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Effects of orthographic consistency on eye movement behavior: German and English children and adults process the same words differently

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ABSTRACT

The current study investigated the time course of cross-linguistic differences in word recognition. We recorded eye movements of German and English children and adults while reading closely matched sentences, each including a target word manipulated for length and frequency. Results showed differential word recognition processes for both developing and skilled readers. Children of the two orthographies did not differ in terms of total word processing time, but this equal outcome was achieved quite differently. Whereas German children relied on small-unit processing early in word recognition, English children applied small-unit decoding only upon rereading—possibly when experiencing difficulties in integrating an unfamiliar word into the sentence context. Rather unexpectedly, cross-linguistic differences were also found in adults in that English adults showed longer processing times than German adults for nonwords. Thus, although orthographic consistency does play a major role in reading development, cross-linguistic differences are detectable even in skilled adult readers.

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Introduction

The current study aimed to investigate cross-linguistic differences in word recognition in an eye-tracking paradigm. In particular, we examined indicators of small-unit processing (length effects) and large-unit processing (frequency effects) in child and adult readers of the consistent German and the inconsistent English orthographies.

Alphabetic orthographies differ with respect to the consistency with which letters map onto sounds, and it has long been established that reading development progresses more slowly in inconsistent orthographies compared with consistent orthographies (e.g., Caravolas, Lervåg, Defior, Seidlová Málková, & Hulme, 2013; Frith, Wimmer, & Landerl, 1998; Seymour, Aro, & Erskine, 2003; Öney & Goldman, 1984). This difference is not only quantitative but also qualitative; beginning readers of inconsistent orthographies such as English have particular difficulties in phonological decoding. Thus, nonword reading is relatively poor in beginning readers of inconsistent orthographies (e.g., Frith et al., 1998; Wimmer & Goswami, 1994). Even though factors such as a language's syllabic complexity, method of reading instruction, and age at onset of formal instruction have all been shown to exert an influence on the development of reading, the crucial factor in explaining the differences in reading acquisition appears to be orthographic consistency (e.g., Aro & Wimmer, 2003; Landerl, 2005; Seymour et al., 2003).

In the context of psycholinguistic grain size theory (Ziegler & Goswami, 2005), the lower rate at which reading development progresses in inconsistent orthographies such as English is explained by the need to develop reading strategies targeting psycholinguistic units at a variety of grain sizes. For children learning to read a consistent orthography, decoding at the smallest linguistic grain size of the phoneme is sufficient during the early phase of reading development. However, this strategy is notoriously unreliable in English, forcing young readers to develop a variety of reading strategies using different linguistic grain sizes such as onsets, rimes, syllables, and whole words in order to cope with the complexities of the English orthography. Therefore, it appears that reading acquisition in an inconsistent orthography is delayed for two reasons: (a) because of the need to develop a number of reading strategies targeting different grain sizes and (b) because both the acquisition and the successful application of grapheme–phoneme correspondence rules are harmed by their inherent inconsistent nature.

It is crucial to note that even early word recognition in consistent orthographies is not *entirely* reliant on small grain sizes (e.g., Burani, Marcolini, & Stella, 2002; Davies, Cuetos, & Glez-Seijas, 2007); conversely, readers of less consistent orthographies are far from being *entirely* reliant on larger grain sizes (e.g., Duncan, Seymour, & Hill, 1997; Goswami, Ziegler, Dalton, & Schneider, 2001). Indeed, differences are relative rather than absolute. To properly test the relative importance of grain size across languages, cross-linguistic studies are of special importance. Following this strategy, a growing number of studies have directly compared reading in different orthographies.

First, nonword reading has consistently been reported to be better in consistent orthographies than in inconsistent orthographies (e.g., Aro & Wimmer, 2003; Frith et al., 1998; Landerl, 2000; Mann & Wimmer, 2002; Seymour et al., 2003; Thorstad, 1991), reflecting the fact that serial decoding of small-unit grapheme–phoneme correspondences is more readily available to beginning readers of consistent orthographies.

Second, a high percentage of reading errors in beginning readers of less consistent orthographies constitute refusals and word substitutions for both words and nonwords (e.g., Ellis & Hooper, 2001; Frith et al., 1998; Seymour et al., 2003), suggesting an inability to apply small-unit grapheme–phoneme correspondences. In contrast, beginning readers of more consistent orthographies have been reported to produce mainly nonword errors, often reflecting minor deviations from the correct pronunciation resulting from a small-unit decoding strategy (e.g., Ellis & Hooper, 2001; Seymour et al., 2003).

Third, direct comparisons have shown stronger word length effects in consistent orthographies than in inconsistent orthographies, also indicating stronger reliance on systematic decoding procedures (Ellis & Hooper, 2001; Goswami, Gombert, & Fraca de Barrera, 1998).

Finally, there is stronger evidence for the use of lexical analogies at the rime level in English than in more consistent orthographies. Thus, the facilitatory effect of orthographic neighborhood size was