Commentary

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In Defense of Position Uncertainty: A Reply to Duñabeitia, Orihuela, and Carreiras (2014)

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There is a high degree of flexibility in letter-position coding during visual word recognition and reading (e.g., “JUGDE” can be easily confounded with “JUDGE”). One leading account explaining this phenomenon is based on the presence of perceptual noise in the information used for locating the positions of objects—namely, letters—across space (overlap model: Gómez, Ratcliff, & Perea, 2008; Bayesian-reader model: Norris, Kinoshita, & van Casteren, 2010). This assumption is shared with formal models of visual attention (e.g., Ashby, Prinzmetal, Ivry, & Maddox, 1996; Logan, 1996).

Recently, Duñabeitia, Orihuela, and Carreiras (2014) purportedly found evidence against this perceptual-noise account. They compared the performance of illiterate versus literate adults presented with sequences of four letters (or symbols). Participants were presented with a four-character string for 300 ms; this string was followed by another string that was either the same (e.g., “NDTF”-“NDTF”; “?€&<”-“?€&<”) or different (via character transposition or replacement; “NDTF”-“NTDF” vs. “NSBF”-“NTDF”; “?€&<”-“?&€<” vs. “?€&<”-“?%$<”). While literate participants showed higher error rates in the transposition condition than in the replacement condition (i.e., a transposed-character effect; letters: 39% vs. 20%; symbols: 44% vs. 30%), this difference was absent in illiterate participants (letters: 62% vs. 62%; symbols: 61% vs. 57%). Duñabeitia et al. concluded that “letter-position coding is a mechanism that emerges during literacy acquisition” (p. 1275) rather than by “a generic noisy perceptual mechanism that processes all visual stimuli—letters and objects—alike” (p. 1279).

Perceptual Uncertainty and the Acquisition of Orthographic Representations

We claim that (a) the null transposed-character effect Duñabeitia et al. reported for illiterate adults had to do not with literacy acquisition per se but rather with the acquisition of orthographic representations, and that (b) the findings of Duñabeitia et al. are fully consistent with perceptual-noise accounts. Our claim is supported by several important considerations. First, the reduction of transposed-character effects with sequences of pseudoletters (or letters from an unknown orthography), which Duñabeitia et al. did not mention, is a well-documented finding in literate adults performing the masked-prime same/different task (i.e., a task that taps early orthographic processes; see Norris & Kinoshita, 2008). In this task, a probe is presented, followed by a masked prime that is replaced by a target (e.g., transposed-letter condition: probe = “NDTF,” prime = “NTDF,” target = “NDTF”; replaced-letter condition: probe = “NDTF,” prime = “NSBF,” target = “NDTF”). García-Orza, Perea, and Muñoz (2010) found a transposed-character priming effect with sequences of four consonants, four digits, and four symbols, but not with sequences of four pseudoletters (see Muñoz, Perea, García-Orza, & Barber, 2012, for electrophysiological evidence). Furthermore, Perea, Abu Mallouh, García-Orza, and Carreiras (2011) found that whereas university students with no knowledge of Arabic failed to exhibit a masked-transposed-letter priming effect with short sequences of Arabic letters, university students who were learning Arabic (i.e., who had acquired orthographic representations of Arabic letters) did show an effect of masked-transposed-letter priming.

To further examine this issue, we used the (unprimed) same/different task employed by Duñabeitia et al. in two experiments with literate adults. Keep in mind that the null finding for illiterate individuals that Duñabeitia et al.

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reported is difficult to interpret, given that error rates for the "different" responses were around 50% to 60%, and sensitivity, as measured by d', was not shown to be significantly higher than chance level (d' was near 0): The participants seemed to simply exhibit a preference for "same" responses. This preference might reflect lack of understanding of instructions, lack of perceptual discriminability, or simply lack of interest in the experiment. Hence, we collected data from participants who performed above chance level. (For a complete description of this experiment, including the method, procedure, analysis, and results, see Position Uncertainty in the Supplemental Material available online.)

Letter-Position Coding in Unfamiliar Orthographies: New Evidence With the Same/Different Task

In Experiment 1, we presented sequences of four Thai letters to native readers of Thai and to Australian participants with no knowledge of Thai. Results revealed a character-transposition effect that was greater for the Thai readers than for the non-Thai readers (Thai readers: 44.0% of errors in the transposed condition vs. 16.7% of errors in the replaced condition; non-Thai readers: 44.7% of errors in the transposed condition vs. 35.4% of errors in the replaced condition). In Experiment 2, on each trial, a group of Spanish students classified two strings of four Devanāgarī letters (a script unknown to them) as the same (e.g., "ग क फ य"-"ग क फ य") or as different (transposed: "ग फ ल ख"-"ग ल फ ख"; replaced: "ग य घ ख"-"ग ल फ ख"). Accuracy was emphasized over speed in the instructions, and the manipulation involved only the two internal characters of each string, as in the experiments of Duñabeitia et al. Results revealed a small but significant transposed-character effect (transposed condition vs. replaced condition: 15.4% vs. 9.1% of errors). Thus, the null effect in illiterate individuals reported by Duñabeitia et al. could have been due to lack of power to detect a small transposed-letter effect (9.3% in Experiment 1; 6.3% in Experiment 2) combined with a near-chance error rate.

Therefore, for illiterate individuals—note that all readers are illiterate for writing systems other than their own—there are no internal representations of unknown letters (i.e., no groups of neurons that selectively fire upon the presentation of these letters). Consequently, the different features of the characters cannot rapidly be bound into a single object (see Lachmann, Khera, Srinivasan, & van Leeuwen, 2012). Hence, the same/different task can be performed above chance level when it involves simple shapes, but not letters of unknown alphabets. This leads to small transposed-character effects in the unprimed version of the task, or even null effects in the masked-priming version of the task (i.e., when the task taps early orthographic processes).

Second, Duñabeitia et al. claimed that their data argue in favor of orthographic accounts of letter-position coding and against perceptual-noise accounts. The strong version of this claim is, in our opinion, not correct. Duñabeitia et al. did not specify which orthographic account accommodates their data. Within the orthographic accounts of letter position coding, open-bigram models (Grainger & van Heuven, 2003) are the most influential, but they are difficult to reconcile with the claim made by Duñabeitia et al. about literate individuals: It is unlikely that readers have developed open bigrams for character pairs such as "€&."

One could, however, soften this position: One of the effects of literacy is the emergence of letters (from a known alphabet) as distinct objects that might be explicitly coded by populations of neurons. This interpretation is perfectly consistent with the perceptual-noise mechanism posited by the overlap and Bayesian reader models: Without an internal representation of letters, the location uncertainty is void of any content.

Author Contributions

M. Perea and P. Gomez developed the study concept. M. Perea, P. Gomez, and H. Winskel contributed to the study design. Testing and data collection were performed by R. Abu Mallouh and L. Barnes. M. Perea, P. Gomez, and H. Winskel analyzed and interpreted the data. M. Perea, P. Gomez, and H. Winskel drafted the manuscript, and R. Abu Mallouh and L. Barnes provided critical revisions. All authors approved the final version of the manuscript for submission.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://pss.sagepub.com/content/by/supplemental-data

Open Practices

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