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Cognitive mechanisms underlying reading and spelling development in five European orthographies

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ABSTRACT

This paper addresses the question whether the cognitive underpinnings of reading and spelling are universal or language/orthography-specific. We analyzed concurrent predictions of phonological processing (awareness and memory) and rapid automatized naming (RAN) for literacy development in a

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large European sample of 1062 typically developing elementary school children beyond Grade 2 acquiring five different alphabetic orthographies with varying degrees of grapheme–phoneme consistency (English, French, German, Hungarian, Finnish). Findings indicate that (1) phonological processing and RAN both account for significant amounts of unique variance in literacy attainment in all five orthographies. Associations of predictors with reading speed, reading accuracy, and spelling are differential: in general, RAN is the best predictor of reading speed while phonological processing accounts for higher amounts of unique variance in reading accuracy and spelling; (2) the predictive patterns are largely comparable across orthographies, but they tend to be stronger in English than in all other orthographies.

1. Introduction

Recently, considerable research interest has been generated by the question whether the cognitive underpinnings of reading acquisition vary between orthographies or whether they are largely similar. All known orthographic systems represent language, however, there is a large degree of variance in the consistency of the mapping between spoken and written language and consequently in the transparency of these mappings for the young learner. The main principle of all alphabetic orthographies that are used in the Western world is that graphic symbols (letters) represent the sound structure of the spoken word. However, few orthographies closely adhere to this alphabetic principle of simple 1:1 relationships between letters and phonemes (like Finnish), while most alphabets provide the reader with a certain degree of inconsistency or irregularity. The English orthographic system with its many complexities is probably on the most extreme end of this continuum of orthographic consistency. Both, theoretical conceptions (Katz & Frost, 1992; Ziegler & Goswami, 2005) and empirical evidence (see Landerl, 2005 for a review) indicate that the development of decoding skills (i.e., the systematic translation of graphemes into phonemes) takes considerably longer in English than in more consistent orthographies. Thus, the complicated and opaque mapping system of English orthography seems to cause particular problems to the young learner. It is probably no coincidence that the investigation of reading acquisition in English strongly dominates the research field. However, the question then arises, whether the outlier status of English orthographic complexity is reflected in the cognitive mechanisms underpinning the reading process which would seriously limit the relevance of such an "Anglocentric view" (Share, 2008) for other orthographies. This issue is not only of high theoretical interest but has important implications for reading instruction as the relevant cognitive predictors are used to identify children who are at risk for reading failure.

1.1. Cognitive predictors of literacy skills

Two cognitive skills that are closely associated with the complex process of reading and spelling acquisition are phonological processing and rapid automatized naming (RAN). Phonological processing refers to the ability to perceive, store and manipulate speech sounds and includes phonological awareness and phonological working memory. In a typical phonological awareness task, a child might be asked to delete a certain sound from a word or nonword pronunciation (e.g., "Say/gulst/without the/l/"). The child then has to maintain the sound sequence in working memory, identify the/l/-sound in the phoneme string, delete it from the pronunciation, and blend the remaining sound parts. Thus, it is obvious that although such tasks are taken to measure phonological awareness, they usually also require working memory capacity. Phonological awareness enables the child to understand and systematically exploit the mappings between graphic symbols and the sound structure of spoken language. It is crucial whenever the graphemes of words or nonwords are decoded during reading and also when words are segmented into their constituent phonemes during spelling. Thus, phonological awareness plays an important role during early literacy development across alphabetic orthographies (e.g., Byrne, 1998; Wagner & Torgesen, 1987), however, in consistent orthographies competent grapheme–phoneme and phoneme–grapheme translation is typically achieved earlier and growth of literacy skills is faster than in inconsistent orthographies like English (e.g., Caravolas, Lervåg, Defior, Seidlová Málková, & Hulme, 2013; Seymore, Aro, & Erskine, 2003). Beyond these early phases of literacy development, phonological awareness is supposed to exert its influence on building-up word-specific representations (Ehri, 1992; Perfetti, 1992). According to this theoretical view, an efficient storage of orthographic patterns depends on multiple associations between phonological segments of a spoken word and the corresponding graphemes of its written form. Word-specific orthographic representations enable direct word recognition during reading and correct orthographic spelling. Once again, the degree of consistency of grapheme- as well as phoneme–grapheme correspondences can be assumed to play an important role. Coping with the many irregularities and inconsistencies inherent in the English orthographic system may particularly challenge the phonological system of the learner. This would imply that the relevance of phonological processing skills should be lower in consistent than in less consistent orthographies.

Rapid automatized naming (RAN) refers to the speed with which an individual can pronounce the names of a sequentially and repeatedly presented limited set of stimuli like letters, Arabic digits, color patches, or pictures of familiar objects. Performing RAN tasks certainly requires phonological skills (accessing the phonological output programs of the required word pronunciations as quickly as possible) and is therefore sometimes seen as a third subcomponent of phonological processing (Torgesen, Wagner, & Rashotte, 1994; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Vaessen, Gerretsen, & Blomert, 2009). However, there is now ample evidence that "naming speed is phonological, but not only phonological" (Kirby, Georgiou, Martinussen, & Parrila, 2010, p. 356) and constitutes a second cognitive mechanism underpinning reading development that is largely independent from phonological awareness and memory. First, the correlation between phonological awareness and RAN is typically only low to moderate (.38 in a meta-analysis of 35 studies that were almost exclusively carried out in English; Swanson, Trainin, Necoechea, & Hammill, 2003). Second, although phonological awareness and RAN contribute some amount of shared variance, both components have consistently been shown to make unique contributions to the variance of literacy skills above and beyond the other one. Third and most importantly, these unique contributions seem to be differential: phonological awareness and RAN have been demonstrated to show specific relationships with particular subcomponents of literacy processing. While phonological skills seem to be most strongly related to literacy skills that involve decoding (most importantly