Acta Psychologica 187 (2018) 30–36

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy

The global precedence effect in English and Korean native speakers with Roman, Korean Hangul and Thai compound letters

Heather Winskel[a,*], Tae-Hoon Kim[b], Jeung-Ryeul Cho[b]

[a] Psychology, Health and Human Sciences, Southern Cross University, Coffs Harbour, NSW 2450, Australia
[b] Psychology, Kyungnam University, Changwon, South Korea

ARTICLE INFO

Keywords:
Analytic processing
Global precedence effect
Korean Hangul
Letters
Navon compound letters
Reading

ABSTRACT

The aim was to investigate whether native English speakers (Experiment 1) and native Korean speakers (Experiment 2) processed familiar letters in an analytic manner in comparison to unfamiliar letters or symbols. Participants performed a two-alternative-forced-choice identification task with Roman, Korean Hangul and Thai Navon compound letters (large letters made up of small letters). The English speakers were familiar with Roman script but not Korean or Thai, whereas the Korean speakers were familiar with Korean and Roman script but not Thai. The global precedence effect (GPE), an indication of holistic processing, is characterised by a global advantage (global processing is faster than local processing) and asymmetric congruence (global processing interferes with the processing of local features). Based on previous research, it was predicted that there would be a global precedence effect for unfamiliar but not familiar letters.

Results from the English speakers did not support this prediction as we found a GPE for familiar Roman as well as unfamiliar Thai letters but not for unfamiliar Korean letters. In contrast, for the Korean speakers, we found support for the prediction as we found a GPE for Thai letters but not for familiar Korean and Roman letters. Based on this evidence, we propose that the Koreans are processing Korean and Roman letters in a more analytic manner than the English native speakers for Roman script. Due to the characteristics of Korean Hangul, Korean readers may be processing letters in a more analytic manner than the English readers.

Reading is a lifelong habitual process that has long term effects. A growing body of evidence has demonstrated the impact of learning to read on the human brain (e.g., Dehaene et al., 2010; Dehaene, Cohen, Morais, & Kolinsky, 2015). The core constituents, letters play an integral and fundamental role in reading alphabetic orthographies. They are fairly arbitrary shapes or symbols that come to be associated or represent particular sounds of a language. The literate reader knows how these symbols represent or map onto the sounds of the language of the speaker. If we do not have this insider knowledge then the shapes or letters appear as meaningless symbols. Through the process of learning to read and becoming literate, letters become special meaningful units that are processed differently from non-letters or symbols. For example, it has been found that meaningful or familiar letters are processed faster than pseudo-letters or symbols (e.g., Burgund, Schlaggar, & Petersen, 2006; Fernandes, Vale, Martins, Morais, & Kolinsky, 2014; Jincho, Lachmann, & van Leeuwen, 2008; Lachmann, Schmitt, Braet, & van Leeuwen, 2014; Poirel, Pineau, & Mellet, 2008). Marked differences in how letters and symbols are processed has also been found using a two-alternative forced choice (2AFC) paradigm with five character position strings of Roman letter consonants and symbols (e.g., T G H K N) (Grainger, Granier, Farioli, Van Assche, & van Heuven, 2006; Jordan, Thomas, Patching, & Scott-Brown, 2003; Tydgat & Grainger, 2009). When participants are required to identify strings of five Roman letters, a W-shaped serial position function has been found (Tydgat & Grainger, 2009; Winskel, Perea, & Peart, 2014; Ziegler, Pech-Georgel, Dufau, & Grainger, 2010). Of particular significance is the initial letter advantage. However, a different Λ-shaped serial position function occurs when identifying unfamiliar letters, symbols or shapes (Tydgat & Grainger, 2009; Winskel et al., 2014; Ziegler et al., 2010). In this case, identification accuracy is optimal at the central letter position of fixation and declines as distance from the central position increases.

However, when a similar study was conducted with Thai speakers, who were also familiar with Roman script, we found an advantage of initial character position but this effect was not only reserved for letters but also applied to the symbols (Winskel et al., 2014). We interpreted the absence of a letter/symbol dissociation in Thai speakers as providing evidence for script-specific adaptations that have occurred when reading this visually complex and crowded non-linear alpha-syllabic

* Corresponding author at: Psychology, Health and Human Sciences, Southern Cross University, Coffs Harbour Campus, Hogbin Drive, Coffs Harbour, NSW 2450, Australia.
E-mail address: heather.winskel@scu.edu.au (H. Winskel).

https://doi.org/10.1016/j.actpsy.2018.05.002
Received 19 November 2017; Received in revised form 19 March 2018; Accepted 5 May 2018

script without interword spaces. We proposed that specialised script-specific adaptations develop to optimise the processing of letters, even at this early stage in processing, when learning to read scripts with alphabetic characteristics.

Lachmann and van Leeuwen (2014), using a range of experimental tasks, have also found a dissociation in the processing of letters and non-letters. They found that analytic processing is associated with reading letters but not for non-letter stimuli. They concluded that as long as the task and presentation conditions were sufficiently similar to those of reading then letters are likely to be processed analytically. This mechanism is thought to be triggered by conditions that are sufficiently similar to a typical reading situation. One of the tasks they used was a two-alternative-forced-choice identification task with compound Navon-like letters (Navon, 1977) that were made up of Roman script letters and non-letter symbols (Lachmann et al., 2014). The letters and non-letters were presented in either congruent (e.g., a large C made up of smaller Cs) or incongruent (e.g., a large C made up of small Fs) conditions. Participants were asked to identify letters/symbols either at the local or global level while ignoring the opposing level. Typically, in these types of tasks, a global precedence effect (GPE) is found (see Navon, 2003 or Kimchi, 2015, for a review). The GPE consists of a global advantage, that is, faster processing of the global than local level and an asymmetric congruence where there is interference from the global level when processing the local level but not vice versa. In other words, there is an incongruence effect (a significant difference between congruent and incongruent trials) for the local level but not for the global level. The global precedence effect is generally considered to be evidence for holistic processing whereas its absence is evidence of analytic processing (Lachmann et al., 2014).

In the Lachmann et al. (2014) study, they selected letters that were placed centrally and of a typical font size used when reading. At the local level letters/symbols were 0.5 degree of visual angle so as to represent the typical size of letters when reading in the central visual field. The global letters had a visual angle of about 6.5° in height and 5.5° in width. Lachmann et al. (2014) found a classic GPE for the non-letters, that is, faster reaction times to the global than local targets and faster responses to congruent than incongruent targets at the local level. For letters, they did not find a global advantage for the global level in comparison to the local level. They also found symmetric congruence, that is, similar local-to-global as global-to-local interference effects. They concluded that reading is primarily an analytic process. Analytic processing is considered to be associated with letters as it is important to be able to distinguish often quite small differences between letters that have a significant impact when reading (Lachmann et al., 2014; Lachmann & van Leeuwen, 2014).

In a follow-up study, Schmitt, van Leeuwen and Lachmann (2017) used identical stimuli and a similar procedure as used previously with a larger number of participants. They also used a training paradigm that involved either using phonological or non-phonological associations to the non-letter symbols. Phonological association was predicted to produce "letter knowledge" for the non-letters and thus eliminate the GPE associated with them. Results demonstrated that the GPE remained regardless of the phonological or non-phonological association learned by participants. For non-letters there was a global precedence effect. For letters, in this larger study, a relatively small global advantage and a symmetric congruence effect for both local (13 ms) and global (18 ms) levels was found. The meaningfulness of the stimuli used can also influence the GPE. Poirel et al. (2008) presented participants with a global-local detection task with compound letters, objects and non-objects. The results revealed that the global level was robust as it was processed faster than the local level regardless of the nature of the stimuli. However, a global interference effect only occurred with meaningful stimuli (letters and objects) but not with non-object stimuli.

In the current study, we investigated whether native English speakers (Experiment 1) and native Korean speakers (Experiment 2) process familiar letters in an analytic manner. Participants were presented with compound Roman, Korean Hangul and Thai letters using similar sized letters and procedure as Lachmann et al. (2014). The English native speakers were familiar with Roman script but not Korean or Thai, whereas the Korean native speakers were familiar with both Korean and Roman script but not Thai. Based on previous research (Lachmann et al., 2014; Schmitt et al., 2017), it was predicted for English native speakers that there would be a global precedence effect for unfamiliar Korean Hangul and Thai letters but not for familiar Roman letters that would be processed in a more analytic manner. The global precedence effect is characterised by a global advantage (global processing is faster than local processing) and asymmetric congruence (global processing interferes with the processing of local features). For Korean native speakers, we similarly predicted that there would be a global precedence effect for unfamiliar Thai but not for familiar Korean Hangul or Roman letters.

An alternative possibility is that there may be specialised script-specific adaptations that have developed when learning to read these different scripts as has been found in previous research (e.g., Winskel et al., 2014). In particular, Korean Hangul letters occur in non-linear blocks (e.g., 밝은/balgeun/"bright") and are consequently visually complex and typically small and densely crowded when reading. Letters are mostly composed of geometric shapes consisting of vertical, horizontal and diagonal lines and circles (e.g., Cho & Ji, 2011). It has been described as an alphabetic-syllabary (Taylor & Taylor, 2014) as both phonemes and syllables are important phonological units (Cho & McBride-Chang, 2005). Hangul is also a relatively shallow orthography as phoneme-grapheme mapping is consistent. Due to the visual complexity and compact nature of Korean Hangul, readers of Korean Hangul may process the letters in a more analytic manner than readers of Roman script. When stimuli are perceived as complex or the task as difficult, analytic processing tends to occur (Lachmann, Khera, Srinivasan, & van Leeuwen, 2012; Roelfsema & Houtkamp, 2011).

In relation to errors and support for a GPE, we can expect less errors for the global than local level (global advantage) and more errors at the local level for incongruent than congruent letters but no difference between incongruent and congruent letter trials at the global level (asymmetric congruence).

1. Experiment 1 English native speakers

1.1. Method

1.1.1. Participants

A total of 30 participants (20 females) were recruited through Southern Cross University. All participants were native speakers of English and had normal to corrected vision. None of the participants could read Korean Hangul or Thai.

1.1.2. Materials

Three different compound or Navon-like letters (Navon, 1977) (global letters made out of local letters) were used as stimuli: Roman script (C/F), Korean Hangul (ㄱ/ㄷ) and Thai (ม/ว) letters (see Fig. 1). Each large letter was constructed of smaller letters from the same script; these could either be congruent (global and local letters matched) or incongruent (global and local letters did not match). There were six blocks of 100 trials; two blocks for Roman script, two blocks for Korean Hangul, and two blocks for Thai. Within each block, 50 of the letters were congruent and 50 were incongruent. Three of the blocks focused on identifying the global letters, whereas the other three blocks focused on identifying the local letters. Stimuli were presented using E-prime 2.0 (Psychology Software Tools, Pittsburgh, USA) on a laptop. The global letters were presented with a visual angle of approximately 6.5° in height and 6° in width, and the local stimuli with a visual angle of approximately 0.5°. These dimensions are similar to Lachmann et al. (2014) and Schmitt et al. (2017).