this chapter may question whether these students may also lack knowledge of comprehension strategies. However, a recent in-depth qualitative comparison of adolescent non-native English speakers, who were U.S.-born and educated, and their native English-speaking classmates demonstrated that both groups were aware of key elements of text known to influence comprehension and were actively attempting to make use of comprehension strategies but were stymied in their text comprehension efforts by relatively low-knowledge of language and vocabulary (Lesaux, Gamez & Anushko, under review). In the absence of adequate knowledge of vocabulary, applying strategies (re-reading, summarizing) did little to support their successful comprehension of the text.

These studies are not to suggest that there are no readers in the secondary classroom that face difficulties developing skills-based competencies. For example, there is a subpopulation of students who may benefit from support developing decoding skills. However, educators should be mindful that this is not the typical ELL profile in the secondary context, and careful diagnostic assessment should be undertaken in order to identify the particular sources of difficulty a reader faces. In turn, teachers should respond with instructional strategies that address the identified need; however, this strategy instruction should also include a rich program of language and background knowledge development.

5.2 Foundational Understanding 4: On Average, ELLs' Rate of Reading Development Is Actually On Par with National Rates of Growth

Given the profound challenges that many ELLs face, educators often are left with the impression that negotiating two languages may compromise overall learning ability—that ELLs are not learning as quickly as their English-only peers. However, this appears not to be the case for the vast majority of ELLs. Despite reading performance levels that appear low, performance growth rates are encouraging for these vulnerable populations. In fact, studies suggest that, compared to the average U.S. monolingual English student, this population demonstrates

equivalent or slightly faster rates of growth in reading and reading-related skills, including vocabulary development (Kieffer, 2008, 2010; Mancilla-Martinez & Lesaux, 2011). By way of illustration, a 10-year longitudinal study following Spanish-speaking children from age 4 (U.S.-born children of immigrants recruited from Head Start centers) through early adolescence, found that both skills-based and knowledge-based reading competencies grew at a rate equivalent to that of the average U.S. monolingual English student (Mancilla-Martinez & Lesaux, 2011).

What, then, explains the finding that the average reading comprehension level by the end of middle school for ELLs (around the 30th percentile) persistently lags behind the national average for monolinguals? To answer this question, we must recall that reading is a cumulative skill and that adolescent literacy skills have their antecedents in early language skills and knowledge-building opportunities. For example, Kieffer's (2008) research using the nationally representative Early Childhood Language Study-Kindergarten (ECLS-K) found that children who entered kindergarten with lower proficiency in English than their age-matched, monolingual peers also had significantly lower scores in eighth grade, despite evidencing slightly faster rates of growth in English reading (Kieffer, 2008). Although children entering school with limited proficiency in English display age-appropriate (even relatively rapid) growth in reading achievement from early childhood through early adolescence, this growth is not enough to compensate for substantial early gaps in linguistic knowledge. Paradoxically, this suggests that while ELLs are swiftly acquiring the skills and knowledge necessary to read complex text, the rate of growth will need to be even faster—accelerated through instruction—if they are to keep pace with their monolingual peers.

6 What Are Some Research-Based Practices that Support ELLs' Literacy Development?: A Focus on Academic Vocabulary Instruction

One mechanism through which educators may support adolescent ELLs to become proficient readers is by bolstering their knowledge of academic language (AL). Rarely used in oral language, AL appears more frequently in complex texts. In contrast to conversational English, we find that academic texts contain more nouns, adjectives and prepositional phrases; verbs or adjectives used as nouns (to destroy → destruction); words and phrases that connect ideas within sentences ('therefore,' 'for example'); more pieces of information in each sentence; and—most relevant for this chapter—a higher proportion of longer, abstract words often derived from Latin (known as academic vocabulary) (Biber, 2006; Snow & Uccelli, 2009). The primary vehicle of AL exposure for adolescents is via complex text; but,

given the high prevalence of struggling readers within the ELL population, we have reason to believe that these opportunities may be uncommon. This, of course, does not have to be the case.

While AL instruction is gaining momentum, it is only just beginning to amass empirical support for bolstering language ability, reading comprehension levels, and content area knowledge (August, Branum-Martin, Cardenas-Hagan, & Francis, 2009; Carlo et al., 2004; Lesaux & Kieffer, 2010; Lesaux, Kieffer, Faller, & Kelley, 2010; Proctor et al., 2011; Snow, Lawrence, & White, 2009; Townsend & Collins, 2009; Townsend, Filippini, Collins, & Biancarosa, 2012; Uccelli et al., 2014; Vaughn et al., 2009). Therefore, we focus in this chapter on one facet of AL teaching for which the most empirical evidence has been amassed: academic vocabulary instruction. Our focus on academic vocabulary is not to suggest that other features of AL do not play a fundamental role in disrupting the text comprehension of adolescent readers (see, for instance, Beers & Nagy, 2011; Crosson & Lesaux, 2013a; Uccelli et al., 2014). Rather, we focus on academic vocabulary because the field now has a clear understanding of how this instruction might progress from multiple intervention studies (August et al., 2009; Lesaux, Kieffer, Faller, & Kelley, 2010). Furthermore, we view academic vocabulary instruction as a natural and manageable entry point into AL teaching for educators, one that can serve as an anchor for building knowledge-based literacy competencies through sustained instruction across the grades (Nagy & Townsend, 2012; Snow & Kim, 2007).

6.1 Beyond 'Instruction as Usual': Avoiding Potential Pitfalls

The type of instruction that ELLs need to bolster their AL skills is not business as usual in the average U.S. classroom—whether in elementary or secondary settings. To date, reading comprehension instruction has often focused on developing a set of reading strategies that support text comprehension (e.g., re-reading, summarizing, self-questioning) (Dewitz, Jones, & Leahy, 2009). While these strategies seek to mimic the processes engaged in by mature readers, a body of growing evidence suggests that teaching only these skills fails to properly acknowledge the repertoire of additional skills—including knowledge of academic language—that successful readers draw upon when comprehending a text. A mixed-methods study conducted with 41 sixth and seventh grade ELLs sheds light on how strategy use during the reading process unfolds for this group of readers who demonstrate below average scores on assessments of reading comprehension and vocabulary knowledge (Harris & Lesaux, 2014). Based on students' responses during semi-structured interviews focused on their reading of a particular passage, findings illustrated how the participants engaged in an active reading process. Students described using a suite of strategies such as constructing inferences about the passage's content and connecting what they knew ('background knowledge') to what appeared in the passage. Despite this active-learner stance, participants tended to construct inappropriate and/or inaccurate representations of the text. The authors

interpreted these results as suggesting that the value of reading strategies was better realized when other components of reading comprehension, including vocabulary and content knowledge, were similarly well developed.

Yet, evidence suggests that vocabulary knowledge is rarely systematically (or comprehensively) taught in secondary school classrooms. In the average classroom, there is very little instructional time allocated to building vocabulary through explicit teaching and to developing oral language skills (Carlisle, Kelcey, & Berebitsky, 2013; Lesaux, Kelley, & Harris, 2015). This is made evident by a recent study examining standard practice in 26 middle school English Language Arts classrooms in a large urban district serving large numbers of ELLs. The authors found that across hundreds of hours of instruction, a very modest amount of time was devoted to vocabulary teaching (8 %) or to rich oral language development (6 %) (Lesaux et al., 2015). When vocabulary instruction did occur, the words taught were overwhelmingly of two types: rare words unlikely to be encountered again with much frequency (e.g., gossamer, somnolence) and content-specific words (e.g., protagonist, tone, mood). Unquestionably, the teaching of content-specific words, often called Tier 3 words (Beck, McKeown, & Kucan, 2002), is an important and entrenched component of supporting students to engage as members of a disciplinary discourse community. However, the teaching of general service academic words, which are a ubiquitous feature of the texts read in all content areas, was markedly absent in these classrooms, although knowing these words facilitates students' understanding of the content-specific words that they surround in text. In fact, we now have ample research to suggest that students' knowledge of general service academic words (e.g., therefore, argument, benefit, role) supports the development of advanced literacy skills (Corson, 1997; Snow et al., 2009; Townsend et al., 2012).

Thus, the challenge facing educators and administrators is to first set an instructional agenda that will accelerate the reading comprehension growth of adolescent ELLs and their classmates and, then, shift current instructional practices. While the tendency may be to respond using the traditional tools and practices, such as teaching academic word lists or adding short blocks of isolated word study, this chapter suggests that a much more systemic response is needed. In particular, we suggest that ELLs benefit from classroom contexts that are oriented towards building knowledge and which recognize that purposeful, targeted academic language development is a necessary component of this instruction.

6.2 What Do We Know About Teaching Academic Vocabulary?

The past decade has seen a relative surge in research that aims to identify instructional mechanisms to accelerate the reading comprehension of adolescent ELLs who are struggling readers (see for example, August et al., 2009; Carlo et al., 2004; Kim et al., 2011; Lesaux, Kieffer, Faller, & Kelley, 2010; Lesaux, Kieffer, Kelley, & Harris, 2014; Lubliner & Smetana, 2005; Snow et al., 2009; Vaughn et al.,

2009). These approaches focus on providing students with deep, language- and content-based instruction with a emphasis on teaching both specialized vocabulary and the specialized structures of language that are found in academic speech and text (i.e., AL). In most cases, these interventions have taken a classroom-wide, universal approach and have been conducted in urban, underperforming schools. That is, they are predicated on developmental data that suggest academically at-risk adolescents, both English-only and ELL students who have been enrolled in U.S. schools for the majority of their formal schooling, would benefit from targeted AL instruction.

Collectively, these intervention studies focus on students from fifth through eighth grade and ranged in duration from 5 weeks (Townsend & Collins, 2009) to 24 weeks (Snow et al., 2009). Although seven interventions were implemented as part of a single subject area's instructional core (i.e., ELA, science, or social studies) (August et al., 2009; Lesaux & Kieffer, 2010; Carlo et al., 2004; Dalton et al., 2011; Lubliner & Smetana, 2005; Proctor et al., 2011; Vaughn et al., 2009), one was designed as a cross-disciplinary initiative to teach a daily vocabulary lesson once in each subject area classroom throughout the week (Snow et al., 2009), and one tested the effects of an afterschool vocabulary intervention (Townsend & Collins, 2009). To date, these intervention studies suggest that such instruction can accelerate vocabulary development as assessed by curriculum-based measures of words taught as well as, to a lesser degree, reading comprehension as measured by norm-referenced assessments (e.g., Lesaux, Kieffer, Kelley, & Harris, 2013; Kim et al., 2011; Vaughn et al., 2009).

6.3 What Are the Promising Practices that Come Out of This Research?

Drawing from Nagy and Townsend (2012), we assert the end goal of academic language instruction is not simply to teach words. Instead, we view this instruction within a much broader frame and suggest that the goal of AL instruction is to equip students with the linguistic tools they need to acquire and express knowledge. To design this instruction, the field has frequently drawn upon principles of vocabulary teaching from work with young monolingual English speakers. This practice is uncontroversial given the findings from six of the seven studies described above examining whether language status was related with treatment effects. These studies found that the interventions were equally effective for ELLs and English-only learners (August et al., 2009; Carlo et al., 2004; Dalton et al., 2011; Lesaux & Kieffer, 2010; Proctor et al., 2011; Vaughn et al., 2009). This points to the potential of adopting principles of vocabulary instruction deemed effective with English-only learners in classrooms that serve linguistically diverse students. The principles of effective vocabulary instruction operationalized in these recent interventions are not novel, having been first articulated in Stahl and Fairbank's (1986) meta-

analysis examining the relationship between vocabulary instruction and reading comprehension. They identified three central components of these curricula:

- teaching a word's definitional and contextual information
- promoting deep processing
- providing multiple encounters with target words.

6.4 *Academic Vocabulary Instruction: The* What *and* How *of Effective Instruction from the Intervention Literature*

However, to understand how these general principles have been operationalized instructionally, we turn to the intervention literature to highlight a series of concrete practices that provide educators the *what* and *how* of efficacious academic vocabulary instruction.

6.4.1 What

Often in our work with educators, we encounter two common queries that speak to the *what* of vocabulary instruction: 'which words should I teach? And, how many words should I teach?' Although there is no simple answer, there is a general consensus that to truly know a word, its forms, how to use the word in context, how the word is related to and used with other words in formulaic ways, and the word's metaphorical uses requires that students are exposed to and offered opportunities to produce the word multiple times in rich contexts and for authentic purposes (Beck & McKeown, 1991; Graves, 2000, 2006; Nagy & Townsend, 2012; Stahl & Nagy, 2006).

In contrast to teaching many words each week, commonly selected from a word list, research suggests teaching that preferences depth over breadth by focusing on a small number of high-utility words is what best serves ELLs and their peers. For instance, focusing on 7–10 words as part of a week-long instructional cycle is not uncommon in successful interventions (Beck et al., 2002; Graves, 2000, 2006; Stahl & Nagy, 2006). By *high-utility* we mean those words that deliver information to readers and must be understood to access the content-specific language that all middle grade texts contain, words such as *analyze* or *theory* (Hiebert, 2005; Nair, 2007). In fact, it has been argued that processing and expressing disciplinary ideas and abstract phenomena are not possible without knowledge of academic language, and so content area teachers of adolescents may view this high-utility academic language instruction as a fundamental part of larger knowledge-building agenda (Nagy & Townsend, 2012). It is in this sense that AL words become, as argued by Nagy and Townsend, tools for communication and comprehension. This focus on high-utility AL is not in opposition to the teaching discipline-specific AL, where the emphasis is on increasing adolescents' facility with the language that is unique

to math, science, or history; rather it is complementary (August et al., 2009; Brown, Ryoo, & Rodriguez, 2010; Vaughn et al., 2009).

6.4.2 How

The intervention research reviewed not only speaks to what academic vocabulary we should teach, but also to the guidance in *how* educators might teach it. In particular, effective academic vocabulary interventions begin by situating word learning within the context in which the words are used, often by reading an engaging text or series of texts on a topic and by providing oral and written language activities (Kelley et al., 2010; Fang & Schleppegrell, 2010; Snow et al., 2009). Language selected as instructional targets appears recurrently in the unit as an artifact of the utility of this vocabulary for communicating the content, and so opportunities to practice using this language when reading and writing are widespread through the unit of study. Often situated around a key question that students were motivated to debate or answer, these units of instruction replicate realistic conditions for word usage and also attend to the developmental needs of adolescent learners (e.g., providing choice, autonomy in carrying out their work in groups, and the opportunity to take a stance). These incidental, authentic exposures and spontaneous opportunities for word usage are balanced with explicit teaching of word meanings and the intentional and systematic support for students to use the target language (Lesaux et al., 2010; Snow et al., 2009; Townsend & Collins, 2009). This explicit teaching commonly occurs by using the same learning activities over multiple instructional units such as procedures for defining words, personalizing word meanings, and engaging in word play routines (Kelley et al., 2010; Snow et al., 2009; Townsend & Collins, 2009). Using the same learning activities over time, but with different content and words, gives students the chance to learn the material without also having to learn the routine. Finally, these interventions go beyond simply teaching words—they also provide students with instruction that supports their independent word-learning by teaching morphology skills or the use of context clues to determine a word's meaning (Kelley et al., 2010).

7 What Should the Research Program of Tomorrow Look Like?: Future Research on Adolescent ELLs' Literacy Skills

The research reviewed and discussed provides a starting point to advancing this population's academic outcomes. However, we now turn to describing a much needed literacy research agenda that will continue to answer the pressing questions posed by educators and policymakers. Further research is particularly pressing as the knowledge and literacy demands of the twenty-first century continue to increase. This is reflected in the current college and career readiness standards,

which mandate that instruction attend to the inherently complex challenge of building students' knowledge of content and language. To that end, the field would benefit from a research agenda driven by the goal of learning how to build ELLs' knowledge--based literacy competencies in the service of improved outcomes. To do so requires explicit attention to their academic language skills across all years of schooling. Specifically, we focus on the need to advance the current research base in at least two ways: (1) continuing to empirically describe typical and atypical reading development among ELLs; (2) empirically describing characteristics of standard instructional practice and effective acceleration/intervention efforts.

7.1 Typical and Atypical Reading Development Among ELLs

By continuing to describe typical and atypical reading development among ELLs, we will further generate a knowledge base about the science of reading that matches today's demographics and, in turn, be able to design even more targeted instructional approaches. To date, models of reading comprehension are predicated on an understanding of reading development for monolingual readers, who have linguistic histories unlike their ELL peers. Thus, developmental studies focused on ELLs may aid the field in rethinking theories of reading comprehension for these at-risk populations, beginning with the delineation of skills-based and knowledge-based competencies. In particular, we have only just begun to explore the broad constellation of language skills—beyond academic vocabulary knowledge—that together comprise 'academic language proficiency' (Crosson & Lesaux, 2013a; Uccelli et al., 2014). These cross-sectional studies suggest that other sub-components of English language comprehension like knowledge of syntax, morphology, text structure, and connectives (among other linguistic skills) are, like academic vocabulary knowledge, linked with reading comprehension outcomes. Certainly, this is what we might expect given that all of these features operate in synchrony to support academic communications—and, so, must also be comprehended in synchrony by readers (Uccelli et al., 2014). Future studies should certainly continue this promising line of inquiry in broader populations of adolescents, including ELLs, and be expanded to include longitudinal samples. In addition, given the complexities of reading and the multi-faceted process that is demanded of students as they approach sophisticated texts, there is also a need for research to determine the socio-emotional characteristics and higher-order cognitive abilities that guide self-regulation, planning and complex thought for ELLs and monolinguals alike (Blair, 2002; Carlson & Meltzoff, 2008; Diamond, 2013; Raver, Gershoff, & Aber, 2007). Such reading component skill data could then inform assessment and instruction.

7.2 Standard Instructional Practice and Effective Acceleration/Intervention Efforts

In addition to a concerted effort to describe the development of reading comprehension competencies for adolescent ELLs, the field would benefit from research that continues to investigate standard instructional practices for student improvement. Bridging the gap between standard instructional practice and what our adolescent ELLs need to develop literacy skills that will provide a platform for academic success is particularly important. For example, many of today's instructional recommendations focus on bolstering language and knowledge development among ELLs, pointing to the promise of providing scaffolded learning opportunities via text-based discussions and analytic writing connected to text (see Snow et al. [2009] or Lesaux, Kieffer, et al. [2010] for examples). Conceptually speaking, by anchoring these classroom tasks in text, there are more opportunities to engage with and acquire content and knowledge, which, in turn, promotes language development. That said, such practices are not commonplace, and there is a dearth of empirical research that would inform the specific design and implementation of such practices. At the same time, advancing the existing academic vocabulary intervention research, to include more studies that are large-scale, implemented under typical conditions, and experimental in nature would help to further inform the design of instruction for ELLs. One strand of such research should be in the domain of content-based literacy instruction in the secondary school, focusing expressly on the language of text and addressing issues for math, science, and history teachers at all levels. In addition, we acknowledge the instructional approaches reviewed represent a step in the right direction but likely lack the intensity (e.g., dosage and duration) needed to augment existing outcomes and to fully prepare ELLs for the workplace or for higher education. A more universal, sustained, and classroom--based model from early childhood through adolescence remains a promising but untested approach.

Finally, although we tend to get focused on instructional strategies and curricula for maximum effect, the overall improvement effort needs to attend both to the instruction itself (e.g., programs and curricula) *and* foundational classroom and setting-level processes to augment the learning environment (e.g., quality of student-teacher interactions, quality of talk). Research needs to unpack the answers to a number of setting-level questions that remain before programmatic changes can take hold. For example, what school- and classroom-level conditions need to be in place for sustained improvement? Taking the case of a salient classroom level process, recent research has examined the quality of the classroom language environment via a measure that tracked the type and diversity of vocabulary used by teachers when speaking to students (Gámez & Lesaux, 2012). Indeed, even in the secondary school English language arts classroom, one of several classes a student attends each day, the quality of teachers' speech influences student reading comprehension over the course of an academic year, garnering effect sizes that parallel those from intervention studies (Gámez & Lesaux, 2012). The field would benefit from additional such studies on classroom processes that may be

levers for improvement and, especially, research that would uncover the kinds of teacher training and development that might improve teachers' ability to create the language-rich environment needed to bolster the reading skills of vulnerable populations.

8 Conclusion

The rapid growth of the ELL population, combined with the population's academic indicators, raises multiple questions for the field of education research to address. In this chapter, we described the ELL population and discussed what makes reading challenging for adolescent ELLs and many of their monolingual peers. We also reviewed the existing research to highlight the aspects of instructional initiatives to date that appear promising for fostering academic vocabulary and language development in the secondary school classroom. We focused on this domain because of the ways in which these knowledge-based competencies undergird text comprehension. The research reviewed and discussed provides a starting point to advancing this population's academic outcomes, but, as described, further research is needed to inform the design of effective instruction to support this growing, vulnerable population's reading comprehension skills and competencies.

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Special Education in Middle and High School

Deborah K. Reed and Kristi L. Santi

Abstract This chapter includes three sections addressing historical, current, and emerging issues in teaching reading comprehension to students with disabilities. The first section reviews special education law, statistics, and practices as they relate to middle and school. The second section reviews the information presented in the content area chapters and discusses how the information presented works with students in special education but receiving the majority of their content instruction (80 % or more of the day) in general education settings. The final section presents an overview of effective instructional practices in light of new issues being raised with instructional fidelity and the need to have students more actively engaged in reading diverse texts, including those that are computer-based.

Keywords Reading disabilities • Special education policy • Instructional fidelity • Digital texts

Comprehending text in the content areas is a concern for most adolescents, but it can be particularly challenging for students in special education. Catts, Compton, Tomblin, and Bridges (2012) recently explored individual changes in students' reading ability over grades K-10 and found that the majority of poor readers persistently exhibited difficulty with reading comprehension alone (52 % of those with difficulty) or in combination with word identification (12 % of those with difficulty). Moreover, 42 % of the students in the study who exhibited poor reading skills were not identified as struggling until grade 4 or later. These findings suggest students do not outgrow their reading difficulties as they transition to more complex texts but, rather, students have an ongoing need for specialized instruction. Some

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students' difficulties are more likely to be identified as their school work becomes increasingly dependent upon reading and learning from texts of different genres.

To help provide a better context for the relationship between the aspects of reading comprehension discussed in this book and the needs of students with reading disabilities (RD), we first provide a brief review of the history of special education in policy and legislation. Then, we relate the education of students with RD to the information on reading comprehension presented in other chapters of this volume, particularly those focused on reading within the content areas (i.e., social studies in chapter "Reading History: Moving from Memorizing Facts to Critical Thinking", mathematics in chapter "Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page", science in chapter "Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension", and English language arts in chapter "Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices"). Finally, we turn to the emerging issues in teaching reading to students with learning disabilities (LD).

1 Reading Instruction for Students with Reading Disabilities: Historical Perspective

Currently, there are 55.5 million school-age children in the U.S. (U.S. Census Bureau, 2012), and approximately 6 million are identified for services under the Individuals with Disabilities Education Improvement Act (IDEA; U.S. Department of Education [DOE], 2008). The majority of the students identified for services spend approximately 80 % of the school day in the general education setting (U.S. DOE, 2008). This number does not include the student population served within the umbrella of IDEA, under Response to Intervention (RtI), which allows for up to 15 % of federal funding to be allocated for providing services to students considered at-risk for reading failure but who have not yet been referred to special education.

Initially, it was up to states or local districts to determine whether or not a student with a disability would be allowed to enroll in school. Parents advocated for ways to get their children in the educational system and were successful in securing small gains. For instance, in 1961 President Kennedy created the President's Panel on Mental Retardation[1] (see excerpt of the 1962 report in Appendix A). As a result of the panel's recommendations, legislation was passed in 1963 to provide funding for research and treatment centers focused on intellectual disabilities as well as training for teachers of students with intellectual disabilities. This momentum continued with President Johnson expanding access to public education for students with disabilities through the signing of the Elementary and Secondary Education Act of 1965.

[1]Mental retardation is now referred to as *intellectual disability*.

In the early 1970s, policymakers continued raising awareness of the need to provide students with disabilities *access* to a free appropriate public education (FAPE) in a least restrictive environment (LRE). With the passage of the Education for All Handicapped Children Act of 1975, commonly referred to as Public Law (PL) 94-142, special education became a federally mandated structure for states to follow. For example, the LRE is a provision designed to assure students will be educated, to the maximum extent appropriate, in regular classes (DOE: 20 U. S. C. §1412 (5) (B)). The ability of the students to move through the education system with checks in place to ensure FAPE meant that clear and consistent procedures were instituted across all U.S. public schools and that students and parents were afforded basic protection of their rights through due process.

PL 94-142 outlined the basic framework for identifying and serving students with disabilities. This consisted broadly of three steps schools had to follow: first, identify and document a need for evaluation of the student based on classroom performance (also referred to as the Child Find mandate); second, communicate with the parents about the process and obtain their consent to test the child; and finally, convene a team that included the parents to design an Individualized Education Program (IEP) for the student. In addition, the federal government established guidance for states and local education agencies to assess the efficacy of the efforts to educate students with disabilities and ensure the protections of the law were provided to all students with disabilities. It is important to remember the original focus was to ensure adherence to procedures for identifying students and safeguards for delivering education in a general classroom setting to the extent possible. The law did not specify the appropriate interventions, modifications, or accommodations to be delivered to all students who qualified for services.

Although the basic premise of the original legislation has not changed, subsequent reauthorizations of the law have attempted to incorporate the growing research base on how to best educate students with disabilities in the general education setting. This has shifted the focus from access (i.e., FAPE) to the evidence based practices that constitute a quality education for all students. The first such movement in this direction occurred with the 1990 reauthorization of the law under PL 101-476, which included a change in the name to Individuals with Disabilities Education Act. More substantive changes included the expansion of services (e.g., more types of disabilities were covered), sanctioning of person-first language (e.g., *student with a disability* instead of *disabled student*), and provisions to hold states accountable for providing the necessary services (e.g., more emphasis was placed on educating students in the same class with their peers who did not have a disability). Additional amendments to the law, such as those passed in 1997, changed various aspects, including further expanding the disability categories and related services, changing IEP guidelines (e.g., requiring the inclusion of a general education teacher on the team), requiring annual evaluation and reevaluation of students, and increasing the emphasis on performance goals and accountability.

Although the improvements made over the nearly 30 years of federal involvement in the education of students with disabilities were by no means trivial, the reauthorization of IDEA in 2004 is the focus of the remaining special education

overview due to the nature of the changes entered into the law. For example, the current law, PL 108-446, no longer requires that a student be administered an IQ test for placement. The use of an RtI framework allows schools to serve more students who are truly in need of additional interventions in a more timely manner. This includes authorizing the use of some federal funds (up to 15 %) to provide preventative instruction to students who are exhibiting risk of educational difficulties but who are not yet identified for special education.

Text Box 1

A Guide to the Individualized Education Program:

The Regular Education Teacher as Part of the IEP Team (p. 8)

Appendix A of the federal regulations for Part B of IDEA answers many questions about the IEP. Question 24 addresses the role of the regular education teacher on the IEP team. Here's an excerpt from the answer:

"... while a regular education teacher must be a member of the IEP team if the child is, or may be, participating in the regular education environment, the teacher need not (depending upon the child's needs and the purpose of the specific IEP team meeting) be required to participate in all decisions made as part of the meeting or to be present throughout the entire meeting or attend every meeting. For example, the regular education teacher who is a member of the IEP team must participate in discussions and decisions about how to modify the general curriculum in the regular classroom to ensure the child's involvement and progress in the general curriculum and participation in the regular education environment.

Depending upon the specific circumstances, however, it may not be necessary for the regular education teacher to participate in discussions and decisions regarding, for example, the physical therapy needs of the child, if the teacher is not responsible for implementing that portion of the child's IEP.

In determining the extent of the regular education teacher's participation at IEP meetings, public agencies and parents should discuss and try to reach agreement on whether the child's regular education teacher that is a member of the IEP team should be present at a particular IEP meeting and, if so, for what period of time. The extent to which it would be appropriate for the regular education teacher member of the IEP team to participate in IEP meetings must be decided on a case-by-case basis."

Source:

Office of Special Education and Rehabilitative Services. (2000). *A guide to the individualized education program*. Washington, DC: U.S. Department of Education. Retrieved from: http://www2.ed.gov/parents/needs/speced/iepguide/index.html?exp=3

There were two distinct educational events that occurred between the time of the 1990 reauthorization and the 2004 reauthorization that impacted the way in which the 2004 legislation was written. The first was the No Child Left Behind (NCLB) Act of 2001 (PL 107-110), designed to build on the existing framework of the Elementary and Secondary Education Act. The guiding principles of the legislation included a stronger accountability system, greater flexibility for states and school districts in the use of federal funds, standards for highly qualified teachers, more school options for families with disadvantaged backgrounds, and a greater emphasis on using instructional strategies that had proven efficacy. Although not specifically targeting special education, there were links between the content of that legislation and the reauthorization of IDEA. In particular, the two acts included requirements for placing teachers with the proper training and certificates in classrooms serving students with disabilities and for implementing evidence based instructional strategies to teach students experiencing difficulties.

In 2002, the President's Commission on Excellence in Special Education (U.S. DOE, 2002) released a report of the specific concerns and comments elicited in public meetings with all parties involved in the education of students with disabilities. The commission made three major recommendations in this report that have a direct link to some of the changes eventually included in the 2004 reauthorization of IDEA. The first recommendation was to change the focus of special education policy from the process of identification and placement to the results of the educational services delivered. The second recommendation was to restructure service delivery models to allow for preventative instruction rather than waiting for the student to fail and, thus, demonstrate a discrepancy between his or her ability and level of achievement before offering supplemental support. The commission's final recommendation was to adopt the perspective that all students belonged to general education first, so all educators shared in the responsibility of the overall quality of education provided. These three recommendations collectively encourage improving education for students regardless of special education designation—or lack thereof.

NCLB, the Report of the President's Commission on Excellence in Special Education, and other supporting data about the gap in educational outcomes between students who were and were not identified with a disability were taken into account when crafting the Individuals with Disabilities Education Improvement Act of 2004 (P.L. 108-446). Despite the slight name change, the law is still commonly referred to as IDEA. The most substantive changes introduced by the reauthorized IDEA concerned the identification process and the provision of preventative services for children not yet identified with a disability. Up to this point, a discrepancy model was used to determine whether students qualified for special education. Typically, students in grade three who were behind in academic performance relative to perceived ability were referred for IQ and achievement testing. Only those students who met a threshold score on an IQ test and demonstrated about a 30-point (or a two standard deviation) difference between IQ and academic achievement test scores were considered to have LD.

This was problematic for several reasons. Several students experienced failure starting in kindergarten, yet were not identified for services until grade three. The delay in identification was mainly provided to allow students time to develop the skills, but also due to the difficulty in measuring very young students' academic skills. We have considerable research demonstrating that early intervention is better. Students who are poor readers at the end of first grade almost never reach an average reading level by the end of elementary (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Juel, 1988; Torgesen & Burgess, 1998). Because reading ability is the basis for all later academic skills, waiting to intervene has serious consequences for students' school success and educational attainment. We also know that, aside from the artificial IQ and achievement cutoff scores, researchers could not find significant differences in students identified with an LD versus those students identified as at-risk or just low achieving (Francis et al., 1996). Therefore, what became known as the *wait-to-fail model* (Fletcher & Vaughn, 2009) hindered the ability of students to catch up to their peers academically.

Text Box 2
Definitions of Specific Learning Disability

While Specific Learning Disability (SLD) is the official name found in the IDEA (U.S. DOE, 2008) legislation and in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5: American Psychiatric Publishing, 2013), the more common reference is simply Learning Disability (LD). The definitions used in federal legislation and in DSM-5 are relatively similar in that SLD is the identification of a persistent impairment in the processing of language (which includes reading, writing, spelling, and math) that are not accounted for due to other conditions.

Nuances:

- Dyslexia is accounted for under the SLD classification in both definitions although a few states have made a decision to make dyslexia a separate category for identification, service, and funding purposes.
- Exclusions are similar with two notable differences.
  - The DSM-5 excludes academic instructional inadequacies.
  - IDEA excludes disadvantages related to environmental, cultural, and economic status.

To offer an alternative to the discrepancy model, the 2004 reauthorization of IDEA also addressed instruction that could be provided to students experiencing reading or other academic difficulties. Hence, the legislation sanctioned RtI as a comprehensive system for delivering a quality education to all students within the general education framework. RtI is not a curriculum or a legal requirement,

but it does provide a clear path for teachers working with students to close the learning gap. There are four distinguishing characteristics of the RtI framework: (a) high quality research based instruction delivered in the general education framework, (b) continuous monitoring of student progress, (c) the use of a screener to identify students potentially at risk for academic or behavioral difficulties, and (d) multiple tiers of progressively more intensive instruction (Memorandum, 2010). Federal legislation does not prescribe any one way to implement RtI; however, the description is of a multi-level instructional framework that is implemented school-wide to address the learning and behavioral needs of all students.

We present the legislation and its component provisions with the intent of helping those in both general education and special education move from considering their systems as separate to a blended approach for working with all students. It is in this vein that we think readers from the two disciplines should consider the chapters presented in this book. The use of an RtI framework and school-wide implementation of evidence based instructional strategies at multiple tiers of intensity are still in the process of being fully implemented in school systems as well as fully included in university teacher training programs. For example, general education teachers responding to a survey on the RtI model tended to self-report their lowest level of knowledge as related to utilizing assessment data and providing services for the differentiated instruction of students in special education (Spear-Swerling & Cheesman, 2012). Notably, less than one-third of the 142 respondents in the study had experience working within an RtI framework. Other survey results suggest that select individuals (e.g., administrators, reading specialists, and RtI coordinators) in the lower elementary grades had higher levels of knowledge about RtI, but the details of how schools were implementing the model varied widely across sites (Jenkins, Schiller, Blackorby, Thayer, & Tilly, 2013).

Ongoing research may help to inform the next reauthorization of IDEA as well as the state and local policies aimed at integrating general and special education. These fields of inquiry encompass not only the particular areas of difficulty experienced by and the effective practices designed for students with RD, but increasingly the research on the nature of reading comprehension also is concerned with what facilitates or hinders content learning among all adolescents in general education classes—regardless of disability status. In the next section, we highlight those issues as raised in the other chapters of this book.

2 Reading Instruction for Students with Reading Disabilities: Current Issues

More rigorous standards for students' college and career readiness (e.g., National Governor's Association Center for Best Practices [NGA], Council of Chief State School Officers [CSSO], 2010) are intended to be aligned to state and national accountability assessments, including measures designed to assess students' reading

comprehension performance (see chapter "Improving Comprehension Assessment for Middle and High School Students: Challenges and Opportunities" for a thorough discussion of next generation reading comprehension assessments). The standards elevate the need to consider the literacy demands of the content areas and the educational practices that can be implemented to support the academic success of students with LD or, more specifically, RD. In chapter "Reading History: Moving from Memorizing Facts to Critical Thinking", Massey provides an overview of literacy instruction designed to support reading in the content areas as it has evolved from a basis in ubiquitous, general learning strategies to a closer examination of what it means (and takes) to be a competent reader and user of discipline-specific texts. This is an important context for approaching the content-focused chapters "(Reading History: Moving from Memorizing Facts to Critical Thinking, Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page, Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension and Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices)" and understanding the challenges associated with teaching students who may have significant deficits in foundational reading skills (i.e., those with RD) in addition to a novice understanding of the content about which they are reading.

For example, older students who struggle with reading may have a difficult time achieving even a literal understanding of informational texts (Conlon & Sanders, 2011), but Brasseur-Hock, Deshler, & Hock explain in chapter "Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices" that this level of skill is only a precursor or first step to accomplishing *close reading*—defined as deriving meaning through recursive interactions with the text and an integration of new and prior knowledge. Because close reading is integral to college and career readiness standards (NGA & CSSO, 2010), Brasseur-Hock and colleagues offer effective practices for fostering this more advanced literacy skill in English language arts (ELA) classes. The authors also note that such instruction in the general education ELA classroom will be insufficient for ensuring successful outcomes for students who have significant reading difficulties, so they also review supplemental and school-wide programs designed to provide multiple tiers of instructional support as in an RtI framework.

In chapter "Reading History: Moving from Memorizing Facts to Critical Thinking", Massey also suggests a form of close reading that involves multi-phasic or recursive processes of understanding and integrating historical texts. In the history discipline, Massey explains the concern is with teaching students to compare information across sources and contexts. This has proven to be a difficult skill for students and one that influences their comprehension (Kim & Millis, 2006). Given that Massey's review of the extant literature indicates historical reading and inquiry skills take time and specialized instruction for adolescents to develop, we might expect students with RD to experience even greater difficulty achieving proficiency in this type of literacy than their peers without disabilities.

The chapters on reading in ELA and in history both recommend having students summarize segments of text as one facet of scaffolding the close reading of discipline-specific texts. However, León and Escudero discuss in chapter "Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension" how summaries are not all equivalent. Rather, they have different structures that reflect different levels of understanding and require different strategies to construct. Findings from a meta-analysis of research conducted with adolescents who have RD indicated that teaching students to summarize text had strong effects on students' reading comprehension (Kim, Linan-Thompson, & Misquitta, 2012). Given the greater complexity of science texts as compared to narratives, León and Escudero suggest student-generated summaries may be particularly relevant to meaningful learning in science.

Moving beyond a narrow use of text for passively obtaining information to more actively building conceptual knowledge is also advocated by Avalos, Bengochea, and Secada in chapter "Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page". These authors argue that the typical emphasis of teaching with math textbooks is to find answers or solve problems, but to help students develop mathematical reasoning, teachers should focus more attention on how to understand mathematical language structures and how to use embedded examples for improving problem solving processes. Students with LD have demonstrated difficulties with mathematical problem solving, and those with both a math and a reading disability have the lowest responsiveness to problem solving interventions (Fuchs, Fuchs, & Prentice, 2004). Therefore, the instructional implications of Avalos and colleagues' findings have relevancy to the approaches general education and intervention math teachers implement.

In fact, what is common across the four chapters on reading comprehension in the core content areas is the critical role middle and high school teachers play in the successful implementation of literacy strategies for deeply processing discipline-specific texts and building conceptual knowledge. We echo this theme throughout the next section in which we consider other emerging areas of research and practice related to the reading comprehension of students with RD.

3 Reading Instruction for Students with Reading Disabilities: Future Directions

There is a consensus that the reading abilities of middle and high school students, in general, have been insufficient to support learning from complex texts (ACT, 2006) and have remained relatively unchanged over time (National Center for Education Statistics, 2013) while the level of rigor in reading material to which adolescents are exposed in their K-12 education has steadily declined over the years (Adams, 2009; Williamson, 2008). Students with RD demonstrate particularly weak

performance that is increasingly disparate from the reading achievement of their typically developing peers (Vaughn et al., 2012). Compounding the challenges this presents classroom teachers are findings that adolescents with RD demonstrate great heterogeneity in their strengths and weaknesses in component reading skills such as word identification, fluency, vocabulary, and comprehension (Brasseur-Hock, Hock, Kieffer, Biancarosa, & Deshler, 2011; Cirino et al., 2013). Furthermore, some students who struggle with reading are twice exceptional, or gifted and talented but possessing a learning disability. These students may have unique needs for goal setting and motivation (McCoach & Siegle, 2003) or impulsivity control (Gunter & Kenny, 2012).

What can general education teachers in middle and high schools do to support such a diverse group of students in reading and learning from content area texts? Although the overall depth and breadth of research on reading instruction and intervention conducted with adolescents is far less than that with elementary students, the knowledge base has been growing in recent years and now supports syntheses of the literature capable of indicating effective and promising practices for students who struggle with reading, including those with RD (e.g., Flynn, Zheng, & Lee, 2012; Solis et al., 2012). Common recommendations are to:

- Explicitly teach key vocabulary utilized in content area texts (Fang, 2006),
- Supplement students' background knowledge about relevant concepts upon which the new readings are intended to build (Vaughn et al., 2009),
- Provide instruction in making inferences about the relationship among ideas in the text (Englert et al., 2009; Meyer et al., 2010), and
- Improve students' metacognitive strategies by having them generate or answer questions while reading as well as monitor their comprehension by paraphrasing or summarizing (Berkeley, Mastropieri, & Scruggs, 2011; Thiede, Anderson, & Therriault, 2003).

Available literature outlines the effective approaches to teaching literacy to adolescents with RD (e.g., Flynn et al., 2012; Kamil et al., 2008; Wanzek et al., 2013), but less has been compiled about more nuanced or novel features of the instructional design that may contribute to students' comprehension of content area texts. In the sections that follow, we highlight emerging areas of research with the potential for improving outcomes in the future.

3.1 Elements of Effective Instructional Delivery

Reading comprehension instruction for middle and high school students can occur in two different settings: (a) general education content area classes such as English language arts, math, science, social studies and (b) supplemental reading intervention classes delivered as an elective for any student experiencing difficulties or as a self-contained course only for students in special education. With respect to the supplemental class setting, it is less likely that high school teachers will have

specialized preparation in delivering intensive reading intervention as compared to middle school teachers (Cantrell, Almasi, Carter, & Rintamaa, 2013). A lack of thorough preparation and ongoing support can lead secondary teachers to have less confidence in their abilities to address students' needs (Reed, 2009). When occurring without strong fidelity of implementing intervention program components, teachers' low self-efficacy has been associated with lower student outcomes in reading comprehension (Cantrell et al., 2013). Interestingly, Cantrell and colleagues (2013) found improved student outcomes were associated with teachers who had high self-efficacy but low treatment integrity, meaning they implemented the intervention program for only 53 % of the instructional time on average.

It has often been reported that adolescents who experience literacy instruction with higher fidelity to the intended program demonstrate greater reading growth than those who experience instruction of lower fidelity (e.g., Benner, Nelson, Stage, & Ralston, 2011; Levin, Catlin, & Elson, 2010). Therefore, it is worth considering what degree of improvisation might be allowable when reading comprehension interventions are being implemented by teachers receiving high quality professional development. To adapt instruction based on continuously gathered student data (as recommended in RtI or multi-tiered models) may require less rigid adherence to programmatic features. Nevertheless, there likely are limits to the nature of the adaptations that can be made. Omitting particular features of literacy instruction (Cuevas, Russell, & Irving, 2012) or reorganizing the delivery of lesson content (Calhoon & Petscher, 2013) have been linked to differences in student outcomes.

A similar balance between adherence and improvisation might need to be struck for literacy instruction occurring in general education, content area classrooms. For example, integrating vocabulary and comprehension strategies with peer collaboration and discussion activities has led to improved student outcomes in reading as well as content learning (McCallum et al., 2011; Morocco, Hindin, Mata-Aguilar, & Clark-Chiarelli, 2001; Wexler, Reed, Pyle, Mitchell, & Barton, 2013). However, using peer-mediated activities as a replacement for having students actively read text for themselves has not proven effective (Cuevas et al., 2012). Even when paired with effective vocabulary and comprehension practices, teacher read-alouds of text do not result in improvements over having students independently read informational text (Reed, Swanson, Petscher, & Vaughn, 2013). There seems to be little substitute for the very powerful act of actively reading high quality texts (Lawrence, 2009).

3.2 Computer-Based Texts

The vast majority of studies conducted with middle and high school students have examined reading of printed text in a linear fashion—that is, reading the text from start to finish and following the order in which the information is presented from sentence to sentence and page to page. However, adolescents today are far more likely to engage in reading Online than in traditional print (Lawrence, 2009;

Nippold, Duthie, & Larsen, 2005). Reading Online is often nonlinear in that students can link to related content and determine in what sequence they access information (Pazzaglia, Toso, & Cacciamani, 2008). Some believe this places an added cognitive load on the reader (DeStafano & LeFevre, 2007) or requires new kinds of skills for reasoning and self-regulating as hypertext information is processed and the navigational path tracked (Calisir, Eryazici, & Lehto, 2008; Coiro & Dobler, 2007). Although more pressure might be placed on the reader's prior knowledge of Internet searching and electronic sources of information (Zhang & Duke, 2008), the nature of hyperlinked text also may have the benefit of offsetting any deficiencies in prior knowledge about the topic or content being read Online (Calisir & Gurel, 2003). Studies of undergraduates (Willoughby, Anderson, Wood, Mueller, & Ross, 2009) and middle school students (Coiro, 2011) revealed that ability to conduct electronic searches and navigate websites was associated with successful information retrieval and reading comprehension, despite having lower levels of prior content knowledge.

Srivastava and Gray (2012) speculated these types of Internet skills might alleviate the cognitive load of Online reading among middle school students as compared to linear paper-based reading, thus allowing more of their cognitive resources to be devoted to comprehending the material. Instead of relying on teachers to supplement their prior knowledge, students might be able to build the requisite foundational knowledge for themselves in nonlinear reading. This presents a new challenge to research on reading comprehension for students with RD because the typical avenues of support investigated, such as pre-teaching background knowledge of the topic or content and sequentially processing information, might not be the kinds of skills needed to successfully understand when reading hyperlinked text (Leu et al., 2007). This could impact what it means to be a successful reader and in what areas we attempt to intervene as textbooks are moved into electronic, hyperlinked delivery systems.

Very little research has been done to determine the impact of these changes in text format on the performance of students with RD. In neither linear nor nonlinear text did eighth graders with language and learning disabilities in the Srivastava and Gray (2012) study demonstrate comparable comprehension to the students without disabilities. This might have been related to the students with disabilities choosing not to access all the hyperlinked webpages and not devoting additional time to answering the questions. In other words, the study participants displayed very common characteristics of students with RD who do not monitor their comprehension or use available resources to fix-up any breakdowns in understanding (Short, Schatschneider, & Friebert, 1992). Having the resources available Online did not guarantee students would bring them to bear on the academic task. Rather, the students with disabilities still were not strategic readers. Moreover, simply using the Internet for independent reading activities, such as emailing and web surfing, has not been shown to improve students' vocabulary knowledge in the same ways that reading traditional narrative and expository texts have (Lawrence, 2009). It should be noted that for students in the Lawrence (2009) study with less well developed vocabularies,

independent reading of traditional texts also was not profitable because the students lacked the requisite knowledge to learn new, unfamiliar words in the linear context.

Hence, there remains a need for a skilled teacher who can appropriately structure learning activities both off- and On-line in linear and nonlinear texts. Electronic media need not be hyperlinked in order to be supportive. Locally created and relatively simple electronic slideshows can be used to embed recommended literacy supports within sequentially presented text. The computer then fulfills the role of the teacher by presenting advanced organizers before reading, prompting students to stop and paraphrase information in writing while reading, providing the meanings of new words in the text, and posing comprehension questions after reading. More sophisticated designs also might incorporate comprehension questions with a structure that parallels those included on electronic reading comprehension measures developed to align with college and career readiness standards (see chapter "Improving Comprehension Assessment for Middle and High School Students: Challenges and Opportunities" of this book). High school students who read computer-delivered text with the types of electronic literacy enhancements described above demonstrated statistically significantly better comprehension on a standardized measure, as well as better outcomes on text-specific assignments, than students who were taught the content in a traditional format (Cuevas et al., 2012).

The computer delivery method might have an advantage over traditional teacher delivery of embedded literacy instruction in that it can be self-paced, but this has not yet been empirically tested as an accommodation within general education for students with RD. Available research indicates that nonlinear or interactive Online reading can engender interest and improve comprehension among students with a threshold level of Internet and conceptual knowledge (Scheiter & Gerjets, 2007), but whether this would apply to linear electronic texts and the comprehension of students with RD requires additional research. In addition, it is not known whether classroom teachers will perceive the electronic slideshows as a feasible means of differentiating instruction in content area courses. Previous studies have found teachers are more likely to implement accommodations in general education classes if those instructional adaptations do not require much extra time, preparation, assistance, or changes to the teachers' typical practices (Mastropieri & Scruggs, 2001; Scott, Vitale, & Masten, 1998). Arguably, well-constructed electronic delivery formats will require an investment of human and capital resources in the initial stages and for ongoing updates or refinements.

4 Conclusion

Reviewing the history of educational policy for individuals with disabilities provides a context for understanding how general education teachers have gradually taken more responsibility for providing instruction to students with LD/RD. That is, special education has evolved from a separate or exclusionary model to one that

is now fully integrated with the general education setting. The push to educate all students—regardless of official labels—has granted general education teachers more access to multiple resources for delivering appropriate instruction to both prevent and remediate students' difficulties. However, this has also placed more responsibility on middle and high educators who likely have more training in teaching a particular content area than in providing reading instruction to heterogeneous groups.

Students with RD often have difficulty understanding simple texts or comprehending at more than a surface level. Yet, their success in secondary schools and beyond rests in meeting renewed expectations for reading and utilizing complex texts in their classes. This requires flexibly adapting to the unique reading demands of different disciplines (see chapters "Reading History: Moving from Memorizing Facts to Critical Thinking, Reading Mathematics: More than Words and Clauses; More than Numbers and Symbols on a Page, Understanding Causality in Science Discourse for Middle and High School Students. Summary Task as a Strategy for Improving Comprehension and Reading Comprehension Instruction for Middle and High School Students in English Language Arts: Research and Evidence-Based Practices)" and text forms, including those incorporating technology (i.e., electronic texts with active links to vocabulary and other related content). Teachers need to take all these factors into consideration when planning instruction for adolescents with RD as these students often need more explicit strategy instruction, extra time to process the information, and alternative ways to demonstrate their learning.

These are pedagogical skills that take time and high quality professional development to acquire (Kosanovich, Reed, & Miller, 2010). As an initial step, middle and high school teachers accustomed to a traditional lecture style need to start more actively involving students in their learning. This will help break the habits of passivity that often characterize students with LD (Newman, 2006). The more facile teachers become at incorporating a variety of instructional strategies, the more likely they will be successful in assisting students with disabilities at making appropriate academic gains throughout the school year.

Appendix A

Excerpt from the transcript of the President's Panel on Mental Retardation (pp. 1–3)

Introduction

The mentally retarded are children and adults who, as a result of inadequately developed intelligence, are significantly impaired in their ability to learn and to adapt to the demands of society. An estimated 3 % of the population, or 5.4 million

children and adults in the United States are afflicted, some severely, most only mildly. Assuming this rate of prevalence, an estimated 126,000 babies born each year will be regarded as mentally retarded at some time in their lives.

Significance of the Problem

Mental retardation ranks as a major national health, social, and economic problem:

- It afflicts twice as many individuals as blindness, polio, cerebral palsy, and rheumatic heart disease, combined; only 4 significant disabling conditions—mental illness, cardiac disease, arthritis, and cancer—have a higher prevalence, but they tend to come late in life while mental retardation comes early.
- About 400,000 of the persons affected are so retarded that they require constant care or supervision, or are severely limited in their ability to care for themselves and to engage in productive work; the remaining 5 million are individuals with mild disabilities.
- Over 200,000 adults and children, largely from the severely and profound mental retarded groups, are cared for in residential institutions, mostly at public expense. States and localities spend $300 million a year in capital and operating expenses for their care. In addition they spend perhaps $250 million for special education, welfare, rehabilitation, and other benefits and services for retarded individuals outside of public institutions. In the current fiscal year, the Federal Government will obligate an estimated $178 million for the mentally retarded, about four-fifths for income maintenance payments and the rest for research, training and for special services. Federal funds for this group have increased by about 75 % in 5 years.
- The Nation is denied several billion dollars of economic output because of the under-achievement, under-production and/or the complete incapability of the mentally retarded.
- The untold human anguish and loss of happiness and well being which results from mental l retardation blights the families in the United States. An estimated 15–20 million people live in families in which there is a mentally retarded individual. Economic costs cannot compare with the misery and frustration and realization that one's child will be incapable of living a normal life or fully contributing to the well being of himself and to society in later life.

Source:

President's Panel on Mental Retardation. (1962). *A proposed program for national action to combat mental retardation*. Washington, DC: U.S. Government Printing Office. Retrieved from: http://www.archives.gov/research/americans-with-disabilities/transcriptions/naid-6050329-report-to-the-president-a-proposed-program-for-national-action-to-combat-mental-retardation.html

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