EEG in PNG: A report on the neurolinguistics of clause chain processing

Hannah Sarvasy[1], Alba Tuninetti[1], Carmen Kung[2], Paola Escudero[1]
[1]MARCS Institute/Western Sydney University, [2]Macquarie University
h.sarvasy@westernsydney.edu.au

Keywords: neurolinguistics, sentence processing, Nungon, Papuan, EEG, clause chains

Models of recursion in sentence processing have largely relied on experiments with speakers of a small sample of familiar languages. Hundreds of other languages, however, involve multi-clausal sentences—'clause chains'—that differ syntactically from English sentences. This paper reports on an experiment using mobile electroencephalography (EEG) to evaluate how speakers of Nungon in Papua New Guinea (PNG) process clause chains. Of special interest are: correlates of working memory, syntactic agreement, and semantic expectation.

In psycholinguistics, recursion can be studied by examining the processing and learning of long-distance dependencies (e.g., Friederici, 2004). Clause chains are important to study in this context as they involve multiple interdependent clauses combined into one sentence. Clause chains differ from English-style sentences in: a) length, b) syntactic dependency, and c) switch-reference marking.

Previous work has examined long-distance dependencies with two to three relative clauses in English (Gouvea et al., 2009), German (Fiebach et al., 2002), and Chinese (Lin & Bever, 2006), as well as subject-verb agreement and prediction in verb-final languages, such as German (Friederici & Frisch, 2000). In these languages, including one or more hierarchical structures within a sentence can negatively affect participants' reaction times and comprehension accuracy (e.g., King & Just, 1991). However, Nungon has no limit to the number of clauses in a sequence, with over 20 attested.

Our study focuses on three brain-potential components: the P600, the anterior negativity (AN), and the N400 as Nungon speakers are auditorily presented with Nungon sentences that contain one of two types of syntactic violation. Because the P600 response is typically taken as a response to grammatical violations (e.g., Gouvea et al., 2009), we expect to see P600 effects for sentences that include a violation. We will further examine the amount of working memory load attested in the EEG signal as chains of multiple clauses including switch-reference markers are processed. As the number of clauses increases, we expect to see a higher working memory load in participants, which can be quantified by a larger AN response after stimulus presentation (King & Kutas, 1995). Finally, semantic switching related to switch-reference markers within the chain will be quantified by the N400, which is greater in amplitude for unexpected compared to expected stimuli (Kutas & Federmeier, 2011). Last, we report on the results of our exit survey of experiment participants, conducted by a Nungon speaker in Nungon.

References

Gouvea, A., Phillips, C., Kazanina, N., & Poeppel, D. (2009). The linguistic processes underlying the P600. *Language and Cognitive Processes, 25*, 149-188. https://doi.org/10.1080/01690960902965951

Fiebach, C., Schlesewsky, M., & Friederici, A. (2002). Separating syntactic memory costs and syntactic integration costs during parsing: the processing of German WH-questions. *Journal of Memory and Language, 27*, 250-272.

Lin, C., & Bever, T. (2006). Subject preference in the processing of relative clauses in Chinese. *Proceedings of the 25th West Coast Conference on Formal Linguistics*, ed. Donald Baumer, David Montero, & Michael Scanlon. 254-260. Somerville, MA: Cascadilla Proceedings Project.

Friederici, A. (2004). Processing local transitions versus long-distance syntactic hierarchies. *Trends in Cognitive Science, 8*, 245-247. doi:10.1016/j.tics.2004.04.013

Friederici, A., & Frisch, S. (2000). Verb argument structure processing: The role of verb-specific and argument-specific information. *Journal of Memory and Language, 43*, 476-507. doi:10.1006/jmla.2000.2709

King, J., & Just, M. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language, 30*, 580-602.

King, J., & Kutas, M. (1995). Who did what and when? Using word- and clause-level ERPs to monitor working memory usage in reading. *Journal of Cognitive Neuroscience, 7*, 376-395.

Kutas, M. & Federmeier, K. (2011). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology, 62*, 621-647. 10.1146/annurev.psych.093008.131123