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The effect of fine and grapho-motor skill demands on preschoolers' decoding skill



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ABSTRACT

Previous correlational research has found indications that fine motor skills (FMS) link to early reading development, but the work has not demonstrated causality. We manipulated 51 preschoolers' FMS while children learned to decode letters and nonsense words in a within-participants, randomized, and counterbalanced single-factor design with pre- and posttesting. In two conditions, children wrote with a pencil that had a conical shape fitted to the end filled with either steel (impaired writing condition) or polystyrene (normal writing condition). In a third control condition, children simply pointed at the letters with the light pencil as they learned to read the words (pointing condition). Results indicate that children learned the most decoding skills in the normal writing condition, followed by the pointing and impaired writing conditions. In addition, working memory, phonemic awareness, and grapho-motor skills were generally predictors of decoding skill development. The findings provide experimental evidence that having lower FMS is disadvantageous for reading development.

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Introduction

Several empirical studies highlight the intriguing role that fine motor skills (FMS) play not just in cognitive and mathematical development (Grissmer, Grimm, Aiyer, Murrain, & Steele, 2010; Luo, Jose, Huntsinger, & Pigott, 2007; Pagani, Fitzpatrick, Archambault, & Janosz, 2010) but also surprisingly in

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aspects of reading and emergent literacy development (Brookman, McDonald, McDonald, & Bishop, 2013; Cameron et al., 2012; Grissmer et al., 2010). Theories as to why FMS and early cognitive and academic variables are connected are unfortunately sparse (Suggate & Stoeger, 2014). Moreover, due to the correlational nature of research into FMS and reading skills, causal inference has been difficult. Therefore, in the current study, children's FMS were experimentally manipulated during an early reading learning task to examine the effect that FMS have on decoding skill development.

FMS, grapho-motor skills, and writing

FMS are defined as “small muscle movements requiring close eye–hand coordination” (Luo et al., 2007, p. 596). Grapho-motor skills comprise a subset of FMS referring to the manual operation of a pencil or pen, typically during writing or drawing. Often, grapho-motor skills are used interchangeably with handwriting skill (Ratzon, Efraim, & Bart, 2007) and in some research paradigms interchangeably with FMS (Bart, Hajami, & Bar-Haim, 2007). Writing, in turn, involves the cognitive knowledge of letters and words in addition to grapho-motor skills such that high-level writing is the ability to produce letters and words with correct form and in a fluent manner. In the current work, an attempt was made to respect these differences among FMS, grapho-motor, and writing skills by using these terms precisely; nonetheless, when FMS are turned to the task of reading and writing, these inevitably become more precisely conceptualized as grapho-motor skills.

In longitudinal work, it may be especially important to distinguish clearly between FMS and writing skills when investigating reading and emergent literacy development because children who have acquired FMS may well have achieved this via engaging in writing activities (Cornhill & Case-Smith, 1996; Stachelhaus & Strauß, 2005). Therefore, there is a danger of multicausality in that through writing activities both FMS and grapho-motor activities alongside the cognitive knowledge of letters and words would all be improved, thereby leading to spurious links between these domains. Accordingly, when FMS measures require grapho-motor or writing skills (e.g., Grissmer et al., 2010; Son & Meisels, 2006), there is danger that FMS and the cognitive knowledge of letters and words are confounded in previous correlational research. However, in experimental work, the difference among FMS, grapho-motor skills, and to some extent writing becomes more trivial because experimental control can be taken over both previous cognitive knowledge of reading and children's FMS.

Early reading and decoding skills

Emergent literacy skills are those that precede and play a role in reading development (Lonigan, Schatschneider, Westberg, & National Early Literacy Panel, 2008). Emergent literacy skills that are important precursors of word reading include letter knowledge (saying “bee” for the letter “b”), knowledge of letter–sound correspondences (saying “buh” for “b”), phonemic awareness (can say that the word “cat” has the sounds /k/ /a/ /t/), fluency with the code (reading words quickly), and handwriting (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Whitehurst & Lonigan, 1998, 2001). Decoding skills are those that enable the reader to turn the symbols of text (i.e., graphemes) into sounds (i.e., phonemes). Research studies and syntheses consistently find that these emergent literacy skills predict reading development in the early grades (Lonigan et al., 2008). Given the focus on preschoolers¹ and reading development, for the purposes of the study, we narrowed emergent literacy skills further down to decoding skills because these are particularly necessary for deciphering words.

FMS and decoding skill development

FMS, emergent literacy, and decoding skills typically undergo development during the preschool period. Accordingly, in the first instance, it is important to ensure that links between FMS and reading

¹ In Germany, children are generally in play-based kindergartens without formal reading instruction until the academic year in which they turn 7 years old. However, here we adopt the closest international term for this group of children and call them preschoolers.

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