INTRODUCTION

Does foreign language immersion in early adulthood change the brain? Learning one's second language (L2) after the purported critical period for language acquisition, defined here as post-puberty language learning (Ullman, 2005), creates unique challenges for the language student, often leading to less success achieving the same level of proficiency as younger learners. However, while late L2 acquisition can pose significant difficulties, it has been shown that late L2 university students can achieve at least some native-like processing not only of lexical items, but also of aspects of grammar, as revealed by electrophysiological data (Bowden, Steinhauer, Sanz, & Ullman, 2013). Further, it has been demonstrated that late L2 learners can acquire (i.e. process online like a native speaker) new grammatical elements that do not exist in their first language (L1) (Foucart & Frenck-Mestre, 2012). This finding is contradictory to the assumptions made by the Shallow Structure Hypothesis in which L1 and L2 processing differ in the depth at which they process syntactic structure (Clahsen & Felser, 2006). L2 may initially be processed in the brain differently from L1. Hypothesis in the field differ as to whether extensive exposure and ample practice in L2 can shift language processing in late learners to be more like native speakers.

These early differences in language processing are explained in one theory by differential reliance on separate memory systems, known as the Declarative/Procedural (DP) Model of language acquisition (Ullman, 2005). The DP Model makes hypotheses about modes of language instruction (**Figure 1**) in that these may differentially engage the declarative and procedural memory systems. In traditional classroom exposure, students are explicitly taught words in L2 and often explicitly learn and memorize grammatical rules, primarily engaging declarative memory. Immersion experience, on the other hand, may be characterized as a more implicit mode of learning, ultimately pushing the learner to rely more on procedural memory for processing syntax. It is not clear if these differences in context of learning have an impact on advanced L2 learners. Do equally advanced L2 learners show differences in L2 processing based on the kind of language experience they have had (i.e. classroom alone vs. with different amounts of exposures)?

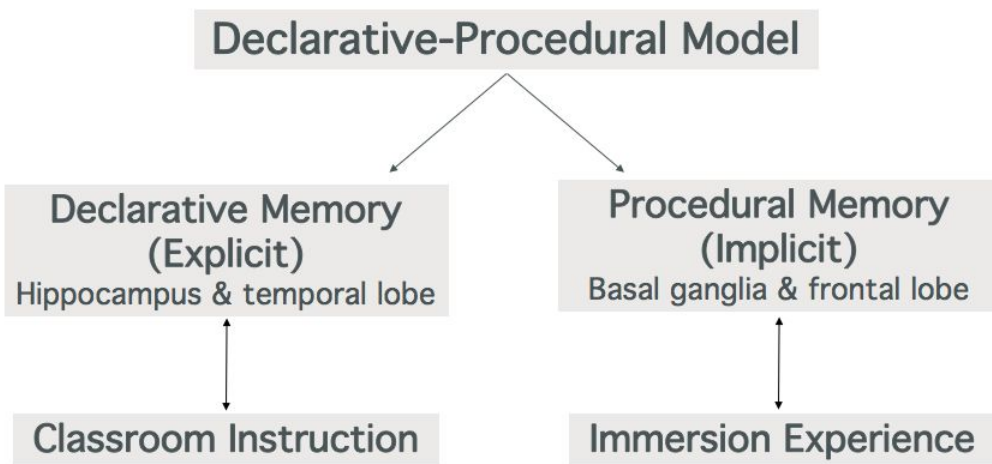


Figure 1. Declarative-Procedural Model. Memory systems posited to be most engaged for grammar learning by learning context.

To address this question, an accurate and thorough measure of proficiency must first be conducted. Achieving a reliable and standardized measure of proficiency among participants is often a point of weakness in many studies of second-language acquisition (SLA) (Bowden, 2016; Tremblay, 2011). Surprisingly, much of SLA research relies on current class level to determine proficiency, without attempting to test proficiency at the individual level. Some studies do assess proficiency, yet rely on self-evaluations alone or non-standardized tests that make it difficult to compare to other studies. Further, these tests often only examine one aspect of proficiency rather than the scope of written and oral production and comprehension. In the present study, each participant's overall abilities in their L2 are assessed.

Foreign language learners differ not only in their degree of proficiency but also in the types of L2 language instruction and experience they have received. Most university-level foreign language students begin their study in the classroom, receiving explicit linguistic input. Other students learn or continue learning their foreign language through an immersion experience. Language immersion is defined here as study abroad experience in which students use L2 daily. The importance of study abroad experience for advancing L2 proficiency has been largely anecdotal with supporting evidence from proficiency measures (Ife, Boix, & Meara, 2000). However, there is little evidence as to changes in brain processing that might result from language immersion, which would be predicted by models like the Declarative/Procedural Model. It is difficult to study the effects of language immersion versus traditional classroom exposure because virtually no foreign language student receives exclusively one type of language instruction. For example, students who study abroad typically spend several years or semesters in a classroom setting before testing their language abilities in an immersive environment. Relatively few studies have looked at the effect of the type of linguistic input (i.e. more implicit or more explicit language instruction) on native-like brain processing. The first study that explored the effect of language instructional mode (implicit/immersion-like vs. explicit/classroom-like) on L2 syntactic processing was an artificial language study conducted by Morgan-Short, Steinhauer, Sanz & Ullman (2012). They found that participants receiving explicit and implicit instruction showed no difference in behavioral measures of syntactic learning; however, electrophysiological data revealed a prominent difference in neural activity between the two groups. Only the implicitly-trained group demonstrated electrophysiological signatures characteristic of native speakers, suggesting that instructional mode plays a critical role in attaining native-like processing.

In addition to instructional mode, the present study also builds on previous work examining the effects of phonological cues in real-time processing of L2 syntax. Phonological cues, or information coded by speech sounds, is rapidly and automatically processed by native speakers. Phonological information can serve as a useful tool for advanced L2 learners when learning verbal inflection, or how verbs endings are altered to convey tense or person (Carrasco-Ortiz & Frenck-Mestre, 2014). In fact, phonological cues can enhance processing of morphological information. In a study by Arteaga, Herschensohn, and Gess (2003), an experimental group who was trained to attune to phonological form outperformed another group who had received traditional orthographic input on a listening discrimination task.

The French language is a particularly interesting case to study the role of phonological cues in processing syntax. French has a notoriously “opaque” orthography (Osterhout et al., 2008). Many suffixes in French are phonologically silent, meaning that changes in orthography (i.e. spelling) are not always pronounced. Regular present tense verbs in French are an example of this phenomenon. For example, changing from first person singular to second person singular verb forms requires the addition of an –s to the verb (e.g. *je parle* becomes *tu parles*). This change in orthography is not accompanied by a change in phonology. The absence of audible distinctions between different morphological forms leads to frequent mistakes in written French even in L1 (Carrasco-Ortiz & Frenck-Mestre, 2014). Because phonological cues are less available in French, it provides an interesting milieu to study the extent to which advanced French speakers are attuned to phonological cues when reading French sentences.

It follows that the act of second-language learning is accompanied by changes in the brain. At present, relatively little is known about the nature of these neural changes, the time during acquisition at which they emerge, and the information these changes convey about L2 learning (Osterhout et al., 2008). It has been found that transient electrophysiological changes occur in response to linguistic stimuli. These electrical changes can be measured using electroencephalography (EEG), an array of electrodes positioned across the scalp that monitor the brain's naturally occurring electrical activity. EEG records event-related potentials (ERPs), which result from postsynaptic activity in cortical pyramidal neurons and are time-locked to events of interest. ERPs can capture short-lived changes in the brain resulting from language processing. Importantly, ERPs are sensitive not only to observable behavioral measures, but also to more subtle discrepancies between L1 and L2 that cannot be detected purely through behavioral measures (Bowden et al., 2013).

Semantic and syntactic manipulations of sentence stimuli have been shown to elicit distinct neural patterns at the scalp in response to these stimuli, referred to as ERP components (McLaughlin et al., 2010). Semantic anomalies, or illicit manipulations of word meaning, result in a negative waveform in the ERP data that peaks approximately 400 ms after the critical stimulus (i.e. the error) is presented. This is known as the N400 component. Syntactic anomalies, or grammatical errors, elicit a positive-going wave that appears around 600 ms after the error. This is known as the P600 component (Osterhout et al., 2008).

The focus of the present study is on real-time processing of French grammar and the emergence of a P600 component. By examining the presence or absence of the P600 signature, we explore the grammaticalization of language, or the concurrent processing of rule-based linguistic information (McLaughlin et al., 2010). Creating grammatical violations in sentence stimuli is expected to elicit P600s, at least in native speakers. Native French speakers have been shown to consistently elicit robust P600 signals when encountering subject-verb agreement errors (Carrasco-Ortiz & Frenck-Mestre, 2014; Frenck-Mestre, Osterhout, McLaughlin, & Foucart, 2008; McLaughlin et al., 2010). Further, advanced French learners living in France (for a mean duration of 5.5 months) have also been shown to elicit P600s as a result of morphosyntactic errors (Carrasco-Ortiz & Frenck-Mestre, 2014; Frenck-Mestre et al., 2008). While these ERP components have been extensively characterized in French speakers, the impact of language immersion versus traditional classroom exposure on brain processing of L2 is a novel question.

The present study aims to determine the extent to which advanced French learners are sensitive to the presence of phonological cues when processing subject-verb agreement errors. Further, we investigate the effects of language immersion on neural processing. Since immersion learners versus traditional classroom learners are receiving different types of linguistic input, we expect to see differences in brain processing across experimental groups, which vary in their degree of language immersion exposure. Further, we predict that groups with more immersion experience will show more nativelike brain processing of L2 than French learners without such experience.

METHODS

Participants

Seventeen native English-speakers (5 males, 12 females) ages 18 to 34 years (mean age 21.9 years) voluntarily participated in this study. Participants were right-handed with normal or corrected-to-normal vision. All participants were classified as high-intermediate to advanced French learners, as determined by standardized proficiency measures. Participants had taken upper-level French courses at the university level and were recruited based on their enrollment in these courses and recommendations by professors. All were “late” second-language learners, with a mean age of acquisition of 14.9 years (SD = 2.8). None of the participants had been substantially exposed to any other languages other than English in their daily life up to age 18.

There were three groups of participants, divided based on their degree of French language immersion (**Table 1**). For the no immersion group (N=5), participants had not been to a French-speaking country and had learned French primarily through classroom instruction. The low immersion group (N=5) were those students who had spent less than a semester abroad in a French-speaking country (mean of 1.6 months). The high immersion group (N=7) had spent at least a semester abroad (mean of 10.3 months).

Table 1. Participant Language Profiles. Averages (and standard deviations) displayed for each of the three groups, including age, language exposure, instruction, and current usage of French.

Group	Age	Age Exposed French	Months Abroad	Hours/week using French	Instruction Before College (years)	College Instruction (semesters)
No Immersion (N=5)	20.2 (1.8)	14.9 (2.4)	0 (0)	8.7 (4.9)	2.7 (2.5)	4.4 (1.3)
Low Immersion (N=5)	23 (3.9)	13.4 (3.3)	1.6 (0.5)	5.7 (4.5)	3.7 (2.0)	4.4 (1.8)
High Immersion (N=7)	23.7 (4.6)	15.3 (3.8)	10.3 (7.0)	6.1 (3.0)	1.0 (1.7)	6.7 (1.5)

Participants were paid for their participation in this study and signed an informed consent statement. This study received approval by the Institutional Review Board under expedited review. At the conclusion of the study, participants were debriefed in full.

Materials

Proficiency Measures

A French language self-evaluation and two proficiency measures were used to determine L2 French proficiency. The language self-evaluation was the *Common European Framework of Reference for Languages: Learning, Teaching, Assessment*

(CEFR). This framework provides a self-assessment grid with six different levels, ranging from beginning (A1) to nativelike (C2). The grid includes descriptions for each corresponding level for five different skills: listening, reading, spoken interaction, spoken production, and writing. Participants circle the description that they think best fits their language ability for each of the five skills. Following the self-evaluation, participants took a cloze test in French developed by Tremblay (2011). The cloze test consists of an article in French wherein words have been omitted from the passage and replaced with blanks. The participant must write down the word that best fits the context and grammar of the sentence. Thus, this test serves as an assessment of both reading comprehension and written proficiency. Cloze tests have been shown to correlate highly with standardized proficiency scores (Tremblay, 2011). Each fill-in-the-blank was worth one point for a maximum score of 45. Participants also took the Elicited Imitation Task (EIT). The French EIT was developed by Tracy-Ventura, McManus, Norris & Ortega (2014). The EIT is a useful tool in measuring L2 oral proficiency, as it reflects L2 processing efficiency (Gaillard & Tremblay, 2016). In this task, participants listen to sentences in French and then repeat what they heard. The EIT is a short task with only nine minutes of audio recording, containing a series of sentences of increasing length and complexity that participants listen to and then repeat back. This task assesses the degree of automaticity in comprehension and production of the L2, given that sentences are too long to simply “parrot” back (Bowden, 2016). The participant’s responses are audio recorded and scored by the researcher. Each repetition was scored from 0 to 4. There are 30 French sentences total with a maximum score of 120.

EEG Stimuli

French sentence stimuli were created following Carrasco-Ortiz & Frenck-Mestre (2014). The critical stimuli consisted of 90 French sentences, using 20 different regular verbs. “Regular” verbs were defined as those ending in *–er* and following regular conjugation patterns. All sentences were written in present tense, declarative form. Subject-verb agreement errors were introduced to the in each sentence stimuli by mismatching the verb’s person agreement. Verb violations were created in one of two ways, thus creating three morpho-syntactic conditions. In the correct condition, subject pronouns were followed by a conjugated verb with the correct verbal inflection (e.g. “je passe”). In the phonologically-realized condition, subjects were followed by an incorrect verbal inflection (e.g. “je passez”), thus creating an error that would be audible if spoken. In the silent condition, the spelling of the verb is changed, but there is not a difference in pronunciation (e.g. “je passes”). Examples of the possible manipulations are shown in **Table 2**. The subjects used for the critical stimuli consisted only of the three singular persons (i.e. je, tu, il/elle). The “nous” (“we”) and the “vous” (plural or formal “you”) were not included in the critical stimuli because any manipulation in verb tense would generate a phonologically-realized error. The third person plural (“ils/elles”) was also excluded. Orthographic cues, rather than phonological, could be playing a larger role in this instance.

Table 2. Sample of the three different sentence conditions (correct, incorrect and phonologically realized, and incorrect and silent) for three different verbal persons used in critical stimuli.

Sentence onset	**Correct**	**Incorrect, phonologically realized**	**Incorrect, phonologically silent**	**Sentence End**
Récemment	je passe tu passes il/elle passe	passez (passons) passez (passons) passez (passons)	passes passe passes	devant le magasin.
Recently	*I pass* *you pass* *he/she passes*	*passes* *passes* *pass*	(does not exist in English)	*by the shop.*

Sentence length varied from five to ten words. Critical verbs varied in their position within the sentence, appearing from the second to the fifth word, but not as the last word in the sentence to avoid sentence wrap-up effects. The 90 correct sentences were used as a base, from which 90 corresponding silent error sentences and 90 phonologically-realized error sentences were derived, for a total of 270 critical sentences. To ensure that each participant only saw one version of each base sentences, three lists were generated such that each critical stimulus sentence was assigned a group letter (A, B, or C) using a rotating Latin square design. Sixty additional filler sentences were incorporated into the stimuli. None of the filler sentences contained morpho-syntactic errors and contained a variety of irregular and regular French verbs. To balance out the overuse of the three singular pronouns in the critical stimuli, filler sentences contained a higher proportion of plural person subject pronouns. The filler sentences were distributed across the three lists (groups A, B, and C) in a pseudorandom fashion, such that there were no more than three of any same pronoun in a row and no more than four irregular verbs in a row. The filler stimuli were not analyzed in the EEG data, but created a balance for correct and incorrect verb conjugations across the entire set of stimuli.

Procedure

The present study was divided into two sessions. In the first session, participants completed an informed consent, a language background questionnaire, the CEFR self-assessment, the Cloze Test, and the EIT. Scores on both proficiency measures--the cloze test and the EIT--were analyzed to determine the reliability of the two assessments. Proficiency scores were also correlated with self-evaluations, and results were examined for trends. By separating the first session from the second session, researchers had ample time to score proficiency measures and determine if participants had achieved a high enough level of French to participate in the study.

In the second session, participants completed the EEG portion of the study. EEG recordings were taken while participants read sentences silently in French. Prior to the presentation of each sentence, participants saw a fixation cross for 500 ms. The French sentence stimuli were presented on a computer monitor, one word at a time (Rapid Serial Visual Presentation, RSVP) via E-Prime. Each word was displayed for 450 ms with a 150-ms blank-screen between each word. At the end of each sentence, participants were presented with a "?????" screen during which they used the mouse to respond if the sentence was acceptable in French before advancing to the next sentence.

Participants were asked to refrain from moving, as much as possible, during stimulus presentation. EEG activity was recorded throughout the entire task from a 64-electrode WaveGuard cap across the scalp with a sampling rate of 512 Hz. We used a common average referencing recording montage so that potentials were measured relative to the average of all electrodes. Two electrodes were used to measure horizontal eye movements, and two more electrodes for vertical eye movements. The EEG data were re-referenced offline to the average of the left and right mastoids and a band-pass filter (0.1-30 Hz) was applied. Each epoch, or time range surrounding the critical stimulus, occurred from 200 ms prior to stimulus onset to 1000 ms after stimulus presentation. Average ERPs were calculated after data had been collected and artifacts were removed from the dataset (average percent rejection of 2.8% with the highest percent rejection being 10.8%). The clear majority of rejections due to artifact removal occurred on noncritical stimuli.

Data Analysis

Proficiency data were scored following rubrics provided by the creators of the Cloze Test and EIT. Scores for each repeated sentence were assigned based on transcribed sentences and following the EIT rubric. Averages and standard errors of the mean were reported for scores on each of the proficiency measures. A two-way ANOVA was performed to analyze the variance in the proficiency data across the three groups for performance on the two proficiency measures.

An ANOVA was also performed for the behavioral data during the EEG session. Mean correct detections of syntactic errors on the Judgment Task were calculated, and one-way ANOVA was used to analyze variance among the three groups on the Judgment Task. EEG data was processed offline using MatLab. The grand average waveforms for were plotted for each of the three groups. Visual analysis of the grand average ERP waveforms was used to examine the presence or absence of P600s. Additionally, scalp maps were plotted for the 500-800 ms time window comparing the baseline condition (i.e. correct verbal inflection) to the two syntactically incorrect conditions (i.e. phonologically-realized verb error and silent verb error). Scalp maps were used to visualize the overall difference in potential between baseline conditions and error-containing sentences across the scalp during the specified time window.

RESULTS

Proficiency data

For participants to participate in the EEG portion of the study, we first determined that each participant possessed a high-intermediate to advanced proficiency level in French. We compared scores reported on the CEFR self-evaluation to actual performance on the written proficiency measure, the cloze test. A positive correlation between self-ratings and cloze test scores was observed for the low and especially high proficiency groups (**Figure 2)**. However, no such relationship was observed for the group without immersion experience.

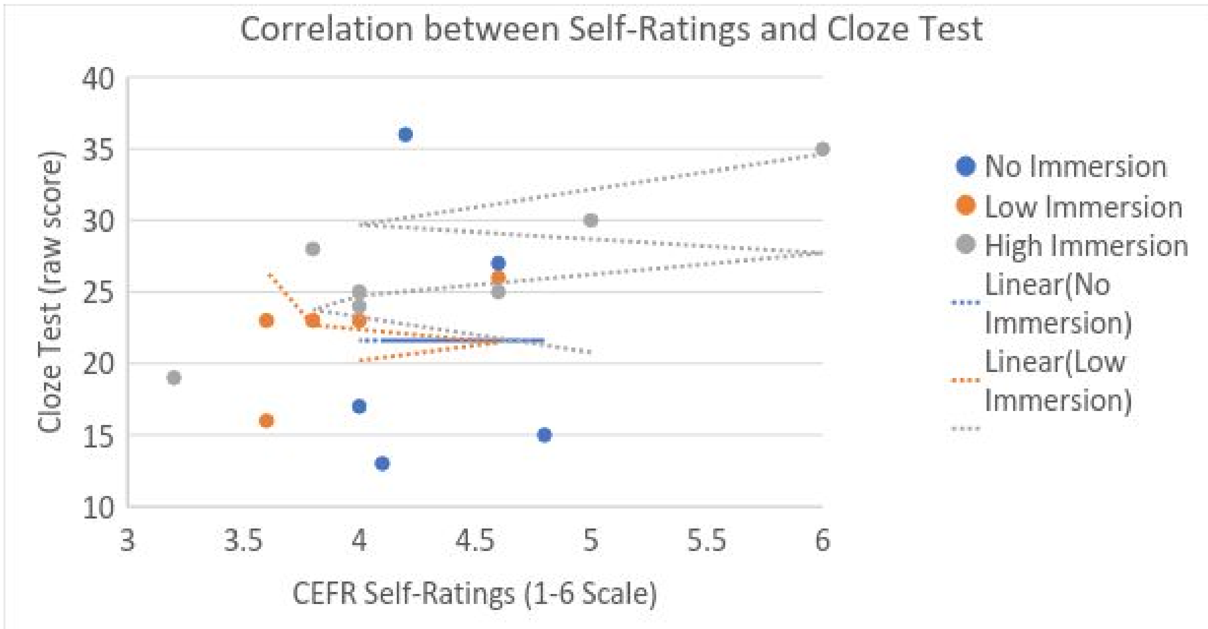


Figure 2. Correlation between self-rating and Cloze Test. CEFR self-ratings correlated with the Cloze Test scores for the two immersion groups, but no such correlation was observed in the no immersion group.

For all participants, we correlated EIT scores with cloze test scores to see if there was a relationship between oral and written proficiency in our cohort. We observed a positive linear relationship between the two proficiency measures (**Figure 3**). Because the two measures correlate highly with each other, this suggests that both the EIT and cloze test provide a reliable test for language proficiency, oral and written.

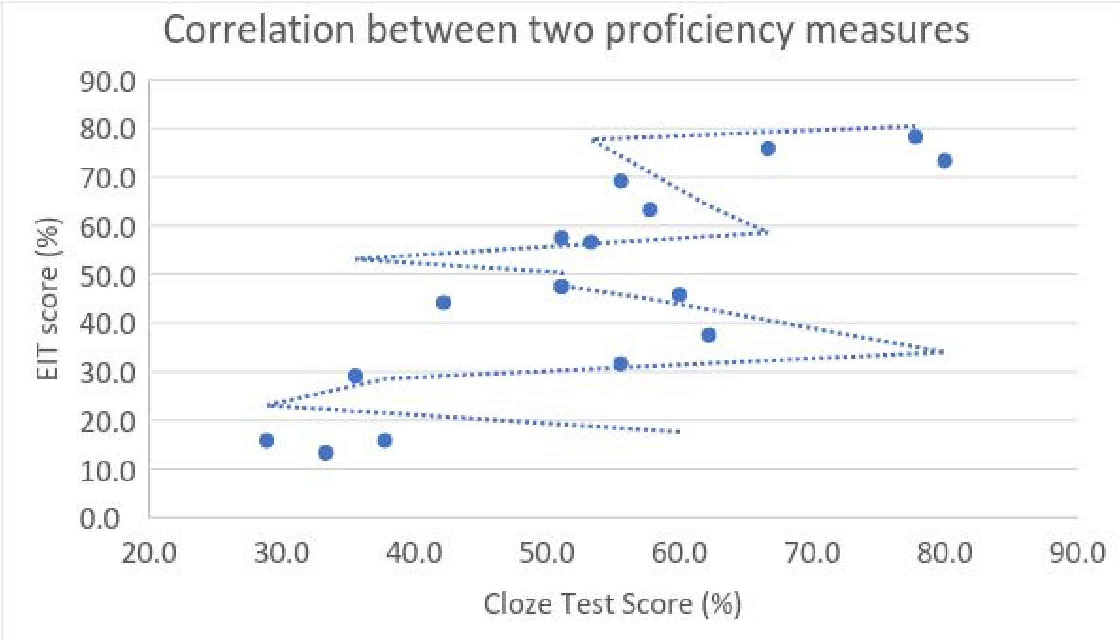


Figure 3. Correlation between proficiency measures. A linear relationship was observed between the Close Test and EIT scores.

We analyzed proficiency scores by group to see if there were any discrepancies in language ability across participant groups (**Figure 4**). Mean proficiency scores for each of the three groups were similar for the cloze test. The no immersion group demonstrated lower oral proficiency (EIT 32.8 %) compared to the low and high immersion group scores (49.0% and 56.2%, respectively) although this difference was not significant (p = 0.31).

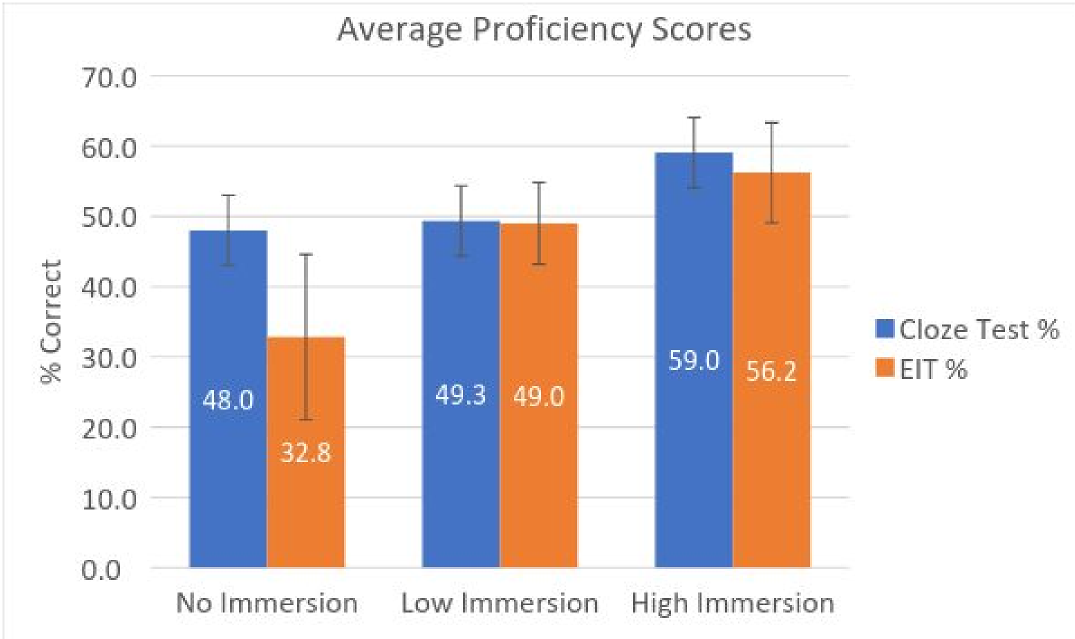


Figure 4. Proficiency Scores. Mean Cloze Test and EIT scores were calculated for each of the three groups. A large discrepancy between oral and written proficiency was observed for the non-immersion group.

Behavioral data

Mean scores for each of the three groups on the Judgment Task were reported (**Figure 5**). Descriptively, the high immersion group outperformed the low immersion group (91.8% versus 87.9%), and the low immersion group outperformed the no immersion group slightly (85.5%). However, a one-way ANOVA yielded no significant differences in Judgment Task scores across the three groups (p = 0.72).

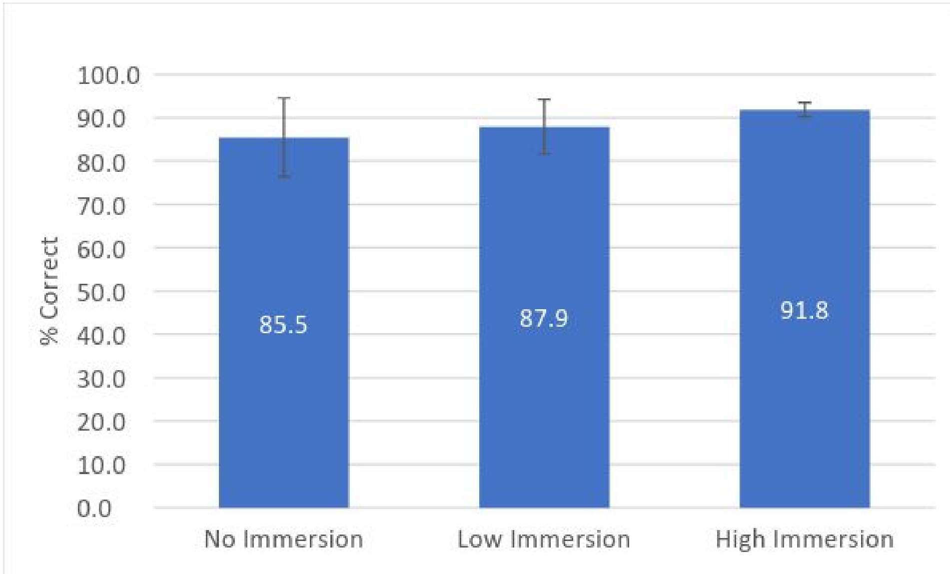
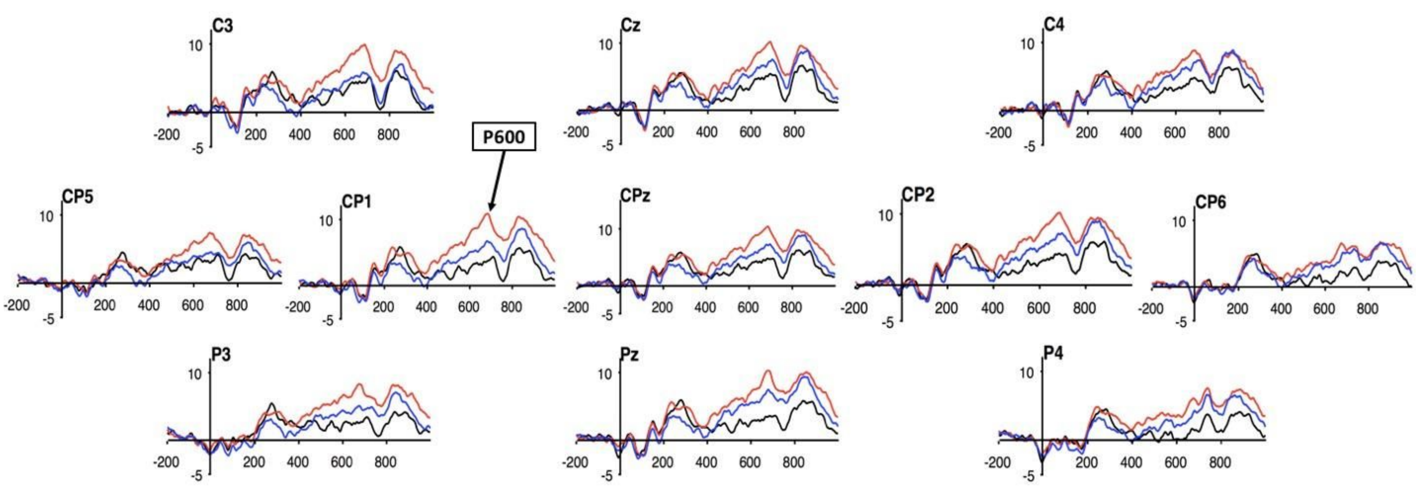


Figure 5. Judgment Task Scores. Average scores on sentence judgment task for each of the three groups, reflecting correct detections of grammatical errors in French stimuli.

Event-related potentials

Grand average waveforms are shown for each of the three groups (**Figures 6-8**). Visual inspection of the resulting ERPs at selected electrode channels revealed the emergence of a P600 component for the low and high immersion groups, but not for the group without immersion experience.



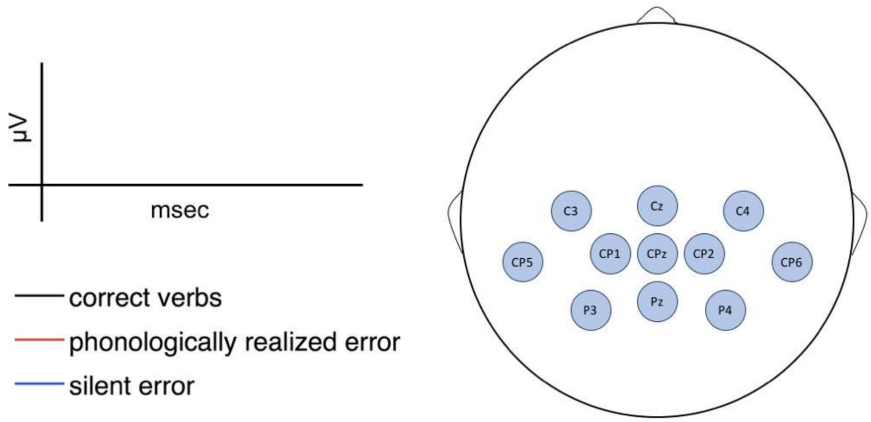


Figure 6. High Immersion ERPs. Grand mean averages for English L1-French L2 learners (high immersion group) as a function of verbal inflection condition and electrode site.

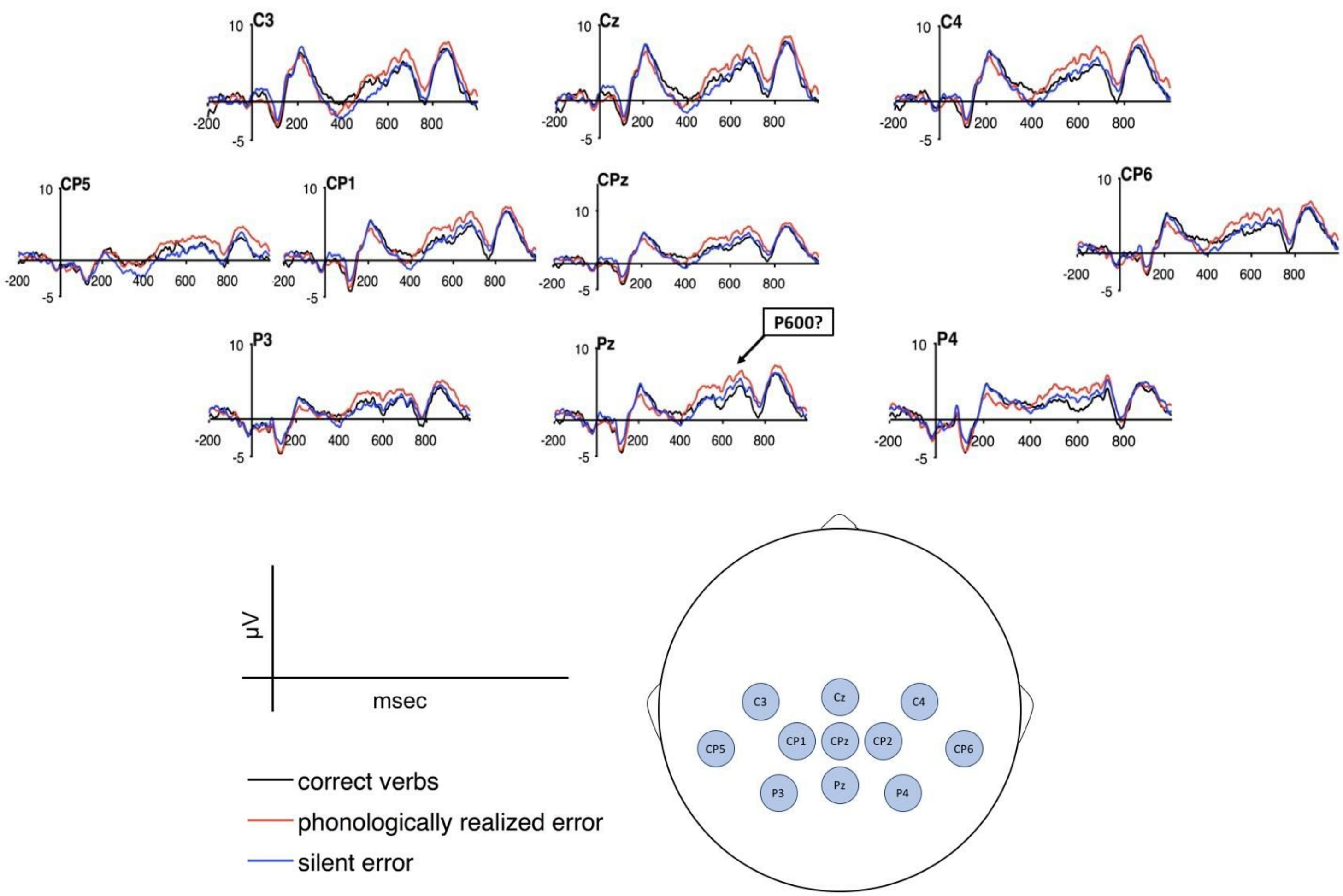


Figure 7. Low Immersion ERPs. Grand mean averages for English L1-French L2 learners (low immersion group) as a function of verbal inflection condition and electrode site. Note: CPz not reported due to noise.

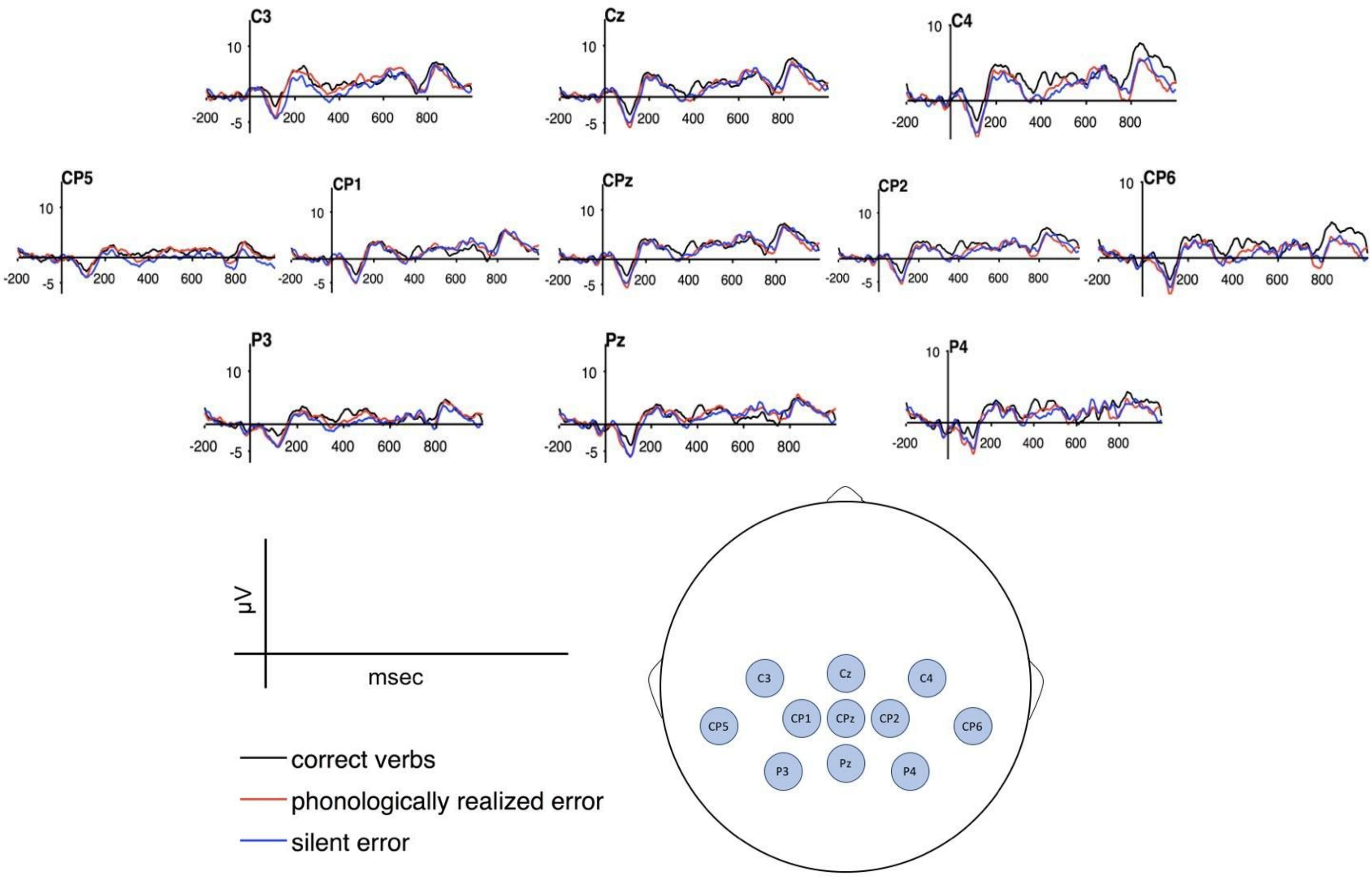


Figure 8. No Immersion ERPs. Grand mean averages for English L1-French L2 learners (no immersion group) as a function of verbal inflection condition and electrode site.

Grand average voltage maps were generated for the two of the three groups reflecting differences in voltage across the scalp between the correct/baseline condition and each of the two anomalous conditions (**Figures 9-10**). Scalp maps are displayed only for the two groups (high and low immersion) who appeared to show a difference in baseline versus anomalous conditions. The scalp maps were generated by subtracting the voltage on the correct condition from that of either the phonologically-realized error condition or the silent error condition. The time interval from 500-800 ms was used the groups, selected based on visual analysis of ERPs and where there appeared to be the greatest difference between baseline and error conditions. Due to time constraints, statistics have not been run.

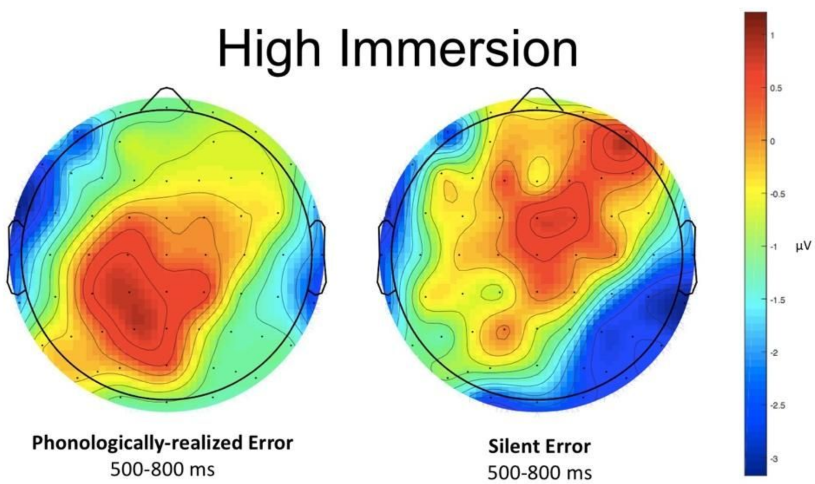


Figure 9. Scalp Maps for High Immersion Group. Scalp maps generated based on the difference in electrical potential between correct/baseline and the two error conditions from the time interval 500-800 ms.

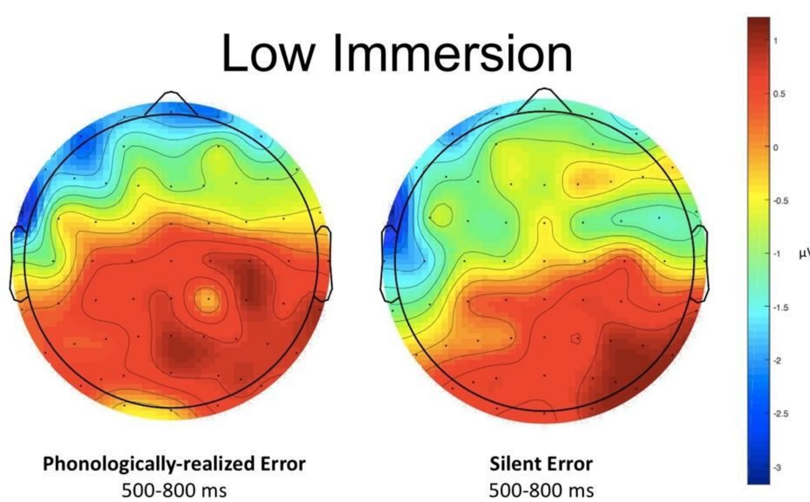


Figure 10. Scalp Maps for Low Immersion Group. Scalp maps generated based on the difference in electrical potential between correct/baseline and the two error conditions from the time interval 500-800 ms.

DISCUSSION

This study examined ERPs resulting from French syntactic errors in three groups of advanced French learners. Groups varied in their level of foreign language immersion, defined here as study abroad experience. Experience ranged from no immersion (participants who had never spent time in a French-speaking country) to low immersion (participants who had spent less than a semester abroad, mean 1.6 months) to high immersion (participants who had spent at least one semester abroad, mean 10.3 months). Participants in the three groups scored similarly on two proficiency measures and on the judgment task during the EEG session. However, preliminary visual analysis of ERPs suggests differences in online processing of French syntax across the three groups.

Consistent with previous ERP research on L1 and L2, syntactic violations elicited a characteristic P600 component for the high and possibly the low immersion groups. Syntactic violations consisted of manipulations in subject-verb agreement error, created both phonologically-realized and silent errors. For both the low and high immersion groups, results from Carrasco-Ortiz & Frenck-Mestre (2014) were replicated. The phonologically-realized subject-verb agreement errors elicited more robust ERP signatures as compared to the silent condition, in which verbal inflection was altered in orthography but not in pronunciation.

The no immersion group did not follow this pattern. Visual analysis of the ERPs for the no immersion group did not show the presence of a P600. Since the three groups showed similar French proficiency levels and similar scores on the judgment task during EEG, we attribute this absence of the P600 component as possible evidence for differences in online processing of French grammar in classroom-only learners versus those that receive language immersion L2. Because P600s are reliably elicited in L1 speakers (Bowden et al., 2013; Carrasco-Ortiz & Frenck-Mestre, 2014; Foucart & Frenck-Mestre, 2012; Frenck-Mestre et al., 2008), the emergence of a P600 in advanced L2 learners is indicative of a more native-like brain processing of L2.

These results are supported by ERP scalp maps for the two groups. For the time windows examined (500-800 ms) there appear to be differences in scalp distribution of the P600 across the scalp when subtracting baseline voltage from error conditions. For the high immersion group, a more centro-posterior effect is observed for the phonologically-realized error as compared to the silent error condition. The scalp map for the silent error appears to be more frontally located. The centro-posterior activation is more characteristic of a P600 component. The low immersion group showed more widespread activation in the posterior part of the brain. Further data collection is needed to determine whether this pattern of activation is suggestive of P600 components.

Previous research on the effect of learning context in foreign language learning has revealed similar ERP results to the present study. Relatively advanced L2 artificial language learners who encountered word-order violations revealed P600 only in an implicitly-taught group. No effect was observed in the explicitly-trained group

(Morgan-Short et al., 2012). Implicit training maps onto immersion experience in the present study, whereas explicit training mimics the type of instruction encountered in a classroom setting. A key difference between our study and Morgan-Short et al. (2012) is that our implicit/immersion group has also received classroom exposure (i.e. explicit instruction). It is unclear what role prior explicit instruction plays in ultimate attainment of native-like brain processing of L2.

The novelty of the present study is the finding that language immersion appears to have an impact on online processing of French grammar, as revealed by ERPs. Further, as time spent in immersive L2 settings increases, we observed an increase in the degree of native-like processing, as demonstrated by more robust ERP signatures in the high compared to the low immersion group, even given a lack of proficiency differences between groups. Finally, we demonstrated that phonological cues enhance the P600 effect for advanced French learners in the low and high immersion group. More robust ERP signatures were present for the phonologically-realized verb violations as compared to the silent verb violations.

Further statistical analysis with ERP data is needed to confirm the significance of these ERP results beyond visual analysis. Secondly, the relatively small sample size (N=17) necessitates further data collection to determine whether this trend is observed in larger cohorts. An interesting future direction would be to look at the effects of other syntactic manipulations and whether immersion learners are processing differently from classroom learners. This could include syntactic elements in L2 that do not exist in L1, such as grammatical gender for our English L1-French L2 speakers.

This research examining the effect of language immersion on late language learners could impact the way university foreign language curriculum is framed. If future studies corroborate the finding that language immersion leads to more native-like brain processing of L2 in university students, efforts on the curricular level could be made to either emphasize the importance of study abroad for university foreign language learners or incorporate language immersion (i.e. a more implicit instructional mode) into the classroom setting.

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