Language-universal and script-specific factors in the recognition of letters in visual crowding: The effects of lexicality, hemifield, and transitional probabilities in a right-to-left script

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Visual crowding, which refers to the failure to identify an object in clutter, imposes a significant constraint on reading and has been linked to reading difficulties (Joo et al., 2018) and developmental dyslexia (e.g., Bertoni et al., 2019). Previous studies in alphabetic scripts have demonstrated that letter recognition within a trigram string is more accurate when the string forms a word compared to a pseudoword (the well-known "lexicality" effect). This effect occurs both in the fovea and the parafovea (Martelli et al., 2005). However, words and pseudowords not only differ in their lexical properties such as print frequency, but also sublexically in terms of the transitional probabilities of their letters (n-grams). These transitional probabilities, which capture the likelihood of a letter given its neighboring letters, play a crucial role in reading. However, the precise mechanism through which transitional probabilities facilitate reading remains unclear. Using a letter recognition task in varying display conditions, we investigated the effects of lexicality (words vs. pseudowords), visual hemifield, and transitional probability (bigram/trigram frequency) among skilled readers (Experiment 1, N = 14; Experiment 2, N = 13) in Hebrew - a script read from right to left. We predicted and confirmed two language-universal effects: a lexicality effect and a right hemifield (left hemisphere) advantage, as well as a strong language-specific effect – a left bigram advantage stemming from the right-to-left reading direction of Hebrew. The latter finding suggests that transitional probabilities are a significant factor in parafoveal letter recognition. The results shed light on the visual system's processing of crowded stimuli in general and in printed words in particular, revealing that script-specific contextual information such as letter combination probabilities influences letter recognition in crowded displays.

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