Saturday, 9:45 – 10:15

Sentential context modulates early phases of visual word recognition: Evidence from a training manipulation

Vicky T. Lai (Max Planck Institute for Psycholinguistics), Albert Kim (University of Colorado, Boulder), & James M. McQueen (Radboud University Nijmegen; Max Planck Institute for Psycholinguistics)
Vicky.Lai@mpi.nl

How does sentential context influence visual word recognition? Recent neural models suggest that single words are recognized via a hierarchy of local combination detectors [1]. Low-level features are extracted first by neurons in V1 in the visual cortex, features are then combined and fed into the higher level of letter fragments in V2, and then letter shapes in V4, and so on. A recent EEG study examining word recognition in context has shown that contextually-driven anticipation can influence this hierarchy of visual word recognition early on [2]. Specifically, a minor mismatch between the predicted visual word form and the actual input (*cake* vs. *ceke*) can elicit brain responses ~130 ms after word onset [2].

The current study further investigates how and when conceptual-semantic knowledge influences visual word recognition. 36 participants took part in a training session followed by a testing session; EEG was recorded throughout. Instead of using nonwords like “*ceke*” as in [2], we used an ambiguous symbol ∂, pretested to be midway between ‘a’ and ‘o’. During training using a perceptual learning paradigm [3], half of the participants were trained to see ∂ as a (they saw ∂ in lexically-biased a-contexts like *l∂ke*). The other participants learned that ∂ was ‘o’ (seeing it in lexically-biased o-contexts like *d∂g*). During testing, all participants saw a-o minimal-pair words (c∂ke for *cake/coke*) embedded in highly predicting sentences (cloze = 80%). Depending on training, contextually-driven anticipation could be congruent or incongruent with the input. That is, “*bake a c∂ke*” would be incongruent for the o-group because “*bake a coke*” is senseless, but congruent for the a-group. If semantic anticipation can influence an early phase of processing, we expect brain responses at ~130 ms [2].

Training was successful. Participants accurately identified ∂-words as words (91%). During training, ∂-words elicited a larger N170 component (160-180 ms) than unambiguous words at a right occipital-temporal site (Fig 1), followed by N400 and P600 effects at the central-parietal sites. During testing, ∂-words in the incongruent condition elicited a larger occipital-temporal P1 (115-135 ms) component than the same ∂-words in the congruent condition (Fig 2), with no N170 or later effects.

These data provide evidence for rapid use of conceptual-semantic knowledge during the recognition of a newly learned letter in context. When the o-group read “*bake a c∂ke*”, for example, the contextually supported representation (CAKE) allows anticipation of the “a”, which conflicts with the training-supported interpretation (COKE) of the input (c∂ke). Because the ambiguous letter is identical across conditions, the conflict appears to be with the interpretation of the ambiguous letter and not with its physical features, hence specifying the timing of the letter interpretation stage [1] in the processing hierarchy.

Figure 1. Training phase, single words

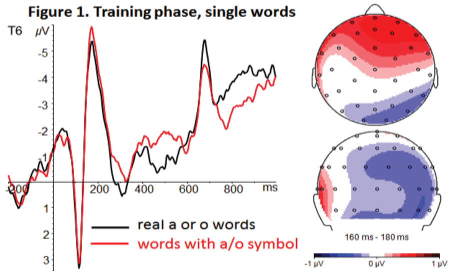
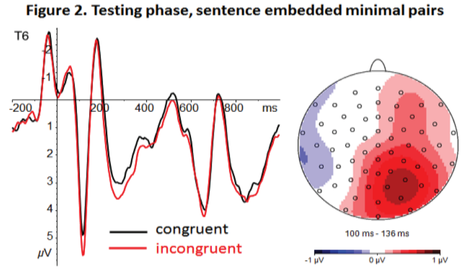


Figure 2. Testing phase, sentence embedded minimal pairs



[1] Dehaene, S., Cohen, L., Sigman, M., & Vinckier, F. (2005). The neural code for written words: A proposal. Trends in Cognitive Sciences, 9, 335–341.
[2] Kim, A., & Lai, V. T. (2012). Rapid interactions between lexical semantic and word form analysis during word recognition in context: Evidence from ERPs. Journal of Cognitive Neuroscience, 24, 1104-1112.
[3] Norris, D., Butterfield, S., McQueen, J. M., & Cutler, A. (2006). Lexically guided retuning of letter perception. Quarterly Journal of Experimental Psychology, 59(9), 1505-1515.