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Pirates at parties: Letter position processing in developing readers

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ABSTRACT

There has been much recent interest in letter position coding in adults, but little is known about the development of this process in children learning to read. Here, the letter position coding abilities of 127 children in Grades 2, 3, and 4 (aged 7–10 years) were examined by comparing their performance in reading aloud "migratable" words (e.g., *bread*, *three*, *diary*) with that in reading aloud words without potential for migration (e.g., *heard*, *boot*, *bitter*). Across all three grade levels, children made many more errors on migratable words than on non-migratable words, and the proportion of migration errors did not decrease with increasing grade level. Within each grade, a tendency to make a high proportion of migration errors was not associated with deficits in other reading subprocesses or with general lexical guessing; indeed, it was associated with strong lexical reading skills. We conclude that letter position coding is generally fragile in developing readers and that this interacts with lexical knowledge to produce migration errors in reading.

Introduction

To read a word accurately, children need to correctly identify each of its letters. However, this alone is not sufficient; they also need to determine the order in which those letters occur. Otherwise, they may mistakenly read *slime* as "smile" or even read *parties* as "pirates". Although there has been a vast amount of research during recent decades on the development of reading ability, particularly focusing on the importance of phonological decoding as a key foundation skill (see, e.g., Adams, 1990), little

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research attention has been directed at the question of how letter position processing develops in children. This question formed the basis of the current study.

In contrast to children, several studies have examined letter position processing in adult readers. Interestingly, the results of these studies reveal that the processing of letter order is somewhat imprecise even in these mature readers. Words that differ from another word by virtue only of a letter transposition (e.g., salt and slat) are responded to more slowly by adults in both naming and lexical decision tasks than control words that differ in letter identity (Andrews, 1996). Similarly, briefly presented transposed letter nonword primes (e.g., brid) facilitate lexical decision performance on their targets (e.g., BIRD),[1] suggesting that such primes activate lexical representations of the target words (Andrews & Lo, 2012; Davis, 2010; Forster, Davis, Schoknecht, Carter, 1987; Grainger, 2008; Perea & Lupker, 2003a, 2003b). Thus, it seems that letter position coding is an aspect of the reading system that does not develop into a precise process in the mature system. The question of how to implement this imprecise process within models of written word recognition is a topic of current debate (see Davis, 2010; Davis & Bowers, 2006; Grainger & van Heuven, 2003; Whitney, 2001).

Given that the letter position coding process appears to be imprecise even in skilled readers, the question arises as to how it might develop and change in beginning readers. Despite the overall fragility of the system, is there nevertheless a developmental trajectory from less precise to more precise letter position coding, or is letter position processing relatively stable across development? There has been surprisingly little research on this question, with the main evidence coming from three recent studies. Grainger, Lété, Bertrand, Dufau, and Ziegler (2012) conducted a lexical decision study with children from Grades 1 to 5 and adult readers. The participants showed a significant decrease in accepting phonological foils (e.g., pseudohomophones such as *trane* vs. control items such as *trand*) with increasing reading ability. In contrast, a significant increase in the acceptance of order foils (e.g., *talbe* vs. control items such as *tarpe*) was reported with increasing reading ability.

In a masked priming study, Castles, Davis, Cavalot, and Forster (2007) found that nonword primes with transposed letters facilitated lexical decision performance in children in Grades 3 and 5 and that this priming did not reduce with advancing grade. Similarly, Acha and Perea (2008) found that transposed letter primes facilitated access to word targets in beginning (Grade 3) and intermediate (Grade 6) readers. Thus, both masked priming studies found evidence for imprecision in letter position coding in children learning to read, but neither found evidence for any developmental change in processing.

If imprecision in letter position coding is a feature of the developing system, it might be expected to be evident not just in masked priming but also in more overt performance such as reading aloud if the items are chosen appropriately. Children might be more likely to make reading errors on words that have anagrams (e.g., bread–beard, could–cloud; henceforth referred to as "migratable" words) than on words that do not. In making such errors, children might be prone in particular to reading migratable words as their anagram partner (e.g., reading *cloud* as "could," which we refer to as a "migration error").

We are aware of only two studies that have used reading aloud tasks to examine letter position coding in children. Perea and Estévez (2008) assessed nonword reading (e.g., *cholocate*) in Spanish students across three age levels (Grade 2, Grade 4, and college). The majority of errors on the nonwords were migration errors (e.g., reading *cholocate* as "chocolate"). The other study was conducted by Friedmann and Rahamim (2007). They tested normally developing Hebrew readers in Grades 1 and 2 on migratable words and found that these children did make migration errors, albeit at very low rates (first graders: <1%; second graders: 3.3%). However, the authors tested only a small number of children at very early stages of reading, and there were some limitations regarding the items used (e.g., the first graders read only words with a potential for migration of exterior letters (e.g., saw–was), which tend to produce much lower migration error rates). As Friedmann and Rahamim (2007) noted, "The description of the development of normal letter position coding requires ... more data from more children" (p. 225).

In the first part of the current study, we examined evidence for imprecision in letter position coding in an unselected sample of children from Grades 2 to 4 using items specifically designed to be

[1] Priming by word primes is less robust and may be modulated by several factors (e.g., Duñabeitia, Perea, & Carreiras, 2009; Velan & Frost, 2011).