ABSTRACT

Title of Thesis:	VOLITIONAL CODE SWITCHING: IS THERE A COST?
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Bilinguals commonly commingle their languages when speaking among other bilinguals in a process known as code switching (CS). Previous studies have been equivocal on whether CS is cognitively demanding, as measured by a time cost. This study sought to identify and compare time cost in CS across two experimental paradigms: naturalistic conversation and self-paced reading. Eighteen participants of similar linguistic background (English-dominant second language learners of French) were recruited and completed both tasks. Results identified a time cost for CS in the conversation task, but not the self-paced reading task. The data were also analyzed for effect of CS direction (either L1 to L2 or vice versa). In the conversation task only, there was a greater time cost for switching from L1 into L2. These results suggest that, while time cost for CS exists, it is limited to tasks that require selection of lexical and syntactic schemas.

VOLITIONAL CODE SWITCHING: IS THERE A COST?

by

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Introduction

It is estimated that one third of the world's population is bilingual, that is, actively uses two or more languages across different environments, including work, family life, and leisure. In the United States, an estimated 35 million people speak languages other than English (Ortman & Shin, 2011). Speech-language pathologists (SLPs), therefore, will continue to serve increasing numbers of bilingual clients. Bilinguals commonly commingle their languages when speaking among other bilinguals. This behavior, known as *code switching* (CS), is defined as the use of two or more languages in a single utterance. While CS is widely attested, the cognitive mechanisms behind CS are still under debate. This project seeks to clarify the nature of CS by examining the cognitive costs of CS in two types of tasks. By doing so, we may gain a more accurate understanding of CS, and in turn be able to better structure the intervention practices of SLPs to serve the needs of bilingual clients.

Bilinguals who code switch have been the subject of a variety of studies interested in determining the constraints of CS, both sociopragmatic and grammatical. One set of theories examines the impact of conversation and discourse structures on CS. Some researchers have identified CS as a method speakers use to repair conversation breakdowns or make additional bids for information, as in discourse-related code-switching, to indicate the speaker's knowledge of in-group information, as in discourse-related insertions, or to negotiate which language to speak in, as in preference-related switching (Auer, 1984). In these situations, aspects of communication beyond sentence structure constraints act upon language choice. In his treatment of conversational CS, Gumperz (1982) identifies conversational functions as well as linguistic constraints of CS. Conversational functions include, among others, the use of quotations, addressee specification, interjections, and reiterations. In other words, these conversational functions of CS modulate emphasis, turn-taking, and conversational repair. The idea of a sociopragmatic negotiation, facilitated through language choice, between speakers is also present in Myers-Scotton's markedness model (1983, 1999), which argues that in any linguistic exchange, certain varieties of speech (e.g., accents, dialects, monolingual or code-switched modes) are either marked or unmarked. Speakers generally choose the unmarked variety unless they have good reason, indicating that CS must be unmarked in some settings. Other researchers, such as Gardner-Chloros (2009) and Timm (1975) consider conversation topic to be a factor that licenses or prohibits code switching in real world environments. While each of these theories have some evidence, research in sociopragmatic constraints of CS have not resulted in overwhelming evidence for one theory, and this is still an area of healthy debate.

Similarly, while it is widely accepted that there are some grammatical restrictions to what makes an acceptable CS, the underlying constraints are still the subject of debate. The grammatical or syntactic constraints of CS have been studied, and several theories have emerged (MacSwan, 2005, 2014; Myers-Scotton, 1999; Belazi, Rubin & Toribio, 1994). One model proposes that one language acts as a frame in which features and constituents of the other language are inserted (the *Matrix Language Frame)* (Myers-Scotton, 1999). Another model proposes that the language feature (e.g., the language of the complement of a functional head cannot vary from the features of that functional head (the *functional head constraint*), which is a constraint generally present in monolingual speech as well (Belazi et al., 1994). In this model, for example, the noun phrase *big shiny red car* includes the functional head *car*, and the language feature of the modifiers in the phrase cannot alternate from English to another language. In a somewhat similar theory, Gumperz (1982) provides syntactic constraints where CS is licensed to occur only under certain conditions. Examples of acceptable conditions include CS across subject-predicate constructions, as well as noun complements, embedded relative clauses, verb complements, and attitude constructions such as *I think* and their complements. Another theory posits a typology of CS that includes *insertions* of single words in one language into a sentence comprised of another; *alternations* of constituent phrases of two languages in a single sentence; and *congruent lexicalization* or *dense CS,* which is characterized by an interaction between the grammar of the two languages (Muysken, 2000). A final model posits that the only constraints on CS are the grammars of the two languages being used (the *minimalist approach*) (MacSwan, 1999; 2000). Each of these models is the subject of debate regarding their relative strengths, weaknesses, and ability to explain CS behavior as seen by researchers in the field.

Code Switching in the Context of Models of Bilingual Language Representation

Given that CS uses two languages and requires an understanding of some underlying grammatical and sociolinguistic constraints, it is conceivable that CS is cognitively and linguistically more demanding than speaking in a single language. Theories of bilingual storage and activation of language can provide some insight into whether CS is more taxing on the cognitive system than speaking in a monolingual mode.

Several studies have found that bilingual speakers make use of a dual system of semantic and lexical representations that interact with language knowledge when performing language tasks (de Groot, 1993; Francis, 1999; Kroll, Bobb, Misra, & Guo, 2008; Kroll & Stewart, 1994). The *revised hierarchical model of bilingual memory* posits that, while lexical and semantic or conceptual links are active in both languages of bilingual language representation, the strengths of these links are contingent upon proficiency and relative dominance between a speakers first (L1) and second (L2) languages (Kroll & Stewart, 1994). For example, L2 to L1 lexical associations are posited to be stronger than lexical links from L1 to L2, because the lexical links from L2 to L1 are used to give meaning to new vocabulary when a speaker is first acquiring a language.

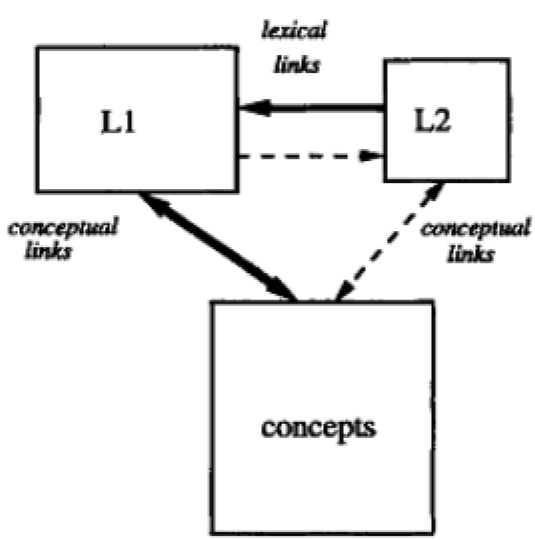

Figure 1. The revised hierarchical model of bilingual memory, from Kroll & Stewart (1994), showing strong connections (solid lines) between conceptual representations/L1 and L2/L1 via lexical links. Weak links (dashed lines) are shown between conceptual representations/L2 and L1/L2 via lexical links.

This model further suggests that strong links exist between L1 and conceptual or semantic representations. By contrast, weak links exist between conceptual representations and L2, and weak lexical links between L1 and L2. As proficiency in L2 increases, however, the connection between L2 and conceptual representations is strengthened. This model was borne out by experiments comparing various translation tasks. In one, reaction times (RT) between naming of images in alternating languages were found to be significantly shorter (about 670 ms) than translating words of one language into another (Kroll & Stewart, 1994). Additionally, naming RTs were approximately 91 ms longer in L2 than in L1, and translation RTs were approximately 119 ms longer from L1 to L2 than from L2 to L1, as consistent with the model (Kroll & Stewart, 1994).

By contrast, syntactic information seems to be equally accessed by languages in the bilingual brain, provided these languages are syntactically similar. One model of syntactic representation adapts the model of the *lemma stratum*, a level of the lexicon where syntactic information is encoded across different combinatorial nodes, such as category nodes that indicate grammatical information (Levelt, Roelofs, & Meyer, 1999). In this adapted model, verb lemmas for both of a bilingual's languages are connected to the same "nodes," such as a node that specifies language (Hartsuiker, Pickering, & Veltkamp, 2004). The activation of one lemma results in an activation of a non-language-specific grammatical structure, into which lexical items of each language are inserted. In this model, then, the activation of a verb in L1 necessarily activates the corresponding verb in L2, and vice versa. This model is supported by the results of experiments that have found that it is possible to prime for sentence types (e.g., passive and active sentences) across languages, suggesting that syntactic information in shared between languages in the brain (Hartsuiker et al., 2004). Subsequent studies have reinforced these findings in different experimental paradigms (Bernolet, Hartsuiker, & Pickering, 2013; Schoonbaert, Hartsuiker, & Pickering, 2007). This model has two major ramifications for bilingual language and CS. First, since language is encoded on the nodes of lemmas, the activation of a lemma entails the activation of all associated language nodes. In other words, during bilingual language production, both languages are always activated. Second, as both languages are activated, it is possible that lexical items from either language can be inserted into the grammatical structure. Therefore, this model easily predicts the occurrence of CS and requires no further constraints on use than the grammar and lexical items of both languages, as in MacSwan's minimalist approach (1999, 2000). Furthermore, we will see that as this model predicts the behavior of CS, one widely accepted model of CS incorporates aspects of both the model of co-activated lemmas and nodes, and the hierarchical model of Kroll and Stewart (1994).

A third model, the *control process model of CS,* states that when selecting which language to use and when, bilinguals who code switch choose language schemas based on contextual appropriateness and subsequently inhibit non-target schemas to prevent their use (Green & Wei, 2014). This model provides an opportunity to unify sociolinguistic, grammatical, and neurocognitive accounts of CS. Contextual appropriateness for each utterance is determined by various factors, including the language of the surrounding conversation, proficiency of both speakers, and discourse factors such as those identified by Auer (1984) or Gumperz (1982). In a single language mode, this will result in the suppression of one language's constituents with the speaker favoring the use of one language. By contrast, in a CS mode, both languages are cooperatively activated, allowing for code switches to occur. It should be noted that in this model, both languages are equally activated, consistent with Hartsuiker's (2004) proposal that the activation of one lemma in the bilingual brain activates both of its language nodes. However, in this model, after activation of both languages, the two languages' representations then compete for selection by the speaker. It is at this *competitive choice layer* that the identification and suppression of an inappropriate language choice occurs. Therefore, when bilinguals exhibit CS behavior, it is reasonable to assume that the act of suppressing one language and then switching to suppress the other throughout the conversation requires more effort than suppressing one language and allowing it to remain at a lower level of activation throughout the conversation. In other words, switching back and forth between languages likely requires additional cognitive effort than remaining in a single language mode. This theory has been further strengthened by subsequent studies of bilingual language processing and production, including several that have incorporated brain imaging studies (Luk, Green, Abutalebi, & Grady, 2012; von Studnitz & Green, 2002).

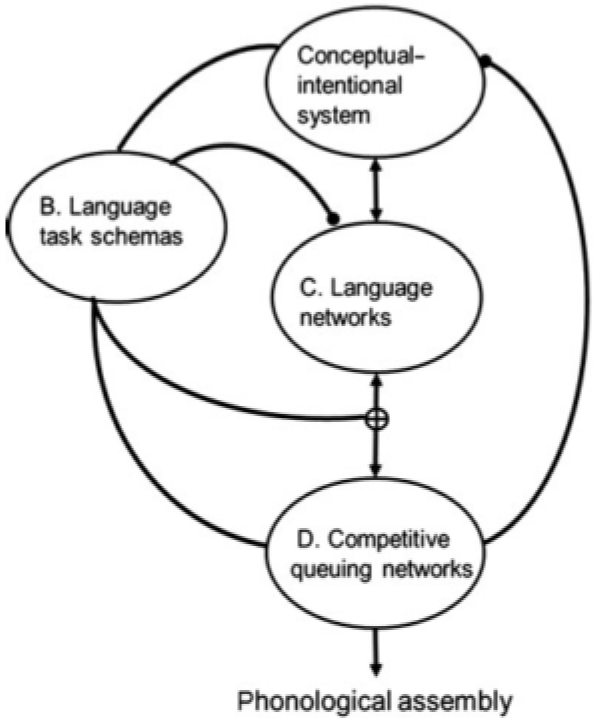

Figure 2. In this figure from Green & Wei (2014), the various systems of the control process model, which include the conceptual representation, language schemas (i.e., syntactic information), language networks (i.e., lexical items), and finally the competitive queueing networks, which select the most activated (i.e., least suppressed) item for production.

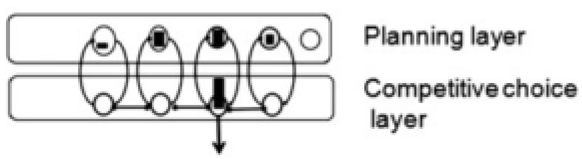

Figure 3. This figure, also from Green & Wei (2014) depicts the planning layer, which includes the activation of lexical items and syntactic structure, and the competitive choice layer, where the most appropriate language constituents are selected for production.

Time Cost in Code Switching

In fact, several studies have found evidence of additional cognitive effort when switching back and forth between languages by identifying the presence of a time cost in during CS (Albert Costa & Santesteban, 2004; Meuter & Allport, 1999; Peeters, Runnqvist, Bertrand, & Grainger, 2014; Schneider & Anderson, 2010; Thomas & Allport, 2000; von Studnitz & Green, 2002). *Time cost* is defined as additional latency, or time, between instances of different languages in the same utterance. Most research on time cost has utilized laboratory tasks such as switching languages in response to a picture, word prompt, or change of text color, rather than in conversation. Therefore, many past studies of CS are limited by the potential confounding factor of cue switching (i.e., changing the stimulus that prompts a response in a participant) rather than focusing solely on the factor of CS.

Some studies have attempted to decouple the effects of cue switch costs from CS time costs (Heikoop, Declerck, Los, and Koch 2016; Slevc, Davey and Linck 2016). These studies found the presence of language switch time costs even when cue switch costs were controlled. Heikoop et al. (2016) used pairs of cues (i.e., faces of the same gender) to prompt the use of either English or German. If a participant was prompted with two different female faces before two naming trials, they were to respond in English both times, despite the change of cue. Their results found an increase of 82 milliseconds (ms) in language switch trials (mean of 1193 ms) over cue switch trials (mean of 1111 ms). Slevc et al. (2016) used Chinese Pinyin (i.e., Romanization of Chinese words with English letters) to elicit either English or Chinese words. Again, even though the experimental cue remained constant, time costs were noted in language-switch trials, with an increase of 127 ms for Pinyin cue responses and an 81 ms increase for English cue responses in mixed language (e.g., alternating language trials) blocks.

There have also been studies of voluntary CS, which do away with cues in order to remove all potential cue switch costs. In one such study, participants were instructed to name pictures in “whatever language comes to mind” rather than being limited to one language or another during a picture naming task (Gollan & Ferreira, 2009). In balanced bilinguals responding in one language, time costs in the picture naming task were relatively equivalent (21 ms more for Spanish than English). Furthermore, balanced bilinguals did not have increased time cost in the mixed language condition (i.e., when the participants were instructed to respond in their chosen language). However, in a subsequent experimental task, when participants were instructed to use each language about 50% of the time to name pictures, no time costs were found, and there was even evidence of a slight switch benefit. The lack of a time cost in voluntary switching was replicated in another study by Gollan, Kleinman, and Wierenga (2014) again found no switch costs associated with voluntary switching. This study used a small set of stimuli, and required participants to respond to the same set of stimuli using different conditions (e.g., switch voluntarily, use only Spanish). Similarly, time costs were not found in another study that utilized a self-paced reading paradigm in a group of Spanish-English bilinguals (Gullifer, Kroll, & Dussias, 2013). In this experiment, participants were asked to read sentences word-by-word as they were presented on screen. The sentences would progress automatically after the participant spoke, and their voice was recorded by the experimental software. These sentences included one insertion of a single word from the one language. The language of the matrix sentence (i.e., the overall sentence, without CS insertion) varied as either the same or a different language. Differences in latencies were extremely slight, ranging from two to six milliseconds. Finally, no time costs were found by Perez-Leroux, O'Rourke and Sunderman (2014) in a self-paced reading task that captured RTs from Spanish-English bilinguals. No significant main effects or interactions in language switching between subjects and predicates, or between clauses were noted. Differences in RTs across different language tasks (e.g., naming in monolingual or mixed-language conditions) were slight, with some mixed-language delays noted, ranging from 28 to 22 ms. Nevertheless, these delays were not found to be significant.

Interestingly, there is extensive research indicating that the direction of CS affects the time cost of the switch. In several studies, switching from L1 (the first or dominant language) to L2 (the second or less dominant language) induces less of a time cost than switching from L2 to L1 (Litcofsky & Van Hell, 2017; Meuter & Allport, 1999; Peeters et al., 2014). This phenomenon was also recorded in studies that did not focus on asymmetrical CS costs. Heikoop et al. (2016) found in a review of L1 (German) versus L2 (English) production that response times (requiring a language switch) into L1 were 98 ms longer than into L2. The asymmetry of time costs in CS is considered the result of lingering inhibition of L1, which results in a need for greater activation (Green, 1998). Under this model, time cost for CS is a result of lingering inhibition of the new target language. Asymmetric time costs arise from the respective magnitudes of effort required to inhibit L1 (greater) versus L2 (lesser). However, in Perez-Leroux et al. (2014), the role of language dominance in CS was not found to be significant, and the observed effect of switching was only about 34 ms. In summary, while several studies have identified an effect of CS direction, the overall results are mixed. These findings complicate the picture of the exact nature of the roles of inhibition and cognitive control in CS.

The Present Study

As seen in the literature review, a variety of experimental methods have been used to examine CS in bilinguals, including picture naming, word reading and self-paced reading. While some studies have found CS time costs (Heikoop et al., 2016; Meuter & Allport, 1999; Peeters et al., 2014; Slevc et al., 2016), other studies have failed to find CS time costs (Gollan & Ferreira, 2009; Gullifer et al., 2013; Kleinman & Gollan, 2016, Perez-Leroux et al., 2014). Hence it is unclear if CS is associated with a time cost. Despite this variety of experimental paradigms, none of these experiments have attempted to identify a time cost of CS in naturalistic conversation, despite calls for such studies to be implemented (e.g., Gardner-Chloros, 2009). Given that discourse and conversation factors modulate aspects of CS behavior (Auer, 1984, 2007; Gumperz, 1982), studies of CS in conversation may be needed to ascertain a full picture of the time costs of CS. Additionally, it is not unreasonable to expect that CS time costs may exist in conversation, particularly in mixed language conditions, as time costs for CS have been discovered in a variety of task types and that asymmetrical costs exist when switching into L1 (the dominant language) from L2 (the non-dominant language).

This project will seek to provide greater clarity on the nature of time costs of CS in conversation by examining the differences in time cost between conversational tasks and experimental (i.e., self-paced reading) tasks in high proficiency bilinguals. Three questions and corresponding hypotheses have been developed for this inquiry.

1) Is there a time cost for CS present during naturalistic conversation tasks? Based on the control process model of CS (Green & Wei, 2014), it is hypothesized

that there will be a time cost in conversational CS, resulting from the additional cognitive control needed to inhibit and activate alternating languages. A time cost in conversational CS would be consistent with previous findings of time cost in CS across different experimental paradigms, as well. By contrast, if there is no time cost in conversation, this indicates that there may not be need for additional cognitive control for CS in conversation.

2) If there is a time cost in naturalistic conversation tasks, how does it compare to time costs found in experimental tasks? It is hypothesized that the time cost of conversation will be greater than the time cost of the self-paced reading task, given the previous findings of little to no time costs in previous studies of self-paced reading tasks (Gullifer et al., 2013). Further, conversational planning is more cognitively demanding than experimental paradigms like picture naming or self-paced reading, because of the syntactic and word finding demands of conversation. Additionally, if the time cost of the conversation is less than the time cost of the self-paced reading task, this may be due to the effect of discourse and sociopragmatic licensing of CS (Auer, 1984; Gumperz, 1982), where CS is sometimes preferred by speakers for convenience or to counter lexical constraints. If this is the case, then CS could function as an escape strategy and not add to time costs.

3) Is the time cost greater when switching from L1 to L2 when compared to time cost when switching from L2 to L1 across both (naturalistic and experimental) tasks? Given the hierarchical model of bilingual memory (Kroll & Stewart 1994), which states that connections between lexical and conceptual representations of words are strengthened as proficiency increases, it is hypothesized that there will be

no difference in time costs between switching from L1 to L2 or from L2 to L1, due to the high level of proficiency of the participants. However, if a greater time cost exists in either direction, this suggests that proficiency does not have a demonstrable effect on reducing time cost in CS.

In order to address these questions, an experimental paradigm that allows time cost to be measured in running conversation was developed. There are several challenges of measuring time cost in conversation, including the speed at which conversation progresses and the variables that factor into spontaneous speech. In conversation, speakers respond to their communicative partners without significant gaps between turns. Similarly, communication partners may engage in a series of interrupting and overlapping utterances. This suggests that speakers do not require utterances to be completed in order to begin planning their responses, and that speech planning occurs in a very rapid manner. Determining when speakers begin to plan utterances and how long it takes for them to do so will be essential for developing a method of measuring time cost in conversation.

Attempts to quantify the time spent between turns in conversation and the amount of time needed to plan conversational utterances have produced fairly consistent results. Numerous authors have determined that the pause between speakers and interlocutors averages approximately 200 ms (De Ruiter, Mitterer, & Enfield, 2006; Levinson, 2016; Levinson & Torreira, 2015; Sacks, Schegloff, & Jefferson, 1974). Studies of speakers of languages other than English have determined similar latencies (Heldner & Edlund, 2010; Stivers et al., 2009). By contrast, the latencies in single word production during picture naming tasks are estimated to be around 600 ms, and more than 1500 ms for the production of simple sentences in picture description tasks. As a result of comparing these known figures, numerous authors have suggested that speakers begin planning their utterances in response to interlocutors as soon as sufficient information becomes available to them rather than after their interlocutors stop speaking (Barthel, Sauppe, Levinson, & Meyer, 2016).

If this is the case, then measuring the precise duration of any time cost related to CS presents several challenges. Namely, when should one begin measuring the CS? It is possible that the conversant had planned the switch long before CS actually occurs, but it is impractical to try and determine exactly where each conversant began to plan each CS. In light of this, choosing to measure as narrow a slice of time as possible may be best, in the hopes of isolating only the CS moment. However, attempting to capture only the silence between words in the CS would present difficulties in the event that any coarticulation between words occurs. Finally, including the entire word at the beginning and end of the CS may result in a wide variance of time measures.

One potential answer to this question arises from speech production literature in the field of psycholinguistics. Several studies have found that the syllable may be an organizational unit during speech planning (Adamou & Shen, 2017; Costa & Sebastian-Galles, 1998; Ferrand & Segui, 1998; Meijer, 1996; Roelofs & Meyer, 1998; Sevald, Dell, & Cole, 1995). This mirrors the evidence in speech perception literature that syllables are instrumental for the segmenting of the speech stream into comprehensible chunks for perception or identification of words (Bertoncini &

Mehler, 1981; Diehl & Kluender, 1989; Kolinsky, Morais, & Cluytens, 1995; Liberman & Mattingly, 1989; Price, Thierry, & Griffiths, 2005). While there are some authors who believe that the phoneme is a more basic unit of speech perception (Decoene, 1993; Norris & Cutler, 1988), studies have not yet been able to rule out the syllable for consideration as a basic unit of speech processing and production.

Using the syllable as a unit of speech production has two advantages. First, the onsets of syllables may be easily identified on a waveform. While complete silence may not be present in between words at the CS moment, acoustic phenomena such as plosives and frication can be seen in a waveform (Oller, 1973; Klatt, 1976). For example:

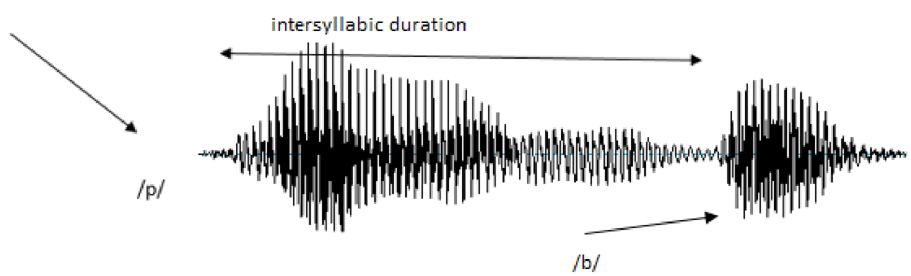

Figure 4. Waveform of the code switched phrase “pommes because” illustrating the intersyllabic duration measure between the the plosive /p/ and the onset of/b/ at the onset of the word “because.”

Note that there is no perceptible silence on the waveform. Second, syllables vary in length to a lesser degree than words. While syllables can vary in length due to stress, word position (e.g., word-final vs. word-initial), utterance position, and the phonemes making up those syllables (Oller, 1973; Klatt, 1976; Peterson & Lehiste, 1960), these factors also influence words, as in lengthening words for emphasis. Nevertheless, as words are made up of many differing numbers of syllables, it follows that word lengths would vary more than syllable lengths.

When measuring time cost in conversation, capturing the duration from the onset of the final syllable of a word in one language to the onset of the first syllable of the next word in the other language would provide visible acoustic markers and reduce excessive variation from varying word lengths.

Methods

Study Design

This study recruited a group of English-French bilinguals of advanced proficiency in French (L2). The experimental tasks were semi-structured conversation and self-paced reading. These tasks were designed to elicit code-switches. The dependent variable is the intersyllabic duration (as shown in Figure 1) in the conversation task and the response time (RT) in the self-paced reading task. The first crucial comparison, related to research question one, is the intersyllabic duration for CS versus words within the same language during conversation. This difference in CS versus same-language intersyllabic durations is the CS time cost. For the second research question, the crucial comparison is magnitude of CS time cost in conversation versus self-paced reading. The third comparison is the magnitude of CS time cost for L1 to L2 vs. L2 to L1.

Participants

Participants included 18 English-French neurotypical bilinguals between 18 and 35 years of age (5 male, 13 female), with a minimum high school education level. All participants were native American English speakers and second language learners of French. Half of the participants (9 in total) spoke additional languages other than

French and English; these included Russian, Chinese, Spanish, and Italian. Both right- and left-handed participants were included. Participants with a reported history of prior neuropsychiatric or speech-language diagnoses were excluded from the study. Participants were recruited with the use of flyers posted on the University of Maryland College Park campus and in the local community, emails sent to various listservs, and the University of Maryland's SONA Psychology Study recruitment platform. Of these participants, 13 completed the study in person, and 5 remotely.

Advanced proficiency in French was determined based on two parameters: the analysis of a language sample, which was compared to the American Council on the Teaching of Foreign Languages (ACTFL) Proficiency Guidelines (American Council on the Teaching of Foreign Languages, 2012), and by participants' performance on LexTale-Fr, a word judgment task that assesses language proficiency (Brysbaert, 2013). ACTFL Proficiency Guidelines for advanced levels of proficiency are included in Appendix A. ACTFL notes that code switching is an indicator of intermediate proficiency on this scale; however, this guideline will be disregarded. The LexTale-Fr test form and testing protocol are included in Appendix B. Acceptable proficiency via LexTale-Fr were determined by a score of at least 11/50. This score represents the 70th percentile of performance in the norming population of L2 French speakers (Brysbaert, 2013). The participants' overall performance on LexTale-Fr indicated a high level of proficiency (mean = 24 points, SD = 14 points).

In order to obtain a history of bilingualism, each participant completed the Bilingual Language Profile (Birdsong, Gertken, and Amengual, 2012), a self-report questionnaire that includes questions regarding language history, use, proficiency, writing ability, and attitudes, in each language. This also yields a language dominance score, which can range from -218 to +218. The middle numbers (-80 to +80) are indicative of balanced bilingualism, with 0 representing perfectly balanced bilingualism. Overall, the participants were English-dominant, indicated by positive dominance scores (mean = 99.04, SD = 41.27).

The participants' attitudes toward CS were also captured by a questionnaire created by the researcher. The questionnaire captured information regarding participants' history of code switching, the frequency at which they code switch in daily life, and their attitudes toward code switching. A copy of this questionnaire and its results are included in Appendix C. Briefly, this questionnaire revealed that 27% code switched frequently (more than 50% of the time) with friends, family, or to themselves, while 74% code switched rarely code switched (less than 50% of the time) in any of these situations. This indicates that the participants, as a whole, primarily spoke in a monolingual mode and may have been unaccustomed to CS. Furthermore, it should be noted that none of the participants reported habitually code switching between French and English; they reported code switching between their home languages (Spanish, Italian, and Chinese) and English. However, prior to the beginning of testing, participants were given a definition of CS and each expressed understanding of that definition. Participants were asked to self-report any hearing loss or vision loss, and any participants who reported either hearing or vision loss were allowed to use their amplifying and vision-correcting devices (such as hearing aids or glasses) if required.

Procedures

Informed consent and background testing. Informed consent was taken prior to completing screenings or any aspect of the study. The participants were given the choice of completing the informed consent form and the LexTale-Fr (Brysbaert, 2013) screening in person or electronically, so that the screener could be scored prior to the appointment time. Participants who scored in the 70th percentile and higher were invited to participate in a phone screen. If the participants elected to complete informed consent and LexTale-Fr in person, the phone screen procedures occurred in person at the time of the appointment.

The phone screening included three questions about the participant’s typical French language usage and one question eliciting French language use. The initial screening is included in Appendix D. The use of French language was matched against the ACTFL (2012) guidelines. Participants who qualified based on ACTFL guidelines were then invited to schedule the remainder of formal testing.

Testing was done in a single 45 to 60 minute session. Participants again gave informed consent verbally prior to all task procedures. During this time, the participants were also given the option of opting out of having the recording from their session shared with other researchers. All participants were told they could revoke this permission at any time. Tasks were balanced across participants (i.e., half of all participants completed the conversational task first, and the other half completed the self-paced reading task first). In addition, the conversation topics were balanced so that three groups of six participants responded to conversation topics and questions in different orders. The self-paced reading task trials were randomized by the software, DMDX (Forster & Forster, 2003). Participants were given the option of taking a 5 minute break between the conversational task and the self-paced reading task.

Conversational task procedures. Participants and their conversation partner (i.e., the researcher) were given a series of three conversation topics. Participants were told to speak as naturally and quickly as possible, using French as much as possible, and to code switch whenever it felt natural or to maintain conversational speed. The directions and introduction were given in a code-switched mode. For example:

> *In this study, nous nous intéressons à code switching. Code switching est un phénom très commun dans bilingual speech. An example would be any time you begin a sentence in one language et terminé dans un autre.*

The conversation partner posed questions and asked for elaborations using code-switched utterances. Materials for the conversational task included the conversation prompts (surrounding the topics of hobbies, work, and family based on Munoz et al.,1999) and follow up questions. The script for the conversation task was reviewed by a second researcher with knowledge of French for grammar and naturalness. The complete conversation prompts and questions can be found in Appendix E. Each conversation topic was discussed for about five minutes, resulting in at least 8-10 minutes of total interaction. All conversations occurred in a quiet, private room with only the participant and the researcher present. Conversations were audio recorded for future analysis.

Self-paced reading task procedures. Participants were in a quiet room with a computer and told that sentences would appear on the screen, but would be masked so that only one word would appear at a time. Sentences for the self-paced reading task included 20 exemplar sentences taken from an online forum (Montreal subreddit; http://www.reddit.com/r/montreal) populated by habitual English-French bilinguals located in Quebec Province, Canada. The exemplar sentences were balanced for direction of CS (either French to English or vice versa). Each exemplar sentence had a corresponding monolingual sentence that had been translated either to English or to French. In addition, there were twenty distractor sentences included in the task to prevent participants from becoming familiar with target CS and monolingual comparison sentences. These distractor sentences were also monolingual (either French or English); however, they were not derived by translating CS sentences for comparison purposes. In order to check for grammar and naturalness, the monolingual French distractor sentences were reviewed by another researcher with advanced knowledge of French. Directions for the task were presented in English. The participants were instructed to read each sentence one word at a time and request the next word by pressing a keyboard. Each participant was able to complete three practice trials prior to starting the actual task in order to ensure that they understood the task procedures. After the practice trials, each remaining sentence trial proceeded as follows. A sentence with each character in each word masked by the pound sign (#) appeared until the participant indicated via keyboard that they were ready to begin. Then, each sentence was presented one word at a time. Each word was presented for a total of 2000 ms, during which time the participant had to read the word silently and press the keyboard to move forward. The experiment was programmed in DMDX (Forster & Forster, 2003), which automatically recorded response times and progressed through the sentences.

Results

Conversation Task

Transcription and coding. The elicited conversations were transcribed in Microsoft Word using VLC Player and following the procedures for identifying utterances in the Clinician's Guide to CLAN (Ratner & Brundage, 2016). According to these guidelines, an utterance is any string of words that:

1. Is followed by a pause of one second or more;
2. Ends with a terminal intonation contour;
3. Has complete grammatical structure.

It is not necessary to meet all three criteria in order to be classified as an utterance; however, at least one criterion must be met. For example, Ratner and Brundage (2016) note that an utterance may be a single word, lacking grammatical structure, or that an utterance may not be followed by a pause at all, if the speaker is interrupted by an interlocutor.

The utterances were sorted into French-only, English-only, and code-switched utterances for each participant. Code switches were identified and coded based on part of speech for each word in the code switch (e.g., "*le* sneaker" coded as determiner+noun). Additionally, whether the switch occurred from L1 to L2 or from L2 to L1 was indicated. The following items will were excluded from analyses: borderline switches (food names, proper names, place names) and socially integrated segments (defined as words or phrases that have been habitualized in one language, such as *siesta* in English) (Poplack, 1980). Cognates and false cognates were included in analysis given the high number of cognates between French and English, despite their exclusion in similar studies (e.g., Poplack, 1980).

The number of CS instances varied between participants, with some participants code switching only once or twice, and others code switching twenty or more times. In total, 45 English-to-French code switches, and 114 French-to-English code switches were identified in the samples.

Duration of code switch. For each CS, duration of the CS was measured from the onset of the syllable prior to the switch to the onset of the next syllable of the new language (the intersyllabic duration), as illustrated in Figure 4. For example:

Je ne veux pas des pommes *because I don't like them.*

(French/English)

In the above example, the intersyllabic duration would be taken from the beginning of *pommes* to the beginning of *because*. All measurements were taken in Praat 6.0.32 (Boersma & Weenink, 2017). Values for all switches were recorded and coded for switch direction (i.e., L1 to L2, or L2 to L1).

Within-language durations. Measures of latency between words of the same language were also taken in order to compare if there was a cost of CS. For each participant, a non-code-switched French or non-code-switched English duration was identified to closely match the linguistic characteristics of the CS utterances.

In order to prevent interference from the effect of the different phonetic features and lexical categories of the words making up the intersyllabic duration measurement, captured CS and monolingual syllables were matched along phonetic and lexical categories. First, for each CS intersyllable duration, the researcher attempted to find a monolingual sample of the same phonetic and lexical features. For example, if the captured coda offset was a vowel and was part of a determiner, the researcher attempted to find a sample with the same determiner and different noun within the sample (e.g., "*le format*" matched with "*le* spelling"; "*trop souvent*" matched with "*trop* cute"). If this was not possible, the researcher attempted to find a sample with similar phonetic features (e.g., "*les études*" matched with "des ideas"). If no similar monolingual sample of similar phonetic features was found, then the researcher would identify a sample of similar lexical category (e.g., "*detéctive* and" matched with "wife and"). If no comparable sample existed, then the CS sample was not provided a matched monolingual sample, but was still recorded for analysis (e.g., "*j'étudie* biology" provided no matches in that participant's language sample). Figure 2 provides a chart indicating how these matches were developed.

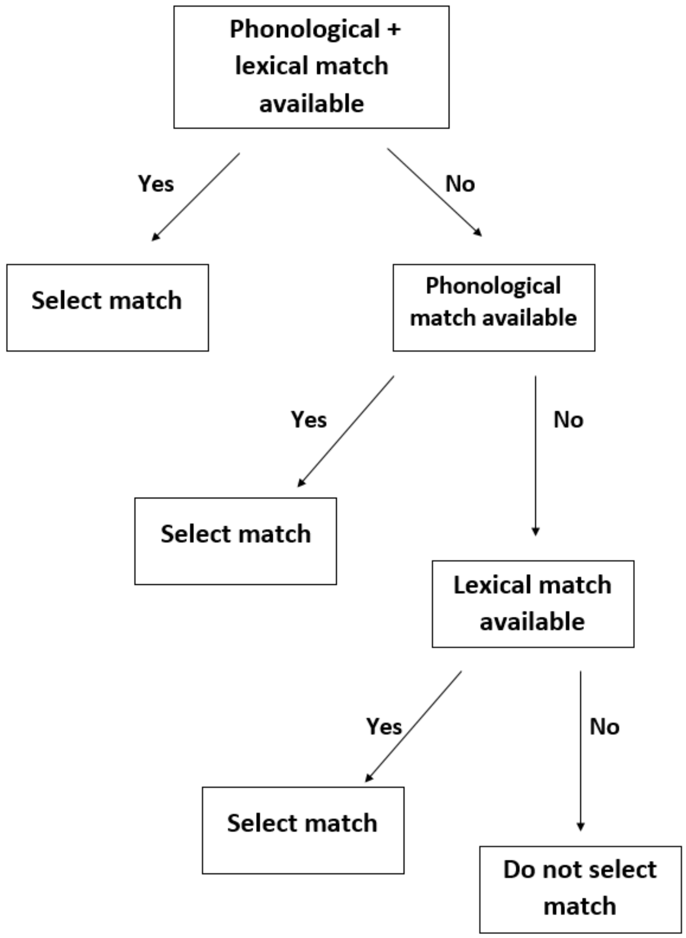

Figure 5. This flow chart presents the method of selecting monolingual utterances for comparison within each participant's language sample.

Reliability. A second researcher was trained to transcribe and code utterances using a sample audio file and coding glossary created by the first researcher. A subset of each conversation, comprising 10% of the total data set, was randomly chosen to be independently transcribed and coded by the second researcher using the original audio files. To compare the reliability of the two transcriptions, the total number of words and utterances for each transcription was divided by the total number of words that matched in each transcription (Muñoz, Marquardt, & Copeland, 1999). This derived a percentage of matched words and utterances. As seen in Table 1, percent reliability ranged from 99-100%.

		Total	Agreement	Percent Reliability
Participant 12	Word Entry	1023	1019	99%
	Utterances	129	128	99%
Participant 16	Word Entry	851	849	99%
	Utterances	153	153	100%

Table 1. The percent reliability of word entry and utterance delineation across two researchers.

A second researcher was also trained to measure the durations of switches using an example audio file and the Praat software. A subset of 10% of the total code switches was randomly selected for reliability measurement by the 2nd scorer. To compare the reliability of the two transcriptions, an intraclass correlation was used to derive a correlation coefficient for the data. The results of the intraclass correlation coefficient (ICC) were ICC = .959 for single measures and ICC = .979 for average measures. Intraclass correlation measures above .70 are considered good, and those above .90 are interpreted as excellent. Any disagreements were resolved by both transcribers reexamining the soundwave on Praat and reaching a consensus.

Results. Prior to analysis, the data were cleaned. Each participant's CS durations were analyzed and cleaned by removing any CS duration 2.5 standard deviations above or below the mean of each participant across both CS and monolingual conditions. Furthermore, any CS duration recorded above 1000 ms or below 100 ms was removed. Durations above 1000 ms were removed to be consistent with Ratner and Brundage's (2016) definitions of utterance, which indicates that pauses longer than 1 second (1000 ms) delineate a new utterance. Durations below 100 ms were removed to control for coarticulatory effects. This resulted in a loss of 6.6% of the data.

SPSS (IBM Corp, Version 24.0) was used to perform the statistical analysis with durations as dependent variables using linear mixed effects models (Baayen, Davidson, & Bates, 2008). The durations were log transformed to achieve a normal distribution because the raw durations were not normally distributed (Levene's test, $p<.05$). To determine whether there was a time cost for CS in the conversation task, we entered condition (monolingual, code switched) as the fixed factor with intercept, participants and items as the random factors. There was a significant effect of condition ($\beta = -.149$, $|t| = 5.153$, $SE = .029$, $p < .05$). CS durations (mean = 373.45 milliseconds (ms), SD =229.53 ms) were consistently longer than the durations of monolingual (mean = 254.86 ms, SD = 162.1 ms) utterances by about 119 ms. Based on the results of this analysis, there is a time cost associated with code switching in naturalistic conversation tasks. Figure 6 illustrates the findings of this task as compared to the self-paced reading task.

To ascertain whether CS direction (either French to English or English to French) impacted the time cost of CS in conversation, the CS durations from the conversation task were sorted by direction of CS. Overall, we found 45 English to French (e2f) code switches, and 114 French to English (f2e) code switches via transcription. A linear mixed model analysis was conducted with direction (f2e vs. e2f) as the fixed factor with intercept and trial as the random factor. The dependent variable was LogD, or the log transformation of the CS durations. There was a main effect of CS direction ($\beta = -.174$, $|t| = 3.795$, $SE = 0.0459$, $p <.05$). Based on the results of this analysis, CS from French to English (mean = 333.15 ms, SD =224.07 ms) were shorter in duration compared to CS for English to French (mean = 461.5 ms, SD = 222.94 ms). Figure 7 illustrates the e2f and f2e durations for the conversation task.

Self-Paced Reading Task

Results. Prior to analysis, the data were cleaned. Each participant's responses were analyzed and cleaned by removing any RT either 2.5 standard deviations above or below the mean RT of that participant across both CS and monolingual conditions. Furthermore, any RT recorded above 2000 ms or below 200 ms was removed to rule out inattention or participant error, respectively. This resulted in a loss of 6.8% of the data.

SPSS (IBM Corp, Version 24.0) was used to perform the statistical analysis with reaction times (RT) as dependent variables using linear mixed effects models (Baayen et al., 2008). The recorded RT times were log transformed to achieve a normal distribution because the raw durations were not normally distributed (Levene's test, $p<.05$). To determine whether there was a time cost for CS in the self-paced reading task, we entered condition (monolingual, code switched) as the fixed factor with intercept and participants and items as the random factors. There was no main effect of condition ($\beta = .002$, $|t| = .27$, $SE = 0.009$, $p > .05$). Based on the results of this analysis, there is not a time cost related to CS (mean = 484.82 ms, SD = 248.6) versus monolingual (mean = 474.9 ms, SD = 202.65 ms) utterances in tasks of self-paced reading. Figure 8 illustrates the findings of this task as compared to the conversation task.

To ascertain whether CS direction (either e2f or f2e) impacted the time cost of CS in the reading task, the CS durations from the reading task were sorted by direction of CS. A linear mixed model analysis was conducted with direction (f2e vs. e2f) as the fixed factor with intercept in the model, and item as the random factor, with LogRT, or the log transformation of the RT, was the dependent variable. There was no main effect of CS direction (β = .029, |t| = 1.473, SE = 0.0194, p >.05). Based on the results of this analysis, across items of f2e direction (mean=499.06 ms, SD = 255.6 ms) and e2f direction (mean = 455.79 ms, SE = 238.87 ms) there was no difference in RT based on CS direction. Figure 9 illustrates the e2f and f2e durations for the self-paced reading task. In light of Kroll & Stewart's (1994) theory that proficiency in L2 can equalize the strength of language network connections in the brain, a correlation coefficient was calculated for proficiency and the length of f2e durations in order to determine if more proficient speakers were able to CS more quickly. However, no correlation was found between proficiency in French (measured by Lextale-Fr) and time cost was found (Person's r = .04).

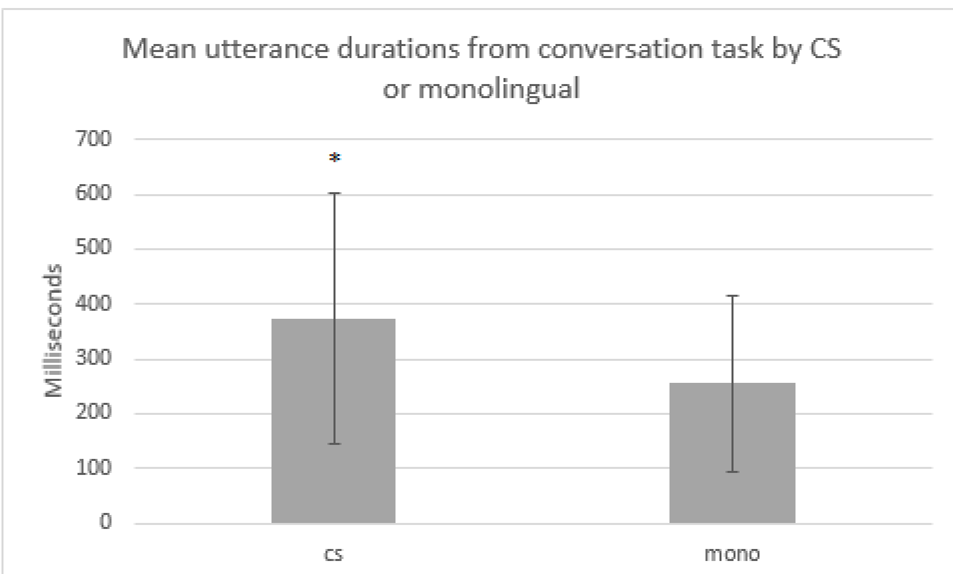

Figure 6. Code switch durations from the conversation task are pictured here. There is a significant increase in duration in CS utterances.

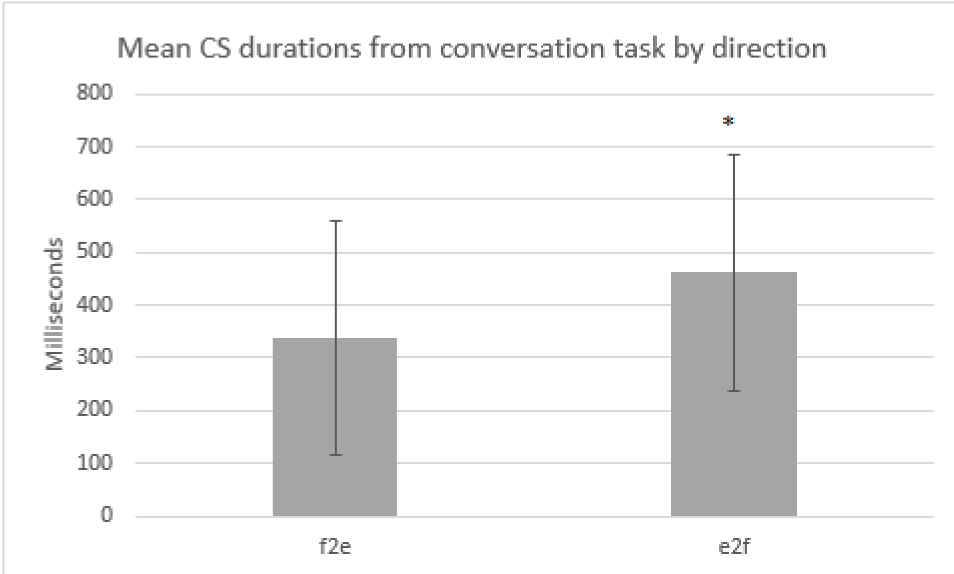

Figure 7. Code switch durations from the conversation task are included here, sorted for direction. There is a significant increase in duration for English to French (e2f) vs. French to English (f2e). In other words, switching from English to French takes longer than switching from French to English.

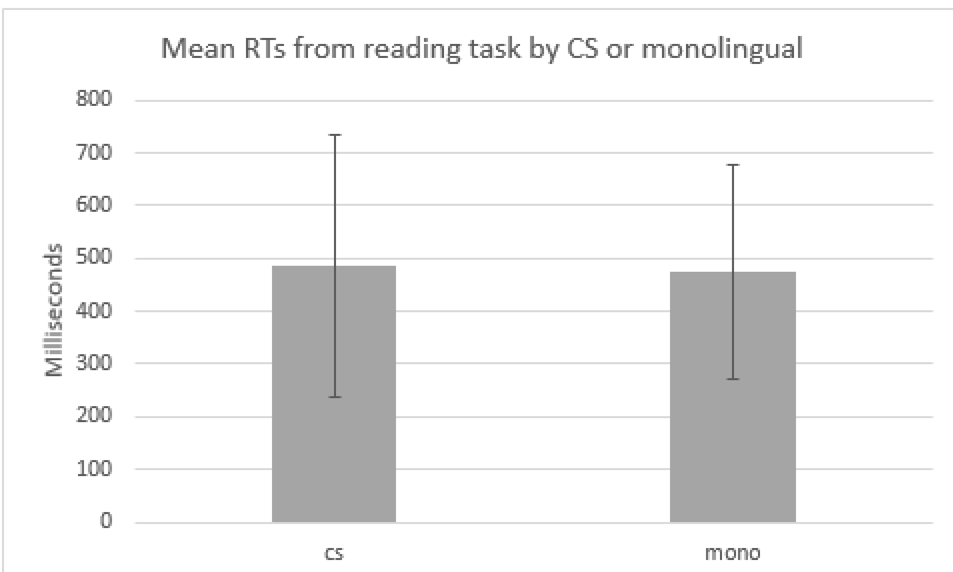

Figure 8. RTs from the reading task are pictured here. There is no significant difference between RTs in the CS or monolingual conditions.

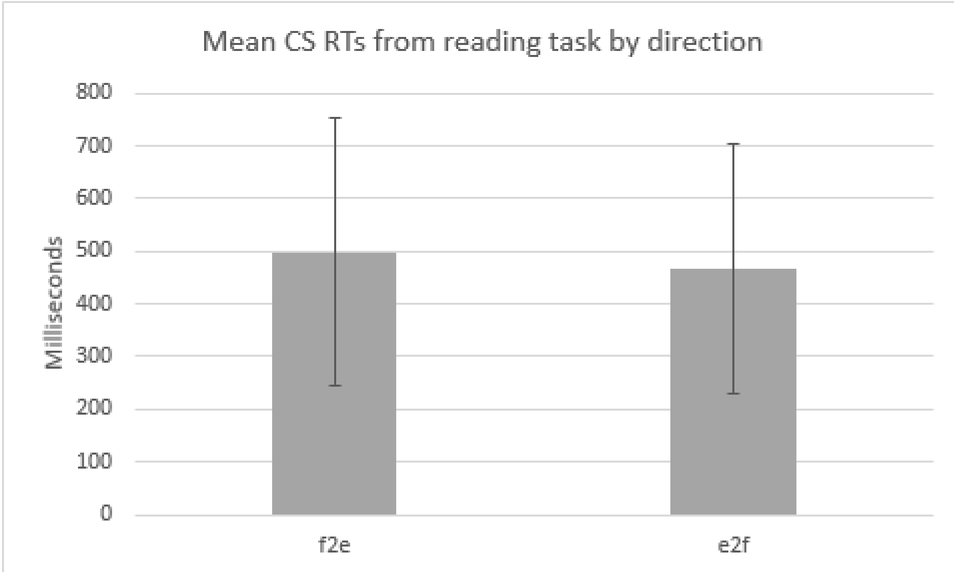

Figure 9. RTs from the reading task are included here, sorted for direction. There is no significant difference between RTs in either direction.

Discussion

The aim of this study was to identify any time cost of CS across two types of tasks: a conversational task, and a self-paced reading task. It was hypothesized that CS in conversation would result in a time cost when compared to monolingual utterances, and that this time cost would be greater than the time cost for a self-paced reading task. In addition, it was hypothesized that CS direction would have no effect on time cost given the high proficiency of the participants. The primary findings of the study included the identification of a time cost of CS in conversation but not in self-paced reading. Further findings included that, in the conversation task, switching from L1 to L2 induced more of a time cost than switching from L2 to L1. In the following paragraphs, each hypothesis will be discussed in light of these results. Then, a more general discussion of the findings in the context of theories of CS and bilingualism will be presented. Finally, implications for clinical practice and further research will be examined.

Conversation Task

The conversation task elicited both CS and monolingual utterances related to several topics from the participants. The directions for the task and researcher questions were delivered in a CS mode, and the participants had the opportunity to respond in whatever way (e.g., length and language of response) they chose. While the participants code switched to differing degrees, each participant code switched at least once during their respective samples. Time cost for each CS and comparable monolingual utterances for each participant were measured and analyzed in order to determine if CS in conversation induced a time cost, and a time cost for CS was identified. The time cost measured in the conversation task indicated that the average CS required approximately 119 ms more than comparable monolingual utterances.

The presence of a time cost in conversation is not wholly surprising given the additional demands of online language production, such as formulating the message, word finding, the creation of a syntactic structure that satisfies both grammars, and speech planning. Furthermore, this finding is consistent with previous studies that have identified time costs associated with CS in other experimental tasks even when other switch costs (e.g., between tasks) were eliminated or controlled (Heikoop et al., 2016; Slevc et al., 2016). In Heikoop et al. (2016), an increase of 82 ms was found in language switch trials over cue switch trials in a task that prompted switching between English and German when shown differing cues, indicating that language switching induces a time cost in excess of that found in cue switch tasks. Another study found time cost of 127 ms to 81 ms when participants switched between languages while the cue that elicited language production remained the same (Slevc et al., 2016). From the results of these previous studies, we see that the pattern of CS time cost is consistent across differing experimental tasks, and the magnitude of the cost is fairly consistent as well. These results suggest that CS in conversation may require more cognitive control in a given speaker than remaining in a monolingual mode, and therefore induce more time cost. This was the theory underpinning the first hypothesis described in this study. The theory of using cognitive control to regulate CS is best captured by Green and Wei (2014), whose model of a control process method of CS posits a system of inhibition and activation of the language feature as well as lexical or syntactic features of words in running speech.

Additionally, the sociolinguistic work surrounding CS reminds us that speakers' considerations during CS include discourse functions (Auer, 1984, 2007; Gumperz, 1982). The question of sociopragmatic appropriateness may modulate the decision to code switch as much as the grammars of the two respective languages. If this is the case, then the additional cognitive load of negotiating these sociopragmatic aspects of communication may also contribute to the observed time cost of CS, as seen in Green's control process model of CS, where information about language appropriateness is gathered from the context of the conversation and acts to suppress inappropriate language choice (Green & Wei, 2014). However, as no previous studies of CS in naturalistic conversation exist for comparison, it is difficult to say with certainty how much of a factor these considerations should be. Therefore, prior to making any further conclusions regarding the existence or degree of CS-induced time cost in conversation, additional studies using a similar model should be conducted. These studies could either seek to replicate the findings of this study, or to manipulate the aspects of the conversation prompts to induce different CS behavior. Replicating the study would provide information about the reliability of the novel experimental model. Additionally, manipulating the conversation prompts may provide a better understanding of the cognitive load of sociopragmatic considerations in CS. For example, the use of sociopragmatically inappropriate instances of CS in the directions or questions used in a conversation task might result in either fewer instances of CS or a greater time cost of CS, due to the participants viewing the researcher as an inappropriate conversation partner for CS utterances.

Self-Paced Reading Task

The second task in this project was a self-paced reading task that included both CS and monolingual comparison sentences. The target sentences were taken from an online forum of habitual French-English bilinguals and code switchers, and comparison sentences were checked for naturalness and grammar by additional researchers. This task was developed as a means of collecting RTs for comparison against the conversation task's CS time costs. After analysis, the data indicated that there was no significant difference in time cost between CS and monolingual comparison sentences in the self-paced reading task. In all, CS RTs were approximately 10 ms longer than monolingual RTs in this task, but again, this difference was not significant.

These findings were anticipated by the second hypothesis, which stated that the self-paced reading task would incur less of a time cost than the conversation task.

This result is consistent with the previous findings of experiments that examined language switch costs in self-paced reading tasks (Gullifer et al., 2013; Perez-Leroux et al., 2014). Gullifer et al. (2013) found that language switching in the context of sentences did not induce a significant effect in CS versus monolingual utterances. This previous self-paced reading task identified a difference of only two to six ms when participants were asked to switch languages while reading target words out loud. The self-paced reading task used in the current study was closely modeled after Gullifer et al. (2013), and so the similarity in their results is to be expected. The lack of CS effect in self-paced reading tasks was also indicated in Perez-Leroux et al. (2014), although the observed differences in RTs were slightly higher in this study, ranging from 22 to 28 ms. Other experimental tasks, such as confrontation naming of images, have also found no effect of language switching (Gollan & Ferreria, 2009; Gollan et al., 2014). RTs in the confrontation naming studies were observed to be approximately 21 ms longer in CS versus monolingual conditions; however, this difference was not found to be significant.

When comparing these results back to the results of the conversation task, it is clear that CS causes a time cost in conversation but not in self-paced reading tasks. As previously stated, CS time cost for the conversational task was approximately 119 ms, a delay of much greater magnitude than what was observed in the self-paced reading task. The presence of the time cost in the conversation but not the self-paced reading task is not necessarily surprising given the demands on participants are greater in conversation than in experimental tasks. In conversation, speakers are required to complete the tasks of word finding, syntactic construction, and appropriate language selection, in addition to speech production. As an example, Kroll & Stewart (1994) propose that word finding in bilinguals requires the speaker to negotiate between strong and weak links modulating conceptual and lexical representations. Furthermore, the selection of a syntactic structure for use in a CS sentence would require the speaker to activate language selection processes either at the level of the lemma (e.g., Hartsuiker et al., 2004) or at a subsequent planning level (e.g., Green & Wei, 2014). By contrast, the researchers, not the participants, in a self-paced reading task complete the task of word finding and syntactic construction, reducing the overall cognitive load of the participants.

A final potential difference between the results of the conversational task and the self-paced reading task is the lack of speech (e.g., motor) planning in the self-paced reading task. In previous studies, such as Gullifer et al., (2013), the self-paced reading tasks required participants to speak each word as it appeared on screen, and a voice trigger prompted the next word to appear. In the present study, the participants responded via keyboard trigger. This means that two areas of speech planning and production, phonological encoding and subsequent articulation of speech, were not included in the self-paced reading task. Additionally, some research has shown that both phonological encoding and the motor plan are used to modulate online speech production (Hickok, 2012), speech perception (Hickok & Poeppel, 2004), and even CS (MacSwan, 2014). This may suggest that the self-paced reading task did not adequately capture all aspects of CS that contribute to a time cost, due to the choice of trigger. Although this represents a difference in procedure, and presents a possible improvement for future research, it is also worth noting that Gullifer et al. (2013)

arrived at the same conclusion as this study, where CS in self-paced reading did not induce a time cost.

CS Direction

Both the conversation task and the self-paced reading task included an analysis that examined the effect of CS direction on time cost. The effect of CS direction on time cost differed across the tasks in this study, with switches from L1 to L2 inducing more of a time cost than switching from L2 to L1 only in the conversation task. In the conversation task, switching from L1 to L2 resulted in time cost approximately 128 ms longer than switching from L2 to L1. In the self-paced reading task, there was no significant effect of CS direction. This may have been a vestige of the lack of CS time cost in the self-paced reading task in general. These results disproved the third hypothesis, which predicted no difference in time cost across CS of different directions. Instead, the results of the conversation task indicated that switching into L1 induced less of a time cost than switching into L2. One possible explanation could have been that differences in proficiency between the participants resulted in this pattern, per Kroll & Stewart (1994). However, no correlation between proficiency and duration of French to English CS was found (r =.04). Therefore, another explanation is needed for this departure.

While the results from the conversation task countered the third hypothesis, the pattern of CS was consistent with the findings of Gollan and Ferreira (2009), who found that English-dominant English-Spanish bilinguals tended to favor switching into English when confronted with difficult (e.g., low frequency, higher level vocabulary) word finding tasks. This behavior of switching to the dominant language during more difficult tasks was named the “bail out” pattern and was replicated in a later study (Gollan et al., 2014). As the participants in the current study were al English-dominant as well, the participants may have benefitted from the “bail out” pattern in switching from L2 to L1, resulting in a lesser time cost for CS of this type. One possible explanation for the “bail out” pattern is taken from theories of activation and inhibition. Green (2008) notes that greater activation of words in one language can result in the need for a greater magnitude of inhibition and activation of L2 during a language switch. Furthermore, it is well-documented that both languages are activated at all times in the bilingual brain, but are activated to different degrees depending on the appropriateness of a given language for a given task (Green & Wei, 2014). In a CS task where participants are required to comprehend CS speech that included L1 and L2 approximately equally, it is likely that both L1 and L2 are stimulated relatively equally (Luk et al., 2012). In this case, L1 representations may be more activated: since greater amounts of effort are required to inhibit or activate L1 (Green 1998), this suggests that L1 has a baseline activation higher than that of L2. This would mean that a “bail out” pattern could still exist in linguistic tasks even for very proficient speakers, as L1 would present itself more aggressively in language selection moments throughout the task.

However, there have been many studies of CS direction that have found the opposite pattern of time cost. One study of English-dominant Spanish-English bilinguals, again participating in a self-paced reading task, found that switching from L2 into L1 induced a greater time cost (Litcofsky & Van Hell, 2017). In this study, switching into the dominant language induced a time cost of 50 ms, while switching into the less dominant language induced a time cost of 15 ms. Additional studies of self-paced digit naming (Meuter & Allport, 1999) and picture naming (Heikoop et al., 2016; Peeters et al., 2014) found switching from L2 into L1 induced a greater time cost than switching from L1 to L2. Historically, the asymmetry of time costs when switching into L1 versus L2 have been explained by a theory of lingering inhibition or suppression of L1 (Green, 1998). Under this model, any time cost for CS is a result of lingering inhibition of the new target language, and asymmetric time costs arise from the respective magnitudes of inhibition required to inhibit L1 (greater) versus L2 (lesser).

However, in these past studies, the participants were not able to choose when they CS; instead, they were cued by the researchers to CS using an additional visual cue. In fact, in previous studies of volitional CS, such as Gollan & Ferreira (2014), the time cost of switching into the dominant language changed when the switch was volitional or not. In cued switches, the time cost was significantly larger when switching into L1 than switching into L2. During voluntary switches, however, the time cost of switching into L1 from L2 was only marginally significant. These results were consistent with previous findings of Gollan (2009), when the previously mentioned "bail out" theory was developed. Thus, while several studies have found the opposite effect of CS direction, these studies did not elicit volitional CS, which seems to present with a slightly different pattern of time cost. Furthermore, in our project, volitional CS was elicited in conversation with the presence of a conversation partner who was known by the participants to be proficient in English (as L1) and French (as L2). The conversation partner also posed questions in a CS mode, using both English and French. The presence of the conversation partner has two implications on the CS time cost. First, as mentioned above, the use of both English and French may have equalized the activation of both languages in the participants. Both language processing and production have been found to induce activation of both languages in the bilingual brain (Luk et al., 2012), so it is possible that the continued reactivation of English, along with its status as a more dominant language, resulted in less time cost as English remained relatively easy to access. Second, in theories of CS that account for the presence of a conversation partner (Auer, 1984; Green & Wei, 2014; Gumperz, 1982) language selection factors in conversation and discourse considerations, such as appropriateness given the audience. If the participants tended to switch into L1, they could have also been switching out of consideration for the conversation partner. This would have further licensed the switch into L1 and may have increased activation of L1 in those instances.

Implications

Overall, the results of this study have some implications for theories of bilingualism. The only way for a CS time cost to be present in the conversation task but not the self-paced reading task would be if the cost is elicited during a process that was present in the conversation task but not in the self-paced reading task. Hartsuiker (2004) and Green & Wei (2014) theorize that language information is encoded in syntactic schemas and lexical representations (i.e., at the lemma). Consistent with these models, our study found that there was a time cost present in the conversation task, but not in the self-paced reading task, and therefore supports the theory that language decision occurs concurrently with the selection of syntactic structures and the lemma. The conversation task did require the participants to navigate the process of lexical and syntactic selection prior to formulating responses. However, the self-paced reading task did not. As the self-paced reading task required minimal syntactic or lexical selection, there would not have been a cost of CS.

Additionally, the cost of CS was seen to vary in the conversation task, where switching into L1 induced less of a time cost than switching into L2. In terms of the model of inhibitory control first proposed by Green (1998), this means that switching into L2 required greater inhibition and activation than switching into L1. However, in Green’s (1998) original theory, switching into L1 was supposed to require greater amounts of effort than switching into L2 due to the greater baseline activation of L1. As the conversation task included heavily code switched speech by an interlocutor, and as the reception of language can trigger activation in the bilingual brain (Luk et al., 2012), the use of English and French in conversation may have affected the languages’ respective activation levels. In terms of Green’s (1998) theory, then, this suggests that exposure to each language in CS speech can affect levels of activation and possibly change the required levels of inhibition and activation needed to switch between languages.

By far, the strongest clinical application of this study is to emphasize the importance of language choice and bilingual service provision in the field of speech language pathology. Currently, the American Speech-Language and Hearing Association (ASHA) estimates that only 6% of its members are qualified to provide bilingual services (American Speech-Language and Hearing Association, 2018) However, as seen in this study, there is extra cognitive effort (identified by the presence of time cost) required in switching between languages in conversation. In effect, this means that if patients are forced to CS in conversation due to a provider's inability to speak the patient's language of choice, the patient is put at a cognitive disadvantage. While cognitive resources are being used to regulate CS, they are not being used to help improve the patient's language disorder. As such, greater effort must be made to recruit and train bilingual SLPs. Additionally, this has an impact on the types of therapeutic activities used by SLPs in bilingual patients. For example, asking a patient to approach word-finding difficulties in one language by using a word from their other language may not be helpful in rehabilitating the original language. This suggests that language intervention should be given in both languages to facilitate recovery of both languages. Again, this emphasizes the need for a higher number of bilingual SLPs.

Conclusion

Two major conclusions can be drawn from this study. First, based on the results of the conversation task, we can assert that there is a time cost to CS in conversation, and this time cost is likely due to the additional effort of making language selection decisions concurrently with syntactic and lexical selections. Second, we can broadly observe that the nature of CS in naturalistic conversation differs from the CS that is elicited in experimental tasks. This assertion is not only borne out by the presence of a time cost in conversation, but no such time cost in the self-paced reading task, but also in the different effects of CS direction on time costs across the different experimental tasks.

One potential limiting factor of this study was that the participant group were second language learners (SLLs) of French, rather than simultaneous bilinguals. The literature surrounding Canadian SLLs use of French reveals specific differences between SLLs and simultaneous bilinguals across both use and acquisition, and these differences persist regardless of how advanced the speakers are (Hancock, 2012; Harley, 1992; Herschensohn, 2001; Lundell & Lindqvist, 2012). This suggests that the results of this study may be applicable to CS only in SLLs, rather than in simultaneous bilinguals.

Future studies may be conducted to address the limitations discussed above. One potential experimental paradigm might contrast CS in SLLs versus CS in simultaneous bilinguals. Additional directions for future studies may include further exploration of the experimental paradigm used in the conversation task. The ability of this experimental model to generate a significant finding suggests an opportunity to analyze data collected from field work and other highly naturalistic environments with methods commonly used in psycholinguistic and neurological studies. However, since the procedure in the conversation task was novel, its validity and reliability as an experimental model should be substantiated by additional studies before widespread use.

Appendix A

Advanced Proficiency Guidelines
Taken from the American Council on the Teaching of Foreign Languages

ADVANCED

Speakers at the Advanced level engage in conversation in a clearly participatory manner in order to communicate information on autobiographical topics, as well as topics of community, national, or international interest. The topics are handled concretely by means of narration and description in the major time frames of past, present, and future. These speakers can also deal with a social situation with an unexpected complication. The language of Advanced-level speakers is abundant, the oral paragraph being the measure of Advanced-level length and discourse. Advanced-level speakers have sufficient control of basic structures and generic vocabulary to be understood by native speakers of the language, including those unaccustomed to non-native speech.

ADVANCED HIGH

Speakers at the Advanced High sublevel perform all Advanced-level tasks with linguistic ease, confidence, and competence. They are consistently able to explain in detail and narrate fully and accurately in all time frames. In addition, Advanced High speakers handle the tasks pertaining to the Superior level but cannot sustain performance at that level across a variety of topics. They may provide a structured argument to support their opinions, and they may construct hypotheses, but patterns of error appear. They can discuss some topics abstractly, especially those relating to their particular interests and special fields of expertise, but in general, they are more comfortable discussing a variety of topics concretely.

Advanced High speakers may demonstrate a well-developed ability to compensate for an imperfect grasp of some forms or for limitations in vocabulary by the confident use of communicative strategies, such as paraphrasing, circumlocution, and illustration. They use precise vocabulary and intonation to express meaning and often show great fluency and ease of speech. However, when called on to perform the complex tasks associated with the Superior level over a variety of topics, their language will at times break down or prove inadequate, or they may avoid the task altogether, for example, by resorting to simplification through the use of description or narration in place of argument or hypothesis.

ADVANCED MID

Speakers at the Advanced Mid sublevel are able to handle with ease and confidence a large number of communicative tasks. They participate actively in most informal and some formal exchanges on a variety of concrete topics relating to work, school, home, and leisure activities, as well as topics relating to events of current, public, and personal interest or individual relevance.

Advanced Mid speakers demonstrate the ability to narrate and describe in the major time frames of past, present, and future by providing a full account, with good control of aspect. Narration and description tend to be combined and interwoven to relate relevant and supporting facts in connected, paragraph-length discourse.

Advanced Mid speakers can handle successfully and with relative ease the linguistic challenges presented by a complication or unexpected turn of events that occurs within the context of a routine situation or communicative task with which they are otherwise familiar. Communicative strategies such as circumlocution or rephrasing are often employed for this purpose. The speech of Advanced Mid speakers performing Advanced-level tasks is marked by substantial flow. Their vocabulary is fairly extensive although primarily generic in nature, except in the case of a particular area of specialization or interest. Their discourse may still reflect the oral paragraph structure of their own language rather than that of the target language.

Advanced Mid speakers contribute to conversations on a variety of familiar topics, dealt with concretely, with much accuracy, clarity and precision, and they convey their intended message without misrepresentation or confusion. They are readily understood by native speakers unaccustomed to dealing with non-natives. When called on to perform functions or handle topics associated with the Superior level, the quality and/or quantity of their speech will generally decline.

ADVANCED LOW

Speakers at the Advanced Low sublevel are able to handle a variety of communicative tasks. They are able to participate in most informal and some formal conversations on topics related to school, home, and leisure activities. They can also speak about some topics related to employment, current events, and matters of public and community interest.

Advanced Low speakers demonstrate the ability to narrate and describe in the major time frames of past, present, and future in paragraph-length discourse with some control of aspect. In these narrations and descriptions, Advanced Low speakers combine and link sentences into connected discourse of paragraph length, although these narrations and descriptions tend to be handled separately rather than interwoven. They can handle appropriately the essential linguistic challenges presented by a complication or an unexpected turn of events.

Responses produced by Advanced Low speakers are typically not longer than a single paragraph. The speaker's dominant language may be evident in the use of false cognates, literal translations, or the oral paragraph structure of that language. At times their discourse may be minimal for the level, marked by an irregular flow, and containing noticeable self-correction. More generally, the performance of Advanced Low speakers tends to be uneven.

Advanced Low speech is typically marked by a certain grammatical roughness (e.g., inconsistent control of verb endings), but the overall performance of the Advanced-level tasks is sustained, albeit minimally. The vocabulary of Advanced Low speakers often lacks specificity. Nevertheless, Advanced Low speakers are able to use communicative strategies such as rephrasing and circumlocution.

Advanced Low speakers contribute to the conversation with sufficient accuracy, clarity, and precision to convey their intended message without misrepresentation or confusion. Their speech can be understood by native speakers unaccustomed to dealing with non-natives, even though this may require some repetition or restatement. When attempting to perform functions or handle topics associated with the Superior level, the linguistic quality and quantity of their speech will deteriorate significantly.

Appendix B

Vocabulary Test French

Hi, this is a test of French vocabulary. On the next page you will find 84 sequences of letters that look "French". Only some of them are real words. Please, indicate the words you know (or of which you are convinced they are French words, even though you would not be able to give their precise meaning). Be careful, however: Errors are penalised. So, there is no point in trying to increase your score by adding tallies to "words" you've never seen before!

All you have to do is to tick the box next to the words you know. If, for instance, in the example below you recognise "oui", "tu", "jamais", "université" and "oublier", you indicate this as follows:

Stimulus	Mot?
ainrir	
osatrome	
oublier	V
avero	
repole	
tu	V

Stimulus	Mot?
jamais	V
reure	
favernais	
oui	V
université	V
pourpreme	

The results of this test are only useful if you do not use a dictionary and if you work on your own!

May we also ask you to add the following information:

- Gender: male / female
- Native language: ____________________________________
- How many years did you study French in school : ____________
- Your own estimate of your knowledge of French (1 = virtually non-existing, 10 = perfect) : _____

Turn the page to start the test. Many thanks in advance!

Please return the test to the experimenter.

Stimulus	Mot?
cheveux	
soumon	
cloche	
fascine	
huif	
semonce	
canoter	
infâme	
fourmi	
cadenas	
racaille	
pourcine	
œillet	
raplaner	
plaiser	
cerveler	
endifier	
jamain	
ennemi	
pouce	
metter	
fosse	
inciter	
salière	
fouet	
cessure	
clouer	
mappemonde	

Stimulus	Mot?
gloque	
lézard	
sacher	
nouer	
occire	
écouce	
osseaux	
rejoute	
escroc	
hache	
parchance	
pinceau	
poisson	
robinet	
amadouer	
peigne	
retruire	
crayon	
sentuelle	
alourdir	
marteau	
esquif	
treillage	
dauphin	
orgueil	
amorce	
cintre	
chameau	

Stimulus	Mot?
bouton	
capeline	
lanière	
honteur	
abêtir	
fenêtre	
écureuil	
caddie	
détume	
oeuiller	
balai	
prioche	
vicelard	
joueux	
agire	
éventail	
boutard	
panier	
citrouille	
bouilloire	
parir	
remporter	
procoreux	
tanin	
église	
indicible	
réporce	
mignon	

Appendix C

Code Switching Profile: History

Participant #	At what age did you first begin code switching?	How many years have you spent in a community where CS occurs?	How many years have you spent in a family where CS occurs?	How many years have you spent in a work environment where CS occurs?
1	14	As early as I can remember	As early as I can remember	2
2	18	2	not yet	1
3	as early as I can remember	as early as I can remember	as early as I can remember	2
4	as early as I can remember	as early as I can remember	as early as I can remember	not yet
5	as early as I can remember	5	as early as I can remember	not yet
6	11	3	not yet	not yet
7	17	as early as I can remember	3	3
8	5	9	14	not yet
9	16	not yet	not yet	not yet
10	15	1	not yet	not yet
11	6	15	10	not yet
12	as early as I can remember	as early as I can remember	not yet	1
13	7	16	18	6
14	10	6	as early as I can remember	not yet
15	13	1	not yet	not yet
16	4	14	16	not yet
17	not yet	not yet	not yet	not yet
18	as early as I can remember	3	20	not yet

Code Switching Profile: Frequency

Participant #	In an average week, how often do you code switch with friends?		In an average week, how often do you code switch with family?		When you talk to yourself, how often do you code switch?	
	CS	Mono	CS	Mono	CS	Mono
1	10%	90%	20%	80%	20%	80%
2	10%	90%	0%	100%	20%	80%
3	70%	30%	90%	10%	90%	10%
4	0%	100%	40%	60%	10%	90%
5	0%	100%	80%	20%	0%	100%
6	0%	100%	0%	100%	0%	100%
7	10%	90%	0%	100%	10%	90%
8	0%	100%	10%	90%	20%	80%
9	0%	100%	10%	90%	30%	70%
10	20%	80%	0%	100%	20%	80%
11	20%	80%	40%	60%	40%	60%
12	0%	100%	0%	100%	10%	90%
13	20%	80%	60%	30%	10%	90%
14	30%	70%	70%	30%	20%	80%
15	0%	100%	0%	100%	0%	100%
16	30%	70%	70%	30%	50%	50%
17	10%	90%	0%	100%	0%	100%
18	20%	80%	30%	70%	10%	90%

Code Switching Profile: Attitudes

Participant #	I feel like myself when I code switch.	I identify with a code switching culture.	Generally, it is all right to code switch.	Code switching is an acceptable way to talk.	Code switching is a grammatical way to talk.
1	6	6	6	6	6
2	2	2	6	6	3
3	6	6	6	6	4
4	5	5	6	6	4
5	1	0	6	6	5
6	0	0	3	3	3
7	1	1	1	1	0
8	6	3	5	5	6
9	0	0	6	6	5
10	6	4	3	2	1
11	6	6	5	4	2
12	6	6	6	6	1
13	3	4	5	5	4
14	6	6	6	4	1
15	4	1	6	6	5
16	6	6	6	6	1
17	5	0	6	5	2
18	6	4	6	4	1

Code Switching Profile: Attitudes

Participant #	I can code switch and still be a good speaker of two languages.	Generally, people should not code switch.	Code switching makes me feel like a non-native speaker of one of my languages.	I can think of some occasions when I would prefer to code switch.	I never code switch if I can help it.
1	6	0	0	6	0
2	6	0	3	6	0
3	6	2	3	6	0
4	6	1	4	5	6
5	6	0	3	6	0
6	1	0	4	0	6
7	1	0	6	5	3
8	5	5	3	4	3
9	6	0	0	3	5
10	5	3	5	6	4
11	6	2	2	6	1
12	6	1	0	3	6
13	5	2	3	3	3
14	5	5	4	6	5
15	5	1	3	4	2
16	6	0	0	5	0
17	3	2	6	6	4
18	6	0	5	6	2

Code Switching Profile: Attitudes

Participant #	Generally, people should choose one language and stick with it when they speak.	Code switching can make me a worse communicator.			
1	0	1			
2	0	2			
3	0	4			
4	0	5			
5	0	0			
6	1	2			
7	3	6			
8	5	3			
9	1	3			
10	3	5			
11	1	5			
12	4	1			
13	2	2			
14	4	2			
15	2	1			
16	0	1			
17	3	5			
18	1	2			

Appendix D

Initial Screening

1. Are you a bilingual speaker of English and French?
2. How long have you spoken French and how did you learn?
3. When was the last time you used any amount of French, and what was the situation?
4. In French, please explain how you get ready in the morning.

Appendix E

Directions and Script for Conversation Task

In this study, nous nous intéressons à code switching. Code switching est un phénom très commun dans bilingual speech. An example would be any time you begin a sentence in one language et terminé dans un autre.

Par exèmple, on peut insert un mot dans un phrase comprimé de l'autre langue. Or, you can change the language you're speaking en train de parler.

Comprénez vous la définition de code-switching?

Je vais vous demander quelques questions. After each one, vous aurez l'occasion de répondre. Please speak as quickly and smoothly as possible, et utilisez français souvent. It's important that you feel comfortable en parlant, so we'll do two practice questions first. Stop me if you have any questions, d'accord?

What's your favorite food et comment vous le préparez?

Qu'aimez-vous faire to relax après un jour difficile?

Le premier sujet c'est hobbies and media. Ça veux dire la télévision, les films, et les livres. Okay?

- Avez vous quelques hobbies ce que vous faites souvent?
- When did you commence à faire ce hobby?
- Quels hobbies voulez-vous apprendre?

Great! Maintenant je vais vous poser quelques questions about media that you enjoy. D'accord?

- Decrivez-moi votre movie favori.
- Okay, if you don't have un film favori, just tell me about the last movie or TV show you watched.
- I haven't seen that movie, mais ca m'interesse. I've heard good things about it.
- C'est quelle genre de movie?
- I see. Moi, je preferes le films d'action, but I also like [genre].
- Qui sont les personnages?
- Comment s'est terminé le film?
- Cool, that sounds like a good ending. I always like knowing how a film ends avant de commencer. I'm the same way with des livres.
- What's your scène favori in the movie?

Okay, great! Maintenant je voudrais parler de travail or school.

- Êtes-vous un étudiant, and if so what are you studying?
- Oh, I don't know much about [subject], but that sounds cool.
- Do you like what you're studying et pourquoi?
- Avez vous un part time job aussi?

- Good for you! Moi, j’ai travaille a la bibliotheque pendant l’universite, and it was really challenging to manage my time.
- Que faites-vous a votre job?
- Aimez vous cet emploi or are you looking for something else?
- De trouver un emploi ce que vous aimez, that’s always exciting, and rare! OR; Yeah, a lot of people are in that situation. Mais j’espere que l’economie picks up a bit.
- Quel genre de travail voulez-vous in the future?

Finalement, we will be talking un peu about your friends and family.

- Où habite votre famille?
- Wow, that’s far away! My family lives in the area, so I was able to visit them. OR; Bien, donc toute le monde habitent nearby. My family lives in the area, too, so I was able to visit them.
- Did you visit them pendant les vacances?
- Décrivez-moi une tradition that your family has for the holidays. My family usually goes to watch a movie in the theaters – et vous?
- Qu’est-ce que vous avez fait during the break?
- That sounds [relaxing/exciting/interesting]. I mostly stayed home, but I did get some shopping done.
- During the break, avez-vous passé du temps avec vos amis?
- Décrivez-moi something you did with your friends during the break.

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