



Predicting the integrated development of word reading and spelling in the early primary grades[☆]



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ABSTRACT

Word reading and spelling processes are assumed to be highly related to each other and to early literacy measures. However, the debate on how reading and spelling interact in early development is far from resolved yet. The present study examined the singular and integrated word reading and spelling development during the first two grades of primary education in relation to kindergarten precursor measures of short-term memory, vocabulary, rapid naming, and early literacy (phonemic awareness, grapheme-to-phoneme knowledge) in 487 Dutch children. Structural equation models showed that word reading and spelling development separately were highly stable and consistently autoregressive in nature during first and second grade. Both word reading and spelling development were predicted by early literacy, and word reading development was additionally predicted by rapid naming. An integrated model for word reading and spelling development showed that word reading skill predicted subsequent spelling skills in Grade 2 over and above the autoregressive prediction. No reciprocal relation of spelling to subsequent word reading has been found.

1. Introduction

One major job for children in elementary school is the development of proper literacy skills. Reading and spelling are two core components of literacy. It has been suggested that reading and spelling derive from the same cognitive and linguistic processes (e.g., Caravolas et al., 2012; Juel, Griffith, & Gough, 1986; Landerl & Wimmer, 2008; Shanahan, 1984). Theoretical models concur with the idea that orthographic, phonological, and semantic components are involved in both reading and spelling processes (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Frith, 1985; Plaut, McClelland, Seidenberg, & Patterson, 1996; Van Orden, Pennington, & Stone, 1990). Indeed, behavioral studies have shown that reading and spelling are highly related (e.g., Ehri, 1989; Juel, 1988), and neuroimaging studies have provided evidence that reading and spelling activate overlapping brain regions (Pugh et al., 2006). Despite this strong suggestion of relatedness, there are only a few longitudinal studies about how the developmental pathways of reading and spelling are related in the early elementary grades. Also, how reading and spelling can be predicted from kindergarten precursor measures of phonemic awareness, grapheme-to-phoneme knowledge, rapid naming, vocabulary and short-term memory needs further investigation. It is noteworthy that only a few studies have combined reading and spelling development as well as

their precursors in one integrated model. Furthermore, such studies have hardly been conducted in relatively transparent orthographies in which reading fluency is a better measure than reading accuracy to establish reading ability. Although it seems a matter of course that reading and spelling are somehow related, the underlying nature of this relation has not yet been clarified. Therefore, the present study aimed to describe the early singular and integrated word reading efficiency and spelling development in the first two primary grades in relation to kindergarten precursors in the relatively transparent Dutch orthography. This large longitudinal Dutch study contributes to the knowledge about the general underlying principles in literacy development.

1.1. Word reading development and its precursors

Word reading development has generally been described as a phase-like model (Ehri, 2005; Frith, 1985). During a first, phonologically driven, decoding phase, children explicitly learn to accurately decode written words into their auditory counterparts by the one-to-one conversion of graphemes into phonemes (Coltheart et al., 2001). After acquiring these elementary decoding skills, children gradually learn to read more complex and longer words containing orthographic structures, for example, consonant clusters and multi-syllables. Every time children encounter a specific internal structure, this larger unit becomes

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better consolidated in an internal orthographic lexicon. Consequently, the orthographic lexicon becomes better specified (Perfetti, 1992). By this self-teaching mechanism, beginning readers gradually become more efficient and fluent (Share, 1999; Tucker, Castles, Laroche, & Deacon, 2016), and the connections between the orthographic (graphemes), phonological (phonemes), and semantic (word meanings) components become stronger, as proposed in the Phonological Coherence model (Bosman & Van Orden, 1997; Van Orden et al., 1990).

High individual stability over time has been evidenced for word reading development in both transparent (e.g., Schaars, Segers, & Verhoeven, 2017; Verhoeven & Van Leeuwe, 2009) and more opaque orthographies (e.g., Caravolas, Lervåg, Defior, Málková, & Hulme, 2013; Furnes & Samuelsson, 2011; Juul, Poulsen, & Elbro, 2014; Steacy, Kirby, Parrila, & Compton, 2014) and precursors of word reading development are well established. Phonemic awareness, grapheme-to-phoneme correspondences, rapid naming, and vocabulary have been found to be relevant precursors of word reading development (e.g., Al Otaiba & Fuchs, 2002; Kirby, Georgiou, Martinussen, & Parrila, 2010; Melby-Lervåg, Lyster, & Hulme, 2012; Moll et al., 2014; Nelson, Benner, & Gonzalez, 2003). Recently, also individual variation in visual and verbal short term memory have been shown to contribute to the prediction of later reading performances (Bosse & Valdois, 2009; Van den Boer, De Jong, & Haentjens-van Meeteren, 2013). The relative contribution of precursors might differ between developmental phases and orthographies, with rapid naming as an especially important predictor of reading efficiency in transparent orthographies (Babayigit & Stainthorp, 2010; Caravolas et al., 2013; De Jong & Van der Leij, 1999; Ziegler & Goswami, 2005, 2006).

1.2. Spelling development and its precursors

Regarding the development of spelling, a few longitudinal studies have been conducted. Most studies, especially on specific difficulties in the spelling system, have been conducted in the English orthography (e.g., Treiman, Cassar, & Zukowski, 1994; but see Caravolas, 2004). However, also in transparent orthographies an autoregressive developmental spelling path has been evidenced, meaning that the individual differences of spelling ability seem to be largely preserved over time. A Norwegian longitudinal study of Lervåg and Hulme (2010) showed for example that, although children varied in how fast they learned to spell words, these individual differences could best be described as variations around a single trajectory. A Dutch cross-sectional study (second to sixth grade) of Keuning and Verhoeven (2008) also showed that spelling development can be best described in terms of a stable continuous learning process. Although literature agrees on a certain autoregressive development of spelling skills, the autoregression is assumed to be less consistent as compared to reading development (Desimoni, Scalisi, & Orsolini, 2012; Pinto, Bigozzi, Tarchi, Gamannossi, & Canneti, 2015).

With regard to the precursors of spelling, converging evidence indicates that as in word reading, phonemic awareness and knowledge of grapheme-to-phoneme correspondences are at least as important (e.g., Caravolas, Hulme, & Snowling, 2001; Furnes & Samuelsson, 2010; Nikolopoulos, Goulandris, Hulme, & Snowling, 2006; Torppa, Georgiou, Niemi, Lerkkanen, & Poikkeus, 2016). In addition, studies on children with dyslexia showed that cognitive and linguistic skills that are important in reading, are also contributing in spelling skills (e.g., Morken & Helland, 2013). However, reading and spelling development are, at least partially, based on different compositions of cognitive and linguistic determinants (Ahmed, Wagner, & Lopez, 2014; Babayigit & Stainthorp, 2010; Caravolas et al., 2001; Caravolas et al., 2012; Nikolopoulos et al., 2006; Torppa et al., 2016). In addition, different compositions have been shown between different orthographies (e.g., Furnes & Samuelsson, 2009; Georgiou, Torppa, Manolitsis,

Lyytinen, & Parrila, 2012). Vaessen and Blomert (2013) found that phonemic awareness and grapheme-phoneme knowledge were stable predictors of spelling in Dutch, whereas their contribution to reading decreased during development. Vaessen and Blomert used a cross-sectional study design in which only concurrent relations between predictors and reading fluency were studied, making interpretations about causality to be taken with caution. Their results do add to the suggestion that the connection between phonology and orthography (see Bosman & Van Orden, 1997; Van Orden et al., 1990) remains more important for spelling than for word reading during development. Babayigit and Stainthorp (2010, in Turkish) also showed higher predictive power of phonological awareness to spelling skills as related to word reading skills.

Vaessen and Blomert (2013) found no contribution of rapid naming to spelling development, whereas the contribution of rapid naming to reading was relatively strong. Although rapid naming has previously been found to be a predictor of spelling ability (Caravolas et al., 2012; Furnes & Samuelsson, 2010; Verhagen, Aarnoutse, & Van Leeuwe, 2010), it has been proposed to be more related to reading skills, since fluent reading is a timed performance from the very beginning (at least in a transparent orthography) whereas spelling is not (e.g., Kirby, Desrochers, Roth, & Lai, 2008; Lervåg & Hulme, 2010). Also, the contribution of short term memory (e.g., Lervåg & Hulme, 2010) and vocabulary (e.g., Verhagen et al., 2010) have previously been evidenced in the prediction of spelling abilities. The Norwegian study of Lervåg and Hulme (2010) longitudinally examined all the before mentioned cognitive and linguistic contributions to spelling development in one and the same study. They found that grapheme-to-phoneme knowledge and phonemic awareness (which could hardly be differentiated from each other) consistently were the most powerful predictors of spelling development. Other studies agree on the contribution of phonemic awareness and grapheme-to-phoneme knowledge to spelling performances (e.g., Caravolas et al., 2001; Hulme, Snowling, Caravolas, & Carroll, 2005; Muter, 1998) and it is in line with the Phonological Coherence model (Bosman & Van Orden, 1997).

1.3. The integrated development of word reading and spelling and their precursors

Word reading and spelling skills have long been considered more or less the same skills, performed in opposite directions (Ehri, 2000; Perfetti, 1997). Similar fundamental skills would be underlying to the performance of both word reading and spelling, in that view. More recently, however, it has been argued that spelling is not a one-to-one reversal of word reading, although word reading and spelling both rely on knowledge of the alphabetic principle (Abbott, Berninger, & Fayol, 2010; Foorman, Arndt, & Crawford, 2011; Shanahan, 2006). The Phonological Coherence model of Bosman and Van Orden (1997) shows a network with recurrent relations between phonemic, graphemic and semantic information. All relations can be activated in both directions, meaning that both conversion from graphemes-to-phonemes and phonemes-to-graphemes are supported in this model.

Spelling, however, is argued to be more difficult than reading (Bosman & Van Orden, 1997). One reason is because inconsistencies in spelling must be resolved with weaker cues of grapheme-semantic relations, whereas inconsistencies in reading can rely on stronger phoneme-semantic cues (Bosman & Van Orden, 1997). In other words, correct spelling requires the active generation of an orthographic structure, whereas reading basically requires its identification and recognition (Fletcher-Flinn, Shankweiler, & Frost, 2004). A second reason is because, in general, there are more graphemes to choose from for writing down a phoneme, than there are phonemes for pronunciation of a grapheme. As a consequence of this asymmetry between the regularity of phoneme-to-grapheme conversion as compared to grapheme-to-phoneme conversion, individual differences in children's spelling skills are larger than those in reading skills from the very beginning. A

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