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DELINEATING PICTURE AND CHINESE CHARACTER RECOGNITION: AN ERP APPROACH

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The logographic nature of the Chinese script has often been compared to alphabet scripts and argued that more visual-spatial analysis is required, given that character components are arranged in a fixed square shape (Tan et al., 2001). The analogy between characters and pictographs or line-drawings has led to some discussion of whether the two are similar or distinct in visual-spatial analysis particularly in the right occipital hemisphere (e.g. Yum et al., 2012; Zhang, et al., 2011). Using ERP's method, this study aimed to address whether visual-spatial analysis of characters is dissociable from line drawings, particularly focusing at the initial occipital P100 component known to reflect visual feature detection, and the N170 component where object and word processing are discriminated along the ventral stream of the brain. Twenty-five right-handed native Chinese speakers performed a repetition detection task where participants were asked to respond when the same stimulus was repeated over consecutive trials, whilst collecting their electrophysiological data. Non-repeated trials consisted of stimuli varying by Domain (line-drawn objects vs. Chinese characters) and Well-formedness (Real, pseudo vs. non-items), giving six conditions (1) real objects, (2) pseudo objects, (3) non-objects (4) real characters, (5) pseudo characters, and (6) non-characters. Pseudo objects were constructed by randomly combining parts of the real objects to make non-existing but plausible objects, and pseudo characters by randomly combining sub-lexical components (radicals) whilst following their positional orthographic rules. Non-objects and non-characters were constructed by random combinations of the same units to form illogical pictures or with the orthographic rules violated, respectively. The ERP results revealed that pictures and Chinese characters are processed distinctively as early as 100ms post-stimulus at the P100 component, and across all subsequent ERP components, with line-drawings of objects generally eliciting greater amplitudes than characters (at the occipital P200 and N400 components). Domain effects were also found at the N170, with characters eliciting a larger N170 than pictures particularly in the left occipital electrodes. Furthermore, the well-formedness of characters was distinguished earlier than pictures at the bilateral occipital N170 component whereby real and pseudo characters elicited greater amplitudes than ill-formed non-characters. Differences in well-formedness of objects were observed at the later occipital P200 component well-formed objects. Lastly, the central-frontal N400 showed independent effects of domain and well-formedness, with line drawings of objects and ill-formed items eliciting greater negativity and effort in accessing semantic features than real characters and well-formed items, including pseudo objects and pseudo characters. The results suggest that although Chinese is considered more visual during orthographic analysis compared to alphabetic scripts, it is nonetheless fundamentally distinct from the processing of line-drawings. More importantly, the left-lateralized N170 is an indicator of orthographic sensitivity across orthographic systems. The overall findings also suggest the great potential of applying the repetition detection paradigm, given its simplicity, to study word processing in less skilled readers and impaired readers.