Social Effects of Code-Switching

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Abstract

Research on event-related brain potentials (ERPs) of bilinguals processing sentences with code-switches found that code-switches elicit a negativity over left fronto-central sites, and a posterior and frontal positivity. However, most of this research ignores the fact that code-switching is a social phenomenon and is only acceptable when all conversation partners are bilingual. Other research has found that awareness of someone's inability to understand language produces a neural marker (N400) indicating semantic difficulty, an effect later suggested to be related to the Autism Quotient. In this experiment, social constraints of code-switching were explored via event-related potentials and behavioral responses. Twelve bilingual Spanish-English speakers completed language proficiency tasks and an ERP reading task over two sessions. The sentences were either completely in English, or switched to Spanish halfway through. The participant spent half of their time reading the sentences in the presence of a monolingual trained confederate, and half in the presence of a bilingual trained confederate. The data collected thus far suggest that the largest effect is coming from the language switch itself, rather than being modulated by who the participant is with. Additionally, higher scores on the Autism Quotient appear to correlate with less sensitivity to the language background of one's partner, as reflected in ERP and behavioral responses.

Key words: Autism, Bilingualism, Code-Switching, Event-Related Potentials, Social Awareness

Introduction

Code switching is defined as the practice of alternating between two languages within the same conversation (Mercado, 2010). For example, a bilingual English-Spanish speaker might say, "He bought a *perro."* The use of the Spanish word for "dog" is an example of code switching. Switching between languages does not occur randomly and it is grammatically and socioculturally constrained (Paradis et al., 2011, p. 103). It is known that bilinguals prefer not to code-switch in the presence of monolinguals, indicating that there are social constraints (Grosjean, 1999). It is socially permitted only if the interlocutor is known to be fluent in both languages as well.

ERP responses associated with code switch processing

Simply processing code switches without a social component has been associated with certain ERP responses. An ERP study (Moreno et al., 2002) on code-switching presented participants with sentences that either ended in an expected English word, a code-switch, or a lexical switch (a low cloze probability item). For example, the sentence, "He heard a knock at the…" ended in either: door, *puerta,* or entrance. The code-switch (e.g., reading *puerta*) was associated with negativity over left fronto-central sites (250-450 ms) and posterior and frontal positivity.

This late positivity and left anterior negativity is consistent with other studies that measured the event-related brain potentials of bilinguals while they processed code-switched sentences (Ng et al, 2014; van der Meij, 2011). Some authors argue that left anterior negativity is associated with increased working memory load (Kluender & Kutas, 1993) and it has also been argued to be related to morphosyntactic processes (Molinaro et al., 2015). The late positivity component that was also observed has been argued to be associated with the processing cost that occurs when processing an unexpected word (Moreno, 2002), or a syntactic anomaly (Hagoort et al., 1993). Some studies (van der Meij, 2011; Proverbio, et al, 2004; Ng et al., 2014) also found an N400 effect. The N400 effect has been described as a neural marker of semantic incongruity (Kutas & Hillyard, 1980), or a neural marker reflecting the activation costs of accessing the less active language (van der Meij, et al., 2011).

The effects may be modulated by the bilinguals' language proficiency. For example, the left anterior negativity observed by van der Meij et al. (2011) was mostly seen in higher proficiency bilinguals, but both high and low proficiency bilinguals showed an N400 effect at the code switches. Moreno et al. found that the late positivity component had a smaller amplitude and an earlier peak with bilinguals who were more proficient with Spanish. This is consistent with Litcofsky and Van Hell's study (2017), which found that code switches elicited a late positivity only when switching from the dominant to the weaker language. Language proficiency was taken into account for the present study on the social effects on code-switching due the evidence that it may affect the ERP responses.

ERP responses associated with awareness of others' knowledge

Another study, unrelated to code-switching, found that language comprehension in the presence of others is related to N400 responses (Rueschemeyer, 2014). In this study, two participants were seated in front of a computer monitor. One participant (Participant 1) received headphones, and the other participant (Participant 2) did not. Both participants saw the same written sentences on the monitor, but Participant 1 received an additional sentence through headphones. When a sentence such as, "The boy had gills," was presented, Participant 1 also heard the sentence, "In the boy's dream, he could breathe under water." Participant 2 judged the sentence they saw to be implausible, but Participant 1 perceived it as plausible because they had added contextual information. When the information was plausible for Participant 1 but implausible for Participant 2, an N400 effect was observed in Participant 1. This effect stemmed from Participant 1 knowing that the other person couldn't comprehend the sentence without the contextual information; the same stimuli did not elicit an N400 effect when Participant 2 was not present. This suggests that information about what others know influences comprehension; being aware of someone else's inability to understand language produces a neural marker (N400) of semantic difficulty.

Autism and language processing

The aforementioned Rueschemeyer study has been replicated, and found to be affected by the Autism Quotient (Jouravlev et al., 2017). Although the Autism Quotient is not a diagnostic tool, it is a measure of autistic features in adults (Baron-Cohen, 2001). Participants rate how strongly they agree with statements such as, "I find it difficult to imagine what it would be like to be someone else." When participants in the study had higher scores on the Autism Quotient, smaller effects of the presumed knowledge of the other person were observed.

Earlier, it was stated that code-switching is socioculturally constrained. Grosjean (2001) suggests that bilinguals will typically be in a monolingual language mode when interacting with monolinguals, and that when they are in this language mode, they deactivate their other language "so that it is not produced and does not lead to miscommunication." We use our knowledge of the other person's mental states when communicating; communication is a "joint activity" (Brennan et al., 2010).

People with autism tend to have deficits in social, pragmatic and language skills, which impact their integration into society. Specifically, it has been suggested that many people with autism have an impaired theory of mind, or "cognitive empathy"—and thus find it difficult to understand others' points of view and track another's mental state during social interaction (Baron-Cohen, 2009). Participating in bilingual context and code-switching are highly dependent on pragmatic skills and the ability to attend to social stimuli, and, thus, may be adversely impacted in bilinguals with autism.

Benning et al. (2016) found that when children with autism processed social stimuli such as smiling faces versus nonsocial stimuli such as vehicles, there was a more pronounced late positive potential with nonsocial stimuli than social stimuli. Although this study did not look at language processing, it does demonstrate that the children with autism attended less to the social stimuli. Attending to social stimuli is a necessary part of code-switching. With this in mind, the study seeks to determine whether autistic traits correlate with sensitivity to the language background of the conversation partner in a code-switching task, through behavioral and/or ERP responses.

Current Experiment

While studies in the past have investigated the effect of reading code switches and comprehending language in front of someone that does not understand the semantic meaning, none of the previous studies have looked at the social constraints on code-switching. Do bilinguals comprehend code switches differently depending on who they are with? The purpose of the study set forth is to examine the extent to which comprehension of code switches is sensitive to the language knowledge of others present. Due to the social awkwardness of the participant comprehending a language that the participant's partner does not understand, we predicted that the ERP response would be affected by the type of confederate in the room with the participant, with the response being more robust in the monolingual confederate condition when reading code-switched sentences. Furthermore, we expected that the higher one's score is on the Autism Quotient, it would be associated with smaller effects of the presumed knowledge of the other person.

Methods

Participants

A total of fifteen Spanish-English bilinguals from the University of Florida (12 women, 3 men, 18-28 years, mean age 19.93 years) were recruited. They were paid or given course credit to participate. All reported having learned English and Spanish simultaneously, or learned Spanish first and English second (but no later than twelve years for English). All participants were right-handed, with no history of neurological problems or language disorders.

All fifteen of the participants participated in both sessions of the experiment, but three of the fifteen were not included in the ERP amplitude analysis due to a large number of artifacts in the EEG signal. Before starting the experiment, participants first read and signed an informed consent form according to the established guidelines by the University of Florida Internal Review Board.

Materials and Design

The paradigm consisted of two sentence types: (a) English sentences, and (b) sentences with an English-Spanish code switch in the middle of the sentence, always at a function word. The sentences were standardized to contain between nine and sixteen words. For example:

(a) The soccer player scored the winning goal in the last minute of the game.

(b) The soccer player scored the winning goal en el ultimo minuto del partido.

The sentences were presented word-by-word at a rate of one word every 500 ms. Each participant saw 80 sentences (40 of type (a) and 40 of type (b) in random order) with a bilingual confederate in the room, and 80 with a monolingual confederate in the room. The order of the type of confederates was counterbalanced, and materials were randomized using a Latin-Square over the four conditions (Mono/bilingual confederate x Switch/No-switch). The critical comparison was between the ERPs starting from the onset of the code-switch and those to the comparable non-switch word in the English-only condition. Switches were always followed by at least three words, so that the brain response to the switch could be investigated two seconds after the switch point.

Sentences were separated into four lists, such that no single sentence appeared more than once in each list and thus no participant would see the same sentence twice. The sentences were split into eight blocks for each list. Each block contained 20 sentences. In order to keep the participants engaged, roughly 25% of the sentences were followed by a comprehension question about the preceding sentence.

In addition to reading the sentences, the participants also completed various language questionnaires. They were given a language background questionnaire, modeled from the LEAP-Q (Marian et al., 2007) and modified to include questions on code-switching use. This information was used to describe participant characteristics, as well as confirm that the participants learned English and Spanish simultaneously, or Spanish first and English second.

The participant was then given English proficiency tasks or Spanish proficiency tasks, and the order of these was counterbalanced over participants. The English proficiency tasks were the Michigan English Language Institute College Entrance Test (the MELICET, an English grammar task), followed by a short version of the Boston Naming Task in English. The Spanish proficiency tasks were the Diplomas of Spanish as a Foreign Language (the DELE, a Spanish grammar task), followed by a Boston Naming Test in which participants named the pictures using Spanish words (Valdés Kroff et al., 2016). Participants then completed the Autism Spectrum Quotient (Baron-Cohen, 2001), a short form of the Edinburgh handedness inventory (Oldfield, 1971), and a short questionnaire to determine whether the participant has had epilepsy or other brain damage, and is currently taking medication that may affect the brain.

Procedure

Participants participated in two different sessions. In the first session, they were given various questionnaires to complete on a computer after informed consent was obtained. These questionnaires were given to assess English and Spanish language proficiency, and to ensure that the participants fulfilled all requirements before the ERP reading session. This session took about 1 to 1.5 hours.

For the second session, participants were seated about one meter away from computer monitor in a study booth. Before EEG was recorded from the participant, the participant was fitted with an electrode cap. To record eye movements, additional electrodes were placed at the outer corners of the eyes, and above and below the right eye. Electrodes were also placed on each mastoid, such that the signal could later be re-referenced to the mean of the mastoids. The electrodes were filled with gel using a disposable syringe. EEG was only recorded during the reading tasks, but the participant wore the cap during the map tasks as well.

The participant was partnered for half of the blocks with a Spanish-English bilingual confederate and with an English monolingual confederate for the other half of the blocks. The order of confederates was counterbalanced between participants. The confederates were trained by the lab to act as if they are a fellow participant when speaking to the actual participant. After the participant was introduced to their partner and rapport was established, the participant and their partner completed a map task (Valdés Kroff & Fernández-Duque, 2017). They were instructed to move objects presented on their respective computer screens, in order to end up with all of the objects in the same place on both computer screens. The bilingual confederate was trained to code-switch throughout this activity, and the monolingual confederate was trained to mention that they only know English, so that the participant is familiar with the language background of the confederate. The map task sessions were recorded, in order to code the dialogue.

After the participant and confederate completed the map task, they were given a practice ERP session of five English-only sentences, and then the ERP reading task began. The participants' EEG were recorded while silently reading sentences, with a confederate sitting next to them. Each participant saw 160 sentences in total. Participants were instructed to only blink between sentences (during a question or a prompt screen) and not during the actual presentation of the stimuli.

Sentences were presented one word at a time. Before the start of each sentence, a fixation cross appeared in the middle of the screen. A word appeared in the center of the computer monitor at a rate of 1 word every 500 ms (word presented for 300 ms followed by a 200 ms blank screen). After each sentence, the message "press for next" was presented. This stayed on the screen until the participant pressed a button on their controller. Words were presented in a bolded, white font on a black background.

Each sentence was followed by a meta-probe: "Was the sentence clear to the other person?" After each meta-probe, the message "press for next" was presented. This stayed on the screen until the participant pressed a button on their controller. At least twenty percent of the sentences also had a comprehension question following the probe. The participant was then asked whether the other person answered the comprehension question correctly. The participants answered “yes” or “no” using a gamepad; the confederate also had a gamepad but their answers were not recorded.

Between each block, the door to the experiment booth was opened and the participant was able to take a short break. After four blocks, a different confederate was introduced to the participant, and the two completed the map task and ERP reading activity for the remaining four blocks. The second session, including set-up, last about 2.5 hours per participant.

Upon completion of the experiment, participants were asked several debriefing questions. These included whether they noticed anything about the sentences that they read and what they were basing their answer on when answering questions about their partners’ understanding. They were also asked about the extent to which they believed that their partners were monolingual or bilingual, as well as whether they believed their partners were actual participants or trained. After these questions were asked, the experimenter explained the purpose of the study and the fact that the partners were actually trained. The participants were asked to not tell anyone else about the trained confederates, and consented to include their data in the research project after learning the true purpose of the study.

EEG Recordings

EEG was recorded from a total of 64 Ag/AgCl (silver-silver chloride) electrodes (ANT WaveGuard Cap). Each electrode was referenced to the left mastoid. To track eye movements and blinks, a snap electrode was placed at the outer canthus of each eye and two others were placed above and below the participant’s right eye. Impedances were kept below 5 KOhms. The

EEG was recorded with an ANT amplifier at a sampling rate of 512Hz, using an average reference.

Data Analysis

The raw EEG data was concatenated. Artifacts such as blinks or other muscle movements were automatically rejected, and later manually checked by the experimenter. The data was then rereferenced to the mean of the left and right mastoid, and filtered between 0.01 and 30Hz. Artifact-free EEG was then averaged across all of the trials for each condition, electrode, and participant. The recording was time-locked to the onset of the critical word (switch point, or equivalent position in the English-only trials). The averages extend from 200 ms prior to the presentation of the critical word to 1200ms after the critical word. The data was baselined between -200ms and 0ms before the presentation of the critical word. Statistical analyses were conducted using R on the average amplitudes between 500 and 900 ms in all conditions collapsed over the posterior electrodes were defined as Cz, CPz, Pz, C3, CP3, P3, C4, CP4, and P4. This interval and these electrodes were chosen to cover the late positive effect reported in prior studies on code switching.

Results

The largest effect appears to be coming from the language switch itself, and not the language background of the person who is with the participant. Compared to English sentences, English-Spanish sentences affected ERP amplitude at posterior sites (β=2.31, SE =.49, t=4.75, p < 0.001), increasing the amplitude by about 2.31 microvolts ±0.54 (standard errors). An ERP wave is pictured in Figure 1 for CPz, an electrode near the back of the head. As one can see from

Figure 1 and Table 1, the largest difference in the amplitudes is between the switch and non-switch conditions.

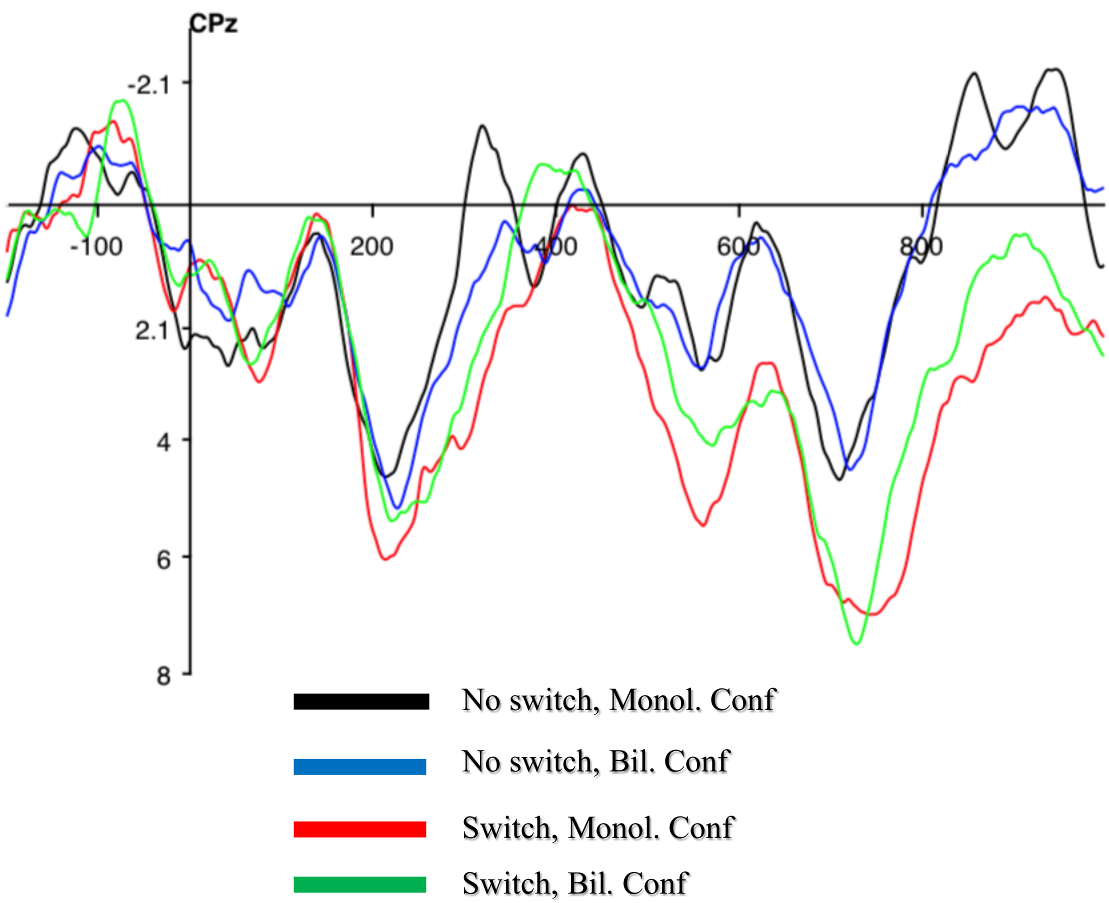

Figure 1. ERPs time-locked to the onset of the critical word for the CPz electrode. Negativity is plotted up.

Effects	Estimate	Std Error	df	t	p
Switch	2.31	0.4867	30	4.746	0.0000476***
Confederate	0.2142	0.4867	30	0.44	0.66306
AQ	-0.1447	0.2356	10	-0.614	0.55288
Switch x Confederate	0.4879	0.9734	30	0.501	0.61988
Switch x AQ	-0.5076	0.2065	30	-2.458	0.01995*
Confederate x AQ	-0.239	0.2065	30	-1.157	0.25627
Switch x Confederate x AQ	-0.7702	0.413	30	-1.865	0.07198+

Table 1. *Fixed effects on posterior amplitude*

*** P < .001; * P < .05, + P < .1

Furthermore, the switch effect is smaller the higher the participant scored on the AQ test (that is, the more autistic tendencies the participant had). Finally, the interaction between Switch, Confederate and AQ is marginally significant, suggesting that those who score low on the AQ have a larger switch effect in the presence of a monolingual than a bilingual confederate.

To further explore this, we tested the correlation between the AQ scores and the difference in mean amplitude between the switch and no-switch conditions. There is a moderately strong negative correlation when comparing the AQ scores of participants and ERP amplitudes when in the presence of a monolingual ($r = -0.69$, $p < 0.05$). When reading English-Spanish sentences in front of a monolingual, those with higher AQ scores tend to have a smaller difference in posterior amplitude when compared to the amplitudes observed reading English sentences. Those with higher numbers of autistic traits had ERP responses that were less reactive to the fact that they were reading Spanish in front of someone who did not understand.

When the same correlation test is performed on the conditions with bilingual confederates, there is no such correlation ($r = -.13$, $p = 0.70$). AQ does appear to modulate the difference in posterior amplitude only when the participant is in the presence of a monolingual.

Furthermore, there is a moderately strong positive correlation between AQ score and how often the participant believed that their monolingual English partner understood the preceding sentence regardless of whether the sentence was English or English-Spanish ($r = 0.60$, $p < 0.05$). This was done by looking at the "yes" responses to the question: "Was the sentence clear to the other person?" in the presence of a English monolingual confederate. The percentage of "yes" responses was calculated for each participant for the switch and no-switch conditions with the monolingual confederate. We then tested the correlation between the AQ score and the difference in the percentage of "yes" responses between the trials with code-switched sentences and the ones completely in English. The data suggest that people with higher AQ scores have less of a difference between the two conditions. In short, people with higher AQ scores are more likely to say that their English monolingual partner understood the preceding sentence, regardless of what language the sentence was in. People with lower AQ scores were more likely to modulate their response accordingly to what they knew their partner could understand.

Discussion

In this study, we measured ERP responses in the brains of bilingual English-Spanish speakers while they read English and English-Spanish sentences in the presence of a monolingual English and a bilingual Spanish-English partner to see if they would process code switches differently. We predicted that there would be a difference in amplitude when reading code switches in front of a fellow bilingual versus a monolingual, with the effect of switching being more robust in the monolingual confederate condition. Code-switching is only socially permitted in situations where the interlocutor is also fluent in both languages, and past research has shown that there is a neural marker associated with the knowledge that someone else does not understand, so we hypothesized that we would be able to observe this awareness in the ERP responses. We observed a 500-900ms positivity in the ERPs for the switch versus the no switch condition. This was not modulated by who the participant is sitting in the room with, at least, not when collapsed over participants.

We also predicted that those with higher Autism Quotient scores would be less sensitive to the language background of their partner. We found that higher AQ scores appear to predict less sensitivity to code switches, both in implicit (ERP) and explicit measures. Higher AQ scores were correlated with a smaller change in posterior amplitude when reading sentences in the presence of a monolingual, and with the participant being more likely to believe that their monolingual partner understood the sentences. In short, the data suggest that those with higher AQ scores may be less likely to consider their partner's language background.

Our data confirmed that there is a brain response associated with reading code switches. Paying attention to social stimuli is something that code-switchers must do frequently, and it seems that those who have higher Autism Quotient scores were not as sensitive to the understanding of their partner.

These findings could have important implications for people with autism. Code-switching is very common in bilingual communities amongst friends and family. Bilingual speakers are thus extremely sensitive to which languages that their interlocutors know, oftentimes limiting the language they speak to the one understood by the monolingual present. These findings suggest that higher numbers of autistic traits even among non-autistic bilingual speakers, are accompanied by less sensitivity to the communicative needs of the other person in the room. Moreover, these results demonstrate this lack of sensitivity in both an explicit task, asking for the participant's judgement of the other person's comprehension, and an implicit task, ERPs, to pragmatic code-switching violations.

One further direction of this research could be to look at ERP and behavioral responses from a study such as this one in individuals diagnosed with ASD, train these individuals to be more sensitive of others' language background through explicit rule-based guidelines, and then measure their ERP and behavioral responses afterward in a similar task and compare them to the baseline. A study done on facial recognition training for individuals with ASD found that the participants were able to gain expertise through focused experience, and this was reflected in a change in brain response as a result of training (Faja et al., 2012). These findings suggest that bilingual speakers with autistic characteristics may benefit from explicit instruction and practice of the "rules" of code-switching in order to improve their communication skills.

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References

Baron-Cohen, S. (2001). Autism-Spectrum Quotient. *PsycTESTS Dataset*. doi:10.1037/t00350-000

Baron-Cohen, S. (2009). Autism: The Empathizing-Systemizing (E-S) Theory. *Annals of the New York Academy of Sciences,1156*(1), 68-80. doi:10.1111/j.1749-6632.2009.04467.x

Benning, S. D., Kovac, M., Campbell, A., Miller, S., Hanna, E. K., Damiano, C. R., . . . Dichter, G. S. (2016). Late Positive Potential ERP Responses to Social and Nonsocial Stimuli in Youth with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders,46*(9), 3068-3077. doi:10.1007/s10803-016-2845-y

Brennan, S. E., Galati, A., & Kuhlen, A. K. (2010). Two Minds, One Dialog. *Psychology of Learning and Motivation The Psychology of Learning and Motivation: Advances in Research and Theory,*301-344. doi:10.1016/s0079-7421(10)53008-1

Faja, S., Webb, S.J., Jones, E., Merkle, K., Kamara, D., Bavaro, J., . . . Dawson, G. (2012). The Effects of Face Expertise Training on the Behavioral Performance and Brain Activity of Adults with High Functioning Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders,42*(2), 278-293. doi: 10.1007/s10803-011-1243-8

Grosjean, F. (2001). The Bilingual's Language Modes. In J. L. Nicol (Ed.), *Explaining linguistics. One mind, two languages: Bilingual language processing* (pp. 1-22). Malden, : Blackwell Publishing.

Hagoort, P., Brown, C., & Groothusen, J. (1993). The syntactic positive shift (sps) as an erp measure of syntactic processing. *Language and Cognitive Processes,8*(4), 439-483. doi:10.1080/01690969308407585

Jouravlev, O., Ayyash, D., Mineroff, Z., & Fedorenko, E. (2017). Robust evidence of the tracking of co-listeners' mental states during language comprehension. CUNY 2017.

Kluender, R., & Kutas, M. (1993). Bridging the Gap: Evidence from ERPs on the Processing of Unbounded Dependencies. *Journal of Cognitive Neuroscience, 5*(2), 196-214. doi:10.1162/jocn.1993.5.2.196

Kutas, M., & Hillyard, S. (1980). Reading senseless sentences: brain potentials reflect semantic incongruity. *Science,207*(4427), 203-205. doi:10.1126/science.7350657

Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing Language Profiles in Bilinguals and Multilinguals. *Journal of Speech Language and Hearing Research,50*(4), 940. doi:10.1044/1092-4388(2007/067)

Mercado, J. (2010). Code Switching. *Encyclopedia of Cross-Cultural School Psychology,*225-226. doi:10.1007/978-0-387-71799-9_74

Molinaro, N., Barber, H. A., Caffarra, S., & Carreiras, M. (2015). On the left anterior negativity (LAN): The case of morphosyntactic agreement: A Reply to Tanner et al. *Cortex,66*, 156-159. doi:10.1016/j.cortex.2014.06.009

Moreno, E. M., Federmeier, K. D., & Kutas, M. (2002). Switching Languages, Switching Palabras (Words): An Electrophysiological Study of Code Switching. *Brain and Language,80*(2), 188-207. doi:10.1006/brln.2001.2588

Ng, S., Gonzalez, C., & Wicha, N. Y. (2014). The fox and the cabra: An ERP analysis of reading code switched nouns and verbs in bilingual short stories. *Brain Research,1557*, 127-140. doi:10.1016/j.brainres.2014.02.009

Oldfield, R. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia,9*(1), 97-113. doi:10.1016/0028-3932(71)90067-4

Paradis, J., Genesee, F., & Crago, M. B. (2011*). Dual language development and disorders: A handbook on bilingualism & second language learning* (2nd ed.). Baltimore, MD: Brookes.

Proverbio, A. M., Leoni, G., & Zani, A. (2004). Language switching mechanisms in simultaneous interpreters: an ERP study. *Neuropsychologia,42*(12), 1636-1656. doi:10.1016/j.neuropsychologia.2004.04.013

Rueschemeyer, S., Gardner, T., & Stoner, C. (2014). The Social N400 effect: how the presence of other listeners affects language comprehension. *Psychonomic Bulletin & Review,22*(1), 128-134. doi:10.3758/s13423-014-0654-x

Valdés Kroff, J. R., & Fernández-Duque, M. (2017). Chapter 9. Experimentally inducing Spanish-English code-switching. *Multidisciplinary Approaches to Bilingualism in the Hispanic and Lusophone World Issues in Hispanic and Lusophone Linguistics,*211-231. doi:10.1075/ihll.13.09val

Valdés Kroff, J. R., Dussias, P. E., Gerfen, C., Perrotti, L., & Bajo, M. T. (2016). Experience with code-switching modulates the use of grammatical gender during sentence processing. *Linguistic Approaches to Bilingualism,7*(2), 163-198. doi:10.1075/lab.15010.val

Van der Meij, M. V., Cuetos, F., Carreiras, M., & Barber, H. A. (2010). Electrophysiological correlates of language switching in second language learners. *Psychophysiology,48*(1), 44-54. doi:10.1111/j.1469-8986.2010.01039.x