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Brief Report

Experimental confirmation of a character-facing bias in literacy development

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ABSTRACT

When learning to write, children often mirror-reverse individual letters. For children learning to use the Latin alphabet, in a left-to-right writing culture, letters that appear to face left (such as J and Z) seem to be more prone to reversal than those that appear to face right (such as B and C). It has been proposed that, because most asymmetrical Latin letters face right, children statistically learn this general regularity and are subsequently biased to write any letter rightward. The evidence for this character-facing bias is circumstantial, however, because letter-facing direction is confounded with other factors that could affect error rates; for instance, J and Z are left-facing, but they are also infrequent. We report the first controlled experimental test of the character-facing bias. We taught 43 Scottish primary schoolchildren (aged 4.8–5.8 years) four artificial, letter-like characters, two of which were left-facing and two of which were right-facing. The characters were novel and so were not subject to prior exposure effects, and alternate groups of children were assigned to identical but mirror-reflected character sets. Children were three times more likely to mirror-write a novel character they had learned in a left-facing format than to mirror-write one they had learned in a right-facing format. This provides the first experimental confirmation of the character-facing bias in literacy development and suggests that implicit knowledge acquired from exposure to written language is readily generalized to novel letter-like forms.

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Introduction

The production of individual letters or even words in a reversed direction, such that they look normal when viewed in a mirror, has long been noted in the writing of children. Early reports portrayed such reversals as markers of slow intellectual development and/or left-handedness (Fuller, 1916; Gordon, 1921; Schiller, 1932). Recent studies have dispelled these beliefs, indicating that, rather than identifying any specific subgroup of children, mirror-writing characterizes a normal stage of literacy development between learning the letter shapes and learning their orientations. Proposed explanations are that the representation of letter shape is subject to an automatic mirror generalization that must be actively unlearned (Corballis & Beale, 1976; Dehaene, 2010; Dehaene et al., 2010) and that the direction of a writing *action* is learned later than its general shape (Della Sala & Cubelli, 2007). Either account entails a period of directional instability during which children will be prone to mirror-write.

For children learning to use the Latin alphabet, in a dextrad (left-to-right) writing culture, mirror reversals are not equally likely for all asymmetrical letters but rather are more likely for letters that are left-facing (Fischer, 2011; Simner, 1984; Treiman & Kessler, 2011; Watt, 1983). A typical left- or right-facing letter has its distinguishing features appended to one side of a vertical or semi-vertical stem (e.g., J vs. F); although observers also agree about the directionality of some letters that do not fit this stem-and-appendage pattern (e.g., S faces right, Z faces left) (Fischer, 2017b; Treiman, Gordon, Boada, Peterson, & Pennington, 2014).[1] The disproportionate reversal of left-facing characters has been confirmed for uppercase letters, lowercase letters, and digits (Fischer, 2011, 2017a, 2017b; Fischer & Koch, 2016b; Fischer & Tazouti, 2012; Treiman & Kessler, 2011; Treiman et al., 2014) and in left- and right-handed children alike (Fischer & Koch, 2016a).

This asymmetry of errors could be explained by automatic statistical learning of letter forms by children exposed to written language (Fischer, 2011; Fischer & Tazouti, 2012; Treiman & Kessler, 2011; Treiman et al., 2014). Right-facing letters make up the majority of the Latin alphabet—especially uppercase—and it is proposed that children extract this general regularity before they acquire the individual letter directions and internalize the expectation that letters face right. This expectation would bias their early writing attempts, promoting the correct writing of right-facing letters and the reversal of left-facing letters. If this expectation were generalized to other letter-like forms, it could also explain why left-facing Arabic numerals are more often reversed even though right-facing forms do not predominate among the digits (Fischer, 2011, 2017a, 2017b; Fischer & Koch, 2016a, 2016b; Fischer & Tazouti, 2012; Treiman & Kessler, 2011; Treiman et al., 2014).

Fischer (2011) proposed the term "right-writing rule" to capture this idea. However, the original formulation has been updated by observations that suggest a pivotal role of current writing direction. Fischer (2017a) retrospectively examined data from 579 children who had written their name on two separate sheets of paper, the layout of which promoted left-to-right writing on one sheet and right-to-left writing on the other (method adapted from Cornell, 1985). Fischer identified 204 children with at least one reversible letter in their name who had written their name in uppercase in both directions. When writing left to right, children more often reversed left-facing letters; however, when writing right to left, the pattern flipped, such that right-facing letters were more often reversed. This suggests that the true internalized expectation is that letters face *in the direction of writing*. In a dextrad writing culture, the typical manifestation would be the greater reversal of left-facing characters.

However, the key evidence for the character-facing bias is still circumstantial because it derives from spontaneous reversals among children using natural language. Character-facing direction is a strong candidate cause of the bias, but other factors could potentially influence the likelihood of errors. For instance, the most often reversed uppercase letters (J and Z) are left-facing, but they are also infrequent (in English and French). Treiman and Kessler (2011) considered several possible confounding influences, including letter frequency, number of segments, and the presence of descenders (parts below the line),

[1] Of the asymmetrical uppercase letters, only J and Z are clearly left-facing, whereas B, C, D, E, F, G, K, L, P, Q, R, and S all are right facing. Of the asymmetrical lowercase letters, a, d, g, j, q, y, and z are considered left-facing, whereas b, c, e, f, h, k, n, p, r, and s are considered right-facing (Treiman et al., 2014).

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