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The Nature and Development of Reading for Understanding

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EXECUTIVE SUMMARY

In 2002, the RAND Reading Study Group (RRSG) described the state of our knowledge about reading comprehension and outlined a research program designed to support the improvement of reading comprehension in children. In the context of the report, *Reading for Understanding*, the RRSG called for "high-quality," "long-term and cumulative" research to inform policies and programs to address the underperformance of U.S. students in reading and the persistent gaps in reading performance among

students in different demographic groups. The RAND report informed the development of the Reading for Understanding (RfU) research initiative from the U.S. Department of Education's Institute of Education Sciences. A competitive process was used to select six teams, described in Chapter 1, to participate in the initiative and collectively address three dimensions of reading comprehension: underlying, malleable processes, interventions, and assessments. Over the past 8 years since the grants were awarded, the RfU researchers have produced hundreds of publications describing the results of their efforts. This chapter is part of the effort to synthesize this vast body of research, articulating key findings and implications for research and practice moving forward.

Several of the RfU teams made a better understanding of the nature and development of reading comprehension a central goal of their work. This chapter summarizes the work of the RfU teams as it relates to these issues. Collectively, the research teams examined language skills, cognitive skills, social skills, and forms of knowledge that may relate to reading comprehension, guided by the Simple View of Reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990) and cognitive models of reading comprehension, including the Construction-Integration Model (Kintsch, 1988; Perfetti, 1999). These examinations extend our collective understanding about comprehension through improvements in research designs. They extend previous research, also, by attending to an array of linguistic, cognitive, and dispositional characteristics that have been shown to influence comprehension in past research, but are not yet entirely understood.

This research offers a set of insights that both support our collective understandings about the processes that underlie the development of reading comprehension and can serve as the basis for design research on instruction and assessment. Key findings from this work include the following:

- **The array of skills and knowledge that support reading comprehension and their relative importance shift as students move through school.** The RfU research has documented the contributions of a broad set of skills and knowledge that influence concurrent reading comprehension and comprehension development from the earliest years of schooling. In doing so, this research both confirms the significance of letter- and word-level skills in the development of comprehension and represents successful reading comprehension as dependent on the coordination of an array of different kinds of skills and knowledge. Among preschool and elementary students, these "other" phenomena include linguistic, cognitive, and behavioral skills. Among adolescent readers, these include background knowledge, vocabulary knowledge, strategy use, and inference making—and may include discipline-specific reading and reasoning skills and epistemological perspectives.
- **Language skills underlie successful listening and reading comprehension.** The RfU research offers evidence about the significance of early language skills, including those related to orthography, phonology, morphosyntax, and vocabulary, as concurrent and longitudinal predictors of listening and reading comprehension. This research suggests that children who struggle with listening comprehension and reading comprehension in the elementary grades may have had underlying difficulties with components of language early in school. However, the findings of this research also offer the caution that language may be best conceptualized as a single skill or closely interrelated cluster of skills in young children, calling into

question assessments and instructional approaches that target discrete language skills. The RfU studies also document the role of academic language skills and other complex skills, such as reasoning and inferencing, in sophisticated forms of reading comprehension in adolescence.

- **Many cognitive skills play a role in listening and reading comprehension, but some are more pivotal than others.** The RfU studies suggest that listening and reading comprehension are associated with and may depend on an array of cognitive skills, such as the ability to activate information relevant to the situation described in a text, to suppress irrelevant information (*inhibitory control*), to evaluate one's own ongoing understanding during reading (*comprehension monitoring*), to form connections within a text and between textual information and prior knowledge (*inferencing*), and to remember and follow sets of directions (an aspect of *self-regulation*). The RfU research offers insight into both the significance and the nature of the relationship between cognitive skills and comprehension, documenting, for example, that some cognitive skills seem to make more substantial contributions to comprehension than others. Skills related to attentional control including inhibitory control and self-regulation make small but significant contributions to comprehension. Other skills, such as comprehension monitoring and inferencing, seem to make more substantial contributions to comprehension and to distinguish stronger and weaker comprehension. The latter may prove more fruitful as the basis of intervention and assessment research.
- **Word and world knowledge enable successful reading comprehension.** The RfU studies bolster substantial prior research demonstrating the significance of word and world knowledge in listening and reading comprehension, particularly as students move into adolescence. The studies also extend our understanding by shedding new light on the nature of the relationship between knowledge and comprehension, suggesting, for example, that word and world knowledge support comprehension, at least in part, by aiding readers' inferencing and monitoring. In spite of these advances, the connections among word and world knowledge, cognitive processes, and comprehension are not yet entirely understood and merit further research.

By looking at a broad and complex array of skills and knowledge, the RfU research has contributed to understanding about the nature of reading comprehension and consequential weaknesses in reading development with sufficient clarity to inform the design of interventions and diagnostic assessments. However, there are key limitations to this research. First, the RfU developmental research largely focuses on reader skills (both cognitive and linguistic) and knowledge as explanations for reading comprehension. Few of the studies consider other contributors to comprehension, including textual and contextual factors. Second, although a number of the RfU studies include large numbers of students, some of the samples do not reflect the racial, linguistic, or economic diversity that characterizes the U.S. school population. Third, the studies have collectively identified statistically reliable correlates and predictors of comprehension. However, like most developmental studies, they do not consistently provide clarity about the relative importance of each element or consider each element in light of the potential for malleability (responsiveness to instruction).

INTRODUCTION

The development of proficiency in reading comprehension is an important milestone for children in part because it underlies success in many other academic, personal, and, later, professional endeavors. The significance of proficient reading comprehension and the fact that it still eludes many students makes it a worthy subject for careful examination. Several of the RfU teams focused on the nature and development of reading comprehension. This chapter is an attempt to answer the question, "What did we learn from the RfU research about the nature and development of comprehension?" We address this question by reviewing a set of papers nominated by the research teams as those that offer insights into the development of comprehension.

Collectively, these teams examined the "usual suspects" involved in reading development, especially the word recognition and listening comprehension that comprise the SVR's depiction of reading comprehension (Gough & Tunmer, 1986), in an effort to better understand the structure and impact of those dimensions. In addition, the teams examined language skills, cognitive skills, social skills, and forms of knowledge that may relate to reading comprehension, guided by cognitive models of reading comprehension, including the Construction-Integration Model (Kintsch, 1988).

This work sheds light on questions about the concurrent correlates of reading comprehension at different stages of reading development, early predictors of later reading comprehension, and the characteristics that distinguish more and less successful comprehenders.

It is well understood that children who master foundational skills and knowledge of reading, including letter-sound knowledge, phonological awareness, and word reading, are more likely to become successful comprehenders. However, skill at the letter and word levels does not ensure students will become strong comprehenders of text (Connor et al., 2015). Successful reading comprehension ultimately requires the coordination of an array of different kinds of skills and knowledge. The RfU teams largely focused on potential explanations for good and poor comprehension beyond letters and words, including the linguistic, cognitive, and dispositional characteristics, which have been shown to influence comprehension in past research but are not yet entirely understood. By looking at a more replete and complex array of skills and knowledge, the teams have helped us to better understand consequential weaknesses in reading achievement at different developmental stages with sufficient clarity to inform the design of interventions and diagnostic assessments.

The teams brought a high level of methodological precision and power to the study of comprehension development with studies involving large samples of students across grades and geographic regions, sometimes employing longitudinal designs, using comprehensive sets of measures for target constructs, and leveraging advanced statistical techniques in the analysis (e.g., Francis, Kulesz, & Benoit, 2018; LARRC, 2015b; Murphy, LARRC, & Farquharson, 2016). In several cases, these advances provided a means to resolve past controversies and to explain more variance in comprehension than previous studies.

The RfU studies discussed in this report can best be characterized as "basic" research designed to refine existing models of comprehension and inform the development of instructional interventions and assessments. The development of diagnostic assessments and effective interventions for students with comprehension difficulties

depends on such knowledge. Nevertheless, where possible, implications for practice—assessment and instruction—as well as future research, are discussed.

This chapter is organized by major insights related to the following themes:

- Models of reading comprehension and the adequacy of the SVR as an explanation for reading comprehension;
- The structure of language and its relationship to reading comprehension;
- Cognitive skills and dispositions in relation to reading; and
- Text characteristics, genre knowledge, and reading comprehension.

MODELS OF READING COMPREHENSION AND THE ADEQUACY OF THE SIMPLE VIEW OF READING AS AN EXPLANATION FOR READING COMPREHENSION

Several RfU studies examined the validity of theoretical models of comprehension, especially the SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990), which posits that reading comprehension is the product of decoding, or word recognition, and listening comprehension. Together, these studies largely validate the SVR's conceptualization of early reading, but they also offer insights into challenges of using the SVR to guide instruction and assessment. Furthermore, the RfU research documents important limitations of the SVR model for understanding reading beyond the early grades, offering theoretical and empirical support for alternative models of comprehension in adolescence.

The Language and Reading Research Consortium (LARRC) (2015a) examined the SVR model in grades 1–3, bringing improved approaches of measurement and data analysis to the question of the validity of the SVR. In particular, the researchers used multiple measures for each construct (word recognition, listening comprehension, and reading comprehension) and used structural equation modeling to examine the overall adequacy of the model and shifts in the relative contributions of word recognition and listening comprehension to reading comprehension across the grades. LARRC found, in line with previous research, that the SVR provides a good estimate of reading comprehension in these grades. LARRC also extends understanding of the model by documenting a shift as early as grade 2 from word recognition to listening comprehension as the leading predictor of reading comprehension. With respect to the word recognition component of the SVR, LARRC found that the role of word-reading *accuracy* (i.e., ability to accurately read words) declines after grade 1, but the role of word-reading *fluency* (i.e., speed of accurate word reading) becomes significant at grade 3. This suggests that fluency may become a better indicator of word recognition as students develop greater accuracy in their word recognition.

LARRC and Chiu (2018) similarly examined the utility of the SVR for understanding grade 3 reading comprehension and pre-kindergarten (pre-K) predictors of comprehension in grade 3. As in LARRC (2015a), the SVR constructs were found to account for a large proportion of the variance in reading comprehension at grade 3 (about 94 percent). In addition, the longitudinal analysis confirmed that oral language and code-related skills in pre-K explained substantial variance in grade 3 reading comprehension. In the longitudinal analysis, a developmental pathway emerged in

which preschool oral language strongly predicted later reading comprehension through listening comprehension.

Lonigan, Burgess, and Schatschneider (2018), of the Florida Center for Reading Research (FCRR) team, examined the validity of the SVR in grades 3–5. As in the studies of younger students, decoding and language factors (vocabulary and syntax) accounted for approximately 90 percent of the variance in reading comprehension. Across the grade levels, decoding and language skills shared substantial variance, and language accounted for a larger proportion of unique variance (24 to 33 percent) than did decoding (10 percent). In addition, decoding explained less variance with older students than younger students, echoing a pattern similar to that found by LARRC (2015a). In addition, vocabulary was a stronger predictor of comprehension for students with higher levels of comprehension skill.

While the overall influence of decoding on comprehension attenuates over time, decoding remains an important factor for students whose word-level skills are underdeveloped. In a study of students in grades 5–12, the Educational Testing Service (ETS) RfU team (Wang, Sabatini, O'Reilly, & Weeks, 2019) identified a threshold of decoding skill below which the decoding and comprehension were only weakly correlated, and they found that grades 5 and 8 students who fell below this threshold made little progress in reading comprehension over 3 years. Among students who performed above the decoding threshold, comprehension accelerated across the grades. For students who struggle with decoding, progress in reading comprehension may depend on interventions that help them reach the decoding threshold.

Taken together, these studies both validate the SVR and suggest a pattern in which language skills become more influential for comprehension once decoding skills are more developed. This suggests the importance of helping students consolidate their word-level skills early in school and providing simultaneous support for oral language as they do.

Although studies conducted by the RfU teams validate the SVR, they also illuminate challenges in using the SVR as a framework for understanding reading comprehension and diagnosing comprehension difficulties in young children. Most notably, the FCRR team (Lonigan & Burgess, 2017) tested the separability of decoding and reading comprehension in kindergarten through grade 5, finding that reading comprehension is not measurable separately from decoding until grade 3. That is, existing measures are unable to distinguish challenges with decoding and challenges with other aspects of reading comprehension in the earliest grades. This finding highlights the need for studies like those discussed later in this report that identify additional potential underlying factors in reading comprehension—including cognitive, linguistic, and dispositional factors that may emerge as obstacles later in school. Currently, children who will experience challenges with reading comprehension related to factors other than decoding may not be identified early in school, because our understanding and measurement of these factors has been limited. This research also points to the need to identify or develop measures of these comprehension-related processes outside of reading tasks so that students who will later struggle with reading comprehension, in spite of adequate word-reading abilities, can be identified early in school.

The RfU studies also add to recent research raising questions about some components of the SVR, particularly the role of vocabulary knowledge in the model. In the

SVR, vocabulary knowledge has been traditionally conceptualized as part of listening comprehension. LARRC (2017) offers confirmatory evidence for this conceptualization in their finding that oral language (vocabulary and grammar) and listening comprehension are only measurable as a single construct, oral language, in pre-K through grade 3. However, two RfU studies (LARRC, 2015a; Wagner, Herrera, Spencer, & Quinn, 2015 [FCRR]) call the SVR's conceptualization into question by offering evidence that vocabulary knowledge may contribute to word recognition, as well as listening comprehension, in grades 1–3. The inconsistent findings suggest the need for additional research and further call into question the adequacy of the SVR as a singular guide for instruction and assessment.

Additional RfU studies sought to move beyond the SVR in their efforts to understand adolescent comprehension. For example, Ahmed et al. (2016) of Promoting Adolescents' Comprehension of Text (PACT) sought to understand sources of variance in reading comprehension for middle and high school students who exhibit a range of reading comprehension skill. Ahmed et al. examined the dimensions of reading comprehension in older students through a validation study of Cromley and Azevedo's (2007) Direct and Inferential Mediation (DIME) theory of reading comprehension. The DIME model describes background knowledge, vocabulary knowledge, and word reading as having a direct influence on comprehension, and it describes background knowledge and vocabulary as also influencing comprehension through inference making and reading strategies. Background knowledge and vocabulary knowledge have the strongest influence on comprehension in the DIME model. The analysis of Ahmed et al. (2016) supports the original DIME model and a second model in which background knowledge, vocabulary knowledge, reading comprehension, word-reading skill, inference making, and the use of reading strategies all make significant direct contributions to comprehension. Moreover, Ahmed et al. (2016) documented a shift after grade 6 in which the role of vocabulary knowledge attenuates, but inferencing skill and background knowledge exhibit an increase in their contributions to reading comprehension.

O'Reilly, Wang, and Sabatini (2019 [ETS]) further examined the role of background knowledge in high school students' reading comprehension. The researchers assessed knowledge of ecology by asking students to evaluate the relatedness of a series of words to the topic. Comprehension was then measured using a multitext, scenario-based assessment on the topic of ecosystems. The researchers identified a knowledge threshold at which the relationship between background knowledge and reading comprehension shifted. For students whose knowledge fell below the threshold, there was a flat relationship between knowledge and comprehension. For students who fell above the threshold, increases in knowledge were associated with increases in comprehension, suggesting a facilitative role for knowledge. This suggests that students may need a minimum amount of topic knowledge to comprehend texts on that topic.

Francis, Kulesz, and Benoit (2018 [PACT]) sought to address limitations of the SVR by proposing a new model that accounts for variation in readers and texts, the Complete View of Reading (CVR*i*). The researchers modeled reading fluency as a proxy for reading comprehension in grades 6–8, using measures of reader characteristics (word-reading efficiency, decoding, verbal knowledge, and listening comprehension) and text characteristics (average word frequency, average sentence length, narrativity, syntactic simplicity, word concreteness, referential cohesion, and deep cohesion).

Francis et al. (2018) found evidence that the development of fluency is heterogeneous across readers, with varying rates of growth over time, and that text characteristics affect readers differently. For example, expository texts and more difficult texts have a negative impact on fluency (i.e., cause students to read more slowly), particularly for better readers who may adjust their reading rate as they encounter more challenging texts. According to Francis et al., these findings suggest that models like the SVR that attribute comprehension entirely to component skills may overlook important variation in how individuals approach comprehension across situations and texts, and they may thus overlook potential pathways for intervention.

Goldman et al. (2016), of the Reading, Evidence, and Argumentation in Disciplinary Instruction (Project READI) team, further augment theoretical conceptualization of adolescent reading by examining underlying processes through a disciplinary lens. Goldman et al. developed a conceptual framework that describes the reading, reasoning, and argumentation practices of disciplinary learning in literature, history, and science. They used an examination of empirical and theoretical literatures to articulate a set of core constructs within each discipline (e.g., epistemological considerations and types of text structures) and a set of related goals that describe reading and reasoning in each discipline. The goals are designed to articulate processes that may be challenging for adolescent readers but are necessary for authentic forms of disciplinary engagement, such as forming intertext generalizations about theme and characterization in literature or evaluating historical interpretations for their completeness and quality of evidence in history. Relatedly, in a study of students in grades 4–7, LaRusso et al. (2016), of the Catalyzing Comprehension through Discussion and Debate (CCDD) team, found that academic language was the strongest predictor of deep comprehension, but that the disciplinary skill social perspective taking (expressing thoughts and feelings of individuals in a scenario and positioning based on contextual and other considerations) accounted for significant variance beyond academic language.

While largely validating the SVR in the early grades and the significance of word recognition in early reading, this RfU research also adds to evidence about the early importance of oral language and the later importance of inferencing skill, vocabulary knowledge, background knowledge, and disciplinary knowledge for successful comprehension. In doing so, it suggests directions for future research on assessment and instruction with a focus on the skills underlying successful reading comprehension. Several of these constructs were examined in subsequent RfU studies. This work is described in the sections that follow.

THE STRUCTURE OF LANGUAGE AND ITS RELATIONSHIP TO READING COMPREHENSION

The RfU studies add to existing evidence regarding the significance of language skills for reading comprehension, suggesting that early language skills likely serve as a foundation for proficient reading comprehension in the elementary grades and that sophisticated forms of linguistic knowledge and skill are associated with reading comprehension in early adolescence.

Previous research had established that language skills are significant concurrent and longitudinal predictors of reading comprehension (e.g., de Jong & van der Leij, 2002;

Ouellette, 2006). In addition, contemporary models of reading comprehension—from the SVR to the Construction-Integration Model (Kintsch, 1988)—have long posited an important role for language. However, oral language and academic language have often been operationalized narrowly as vocabulary knowledge. The research of the RfU teams extends our conceptualization of language by documenting the predictive relationships of a broader array of language skills, including grammatical skill and morphological knowledge, to comprehension in the early elementary grades (Apel, Diehm, & Apel, 2013 [FCRR]; LARRC & Logan, 2017). This work produced several major findings.

First, in addition to documenting the significance of knowledge for comprehension, longitudinal examinations of reading comprehension conducted by the RfU teams have identified early language-related skills and profiles of skills that predict later listening and reading comprehension. Quinn, Wagner, Petscher, and Lopez (2015 [FCRR]) found that students with higher levels of vocabulary knowledge in grade 1 made greater growth in their reading comprehension across grades 1–4, supporting an instrumental view of vocabulary knowledge in which knowledge of word meanings leads to better comprehension over time (Anderson & Freebody, 1981). Murphy et al. (2016 [LARRC]) examined profiles of lexical quality in pre-K as predictors of grade 1 reading comprehension, listening comprehension, and word recognition. They found that students' orthographic, phonological, morphosyntactic, and vocabulary skill accounted for substantial variance in grade 1 reading comprehension. They also found that students within a particular band of grade 1 reading comprehension performance (low-average) had somewhat different underlying skill profiles in pre-K compared with other groups. Students who had low letter knowledge in pre-K had similar grade 1 word recognition as students who had been low in language, but the students who had lower language skills in pre-K were lower on listening comprehension at grade 1. This suggests that low language skills are a better predictor of later reading comprehension difficulties than low letter knowledge. Alonzo, Yeomans-Maldonado, Murphy, Bevens, and LARRC (2016) examined pre-K predictors of grade 2 listening comprehension. They used a variety of language-related predictors, including listening comprehension, and found that the broad set of language measures used in the study accounted for substantial variance (55 percent) in grade 2 reading comprehension. However, only a pre-K measure of listening comprehension and a measure of working memory and language skills predicted grade 2 listening comprehension. It is possible that some additional aspects of language, such as vocabulary knowledge, were captured by the listening comprehension measures. Taken together, these findings point to the significance of early oral language for later reading comprehension and suggest that language development early in school may set the stage for later success with comprehension.

> Our team went "all-in" to better understand the role of language in skilled reading comprehension, doing work to examine the potentially causal relations between language and reading via a range of methodologies, including experimental design.
>
> *—Laura Justice, Steering Committee Representative from LARRC*

Second, the RfU studies found that, among students in the upper elementary through middle school grades, additional academic language and reasoning skills predict

sophisticated forms of reading comprehension. Uccelli, Galloway, Barr, Meneses, and Dobbs (2015 [CCDD]) validated a measure of academic language skills that includes understandings about register and argument, as well as higher-level grammar and morphology. The measure, the Core Academic Language Skills Instrument (CALS-I), predicted students' reading comprehension beyond grade level, English-proficiency designation, socioeconomic status, word reading, and vocabulary knowledge in grades 4–6, accounting for 12 percent of the variance in reading comprehension. LaRusso et al. (2016 [CCDD]) found that the academic skills measured by the CALS-I predicted students' deep comprehension in grades 4–7, as well as students' ability to position actors (or characters) in a text based on their roles and contexts. Deep comprehension was measured using the Global Integrated Scenario-Based Assessment (GISA) (O'Reilly & Sabatini, 2013 [ETS]), a multitext, problem solving–focused comprehension assessment (see Chapter 3 in this volume). Phillips Galloway and Uccelli (2019 [CCDD]) examined growth on the CALS-I and its association with reading comprehension among emergent bilingual students and English-proficient students across grades 6 and 7. They found that emergent bilingual students had significantly lower initial scores on both measures but exhibited similar rates of growth compared with their English-proficient peers. They also found that students who had higher initial scores on the CALS-I also had higher levels of reading comprehension and higher growth in reading comprehension over time. These studies offer a promising measure of academic language that specifies a range of skills and knowledge needed for engagement with content-area texts. In addition, these studies highlight the need to consider complex acts of comprehension, such as deep (intertextual, problem-oriented) comprehension of challenging texts, in constructing models of comprehension, and they point to the sophisticated knowledge and reasoning skills that may support success with these tasks.

Third, while the significance of language skills for reading comprehension is evident as early as grade 2, different aspects of language are challenging to distinguish in the youngest students. Five studies in this review examined the relationships among dimensions of oral language in the primary and elementary grades with some differing results. LARRC (2017) found that oral language (grammar and vocabulary) and listening comprehension are best characterized as a single oral language construct in pre-K through grade 3. LARRC, Jiang, Logan, and Jia (2018) also found that grammar and vocabulary scores are closely associated in preschool through grade 3. LARRC (2015b) supported a single-factor model (i.e., grammar, vocabulary, and discourse were not distinguishable) at pre-K and kindergarten, a two-factor model (i.e., vocabulary and grammar comprising one dimension and discourse skills comprising a second) at grades 1 and 2, and a three-factor model (grammar, vocabulary, and discourse) at grade 3. By contrast, Lonigan and Milburn (2017 [FCRR]) found dimensionality in oral language with separate factors for vocabulary and syntax/listening comprehension for students in pre-K through grade 5. LARRC (2015c) found that dimensionality of oral language was evident in pre-K students who were Spanish-English dual language learners. The best model for these students included a dominant general language factor and two highly correlated factors representing word knowledge and grammatical knowledge. In addition, Spencer, Muse, et al. (2015 [FCRR]) found that vocabulary knowledge and morphological knowledge are best understood as a single construct in grade 4.

Some of the differences in the results of these studies are likely attributable to the use of different measures to represent core constructs. In particular, comprehension monitoring and inferencing are treated differently across studies. For example, LARRC (2015b) used an inferencing task as part of the discourse construct along with measures of comprehension monitoring and text structure knowledge, whereas LARRC (2017) used an inferencing task as part of listening comprehension. What emerges, however, is a conceptualization of oral language as dominated by an overall, or general, language factor in the earliest grades, becoming increasingly separable into word-level, grammatical, and higher-level (discourse- and inferencing-related) constructs as students move from primary into elementary grades. These findings have implications for the assessment of oral language—suggesting that an omnibus oral language assessment may be unable to distinguish particular language-related obstacles but may be useful in identifying students with less developed oral language skills that may undermine the development of reading comprehension.

COGNITIVE SKILLS AND DISPOSITIONS IN RELATION TO READING

Attention, Memory, and Self-Regulation

Several RfU studies examined the contributions of cognitive skills, especially attention, memory, and self-regulation, to listening and reading comprehension. The results of these studies suggest that a range of cognitive skills is associated with listening and reading comprehension as early as kindergarten and that some of these skills may have reciprocal relationships with reading comprehension development.

Among the attention-related skills studied in the RfU research is the ability to suppress irrelevant information or meanings during reading or listening, a skill that is sometimes labeled *inhibitory control* or *cognitive inhibition*. In the RfU research, this skill was found to contribute to listening comprehension in kindergarten and grade 1 (Kim & Phillips, 2014 [FCRR]) and reading comprehension in grades 6–12 (Arrington, Kulesz, Francis, Fletcher, & Barnes, 2014 [PACT]; Barnes, Stuebing, Fletcher, Barth, & Francis, 2016 [PACT]). The ability to maintain sustained attention and focus on task-relevant goals also predicted reading comprehension in the Arrington et al. study, as did working memory. LARRC, Jiang, and Farquharson (2018) studied behavioral attention and working memory in relation to listening comprehension and reading comprehension. Both attention and memory were concurrent predictors of listening comprehension at each grade and, with the exception of attention at grade 3, both predicted reading comprehension at each grade. The effects on listening comprehension were direct, but the effects on reading comprehension were mediated by listening comprehension and/or word reading both concurrently and longitudinally.

In a study of struggling readers in grades 7–12, Swanson, Barnes, Fall, and Roberts (2018 [PACT]) found that vocabulary and inference-making ability, but not decoding ability, predicted reading comprehension among students with different levels of inattention and hyperactivity. In addition, working memory predicted comprehension for two of the three groups of students: those with low inattention and low hyperactivity and those with high inattention and low hyperactivity. However, for students with the highest levels of inattention (those in the high-inattention and high-hyperactivity

group), working memory did not predict comprehension, suggesting the possibility that high levels of inattention mediate the relationship between working memory and comprehension.

A second, related cognitive skill, comprehension monitoring, operationalized as the ability to evaluate one's own understanding of a story, predicted students' listening comprehension of narrative text in kindergarten and grade 1 (Kim & Phillips, 2014 [FCRR]) and, when considered as part of higher-level language skills, predicted reading comprehension in grade 3 (LARRC & Logan, 2017; see above). Denton, Enos, et al. (2015 [PACT]) also found that comprehension monitoring skill distinguished adequate comprehenders from poor comprehenders in middle and high school. LARRC and Yeomans-Maldonado (2017) found that vocabulary predicted comprehension monitoring in grade 1, and grade 1 comprehension monitoring contributed to grade 3 reading comprehension, even after controlling for vocabulary, decoding, and working memory. Connor et al. (2015 [FCRR]) used eye-tracking technology to examine students' growth in comprehension monitoring in grade 5. They found evidence that students with higher academic language skills made more attempts to repair their understandings of text than did students with lower academic language skills. These attempts were considered an indicator of comprehension monitoring. Specifically, students with higher academic language skills had a greater gap in rereading times between sentences with implausible words as opposed to plausible words (e.g., "Last week Kyle flew to visit his family in another city. The large **plane**/**truck** was spacious and quickly transported them" [p. 117]). Rereading time is the total time spent focusing on the target word (bolded in the example) after the initial fixation. Higher rereading times (more time spent fixating on the implausible word) is assumed to indicate attempts to repair understanding. As such, the higher rereading times for students with higher academic language skills suggest that these students were better at monitoring their comprehension, or noticing a breakdown in comprehension and attempting to repair it. These studies suggest that comprehension monitoring may play an important role in the development of comprehension and may be associated with language skills.

A third attention-related skill, self-regulation, was examined in four RfU studies included in this review. Day and Connor (2017 [FCRR]) developed a new measure of self-regulation, the Remembering Rules and Regulations Picture (RRRP) task, which required students to remember and follow directions (e.g., students are given blocks and pictures and are asked to "Put a blue block on the squirrel by the rock.") (p. 100). Day and Connor found concurrent and predictive relationships between scores on the measure and some reading skills in grade 3. For example, one part of the two-part RRRP predicted fall-to-spring gains in reading comprehension and vocabulary. Connor (2016 [FCRR]) tested a "lattice" model of reading in which cognitive, linguistic, and text-specific processes have reciprocal and interacting effects on reading development. Connor found that, in grades 1 and 2, self-regulation and word and world knowledge have reciprocal relationships with reading comprehension. Importantly, Connor found that classrooms with teachers receiving reading-related professional development had higher and less stable growth in reading comprehension, meaning that students' reading skills in grade 1 were less likely to predict skills in grade 2 than in the comparison group. This suggests that instruction influenced students' trajectories to a greater degree in the classrooms of teachers receiving the professional development. Day,

Connor, and McClelland (2015 [FCRR]) examined behavioral self-regulation skills in relation to *noninstructional* classroom time and reading skill in grade 1 students. Day et al. were particularly interested in whether children's behavioral self-regulation skills in fall were related to growth in reading skill (word identification and passage comprehension) and time spent in productive or unproductive noninstructional activity over the course of the year. Noninstructional activity that related to learning was considered *productive* (e.g., explaining the importance of a lesson) while activity not related to learning was considered *unproductive* (e.g., waiting time or time spent dealing with disruptions). Day et al. found that students with high self-regulation and reading skills in the fall had stronger reading skills in spring. They also found, among other things, that students with weak regulation skills were more likely to be in classrooms with higher levels of teacher-managed unproductive time. When teachers decreased the amount of productive noninstruction time over the course of the year, students had stronger spring reading scores; this was particularly true for students with weaker behavioral regulation skills. Students in these classrooms may have benefited when the teachers were able to establish clear routines and devote more time to instructional activities across the year. Denton, Wolters, et al. (2015 [PACT]) found that adequate adolescent comprehenders also had stronger self-regulation skills than did struggling comprehenders (see below).

It is important to note that while these studies collectively document the contribution of specific cognitive skills to reading comprehension, some of these contributions are small. For example, Barnes et al. (2016 [PACT]) suggest that the contribution of inhibitory control (suppression of irrelevant information, accounting for about 1 percent of the variance in reading comprehension) is too small to warrant the development of interventions targeting this skill in particular. Moreover, the nature of these relationships is not entirely understood; for example, we do not know precisely how self-regulation (as the ability to follow directions) contributes to comprehension and how it relates to other dimensions of executive functioning. Given the large number of cognitive skills that make meaningful, but small, contributions to reading comprehension and preliminary evidence that they have reciprocal relationships with reading comprehension, there is reason to consider the possibility that multicomponent interventions that focus on supporting reading comprehension may better support students than those that target weaknesses in specific skills (see Chapter 5). Nevertheless, the understandings about the role of cognitive processes in decoding and comprehension offered by this work may lead to a better understanding of reading proficiency and may lead to more effective and well-rounded reading interventions.

Inferential Processes

Several studies conducted by the RfU teams focus on inferential processing, offering insights about the associations between inferencing skills and reading comprehension. For example, the RfU studies found that the ability to make inferences about the states or perspectives of actors (i.e., characters) in text predicts listening comprehension in kindergarten and grade 1 (Kim & Phillips, 2014 [FCRR]) and reading comprehension in grades 4–7 (LaRusso et al., 2016 [CCDD]; see above). In addition, the ability to use visual-spatial information acquired from studying a three-dimensional model of a space

before reading a text set in that space is related to comprehension in elementary-age and adolescent readers (Barnes, Raghubar, Faulkner, & Denton, 2014 [PACT]).

Overall, inferencing skill distinguished more and less proficient adolescent comprehenders across several studies. In particular, adequate comprehenders are more skilled at forming the text-based and knowledge-dependent inferences that establish and maintain local coherence and global coherence during reading. Local coherence refers to understanding across information that appears close together in a text, for example in neighboring sentences, such as resolving anaphora (the "he" refers to Henry) or connecting what is reported in one proposition as a plausible cause or explanation of an event or outcome reported in a preceding or following proposition. Global coherence refers to constructing meaning across longer distances in a text (connecting them all to a theme or topic, for example). Denton, Enos, et al. (2015 [PACT]) found that adequate comprehenders in middle and high school have higher levels of acceptable inferences, acceptable paraphrasing, and comprehension monitoring than poor comprehenders when reading informational text. Barth, Barnes, Francis, Vaughn, and York (2015 [PACT]) found that, compared with struggling adolescent comprehenders, adequate comprehenders were able to evaluate the consistency of causal bridging (intratextual) inferences more quickly and were better able to rely on working memory to form connections across adjoining propositions in order to maintain local coherence. Barnes, Ahmed, Barth, and Francis (2015 [PACT]) similarly found that weaker comprehenders were less able than more skilled comprehenders to make inferences that maintain local coherence. Weaker comprehenders struggled to maintain local coherence even when they had relevant knowledge to bring to bear on knowledge-dependent inferences. Denton, Wolters, et al. (2015 [PACT]) found that, compared with struggling comprehenders, adequate comprehenders reported more frequent use of strategies associated with text- and knowledge-based inferences and text evaluation, as well as regulation strategies associated with adjusting reading to enhance comprehension, including rereading and changing reading rate. Taken together, these studies support prior research documenting the contributions of inferencing skill to successful reading, including reading comprehension, and they suggest that weak inferencing skill is a potential source of reading comprehension difficulty in struggling comprehenders.

The RfU research also points to text and reader characteristics that are associated with more and less successful inferencing. Three themes emerge from this research.

First, students may have greater difficulty with inferencing when reading informational text compared with narrative text. Denton, Enos, et al. (2015 [PACT]) found that, regardless of reading comprehension proficiency level, students produced fewer acceptable inferences and paraphrases from informational text versus narrative text.

Second, some kinds of relationships among propositions in text are more challenging to process than others. Barth et al. (2015 [PACT]) found that middle school students at all levels of comprehension proficiency had more difficulty making successful bridging (intratextual) inferences across longer spans of text compared with inferences that depend on information in adjoining sentences. In addition, Vorstius, Radach, Mayer, and Lonigan (2013 [FCRR]) found that, for grade 5 students, negative causal relationships (e.g., "although") were more challenging than positive causal relationships (e.g., "because"). Barnes et al. (2015 [PACT]) found that, in forming bridging inferences that

rely on connections to prior knowledge, texts that included stronger causal connections across pairs of sentences were easier for students to process than those that relied on weaker causal (temporal) connections.

Third, the RfU studies provide suggestive evidence that, in addition to comprehension skill, background knowledge and vocabulary knowledge are associated with ease or speed of processing inferential relationships in text and with comprehension monitoring. Barnes et al. (2015 [PACT]) found that high school students with higher levels of background knowledge read pairs of causal sentences more quickly. Connor, Radach, et al. (2015 [FCRR]) found that fifth graders' academic language skills predicted their comprehension monitoring behavior during reading. LaRusso et al. (2016 [CCDD]; also discussed above) found that academic language skills predicted "deep comprehension," or comprehension that demands sophisticated inferential processing within and across texts in the interest of problem solving.

A challenge identified by the RfU research regards the measurement of inferencing. Comprehension theory and research have long relied on the understanding that there are distinguishable types of inferences (e.g., Diakidoy, Mouskounti, and Ioannides, 2011; Graesser, Singer, & Trabasso, 1994). LARRC and Muijselaar (2018) found that, while different types of inferences have been distinguishable in some research, local and global inferences cannot yet be measured reliably as two distinct types. LARRC and Muijselaar examined whether local and global inferences could be distinguished statistically. While the two types of inferences were distinguishable, a general inference-making factor explained most of the variance across items.

Motivations and Reading Comprehension

One study included in this review looked at the associations between motivation and reading comprehension. Wolters, Denton, York, and Francis (2013 [PACT]) examined a range of motivational factors, including those related to competence and expectancies, valuing of reading, achievement goals, and socially mediated aspects of motivation for reading. Wolters et al. (2013) found that most of the factors were positively and significantly related to each other. In addition, the researchers found that, among aspects of motivation, feelings of competence and expectancies for success were most closely associated with reading comprehension. Compared with their highly skilled peers, adolescent students who were less skilled comprehenders tended to express lower levels of belief in their ability to do well at reading if they chose to do so. Importantly, stronger and weaker comprehenders were similar in their assessments of importance and utility value and in their goal orientations. Although substantial previous research has addressed the relationship between reading comprehension and motivations in young children, few studies had looked at adolescent students. This study suggests that adolescent students who have struggled with comprehension have less adaptive reading motivations, particularly perceived control or ability to succeed, but similar value-related judgments. In pointing to specific, and potentially malleable, aspects of comprehension, this study provides possible directions for future intervention research.

TEXT CHARACTERISTICS, GENRE KNOWLEDGE, AND READING COMPREHENSION

Although text characteristics were not a central focus of the RfU research, three studies nominated for this report add evidence to previous research regarding the role of text characteristics and genre knowledge in comprehension. In a study of middle and high school students' performance on a standardized comprehension measure, Kulesz, Francis, Barnes, and Fletcher (2016 [PACT]) examined how reader characteristics (decoding accuracy, fluency, working memory, background knowledge, and vocabulary), test properties (passage genre, passage cohesion, word difficulty, sentence length, and test memory/recall versus inferential questions), and their interactions influenced students' performance in grades 7–9 and grades 10–12. Kulesz et al. (2016) found that expository passages were more difficult than narrative passages and that passages that were high in deep cohesion were easier than those that were low in cohesion. In addition, vocabulary knowledge and background knowledge were significant reader characteristics above word reading, reading fluency, and working memory for both grade bands. For students in the upper grade band, background knowledge was particularly influential when text cohesion was low.

Weak comprehenders' challenges with informational text may be related to low levels of knowledge or low motivation, but they may also be an indication that these students have underdeveloped understandings about what it means to comprehend informational text. Denton, Enos, et al. (2015 [PACT]) used a think-aloud methodology to examine middle and high school students' text processing with texts of different genres (narrative and informational) and different difficulties (on level and above challenging). Poor comprehenders made fewer acceptable inferences than did stronger comprehenders when reading informational text. Denton, Enos, et al. (2015) suggest that poor comprehenders may believe that the development of a text base, or remembering information for the sake of a test, is sufficient when reading informational text.

The RfU research offers some evidence that genre knowledge influences comprehension even among the youngest children. Barnes, Kim, and Phillips (2014 [FCRR]) examined pre-K through grade 1 students' use of literate language features (adverbs, conjunctions, mental and linguistic verbs, and elaborated noun phrases) in narrative retellings and narrative production. They found that use of the literature language features was not related to listening comprehension or narrative production. However, awareness of the features of narrative text structure (as indicated by the proper introduction of characters in a narrative) was related to the quality of grade 1 students' narrative comprehension (ability to recall narrative features after hearing a story), their production of narrative text (ability to produce a story based on a set of illustrations including key narrative elements), and their listening comprehension.

Overall, this work confirms and extends prior research suggesting that informational text and less cohesive text may be more challenging for readers than narrative text and more cohesive text (e.g., Best, Floyd, & McNamara, 2008; O'Reilly & McNamara, 2007). Moreover, these text characteristics may be particularly salient among students who struggle with comprehension. What is not clear from this work is the source of the difference between these two broad "genres." It is not entirely clear why informational text is often more challenging than narrative. It may be that students have more experience with the features and structures of narrative genres and their underlying

structures, or it may be that they have less familiarity with the topics and language often featured in informational text.

DISCUSSION

Overall Implications

The research reported in this chapter is best characterized as "basic" research. The goal of such research is to build our collective understanding about basic processes—in this case, the underlying processes that influence the development of comprehension across the age span—but basic research does not alone offer a sufficient basis for the development of recommendations regarding the practice of reading instruction or assessment. Recommendations regarding practice are best formulated through intervention research conducted with students, such as the large body of work synthesized in Chapters 4 and 5 (this volume). However, all things being equal, interventions based on solid developmental research are more likely to be effective, because they are grounded in sound understandings about the nature of the reading process and how it evolves as children learn to read. While basic developmental studies do not speak directly to the practice of reading instruction or assessment, they do provide foundational insights that can support the design of intervention research that would yield such recommendations. As such, while caution is warranted when discussing implications for practice, this section outlines key contributions of the RfU studies with an eye to the formulation of design research on comprehension instruction and assessment.

The RfU research sheds light on the wide array of skills and knowledge that underlie successful reading comprehension, concurrently and longitudinally. In current educational practice, many early reading assessments and interventions focus on word reading as the primary enabling skill for proficient reading comprehension, but they often lack attention to other skills and knowledge that may enable successful reading and listening comprehension as students advance into the upper elementary grades and beyond. The RfU researchers used sophisticated research designs—often large-scale, longitudinal, and analytically sophisticated approaches—in order to better understand a wider array of concurrent and longitudinal contributors to comprehension among students at different stages of development.

The RfU research has documented the contributions of a broad set of skills and knowledge that influence reading development from the earliest years of schooling. In doing so, this research suggests that, while the SVR provides a good concurrent and longitudinal explanation of reading comprehension in the early elementary years, there are some important limitations to the model. Although the model accounts for most variance in reading comprehension in the primary grades, it may not provide sufficient guidance for the development and application of interventions. In focusing on two broad predictors of comprehension that are difficult to distinguish in the earliest grades (Lonigan & Burgess, 2017 [FCRR]), the model may overlook underlying factors that will affect some students' reading comprehension later in school. Addressing the underlying skills for successful comprehension in later elementary school and adolescence requires a more expansive and forward-looking gaze than that provided by the

SVR. Among elementary students, this may involve consideration of linguistic, cognitive, and behavioral skills, including attention and self-regulation.

Preliminary evidence within the RfU portfolio suggests that word-level skills contribute less to comprehension over time as decoding is consolidated and students encounter texts and tasks that require sophisticated forms of academic language and knowledge. As such, explaining comprehension for older students may involve unpacking the infrastructure of the Simple View (e.g., What is entailed in the listening comprehension component of the Simple View?) or augmenting it with additional facets, such as those investigated by Ahmed et al. (2016 [PACT]) and Francis et al. (2018 [PACT]). Characterizing the reading comprehension of middle and high school students requires a more complex model that includes background knowledge, vocabulary knowledge, strategy use, inference making, and disciplinary reading and reasoning skills. More research is needed to understand the nature of these skills and knowledge and their interactions with other reader, text, and task variables. While the explanations for reading comprehension become more complex in adolescence for most students, the RfU research also suggests there are students whose underdeveloped decoding skills markedly suppress progress in reading comprehension in grade 5 and beyond (Wang et al., 2019 [ETS]).

Overall, the results of the RfU studies suggest that a focus on word reading in early interventions is an important foundation for the development of reading comprehension and should be accompanied by attention to other important skills and knowledge that are necessary for reading comprehension once word-level skills are well developed (e.g., LARRC, Jiang, & Farquharson, 2018). In addition, the RfU research suggests that the focus on word reading in early assessment may be driving the underidentification of students who will later experience difficulties with listening comprehension and reading comprehension due to challenges with other enabling skills related to language and cognition (Alonzo et al., 2016 [LARRC]).

The RfU research documents the nature and significance of language skills for comprehension development. The RfU research suggests that language skills are an important foundation for skilled comprehension, and the studies provide potential insights about the nature, measurement, and instruction of language. Several RfU studies attest to the significance of early language skills as concurrent and longitudinal predictors of listening and reading comprehension. These studies suggest that children who struggle with listening comprehension and reading comprehension in the elementary grades may have had identifiable underlying difficulties with components of language years earlier, including lower-level knowledge and skills related to orthography, phonology, morphosyntax, and vocabulary (e.g., Murphy et al., 2016 [LARRC]). In addition, academic language skills and other complex skills, such as reasoning and inferencing, predict sophisticated forms of reading comprehension in adolescence and distinguish stronger and weaker adolescent comprehenders (e.g., Uccelli et al., 2015 [CCDD]).

These findings and prior research showing that older children with adequate word-reading skills, but poor reading comprehension, may have had low language skills earlier in school suggest the need for assessment and instruction early in school. The RfU studies shed light on how weaknesses in a broad skill domain, such as language and comprehension, relate to profiles of specific skills and knowledge, potentially positioning educators

to do stronger diagnostic work and to develop richer conceptualizations of the skills and knowledge that enable successful comprehension in childhood and adolescence.

However, the RfU research also offers cautions about the assessment and instruction of language skills. In particular, although the language skills associated with reading comprehension ultimately include several different dimensions, these dimensions (e.g., grammar, vocabulary, and higher-level discourse skills) are difficult to distinguish at the preschool and early elementary levels, becoming increasingly separable as students move further into elementary grades. It is unclear whether the lack of differentiation is more attributable to children's development (i.e., skills in fact become more distinct over time through exposure to more sophisticated language structures in text or through a consolidation of lower-level language skills that leads to the development of higher-level skills), or the limitations of current assessments.

Either way, the RfU research suggests that, although many commercially available language and literacy assessments include numerous subtests, the subtests may measure just a few highly related language skills. As such, approaching variation in scores on different subtests as evidence of specific strengths and weaknesses may not produce valid interpretations. That is, because language skills appear to be largely undifferentiated early on, it is not clear that multiple subtests provide information about distinct aspects of students' language development. Additional studies in this report suggest possible candidates for language assessment, including an omnibus assessment of oral language (see LARRC, 2017) or listening comprehension (Alonzo et al., 2016 [LARRC]), which may be sufficient to identify students at risk for later reading difficulties due to underdeveloped language skills.

The lack of differentiation among language skills early in reading development may also offer implications for instruction. For example, the results documenting that various dimensions of language, such as grammar and vocabulary skills, tend to be closely associated in children—both in their initial scores and in their growth trajectories across the early years of schooling—suggest that language may be best conceptualized as a single skill or closely interrelated cluster of skills in young children (e.g., LARRC, Jiang, Logan, & Jia, 2018). There are several possible implications for instruction that might be explored in future research. For example, it may be that rich language experiences can be used to develop multiple aspects of language concurrently, providing better support for successful reading comprehension than instruction targeting discrete language skills. It may also be that targeted interventions, which are focused on the more malleable dimensions of language (e.g., grammar rather than vocabulary), affect other associated dimensions of language. Given the significance of language for reading comprehension, future intervention research should explore these possibilities.

The RfU research offers insights regarding the role of cognitive skills in comprehension. The RfU studies suggest that listening and reading comprehension are associated with and may depend on cognitive skills, such as the ability to activate information relevant to the situation described in a text, to suppress irrelevant information (inhibitory control), to monitor comprehension, to engage in successful inferencing, and to remember and follow sets of directions (self-regulation).

This research offers insight into both the significance and the nature of the relationship between cognitive skills and comprehension. For example, challenges with

inhibitory control may undermine comprehension because irrelevant information that remains active interferes with meaning construction for poor comprehenders (Arrington et al., 2014 [PACT]; Kim & Phillips, 2014 [FCRR]). In addition, for some students, poor reading comprehension may involve an inability to maintain sustained attention to the text and thus an inability to develop a coherent understanding of the text (Arrington et al., 2014 [PACT]).

Although the RfU studies have identified a broad array of cognitive skills that make significant contributions to comprehension, it is important to continue to characterize these skills in terms of the magnitude of their contribution to comprehension, their significance in distinguishing students at different levels of comprehension skill, their relationships with comprehension, and their malleability. Based on the evidence in the RfU studies, several cognitive skills, including those related to attentional control and self-regulation, make small but significant contributions to comprehension while others, such as monitoring and inferencing, seem to have substantial and intrinsic relationships with comprehension and distinguish stronger and weaker comprehension. In adolescence, for example, less skilled comprehenders have difficulty maintaining both local and global coherence through text- and knowledge-based inferences (Barnes et al., 2015 [FCRR and PACT]; Barth et al., 2015 [PACT]; Denton, Enos, et al., 2015 [PACT]), particularly when reading informational text.

Taken together, this research suggests that efforts to improve comprehension should include attention to the development of cognitive skills. However, given the large number of cognitive skills that make meaningful, but small, contributions to reading comprehension and preliminary evidence that they have reciprocal relationships with reading comprehension, there is reason to consider the possibility that multicomponent interventions that focus on supporting reading comprehension may better support students than those that target weaknesses in specific skills. For example, attentional issues may be best addressed as part of holistic interventions designed to support students' reading comprehension, while comprehension monitoring and inferencing may merit more focused instructional attention. It is also possible that some cognitive and attentional skills have a critical role in comprehension for particular students, suggesting different

Our team's efforts were two-fold. First, we focused on identifying skills that contributed in meaningful ways to reading comprehension in the elementary school grades. Our approach to these questions employed a broader focus and allowed more rigorous methods to identify unique and important contributors to reading comprehension than most prior studies. Second, we were strongly committed to developing and evaluating instructional interventions informed by our ongoing investigations of skill areas with sizable contributions to reading comprehension. We developed multiple interventions that were revised and refined over several year-long cycles of evaluation. We found that our interventions, which focused on building language, knowledge, metacognitive skills, and text structure in preschool, kindergarten, and early elementary school grades, directly affected the intervention targets and were more effective when multiple component interventions were combined.

—Christopher Lonigan, Steering Committee Representative from FCRR

approaches to intervention. More research on variation among readers is needed. In spite of remaining uncertainties, the understandings about the role of cognitive processes in decoding and comprehension offered by this work may lead to a better understanding of reading proficiency and may lead to more effective and well-rounded reading interventions. And, of course, this is precisely the role that good basic research on development should play—generating plausible interventions that can be tested in the crucible of classroom curriculum and instruction.

The RfU research adds evidence regarding the significance of word and world knowledge for reading comprehension. The RfU studies bolster substantial prior research demonstrating the significance of word and world knowledge for comprehension, particularly as students move into adolescence. The studies also extend our understanding by, for example, suggesting that vocabulary may contribute to both word reading and listening comprehension early in school (LARRC, 2015a; Wagner et al., 2015 [LARRC]); that knowledge and vocabulary support comprehension, at least in part, by supporting readers' inferencing and monitoring (Ahmed et al., 2016 [PACT]; Connor et al., 2015 [FCRR]); and that the relationship between world knowledge and comprehension is reciprocal (Connor, 2016 [FCRR]). They also find that, at least in adolescence, comprehension may be dependent on a minimum amount of knowledge about the topic of the text (O'Reilly et al., 2019 [ETS]). These studies suggest the need to redouble efforts to build students' vocabulary knowledge and to develop approaches to building students' general and text-specific knowledge. The studies also point to specific features of design work related to word and world knowledge. For example, Spencer, Muse, et al. (2015 [FCRR]) provide evidence that different aspects of word knowledge are acquired simultaneously and that a comprehensive understanding of students' knowledge requires the use of multidimensional approaches to vocabulary assessment. In addition, this suggests that students may benefit from vocabulary instruction that extends beyond the instruction of definitions to include many kinds of information about the words and should attend to students' morphological knowledge and skill.

These findings regarding the significance of knowledge, along with those related to inferencing, support contemporary cognitive models of comprehension (e.g., Kintsch, 1988; van den Broek, Risden, Fletcher, & Thurlow, 1996). These models describe development of a coherent mental representation of a text as dependent on forming connections between the propositions in a text and the knowledge stored in long-term (and short-term) memory. However, the connections among word and world knowledge, cognitive processes, and comprehension are not yet entirely understood. As Barnes et al. (2015 [FCRR and PACT]) discuss, it is possible that the accessibility of readers' knowledge in long-term memory affects the knowledge integration process. That is, knowledge that is well elaborated and connected to other concepts in memory may result in more efficient retrieval and thus ease inferencing. Denton, Enos, et al. (2015 [PACT]) and Connor et al. (2015 [FCRR]) raise the possibility that comprehension monitoring may depend on word and world knowledge, and lower levels of these knowledge sources may be partially responsible for struggling comprehenders' difficulties with comprehension monitoring. As Connor et al. discuss, the ability to monitor comprehension and resolve breakdowns in meaning (such as the appearance of implausible words in sentences) may depend in part on students' academic language skills, including their vocabulary

knowledge and background knowledge. Understanding more about these interactions may support the development of interventions.

Key Limitations of This Work

In their report outlining a research agenda on reading comprehension, the RRSG described reading comprehension as consisting of three key elements: the reader (skills and dispositions), the text, and the activity or purpose for reading, all interacting in a larger sociocultural context that relates separately with each element and in combination across elements. In addition, the RRSG's vision of the reader describes individuals as influenced by a broad constellation of cognitive capabilities, motivations, types of knowledge, and experiences. Relative to the RRSG's expansive vision of comprehension and its influences, the RfU teams addressed a narrower set of individual student characteristics as explanations for the development of comprehension. The preponderance of the RfU teams' research offers insights about reader skills and knowledge. Only a small number of the RfU studies look outside the reader to text and task in characterizing the development of comprehension over time. Even within the studies looking at readers, attention was directed toward students' component skills and knowledge with less focus on motivations or life experiences or even consolidated assemblages of skills that may influence comprehension development. It is notable that, in line with previous research, the few RfU studies (by the FCRR team) that did include environmental variables, such as characteristics of classroom environments, found significant associations with students' skills and literacy development (e.g., Connor, 2016 [FCRR]; Connor et al., 2015 [FCRR]; Day et al., 2015 [FCRR]).

In their description of a research agenda for reading comprehension, the RRSG discussed the significance of sociocultural and other contextual factors for understanding comprehension. They point out, for example, that readers' skills and dispositions are "shaped by cultural and subcultural influences, socioeconomic status, home and family background, peer influences, classroom culture, and instructional history" (p. 20). As a result, they call for understanding factors that influence "both the inter- and intraindividual" dimensions of reading (p. 20). In particular, the RRSG notes that one motivating factor for the development of a research agenda is to address persistent and unacceptable gaps in reading performance between students in different demographic groups. The RfU teams only partially realized this vision in their research. While the instructional research reported later in this volume involved diverse samples, some of the research that was most pointedly about development was conducted with fairly homogeneous student samples that do not reflect the racial, linguistic, or economic diversity that characterizes the U.S. school population (Alonzo et al., 2016 [LARRC]; McIlraith & LARRC, 2018; Murphy, LARRC, & Farquharson, 2016). In addition, diversity was often treated as a covariate, rather than investigated to identify potential differences in the development of comprehension as a function of such factors as first language and socioeconomic level. Including diverse samples of students is critical when characterizing developmental patterns in reading.

One risk in examining underlying processes in a complex task such as reading with comprehension is that the complex task will be disaggregated into a multiplicity of small components, leading to an assumption that each of these components plays an

equally important role in the comprehension process and is therefore equally important in the design of high-quality instructional routines and assessments. Although the RfU studies have collectively identified statistically reliable correlates and predictors of comprehension, they do not provide a consistent portrait about the relative importance (i.e., asking, Is this element absolutely pivotal for comprehension development? Is it uniquely important?) and malleability (i.e., Is this element amenable to instruction?) of each element. As Ahmed et al. (2016 [PACT]) point out, it is important to understand which of the many factors that are related to comprehension are actually most integral to comprehension and which are most malleable. Future research is needed to determine the significance and malleability of different skills at different points in students' development and in relation to particular text genres and characteristics.

One important advantage of the RfU research reported here is that multiple measures were often used to capture underlying constructs for concurrent and longitudinal prediction of comprehension. In addition, several of the studies of middle and high school students used measures of deep comprehension, requiring sophisticated inferential understandings within and across texts. However, the studies of young students modeled comprehension using well-established standardized measures of comprehension that largely capture literal comprehension of short passages. We should not assume that the contributors to comprehension would be identical had the measures required more complex forms of textual and intertextual comprehension and application.

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