Reading Fluency and the Role of Its Dimensions: Conceptualizations and Mechanisms

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Abstract: Based on a review of existing research, this analytical research paper presents a theoretical discussion of the function of two overarching dimensions of reading fluency—automatic word reading and prosody—and the relations between them from a perspective of cognitive science. We examine the term "fluency", which was first introduced to denote automatic word recognition in 1970, and then extended to include prosody—the expressive aspect of oral reading. We review the research evidence demonstrating that fluent readers recognize words easily and automatically, thus making limited demands on mental resources such as active attention and short-term memory. We trace how automaticity enables children to conserve mental resources needed for reading comprehension. Our review demonstrates that the directional relations of prosody and comprehension are not well understood and require further research.

Introduction

Based on a review of existing research, this analytical research paper presents a theoretical discussion of the function of the two overarching dimensions of reading fluency—automatic word reading and prosody—and the relations between them from a perspective of cognitive science. We examine the term fluency, which was first introduced to denote automatic word recognition in 1970s and then extended to include prosody—the expressive aspect of oral reading. We review the research evidence demonstrating that fluent readers recognize words easily and automatically, thus making limited demands on mental resources such as active attention and short-term memory. We trace how automaticity enables children to conserve mental resources needed for reading comprehension. Our review demonstrates that the directional relations of prosody and comprehension are not well understood and require further research.

Conceptualizations of Reading Fluency

Due to the dominant role of behaviorism before the 1950s and the whole language movement in the 1970s, reading fluency as a cognitive process did not arouse much interest in researchers and had long been neglected (Allington, 1983; National Institute of Child Health and Human Development [NICHD], 2000; Samuels, 2006). The few studies (Hebb, 1949; Huey, 1908) that explored the concept of reading fluency and how it developed were scattered through a large body of research literature spanning several decades. From the 1950s, the rise of cognitive psychology led some researchers to focus on the cognitive underpinnings of reading fluency and its contribution to reading comprehension.

Fluency is a term that has evolved over time. Originally, *fluency* was a concept found in speech pathology that represented the flow of syllables and words (Garnett, 2011). LaBerge and Samuels (1974) introduced this term to denote automatic information processing in reading, conceptualizing reading fluency as automaticity in word recognition. According to these authors, the degree of reading fluency can be divided into two levels — accuracy and automaticity. *Accuracy* focuses on the degree of success in word identification. It is associated with the extent to which children need to pay labored attention to the details of words, thus affecting reading speed. At the highest level of *automaticity*, reading becomes not only accurate but also quick and effortless. LaBerge and Samuels (1974) explained this process using the theory of automaticity, stating that with repetition and practice, children's minds can be freed from word recognition to give more attention to the semantic aspects of reading.

Other researchers (Schreiber, 1980, 1987, 1991; Schreiber & Read, 1980), however, found that automaticity of word recognition did not completely capture the nature of reading fluency. They pointed out that children who could decode quickly and effortlessly may still have problems with reading fluency due to difficulty in grouping words into sentences with proper expression — or prosody — which requires adequate understanding. Thus, they conceptualized reading fluency as the combination of prosody and automaticity in word recognition.

More recently, researchers have defined reading fluency in other ways, such as "the bridge from phonics to comprehension" (Rasinski & Samuels, 2011, p.95), "speed, accuracy, and proper expression" (NICHD, 2000, p. 3-1),

and "the ability to decode and comprehend at the same time" (Samuels, 2006, p. 39). Overall, these definitions have focused on two dimensions of fluency — automaticity of word recognition and prosody.

The Role of the Dimensions of Reading Fluency

In this section, definitions of and rationales for the two dimensions of reading fluency are discussed, as well as their respective roles in reading fluency and fluent reading.

Automaticity of Word Recognition

Definition. To understand this dimension, we first need to clarify the two key concepts. *Automaticity* can be explained and understood in the context of completing a mental task. Psychologists proposed that the amount of effort needed to complete a mental task falls between two extremes of a continuum, one end of which is called automatic processing and the other controlled processing (Adams, 2001). With a highly familiar mental task, the amount of effort required is closer to the automatic end of the continuum, where the task demands less active attention and can be completed quickly and unconsciously. With a less familiar mental task, the amount of effort required is closer to the controlled end of the continuum and so demands more active attention; it has to be completed slowly and with awareness (Schneider, 1999; Shiffrin, 1988).

Logan (1997) extended the understanding of automaticity by proposing four properties: it is fast, effortless, autonomous, and unconscious. The first two properties are self-evident. Automaticity is autonomous in that it requires no active attention and cannot be stopped by intention. If some cognitive process happens with automaticity, it means that one does not need to spend their attention on it and cannot stop it from happening. Automaticity is unconscious because automatic processes occur outside of human awareness. Controlled processing has four opposite properties: it is slow, has a high demand for active attention (effortful), is stoppable, and is a conscious effort.

To understand word recognition, it is necessary first to define decoding. Decoding — literally meaning to break the code — refers to the ability to retrieve word identity through the analysis of letter-sound relations (Gough & Tunmer, 1986; Harris & Hodges, 1995). Decoding also lies on a continuum; the slow and attention-consuming end is called *word attack*, and the end that operates quickly and needs little active attention is called *word recognition* or instant word reading (Beck & Juel, 1995). When decoding is analyzed as a mental task, word attack is related to controlled processing of a task, while sight-word recognition is related to automatic processing. Thus, automaticity of word recognition refers to the ability to understand the meaning of a word by connecting its print form to its spoken sounds in a fast, effortless, unstoppable, and unconscious way.

Role of the Automaticity of Word Recognition in Reading Fluency and Fluent Reading. To comprehend the importance of the automaticity of word recognition, it is necessary to also understand three important aspects of the reading process: the two mental resources used in the reading process, the two overarching processes of reading comprehension, and the differences in reading between beginning readers and skilled readers. Based on these three aspects, we analyze and discuss the role of word recognition automaticity in reading fluency and fluent.

First, two mental resources — active attention and short-term memory — play an important role in the reading process. One important feature of active attention is that it is indivisible and unifocal (Adams, 2001). In other words, it can focus on only one task at a time and cannot be distributed to other tasks. The other resource is short-term memory (STM), where language information can be stored temporarily (Harris & Hodges, 1995) at only 18 seconds (Samuels, 2006). Because of the limitations of these resources, reading efficiency and fluency are determined by whether one can use these resources economically and efficiently.

We then need to consider the components of reading and other relevant cognitive processes. According to the Simple View of Reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990), the reading process consists of two overarching components — decoding and linguistic comprehension. Decoding, as earlier noted, refers to the ability to retrieve word identity by matching the speech sound to the print (Gough & Tunmer, 1986; Harris & Hodges, 1995). Linguistic comprehension refers to the ability to understand the semantic information of words, sentences, and discourses. According to Hoover and Gough (1990), reading comprehension refers to the ability to process graphic information via visual input, while linguistic comprehension refers to the ability to gain meaning via language input,

whether auditory or other modes such as print. In addition, Samuels (2006) pointed out that a cognitive process called mental metacognition was also involved in the reading process, allowing the reader to self-monitor comprehension and use the information from self-monitoring to regulate the reading process. When readers detect confusion, for example, they may decide to reread an earlier section to resolve this confusion before proceeding further in the text.

In addition to the considerations of mental resources, cognitive processes, and the components of reading, it is necessary to understand the different processes experienced by beginning and skilled readers. According to Adams (2001) and Samuels (2006), beginning readers have low familiarity with the activity of reading; therefore, decoding, linguistic comprehension, and metacognition are all controlled processes that demand active attention. Since active attention is unifocal and indivisible, beginning readers must switch their active attention between decoding, linguistic comprehension, and metacognition, which makes the reading process laborious and time-consuming. In addition, due to the slower pace of beginning reading processes, only limited language information can be stored in the STM. Thus, within the amount of time available, only a limited number of words or sentences can be processed, which makes the controlled processing even slower and more effortful. In contrast to novice readers, skillful readers have a high familiarity with the activity of reading; for them, decoding, metacognition, and aspects of comprehension become automatic processes (Samuels, 2006). An automatic process does not demand active attention and thus can occur concurrently with the processing of other mental tasks (Adams, 2001). In other words, for a skillful reader, active attention can focus on the process of comprehension and does not need to switch between mental tasks. In addition, due to the speed of an automatic process, skillful readers can store more language information in STM and then process it, which makes the reading much faster and more effortless.

Research on these three aspects suggests that automaticity of word recognition is necessary for reading fluency and fluent reading. In other words, it largely determines whether a child may read quickly and effortlessly or slowly and haltingly. Empirical studies provide evidence for the relations between word recognition, fluency, and reading comprehension. Geva and Farnia (2012) found that children's word recognition ability had highly significant zero-order correlations with word and text fluency and reading comprehension for both first and second language learners in Grade Two and Five. Multiple regression analysis also indicated that Grade Five children's word recognition and text fluency contributed to the variance in their Grade Five reading comprehension. Other studies, such as that by Biemiller & Siegel (as cited in Bowers, 1993), found that children with poor comprehension tend to be weak in word recognition and reading fluency. Cadime et al. (2016) found that word recognition positively predicted reading comprehension through reading fluency. Nunes et al. (2012) reported that children's word recognition skills made independent contributions to their reading fluency and reading comprehension.

In summary, automaticity of word recognition, as one dimension of reading fluency, is a sign of the efficient use of cognitive reading resources, fast decoding and linguistic comprehension, and readers' skillfulness in reading. In short, automaticity of word recognition is the indispensable basis of reading fluency and fluent reading.

Prosody

Definition. Reading prosody refers to the ability to read in a melodic way with appropriate pitch, stress, and phrasing that conveys the meaning of a passage (Carreker, 2005; Garnett, 2011; Rasinski et al., 2009; Rasinski & Samuels, 2011). Prosody refers to the rhythmic flow of spoken words, which can help listeners understand the meaning of speakers (Garnett, 2011). A fluent reader is expected to read with appropriate prosody or expressiveness (Rasinski & Samuels, 2011).

The Role of Prosody in Reading Fluency and Fluent Reading. The theory of automaticity proposed by LaBerge and Samuels (1974) is one rationale for reading fluency. They suggest that automaticity of word recognition frees a reader's mind from the decoding process and contributes to reading fluency and fluent reading. Schreiber (1980, 1987, 1991; Schreiber & Read, 1980) pointed out that this rationale is not sufficient because fluent word recognition does not equate to fluent reading. Fluent readers still need to connect words into sentences appropriately and expressively; they need to know where to pause, where to emphasize, or where to use high or low pitch. Moreover, Schreiber (1980, 1987, 1991; Schreiber & Read, 1980) posited that good prosody results from sufficient understanding of the reading passage, which is also an essential aim of fluent reading. In other words, prosody connects automaticity of word recognition and reading comprehension (Rasinski & Samuels, 2011). Researchers have suggested that reading fluency also includes prosody as an essential component.

Research suggests that prosody is dependent on the comprehension of a reading passage. Schreiber's model of reading fluency (Schreiber, 1980, 1987, 1991; Schreiber & Read, 1980) posited that prosody is a good indicator of reading comprehension. Empirical studies (Daane et al., 2005; Rasinski et al., 2009) have supported this conclusion. Rasinski et al. (2009) found that the prosody of children from Grade Three, Five, and Seven had moderately strong correlations with their silent reading comprehension. Some studies, however, have reported contrary findings, noting that prosody may mask a significant lack of reading comprehension. Garnett (2011) offered the example of an adult subject who could read the newspaper with melodic expression but without understanding. This anecdote mirrors the example of many hyperlexics—young readers who have excellent decoding skills and can read rhythmically but cannot understand the reading material (Wren, 2000). Thus, prosody is not a stable indicator of children's comprehension of a passage.

With regard to causal relationships, Rasinski (1990, 1994) found that using phrase-cued text—that is, sentences that are split into phrases using visual cues such as "/" to assist reading — has a positive effect on the reading performance and syntactic sensitivity of certain types of children, including their reading comprehension. It should be noted that phrase-cued text merely represented one aspect of prosody. Rasinski et al. (2009) cited two studies (Miller & Schwanenflugel, 2006; Whalley & Hansen, 2006) to support their statement that a causal link exists between prosody and reading comprehension. However, both studies employed correlational designs that could not prove a causal relationship. Thus, as some researchers (Garnett, 2011; Rasinski & Samuels, 2011) have suggested, it is hard to draw a conclusion about whether prosody improves, results from, or merely indicates reading comprehension based on the present literature.

Although the role of prosody in reading fluency and fluent reading is unclear, prosody needs to be further investigated in future research because it is necessary for children to learn how to read expressively with understanding, and little is known about this phenomenon. As Rasinski and Samuels (2011) stated, more attention should be paid to the relationship between prosody and comprehension, without which "reading fluency is an empty vessel" (p. 96).

Interrelationships Between Prosody and Automaticity of Word Recognition

Theoretically, for fluent readers, decoding is automatic and can occur concurrently with comprehension (Adams, 2001; Samuels, 2006). The active attention of fluent readers can focus on comprehension and process semantic information accurately, rapidly, and effortlessly. In other words, the automaticity of word recognition facilitates children's reading comprehension. Further, although prosody may not stably reflect the level of reading comprehension (Garnett, 2011), it is reasonable to expect that a good understanding of a passage helps children decide where to pause, where to emphasize, and where to use lower or higher pitch. That is to say, a good level of reading comprehension, which is built up by automatic word recognition, positively impacts the level of prosody. In contrast, beginning readers or disfluent readers need to pay active attention to almost all the reading processes, in that their active attention switches among decoding, comprehension processes, and metacognition (Adams, 2001; Samuels, 2006), which makes the reading process slow, effortful, and error-filled. In addition, the limitations of STM make an already slow process even slower (Samuels, 2006). For beginning readers, the comprehension process is halting, which might hinder the prosody of such readers.

From this theoretical analysis, it is evident that automaticity of word recognition provides a solid base for prosody to build upon. This conclusion can also be supported by Adams' Parallel-Distributed Processing (PDP) model (2001). In this model, the orthographic processor, where the information of letters and spellings are dealt with, is first activated by the print word and sets the whole word recognition system in motion. The orthographic processor then directly communicates signals with the semantic processor — where the meaning information of the word is processed — and indirectly through the phonological processor — where the phonological information of the word is processed. When figuring out the word meaning, the semantic processor is also communicating with the context processor, where the contextual information about the word is processed. The word *communicate* is used because the connection between the processors is bidirectional; for example, after the orthographic processor senses the print word "flower," it will send a signal to the semantic and the phonological processors, which then send signals back to the orthographic processor to reinforce the tie between them.

Interestingly, as Adams (2001) pointed out, the indirect word recognition path—from orthographic processor to phonological processor, to semantic processor — dominates in English word reading due to the phonographic nature of the language. The direct path by which the orthographic processor communicates with the semantic processor directly is more dominant in the recognition of sight words (high-frequency words that can be recognized as a whole) and in ideogrammatic languages, such as Chinese. That is to say, for English word recognition, the dominating and fundamental process involves a two-step procedure. First, the orthographic processor communicates with the phonological processor to build a connection between the letters/spellings of the word and the sound. Second, the phonological processor communicates with the semantic processor to retrieve the meaning of the word. In this two-step procedure, the comprehension of the word meaning comes after the letter-sound combination. Therefore, with respect to reading fluency, prosody, which has an obvious connection with reading comprehension, is largely built upon accurate and fast word recognition that triggers semantic and syntactic confirmation of word meaning to support text comprehension. Although these theoretical analyses provide some evidence for the interrelations between the two dimensions of reading fluency, further exploration, especially empirical exploration, is still needed to explain the exact cognitive processes and mechanisms associated with the interrelations between the two dimensions of reading fluency.

Future Directions

This paper has reviewed conceptualizations of reading fluency and the role of its dimensions and illuminates important future research directions needed in this area. First, the growth in our understanding of reading fluency does not reflect in the development and the employment of more complete measures of reading fluency in research and in classrooms. As reviewed in the first section of this paper, reading fluency consists not only of automaticity in word reading but also of expressiveness in reading. Many researchers, however, have focused on reading rate to measure reading fluency (e.g., Geva & Farnia, 2012; Pagan & Sénéchal, 2014; Quirk et al., 2009). Rasinski and Samuels (2011) also reported that many teachers, or those implementing instructional programs, use the same measure. Measures of prosody are seldom used in research and practice because prosody is not easy to assess efficiently and reliably (Bear, 1992). In future studies, researchers may explore the development and use of comprehensive measures of reading fluency. Such work may contribute to a better understanding of the cognitive underpinnings of reading fluency and the interrelations between these cognitive underpinnings. As some researchers (e.g., Quirk et al., 2009) have pointed out, although there seems to be a consensus on what reading fluency looks like — reading with automaticity and prosody — the cognitive process of fluency and how it relates to reading are not clearly understood.

Conclusion

Reading fluency refers to performing decoding and comprehension simultaneously and includes two dimensions — automaticity of word recognition and prosody. The theory of automaticity is the rationale for the first dimension. When word reading becomes automatic, it is characterized as accurate, fast, effortless, unstoppable, and not subject to effortful attention. Readers are freed to focus on the process of comprehension since word recognition occurs concurrently and automatically. While comprehensive definitions of fluency include prosody, the exact relationship between prosody and reading comprehension is not as well understood. Theoretical models and some empirical evidence suggest that automaticity of word recognition forms the basis for prosody, but the exact cognitive processes and mechanisms still need further exploration. Such refinement in future studies is important not only for testing the theoretical model but for closing gaps in research on the cognitive underpinnings of reading comprehension. The importance of automaticity to comprehension provides clear direction for reading instruction. A clearer picture of the relation between prosody and comprehension can better inform the extent to which prosody should be a focus of instruction, especially given that oral reading, while a staple in primary classrooms, gives way to silent reading as readers mature. Thus, a better understanding of the relationship of oral reading prosody to silent reading comprehension can provide guidance regarding the attention it should receive in classroom instruction.

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