



Effectiveness of an early reading intervention in a semi-transparent orthography: A group randomised controlled trial



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ABSTRACT

This study reports on the effectiveness of an early reading intervention, based on current research on early reading acquisition, and aligned to Norwegian orthography. Thirteen schools were randomly assigned to one of two interventions or a control condition. First grade students ($n = 744$) were screened at school entry, and children at risk of reading difficulties ($n = 140$) were identified. At-risk students in schools allocated for intervention received comprehensive teacher-led instruction also containing an individually-delivered computer component. The only difference between the two interventions was whether the computer application had adaptive learning features. Both interventions had significant impact on reading and spelling with no significant difference between the two different intervention conditions. Findings indicate that Norwegian children identified to be at-risk at school entry can profit from intensive intervention that combines training in letter knowledge with explicit instruction in phonetic decoding and word recognition, free spelling, connected text reading and shared reading.

1. Introduction

Over the past decades, we have witnessed encouraging advances in how to intervene effectively in early reading development for children at risk of reading difficulties (RD). Yet, for many groups of learners we are basing our instructional decisions on research from disparate populations, including wide variation in language types. Most reported reading interventions, however, have been carried out in English-speaking countries, with English being a highly opaque orthography (Galuschka, Ise, Krick, & Schulte-Körne, 2014; Share, 2008). A body of research from Finland (e.g. Richardson & Lyytinen, 2014; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011) also informs this work, with Finnish being a highly transparent language.

Problems experienced by children with dyslexia and those struggling to acquire reading skills, have been consistently related to phonological processing and word-level reading (Ehri, Nunes, Stahl, & Willows, 2001; Stanovich & Siegel, 1994). Even so, the ease of becoming phonemically aware and learning to read have been found to relate to the “orthographic depth” of a language, (Katz & Frost, 1992; Seymour, Aro, & Erskine, 2003). Consequently, it is easier to learn to read accurately in orthographies with consistent grapheme-phoneme correspondents (i.e. transparent orthographies) than in orthographies containing many inconsistencies and complexities (i.e. opaque

orthographies). Further, the phenotype of dyslexia varies with the transparency of the language. While, *reading accuracy* has been observed as a core problem in opaque orthographies, *reading fluency* seems to be the most consistently observed problem across languages. (Landerl, Wimmer, & Frith, 1997; Ziegler, Perry, Ma-Wyatt, Ladner, & Schulte-Körne, 2003). An urgent question is thus whether at-risk students learning to read more transparent orthographies also profit from intervention in early phases of reading development, i.e. when the main goal of the instruction is teaching students to read accurately. In order to answer this question, studies from a wider range of orthographies are needed (Galuschka et al., 2014). The present study was undertaken in a Norwegian context. According to Seymour et al. (2003), Norwegian orthography is considered a semi-transparent orthography (i.e. more transparent than English, but less transparent than Finnish). Norwegian children start school the year they turn six years old, and there is no formal instruction in kindergarten (NMER, 2011). The goal of this study was to identify children at risk for RD at school entry, then develop and evaluate the effect of an early reading intervention informed by previous research.

1.1. What characterises effective early reading interventions?

Effective reading interventions (implemented alongside formal

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reading instruction) typically involve letter-sound correspondences, phonics instruction on how to use these correspondences to read and spell words (Ehri et al., 2001; Galuschka et al., 2014; McArthur et al., 2012) and/or comprehension strategies (Scammacca, Vaughn, Roberts, Wanzek, & Torgesen, 2007; Suggate, 2010). In a meta-analysis of interventions for at-risk and struggling readers in preschool through Grade 7, Suggate (2010) makes a distinction between studies that explicitly target (a) phonemic awareness, (b) phonics, (c) comprehension or (d) a mixture of these, and concludes that phonics interventions were more effective until Grade 1. After Grade 1, comprehension interventions and mixed interventions tended to be most effective. Also, Scammacca et al. (2007) examined interventions that provided 100 sessions or more in Grades K-3, and concluded that all successful interventions included explicit instruction in phonemic awareness and phonetic decoding, along with practice in reading texts and comprehension instruction.

Relatively less evidence is available concerning long-term outcomes following early intervention (Lovett, Barron, & Frijters, 2013; Suggate, 2016). Children already significantly behind their peers in reading in Grade 1 and 2 do not improve relative to their peers in the absence of intervention (Cirino et al., 2002), and some have asserted that relative decline is more the norm (Stanovich, 1986). A few studies have shown that early intervention can result in a persisting benefit over time (e.g., Blachman et al., 2004, 2014; Fälth, Gustafson, Tjus, Heimann, & Svensson, 2013; Lovett et al., 2017; Morris et al., 2012; Saine et al., 2011), but such effects tend to be small, and do not move children's relative skill within their peer group (e.g., a child who is at the 15th percentile at the end of intervention, will remain at the 15th percentile in the years after intervention). Studies that have included long-term follow up, on average have only tracked children for 1-year post-intervention. Of the 71 studies reviewed by Suggate (2016), the mean time to follow up was 11.7 months.

Intervention intensity (e.g. size of the instructional group, how frequently intervention is provided, length of each session, duration of intervention, knowledge and experience of the teacher) has also been found to affect efficacy (Vaughn, Denton, & Fletcher, 2010). Even so, recent meta-analyses (Galuschka et al., 2014; Suggate, 2010, 2016) have failed to document a moderating effect for such intervention features. However, the authors of these meta-analyses suggest that the absence of moderating effects might be a consequence of intervention features typically being confounded, which in turn would reduce the observed association between such moderators and outcomes.

1.2. Computer-assisted interventions

The general rationale for early remediation of children with RD encompasses intensified scaffolding and support directed towards their specific skill needs. As such, computer-assisted interventions (CAI) have attracted major interest in the field because of its capacity to provide highly specialized instruction, with considerations for immediate reinforcing feedback, item difficulty optimized for observed ability, and high levels of engagement (Corbett & Anderson, 1995; Corbett, 2001). Possible advantages have been especially emphasized in early phases of reading instruction and for children at risk for or with RD (Cheung & Slavin, 2012, 2013). In a best-evidence synthesis on the effects on educational technology applications on reading outcomes for struggling readers in Grades 1–6, Cheung and Slavin (2013) report positive, but small, effects on reading skill. Studies reveal higher effect sizes when computer software is provided in small groups (Cheung & Slavin, 2013; Torgesen, Wagner, Rashotte, Herron, & Lindamood, 2010).

There are two main ways in how game progression is implemented in CAIs: a fixed and an adaptive approach. According to research on neuroplasticity, long lasting cognitive benefits can be mediated by two primary design elements: continuous feedback and adaptation to the in-moment performance (Mishra & Gazzaley, 2014). Holding the element of continuous feedback constant, a distinction can be drawn between

applications that have a fixed presentation, following a strict sequence of increasing difficulty to be mastered, and adaptive applications that provide the player with content based on the player's actual performance. The preference for an adaptive approach has been based on the increased potential for facilitating engagement by simultaneously providing students with both sufficient challenge and ample opportunity for success (Richardson & Lyytinen, 2014).

1.3. Objectives of the study

Previous contributions to the literature on early intervention for struggling readers have occurred in orthographies at the extreme ends of the transparency-continuum (e.g., English vs Finnish). These studies have only indirectly informed construction of efficient interventions in semi-transparent orthographies, such as Norwegian. The present study sought to investigate the efficacy of an early reading intervention delivered alongside formal reading instruction to Norwegian 6-year olds identified to be at risk for RD at school entry through a group randomized controlled trial, with a two-year long term follow up after intervention.

When designing the intervention, we emphasized intensity, structured content and explicit instruction. Through training of grapheme-phoneme correspondences, word reading, text reading, free spelling, and reading comprehension, reading skill was enhanced from different angles. Every session included alternations between the parts (letters or words) and the whole (words or texts), a process that in the present study is considered to be a hermeneutic approach to reading and writing (Lundetræ, Solheim, Schwippert, & Uppstad, 2017; Tønnessen & Uppstad, 2015). Hermeneutics is a general theory about interpretation and meaning, that has been particularly prominent on the European Continent (see Gadamer, 1960). This theory also applies to the learning of literacy: frequent meetings with a letter in words promotes knowledge of the letter and how it is applied and pronounced in different words. Conversely, reading or spelling a word promotes the child's knowledge about the word, but also about the letters it consists of.

The intervention was teacher-delivered, and included guided reading; free spelling; shared reading as well as a CAI component. The computer applications were used for training letter knowledge and word reading, and were custom-programmed for the present study. We implemented a Norwegian version of the learning environment GraphoGame (Richardson & Lyytinen, 2014) as well as a competing game: 'On Track ABC', without individual adaptation, but with 3 levels of increasing difficulty within 3 of 5 mini-games. Although some studies have compared the efficacy of playing different versions of GraphoGame (see e.g. Kamykowska, Haman, Latvala, Richardson, & Lyytinen, 2014; Kyle, Kujala, Richardson, Lyytinen, & Goswami, 2013) no previous study has, to our knowledge, targeted the *adaptive* feature by comparing the efficacy of GraphoGame to other reading software without this adaptive feature.

The research questions were as follows:

1. Is there a short-term effect of the On Track interventions in Grade 1 on word reading, sentence reading and spelling?
2. Is the intervention including adaptive gaming software (GraphoGame) more effective than the intervention including a non-adaptive software (On Track ABC app)?
3. Are the possible effects of the On Track interventions sustained over the long term?

2. Method

This study is part of a longitudinal project, On Track, investigating the effect of early intervention for children at risk for RD (Lundetræ et al., 2017). A total of 1199 students from 19 primary schools in the Southwest of Norway were enrolled in the study in 2014. The schools

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