Computerized trainings in four groups of struggling readers: Specific effects on word reading and comprehension

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ARTICLE INFO

ABSTRACT

Four groups of poor readers were identified among a population of students with learning disabilities attending a special class in secondary school: normal readers; specific poor decoders; specific poor comprehenders, and general poor readers (deficits in both decoding and comprehension). These students were then trained with a software program designed to encourage either their word decoding skills or their text comprehension skills. After 5 weeks of training, we observed that the students experiencing word reading deficits and trained with the decoding software improved primarily in the reading fluency task while those exhibiting comprehension deficits and trained with the comprehension software showed improved performance in listening and reading comprehension. But interestingly, the latter software also led to improved performance on the word recognition task. This result suggests that, for these students, training interventions focused at the text level and its comprehension might be more beneficial for reading in general (i.e., for the two components of reading) than word-level decoding trainings.

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1. Introduction

Reading and understanding what is read are central in ensuring academic achievement and social integration. Reading therefore appears to be one of the most crucial abilities children have to acquire during their elementary school years. However, even after leaving elementary school, many older students fail to master even the most basic reading skills (Denton, Wexler, Vaughn, & Bryan, 2008; Kamil, 2003; see also PISA[1] results, OECD, 2010). It appears necessary to develop efficient remedial programs designed to help these students. For many years, however, research has instead focused on improving the reading skills of elementary school children. Early intervention is indeed a key component in the remediation of reading difficulties and in preventing future reading problems. Unfortunately, not all at-risk students receive intervention at an early age and in some cases the provided interventions have proved to be ineffective. As a result, there are still a significant number of students with reading disabilities in the middle school grades (Flynn, Zheng, & Swanson, 2012). Their difficulties are not likely to decrease spontaneously over time. Indeed, children who fall behind in reading tend to dislike

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[1] PISA is an international assessment coordinated by the Organization for Economic Cooperation and Development (OECD) that measures 15-year-old students' reading, mathematics, and science literacy.

reading and read less, and the gap between them and their skilled peers therefore increases (*Matthew effect* phenomena; Stanovich, 2000).

In France, these learning disabled students are generally placed in special classes called SEGPA (*Sections d'Enseignement Général Professionnel Adapté*; [Classes for General and Professional Adapted Teaching]). Students in SEGPA are considered as severely disabled learners since they experience considerable difficulties in literacy and numeracy skills and have also repeated a year of primary school. In the same way, as students with learning disabilities in general (e.g., Lyon & Flynn, 1991), these students are likely to form a heterogeneous group. It therefore appears necessary to precisely identify their specific reading difficulties in order to choose appropriate means to correct them (Spear-Swerling & Sternberg, 1996). Unfortunately, research into effective intervention for older readers is still scant and interventions specifically targeting severe learning disabled adolescents even more limited.

1.1. The two components of reading: identification of poor readers' subgroups

According to the classical model of reading (e.g., *Simple View of Reading* model; Gough & Tunmer, 1986), reading can be thought of as the product of two main components, namely decoding and comprehension. The former is specific to reading and consists in establishing a correspondence between the orthographic, phonological and semantic representations of a word to access its representation stored in the mental lexicon. The latter component does not appear to be specific to reading (e.g., Gernsbacher, Varner, & Faust, 1990; Kendeou, Bohn-Gettler, White, & van den Broek, 2008). It refers to the semantic processes that are involved in the processing of texts and that contribute to the integration of all the textual information in a single, coherent representation to ultimately construct a mental model of the situation described in a text. In typically developing readers, these two components are highly interrelated. Indeed, the progressive automation of word decoding processes during the elementary school years frees up cognitive resources which are then available for comprehension (e.g., Roberts, Good, & Corcoran, 2005). In most individuals, good decoding skills are therefore coupled with good comprehension abilities. These individuals are good readers with a mastery of both types of reading processes (labeled NDNC in this study: normal decoders/normal comprehenders). However, in the case of other individuals, the reading components can be considered to be partly independent since difficulties can specifically affect one or other of these components (e.g., Aaron, Joshi, Gooden, & Bentum, 2008). Based on this principle, it is possible to distinguish between different subgroups of readers. On the one hand, some poor readers have difficulties in decoding written words but no deficit in listening comprehension (e.g., Aaron, Joshi, & Williams, 1999; Catts, Hogan, & Fey, 2003). In the present study, these poor readers are labeled PDNC (poor decoders/normal comprehenders). Although these readers sometimes exhibit impaired reading comprehension skills, these impairments are solely due to their insufficiently automated decoding skills. On the other hand, some poor readers possess adequate decoding skills but present a persistent deficit in the comprehension of both written and oral material (e.g., Cain & Oakhill, 2006; Nation, 1999). These readers are labeled NDPC (normal decoders/poor comprehenders) in the present experiment. Finally, other readers may exhibit impaired skills on both reading components, i.e., difficulties both in identifying written words and in understanding what they hear or read (Goulandris, Snowling, & Walker, 2000; Heath, Hogben, & Clark, 1999). These readers can be referred to as garden-variety poor readers or, for the purposes of this study, PDPC (poor decoders/poor comprehenders). Although the prevalence of these different profiles of readers in the general population varies across studies and native language, they generally represent around 10%, and up to 15%, of the school age population (Torppa et al., 2007). One might expect this prevalence to be higher in special education classes such as SEGPA. However, to date no study has directly examined this issue (but see Lyon & Flynn, 1991, for other reader subtypes among learning disabled children).

1.2. Effective interventions for encouraging reading and comprehension skills

Several intervention programs have proved to be effective in remediating reading difficulties in readers with learning disabilities (e.g., Edmonds et al., 2009; Flynn et al., 2012; Scammacca et al., 2007; Scammacca, Roberts, Vaughn, & Stuebing, 2015). However, for several decades, these interventions have primarily focused on improving the decoding skills of poor decoders. In this regard, phonemic awareness training appears to be particularly effective (see the meta-analysis by Ehri et al., 2001). More specifically, programs that focus explicitly on the links between orthographic and phonological units are likely to be the most beneficial for poor decoders. The National Reading Panel (2000) reported that the mean effect size on reading of training that explicitly establishes orthographic and phonological associations exceeded that of phonological awareness training used in isolation. To improve decoding skills, the most effective techniques are therefore those based on the correspondences between graphemes and phonemes (e.g., Harm, McCandliss, & Seidenberg, 2003).

As far as comprehension is concerned, several studies have demonstrated that comprehension skills can also be developed through explicit teaching (e.g., Clarke, Snowling, Truelove, & Hulme, 2010; Elbro & Buch-Iversen, 2013). For example, the National Reading Panel (2000) has identified six strategies that have proved to be efficient in improving comprehension: (a) monitoring one's own comprehension, (b) using tools to visually represent the main ideas of a text, (c) identifying the structure of a text, (d) testing comprehension with immediate feedback, (e) answering questions about the text and (f) summarizing the main ideas. Instructions implementing these strategies seem to be beneficial for children and adolescents with comprehension difficulties (e.g., Corte, Verschaffel, & Ven, 2001; de Bruin, Thiede, Camp, & Redford, 2011; Gersten, Fuchs, Williams, & Baker, 2001).