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THÉORIES, MÉTHODES, RECHERCHE EN ÉDUCATION

READING FLUENCY: HOW THE CONSTRUCT HAS DEVELOPED AND ITS RELATIONSHIP TO COMPREHENSION

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Abstract

There are different definitions of reading fluency and, even though there is a growing consensus that reading fluency involves accuracy, automaticity and prosody, the definitions make it unclear whether fluency contributes to comprehension, whether comprehension promotes fluency, or whether the relationship is reciprocal. This integrative review investigates, describes and compares such definitions, aiming to examine how they address the relationship between fluency and comprehension. The results show that when including prosody in the definition of fluency, it is clear that some level of comprehension is necessary for fluent reading, showing a reciprocal relationship between fluency and comprehension. The conclusions emphasize the importance of directing research towards a better refinement and operationalization of the construct. Pedagogical developments are suggested.

READING • FLUENCY • TEXT COMPREHENSION

FLUÊNCIA DE LEITURA: EVOLUÇÃO DO CONSTRUTO E RELAÇÕES COM A COMPREENSÃO

Resumo

Há diferentes definições de fluência de leitura, e, mesmo existindo consenso crescente de que envolva precisão, automaticidade e prosódia, as definições não deixam claro se a fluência contribui para a compreensão, ou se a compreensão promove fluência, ou se a relação é recíproca. Esta revisão integrativa investiga, descreve e compara tais definições, objetivando examinar como elas abordam a relação entre fluência e compreensão. Os resultados apontam que, ao incluir a prosódia na definição, fica claro que um nível de compreensão é necessário para a leitura fluente, indicando uma relação recíproca entre fluência e compreensão. As conclusões mostram a necessidade de direcionar as pesquisas para melhor refinamento e operacionalização do construto. Desdobramentos pedagógicos são sugeridos.

LEITURA • FLUÊNCIA • COMPREENSÃO DO TEXTO

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

FLUIDEZ LECTORA: EVOLUCIÓN DEL CONSTRUCTO Y RELACIONES CON LA COMPRENSIÓN

Resumen

Hay diferentes definiciones de fluidez de lectura e, incluso existiendo un consenso creciente de que implica precisión, automaticidad y prosodia, las definiciones no dejan claro si la fluidez contribuye a la comprensión, o si la comprensión promueve la fluidez, o si la relación es recíproca. Esta revisión integradora investiga, describe y compara tales definiciones, con el objetivo de examinar cómo abordan la relación entre la fluidez y la comprensión. Los resultados indican, al incluir prosodia en la definición, está claro que un nivel de comprensión es necesario para una lectura fluida, lo que indica una relación recíproca entre fluidez y comprensión. Las conclusiones muestran la necesidad de dirigir la investigación para un mejor refinamiento y operacionalización del constructo. Se sugieren desdoblamientos pedagógicos.

LECTURA • FLUIDEZ • COMPRENSIÓN DE TEXTO

FLUIDITÉ DE LA LECTURE : ÉVOLUTION DE LA CONCEPTION ET SES RAPPORTS AVEC LA COMPRÉHENSION

Résumé

Plusieurs définitions de la fluidité en lecture coexistent mais, malgré un consensus croissant sur le fait que celle-ci implique la précision, l'automaticité et la prosodie, ces définitions n'indiquent pas clairement si la fluidité contribue à la compréhension, si c'est la compréhension qui favorise la fluidité ou si la relation est réciproque. Cette révision intégrative se propose d'investiguer, de décrire et de comparer ces définitions pour examiner leur façon d'aborder la relation entre fluidité et compréhension. Les résultats montrent clairement que lorsque la prosodie est prise en compte, un niveau de compréhension est nécessaire à l'acquisition d'une lecture fluide, indiquant une relation réciproque entre fluidité et compréhension. Les conclusions montrent qu'il faut orienter les recherches pour mieux raffiner et opérationnaliser cette conception. Des développements pédagogiques sont proposés à cette fin.

LECTURE • FLUIDITÉ • COMPRÉHENSION DE TEXTE

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

Reading, based on a cognitive neuropsychological approach, is a process that begins with the ability to recognize words, which improves as fluency develops and results in the ability to comprehend the written word (Corso et al., 2017). However, the numerous research in this area has only been focused on investigating word recognition and comprehension, and very few studies in this country and abroad have addressed reading fluency. For many decades, the construct has been treated as the immediate result of being proficient in recognizing words (Kuhn et al., 2010). The Literacy Dictionary defines fluency, for example, as the ability to recognize words easily (Harris & Hodges, 1995). As a result, over the years, education has been focused on developing decoding abilities, while fluency has been neglected by institutions and also by researchers in this field (Kuhn et al., 2010).

In recent years, the understanding of what is involved in fluent reading has expanded. This change has been due, in part, to the inclusion of this construct as one of the areas reviewed by the National Reading Panel (NRP), a report commissioned by the United States government to assess existing research and evidence and find the best way to teach children to read. Fluency was defined in the report as the ". . . ability to read a text quickly, accurately and with proper expression" (2000, pp. 3-5). Currently, despite the increase in research, fluency is still a controversial issue. On the one hand, there seems to be a growing consensus that accuracy, automaticity, and prosody are part of the construct of fluency (Hudson et al., 2005; Navas et al., 2009; Kuhn et al., 2010; Basso et al., 2018). On the other hand, the definitions are varied in how they emphasize these components, and it is still unclear whether fluency aids comprehension, whether comprehension encourages fluency, or whether the relationship is reciprocal. Therefore, it is worth examining how the different definitions of reading fluency address the relationship between fluency and comprehension.

This article aims to (1) carry out an integrative review of the construct of reading fluency, in order to (2) answer the question *How do different definitions of fluency address the relationship between fluency and comprehension?* Initially, the components, accuracy, automaticity and prosody will be addressed. After this, we will describe some of the definitions of fluent reading taken from the literature, and identify what role they give to fluency in reading comprehension. We will also identify the different ways to assess skills and studies involving interventions on fluency. These aspects will enable us to shed some light on the relationship between fluency and reading comprehension. Finally, we will discuss the educational implications of the different views of the relationship between fluency and reading comprehension.

The components of reading fluency

Readers with a lack of fluency have a level that is at the initial stages of acquisition: decoding is slow and not yet automatic. Such readers tend to ignore punctuation and read in an expressionless, monotonous manner (Navas et al., 2009). The authors state that children who are learning to read, read more slowly, since they are processing the text by the phonological route of grapheme to phoneme conversion. As they start to decode more fluently, their reading becomes progressively faster. They begin to read more and become familiar with the visual forms of frequently encountered words. This builds up a mental lexicon that contains the orthographic representation of the most familiar words, which enables the reader to visualize the words directly, without needing any phonological intermediary (Navas et al.,

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

2009). This way, children start favoring reading using the lexical route (Coltheart, 2013), which is characteristic of fluent reading. Fluency, therefore, can be demonstrated by the ease of word recognition, rhythm, phrasing and speech intonation when reading, involving accuracy, automaticity and prosody (Kuhn et al., 2010): the components which are described below.

Accuracy

Reading accuracy relates to the ability to recognize words correctly, i.e. to properly decode text through grapheme to phoneme conversion (Basso et al., 2018). The skills necessary for accurate word recognition are a good understanding of the principles of the alphabet, the ability to combine sounds and a knowledge of a bank of high frequency words in the language. During this process, readers need to be able to 1) identify the sounds represented by letters or letter combinations, 2) combine phonemes, 3) read phonograms (common patterns in words) and 4) use letter-sounds and suggested meaning to determine the exact pronunciation and meaning of the word in the text (Hudson et al., 2005). Poor accuracy in recognizing words has a negative impact on reading comprehension. A reader, who does is not have accuracy, reads words incorrectly and will not understand the meaning of the text as intended by the author. This leads to misinterpretations (Hudson et al., 2005).

Automaticity

Automaticity refers to the ability to perform a complex activity, quickly, using a limited amount of attention, result of prolonged practice (Basso et al., 2018). According to Kuhn et al. (2010), automatic recognition is central to developing fluent reading. According to the authors, processes can be considered automatic when they have four qualities: speed, lack of effort, autonomy and a lack of conscious attention.

Speed is one of the main aspects that indicates automaticity in reading, and fluency develops as it improves (Basso et al., 2018). It features at the same time as accuracy as the reader is engaged in reading. As automaticity develops, the reader's ability becomes both more accurate and quicker. As mentioned above, children who are learning to read, read slowly and as their decoding process gets better, they become more familiar with the visual appearance of words, more accurate and read faster (Navas et al., 2009). However, this increase in speed is not unlimited. There is a learning curve, known as a power law, which indicates when they reach their limit. In this way, speed increases throughout reading practice, but the gains are greater at the beginning and stabilize with more practice (Puliezi & Maluf, 2014; O'Connor, 2018).

The absence of effort relates to the ease with which a task is performed and the ability to perform a second task while performing the first, automatically. It is characterized by effortless decoding, which allows the reader to focus on the process of comprehension (Basso et al., 2018). When readers are inefficient at recognizing words, they use up cognitive resources, which are important for comprehension, and so comprehension is affected. However, when the reader can use lower level processes like word recognition automatically, they can concentrate on comprehension, a higher level skill, while reading. Therefore readers who are not fluent are unable to combine the use of lower-level skills and higher-level ones due to the need to concentrate on recognizing words (Kuhn et al., 2010).

Automaticity also involves autonomy. In other words, automatic processes are also autonomous. They take place without conscious intention; starting and finishing without the individual intending to. When it comes to reading, fluent readers read without having to decide to do so. For example, this takes place when the reader unintentionally reads the captions at the bottom of a news program, despite having the cognitive ability to avoid doing so, which is not the case with early readers (Kuhn et al., 2010; Basso et al., 2018).

The lack of conscious attention relates to a lack of awareness when decoding. As their ability to recognize words becomes automatic, they stop being aware of the sub-skills that make it up. According

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

to Kuhn et al. (2010), it is this lack of conscious awareness in recognizing words that differentiates fluent from non-fluent readers. Non-fluent readers tend to be well aware of the steps they need to take to recognize written words, which slows down the process. While, for fluent readers, decoding is automatic. They recognize words without any conscious effort and this makes comprehension easier.

Prosody

Although automaticity is considered to be central to developing fluency, it does not explain all aspects of this construct. Another critical component of fluent reading is the ability to read with prosody (Kuhn et al., 2010). Prosody in reading refers to expression, rhythm and intonation of speech. It is the musicality of oral language (Basso et al., 2018). It relates to the ability to read with respect for punctuation and with appropriate expression and intonation, which ensures the meaning is maintained (Kuhn et al., 2010). Among the important characteristics of prosody in reading are: intonation, accent and intensity, duration and pauses. These elements indicate doubt, surprise, certainty, among others, not just semantics (Basso et al., 2018).

Intonation refers to the frequency of speech, which creates noticeable changes in melodic pitch (Puliezi & Maluf, 2014). In speech, sentences usually have a marked initial rise in intonation, which then declines. When sentences are longer, intonation generally gets weaker. When children read long or complex sentences, their intonation tends to get less at the end of sentences, for example. When a sentence has a rising intonation, this suggests to the listener that the sentence or phrase is likely to carry on and when intonation becomes lower, it indicates that what is being said is coming to an end (Kuhn et al., 2010).

Accent and intensity are also components of prosody (Basso et al., 2018). Accented stress is important in pronunciation because some languages are characterized by a predominant stress on words. In Portuguese, most words are paroxytone and many of the words that are not have indicative orthographic signs. Tonicity can be used to distinguish grammatical forms such as "sede" (desire to drink) and "sede" (residence) (Puliezi & Maluf, 2014). However, according to the authors, each language has its own tonic pattern, therefore, you need to consider the usual patterns of accentuation associated with the spoken language, when assessing prosody in reading (Kuhn et al., 2010).

Another characteristic of prosody is the duration of which a sound, syllable or utterance is articulated (Puliezi & Maluf, 2014). The effect of the duration depends on the overall speed that the speaker talks at, as it varies with the rate of speech. Therefore, the segments of faster readers are shorter than slower readers (Puliezi & Maluf, 2014). Syllable length, for example, will get shorter as readers progress through long sentences. This means that a child who is asked to read quickly will demonstrate less accentuation and lengthening at the end of the sentence (Kuhn et al., 2010).

The final characteristic of prosody is pauses, which are the periods of time where there is no phonation (Puliezi & Maluf, 2014). According to the authors, there are two factors that create pauses. One of them is physiological. The finite capacity of the lungs means it is necessary to pause to take in more air. The second, and most important for prosody, is about meaning. If we understand that every sentence is a unit of meaning, then we assume that it is formed of lesser units of significance, such as words that are connected by semantics and syntax around a nucleus, so that when they are read they are separated by a pause. When a sentence is read without pausing, or they are in inappropriate places in the text, the reading becomes irregular (Kuhn et al., 2010; Basso et al., 2018).

The definition of reading fluency

Having discussed the components of accuracy, automaticity and prosody, which are currently identified in the literature as being important for fluent reading (Hudson et al., 2005; Navas et al., 2009; Kuhn et al., 2010; Basso et al., 2018), we will now describe the different ways fluency can be defined and how they approach the relationship to comprehension. This is an important discussion,

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

as these components are often given a different emphasis by different studies and this has implications for teaching and assessing abilities. While many definitions of fluency highlight the importance of accuracy, automaticity, and prosody in comprehending text, there is considerable variation in the research as to which elements should be emphasized and the role that these components have in developing reading proficiency (Kuhn et al., 2010).

Fluency based on accuracy and automaticity

This definition focuses on accurate and automatic recognition of specific words and components, such as phonemic awareness and letter-sound matching; in other words, skills that enable the reader to quickly and correctly identify words (Fletcher et al., 2009). Kuhn et al. (2010) states that recognizing words accurately and automatically is a critical part of fluent reading, and phonemic awareness, letter naming, etc. which helps students to develop and consolidate their ability to recognize words. According to the authors, accuracy and automaticity have a central role in fluent reading. However, they argue that the emphasis given to these components is usually because they are easier to quantify and that there is a tendency to disregard expression, rhythm and intonation, i.e. prosody.

Empirical studies that have assessed fluency using accuracy and automaticity as their measurements can point to a significant correlation with reading comprehension. Kang and Shin (2019) recently assessed 329 American students (average age 9.8 years old) in the 4th grade of elementary school with reading difficulties. In this study, all the correlations between comprehension and the measurements for fluency were statistically significant. Of the three comprehension measures, the one that showed the strongest correlation to fluency (.53 p < .001) was the WJ3–PC test (Woodcock et al., 2001), which involves filling gaps in the text with words that make sense.

Although the elements of accuracy and automaticity are considered central to reading fluency in many studies, they are not the only critical elements identified by researchers (Hudson et al., 2005; Basso et al., 2019). As far as we could determine, prosody ensures readers produce expression, rhythm and intonation, and these are all related to comprehension (Arcand et al., 2014).

Fluency based on prosody

The National Assessment of Educational Progress (NAEP)[1] considers the most important indicator of proficient reading to be oral reading ability. However, although it includes measures of accuracy and speed as part of its assessment, it separates fluency into a distinct component, defining it as ". . . phrasing, adherence to the author's syntax, and expressiveness" (Daane et al., 2005, p. 5), which equates fluency to the definitions of prosody. Kuhn et al. (2010) explain that this distinction is because of the assessment's history. It was the first large-scale assessment of oral reading ability, while fluency was still a neglected aspect. In the few articles that considered this construct, speed and accuracy were emphasize, which were measured by the number of words read correctly per minute (reading rate). Therefore, one of the original goals of the NAEP was to identify aspects of oral reading, beyond accuracy and speed. When they designed the Oral Reading Fluency Scale, the NAEP authors hoped to offset some of the emphasis on speed and accuracy, and to include oral language elements as part of reading performance. So, while these assessments were running, you can see the emphasis given to prosodic elements in most of the definitions of fluency. It is important, however, to focus on an integrated definition of fluency that includes accuracy, automaticity, and prosody. A definition that only covers speed and accuracy can reinforce the idea that reading rate can be used in isolation as a measure of oral reading ability (Kuhn et al., 2010).

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1 The National Assessment of Educational Progress (NAEP) is a representative and ongoing assessment of what American students know and what they can do in the different subjects on the curriculum.

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

Empirical studies that have focused on assessing prosody show that the construct has a significant correlation to reading comprehension. Klauda and Guthrie (2008) assessed 278 American children in the 5th grade of elementary school. The authors found that changes in prosody over the year were related reciprocally to changes in reading comprehension. Taking a different tack, Arcand et al. (2014) assessed 261 Canadian 2nd grade elementary school students. The authors examined whether prosodic reading would aid reading comprehension using a model where vocabulary, automaticity and reading accuracy were controlled. In the study, both measurements of prosody were able to predict the level of reading comprehension.

Fluency based on proficient reading

Another definition of fluency is where it is generally equated with proficient reading, in which the most important characteristic of a fluent reader is the ability to decode and comprehend the text simultaneously. Accuracy in recognizing words, automaticity and the ability to read orally with expression are only indicators that they are able to read proficiently (Samuels, 2006). According to Kuhn et al. (2010), it becomes possible to differentiate two groups of readers by including comprehension in the definition of fluent reading: wordcallers, those who simply read the words without paying attention to the meaning, and fluent readers, who realize the significance of the text, as they read it. According to the authors, although wordcaller readers are not the majority, there are more in elementary school. Therefore, teaching, that focuses on speed and accuracy while recognizing words with little or no regard for comprehension, will increase the number of students who read without understanding the text (Kuhn et al., 2010).

Reading proficiency is complex and the reader needs to be able to coordinate different information, including syntax, spelling, vocabulary, affective factors, and so on, which enables them to construct a meaning from the text (Kuhn et al., 2010). For the authors, just as a reader's fluency can vary depending on the text (i.e. readers may be able to read some texts fluently, but lack fluency when reading text that has difficult vocabulary or content), it is also possible that their understanding of difficult text will vary, despite being able to read fluently.

Fluency's reciprocal relationship to comprehension

This definition is based on the idea that there is a reciprocal relationship between fluency and reading comprehension (Chard et al., 2006). On this basis, the construct assists and may helped by the readers' ability to understand written text. The components of fluency, such as automaticity and prosody, both help and benefit from comprehension. Kuhn et al. (2010) explains that this definition therefore is different from a superficial conceptualization of fluency, which sees the construct principally as a phenomenon of oral reading and, instead, tends to emphasize its more concrete elements as part of teaching and assessment. This is important as we mostly read silently, not orally (Kuhn et al., 2010).

Fluency based on accuracy, automaticity and prosody that aids with comprehension

There is another definition in the literature of reading fluency. In this definition, fluency is a combination of accuracy, automaticity and prosody in oral reading. These components help the reader to create meaning, or in other words, comprehension. (Kuhn et al., 2010). For the authors, fluency is demonstrated during oral reading by being able to recognize words easily as well as the rhythm, phrasing and intonation of the prose. Fluency is also a factor in both oral reading and silent reading that can limit or support comprehension.

According to Kuhn et al. (2010), even though this definition is influenced by the others which have been discussed (Harris & Hodges, 1995; Chard et al., 2006), it aims to make a number of critical points about fluency. First, it highlights the relationship between fluency and understanding. Second, it includes prosody alongside the accurate and automatic recognition of words, without any particular preference. Thirdly, it points out that fluency has a role in both silent and oral reading.

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

Evaluating reading fluency

As well as the different definitions of fluency, there are also different ways in the literature to assess this construct. While some empirical studies measure accuracy and automaticity, others include prosody in their assessments. The different ways to assess fluency, as well as demonstrating how they understand the construct, also affect the way in which we understand the relationship with reading comprehension.

Reading fluency can be assessed in relation to words, sentences or whole texts. According to Basso et al. (2018), examining the construct by reading isolated words is linked to the brain's processing speed, when activated during reading. Assessing fluency by reading sentences and texts takes into account the dimensions of accuracy (the ability to recognize words), automaticity (processing speed) and prosody (intensity, duration, rhythm, expression and intonation); in other words, the three dimensions of fluency and comprehension too. Using fluency measures to assess comprehension is still controversial, however researchers have pointed out that it is an important assessment measure because of its relationship to fluency (Daane et al., 2005; Navas et al., 2009; Basso et al., 2018). This type of assessment measures the percentage of words read correctly, the rate of oral reading, the appropriate use of pauses, rhythm and intonation, and comprehension, based on a questionnaire about the text that has been read (Basso et al., 2018). Examining fluency by reading sentences or text is considered a more complete measurement, as you can only use this to measure the prosodic aspects such as intonation, stress and intensity, duration and pauses. According to the National Reading Panel (2000), a detailed fluency assessment is essential to rule out any possible failings in one of its dimensions, as well as to be able to create intervention programs.

Basso et al. (2018) points out that when assessing fluency, each type of task is specific, as reading words or text fluently is a measurement of different constructs. While reading lists of words to assess fluency is related to proficiency at recognizing words, fluency at reading text is related to processing information for both words and more. When reading text, words are part of a context and therefore they can be read faster than words in a list, which are unrelated. Assessing fluency by reading text demonstrates that fluency and comprehension are related. Studies have also pointed out that assessing fluency at reading text is more closely correlated to reading comprehension than assessing the reading of a list of isolated words (Fuchs et al., 2001).

There has been little investigation of this ability in Brazil, and therefore there are few standardized tools to assess reading fluency in this country. Tools to assess fluency at reading text are even scarcer (Basso et al., 2018). Those studies that have been found, which looked into this construct, were focused on fluency using lists of isolated words. However, a brief standardized tool, the *Avaliação da Fluência de Leitura Textual* (AFLeT) (Basso et al., 2018) (Textual Reading Fluency Assessment) was recently added to the ANELE collection – *Avaliação Neuropsicológica da Leitura e da Escrita* (Neuropsychological Assessment of Reading and Writing), which assesses all of the components that are part of fluency (accuracy, automaticity and prosody) and comprehension. It is one of the only Brazilian tools that provides a broad assessment of this construct. The tool is intended for children from 7 to 10 years old, students who are in the 2nd to 4th year of elementary school in public and private schools. Its aim is to assess their fluency on a narrative text and also identify any possible difficulties in their oral reading fluency. It may be used in healthcare or education, by physicians, psychologists, speech therapists, occupational therapists, educational psychologists or teachers for example.

Using this tool consists of reading a narrative text aloud and then answering a multiple-choice questionnaire. The number of words read per minute are counted as part of the assessment, as well as the types of mistakes on accuracy, the number of words correctly read per minute and pausing, intonation and fluidity mistakes, and other variables. The results of the psychometric studies show that the AFLeT is an important measurement of fluency, as it enables differences in performance to be identified, based on age, education, type of school, socioeconomic level and whether they have reading difficulties, and

provides ways to evaluate the criteria (Piccolo et al., 2018). The standard sample scores also correlated significantly with reading isolated words and pseudowords, fluency in reading isolated words, and rapidly naming a series of letters, pictures and numbers. Studies to examine the tool's internal consistency and agreement between assessors also provided evidence that it was a reliable tool (Sbicigo et al., 2018).

Intervention studies on reading fluency

As well as tools for assessing ability, studies on intervention activities on reading fluency in the literature are also scarce. In many studies, the instructional techniques also do not focus on all of the components of the construct (accuracy, automaticity and prosody): prosody is the component that is less likely to be addressed as part of an intervention. Even so, studies have shown that there is an important correlation with comprehension ability. This is important in order to understand how the relationship between fluency and reading comprehension works.

In the study by Amendum et al. (2015), 636 American children (mean age 6.5 years) from the 1st, 2nd and 3rd grades of elementary school were given instruction based on reading programs such as Scott Foresman Reading (Afflerbach et al., 2002). The instructions were given by the class teachers and they involved phonemic awareness, phonetic knowledge, fluency, vocabulary and reading comprehension. Revision materials, student written texts and various books were used. Students also took part in small reading groups every day. By the end of the school year, around 25% of the children from each of the 147 classrooms were assessed. The assessment consisted of reading aloud progressively difficult sentences followed by comprehension questions. To assess fluency, the percentage of words read correctly (accuracy) and the reading rate, as a measure of speed, were measured. Based on this assessment, the students were divided into two groups: those students whose reading was at the level for their grade and students whose reading was above the level for their grade (Amendum et al., 2015).

The results of the analyzes showed that there was a significant relationship between reading rate and comprehension, but the relationship varied depending on the level of the text. There was also a significantly weak relationship between accuracy and comprehension, but the relationship also varied depending on the level of the text. An analysis of the covariance (ANCOVA), using comprehension as the dependent variable, also showed that as the reading rate of students with on-grade level reading increased, comprehension scores increased (from 70.77% to 81.01%). The results also showed that in both groups of students, as reading accuracy increased, comprehension of the text also increased. For those whose reading level was above their grade, comprehension significantly increased (25.71%), as accuracy increased (Amendum et al., 2015).

In a more recent Brazilian study (Martins, 2018), 30 students (between 8 and 11 years old) with reading difficulties, from the 3rd, 4th and 5th grade of elementary school, from a public school in the city of São Paulo, were given a fluency and reading comprehension assessment. After the before-test, the students were given instruction in fluency, which consisted of applying a translated version of the Helping Early Literacy with Practice Strategies (HELPS) program (Begeny, 2009). 30 sessions of 10 minutes were held three times a week. The strategies included repeated timed readings, modeling, correcting sentence errors, verbal stimuli, setting goals, feedback, and a motivational reward system (Martins, 2018). Once the intervention was complete, fluency and comprehension were reassessed. Accuracy and reading rate (automaticity) were measured based on reading a narrative text for one minute. The word reading subtest from the *Protocolo de Avaliação de Habilidades Cognitivo-linguísticas* (Cognitive-Linguistic Skills Assessment Protocol) (Capellini et al., 2012) was also used to assess fluency, which consists of reading 40 real words. The *Protocolo de Avaliação da Compreensão da Leitura* (Reading Comprehension Assessment Protocol) (Cunha & Capellini, 2014) was used to assess comprehension, in which students read a text followed by literal and inferential questions (Martins, 2018).

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

The after-test showed that, in relation to reading comprehension, only 3rd year students in the sample group showed a statistically significant difference between the before and after-test; while for 4th and 5th year students there was a slight decrease in the mistakes in answering the comprehension questions. Martins (2018) suggests that the reading performance of students with fluency difficulties improved and, consequently, their comprehension performance too.

In summary, the studies we have presented do not show a hard and clear significant correlation to reading comprehension. Many studies have also produced differing results, due to the variety of measures used. As far as we could determine, measurements of prosody were not applied in the aforementioned intervention studies. However, the authors point out that as well as being correlated, prosody is the aspect of fluency that best demonstrates how well a reader has understood a text, since if they use prosodic elements properly it demonstrates that they understand what they are reading (Kuhn et al., 2010). In other words, if one was to include measures on the instruction and assessment of prosody in these studies, it could provide a clearer and more consistent indicator of what the relationships are to reading comprehension.

Discussion about the findings and their implications for education

In trying to answer the question that gave rise to this article: *How do different definitions of fluency address the relationship between fluency and comprehension?* it has become clear that the lack of a consensus on the definition of fluency is due to the difference in prominence assigned to the variables underlying this construct, or perhaps that there is still no agreement on which variables fluency is made up of. Some studies have defined it as automaticity and accuracy and others, as prosody. What the relationship is between fluency and comprehension has probably not been clearly established, as a result. The different research has not make it clear whether fluency is a cause, a consequence or whether it has a reciprocal relationship to comprehension (Kuhn & Stahl, 2003). There is evidence in the literature to support the different positions taken (Schwanenflugel et al., 2004; Klauda & Guthrie, 2008; Arcand et al., 2014).

We believe that it will be vital to deal with these controversial points in order to take this area of research forward, but most especially, to reflect the educational impact that is an inherent part of it. Classroom teaching is based on the teachers' understanding of this construct, in other words, the way they perceive how the reading process works, plays a decisive role in how they teach and assess it. Furthermore, the different ways in which the teacher teaches and assesses in the classroom has a major effect on the students' understanding of what it is to read and what it means to be a reader (Kuhn et al., 2010).

For example, if they emphasize the more quantifiable elements of fluency such as accuracy and automaticity, then there is a risk that students will only be taught to recognize words. If students are encouraged to focus on decoding speed rather than prosody, they will be asked to read as fast as possible, without expression, rhythm and intonation. Therefore, it is important to consider reading fluency from a broad perspective and also include less quantifiable elements. Fluency, on this basis, involves accuracy, automaticity and prosody and these components can work together to help or hinder reading comprehension.

At this point, the following questions suggest themselves: *What would be the consequence for the teaching of thinking about this skill as a cause of comprehension? Or if fluency was treated as a consequence? Or if we took the perspective that it was a reciprocal relationship?* We believe that if we consider fluency to be the reason behind reading comprehension, then there is a risk that teaching will only aim to develop decoding skills, while students would first need to be able to read the words accurately and quickly, and then to read and understand written text. In schools, many teachers believe that they should not give written text to students when they are learning to read, because they do not yet read fluently. On this line of thinking, it is essential to include prosody, because, as far as we could determine, we develop the ability to read with rhythm, expression and intonation by reading sentences and text, as this is linked to comprehension (Kuhn et al., 2010).

On the contrary, if fluency is believed to be a result of comprehension, then we can take the focus away from decoding and give greater preference to comprehension, through reading text. However, students who cannot yet recognize words accurately and automatically would not be able to understand the meaning and, therefore would not understand the text. We know that, however, one can only ascertain meaning from a text if the words can be read correctly and with enough automaticity so as to not overload the cognitive resources needed to understand it (Kuhn et al., 2010).

If we believe there is a reciprocal relationship between fluency and comprehension, in which fluency may contribute and may possibly result from a readers' understanding of the text, then we can conclude that all areas of reading should be addressed at the same time, from when students begin to learn to read. This is important, because children should not only be taught to decode accurately and automatically, but also to understand what they read. We believe that including the prosody subcomponent in the definition of fluency has a decisive part to play when considering the relationship between fluency and reading comprehension. When you take prosody into account, it is clear that some level of comprehension is required to read fluently. As far as we could determine, empirical studies have shown that prosody plays a fundamental role in reading comprehension. Arcand et al. (2014), using controlled vocabulary, automaticity and accuracy, found that prosody measurements could predict the reading comprehension abilities in the 2nd grade of elementary school. The study by Klauda and Guthrie (2008), showed that changes in prosody were reciprocally related to changes in reading comprehension over the 5th year.

These studies have shown that the relationship between fluency and comprehension probably changes as students learn to read. In the early school years fluent reading provides a bridge to comprehension; in other words, it helps them to understand the text: as the child uses all of their attention and their memory resources to decode, they are unable to carry out the high-level processes required for comprehension, such as inferences. As their ability to read develops, and their automaticity improves, the relationship between fluency and comprehension is likely to become reciprocal, in other words, the more fluent the reader becomes, the better their comprehension, just as the more they understand, the better their fluency. Therefore, the way reading is taught needs to change as the ability to read develops; in other words, the emphasis should change as the students become more competent (Snow & Juel, 2013), because the cognitive processes that determine reading proficiency are different as the skill develops (Corso et al., 2013). However, it is important that comprehension is treated as the goal of reading, so this idea should even permeate through to the initial stages of teaching, even if the initial focus is on recognizing words. Therefore, we believe that reading fluency involves accuracy, automaticity and prosody and that together these components are mutually related to reading comprehension.

On this basis, we would tend to say that prosody is not always an important part of a definition of fluency because most of the research into reading still takes place, most intensely, in the early years of elementary school, which focuses on learning to read and decoding. We believe that if there is future research that covers more skilled readers, students in the final years of Elementary School and in High School, then these will be able to help refine the definition of fluency, and investigate how the balance between the different components of the construct (accuracy, automaticity and prosody) work at these grades, as well as examine the relationship to reading comprehension at later stages of school.

Final conclusions

The different positions taken in relation to fluency have important implications for the teaching and assessment of the ability, which means that we have to be cautious when trying to define the construct. As the research on fluency is quite recent, it is not surprising there is disagreement on this ability and this indicates that further investigation is required. However, despite the disagreement over this subject, the different definitions of fluency show that the construct has developed, as the separate

Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

subdomains (word recognition, fluency and comprehension) of reading are still relatively new. More recent studies, such as those mentioned above, have also demonstrated consensus on some aspects, such as: 1) the definition of fluency has to include prosody, and not just automaticity and accuracy, 2) fluency and comprehension are related, although there is no definitive data on the nature of this relationship, 3) fluency is not just important for oral reading, as comprehension will also be limited if silent reading is not fluent, 4) assessments of reading need to include fluency measurements, in other words, when measuring oral reading, if the student can decode the material, this does not mean that they are fluent in reading, nor that they understand what they are reading and 5) it is important to work on the three areas of reading, word recognition, fluency and comprehension.

This is why it is important to direct research towards refining the concept of fluency and how it can best be utilized. Progress on this subject could provide a promising future for the field of reading, with regard to teaching and assessment. If fluency can be refined and applied effectively then the format of the tools available to assess fluency can be improved and, consequently, it will be possible to identify those who have difficulties at an early stage. This would enable effective intervention programs to be designed, that take the different variables that underlie the theme into account. Therefore, this is a fertile area for further investigation, both to prevent issues with reading and for resulting interventions.

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Amanda Oliveira Meggiato, Helena Vellinho Corso, Luciana Vellinho Corso

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Amanda Oliveira Meggiato wrote the article including the review of the theory, under the guidance of the authors Helena Vellinho Corso and Luciana Vellinho Corso, who also contributed to its structure, reviewed the text and wrote up the results and conclusions.

Data availability statement

The data underlying the research text are reported in the article.

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