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Trainability in lexical specificity mediates between short-term memory and both vocabulary and rhyme awareness

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ABSTRACT

A major goal in the early years of elementary school is learning to read, a process in which children show substantial individual differences. To shed light on the underlying processes of early literacy, this study investigates the interrelations among four known precursors to literacy: phonological short-term memory, vocabulary size, rhyme awareness, and trainability in the phonological specificity of lexical representations, by means of structural equation modelling, in a group of 101 4-year-old children. Trainability in lexical specificity was assessed by teaching children pairs of new phonologically-similar words. Standardized tests of receptive vocabulary, short-term memory, and rhyme awareness were used. The best-fitting model showed that trainability in lexical specificity partially mediated between short-term memory and both vocabulary size and rhyme awareness. These results demonstrate that individual differences in the ability to learn phonologically-similar new words are related to individual differences in vocabulary size and rhyme awareness.

1. Introduction

Difficulties in reading and learning to read can cause major problems, for both children and adults. Learning to read is therefore a key goal in the early years of elementary school. Since the process of learning to read involves mapping graphemes onto existing segmental knowledge (used for example in speech processing), a vast amount of research has looked into phonological precursors to literacy, attempting to establish which factors predict successful reading and reading acquisition (Bradley & Bryant, 1983; De Jong & Van der Leij, 1999; Ehri et al., 2001). The current study aimed to investigate the relationships between individual differences in four known precursors to literacy, namely, phonological short-term memory, vocabulary size, rhyme awareness, and the ability to learn new words that phonologically differ minimally from each other (what we label as trainability in lexical specificity).

Specifically, this study investigates how trainability in lexical specificity is related to the other precursors, testing the hypothesis that short-term memory predicts vocabulary and rhyming through the mediation of underlying phonological representations. Although it is clear that these four factors predict early literacy, to our knowledge, no previous study has looked at the interrelations among all four of them. Insight in the underlying interrelations between these predictors to early literacy could, however, shed light on the development of these precursors and hence in the process of learning to read.

Phonological short-term memory capacity is a well-documented precursor to early literacy (Baddeley, 2003; De Jong & Van der Leij, 1999). A meta-analysis by Swanson, Zheng, and Jerman (2009) showed that children with reading disabilities had more problems with short-term memory and working memory than average readers. The ability to temporarily store and manage phonological information may be related to literacy in a direct way (Gathercole & Baddeley, 1993; Torgesen & Burgess, 1998; Wagner & Torgesen, 1987), in an indirect way, mediated by other underlying phonological factors (Melby-Lervåg, Lyster, & Hulme, 2012; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993), or by mediation of the quality of or access to underlying phonological representations (Metsala, 1999).

Second, vocabulary is a predictor of emergent literacy (Verhoeven, Van Leeuwe, & Vermeer, 2011). Children's vocabulary size predicts print decoding skill (Garlock, Walley, & Metsala, 2001) and is important for word decoding, visual word recognition, and reading comprehension (Ouellette & Beers, 2010). Especially before starting kindergarten, children show large individual differences in vocabulary size (Stoel-Gammon, 2011).

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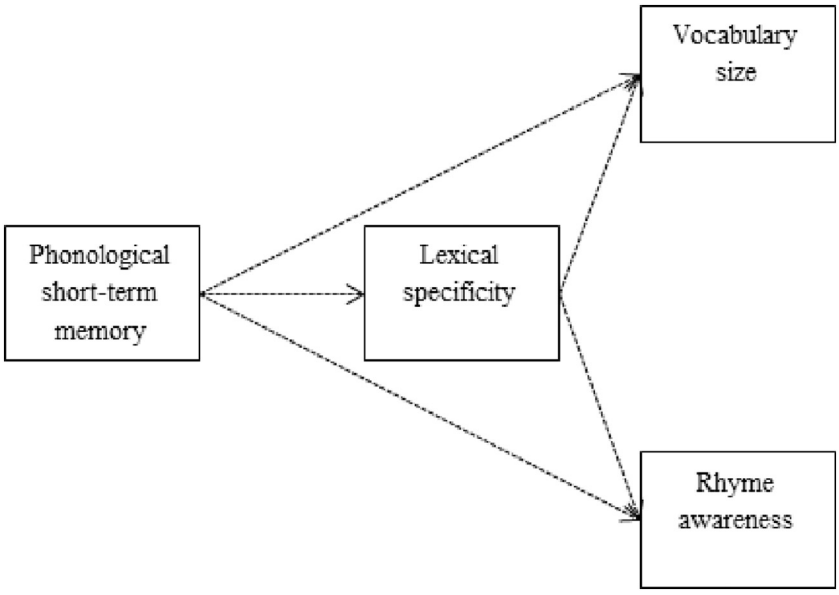

Fig. 1. Hypothetical relations between phonological short-term memory, trainability in lexical specificity, vocabulary size, and rhyme awareness.

A third precursor to literacy is phonological awareness, that is, the ability to consciously reflect upon and manipulate speech sounds. It consists of several subskills (e.g., rhyme awareness and phoneme identification) that develop from awareness of larger to smaller sound units, and is an important predictor of emergent literacy in alphabetic orthographies (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003; Bradley & Bryant, 1983; Ehri et al., 2001; Stanovich, 1992; Vloedgraven & Verhoeven, 2007; Ziegler & Goswami, 2005). For example, success in learning to read is predicted by rhyme awareness before formal reading education (Bradley & Bryant, 1983).

Fourth and finally, the phonological specificity of representations in the mental lexicon and, relatedly, the ability to learn minimally different new words influences print decoding skill and emergent literacy (Elbro, Borstrøm, & Petersen, 1998; Fowler, 1991; Metsala & Walley, 1998; Van Goch, McQueen, & Verhoeven, 2014). Furthermore, variation in the quality of word representations has been shown to influence reading skill (Perfetti, 2007).

These four precursors interact with each other and hence both independently and jointly contribute to the process of learning to read. For example, training lexical specificity by teaching children new words that phonologically differ minimally from each other, fosters phonological awareness (Janssen, Segers, McQueen, & Verhoeven, 2015; Van Goch et al., 2014). Garlock et al. (2001) showed that phonological awareness, receptive vocabulary and phonological short-term memory contributed to word reading. In particular, vocabulary size predicted print decoding skill and phonological awareness, and the latter in turn also predicted print decoding skill (Garlock et al., 2001). In a study on predicting dyslexia from kindergarten, Elbro et al. (1998) showed that phonological awareness predicted print decoding skill, and lexical specificity predicted both phonological awareness and print decoding skill. Gathercole and Baddeley (1993) showed that phonological short-term memory is related to vocabulary and reading acquisition. Furthermore, in a longitudinal study with Dutch children, phonological awareness predicted reading acquisition, and phonological short-term memory predicted phonological awareness (De Jong & Van der Leij, 1999). Rispens and Baker (2012) showed that phonological short-term memory and lexical specificity both contributed to non-word repetition, which is associated with vocabulary and literacy (Conti-Ramsden & Durkin, 2007; Gathercole, 2006). Another important aspect of these precursors is that they develop over time. These skills are not static, and their development is prolonged: vocabulary size and memory capacity expand, phonological awareness increases and becomes more detailed, and, through the process of lexical restructuring, lexical representations become more specified. Again, the development of these skills, and their individual and joint influence on reading acquisition, co-occurs and co-exists.

This study asks how the development of these precursors is interrelated. Previous evidence is inconclusive about the correlational relationships among these precursors in 4-year-olds. For example, as discussed earlier, short-term memory predicts vocabulary size and rhyme awareness. However, the specificity of phonological representations likely plays a role in this relation. According to lexical restructuring theories (Metsala & Walley, 1998; Munson, Edwards, & Beckman, 2011; Stoel-Gammon, 2011), increasing vocabulary size leads to increasingly specified lexical representations, which leads to phoneme awareness. Indeed, lexical specificity training fosters different aspects of phonological awareness (Janssen et al., 2015; Van Goch et al., 2014). The lexical restructuring process is believed to continue into elementary school years. However, studies with younger children suggest that lexical restructuring is a process that occurs earlier in development, before children learn to read. Moreover, the evidence that lexical specificity predicts phonological awareness suggests that an important part of lexical restructuring happens in early childhood. For example, six-year-olds already have detailed and abstract phonological representations (McQueen, Tyler, & Cutler, 2012). At an even earlier age, toddlers show sensitivity for fine-grained differences in the pronunciation of words (Swingley & Aslin, 2000; White & Morgan, 2008) and flexibility in their interpretation of phonological detail (White & Aslin, 2011), both suggesting that their lexical representations are specified to a certain extent.

The current study was thus set up to investigate the role of trainability in lexical specificity in 4-year-olds showing typical lan-