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A developmental investigation of the first-letter advantage

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ABSTRACT

Skilled adult readers identify the first letter in a string of random consonants better than letters at any other position, and this advantage for the initial position is not seen with strings of symbols or familiar shapes. Here we examined the developmental trajectory of this first-letter advantage by testing children in Grades 1 to 5 of primary education in a target-in-string identification paradigm. Strings of five letters or five simple shapes were briefly presented, and children were asked to identify a target letter/shape at one of the five possible positions. Children responded by choosing between the target and an alternative that was a neighboring letter/shape (e.g., TPFMR—M vs. F at position 4). The serial position function linking accuracy to position-in-string was found to be affected by reading ability differently for letter stimuli compared with shape stimuli, and this was found to be almost entirely driven by differences in performance in identifying targets at the first position in strings. Here, accuracy increased more rapidly for letter stimuli than for shape stimuli as reading ability increased. This developmental pattern, plus the fact that letter strings were composed of random consonants and the task minimized the involvement of verbal recoding, allows us to exclude an explanation of the first-letter advantage in terms of serial reading strategies or phonological decoding. The findings suggest that the first-letter advantage is a function of, and a marker for, increasingly efficient orthographic processing.

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Introduction

Building on the theoretical work of Ehri (1992) and Share (1995), there has been a growing interest in the contribution of orthographic processes to reading development, particularly with respect to the transition from relatively laborious elementary reading skills, such as phonological decoding, to the fast and efficient retrieval of meaning from print that characterizes skilled reading (e.g., Acha & Perea, 2008; Castles, Davis, Cavalot, & Forster, 2007; Castles & Nation, 2006; Grainger, Lété, Bertrand, Dufau, & Ziegler, 2012; Grainger & Ziegler, 2011; Kohnen & Castles, 2013; Lété & Fayol, 2013; Paterson, Read, McGowan, & Jordan, 2015; Perea, Jiménez, & Gómez, 2015; Ziegler, Bertrand, Lété, & Grainger, 2014). In the current study, we focused on the very earliest stage of orthographic processing, the processing of letter identities and letter positions, by examining changes in the way letters are identified in strings of random consonants. Using random consonant arrays rules out any role for lexical or phonological information and, therefore, allows one to focus on the bottom-up mechanisms involved in the early recovery of letter identity and letter position information from a string of letters.

Prior research with adult participants suggests that post-cued letter-in-string identification (i.e., partial report procedure) is one paradigm that taps into the earliest phase of orthographic processing, that is, the processing of information about letter identities and letter positions. In a typical experiment, a string of random consonants (e.g., FMRBT) is briefly presented and backward masked, with a cue for one of the positions in the string accompanying the mask (e.g., Haber & Standing, 1969; Merikle, Lowe, & Coltheart, 1971; Wolford & Hollingsworth, 1974). Participants simply need to report the identity (or choose between alternatives) of the letter at the cued location, a procedure thought to minimize any role for sequential scanning strategies (e.g., Merikle et al., 1971). Importantly, this paradigm can also be applied to other kinds of stimuli, and one key finding is that strings of letters and digits are processed differently compared with strings of symbols and shapes. This pattern has been found with adult participants (Chanceaux & Grainger, 2012; Collis, Kohnen, & Kinoshita, 2013; Tydgat & Grainger, 2009) and children (Ziegler, Pech-Georgel, Dufau, & Grainger, 2010) and is also found with variants of the target-in-string identification paradigm (e.g., Pitchford, Ledgeway, & Masterson, 2008; Scaltritti & Balota, 2013; see Tydgat & Grainger, 2009, for a review of the seminal work of Mason, 1982; Mason & Katz, 1976, and Hammond & Green, 1982, using a target-in-string search task).

The most systematic difference in performance to letters/digits compared with symbols/shapes seen in prior research concerns accuracy in identifying targets located at the initial position of the string. Superior processing of the initial letter, compared with letters at other positions in the string, is referred to as the first-letter advantage (e.g., Scaltritti & Balota, 2013). What is crucial, however, with respect to the current study is that in post-cued target-in-string identification, whereas performance is highest for letters at the first position (Marzouki & Grainger, 2014; Scaltritti & Balota, 2013; Stevens & Grainger, 2003; Tydgat & Grainger, 2009), symbol stimuli often show lowest performance at the first position in the string and certainly never show the best performance (Tydgat & Grainger, 2009). It is this contrast in performance for alphanumeric stimuli (letters and digits) and non-alphanumeric stimuli (symbols and shapes) at the first position in strings that was the focus of the current study.

In this study, we aimed to test two alternative accounts of the first-letter advantage seen in post-cued item-in-string identification tasks. According to one account, the first-letter advantage is the result of an adaptive mechanism that operates to improve processing of the initial letters of words given the constraints imposed by parallel orthographic processing (Tydgat & Grainger, 2009). According to this account, the first-letter advantage is the result of adaptation of low-level visual processing in order to prioritize processing of the initial letter in words when children learn to read. More specifically, it was hypothesized that prioritizing initial-letter processing could be achieved via modifications in the shape of receptive fields of location-specific letter detectors. Giving priority to the initial letter of words is important because this letter is the most informative with respect to word identity (e.g., Dandurand, Grainger, Duñabeitia, & Granier, 2011; Grainger & Jacobs, 1993), and its efficient processing is essential for fluent reading aloud. However, skilled reading involves parallel processing of all letters in the word, often within a single fixation, the location of which is typically