

Native-like second language processing modulated by proficiency, working memory, and subject-verb dependency distance

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Background

One of the primary interests of the second language acquisition (SLA) field is understanding the limits on foreign and second language (L2) learning. In addition to examining classroom performance and real-world language production, researchers in this field also wish to clarify whether the cognitive processes of language learners can resemble those of native (L1) speakers, and one tool for this type of investigation is the event-related potential (ERP) cognitive neuroimaging technique. ERPs measure voltage at the scalp which in turn reflects brain activity, and they provide information about the timing and manner of language processing.

Previous research has established that native speakers and second language learners usually display different ERPs when reading sentences that contain grammatical errors, such as *The senators *hopes to succeed*. Native speakers display a P600 effect, which means that the electrical potential at the scalp becomes more positive in response to the grammatical error. Second language learners, on the other hand, generally display an N400 effect, meaning that the electrical potential at the scalp becomes more negative. However, under certain conditions second language learners have been observed to exhibit a native-like P600 effect, and much work is currently being done to determine exactly what factors can lead to this sort of native-like language processing. To date, evidence has been found suggesting that proficiency in the second language, similarity between the first and second language, the type of instruction, and the rate of learning might modulate the nativelikeness of ERPs in the second language.

In our recent work, we have looked at a new individual variable: working memory capacity. The logic is that, with a higher capacity for storing words and grammatical features in working memory during language processing, a second-language learner should have an easier time tracking subject-verb agreement across discourse, and should therefore have a more native-like response to errors of agreement. Relatedly, we are also examining whether the distance between the subject and verb modulates nativelikeness, as a longer interval between the subject and verb should require more working memory resources to keep track of the agreement and therefore be more difficult to process.

Experiment 1

In a first experiment, we recorded ERPs from 10 native speakers of American English who began learning French as a foreign language at or after the age of 10. We assessed participants' proficiency in the second language, as well as their working memory capacity in English and in French. Over two sessions (the first in French, the second using roughly equivalent items in English), participants read sentences containing subject-verb agreement errors where the subject was either adjacent to the verb (e.g. 'For this great poet, the daughter



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*roast a big ham’) or separated from it by intervening material (e.g. ‘The daughter of this great poet *roast a big ham’) while scalp ERPs were recorded from nine electrode channels (Fz, F3, F4, Cz, C3, C4, Pz, P3, P4) of an elastic electrode cap. The results showed qualitatively different ERPs in the L1 and L2. In English, participants showed a P600 effect in the adjacent condition and a biphasic N400-P600 in the non-adjacent condition. By contrast, in French they showed only N400 effects, the size of which increased as the participants’ WM capacity in English increased. The results of our study also showed that the size of the L2 learners’ N400 effect decreased when the subject noun was not adjacent to the verb as compared to when it was adjacent to the verb. These findings could suggest that L2 learners’ sensitivity to subject-verb agreement decreases as the length of the dependency (and thus WM load) increases.

Experiment 2

In an ongoing followup experiment looking at higher-proficiency learners of French as a second language, we presented 8 participants with sentences containing subject-verb agreement violations where the subject and verb were either adjacent to each other (*Chaque vendredi, les cuisiniers *finit de travailler très tard* ‘Each Friday, the cooks *finishes working very late’) or were separated by intervening material (*Les cuisiniers, chaque vendredi, *finit de travailler très tard* ‘The cooks, each Friday, *finishes working very late’). Preliminary results indicate that these learners exhibited P600 effects in response to the errors (much as is typically seen among native speakers). This effect was stronger in the adjacent condition than in the long-distance condition. We also found positive correlations between L2 proficiency and the size of the effect in the short-distance condition. These findings suggest that near-nativelike processing of L2 morphosyntax is possible, and that the length of the verb agreement dependency plays a role.

Conclusions

This line of research extends the view of the possible modulating factors on the nativelikeness of second language processing by suggesting that, in addition to a learner’s overall proficiency in the L2, factors such as the distance between the subject and the verb and the learner’s working memory capacity might help determine whether their language processing in the L2 can resemble that of a native language.

Further Reading

- Coughlin, C. E. & Tremblay, A. (2013). Proficiency and working memory based explanations for nonnative speakers’ sensitivity to agreement in sentence processing. *Applied Psycholinguistics*.
- McLaughlin, J., Tanner, D., Pitkänen, I., Frenck-Mestre, C., Inoue, K., Valentine, G., et al. (2010). Brain potentials reveal discrete stages of L2 grammatical learning. *Language Learning*, 60, 123–150.
- Morgan-Short, K., Sanz, C., Steinhauer, K. & Ullman, M. T. (2010). Acquisition of Gender Agreement in Second Language Learners: An Event-Related Potential Study. *Language Learning*, 60, 154–193.
- Reichle, R. V., Tremblay, A., & Coughlin, C. E. (in press). Working-memory capacity effects in the processing of non-adjacent subject-verb agreement: An event-related brain potentials study. *Selected Proceedings of the 2011 Second Language Research Forum*. Somerville, MA: Cascadilla Proceedings Project.
- Steinhauer, K., White, E. J., & Drury, J. E. (2009). Temporal dynamics of late second language acquisition: Evidence from event-related brain potentials. *Second Language Research*, 25, 13–41.