Neural evidence for a single lexicogrammatical processing system

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Sinclair (1991) and Wray (2002) both posit the existence of two processing systems, arguing that the grammatical system is secondary to the system which processes language using memorized preconstructed or prefabricated chunks (Sinclair 1991:114; Wray 2002:10). By contrast, the theories of Lexical Priming (Hoey 2005), Pattern Grammar (Hunston and Francis 2000), and Construction Grammar all attempt to account for the whole of language without positing the existence of a separate grammatical system.

In neurophysiological research, lexis/semantics and grammar are typically studied as though they are part of entirely separate systems. Indeed, language-based ERP (event-related potential) studies, which use scalp electrodes to detect the neural activity that occurs in response to a particular stimulus, have revealed distinct brain responses to reading semantic and grammatical errors. Reading a semantic error elicits what is known in ERP research as an N400 (i.e. a negative voltage deflection occurring 400 ms after the onset of the stimulus) (Kutas and Hillyard 1980); while reading a grammatical error elicits a P600 (i.e. a positive voltage deflection occurring 600 ms after the onset of the stimulus) (Osterhout and Holcomb 1992).

However, more recent studies have shown that the N400 is sensitive to morphosyntactic violations (e.g. Severens et al. 2008:141; Nieuwland et al. 2013:151), and the P600 is sensitive to semantic violations (e.g. Geyer et al. 2006). This suggests that there is not a separate component specifically reflecting syntactic processing and another component specifically reflecting semantic processing. Rather, the N400 and P600 seem to be part of a system that somehow encompasses both.

In this presentation, I present the results of an ERP experiment which consists of two parts. In Part 1, I provide further evidence to suggest that the N400 and P600 work together as part of a single processing system. The stimuli consists of 30 sentences containing collocational adjective-noun bigrams (e.g. *nineteenth century*) and 30 sentences containing matched non-collocational adjective-noun bigrams (e.g. *nineteenth position*). The collocational bigrams are extracted from the written BNC1994, while the matched non-collocational bigrams do not occur in the BNC1994 at all. The sentences are presented one word at a time to 16 native speakers of English.

The results show that reading non-collocational bigrams elicits an enlarged N400 as well as an enlarged P600, suggesting that the voltage deflections which are typically known to be associated with lexical/semantic and grammatical processing are not entirely independent.

In Part 2 of this experiment, I investigate the psychological validity of different association measures, namely transition probability, mutual information, log-likelihood, z-score, t-score, Dice-coefficient, MI3, and raw frequency. The results show that, while there is a strong correlation between the amplitude of the ERP response and *all* of the association measures investigated in this study, the strongest correlation exists between amplitude and z-score, closely followed by amplitude and MI3, amplitude and Dice coefficient, and amplitude and t-score. Meanwhile, the weakest correlations exist between amplitude and log-likelihood, and amplitude and mutual information. These results have important implications for corpus-based studies of lexicogrammar.

References

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