The Complex Nature of Reading Fluency: A Multidimensional View

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Reading fluency is commonly defined as reading accurately at a quick rate with appropriate prosody—a simple sounding definition. In fact, this definition hides complex processes and skills needed to produce the seemingly effortless performance of a fluent reader. Using both theory and empirical research, the presence and role of underlying processes and knowledge such as decoding fluency, processing speed, vocabulary, letter sound fluency, and sight word fluency are discussed. In doing this, we explain the elements needed for fluent reading and how they relate to each other in a multilayered fashion in young readers, and discuss the implications of this model in the development and assessment of reading fluency.

Reading fluency is a topic that has received considerable attention in recent years. Since the Report of the National Reading Panel was published in 2000, attention has shifted from phonemic awareness and decoding to those areas...
where less consensus has been established, including reading fluency. As a result of the renewed interest in this topic, the lack of agreement on what reading fluency actually is has been brought to the forefront. Reading fluency is often defined as accurate reading of connected text at a conversational rate with appropriate prosody (e.g., Armbruster, Lehr, & Osborn, 2001; Hudson, Lane, & Pullen, 2005; National Reading Panel, 2000) and is often measured as a combination of rate and accuracy—the number of correct words read aloud in one minute (e.g., Fuchs, Fuchs, & Maxwell, 1988; Shinn, Good, Knutson, Tilly, & Collins, 1992; Torgesen, Rashotte, & Alexander, 2001). Eschewing the concept of rate, Daane, Campbell, Grigg, Goodman, and Oranje (2005) define fluency “in terms of phrasing, adherence to the author’s syntax, and expressiveness” (p. v)—in other words, prosody. Taking a slightly different stance, Samuels (2006) defined reading fluency as “decoding and comprehending at the same time” (p. 39) and suggested that rate, accuracy, and prosody are indicators that this happening.

The variability in these definitions reminds us that reading fluency is a complex, multifaceted construct. In theory, because reading fluency is typically assessed while students are reading meaningful text, one’s definition of fluency might easily encompass all that is important about “proficient reading”: it is accurate and efficient, it occurs with reasonable speed that varies with the text, and it involves good comprehension of the meaning of the text. The definitions outlined above differ in the extent to which they emphasize one or more of the dimensions of what is typically meant by proficient reading of text. The definition offered by Daane et al. (2005) emphasizes comprehension as the most important part of the definition of reading fluency (because prosody of oral reading reflects comprehension), while the operational definition often used in studies of oral reading fluency (e.g., Fuchs et al., 1988) emphasizes accuracy and rate of reading. Samuel’s definition (2006) is actually theoretically driven, as his earlier work (LaBerge & Samuels, 1974) implies that decoding and comprehension are most able to occur together when parts of both processes operate “automatically.” Rate is one dimension of automaticity; suggesting that decoding and comprehension must occur together in fluent reading is to imply that decoding, or word identification, is occurring at a reasonable rate.

When thinking about the components of a definition of reading fluency, we are reminded of this statement by Wolf and Katzir-Cohen (2001):

[T]he unsettling conclusion is that reading fluency involves every process and subskill involved in reading. . . . Unlike reading accuracy, which can be executed without utilizing some important reading components like semantic processes, we argue that fluency is influenced by the development of rapid rates of processing in all the components of reading.

(p. 220)
Fuchs, Fuchs, Hosp and Jenkins (2001) add to this emphasis on complexity:

“Oral reading fluency represents a complicated, multifaceted performance that entails, for example, a reader’s perceptual skill at automatically translating letters into coherent sound representations, unitizing those sound components into recognizable wholes, and automatically accessing lexical representations, processing meaningful connections within and between sentences, relating text meaning to prior information, and making inferences to supply missing information.” (pp. 239–240)

These researchers, along with Adams (1990), Ehri (e.g., 1998), Laberge and Samuels (1974), and Perfetti (1985), were among the first to unpack reading fluency by examining the various processes, skills, and knowledge needed to read fluently. We join in their efforts to discern the multifaceted nature of the construct in order to better understand how to assess and teach reading fluency.

MULTIDIMENSIONAL NATURE OF READING FLUENCY

The purpose of this article is to discuss our conceptual framework for reading fluency and its implications for assessment and instruction. We will explain the elements needed for fluent reading and how they relate to each other in a multilayered fashion, and discuss the implications of this model in the assessment and instruction of reading fluency. Before we outline our framework, however, we must acknowledge that we will address only part of what many reading scientists regard as the complete definition of reading fluency. Our focus will be primarily on the aspects of reading fluency that involve accuracy and rate, rather than prosody or reading comprehension. We will discuss comprehension only as it relates to, or is facilitated by, accurate reading that occurs at a reasonable rate. We recognize that this considerably narrows the focus of this paper, but it is beyond the scope of our current expertise to present a framework that encompasses all aspects of fluency in the reading process.

Theoretical Assumptions

It is important to make explicit the theoretical assumptions underlying our conceptual framework. First, we assume that the processing taking place during reading is parallel rather than serial (McClelland & Rumelhart, 1986; Seidenberg & McClelland, 1989). Adams’s (1990) model of reading processing illustrates the interconnection of the orthography, phonology, and morphology of words as they are read. The orthographic (visual),
phonological (sound), meaning, and context processors work together in a parallel fashion to decode words and derive meaning from print. Through feedforward and feedback information, lower-level processes affect and are affected by higher-level processes. (For a complete explanation, see Adams, 1990.)

Our second assumption is that automaticity at the sub-lexical and lexical levels is necessary for fluent reading. According to Logan (1988, p. 493), “automaticity is memory retrieval: performance is automatic when it is based on single step direct-access retrieval of past solutions from memory.” For a process to be automatic, it must be fast, effortless, autonomous, and able to be completed without conscious control or attention (Laberge & Samuels, 1974; Logan, 1988, 1997; Posner & Snyder, 1975). When applied to reading, these elements are easily identified. Speed can be seen in the instantaneous reading of sight words, words that are read as a whole from memory, which is much quicker than any analytic process such as using analogy or phonemic decoding (Ehri, 1998). Effortlessness is obvious when observing a fluent reader read for hours without a break or fatigue. Effortlessness is also linked to lack of demand on attentional resources, meaning that when word recognition is automatic, attention can be devoted to understanding what is read (Laberge & Samuels, 1974). Autonomy is most easily seen by the lack of control a reader has over word recognition; the process is encapsulated and occurs whether a reader wishes to read the words or not, as evidenced by the Stroop effect (Ehri, 1987). Finally, automatic processes happen so quickly that they are beyond conscious control or analysis by the reader. It is impossible for a good reader to explain how he or she automatically reads a word by sight.

Automaticity in reading can be thought of as a race between memory (e.g., sight word reading) and an algorithm involving analysis (e.g., use of analogy, context, or phonemic decoding) (Logan, 1988). When a reader can recognize a word automatically, the memory trace will always produce faster identification of the word than a process that requires analysis and application of an algorithm. Automaticity is not an all-or-nothing proposition, but rather follows a predictable curvilinear pattern of increasing speed to an asymptote. The main mechanism for improvement in automaticity is practice with consistent input (letters) and consistent output (sound and meaning) pairings (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).

Automaticity is also item-specific. Because it is based on memory traces (Logan, 1988, 1997), each letter, each rime, and each word becomes automatic, with little transfer to other letters, rimes, or words. However, there will be transfer between words that share the same letter patterns (Berends & Reitsma, 2007; Ehri, 2002). This item-specific phenomenon explains the effect text difficulty has on reading fluency because the number of words that a reader can read automatically will vary based on the difficulty and topic of
the text. No reader is either fluent or not fluent; instead we can speak of a reader who is fluent in a given text.

A third assumption in our model is that automaticity in reading text follows a predictable pattern of development, from the use of simple visual cues for words through the use of the alphabetic principle to identify unfamiliar words in text, to reading words “at a single glance” using fully-amalgamated representations in memory (Ehri, 1992). As Ehri (2005) comments:

How do children learn to read words by sight? The process at the heart of sight word learning is a connection-forming process. . . . Readers learn sight words by forming connections between letters in spellings and sounds in pronunciations of the words (Ehri, 1992, 1998). The connections are formed out of readers’ knowledge of the alphabetic system. (p. 170)

For a theoretical discussion of how readers develop automaticity in reading words, interested readers are directed to Ehri (1998, 2002, 2005).

Like Perfetti (1985), we assume that reading processes share limited-capacity processing resources often termed working memory. These resources limit the amount of processing and storage in memory that may occur simultaneously. According to Perfetti’s verbal efficiency theory, as processes become more efficient or automatic, they use fewer of the resources of working memory, allowing other processes to proceed more completely. The higher-order processes of comprehension such as proposition encoding, inferring, interpreting, and integrating information are, by their very nature, resource-intensive. In contrast, processes such as letter recognition, word recognition (access to the word’s name), and semantic encoding (access to the word’s contextual meaning) may become extremely efficient and automatic. When these processes are sufficiently automatized, according to verbal efficiency theory, this frees up working memory space for additional, or more complex comprehension processes. Conversely, when word recognition processes are not efficient, they cause a bottleneck that constrains the operation of comprehension processes in working memory.

Conceptual Framework

Like previous researchers, we see reading fluency as a complex orchestration of multiple sub-processes working at different levels—letter recognition to meaning construction—that logically should explain individual differences in reading fluency defined in the broadest sense. We have previously explained parts of our conceptual framework that focuses primarily on reading accuracy and rate (Hudson, Torgesen, Lane, & Turner, 2006; Torgesen & Hudson, 2006; Torgesen et al., 2001), but here we expand those beginnings, which are visually represented in Figure 1. It is immediately obvious from
Figure 1 that our discussion of the elements of reading fluency is restricted to those that are important for accurate and rapid word recognition. What we have explicitly left out of this model is the possible influences that comprehension may have on reading rate and accuracy (Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003b), except as that is indicated in the arrow descending from reading comprehension to reading fluency. We have also left out, of course, any explicit consideration of the factors that lead to fluent comprehension.

The terms automaticity and fluency are often used interchangeably, but the concept of automaticity actually implies more about a response than does the concept of fluency. In this paper, we will restrict the use of the word automaticity to situations in which we mean to imply that a response is “automatic” in the sense that it requires few processing resources, is obligatory, and outside of conscious control. In most cases involving practical assessment of fluency, we do not actually know whether the fluent response also has these characteristics of automaticity. We will use the terms fluency and efficiency to refer to these instances.

**ELEMENTS OF DECODING EFFICIENCY**

Following the model from the lowest level up to reading comprehension, we begin at the sub-processes that are related to differences in decoding automaticity. Because beginning readers routinely encounter words they
have never read before while reading text at their general grade level (and this process continues through elementary and into middle and high school), decoding unknown words quickly and accurately by identifying the sounds associated with the letters in a word and blending these sounds together to approximate the word's pronunciation is an important part of our restricted model of reading fluency. If any of the analytic or knowledge retrieval processes that are required for decoding unknown words operate slowly or inaccurately, this should have a noticeable impact on both the speed and accuracy of decoding unknown words.

**Phonemic Awareness.** More than 20 years of research has established the importance of phonemic awareness in learning to decode (e.g., National Reading Panel, 2000; Rayner et al., 2001; Wagner & Torgesen, 1987). Decoding involves not only identifying the sounds associated with the letters in a word, but also blending these sounds together to form the word's pronunciation. If this blending process isn't fluent, then we see readers who have difficulty blending the letter sounds they identify into a word, often leading to multiple attempts to correctly pronounce an unknown word.

**Letter Knowledge.** Learning grapheme-phoneme (letter-sound) relationships is at the heart of the alphabetic principle. Without the knowledge of how sounds are systematically represented by letters, children cannot be successful readers in an alphabetic language (e.g., Adams, 1990; Ehri, 1998; National Reading Panel, 2000). Because decoding novel words typically involves assembling or blending together multiple letters/sounds, if these letters and the sounds they represent are not identified automatically, then the whole decoding process will suffer and become less efficient (Wolf & Bowers, 1999). According to Adams (1990), speed and accuracy in letter recognition is critical to the whole endeavor. If letter recognition is too slow, the activation of the first letter is gone before the last is activated, and the spelling pattern is not perceived:

> Letter identification must proceed quickly enough that the units representing all of the letters within a spelling pattern are near peak excitation at once. (Adams, 1990, p. 162)

**Larger Letter Patterns.** Automaticity in the recognition of phonograms (i.e., letter groups within a word that share a pattern across words such as rimes and suffixes) is also critical in the development of decoding fluency. Without knowledge of patterns across words, students will not be able to move to more advanced, efficient decoding involving recognition of phonograms represented by multiple letters in addition to phonemes represented by single letters (Ehri, 2002). In addition, English is more regular at the level of rimes
(a vowel plus syllable ending) and larger chunks than at the phoneme level (Kessler & Treiman, 2003; Moats, 2000), making sound-symbol relationships at that level more predictable and useful in decoding words. Readers need to develop context-sensitive mappings of relationships between phonemes and graphemes as well as larger units (Brown & Deavers, 1999) to become fluent decoders.

**Evidence.** We provide evidence of these proposed relationships using research conducted by several of the authors. We investigated the role these sub-processes play in explaining the decoding rate and accuracy of 209 children in second grade (Hudson, et al., 2006). To measure the decoding automaticity of the students, we used the Nonsense Word Fluency subtest (NWF) from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Good & Kaminski, 2002) and the Phonemic Decoding Efficiency (PDE) subtest of the Test of Word Reading Efficiency (Torgesen, Wagner, & Rashotte, 1999). The predictor variables were fluency in letter sounds (LSF), phonemic blending (PBF), naming of phonograms (PGF), orthographic coding knowledge (Olson, Forsberg, Wise, & Rack, 1994), RAN-letters (CTOPP; Wagner, Torgesen, & Rashotte, 1999), and speed of global processing (Woodcock Johnson Cognitive Battery).

We analyzed our data using structural equation modeling, and our results indicated that when the predictor variables were considered separately, all were significantly related to decoding fluency (see Table 1 for the

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<th>TABLE 1 Predictors of Decoding Automaticity</th>
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<td>Phonemic blending fluency</td>
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* *p < .05, **p < .01.  
Model is saturated, so no model fit statistics are available.  
\( \chi^2 = 0.08, \text{ df} = 1 \text{ CFI} = 1.00 \text{ RMSEA} = .000 (90\% CI .000 to .006). \)  
\( \chi^2 = 14.92, \text{ df} = 11 \text{ CFI} = .996 \text{ RMSEA} = .042 (90\% CI .000 to .091). \)
standardized structural coefficients). We next controlled for all of the predictors with a model that included all variables. In that model, processing speed, naming rate and accuracy for phonograms, and orthographic knowledge had significant direct relationships to decoding fluency (see Table 1). There were substantial correlations among the phonological tasks (LSF, PBF, and PGF) and between each of them and RAN, in contrast to orthographic knowledge, which was not related to the phonological tasks.

For this article, we conducted a post-hoc analysis to explain relationships among the predictor variables and phonogram naming fluency and orthographic knowledge. These models are found in Figures 2 and 3. Our findings indicate that fluency in phonemic blending, letter sounds, and phonograms are related to each other and to decoding fluency in a complex, multilayered fashion. The effects of phonemic blending and processing speed were mediated by automaticity in letter sounds rather than a direct effect, although other variables are also at work, as the model explains only 38% of the variance in phonogram naming fluency. With orthographic knowledge, only 15% of the variance was explained, but within that variance, there were no mediated or direct effects from letter sound or phonemic automaticity, with the only effects coming from RAN-letters and processing speed.

ELEMENTS OF READING FLUENCY

**Word-Related Processes**

Sight word automaticity. How automatically readers can identify the words in the passage has a large role to play in how fluently they read. We have found in previous work that the size of a reader’s sight word vocabulary, or the proportion of words in any given passage that can be recognized by sight, plays a pivotal role in how quick and accurate a reader is (Torgesen et al., 2001), particularly for students who are below average in reading rate. By “reading by sight,” we mean that “sight of the written word activates its spelling, pronunciation, and meaning immediately in memory” (Ehri, 1998, p. 8). If a student is asked to read a passage in which a relatively high proportion of the words must be decoded analytically or identified by contextual inference, this will have an obvious negative effect on reading fluency.

Decoding fluency. When words are not read by sight, they must be identified analytically. If too many words in a text must be identified analytically, then overall text reading fluency will suffer. Further, it may not be enough to be able to analytically decode unknown words accurately if that decoding process isn’t reasonably efficient. When children are not efficient
in the use of analytic decoding processes to read unknown words, they often fail to use those processes when reading, and their accuracy suffers. When considerable effort is expended in deciphering a word, the reader may expend that same level of effort for the next one, but is unlikely to do so for a third or fourth. It is exhausting to read text with unfamiliar words when one’s decoding processes are not fluent.

Orthographic knowledge. How well word-specific orthographic knowledge is represented in a reader’s lexicon contributes to early reading achievement (Ehri, 1992). Knowledge of the specific, unique visual spelling patterns in words (Vellutino, Scanlon, & Tanzman, 1994) plays a role separate from that of sound-symbol relationships. A commonly used method to assess orthographic knowledge developed by Olson et al. (1994) is to ask a student which of two letter strings with identical pronunciations is a real word (e.g., blume, bloom). Thomson et al. (2005) found a direct relationship between orthographic knowledge and reading accuracy, reading rate in connected text, reading comprehension, spelling, and written composition in children and adolescents with dyslexia. Hudson et al. (2006) also found orthographic knowledge to play a large role in the decoding fluency of second graders, a finding that suggests that naming nonsense words can occur by either using sound-symbol relationships or analogies to larger patterns in known words.

Integration of multiple cues. Many unknown words in text cannot be decoded completely by using phonemic decoding processes alone. Children must first identify and blend individual sounds to obtain an approximate pronunciation for an unknown word in text, and then use their sense of the meaning of the passage to select a word that most “sounds like” the unknown word and makes sense in the context of the passage (Share & Stanovich, 1995; Snow, Burns, & Griffin, 1998). Integration of these graphophonemic and morphosyntactic cues is critical when determining the exact pronunciation of the word being decoded. The speed with which students can combine information from these multiple cues should contribute to the overall fluency of reading connected text.

Meaning Related Processes

Reading Comprehension. There is considerable evidence to suggest that the relationship between reading fluency (with an emphasis on accuracy and rate) and comprehension is reciprocal. Reading rate and accuracy have been identified as important facilitators of reading comprehension (Adams, 1990; Fuchs et al., 2001) in average and disabled readers (Breznič, 1987, 1991; Chard, Vaughn, & Tyler, 2002; Dowhower, 1987). More specifically, individual differences in reading rate and accuracy in the third grade were found in one large study to be the single most important factor in accounting
for differences in performance on a measure of comprehension of complex text (Schatzschneider, Buck, Torgesen, Wagner, Hassler, Hecht, & Powell-Smith, 2004).

On the other hand, it also appears that comprehension facilitates quick and accurate reading of text. For example, words in context are read faster than the same words out of context (e.g., Biemiller, 1977–1978). Using an eye-movement methodology and studying children reading in German, Radach (2006) found that the major locus of development from second to fourth grade appeared to be a large reduction in the time spent re-reading previously fixated areas of text. Rereading text usually indicates post-lexical sentence- and text-level processing (e.g., in order to comprehend the text and answer questions). If what we know about eye movement parameters for adults (Radach & Kennedy, 2004) is also true for children, then the mental effort in the service of post-lexical comprehension is a major ingredient of reading fluency, meaning that the more time readers spend in processing the meaning of the text, the lower their reading fluency is in connected text. Radach concludes that “it may well make more sense to see comprehension predicting fluency than vice versa” (Radach, personal communication). Jenkins et al. (2003b) found support for the view that the relationship between reading rate and comprehension is reciprocal. In examining fourth graders, they found that reading words in context explained more variance in reading comprehension than did reading the same words in a list (70% vs. 9%). They also found that the students’ reading comprehension score explained more variance in oral reading rate and accuracy in connected text than did reading the same words in a list (70% vs. 54%).

Passage context. Although passage context by itself does not play a large role in increasing word reading fluency for skilled readers (Stanovich & Stanovich, 1995), it does provide useful support for younger and poor readers (Ben-Dror, Pollatsek, & Scarpati, 1991; Perfetti, Goldman, & Hogaboam, 1979; Pring & Snowling, 1986; West & Stanovich, 1978). In addition, there is evidence of substantial priming effects on word reading due to various types of meaning cues (e.g., Forster, 1999; Hartsuiker & Westenberg, 2000), even when the prime is presented so quickly that the participant is not consciously aware of it. Children more adept at constructing meaning because of a larger knowledge base may experience a stronger beneficial effect of context on reading fluency than those who are less able to construct the meaning of a passage.

Vocabulary. It seems likely that the speed with which word meanings are identified would also affect the rate at which a passage is read. Because Perfetti suggests that both lexical access (word name) and semantic encoding (contextual word meaning) processes must be efficient, it is reasonable to think that reading fluency would be limited if semantic activation is not
automatic. Evidence of this possible relationship can be found in studies by Perfetti and Hogaboam (1975) and Lane et al. (2009/this issue). In addition to finding that good comprehenders read low-frequency and nonsense words more quickly than poor comprehenders, Perfetti and Hogaboam also found that whether a participant knew the meaning of the word significantly affected the poor readers but not the good ones. When reading words they did not know, poor comprehenders were both slower and less accurate than when reading words they knew the meaning of while good readers were equally fast and accurate with both types of words. Lane and her colleagues found that the receptive vocabulary of students in first and second grade predicted their end-of-year decoding and reading rate and accuracy scores and, in the first grade, the slope of improvement in reading rate and accuracy in connected text. As long as readers are under obligation to be actively thinking about the meaning of what they are reading, speed of identification of word meanings may play a role in limiting oral reading rate and accuracy.

Metacognition. While generally thought of as a part of reading comprehension, we suggest that metacognitive differences are likely to also influence reading rate and accuracy. While beginning readers often see reading as word recognition, better readers are likely to view reading as a problem-solving activity (Walczyk, 1994). Because metacognition refers to being aware of and regulating one’s own thinking, its application to this problem-solving is clear. The larger social context of a reading activity and readers’ purposes and motivation to read a particular text will all influence how fluently they read. Readers make many conscious and unconscious decisions about how to approach a reading activity based on a wide range of factors, and these decisions are likely to affect the rate at which they read the text.

For example, the value readers set on accuracy vs. speed will affect how quickly they read. Some students may be so concerned about making errors when reading orally for an audience that they unnecessarily slow their rate to provide an extra measure of insurance against mistakes. In contrast, other students may place a premium on getting through the text quickly, and as a result they make more errors than they would have if they allowed themselves to read at a little slower rate. This is an important issue to consider given the widespread use of oral reading rate and accuracy for progress monitoring and instructional decision making. Hudson, Torgesen, and Schatschneider (2006) looked at this phenomenon by providing differential cues to induce second grade students to have different reading goals while reading short narrative passages. They asked students to read carefully matched passages either for speed or for accuracy and counted how many words were attempted and number of errors in one minute. Hudson et al. found that, on average, students increased their reading fluency significantly under the speed condition while only increasing their error rate by one. Colón and Kranzler (2006) also studied this speed-accuracy trade off and
found that fifth-grade students read significantly faster when directed to do so than when asked to do their “best reading” or were given no prompt as to the reading strategy. However, in contrast to Hudson et al., students in this study also made significantly more errors in the speed condition than the other two. Pressley, Hilden, and Shankland (2006) also examined the effect of varying instructions on the reading rate and accuracy of third graders reading three DIBELS ORF passages. They contrasted directions that provided a non-specific cue (“do your best reading”), encouraged speed (read “as quickly as possible”), or encouraged reading for comprehension (“read in order to understand the story”). They found that for two of the passages, students read significantly faster when told to do their best reading than when cued to read for understanding. No other significant differences were found. Taken as a whole, these findings suggest that children can modify their reading rate with varying changes in accuracy, but do not always do so, and asking students to read for understanding may encourage a slower reading rate. More research is needed on the effects of various reading goals on the reading of students in elementary school.

Global Processes Related to Reading and Decoding Fluency

Rapid automatized naming (RAN). A large body of research has demonstrated the relationship of RAN to reading achievement across various samples of typical and atypical readers (Wolf, 1997; Wolf & Bowers, 1999). Rapid automatic naming can be thought of as a measure of lexical access (Wagner et al., 1993), a measure of speed of processing verbal information (Catts, Gillispie, Leonard, Kail, & Miller, 2002), or an index of a precise timing mechanism in reading (Wolf, Bowers, & Biddle, 2000). A timing deficit in RAN has been found in poor readers as compared to good readers (Catts et al., 2002; Wolf et al., 2000), and Thomson et al. (2005) found a direct relationship between rapid naming and reading rate in connected text, but not to accuracy measures, in children and adolescents with dyslexia.

Perfetti (1985) provides information that may help understand how RAN is related to decoding and reading rate. He suggests that a reader's rate of “general symbol activation and retrieval” will set overall processing rate limits so that “no other process can occur faster than the access and retrieval of an over learned symbol name” (p. 169). It may be that RAN-letters (as a measure of an overlearned symbol name) is a valid measure of this basic processing rate, and provides an estimate of the overall limit that plays a role once the other processes have reached their maximum levels of efficiency.

Global processing speed. Because the various levels of reading share limited resources, it stands to reason that how quickly and completely readers can process information will explain many aspects of reading fluency. The processing speed subtests of the Woodcock-Johnson Cognitive Battery (Cross-Out, Decision Speed, and Visual Matching) require participants to hold
information in their memory while simultaneously searching for items that meet certain requirements (are most alike or match), make a decision about the items, and count the number that should be marked. They are non-verbal and confound motor ability with pure processing speed, but provide a good proxy for the complex, simultaneous processes of reading fluently. Interestingly, the subtests are not equally related to decoding and reading rate and accuracy. In a sample of second graders, we found that decision speed was not significantly correlated to two measures of decoding fluency while visual matching, which involves digit strings, was (Hudson et al., 2006). Both were significantly related to oral reading fluency, but visual matching had a much stronger relationship (.45 vs. .22) (unpublished data).

Summary
The foregoing analyses indicate that effortless, fluent reading is the result of a large number of sub-processes that must be accomplished efficiently and automatically and that interact with each other (Breznitz, 2006). Without automatic access to letter-sound relationships, quick and accurate operation of phonemic analysis and blending processes, automatic access to knowledge of phonograms, a large number of words that can be recognized “by sight,” quick access to vocabulary knowledge, and efficient operation of basic information processes, reading fluency (at least the component of fluency involving reading rate) in reading text will suffer. We turn now to a discussion of the implications of this framework for assessment and instruction.

IMPLICATIONS FOR ASSESSMENT AND INSTRUCTION

The framework that we have proposed suggests that reading rate and accuracy is the result of efficient operation of multiple processes that must be executed either simultaneously or within a very brief time span. An individual must build fluency and automaticity at each layer to be a skilled reader. The multilayered fluency framework that we have proposed, in conjunction with models of development of word recognition skills such as those proposed by Ehri and her colleagues (e.g., Ehri, 2005), have implications for both assessment and instruction.

Often, assessments of students’ reading achievement, particularly for students beyond the primary grades, focus on reading comprehension (e.g., Biancarosa & Snow, 2004; Durkin, 1978). Most, if not all, state accountability tests require students to read extended passages and answer questions or write extended responses. Based on a student’s performance on these measures, it is determined that the student is either a good or poor reader. However, if the student does not perform well, this type of assessment does not provide information about where a breakdown is occurring (i.e., the
cause of the reading failure). Research by Buly and Valencia (2002) suggests that there are multiple areas of reading difficulty that can be associated with a failing score on a state test. The framework outlined in this paper suggests that it may be useful to assess multiple layers of fluency, in addition to other dimensions of skill and knowledge that contribute to reading comprehension, in order to obtain a more complete understanding to guide targeted reading interventions. Figure 4 illustrates our multilayered framework in a hierarchical fashion. Although the acquisition of these skills is not a perfect hierarchy, this model provides a foundation on which to base assessment and instruction. The interrelated sub-processes from Figure 1 are depicted on a ladder. Each rung on the ladder represents a sub-lexical or lexical process moving from phonemic awareness upward to the top rung which represents reading comprehension. In the following sections, assessment of efficiency or fluency in each layer will be discussed.

**FIGURE 4** Multileveled framework for assessing processes and sub-processes of reading fluency.
Like the definition of reading fluency, how to best assess it is currently a subject of controversy (e.g., Samuels, 2006). We suggest that to assess reading fluency, teachers must listen to students read aloud and consider a student’s word reading accuracy, reading rate, and prosody. Just as definitions or assessment procedures that address only reading rate and accuracy miss critical aspects of the broader conceptualization of reading fluency, so do definitions and assessments that emphasize only prosody and phrasing. Few would argue that although rate is not the only important aspect of fluency (broadly defined), it is one of the critical features of the concept.

The most common method for assessing reading fluency, frequently referred to as Curriculum-Based Measurement Oral Reading Fluency (R-CBM), measures the number of words read correctly in one minute. This method of assessing oral reading fluency has rich evidence of its validity and reliability (e.g., Deno, Marston, Shinn, & Tindal, 1983; Deno, Mirkin, & Chiang, 1982; Fuchs et al., 1988, 2001; Good, Simmons, & Kame’enui, 2001; Hosp & Fuchs, 2005; Marston, 1989; Shinn et al., 1992; Stecker, Fuchs, & Fuchs, 2005, but see Rasinski, 2004; Samuels, 2006). However, some researchers and teachers have suggested problems with a one-minute timing because a student may be able to sustain a rate for one minute that is not sustainable in a longer passage, potentially making it an inaccurate estimate of the student’s true fluency, or rate for longer passages.

Another issue some teachers have with R-CBM is the perception that some students, termed word callers, merely read the words aloud quickly and accurately without comprehending them, thereby providing an overestimation of the students’ reading achievement. Hamilton and Shinn (2003) investigated this phenomenon by comparing the reading fluency and comprehension of teacher-identified word callers (WC) and similarly-fluent peers (SFP). They found that the SFPs scored significantly better than the WCs on all measures of reading comprehension with very large differences between groups (E.S. from .92 to 1.36). They also found that the SFPs were significantly quicker and more accurate than the WCs (E.S. = 1.07). It would appear that the WCs were not reading fluently while comprehending little; they had large deficits in both areas. A final concern about the short, one-minute timing is that students are not required to decode and comprehend at the same time. Samuels (2006) suggests that this is simply a speed test, and that determining the CWPM on a short passage and asking comprehension questions may be a better measure of oral reading fluency. We recommend a combination of these methods that will provide the most accurate and valid picture of a student’s reading fluency, if the goal is to assess the full complexity of the fluency construct.
Judging by the lack of psychometric information, measuring prosody reliably is more difficult than measuring accuracy and rate, and consequently, it is done less frequently. However, many researchers maintain that to obtain a comprehensive analysis of oral reading fluency, prosody should be considered (e.g., Mathson, Allington, & Solic, 2006; Rasinski, 2004; Zutell & Rasinski, 1991). This will be easier to accomplish when scales with demonstrated reliability that are easy to administer have been developed. In the meantime, teachers can listen to a student read a passage orally and attend to the student’s inflection, phrase boundaries, and expression using a rubric or checklist (e.g., Daane et al., 2005; Hudson et al., 2005; Pinnell et al., 1995; Zutell & Rasinski, 1991). The results from Miller and Schwanenflugel (2006) suggest that pitch change at the end of declarative and yes/no question sentences would be particularly important to monitor. The National Assessment of Education Progress (NAEP) includes a measure with reasonable reliability and validity that provides a four-point scale evaluating a student’s phrasing of words, adherence to syntax, and expressiveness (Daane et al., 2005). The NAEP Fluency Scale is provided in Daane et al.’s *Fourth-grade students reading aloud: NAEP 2002 Special Study of Oral Reading* (NCES 2006—469, Washington, DC: U.S. Government Printing Office).

Assessing Sight Words

As a result of the reciprocal nature between comprehension and reading fluency, words that appear in context will be read more quickly than words read in isolation. However, Ehri (2005) and Samuels (2006) point out that in order to be fluent, readers must have unitized words such that they are recognized by sight; furthermore, this recognition must be automatic to ensure fluent reading (Torgesen et al., 2001). The lack of fluent sight word recognition skills appears to be a particularly salient aspect of the reading fluency problems of below average readers (Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003a). Thus, particularly for struggling readers, it is important to assess the extent to which students can recognize relatively common words fluently. The *Test of Word Reading Efficiency* (TOWRE; Torgesen et al., 1999), Sight Word Efficiency subtest is an easy-to-administer assessment of word reading fluency. This subtest assesses how many words a student can read aloud in 45 seconds: it is extremely reliable and has strong evidence for criterion validity. It only has two forms, and while good for diagnosis, it should not be used for monitoring progress in reading.

Assessing Phonogram Identification

Phonograms (i.e., letter groups within a word that share a pattern across words) are critical for readers to learn. Without knowledge of patterns across
words, they will not be able to move to more advanced, efficient decoding using chunks instead of phonemes (Ehri, 2002). In order to assess a student’s knowledge of common phonograms, we can construct a measure by listing common phonograms that are not words (for example, eed, op, um, ab, eam, arp). Lists of common phonograms are available in resources such as The Reading Teacher’s Book of Lists (Fry, Kress, & Fountoukidis, 2000), Word Matters: Teaching Phonics and Spelling in the Reading/Writing Classroom (Pinnell & Fountas, 1998), or district curriculum guides. In order to give this assessment, follow these instructions from Hudson (2006):

Choose three phonograms to use as practice items, and type them on a separate sheet. Put the practice items in front of the student and say, *I am going to ask you to read as many of these phonograms as you can.* A phonogram is a set of letters we see a lot in words, so you may have seen them before as a part of words you’ve read. Try to read each one like you would in a word, but don’t make it into a real word if it isn’t one. *I’ll show you how with the first one.* Read the phonogram aloud. *Now you try the next one* (point to the next one). If the response is correct, then say, *That’s right. Now read this one.* If the response is incorrect, say *The phonogram says_______. You try it* (Pause for answer). *Now read this one.* Put the list of phonograms in front of the student and follow the same procedures as for measuring R-CBM. This will yield a score of correct phonograms per minute.

While no norms exist for this new measure, it is reasonable to expect students to read phonograms at the same rate as single words at their grade level.

Assessing Phonemic Decoding

When assessing phonemic decoding, the essential element that is being indexed is the students’ understanding of the alphabetic principle. Because of this, assessing decoding efficiency is necessarily different from assessing sight word fluency. When provided with a real word, there is no way to determine if the student is using memorization or decoding skills. Because nonwords represent novel combinations of letters that students are unlikely to have encountered before, they most purely assess students’ knowledge of sound-symbol relationships, or the alphabetic principle.

One resource for a test of fluency in decoding is the DIBELS nonsense word fluency (NWF) subtest (Good & Kaminski, 2002). This subtest contains Vowel-Consonant (VC) and Consonant-Vowel-Consonant (CVC) combinations (e.g., ip, rop). Because the DIBELS provides multiple forms of this subtest, it can be used for progress monitoring as well as diagnosis. There is some disagreement about the adequacy of the DIBELS NWF subtest as a useful measure of the alphabetic principle for instructional decision
making (e.g., Fuchs, Fuchs, & Compton, 2004). Because students can receive a correct score for either saying the sounds in isolation or blended together, letter-sound knowledge and decoding are combined and students in transition from single letter sounds to phonemic decoding may be penalized by first saying the individual sounds and then blending the nonsense words together (Angus, 2007). Fuchs et al. (2004) also found that the slope of improvement in word identification fluency explained significantly more variance in oral reading rate and accuracy than DIBELS NWF did. However, Good et al. (2001) found that NWF had good classification accuracy when predicting performance on oral reading fluency (ORF), and Schatschneider (2006) found that NWF scores in fall of first grade had good specificity when identifying students who would go on to do well on a reading comprehension measure at the end of second grade. Good, Baker, and Peyton (2009/this issue) also found that NWF slope explained a significant amount of variance in the ORF of first graders after controlling for initial NWF status, while Powell-Smith, Castillo, Hudson, and Dedrick (in review) had similar results. They found that NWF slope explained a significant amount of variance in both ORF and reading comprehension in first grade and ORF in second grade students at low, moderate, and high risk after controlling for NWF initial status, vocabulary, and grade retention.

The TOWRE (Torgesen et al., 1999) provides another measure of phonemic decoding with its Phonemic Decoding Efficiency subtest. This subtest measures the number of nonsense words a student can pronounce correctly in 45 seconds. Unlike the DIBELS NWF subtest, this measure extends beyond VC and CVC combinations to include complex letter patterns (e.g., clirt, drep-nort, plenador) and requires a fully-blended response to be correct; thus, this measure is appropriate for older as well as younger students. As with the Sight Word Efficiency test, the reliability and evidence for validity are quite strong and there are only two forms, so while good for diagnosis, it is inappropriate for use in monitoring progress.

Assessing Letter Knowledge

Letter knowledge has long been recognized as a robust predictor of reading achievement (Catts, Fey, Zhang, & Tomblin, 1999; Pullen & Justice, 2003; Scanlon & Vellutino, 1996; Whitehurst & Lonigan, 1998). The DIBELS and AIMSWeb each provide a Letter Naming Fluency subtest. These measures assess a student’s ability to quickly and accurately name upper and lowercase letters. Assessments of letter knowledge should also include the extent to which an individual knows the corresponding sound for a grapheme. In addition to a letter naming fluency measure, AimsWeb (EdFormation, Inc., 2006) provides a letter-sound fluency measure that can be used to measure students’ automaticity in sound-symbol relationships.
Assessing Phonemic Awareness

Phonemic awareness includes the ability to detect, match, blend, segment, or otherwise manipulate the individual sounds (phonemes) in spoken language (Lane & Pullen, 2003). It is a necessary yet insufficient skill required to master phonemic decoding. Although rapid automatic naming tasks appear to have a stronger predictive value in kindergarten for later reading fluency, phonemic awareness is linked to later fluency outcomes and should be examined when reading difficulties occur (Allor, 2002; Phillips & Torgesen, 2006; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). In particular, assessment of phonemic awareness should focus on blending and segmentation skills, because these are the two skills most closely linked to decoding. Several measures of fluency in phonemic awareness are available, including the DIBELS Phonemic Segmentation Fluency (PSF) and Initial Sound Fluency (ISF) subtests (Good & Kaminski, 2002) and AIMSweb Phoneme Segmentation Fluency. While these are the only measures of fluency in phonemic awareness that we are aware of and have gone through substantial development and testing, assessors should pay careful attention to the validity of the scores for individual students and purposes when using these measures. DIBELS ISF has modest concurrent (.36 and .60) and predictive (.36 and .45) correlations with other measures of early reading achievement (Good et al., 2001; Hintze, Ryan, & Stoner, 2003), while PSF has larger concurrent correlations ranging from .53 (Hintze et al.) to .68 (Good et al., 2001) and predictive correlations ranging from .54 to .73 (Good et al., 2001).

Making Instructional Decisions

The assessment of each of the interrelated layers will determine where intervention is required. For example, if a student performs poorly on a measure of oral reading rate and accuracy, it is insufficient to begin providing intervention in fluency of connected text alone. If any one of the sub-skills is failing, it may be difficult for the student to profit from typical interventions that focus on practice reading text. Intervention, therefore, should begin at the point where the breakdown occurs. For example, if it is determined that a student has not developed fluency in decoding, then intervention should focus on explicit and systematic instruction in the alphabetic principle and include ample decoding practice. With that said, however, we should also acknowledge that it is not clear at this point exactly how fluent decoding skills must be in order to provide adequate support for the growth of text reading fluency. We believe that inaccurate practice of text is not as effective as accurate practice of text (Schwanenflugel & Ruston, 2007), but it is not clear how far decoding skills must be developed before text reading practice becomes an effective form of fluency instruction.
Wolf and Katzir-Cohen (2001) emphasize the importance of early instruction that ensures the growth of accuracy before problems in fluency can develop. They support approaches such as Ehri’s (1998), which begin with an emphasis on the development of word reading accuracy and shift to a focus on increasing the rate of processing. Ehri recommends that a primary goal of first-grade reading instruction should be to help children reach the full alphabetic phase of word reading. Practice at this level develops students’ decoding accuracy and readies children to read chunks and, eventually, whole words automatically.

One final point about the early instruction necessary to support reading rate and accuracy is raised in two relatively recent studies. One of these studies (Miller & Schwanenflugel, 2006) showed that prosody is a relatively strong indicator of whether or not a student is comprehending the text being read. Another study already cited (Jenkins et al., 2003b) showed that students who have greater comprehension of what they are reading also read more fluently. They hypothesized that certain “automatic” comprehension processes develop when students read large amounts of text while attending to meaning, and because of the reciprocal nature of reading fluency and comprehension, these relatively “automatic” comprehension processes are instrumental to the development of reading fluency. Thus, when teachers encourage students to read with prosody, they are actually encouraging them to attend to the meaning of what they read. Reading practice in which students are actively encouraged to attend to meaning thus builds both word recognition skills through repeated opportunities to practice reading individual words and also comprehension skills that make word recognition easier with resulting increases in reading fluency.

CONCLUSION

In this paper, we have attempted to outline the complex, multifaceted nature of reading fluency (with an admitted emphasis on the element of reading rate). The major lesson from this discussion is that teachers should not think of a single way of increasing reading fluency, but of multiple ways. Professional development for pre-service and in-service teachers needs to focus on ensuring a deep understanding of both the complex nature of reading fluency (Lane et al., 2009/this issue) and multiple methods to foster it in their students. However, the research of Ash, Kuhn, and Walpole (2009/this issue) suggests that this professional development should be ongoing and deliberately focused on helping teachers learn research-based practice sufficiently deeply to actually implement them in the classroom.

The early foundations for reading fluency are laid by attention to powerful instruction in the alphabetic principle and the establishment of reading accuracy. However, accurate readers who do not read large amounts of text
will not expand their sight word vocabulary sufficiently to be fluent readers by third grade, nor will their fluency continue to expand as they are required to read increasingly complex text after third grade. At the same time, we must encourage students to read for meaning from the earliest stages of reading instruction, as this supports the development of vocabulary, knowledge about the world, and the growth of automatic comprehension processes that themselves facilitate the growth of reading fluency. In short, the growth of reading fluency, in all its multifaceted glory, is an outcome of many different kinds of instruction and practice—it is the natural result of explicit, systematic, and comprehensive instruction coupled with large amounts of carefully orchestrated reading practice.

REFERENCES


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