Profiles of French poor readers: Underlying difficulties and effects of computerized training programs

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ABSTRACT

Three subgroups of poor readers were identified within a sample of French 2nd Graders ($n = 258$): children with Specific Decoding Difficulty (SDD), children with Specific Comprehension Difficulty (SCD) and children with General Reading Difficulty (GRD). We first compared them on skills related to either decoding or comprehension (or to both reading skills). This analysis showed that although specific underlying difficulties characterized each subgroup (e.g., phonological and decoding difficulties for SDD and vocabulary and monitoring difficulties for SCD), all subgroups showed impaired performance on certain skills (e.g., memory). Second, each subgroup received a computerized training to promote the component of reading for which they initially presented the greatest difficulty (decoding or comprehension). While the decoding training tended to induce more specific improvements in word reading and phonology, the effects of the comprehension training tended instead to be more general. These results are discussed in terms of their pedagogical implications.

1. Introduction

Reading is a critical skill for success in school, because most of the knowledge transmitted in formal education is based on written material. The ability to read well is also strongly predictive of economic well-being as well as of personal and social development (Snow, 2002). The standardized Program for International Student Assessment (PISA) conducted by the OECD (Organization for Economic Cooperation and Development) reveals "about 20% of students in OECD countries, on average, do not attain the baseline level of proficiency in reading. This proportion has remained stable since 2009" (OECD, 2016, p. 4). Similarly, Fluss et al.'s (2008) study, conducted among 1062 French pupils, revealed that approximately 13% of 1st and 2nd Graders had word reading difficulties (i.e. decoding scores below the 10th percentile and reading speed one standard deviation below the norm). Continuity of reading disabilities has been shown in longitudinal studies in different orthographies (in English: e.g. Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005, Finnish: Eklund, Torppa, Aro, Leppänen, & Lyytinen, 2015 and German: Landerl & Wimmer, 2008). This high percentage of poor readers in the early stages of reading acquisition, and the number of such readers that persist at the end of compulsory education, clearly emphasizes the importance of the early detection of poor readers as a prerequisite for the implementation of suitable reading interventions. Nevertheless, not all poor readers are the same. Consequently, it is necessary to determine the deficits that could underlie different types of reading difficulties in order to offer specific remediation.

1.1. Different profiles of poor readers

Not all poor readers present the same types of reading difficulties. According to the *Simple View of Reading* model (Gough & Tunmer, 1986, see also more recently Kendeou, Van Den Broek, Helder, & Karlsson, 2014), reading can be considered as the product of two components: Written word decoding and language comprehension. The first component is specific to the activity of reading and implies either the identification of written words via a direct association from visual input to lexical representation or the use of grapheme-phoneme correspondence to decode the word. The second component - comprehension - however, is seen as a general ability, i.e., not specific to the written format. Similar comprehension processes are indeed likely to be employed to understand not only written but also oral or pictorial information (see, for example, Berl et al., 2010; Gernsbacher, Varner, & Faust, 1990; Kendeou, Bohn, White, & van den Broek, 2008).

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In order to extract meaning from a text - which generally represents the aim of the reading process - a reader should be able both to decode written words quickly and precisely, on the one hand, and to have adequate comprehension skills on the other. These two components are generally considered to be highly interrelated. As a result, reading appears to be deficient if either of these two components is impaired. According to the verbal efficiency hypothesis (Perfetti, 1992), decoding and comprehension share a fixed amount of cognitive resources. Thus, the more resources are devoted to decoding, the less there are available for comprehension. As decoding processes become increasingly automated, resources are released for comprehension (e.g., Roberts, Good, & Corcoran, 2005).

However, the two processes are also partially independent. Difficulties in reading can indeed be specifically related to one or other of these reading components (Catts, Compton, Tomblin, & Bridges, 2012), thus resulting in three profiles of poor readers (Aaron, 1991; Catts, Hogan, & Fey, 2003; Elwér, Keenan, Olson, Byrne, & Samuelsson, 2013). Hence, a "poor" reader can have a) difficulties in word reading but good comprehension skills (i.e., *poor decoder*), b) difficulties in comprehension but good word reading skills (i.e., *poor comprehender*) or c) difficulties in both components (i.e., *general poor reader*). Developmental and genetic studies (Harlaar et al., 2010; Keenan, Betjemann, Wadsworth, DeFries, & Olson, 2006) further support the hypothesis that decoding and comprehension skills are dissociated and follow independent development trajectories.

1.2. Cognitive and linguistic skills associated with the two reading components

On the one hand, learning to read in an alphabetic system (e.g. French) requires the understanding of the alphabetic principle, namely that written units (graphemes) represent phonological units (phonemes). Emerging readers further need to understand that spoken words are composed of phonological units. They have to be able to identify and consciously manipulate them (for a review, see Castles & Coltheart, 2004; Melby-Lervåg, Lyster, & Hulme, 2012; Ziegler et al., 2010). In other words, they have to acquire phonological skills. On the other hand, different factors predict success in reading and listening comprehension (Hulme & Snowling, 2011; Oakhill, Cain, & Bryant, 2003). These comprehension-related factors relate to vocabulary (Lonigan, Burgess, & Anthony, 2000; Oakhill & Cain, 2011; Oakhill et al., 2003; Vellutino, Tunmer, Jaccard, & Chen, 2007), comprehension monitoring (i.e., the ability to evaluate one's own comprehension of a text; Cain, 1999; Oakhill, Hartt, & Samols, 2005) and working memory (Carretti, Cornoldi, De Beni, & Romanò, 2005; Florit, Roch, Altoè, & Levorato, 2009; Swanson, Howard, & Saez, 2006).

Each of the aforementioned subgroups (poor decoders, poor comprehenders and general poor readers) is therefore likely to exhibit particular and specific underlying difficulties. In a longitudinal follow-up study from preschool to Grade 4, Elwér et al. (2013) analyzed the cognitive and linguistic predictors of decoding and comprehension in specific poor decoders and specific poor listening comprehenders. They observed that poor decoders had lower performances in phonological awareness, whereas poor listening comprehenders had lower performances in vocabulary and verbal memory. These results are consistent with the literature (e.g., De Jong & Van der Leij, 1999; Lynch et al., 2008; Oakhill & Cain, 2011; Potocki, Ecalle, & Magnan, 2016; Wagner, Torgesen, & Rashotte, 1994; Wimmer, Mayringer, & Landerl, 2000), which suggests that these factors are important predictors of decoding and comprehension, respectively.

In addition, Catts et al.'s (2003) data suggest that the identified subgroups of poor readers are relatively stable over time, meaning that reading difficulties are not likely to decrease spontaneously. These observations (Aaron, 1991; Catts et al., 2003; Elwér et al., 2013) highlight the need to provide training that specifically remediates each subgroup's underlying difficulties.

1.3. Reading interventions

Several intervention programs have been shown to provide effective support for struggling readers. As regards the decoding component, training aimed at fostering phonemic awareness generally leads to improvements in decoding skills (see the meta-analysis by Suggate, 2010). More precisely, training combining the presentation of phonological information with visual-orthographic information is likely to be the most beneficial for poor decoders. In French, the syllable appears to be an important phonological unit in French pre-readers (see Duncan, Seymour, Colé, & Magnan, 2006). This is also an important orthographic unit in French readers (Doignon-Camus & Zagar, 2014). Various studies using different experimental paradigms (e.g. Chetail & Mathey, 2009; Colé, Magnan, & Grainger, 1999; Doignon & Zagar, 2006; Maïonchi-Pino, De Cara, Ecalle, & Magnan, 2012a; Maïonchi-Pino, De Cara, Ecalle, & Magnan, 2012b; Maïonchi-Pino, Magnan, & Ecalle, 2010a, 2010b) confirm this idea. As a result, grapho-syllabic training in French poor readers has been shown to improve written word identification (Ecalle, Kleinsz, & Magnan, 2013; Ecalle, Magnan, & Calmus, 2009). To be fully effective, programs designed to encourage decoding abilities have a) to focus on phonological skills and grapho-phonological correspondences, b) to take place individually or in small groups, and c) to be explicit, repetitive and provide positive feedback (see the meta-analysis by Suggate, 2010). In French readers, these programs should be based on the syllabic unit since this appears to be a functional unit in word recognition.

As far as comprehension is concerned, numerous studies have demonstrated that comprehension skills can also be improved through explicit training (for reviews, see Edmonds et al., 2009; Gersten, Fuchs, Williams, & Baker, 2001; Solis et al., 2012). The National Reading Panel (2000) identifies six different strategies for enhancing comprehension skills (e.g., identifying the structure of a text, answering questions about the text). The training of inferential skills appears to be the most beneficial for remediating comprehension difficulties (e.g., Elbro & Buch-Iversen, 2013; Potocki, Ecalle, & Magnan, 2013a). The ability to generate inferences is indeed a critical component of good text comprehension and poor comprehenders generally exhibit difficulties in this skill (Cain & Oakhill, 2006; Oakhill & Cain, 2011). Different types of inference can be drawn when attempting to understand a text (Cain & Oakhill, 1999). Some of them (text-connecting inferences) are necessary in order to connect successive textual statements, while others (knowledge-based inferences) make use of the reader's background knowledge in order to fill in the gaps that can occur in the story. Comprehension programs that could foster these different aspects of text comprehension, and especially inferencing skills, are likely to be particularly suitable for helping poor comprehenders to overcome their difficulties (see, for example, Potocki et al., 2013a; Yuill & Joscelyne, 1988; Yuill & Oakhill, 1988).

1.4. Use of computer assisted reading programs

One way to implement reading interventions is to make use of computer-assisted (CA) programs. CA programs have indeed proved their worth as components in educational programs for children. The various advantages CA programs provide over traditional learning include greater motivation (e.g. Wild, 2009) and a higher level of attention (e.g. Karemaker, Pitchford, & O'Malley, 2010). This is probably due to their multimedia approach. However, the presentation of too much multi-modal information can be distracting and seems to be unnecessary since the greatest benefits are achieved by simply combining the oral and visual modalities (Ricci & Beal, 2002). This observation is of particular interest for CA reading programs. Indeed, the bimodal (e.g. oral and visual) presentation of a word can increase word recognition by improving the mapping between orthographic and phonological word representations (e.g., Ecalle et al., 2009; Ehri et al., 2001; Karemaker et al., 2010). This bimodal presentation is also of interest for