INTERNATIONAL LITERACY ASSOCIATION READING RESEARCH QUARTERLY

The Science of Reading Progresses: Communicating Advances Beyond the Simple View of Reading

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ABSTRACT

The simple view of reading is commonly presented to educators in professional development about the science of reading. The simple view is a useful tool for conveying the undeniable importance—in fact, the necessity—of both decoding and linguistic comprehension for reading. Research in the 35 years since the theory was proposed has revealed additional understandings about reading. In this article, we synthesize research documenting three of these advances: (1) Reading difficulties have a number of causes, not all of which fall under decoding and/or listening comprehension as posited in the simple view; (2) rather than influencing reading solely independently, as conceived in the simple view, decoding and listening comprehension (or in terms more commonly used in reference to the simple view today, word recognition and language comprehension) overlap in important ways; and (3) there are many contributors to reading not named in the simple view, such as active, self-regulatory processes, that play a substantial role in reading. We point to research showing that instruction aligned with these advances can improve students' reading. We present a theory, which we call the active view of reading, that is an expansion of the simple view and can be used to convey these important advances to current and future educators. We discuss the need to lift up updated theories and models to guide practitioners' work in supporting students' reading development in classrooms and interventions.

The simple view of reading (SVR; Gough & Tunmer, 1986) is widely used to explain the science of reading to classroom teachers and others involved in reading education and to guide instructional practice (e.g., Moats, Bennett, & Cohen, 2018; Rose, 2006, 2017). In fact, a Google search finds that the terms *science of reading* and *simple view* appear together in websites over 71,000 times, and although 35 years old, the theory is cited more often now than ever. Yet, science progresses. Our purpose in this article is to describe three key advances that have emerged in the scientific evidence since the formulation of the SVR. We identify research studies that have shown that instruction aligned with each of these advances improves students' reading. We also present a model of reading that can be used to convey these important advances to current and future educators so as to better align instructional practice with the evolving science of reading.

Although a number of more complex models of reading have been proposed and shown to hold up well in research (e.g., Cromley & Azevedo, 2007; Joshi & Aaron, 2000; Kim, 2017), the SVR has remained the model most commonly presented to practitioners. This is likely partly because of lack of awareness of some model-building and

INTERNATIONAL LITERACY ASSOCIATION

Reading Research Quarterly, 56(S1)
pp. S25–S44 | doi:10.1002/rrq.411

model-testing developments in research and partly because various statistical models are perceived to be too complex to be readily applied in practice. Thus, although we are certainly not the first scholars to evaluate the SVR (see, e.g., Cervetti et al., 2020, in *Reading Research Quarterly*'s first special issue on the science of reading), we focus particularly on the need for models that are readily applicable to practice and that better reflect three key scientific advances derived from the current science of reading that are not included in the SVR or fully reflected in other existing models of reading.

The SVR

The SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990) posits that reading is the product of two independent components: decoding and listening comprehension. The model is captured in the equation D × C = R, where D = decoding, which Gough and Tunmer (1986) viewed as the ability to "read isolated words quickly, accurately, and silently," fundamentally through "the use of letter-sound correspondence rules" (p. 7); C = comprehension, specifically listening comprehension (the term they used nine times in the article) or linguistic comprehension (the term they used two times); and R = reading. These components were believed to occur independently and sequentially: "The simple view presumes that, once the printed matter is decoded, the reader applies to the text exactly the same mechanisms which he or she would bring to bear on its spoken equivalent" (p. 9). The authors used the term *reading* to mean comprehension of written text (Gough & Tunmer, 1986; Hoover & Gough, 1990), not just word reading, as the term is sometimes used today. Throughout this article, we also use the term *reading* to mean reading comprehension.

Although the original SVR specified decoding and listening comprehension as the foundational constructs of reading, in contemporary work, these terms are frequently broadened to *word recognition* and *language* (or *linguistic*) *comprehension*, respectively. In fact, two of the model's originators recently offered an expansion of the SVR, the cognitive foundations framework (Hoover & Tunmer, 2020), which essentially retains the SVR's original structure, but uses the broader terms *word recognition* and *language comprehension* and unpacks subcomponents within those. From this point on, unless discussing a specific claim in the SVR, we use the terms *word recognition* and *language comprehension* as well; broadening to those terms (and the broader constructs they represent), rather than using the original *decoding* and *listening comprehension*, is a substantial improvement over the original SVR that better reflects the science of reading.

Gough and Tunmer (1986) initially proposed the SVR to emphasize the importance of decoding to reading. In contemporary work, when people have invoked the SVR, they have often done so to emphasize the contribution of decoding, language, or both to the reading process, reading development, or reading instruction. Indeed, mountains of research have indicated that word recognition and language comprehension are each very important contributors to reading (e.g., Byrne & Fielding-Barnsley, 1995; García & Cain, 2014; Georgiou, Das, & Hayward, 2009; Hogan, Adlof, & Alonzo, 2014). The austerity of the SVR and its depiction as an equation likely lend it credibility. However, as Hoover and Tunmer (2018) noted, "there is much more to understand about reading than what is represented in the SVR" (p. 311).

In the sections that follow, we identify three key understandings about reading, beyond the SVR, derived from scientific research (i.e., the science of reading) that do the following:

1. Point to causes of reading difficulty within and beyond word recognition and language comprehension
2. Reflect the considerable overlap between word recognition and language comprehension and the important processes that bridge these skills and/or operate through that overlap
3. Represent the important role that active self-regulation plays in reading

We propose an expansion of the SVR, the active view of reading, which reflects these three advances. We document that each element of the active view has been shown, when taught, to improve students' reading achievement. We then compare the active view of reading with some past models that expanded on the SVR. Finally, we offer some recommendations for using the active view in the preparation of and professional development for education practitioners.

Reading Difficulties Have Many Causes Within and Beyond Word Recognition and Language Comprehension

In the original article on the SVR (Gough & Tunmer, 1986), the authors contended, based on their model, that there are three types of reading disability: difficulties with decoding (D), which they called dyslexia; difficulties with listening comprehension (C), which they called hyperlexia; and difficulties with both processes, which they called garden-variety reading disability. In the updated model, Hoover and Tunmer (2020) reprised these claims and described the same three categories of reading disability, arguing that "wherever there is high skill in decoding and language comprehension, there will be high skill in reading" (p. 27). As one would expect scientists to do, Gough and Tunmer (1986) originally invited tests of this assumption:

> The simple view asserts only that both decoding and comprehension are essential to reading. This may be wrong: It may be that there are individuals who can both decode and listen who cannot read, individuals who can do one but not the other and still read, or even individuals who can neither decode nor listen yet still read with understanding. The existence of any such individuals will falsify the simple view. (p. 9)

Difficulties Exist Beyond the Simple View Classifications

Multiple studies have identified students with decoding and listening comprehension at grade-appropriate levels who nevertheless exhibit reading difficulties (Aaron, Joshi, & Williams, 1999; Catts, Hogan, & Adlof, 2005; Catts, Hogan, & Fey, 2003; Ebert & Scott, 2016; Hock et al., 2009; Morris et al., 2017; see Table 1). Instructional practice guided by the SVR leaves educators ill prepared to understand or identify instructional targets for poor comprehenders with grade-appropriate decoding and listening comprehension, because no source for such difficulties is evident in the SVR. Later, we discuss contributors to reading beyond word recognition and language comprehension that may explain readers with reading difficulties despite age-appropriate decoding and language comprehension.

Unpacking Contributors to Reading

The SVR also does not name specific factors within word recognition and/or language comprehension that can cause reading difficulty. We agree with Hoover and Tunmer (2020) that it is essential for educators to unpack a student's profile of strengths and weaknesses within these broad constructs. For example, is the difficulty with word recognition primarily due to core phonological processing issues, limited orthographic knowledge, or some combination? Many researchers have worked to identify profiles of reading difficulty (e.g., Foorman, Petscher, Stanley, & Truckenmiller, 2017; Riddle Buly & Valencia, 2002). Although the profiles vary somewhat, likely because of factors such as study measures, analytic approach, and characteristics of the sample, studies typically have yielded a richer array of profiles than revealed to practitioners in the SVR.

Unpacking the range of contributors to reading may be especially important when it draws attention to a construct that may otherwise be missed in identifying causes of reading difficulty or targets for instruction. One such construct is cultural and other content knowledge. The broad label of language comprehension, under which cultural and other content knowledge falls, is not likely to trigger attention to content knowledge. Yet, there is a growing case in research for the importance of content knowledge to reading (e.g., Cabell & Hwang, 2020).

Knowledge predicts reading ability even in models in which the original SVR components of decoding and listening comprehension are controlled (Hwang, 2020; Nusca, 1999; Talwar, Tighe, & Greenberg, 2018). Knowledge encompasses information and the organization of that information in long-term memory (Cook & Gueraud, 2005). Although there is no doubt that this construct is related to vocabulary (i.e., words in one's vocabulary label concepts in one's knowledge base), knowledge predicts unique variance in reading ability in models that include vocabulary (Ahmed et al., 2016; Cromley & Azevedo, 2007; Cromley, Snyder-Hogan, & Luciw-Dubas, 2010). Knowledge goes beyond just knowing

TABLE 1
Studies Documenting Students With Low Reading (R) Ability Despite Grade-Appropriate Decoding (D) and Listening Comprehension (C)

Study	Grade or age group	Students with low R for their grade level who had grade-appropriate D and L
Aaron, Joshi, and Williams (1999)	Study 3: "Title I Classroom" (grade not specified)	20% "undetermined"
	Study 4: Grades 2–5	9% "undetermined"
Catts, Hogan, and Adlof (2005)	Grade 2	15%
	Grade 4	13.8%
	Grade 8	23.6%
Catts, Hogan, and Fey (2003)	Grade 2	13.4% "non-specified reading problem"
Ebert and Scott (2016)	Grades 1–10	34.5%
Hock et al. (2009)	Adolescents	13.3%
Morris et al. (2017)	Grades 5 and 6	13.8%

specific word meanings to include knowledge of concepts, objects, and experiences (often discussed as script/scenario knowledge or schemata). Indeed, knowledge from one's cultural experiences affects listening and reading comprehension (e.g., Bell & Clark, 1998; Murata, 2007). For example, one study found that if readers had experience with a particular religious ceremony, they better understood a text about that ceremony than if readers did not (Pritchard, 1990).

Explicitly drawing practitioners' attention to the role of cultural and other content knowledge may lead to more instruction aimed at building students' knowledge, which research has found positively impacts reading development (e.g., Cabell & Hwang, 2020; Connor et al., 2017). It might also lead to a shift in thinking regarding reading difficulties, highlighting that reading difficulties are sometimes context dependent, occurring when there is a mismatch between the knowledge assumed by the author/text (and teacher) and the knowledge of the reader. This in turn opens the door for considering how and why race, religious background, socioeconomic status, and other factors impact the reading process—why social justice concerns are relevant, even in understanding the process of reading. For example, readers who are rarely provided with opportunities to read texts that reflect their cultural background will experience the reading process differently than those with the privilege of a frequent match of their cultural background and the knowledge assumed by an author/text.

Summary

Reading difficulties can have causes beyond word recognition and language comprehension, and many different profiles of reading difficulty exist within word recognition and language comprehension. In the next section, we synthesize research suggesting the need to recognize factors that work across word recognition and language comprehension as well.

Word Recognition and Language Comprehension Are Not Entirely Separate, and Important Processes Bridge Them

The way the SVR equation was originally written, and is still conveyed today, decoding/word recognition and listening/language comprehension are entirely separate. There is no variable included in the model that reflects any overlap or variance shared between decoding and listening comprehension—no mechanism for them to influence each other. Indeed, the founders of the SVR suggested that these processes were not only entirely separate but also occurred sequentially, decoding first and listening comprehension second, leading to unfounded assumptions that students should be taught to decode first and then to comprehend (Houck & Ross, 2012). Some more complex depictions of reading that share intellectual roots with the SVR, discussed later, also do not allow for a construct to be included in, or affect both, word recognition and language comprehension; each construct is placed into either the word recognition or the language comprehension strand, not in both.

Contrary to the SVR, research has found that there is considerable variance shared (overlap) between word recognition/decoding and listening/language comprehension in the prediction of reading. For example, Lonigan, Burgess, and Schatschneider (2018) found that 41–69% of variance predicted in reading was shared between word recognition and language comprehension in a sample of 757 students in grades 3–5. In contrast, only 38% of variance in reading, on average, was due uniquely to word recognition or language comprehension (for similar findings in other samples, see Cutting & Scarborough, 2006; Foorman & Petscher, 2018; Foorman, Wu, Quinn, & Petscher, 2020; Taboada Barber, Cartwright, Hancock, & Klauda, 2021, this issue). In other words, more variance in reading was predicted by the variance shared (i.e., the overlap) between word recognition and language comprehension than was predicted uniquely by these foundational processes of the SVR. Notably, the existence of this overlapping or shared variance in predicting reading does not necessarily mean that the SVR as originally conceptualized explains less variance in reading comprehension. Rather, as seen in Figure 1, word recognition and language comprehension can share a lot of variance (i.e., overlap quite a bit) or no variance (i.e., not overlap at all, as posited in the original SVR) and still explain the same amount of variability in reading comprehension.

The existence of overlap between word recognition and language comprehension in the prediction of reading is consequential for practitioners because it suggests the need to consider contributors to reading not only within word recognition and language comprehension, as in the SVR, but also across them. Attention to these bridging factors may be necessary for word recognition and language comprehension interventions to be sufficiently effective for developing readers; thus, there is a need to draw educators' attention to those factors and their influence on both constructs. Nation's (2019) expanded view of the SVR depicts one major factor, language, as influencing both decoding and linguistic comprehension, and the many arrows in her model reflect some of the complex interrelations among constructs that influence reading. Presenting Nation's model, rather than the original SVR, would likely better support practitioners' understanding of the science of reading and better draw their attention to factors to address in instruction that affect

FIGURE 1
Varying Degrees of Variance Shared Between Word Recognition (WR) and Language Comprehension (LC) in Reading (R)

both decoding and linguistic comprehension. However, we can unpack the language component of Nation's model further by explicitly naming factors that research in the science of reading has shown to bridge word recognition and decoding. In this section, we discuss several such variables.

Vocabulary

Many people associate vocabulary knowledge exclusively with language comprehension, but vocabulary is also related to word recognition (e.g., Kearns & Al Ghanem, 2019; Kendeou, Savage, & van den Broek, 2009; Mitchell & Brady, 2013) and contributes directly to word recognition (and to reading through word recognition) in path analytic models of reading in young students (Tunmer & Chapman, 2012) and adults (Georgiou & Das, 2018). Consider that many words in English could plausibly be pronounced multiple ways (i.e., heteronyms; e.g., *desert,* a geographic region or the action of leaving; *wind*, a weather condition or the act of turning something). Vocabulary knowledge is part of what enables us to know which pronunciation is correct and also to monitor whether the text with that word in it makes sense. These kinds of links among phonology, orthography, and words' meanings (i.e., vocabulary) are at the heart of orthographic mapping: the linking of words' spellings, pronunciations, and meanings in memory (Ehri, 2014).

What might be going on in that bridging space, shared across word recognition and language comprehension, to enable such mapping to occur? In their reading systems framework, Perfetti and Stafura (2014) proposed that executive skills enable readers to coordinate processes that cut across word recognition and language comprehension and to forge the essential connections among phonology, orthography, and meaning necessary for the mature orthographic mapping observed in skilled readers. Indeed, neurobiological evidence supports this contention, revealing that the executive function (EF) network supports coordination of and connections between processes, such as phonological and semantic processes, playing a sort of behind-the-scenes role in reading (Aboud, Bailey, Petrill, & Cutting, 2016; Aboud, Barquero, & Cutting, 2018; Yu et al., 2018). (We take up the role of EF skills in reading further next; as we note there, reading-specific EFs play an important role in coordinating and bridging word recognition and language comprehension.) Perhaps because of its influence on both word recognition and language comprehension, vocabulary predicted variance in reading ability above and beyond measures of SVR components in many studies (Nation & Snowling, 2004; Ouellette & Beers, 2010; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009; Verhoeven & van Leeuwe, 2008), although not all of them (Braze et al., 2016). It is critical that practitioners are presented with a model of reading that names vocabulary and makes clear that vocabulary knowledge may not only be affecting students' language comprehension but also their word recognition.

Reading Fluency

In contrast to vocabulary, which is typically associated only with language comprehension (erroneously, as we have shown), reading fluency is often associated only with decoding or word recognition. However, reading fluency actually reflects and is affected by language comprehension as well. Indeed, fluency has been called a bridge between word recognition and comprehension (Pikulski & Chard, 2005). Fluency is typically seen as encompassing accuracy of word reading, automaticity of text reading, and prosody—or reading "with appropriate expression or intonation coupled with phrasing that allows for the maintenance of meaning" (Kuhn, Schwanenflugel, & Meisinger, 2010, p. 233). Thus, fluency involves not only word recognition ability but also semantic and syntactic knowledge, as well as knowledge of how written text features, such as punctuation marks, signal prosody (Schwanenflugel & Benjamin, 2017). The bridging nature of fluency may explain why some studies have found that adding a fluency term to the SVR model predicts additional variance in reading comprehension beyond word recognition and language comprehension (Adlof, Catts, & Little, 2006; Silverman, Speece, Harring, & Ritchey, 2013; Tilstra et al., 2009). Effective approaches to developing reading fluency often draw on and foster both language comprehension and word recognition (e.g., Kuhn et al., 2006; Stevens, Walker, & Vaughn, 2017), so it is important that practitioners are presented with a model more consistent with the science of reading that names fluency and reflects its shared variance with both of these constructs in contributing to reading.

Morphological Awareness

Morphological awareness has been the subject of a great deal of research in recent decades. Morphological awareness has been shown to exert a direct influence on reading ability (e.g., Gottardo, Mirza, Koh, Ferreira, & Javier, 2018; Kirby et al., 2012; Zhang & Ke, 2020), is implicated in reading difficulties (e.g., Tong, Deacon, Kirby, Cain, & Parrila, 2011), and is widely understood to be related to both word recognition and language comprehension. Importantly, morphological awareness provides a clear counter to the notion that we can develop reading simply by working on word recognition and oral language, as morphological awareness has a particular value in written text. For example, morphological awareness allows a reader to recognize that the written words *magic* and *magician* are semantically related despite considerable differences in their oral pronunciation. Morphological awareness is not named in the SVR or many other models of reading, yet research has documented the contributions of morphological awareness to reading, including through word recognition and language comprehension. Further, instruction in morphological awareness has been shown to foster reading achievement in students with and without reading disabilities (e.g., Goodwin & Ahn, 2010, 2013). It is important that a model of reading presented to practitioners includes morphological awareness.

Summary

In sum, presenting practitioners with models that depict word recognition and language comprehension as entirely separate is inconsistent with research, which has documented considerable shared variance between these constructs in the prediction of reading. Research has identified important constructs that bridge word recognition and language comprehension, predict reading, are implicated in reading difficulty, and are amenable to instruction, including, but not limited to, vocabulary, reading fluency, and morphological awareness. Models of reading presented to practitioners should reflect this updated science of reading.

Active Self-Regulation Is Central to Reading

A large and growing body of research has demonstrated that skilled readers are highly active, strategic, and engaged, deploying executive skills to manage the reading process (e.g., Georgiou & Das, 2018; Ho & Lau, 2018; Pressley & Afflerbach, 1995). Readers play a central role in making reading happen. In addition to acquiring necessary word-reading and language comprehension knowledge and skills, readers must learn to regulate themselves, actively coordinate the various processes and text elements necessary for successful reading, deploy strategies to ensure reading processes go smoothly, maintain motivation, and actively engage with text. None of this is apparent to practitioners in the SVR model. Yet, as we describe next, active self-regulation is amenable to instruction. Thus, to be consistent with the current state of the science of reading, a model of reading for practitioners should explicitly address active self-regulation and include the clusters of skills and strategies discussed next.

EF Skills

EF skills are higher order self-regulatory neurocognitive processes recruited particularly in complex, goal-directed tasks. EFs include three core skills—cognitive flexibility, working memory, and inhibitory control—and skills such as attention and planning (Dawson & Guare, 2018; Diamond, 2013). In recent years, EFs have been the subject of an enormous amount of scientific research in relation to reading (for reviews, see Butterfuss & Kendeou, 2018; Cartwright, 2015; Follmer, 2018). Scientific evidence indicates that both domain-general and reading-specific EFs contribute to reading. We address each of these below.

Domain-General EF

Several EF skills contribute directly to reading: cognitive flexibility (also called shifting; Georgiou, & Das, 2018; Kieffer, Vukovic, & Berry, 2013), inhibitory control (Kieffer et al., 2013; Potocki, Sanchez, Ecalle, & Magnan, 2017), working memory (Nouwens, Groen, Kleemans, & Verhoeven, 2020; Potocki et al., 2017; Sesma, Mahone, Levine, Eason, & Cutting, 2009), planning (Nouwens et al., 2020; Sesma et al., 2009), and attentional control (Conners, 2009). These contributions make sense, given the complexity of reading processes that require the ability to direct attention to particular aspects of text (attentional control), build and maintain a model of text meaning while decoding the words in the text (working memory), suppress distracting information (inhibitory control), shift continuously between key processes (cognitive flexibility), and plan and manage one's progression toward the goal of a reading task (planning). Domain-general

EF skills also contribute to reading ability indirectly, through both word recognition and language comprehension processes (e.g., Kieffer et al., 2013; Language and Reading Research Consortium, Jiang, & Farquharson, 2018; Taboada Barber, Cartwright, et al., 2020), and thus also help explain the shared variance between word recognition and language comprehension. As noted earlier, EF skills play a key behind-the-scenes role in helping readers achieve orthographic mapping, which involves links across elements of word recognition and language comprehension (Aboud et al., 2016, 2018; Ehri, 2014; Perfetti & Stafura, 2014; Yu et al., 2018). Recent work has supported this notion, demonstrating that EF skills contribute to reading through a path from language comprehension to word recognition to reading (Cartwright, Lee, et al., 2020; Taboada Barber et al., 2021). Further, domain-general EF skills are amenable to intervention, which directly improves reading (e.g., Dahlin, 2011; Johann & Karbach, 2019; Loosli, Buschkuehl, Perrig, & Jaeggi, 2012).

EF is so important to reading that there is reason to believe that for some students, limited EF skills are the primary cause of reading difficulty. To illustrate, Cutting and Scarborough (2012) studied 19 students (7–14-year-olds) identified with poor reading comprehension despite adequate word recognition ability (Gough & Tunmer's, 1986, hyperlexic profile). The researchers administered a standardized assessment of receptive vocabulary, consistent with the SVR founders' position that standardized measures of verbal ability serve as "a reasonable estimate of C" (Gough & Tunmer, 1986, p. 9). Only 15.8% of the students showed vocabulary-only weaknesses that would be expected from a hyperlexic profile. A total of 52.6% showed difficulty in vocabulary and EF. The remaining 36.8% showed EF-only weaknesses. In other words, at least to the degree that the students' vocabulary assessment results serve as a proxy for language comprehension, for 36.8% of the sample, weaknesses in EF appeared to be the primary cause for their reading difficulty. Practitioners guided by the SVR might miss these students' difficulties entirely and be ill prepared to address these students' difficulties.

Reading-Specific EF

Domain-specific EF tasks have been shown to be even more effective for assessment and intervention in academic domains, such as reading (e.g., Melby-Lervåg & Hulme, 2013). One reading-specific EF that is amenable to intervention is graphophonological-semantic cognitive flexibility (GSF), a bridging process that involves the ability to simultaneously consider and actively switch between the letter–sound (graphophonological) and meaning (semantic) features of printed words. Thus, by definition, this ability transcends language comprehension because language comprehension does not involve graphemes, and transcends word recognition because, as conceived in the SVR, word recognition does not include semantics. Numerous studies have shown that GSF predicts variance in reading ability above and beyond various assessments of word recognition and language comprehension in children and adults (e.g., Cartwright, 2002; Cartwright, Lee, et al., 2020; Knudsen, López, & Archibald, 2018). This type of reading-specific EF skill can be taught in order to address EF difficulties that negatively impact reading. For example, researcher-delivered GSF intervention improved EF skill and reading in typically developing students in grades 2–4 (Cartwright, 2002). Similarly, teacher-delivered GSF intervention improved EF skill and reading in third-grade students with reading comprehension difficulties, despite adequate decoding ability (Cartwright et al., 2017), and in teacher-identified struggling readers in grades 2–5, even after controlling for word recognition, verbal ability, and grade level (Cartwright, Bock, et al., 2020). Given these and other findings, we appreciate Cutting, Bailey, Barquero, and Aboud's (2015) version of Scarborough's (2001) rope model of reading, in which EF is added by encircling the strands of the rope. That depiction helps communicate the important role of EF in reading. In contrast, there is no place in the original SVR for EF skills, nor does the SVR suggest EF interventions as an option for instruction or intervention for reading difficulty. Models consistent with the science of reading must include a role for EF skills.

Motivation and Engagement

Motivation and engagement also reflect active, self-regulated reading and predict reading ability above and beyond word recognition and language comprehension (Cartwright, Lee, et al., 2020; Taboada Barber, Klauda, & Stapleton, 2020). Further, engagement mediates effects of word recognition on reading (Taboada Barber, Klauda, & Stapleton, 2020); additional work is needed to understand whether and how motivation and engagement contribute through the shared variance between word recognition and language comprehension. One might also make the argument that motivation operates solely through EF, which we previously established predicts reading ability, but a study that included EF in addition to SVR components still found motivation to predict variance in reading ability beyond EF skills (Cartwright, Lee, et al., 2020).

Efforts to implement practices for fostering reading motivation have been shown to improve reading achievement. For example, Guthrie and Klauda (2014) demonstrated statistically significant effects of an intervention (Concept-Oriented Reading Instruction) designed to improve motivation and engagement on informational text comprehension in a sample of 615 seventh-grade students; increases in students' intrinsic motivation for, and engagement with, reading were also observed. Furthermore, a recent systematic review and meta-analysis (McBreen &

Savage, 2020) examined the impact of various approaches to enhancing reading motivation, including instruction in self-regulation, instruction to foster students' reading interests and sense of the value of reading, and instruction designed to shift students' mind-sets around reading success and difficulty. The researchers meta-analyzed 49 studies and found positive effects on word reading, reading fluency, and reading comprehension. Given that motivation and engagement predict reading achievement and are amenable to instruction, it is important that a model of reading explicitly draws practitioners' attention to these additional aspects of the science of reading.

Strategy Use

Another aspect of active self-regulation entailed in reading, and perhaps the one most familiar to practitioners, is the use of reading strategies. "Reading strategies are deliberate, goal-directed attempts to control and modify the reader's efforts to decode text, understand words, and construct meanings of text" (Afflerbach, Pearson, & Paris, 2008, p. 368; see also Manoli & Papadopoulou, 2012). Developing readers are able to use strategies, such as chunking words into parts to decode them, and research has shown that teaching students decoding strategies improves the ability to read some types of words (e.g., Steacy, Elleman, Lovett, & Compton, 2016). Readers also use strategies to ascertain the meanings of unfamiliar words as they read, such as drawing on sentential context or graphics for clues to word meaning. It is less clear whether instruction in doing so improves comprehension; thus far, it appears that interventions that teach flexible use of a number of vocabulary strategies are most promising (Wright & Cervetti, 2017).

A large amount of research has focused on comprehension strategies, such as asking oneself questions as one reads or generating mental images during reading. Research has long shown that comprehension strategy use predicts reading ability (e.g., Samuelstuen & Bråten, 2005). In fact, comprehension strategy use has been shown to predict reading ability even beyond word recognition and language comprehension. For example, in studies of a model of reading comprehension developed and tested repeatedly by multiple research teams over the past 15 years, the direct and inferential mediation (DIME) model of reading comprehension, comprehension strategy use directly predicts reading in a structural equation model that includes measures of vocabulary (as a proxy for language comprehension) and word reading, as well as inferencing and background knowledge (Ahmed et al., 2016; Cromley & Azevedo, 2007; Cromley et al., 2010). A study independent of the DIME model, also employing structural equation modeling, found that comprehension strategies (and working memory) predicted reading ability in a model that included reading fluency and vocabulary (Muijselaar et al., 2017). Although these models did not include an array of EF skills, it is notable that some research has suggested that GSF may mediate the relation between strategy use and reading ability (Gnaedinger, Hund, & Hesson-McInnis, 2016).

There is an extensive body of scientific research showing that teaching comprehension strategies improves reading, even in young students, in students with learning disabilities, and in whole-class formats (e.g., Berkeley, Scruggs, & Mastropieri, 2010; Okkinga et al., 2018; Shanahan et al., 2010). Strategy application typically involves not only an oral language context but also a written language context. In fact, some strategies, such as previewing a text and rereading, do not have a clear correlate in an oral language comprehension context. Given that comprehension strategies predict reading ability and are amenable to instruction, it is important to present a model of reading for practitioners that explicitly includes comprehension strategies to more fully reflect the science of reading.

Summary

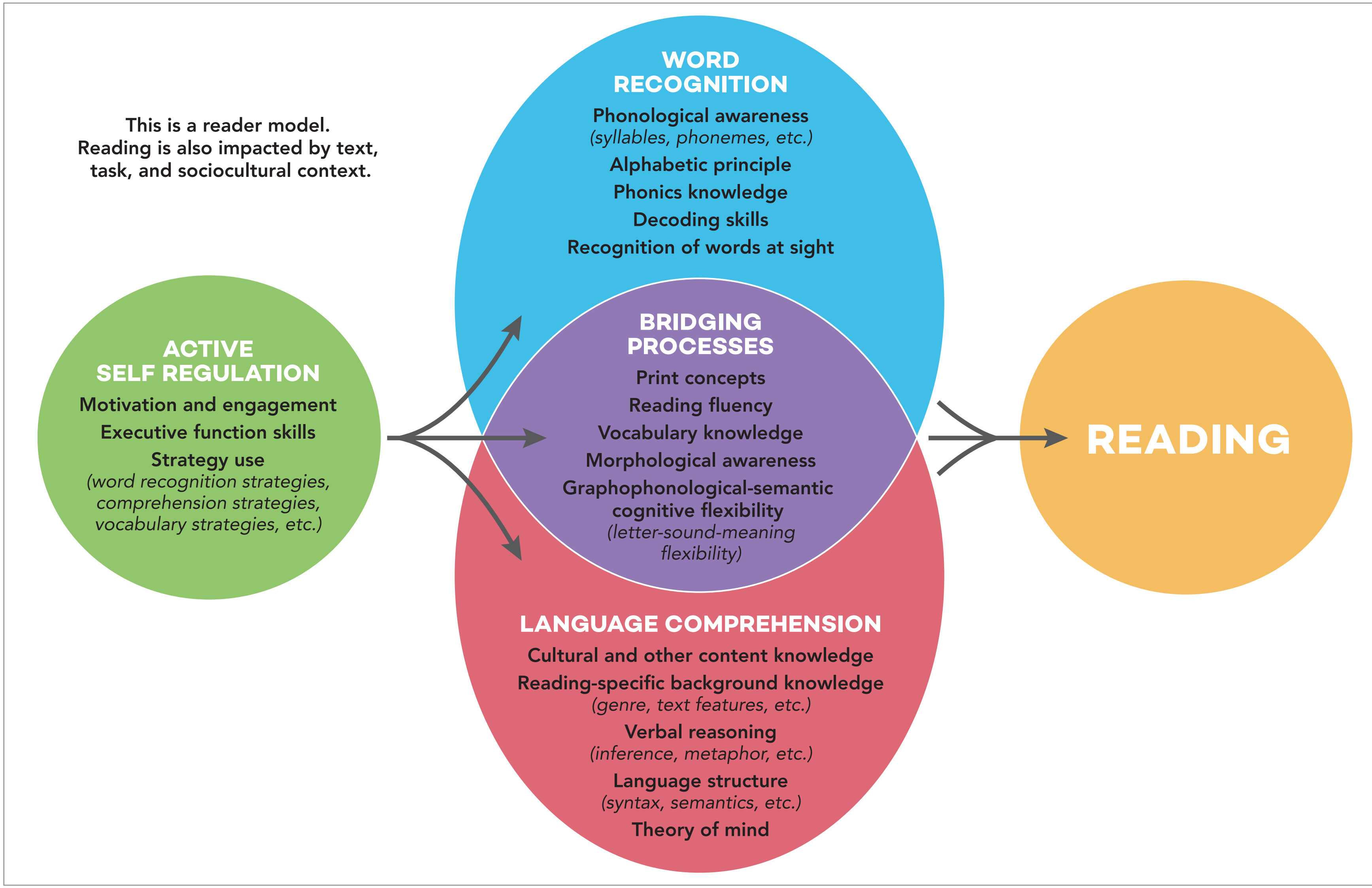
Scientific research on reading has found that active self-regulation, including but not limited to EF skills, motivation and engagement, and strategy use, impact reading and can be impacted by instruction. Thus, a model of reading for practitioners should include these elements.

The Active View of Reading

In Figure 2, we offer our active view of reading model, which reflects the three major research advances discussed in the previous sections. A key feature of the model is that it explicitly lists contributors to reading—and, thus, potential causes of reading difficulty—within, across, and beyond the broad categories of word recognition and language comprehension. This feature of the model reflects the research we reviewed in the section on causes of reading difficulty, in which we documented that not all profiles of reading difficulty are explained by low word recognition and/or language comprehension and that there are many distinct profiles of reading difficulty within contributors to word recognition and/or language comprehension.

A second feature of the active view of reading model is that it depicts word recognition and language comprehension as overlapping and explicitly identifies processes that bridge these constructs. This feature of the model reflects the shared variance (i.e., the overlap) that many studies have found between word recognition and language comprehension and reflects research on contributors to reading that bridge word recognition and language comprehension (see the Word Recognition and Language Comprehension Are Not Entirely Separate, and Important

FIGURE 2
The Active View of Reading Model



Note. Several wordings in this model are adapted from Scarborough (2001).

Processes Bridge Them section). This feature is an important departure from the SVR, which depicts decoding and listening comprehension as entirely separate and does not name processes that bridge these constructs. As we explain in the next section, this is an important departure not only from the SVR but also from several other models of reading.

A third feature of the active view of reading is inclusion of active self-regulation and its placement as influencing word recognition, bridging processes, and language comprehension (see the three arrows in Figure 2). This feature of the model allows researchers to account for many findings from the large body of research on the impact of motivation and engagement, EF skills, and strategy use on reading (see the Active Self-Regulation Is Central to Reading section).

A fourth feature of the active view of reading is that each construct named in the model is instructionally malleable; that is, practitioners can affect it. In Table 2, we define each construct and provide an example of a study (or review of studies) showing that instruction in that construct can improve reading comprehension.

How the Active View of Reading Compares With Other Models of Reading

We are certainly not the first to call for a model of reading that expands beyond the SVR. In this section, we discuss how the active view of reading compares with some other models of reading.

The Rope Model

Next to the SVR, the rope model of reading (Scarborough, 2001; see Figure 3) is perhaps the model most commonly shared with practitioners. In our view, this model is a substantial improvement over the SVR because the rope model unpacks the word recognition and language comprehension constructs, as we call for in this article. In fact, there is a great deal of overlap in the constructs included in the rope model and those in our active view of reading model, although in some cases, we use somewhat different labels, grain sizes, or groupings. Additionally, although an updated version of the rope model exists, and includes an EF strand that weaves around and through the other rope elements (Cutting et al., 2015), the original model is the one that is routinely shared with practitioners (e.g., International Dyslexia Association, 2018).

Within language comprehension, there is one construct in our active view of reading model not represented in the rope model: theory of mind. Theory of mind—the understanding of one's own and others' mental states, such as thoughts, feelings, beliefs, intentions, or desires—has been included in recent models of reading (e.g., the direct and indirect effects model of reading [DIER]; Kim, 2017) and is an important contributor to reading (for a review, see Dore, Amendum, Golinkoff, & Hirsh-Pasek, 2018). Theory of mind develops across childhood and supports inferences about others' actions in everyday life, such as when a child understands that her mother is looking under the couch for her missing keys because she thinks they are there, even though the child knows the missing keys are on the table. These kinds of social inferences about characters' thoughts, feelings, and intentions contribute to reading concurrently and longitudinally (Guajardo & Cartwright, 2016) but do not necessarily occur naturally for elementary school students, who are more likely to focus on characters' actions, with limited attention paid to characters' internal mental or emotional motivations unless they are stated explicitly (e.g., Shannon, Kameenui, & Baumann, 1988). Instruction in such social reasoning improves reading comprehension (e.g., Lysaker, Tonge, Gauson, & Miller, 2011) but may be missed by practitioners guided by the rope model.

A second way in which the active view of reading differs from the rope model is that the latter model does not have processes shared across word recognition and language comprehension (the overlapping ovals in our model), at least until the two major strands of the model braid together. The rope model places vocabulary only in language comprehension, whereas we characterize it as a bridging process based on research reviewed earlier. The rope model places print concepts in language comprehension, but instead, we place them in bridging processes because print concepts are needed not only for language comprehension but also for word recognition. For example, the concept of directionality (the direction in which we read words; e.g., left to right in English) is a necessary component of word recognition. Another construct we depict as a bridging skill, fluency, is not named in the rope model, but once the strands braid together, the model states that skilled reading entails "fluent execution and coordination of word recognition and text comprehension" (Scarborough, 2001, p. 98). Two other constructs in the bridging processes portion of our model, GSF and morphological awareness, are not included in the rope model; we include those because of the findings of research reviewed earlier in this article.

A third way in which the rope model differs from the active view of reading is that the former model does not include the active self-regulation category. One construct that we placed in that category, strategy use, is included in the rope model in some sense with the arrow labeled "increasingly strategic" (see Figure 3), although that label is applied only to the language comprehension strand of the rope. Two other constructs that we placed in the active self-regulation category—motivation and

TABLE 2
Definition and Example Supporting Study (or Review of Studies) for Each Construct Within the Active View of Reading Model

Construct in the model	Definition of the construct	Example study finding that instruction in the construct improves reading comprehension
Active self-regulation		
Motivation and engagement	Reading motivation involves expecting value in, having interest in, and having a desire to read; motivation facilitates engagement, which is active participation in reading and interaction with text.	McBreen and Savage (2020)
Executive function skills	Higher order self-regulatory neurocognitive processes recruited particularly in complex, goal-directed tasks (including reading)	Johann and Karbach (2019)
Strategy use	"Deliberate, goal-directed attempts to control and modify the reader's efforts to decode text, understand words, and construct meanings of text" (Afflerbach, Pearson, & Paris, 2008, p. 368)	Word-reading strategies: Lovett et al. (2000) Comprehension strategies: Okkinga et al. (2018)
Word recognition		
Phonological awareness	Conscious attention to the sounds in spoken language, including words, syllables, onsets, rimes, and individual phonemes (phonemic awareness)	Ehri et al. (2001)
Alphabetic principle	The understanding that in alphabetic languages, sounds in spoken language are represented by letters in written language	This construct is typically taught along with those above and/or below this row.
Phonics knowledge	Knowledge of specific phoneme–grapheme relations, such as that the letters *sh* together typically represent the sound heard at the beginning of the word *ship*	Connelly, Johnston, and Thompson (2001)
Decoding skill	The ability to associate graphemes with phonemes and to blend those phonemes to produce a word	Cunningham (1990)
Recognition of words at sight	The ability to identify/read a word automatically or at sight, which typically results from having previously decoded the word multiple times	McArthur et al. (2015)
Bridging processes		
Print concepts	Understanding of how print works, such as reading it from left to right and top to bottom in English	This construct is typically taught along with others, but effects on comprehension have been found by Piasta, Justice, McGinty, and Kaderavek (2012).
Reading fluency	The accuracy, automaticity, and prosody with which a person reads	Stevens, Walker, and Vaughn (2017)
Vocabulary knowledge	Understanding of the denotative and connotative meanings of words and phrases within a language	At least for comprehension of passages with taught words: Wright and Cervetti (2017)
Morphological awareness	Awareness and knowledge of the smallest meaningful units in language, such as recognizing that *returnable* has three morphemes: *re*, *turn*, and *able*	Goodwin and Ahn (2013)
Graphophonological-semantic cognitive flexibility	The ability to simultaneously consider and actively switch between the letter–sound (graphophonological) and meaning (semantic) features of printed words	Cartwright, Bock, et al. (2020)

(*continued*)

TABLE 2
Definition and Example Supporting Study (or Review of Studies) for Each Construct Within the Active View of Reading Model (*continued*)

Construct in the model	Definition of the construct	Example study finding that instruction in the construct improves reading comprehension
Language comprehension		
Cultural and other knowledge	A body of information acquired over time through experiences, such as formal education and daily activities within one's cultural group(s)	Cabell and Hwang (2020)
Reading-specific background knowledge	Knowledge specific to understanding written language, such as knowledge of common genres of written text and written text features (e.g., headings, diagrams)	Hebert, Bohaty, Nelson, and Brown (2016)
Verbal reasoning	Reasoning about aspects of text meaning beyond vocabulary and printed text, such as when making inferences or when interpreting the nonliteral meanings of metaphors and figures of speech	Elleman (2017)
Language structure	The organization of language to convey meaning, such as how words are ordered within a sentence (syntax); some aspects of language structure are encompassed in other constructs	Weaver (1979)
Theory of mind	A kind of social reasoning that involves "the ability to understand and take into account one's own and others' mental states (Premack & Woodruff, 1978)" (Weimer et al., 2021, p. 1), including characters' mental states (e.g., thoughts, feelings, intentions) to understand, reason about, and make inferences from text	Lysaker, Tonge, Gauson, and Miller (2011)

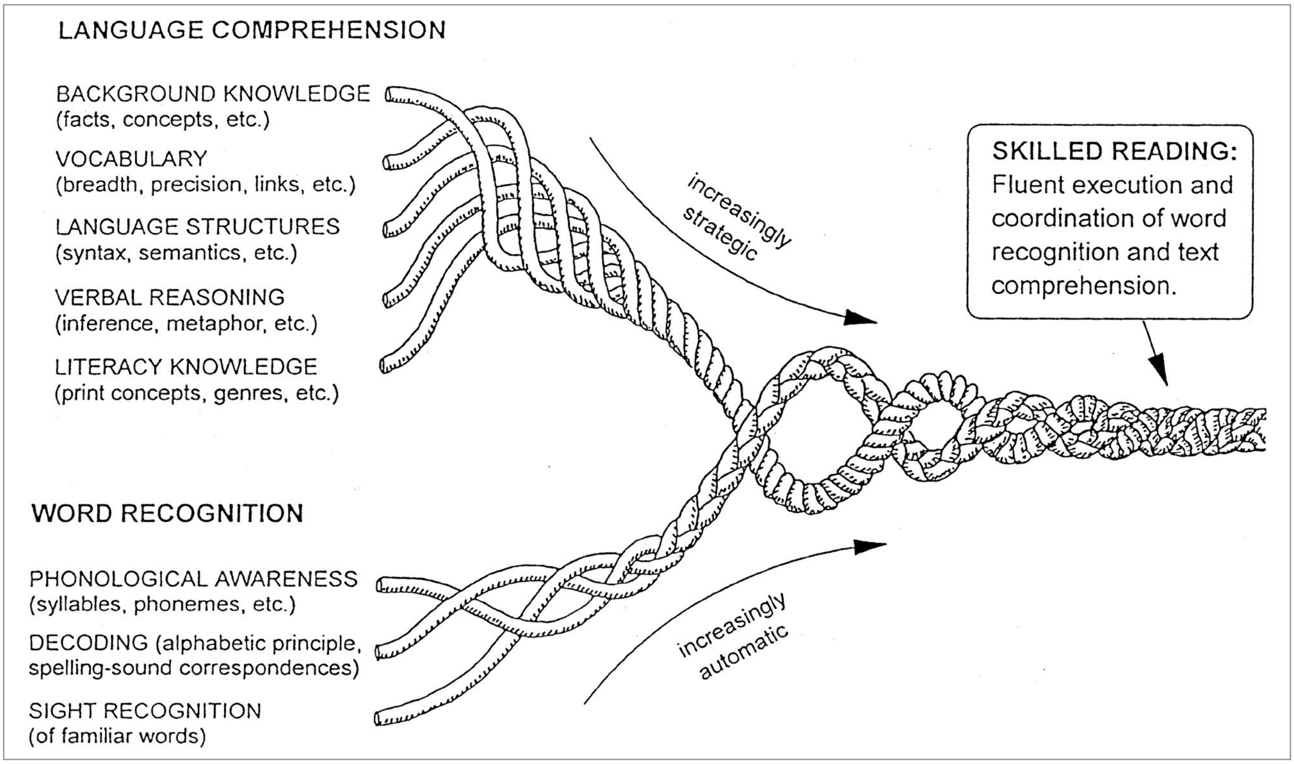
engagement, and EF—are not included in the original rope model at all. Notably, Cutting and colleagues' (2015) update of the rope model incorporates EF through arrows surrounding each strand of the rope. However, as we noted earlier, the original rope model, without attention to EF, is the version most commonly shared with and referenced by practitioners (e.g., International Dyslexia Association, 2018).

In sum, the rope model unpacks the word recognition and language comprehension constructs of the SVR and shows that, at least eventually, they are coordinated. However, quite understandably given the age of the rope model, it does not reflect some other key research advances from the science of reading, such as the contributions of theory of mind, morphological awareness, GSF, motivation and engagement, and EF to reading. The rope model also does not fully reflect research showing shared variance or bridging processes between language comprehension and word recognition, nor does it guide practitioners to consider potential causes for reading comprehension difficulties outside word recognition and language comprehension. Therefore, we see the active view of reading as a valuable update to the rope model, reflecting more of the research that has been conducted on the science of reading.

The DIME and DIER Models

Goals in model building vary. Our goal in proposing the active view of reading was to offer an alternative to the dominant model presented to practitioners, the SVR, that reflects key insights from scientific research on reading not captured in the SVR. Other models that have been proposed to expand on the SVR have been intended to model statistically the processes involved in skilled reading, so the models have been presented as structural equation models with factor loadings and so forth. Two theories that model reading in this way, which we mentioned previously, are the DIME and DIER models. Each unpacks the word recognition and language comprehension components of reading, while drawing attention to other contributors to skilled reading not obvious, or completely missed, in the original SVR. For example, the DIME model adds background knowledge, inference, and strategies constructs (Ahmed et al., 2016), and the DIER model adds inference, comprehension monitoring, grammar, working memory, and theory of mind components (e.g., Kim, 2017). Neither model fully addresses the self-regulatory variables we identified in the active view of reading, such as domain-general and reading-specific EFs and motivation and engagement. Also, neither model addresses the substantial overlap between word recognition and

FIGURE 3
The Rope Model of Reading



Note. From "Connecting Early Language and Literacy to Later Reading (Dis)abilities: Evidence, Theory, and Practice," by H.S. Scarborough, 2001, in S.B. Neuman and D.K. Dickinson (Eds.), *Handbook of Early Literacy Research* (Vol. 1, p. 98), New York, NY: Guilford. Copyright 2001 by The Guilford Press. Reprinted with permission.

language comprehension constructs, as well as the skills that bridge both constructs. Understandably, given the two models' purposes, neither as readily offers practical implications for identification of, and intervention for, students with reading difficulties.

The Componential Model of Reading

Soon before the rope model (Scarborough, 2001) was published, Joshi and Aaron (2000) published "The Component Model of Reading: Simple View of Reading Made a Little More Complex." Their model, now called the componential model of reading, has undergone multiple iterations (e.g., Aaron, Joshi, Boulware-Gooden, & Bentum, 2008; Li, Koh, Geva, Joshi, & Chen, 2020). In brief, the componential model features a cognitive domain with word recognition and linguistic comprehension as the two primary components (drawn from the SVR); a psychological domain, which includes motivation; and an ecological domain, which includes contextual factors, such as the number of books in the home. The inclusion of these ecological factors suggests that the purpose of the model is somewhat different from the purpose of the SVR and other models discussed in this article. The componential model aims to include constructs, such as number of books in the home, that are not actually part of the process of reading, not implicated in reading disability, and not amenable to instruction.

The componential model of reading has been empirically supported in studies that tested various complex statistical structural models, similar to the DIER and DIME models, to understand how constructs within the cognitive, psychological, and ecological domains interact to predict reading (for a test of this theory in bilingual learners, see Li et al., 2020). Additionally, the componential model provides some implications for instruction, such as addressing students' weaknesses in components of decoding (word recognition) or linguistic comprehension, improving motivation, and considering ecological factors that may impact reading comprehension (Joshi, 2019).

One way in which the componential model of reading differs from the active view of reading is that the former model points to the SVR's original, limited classifications in conceptualizing bases of reading disability (Joshi, 2019), whereas the latter model draws attention to factors within and outside word recognition and language comprehension as potential causes of reading disability. A second way the componential model differs from the active view is that the former model's cognitive domain parallels that of the SVR and its contemporary expansion, the rope model (Scarborough, 2001), by proposing two separate constellations of skills that constitute the word recognition and language comprehension components. The active view of reading expands on the componential model by addressing the substantial overlap between, rather than orthogonality of, word recognition and language comprehension and identifying bridging processes that contribute to both elements of the componential model's cognitive domain. Finally, a third way the active view expands beyond the componential model is in the inclusion of active, self-regulatory processes that drive word recognition, language comprehension, and the processes that bridge those skills. The componential model's inclusion of motivation and ecological factors certainly extends it beyond the SVR. However, in our reading of the componential model, there is no component that addresses causes of reading disability beyond those within word recognition or language comprehension, the shared variance (i.e., overlap) between word reading and linguistic comprehension, or some self-regulation processes that contribute to and through that overlap, such as executive functioning (e.g., Taboada Barber et al., 2021).

The Cognitive Foundations Framework

As noted earlier, two of the researchers involved in the original work on the SVR offered a new model called the cognitive foundations framework (Hoover & Tunmer, 2020). This model retains the notion that reading comprises two broad constructs, word recognition (decoding in the original SVR) and language comprehension (originally either linguistic or listening comprehension in the original SVR). The cognitive foundations framework unpacks language comprehension into two components: (1) background knowledge and inferencing skills and (2) linguistic knowledge. Within linguistic knowledge, the model lists phonological, syntactic, and semantic knowledge. Within word recognition, the model lists one component, orthographic coding skill. Within orthographic coding skill are concepts about print and knowledge of the orthographic principle. Finally, knowledge of the orthographic principle comprises knowledge of orthographic units and phonological awareness.

All of the constructs in the cognitive foundations framework are also included in the active view of reading, although they are sometimes grouped, subgrouped, or labeled in different ways. Some items within the active view of reading are not included or explicitly named in the cognitive foundations framework, such as morphological awareness and theory of mind. The active view of reading also differs from the cognitive foundations framework in reflecting the shared variance between word recognition and language comprehension and the bridging skills that cut across and contribute to both of these constructs. Hoover and Tunmer (2020) noted a bidirectional relation in that better reading comprehension contributes to better word recognition and better language comprehension over time. The active self-regulation component of the active view of reading (which, again, includes motivation and engagement, EF skills, and strategy use) is not included in the cognitive foundations framework. With respect to categorization of reading disabilities, Hoover and Tunmer presented a more complex typology than in the SVR, although they continued to have all disabilities occurring through word recognition, language comprehension, or both. We reviewed research supporting our position with respect to each of these differences earlier (see Table 1), and with respect to instruction, example studies are provided in Table 2.

Limitations of the Active View of Reading

Although we see our active view of reading model as comparing favorably with existing models of reading, it has several limitations that should be noted. First, it only reflects research conducted to date. We fully expect that as research on the science of reading continues, our model will need to be updated or replaced as well. Second, like the SVR, our model directly addresses only reader factors in reading, not how texts, tasks, and sociocultural context impact reading or reading development. In previous work aimed at practitioners, we attempted to use a metaphor, driving, to explain the role of text and context, as well as the reader, in the reading process (Cartwright & Duke, 2019; Duke & Cartwright, 2019). There have also been important efforts to build and test models that illuminate for the research community how texts and contexts impact reading (e.g., the complete view of reading; Francis, Kulesz, & Benoit, 2018), but understandably, those models consider far fewer reader factors than we have included here. All of this said, our highlighting of the role of the reader's cultural and other content knowledge in our model identifies a mechanism by which the sociocultural context and the reader's social identity, including racial, religious, socioeconomic, gender, and many other sociodemographic aspects of identity, impact the reading process.

A third limitation of our active view of reading model is that it has not been tested as a whole in research. As shown in Table 2, each element within the model has been tested in instructional research demonstrating positive, causal influences on reading comprehension. The ways in which we characterized relations among the elements (e.g., the overlapping or shared variance, the influence of active self-regulation on both language comprehension and word recognition) have also been tested in research. However, the model as a whole is in need of testing.

Another limitation of our model is that, like the SVR, it does not reveal how contributors to reading change over time and, thus, how instructional targets in reading education might change over time. The lack of developmental information conveyed by the SVR continues to be the subject of critique, although it should be noted that the SVR allows for the relative importance of word recognition and language comprehension in reading to shift over time, which reflects research findings that as readers advance, word recognition skill explains progressively less variance in reading comprehension, and language comprehension explains progressively more (e.g., Gough, Hoover, & Peterson, 1996; Hogan et al., 2014; Kershaw & Schatschneider, 2012; Language and Reading Research Consortium, 2015). Building developmental models is an important direction for continued research, particularly in light of the substantial portion of variance in reading ability longitudinally that is left unexplained by word recognition and language comprehension alone. In a meta-analysis of 42 studies that examined predictors of reading longitudinally, Hjetland, Brinchmann, Scherer, Hulme, and Melby-Lervåg (2020) found that approximately 40% of variance was not explained by word recognition and language comprehension, leaving considerable room for further explanation. That said, our aim in this article is more modest: to offer an alternative to the dominant model presented to practitioners, the SVR, that conveys key advances from scientific research on reading not captured in the SVR. What our model lacks in simplicity, it makes up in actionability, pointing to many specific contributors to reading, and their relations, that practitioners can impact through instruction.

Communicating the Science of Reading

The researchers who developed the SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990) made a landmark contribution to the field. As is typical in science, they drew on the work of previous scientists, such as Huey (1908), and in turn, many scientists have since built on the SVR creators' work. Over decades, research studies have identified many productive modifications and additions to the original SVR, and many researchers have pointed to directions for understanding reading beyond the SVR (e.g., Catts, 2018; Cervetti et al., 2020; Hoffman, 2009; Nation, 2019; Snow, 2018). As Seidenberg, Cooper Borkenhagen, and Kearns (2020) argued, "theories of reading have become more complex and less intuitive as the field has progressed" (p. S119), and the field now needs to pay greater attention to how to communicate and translate the science of reading in ways that support practitioners and the students with whom they work. Given the enormous popularity of the SVR as the guiding framework for the current "science of reading" movement, many practitioners have not yet been offered other models that can more productively guide their practice. The active view of reading better reflects the current science of reading by accounting for cases of reading comprehension difficulty despite age-appropriate word recognition and language comprehension, by explicitly naming a number of constructs that research has shown to be entailed in reading, by depicting the considerable shared variance or overlap between word recognition and language comprehension, and by including a key role for active self-regulation. Of particular value for practitioners is that each element within the active view of reading has been shown, when taught, to improve reading comprehension through scientific research.

Developments in our understanding of reading, particularly contributors to reading that are amenable to instruction, require updating and enhancing initial and continuing professional development of teachers, literacy specialists, instructional coaches, speech and language pathologists, and others who interface with U.S. reading education. There is no shame in the need for revision; in fact, it is a sign of embracing science over ideology, progress over nostalgia. One productive direction for future research is to design and conduct studies in which teachers are randomly assigned to professional learning guided by the SVR or by the active view of reading (or other, more complex models of reading) to see which has a greater impact on students' learning.

Many fields have focused attention on how to ensure that practitioners within the field can stay current with developments in research in the field. For example, in medicine, providing effective continuing medical education for physicians has been the subject of numerous publications and initiatives (e.g., Dowling, Last, Finnigan, & Cullen, 2018). This literature is predicated on the fact that medical research continually identifies improvements in patient care of which physicians and other medical professionals should be aware. Similarly, research related to reading education (and other educational domains) continually offers new insights that should be known to teachers and others involved in education. We look forward to the field's deeper engagement in this enterprise.

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Submitted July 20, 2020
Final revision received March 22, 2021
Accepted March 24, 2021

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