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SPEAKING THE NATIVE LANGUAGE IN SECOND LANGUAGE CONTEXTS

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ABSTRACT

Language immersion has long been considered the best way to learn a second language (L2). However, it is possible that while the L2 is enhanced by immersion, the first language (L1) suffers some costs. In the present study, two groups of Japanese-English bilinguals – one in the U.S. and one in Japan – named pictures in each language. In one condition, the pictures in a given block were named in one language alone, either Japanese or English. In the other condition, picture naming language was cued by a colored frame surrounding the picture, indicating whether the picture was to be named in Japanese or in English. Although both bilingual groups were dominant in Japanese as the L1 and also highly proficient in English as the L2, they revealed significant costs to the L1 when naming in the L1 following the L2 and when naming in the mixed language block. The group immersed in the L2 suffered greater costs to their L1 and were generally slower to name pictures in both languages. These results suggest a contribution of both local and global inhibitory processes in bilingual speech production. Most critically, they demonstrate that it is possible for bilinguals to lose the advantage in spoken fluency of the native language if the L2 was recently used actively.

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Chapter 1

Introduction

In the growing literature on bilingualism, one prevalent question is how immersion affects language learners. As the world becomes increasingly more aware of the economic, political, and social benefits of knowing multiple languages, and as schools and universities move to strengthen their second language (L2) courses, the effectiveness of such experiences as study abroad has become an issue of concern. In the past, studies have shown almost undeniable benefits of studying abroad for second language learning (e.g., Freed, 1995; Linck, Kroll, & Sunderman, 2009), but not many have considered the changes that influence the first language (L1). Furthermore, the research has mostly focused on languages that share a Roman writing system, such as English and Spanish or French and German (e.g., Baus, Costa, & Carreiras, 2013; Fernandez, Tartar, Padron, & Acosta, 2013; Linck, Kroll, & Sunderman, 2009; Meuter & Allport, 1999; Pearson, Fernandez, & Oller, 1993), although many recent studies have begun focusing on other languages such as Chinese and other Eastern languages (e.g., Chang, 2012; Guo, Liu, Misra, & Kroll, 2011; Guo, Misra, Tam, & Kroll, 2012; Hoshino & Kroll, 2008). Bilingualism research is a relatively new trend in the language sciences and psycholinguistics; until about two decades ago, despite the prevalence of multilingualism in the world, most of the literature focused on monolinguals – people fluent in only one language – and placed bilinguals in a 'special group' (Kroll, Dussias, Bogulski, & Valdes-Kroff, 2012). However, in recent years researchers have been trying to apply or otherwise alter existing models of language and cognition to fit bilinguals as well and further pursue how language affects the brain and cognition. The present study aims to look further into the effects of immersion on language by considering both how it affects the first and second languages, and whether or not a difference in script influences performance.

The present study aims to investigate the question of what studying abroad can do to a bilingual's languages by comparing and contrasting bilinguals in the two contexts in which language is most often studied: in the native language (L1) environment and in the immersed L2 environment. Furthermore, the study looked at two languages that are quite distinct, particularly in written script: Japanese and English. The following sections will present a selective review of the literature and hypotheses on production, cognition, and immersion for bilinguals.

Spoken Production

For the purpose of the present study, we have focused on language production. Bilinguals are constantly doing many things with their two languages: writing, reading, speaking, and listening. However, of these, production is possibly the most difficult language task for a bilingual to achieve, especially a late bilingual who is learning the L2 as an adult. The difficulty is most evident in the fact that many late bilinguals continue to have an accent even after attaining high to native proficiency (DeKeyser & Larson-Hall, 2005; Johnson & Newport, 1989; Piske, MacKay, & Flege, 2001; Runnqvist, Strijkers, Sadat, & Costa, 2011; Saito, 2013; Saito & Brajot, 2013; Vanhove, 2013). Considering this and the fact that L2 immersion generally shows considerable improvements in L2 production as compared to the other areas, we hypothesized that L1 production could be affected by L2 immersion as well (Freed, 1995).

For any bilingual, the presence of multiple languages has consequences for each of the languages. Apart from being able to speak, think, and experience the world in two languages, bilinguals have been shown to have smaller vocabularies in both languages when compared to monolinguals (Pearson et al., 1993; Poulin-Dubois, Bialystok, Blaye, Polonia, & Yott, 2012).

This is fairly understandable, as a bilingual is given the same amount of time in life to “learn language” as a monolingual, but has to focus on two different grammars, vocabularies, and cultures. Additionally, bilinguals have been found to show slower reaction times in production tasks when compared with monolinguals (e.g., Hanulová, Davidson, & Indefrey, 2010), indicating impaired access to the target language resources. This is widely understood to be a result of inhibitory processes being used to suppress the non-target language when speaking, suggesting also that bilinguals never switch either of their languages off or on. This concept is called language non-selectivity (e.g., Dijkstra, 2005; Kroll, Bobb, Misra, & Guo, 2008). The premise behind this is that if languages were separate, then bilinguals and monolinguals should perform identically on linguistic tasks, since bilinguals would essentially be two separate monolinguals in one. This, however, has not been supported in the laboratory research, where several linguistic performance differences have been found between bilinguals and monolinguals, demonstrating that the two languages are in fact connected or interacting in some way. Dijkstra reviews the various models, hypotheses, and data on bilingual lexical access and argues that single word processing in bilinguals appears to be nonselective, meaning that when trying to access a single word in a single language, the bilingual is presented with representations of the word in both of the languages, from which the bilingual is then made to choose one. However, it is also found that this nonselectivity can be affected by contexts, such as the bilingual’s current state of language activation or the nature of the instruction given during a task.

One of the most prominent of these effects is the cognate effect, which is the phenomenon that bilinguals who are made to access words that are phonologically similar in their two languages – called cognates – react faster to these words compared to words that are dissimilar in the two languages. For example, in Spanish and English, the word for ‘guitar’ is a cognate – guitar in English and guitarra in Spanish – but the word for ‘shirt’ is not – shirt in English and camisa in Spanish (Hoshino & Kroll, 2008). The cognate effect suggests that because there is an overlap between the two representations of the word, the bilingual has easier access to the word in production. Hoshino and Kroll, using a picture naming task that is partly replicated in the present study, show that cognate effects are present in even different-script bilinguals, meaning that bilinguals are likely processing these words and identifying the similarities by sound and not just visual orthographic similarities, thereby having the same benefits in cognate processing as same-script bilinguals.

Along with being faster at naming cognates than non-cognates, bilinguals have been found to generally be slower at language tasks in both of their languages compared to monolinguals. It is hypothesized that this is due to the inhibitory processes that most likely regulate bilinguals' languages. Guo et al. (2011), on which the present study is based, used picture naming to generate a situation in which global and local inhibition could be compared through fMRI. Global inhibition is the inhibition of one language during a task using solely the other language, such as naming pictures for an extended period of time in only one language or having a conversation with a monolingual. Local inhibition, on the other hand, is inhibition of one language or the other in a situation where both languages are being used or accessed, such as naming pictures in both languages, or switching between languages in a conversation with another bilingual. In other words, during global inhibition, it can be assumed that the bilingual is suppressing the entire non-target language, whereas in local inhibition, the bilingual is only suppressing a portion of each language set.

The task in the Guo et al. (2011) study was divided into four sets, or 'runs,' with the first two named only in one language at a time – Chinese or English – and the last two mixed – in both languages – so that the participant could not anticipate the language in which he or she would have to name next. As hypothesized, bilinguals had difficulty switching from one language to the other. It was found that even after achieving high proficiency in English, Chinese-English bilinguals still accessed their L1 translations of L2 words, showing that even though they are immersed in their L2 and have reached a level of proficiency where they should no longer rely on L1 mediation, the bilinguals are still accessing L1 translation equivalents of L2 words. Also, it was found that local and global inhibition showed different patterns of activation within the brain, especially in terms of attentional control. One interesting finding was that mixed naming was accompanied by increased activation in the bilateral supplementary motor areas (SMAs), which are commonly associated with a go/no-go task. Guo et al. explain this to be possibly attributable to the fact that in mixed naming, the two languages are given more equal activation throughout the task than they would be in the blocked naming, resulting in an almost go/no-go situation within the brain with regards to which language representation to choose. Furthermore, switching from L1 to L2 showed more brain activity toward the frontal areas of the brain than switching from L2 to L1, which showed more activity toward the posterior areas of the brain. While possible confounds, such as time allowed by the task – when given more processing time for a task, subjects will think more thoroughly and access the translation equivalent to support their reasoning – have been identified, in terms of the L1-L2 interaction during immersion, this finding may imply a very limited use of L1 during quick processing such as in day-to-day communication, but increased access to L1 translation equivalents in less time-demanding tasks such as reading.

While the effects that bilingualism has on language production have been demonstrated in many laboratory studies, they can potentially vary depending on the environment or even the particular local context. Of the many differences that bilinguals show when compared with monolinguals, the present study is interested in investigating the effects, characteristics, and degrees of hypothesized inhibition that bilinguals exhibit in different language environments. It is likely that due to prolonged L1 inhibition in an L2-dominated environment, immersed bilinguals will have more difficulty accessing the L1 than non-immersed bilinguals.

Cognitive Consequences of Bilingualism

Bilingualism has been found to have consequences for more than just language processing itself. In the above sections, we reviewed the effects that bilingualism has on bilingual language production and processing. However, in much of the research, there seem to be effects on cognitive processes as well, particularly in areas requiring suppression of certain information (Bialystok, Craik, & Luk, 2012; Linck, Hoshino, & Kroll, 2008). This suggests that the inhibitory processes that bilinguals use to control their two languages have consequences for not only language accessibility but ability to perform cognitive tasks unrelated to language. Prior and Gollan (2011) showed that bilinguals who frequently switched between languages – known as code-switching – showed reduced switching costs when presented with non-linguistic tasks as compared with monolinguals. It appears that the inhibitory processes being used to speak the target language are also being applied in other areas of mental processing that do not necessarily involve suppression of language.

Despite the fact that bilinguals show slower reaction times than monolinguals and smaller vocabularies than monolinguals, many studies have found that bilingualism can affect cognitive resources as well, giving bilinguals an advantage in non-linguistic processes such as executive control, a part of working memory that allocates cognitive resources to different tasks, allowing for multitasking (Baddeley, 1996; Bialystok et al., 2012; Festman, 2011). While the exact degree to which bilingualism affects cognition is unclear, much of the literature supports bilinguals' abilities to inhibit useless, distracting, or otherwise less necessary information, which is likely due to the constant suppression of their non-target language. In other words, when all else is equal, bilinguals tend to be better at multitasking.

Countless studies have found that when presented with a non-linguistic task that involves doing multiple tasks at once (e.g., Operation Span Task) or doing a main task while ignoring distracting information (e.g., Simon Task), bilinguals are not only quick to react, but also accurate (e.g., Bialystok, 1999; Bialystok et al., 2012; Fernandez, Tartar, Padron, & Acosta, 2013; Stocco, Yamasaki, Natalenko, & Prat, 2012). This has been interpreted as one of the products of the inhibitory process that bilinguals are constantly employing to speak the target language or languages; they use a similar process to suppress unimportant information as they do to suppress the non-target language. Similarly, switching between languages would seem difficult because the speaker cannot keep one language suppressed, but has to have both available, which resembles doing two separate tasks at the same time, such as performing simple arithmetic while memorizing words in the operation span task (Guo et al., 2012; Linck et al., 2008, Michael & Gollan, 2005).

Immersion

While the existence of two languages affects the bilingual no matter the bilingual's location or environment, research on immersion has found that there is potential for dramatic changes in the magnitude of these effects as a result of dramatic change in language environment. For this study, we were interested in looking at how immersion can affect language processing and control.

Immersion in the L2 environment is a topic of particular interest, as it puts a person into a specific language environment where their L1 is not dominant, thereby forcing the person to be completely surrounded by their L2. Research and (for many second language learners) experience have shown that immersion in the L2 environment can show considerable benefits for L2 learning (Freed, 1995). However, while much has been said about the effects of L2 immersion on the L2, not much has been said about the possible effects on the native language. Although increasing, only a handful of studies have looked into the effects on L1 and even those were mostly done with languages that share a Roman alphabetic script.

Assuming that most bilinguals are not completely balanced, meaning that they are not equally proficient in their two languages, inhibition of the two languages should not be exactly equal either. On top of this, most bilinguals are dominant in a certain language depending on their environment. For example, L2 learners in their native language environment are most likely dominant in their L1 since it is what they speak, write, read, and hear throughout most of the day. While there are many hypotheses about how dominance and inhibition interact, the present research is most concerned with how levels of inhibition are affected by such external factors such as immersion and language dominance.

Following this nonselective processing of language, in the immersion situation a person should have his or her L1 active, even during L2 speaking, reading, or listening tasks (Linck et al., 2008). However, according to Linck et al. (2009), while immersion does significantly help L2 proficiency and processing, it also has some negative effects on L1 accessibility. Linck et al. (2009) investigated this hypothesis using two language tasks – translation-recognition and verbal fluency – and two cognitive tasks, finding the immersed learners to be significantly quicker at translation recognitions. In verbal fluency, immersed subjects produced more L2 exemplars than their classroom learner counterparts, while also producing less English exemplars. Not only was the gap in number of exemplar produced in each group much narrower than the non-immersed group, the overall performance showed reduced access to the L1 during immersion. This is tentatively attributed to an inhibitory process of the L1 in immersed L2 learners, where L2 functions dominantly, and L1 is suppressed. However, it is important to note that in studies such as Linck et al. (2009) that examine L2 learners, individuals are generally quite dominant in their L1 even when immersed. What is striking is that the reduction in L1 can be observed even when the L1 is much stronger than the L2.

To further investigate the results from Linck et al. (2009), Baus et al. (2013) conducted a longitudinal study of German-Spanish bilinguals at the beginning and end of an immersion experience in a Spanish-speaking environment. A picture naming task and a verbal fluency task were used to investigate the ease of access to L1 and L2 at different points in immersion, through naming latencies, and cognate effects. It was found that in picture naming, words in the L1, particularly those which are low-frequency – they do not occur often in normal language use – and non-cognates are susceptible to weakened access during immersion. However, unlike in past experiments, no difference in performance in verbal fluency was found based on length of immersion, which is speculatively attributed to the longitudinal nature of the experiment, compared to the past cross-sectional studies. Baus et al. concluded that although there seems to be a cost to the L1 during L2 immersion, this cost is not spread evenly across the lexicon and is instead more specific to words that are not frequently used in the language and those that do not share phonological similarities with their translation equivalents in the L2.

Linck et al. (2008) also show a number of interesting findings with regards to this inhibition. First, inhibitory control in linguistic and non-linguistic tasks is found in not only early bilinguals, but also later bilinguals; regardless of the age of L2 acquisition, bilinguals show a cognitive advantage. Second, L2 immersion was in fact shown to be associated with a decline in inhibitory control. This was shown mainly using the results from the Simon task and a working memory task, comparing monolinguals with bilinguals, immersed and non-immersed bilinguals, higher and lower proficiency bilinguals, and later Spanish-English and Japanese-English bilinguals. The observed phenomenon can be attributed to many factors, such as getting accustomed to controlling both languages and therefore no longer needing to inhibit one or the other as much. Consistent with the second finding, the results did not show that more proficient bilinguals show greater inhibitory control. When comparing same-script (Spanish-English) and different-script (Japanese-English) bilinguals, no difference in inhibition between the two groups was found, meaning that script may not affect a speaker's efforts to suppress their L1.

The Present Study

The present study considers the role of immersion and language dominance on both the L1 and L2 in Japanese-English bilinguals, using a picture naming task. Japanese-English bilinguals were chosen as the subject of study mainly because their two languages differ in script and because they are not widely tested compared to other bilingual communities. These bilinguals were tested both in the U.S., the immersed condition, and in Japan, the non-immersed condition. English monolinguals were also tested as a control group to contrast with the two bilingual groups and were given all of the same tasks in English only.

The entire experiment consisted of six computer-based tasks and two paper-based questionnaires. The critical picture naming task, based on Guo et al. (2011), replicated the local and global inhibition-inducing paradigm, using three 'runs' of solely English, solely Japanese, and mixed English and Japanese naming (Figure 1).

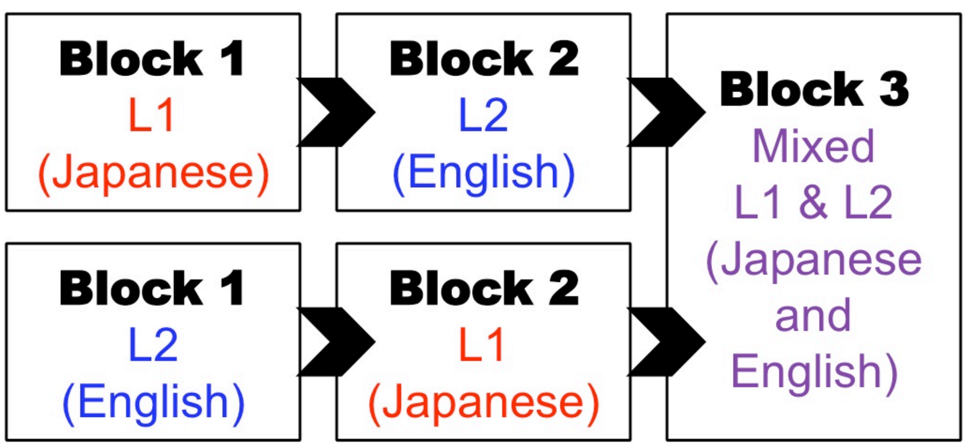

Figure 1. **Critical picture naming task order. This figure illustrates the order of the three runs in the critical picture naming task, with two runs of blocked naming and one run of mixed naming.**

In the first run, half of the participants were asked to name in the L1 Japanese, while the other half were asked to name in the L2 English. For the second run, the two groups were asked to name in the other language. This resulted in the first two runs being done in entirely one language at a time. It was hypothesized that an order effect would result in which participants who named in the L1 first would show different latencies in naming from those who named in the L2 first. We expected that after naming in the L2 for a whole block, the L1 would be inhibited and therefore would take longer to name than in the opposite situation (Meuter & Allport, 1999). Since we suspected that most of our subjects, immersed or non-immersed, would be dominant in the L1, we expected that L1 should be generally more accessible so that when L1 is named first, pictures named in L1 would generally be named faster than those in L2.

In the third run, the language in which pictures were to be named was cued on each individual trial. Surrounding each picture was a colored frame that also appeared in the first two runs. A red frame cued to name in Japanese and a blue frame cued to name in English. The colored frames in the first two runs were used to get participants accustomed to naming with the frames and to keep the format of all of the runs consistent. The purpose of the mixed run was to examine local inhibition of both the L1 and the L2 by creating a situation in which both languages must be readily available to switch back and forth. Because participants cannot predict which language to name in next, it is assumed that they will not fully inhibit the non-target language on each trial. This run was designed to induce local inhibition, which would make naming in both languages slower than in blocked naming.

Although Guo et al. (2011) used fMRI to compare local and global inhibition, we compared the behavioral effects of the two types of inhibitory control in two groups of bilinguals. Guo et al. found that different brain areas appeared to be engaged by each of these mechanisms of inhibitory control. In the present study we asked whether language immersion affects one or both of these mechanisms. The main prediction is that, while the effects of inhibition in blocked and mixed naming will look similar, the magnitude of the effects on global inhibition will be more likely to be influenced by the language environment in which a bilingual is living.

In a second picture naming task, we used the materials that were part of the design of the Hoshino and Kroll (2008) cognate picture naming task. The purpose of this task was to compare bilingual performance on picture naming for cognates, words with the same meaning and similar phonology, and non-cognates, words with the same meaning and different phonology, in Japanese and English. Since the cognate effect indicates co-activation of both languages, we predict that both immersed and non-immersed bilinguals will show a cognate effect, but possibly of differing degree. In using the picture naming task, we can again systematically compare the degree of cognate effect in the two groups by looking at latencies in naming. Since we hypothesized that in the immersed environment, the L1 would be less available than in the non-immersed situation, we predicted that there will be a smaller cognate effect in the immersed condition. Also, in combination with the first picture naming task, this task will help us investigate further the strength of activation of the two languages in both conditions.

Following the critical tasks, there were four tasks designed to measure individual differences in linguistic and cognitive abilities. In order to determine language proficiency in English and Japanese, two other language tasks were used. A lexical decision task, in which participants were presented with words and non-words and were instructed to indicate whether or not the word exists, was performed in English only. This was used to measure how familiar each participant was with the English language. A verbal fluency task, for which bilinguals were presented with the name of a semantic category (e.g., FRUITS) and given 30 seconds to name as many exemplars of the category as possible (e.g., apples, bananas, pears), was also used to determine general vocabulary in both Japanese and English. Each participant was presented with eight semi-randomized categories, the first four to be named in Japanese and the remaining four to be named in English. Participants were given instructions on which language in which to name before the trials and each category name was presented in the language of naming.

To measure cognitive processing, an operation span and Simon task were used. The operation span task, in which participants must solve simple arithmetic equations while memorizing words, was performed using Japanese words, as this was their dominant language. Since the task was not meant to measure language abilities, having it performed in the dominant language would control to some degree for variance in language ability for memorizing the words. In the Simon task, participants were shown a series of blue or red squares on the computer screen and were asked to indicate the color of the squares, but ignore the position of the squares (left, center, right). These tasks were designed to measure executive function, which is hypothesized to be enhanced with more inhibition. Counter to the assumption that different-script languages are more easily separated than same-script languages, we hypothesized that the two groups would show very similar results to the same-script bilinguals studied in the past. We also expected to see more inhibition in immersed bilinguals than in non-immersed bilinguals, and a cognate effect in the cognate and critical picture naming tasks for both groups.

Chapter 2

Methods

Participants

The experimental group consisted of thirty-four Japanese-English bilinguals at the Pennsylvania State University, University Park, USA, and forty-two at the Kobe City University of Foreign Studies, Kobe City, Japan. Thirty-four English monolinguals were also tested as a control group. All subjects were either compensated with course credit in an approved course or paid an equivalent of ten U.S. dollars for their participation.

Table 1 details the properties of the groups tested. All Japanese-English bilinguals were intermediate to advanced English speakers. The two groups were balanced in language dominance and average proficiency in both Japanese and English, based on self-ratings and performance on the lexical decision (accuracy and reaction time in determining if a presented string of letters was a word or non-word in English) and verbal fluency (number of correct exemplars of a cued category produced in each language) tasks. In the immersed group, the average number of years of immersion in an English-speaking environment (M=5.66) was significantly higher than in the non-immersed group (M=0.62).

Table 1. **Characteristics of participant groups.**

Characteristics	Immersed group	Non-immersed group	Monolingual control group
Number of participants	26	32	34
Age (years)	24.00	23.41	20.65
Age of L2 acquisition (years)	10.38	11.00	
Experience living in English-speaking country (years)	5.67	0.68	0.37
Current percent language use[a]			
Percent L2 use	54.27%	17.44%	98.90%
Percent L1 use	45.54%	82.41%	1.10%

[a]Four participants in the monolingual group claimed to have no experience learning a second language and did not provide a self-rating for percentage of L1/L2 use; the means provided for the control group in L2 are therefore based on a sample size of 30.

A total of ninety-two subjects (32 in the non-immersed bilingual group, 26 in the immersed bilingual group, and 34 in the monolingual control group), were used in the final analysis. Of the 109 participants tested, nine were eliminated and replaced by later participants due to technical errors with the computer or voice recorder, resulting in lost data, or misunderstood instructions. For the final analysis, eight more participants from the bilingual groups were eliminated due to outlier performance on English proficiency tasks (n=7), indicating insufficient proficiency in English, or outlier performance in the critical picture naming task (n=1).

Materials & Procedure

Six computer-based tasks were conducted in an individual sound-attenuated chamber in the immersed and English monolingual conditions, and in an isolated classroom in the non-immersed condition. Of the six tasks, three – picture naming, cognate picture naming, and verbal fluency – were voice recorded, and the remaining three used only the computer keyboard provided. Tasks were presented using E-Prime on a Windows 7 Dell desktop computer (immersed and control groups) or laptop computer (non-immersed group).

Picture Naming and Cognate Picture Naming

The critical task in this experiment was a simple picture naming task based on Guo et al. (2011). Ninety black and white line drawings taken from UCSD International Picture Naming Project were used in in this task as experimental stimuli and thirty were used as practice items. Each stimulus was preceded by a black fixation cross "+" on a white background and appeared surrounded by either a red or blue frame to indicate the naming language (Japanese and English, respectively). Item conditions were counterbalanced and trials in the first two blocked runs were randomized across participants, while trials in the mixed block were pseudo-randomized.

In the picture naming task, there were three runs: the first two blocked language runs were each performed in either the L1 or the L2, and the third run was mixed. The language order of the two blocked runs was balanced between participants, with half producing L1 first followed by L2 and the other half producing L2 first followed by L1. In the mixed condition, participants were balanced for stimuli and for language.

In the blocked runs, stimuli appeared in either a red frame, for Japanese, or blue frame, for English, indicating the language of production, which was kept constant throughout the run.

This was done so that participants could get practice in naming in a certain language with a certain colored frame, even though the language in the first two runs was fixed and therefore did not need to be cued. In the mixed run, stimuli were again presented in red or blue frames and language mapping was kept consistent so that when presented with a picture in a red frame, participants would name in Japanese and when presented with a picture in a blue frame, they would name in English.

Each run consisted of thirty pictures and ten practice items. A 500 ms blank screen followed by a 500 ms fixation cross "+" were presented before each stimulus, and another 1700 ms blank screen was presented after the stimulus disappeared. Participants were asked to name the presented pictures as quickly and accurately as possible and to speak loudly and clearly. Stimuli were presented with no limit to duration, and disappeared when the participant spoke into a reaction time microphone, which detected and recorded the time at which the participant began to name the picture. Participants were instructed to say either "NO" or "IIE (Japanese for "no")" in response to stimuli they could not identify, and to minimize any extra sounds so as to keep reaction time measurements accurate. Trials in which participants made an audible sound other than the target word were coded as incorrect and eliminated from analysis.

The materials and procedure for the cognate picture naming task were taken from Hoshino and Kroll (2008). Because participants had already been naming pictures by performing the critical picture naming task and the cognate picture naming task directly followed it, practice trials were not included. Participants were again asked to name the pictures as quickly and accurately as possible, and to speak loudly and clearly. Also, as an additional instruction to the task, they were asked to press the space bar on the computer keyboard to make the pictures appear – if they did not press the space bar, the screen would not proceed from the fixation cross "+." This task was performed in Japanese only to see if and how cognate effects show in the L1 and how they differ in immersed bilinguals compared to non-immersed bilinguals.

Language Proficiency Measures

To account for individual differences in language ability, two proficiency tasks were incorporated: a lexical decision task in English and a verbal fluency task in English and Japanese. In the lexical decision task, participants were presented with 112 letter strings, half of which were words (n=56) and the other half of which were non-words (n=56). They were instructed to indicate whether the string was a word in English, by pressing the "c" key on the computer keyboard, or not a word in English, by pressing the "m" key on the same keyboard. All non-words were homonyms to existing words in the English language, meaning that when read aloud they had the same sound as a word, but had a different spelling (e.g., "chayn," which is a homonym with "chain"). Accuracy in determining words and non-words was used to determine familiarity with the English language.

For the verbal fluency task, participants were presented with the name of a category in the center of the screen and asked to name as many exemplars of that category within a 30 s blank screen following the presentation of the category name. The number of correct responses for each language were counted and used to determine general size of Japanese and English lexicons.

Cognitive Process Measures

To account for individual differences in cognitive ability, and to compare the groups in cognitive processes, two non-linguistic cognitive tasks were incorporated. First was the operation span task, in which participants were presented with simple arithmetic equations (e.g., "(1 * 3) + 5 = 8"), for which they were instructed to indicate whether the answer given was correct, using the "d" button on the keyboard, or incorrect, "k" on the keyboard. Following this decision, a word in Japanese (the dominant language) was shown and the participant was asked to remember the word for later recall. After several of these trials, participants were asked to recall the words presented previously, for which they were given unlimited time. There were fifteen sets of arithmetic-word pairs, which began with two pairs and increased every three sets, ending in six pairs. The task was done using words in the native language because it was not meant to test for language proficiency and therefore should be performed in the language with which participants are more familiar.

Next, the Simon task presented participants with a series of red and blue squares, appearing on the screen at one of three positions – left, right, and center – one at a time, to which participants were asked to indicate the color of the square using the "\" key for red and the tab key for blue (Guo et al., 2012; Linck et al., 2008, 2009). Like the operation span test, this was meant to measure for executive control, or ability to ignore unimportant information – in this case, the position of the square. Because the tab key is situated on the leftmost side of the keyboard and the "\" key on the rightmost side, participants' ability to ignore the location of the square and only indicate the color would be most evident when the square was presented on the side of the screen opposite the corresponding key (e.g., a red square appearing in the left position).

Both of these tasks were used to measure the degree of cognitive control processes that bilinguals used on an individual and group basis. Because inhibition is thought to strengthen executive control processing, bilinguals who inhibit more should show a higher aptitude for these two tasks, and both bilingual groups should show higher performance than the monolingual group, who only have one language and therefore should not need to inhibit another.

Analysis

Picture Naming

The picture naming and cognate picture naming data were first coded using a key for accuracy. Absolute Correct answers were marked with a “1” and consisted of responses that matched exactly with the listed stimulus name. Variant answers were marked with a “2” and represented lexical variations of the same word (i.e., “plane” for “airplane” or “bike” for “bicycle”). Related answers were marked with a “3” and were answers that seemed either semantically related or were deemed as possible misinterpretations of the picture. Incorrect answers were marked with a “0” and consisted of answers in which the participant said either “NO” or “IIE;” made other sounds before saying the word; stuttered, repeated, or changed the word; or any other answer that did not fit the Variant or Related answer categories. Any response that was not an Absolute Correct answer was also transcribed for later analyses.

Based on the transcribed responses, a list of Liberal Correct answers was compiled; liberal responses were marked with a “4.” All responses marked with either a 1 or a 4 (Absolute Correct and Liberal Correct, respectively) were considered correct and included in the analyses.

All responses with reaction times lower than 300ms and higher than 3000ms were eliminated from the analysis. To further account for individual differences in average latency, trails with reaction times of less than -2.5 standard deviations and greater than 2.5 standard deviations from the mean per participant were also eliminated.

Chapter 3

Results

Language Fluency and Dominance

The results from the language history questionnaire self-ratings and the verbal fluency task, as outlined in Table 2, show that both Japanese-English bilingual groups – in the U.S. and in Japan – are extremely dominant in their native language.

***Table 2*. Language proficiency measures.**

Tasks	Immersed group	Non-immersed group	Monolingual control group
Verbal fluency (words)			
English	39.46	37.66	53.12
Japanese	48.19	49.66	
Self-rated proficiency (L2)[a,b]			
Overall	4.78	4.09	2.37
Reading	4.85	4.41	2.60
Writing	4.69	4.06	2.30
Listening	4.81	4.06	2.43
Speaking	4.77	3.84	2.13
Self-rated proficiency (L1)[a]			
Overall	6.26	5.80	6.68
Reading	6.27	5.72	6.56
Writing	5.88	5.59	6.69
Listening	6.31	5.84	6.74
Speaking	6.58	6.03	6.75

[a]Self-ratings were made on a 7-point Likert scale ranging from 1 (*not literate/able to uunderstand*) to 7 (*very literate/able to understand*). [b]Four participants in the monolingual group claimed to have no experience learning a second language and did not provide a self-rating for L2

proficiency; the means provided for the control group in L2 are therefore based on a sample size of 30.

The average self-rating for proficiency in the L1 Japanese did not differ significantly between the Japan group (M=5.80) and the U.S. group (M=6.26) and for proficiency in the L2 English also did not differ significantly between the Japan group (M=4.09) and the U.S. group (M=4.78), $F(1,84) = 0.00$, $p>0.05$. The slightly higher average rating in the immersed group was not surprising, as immersed bilinguals tend to rate themselves higher in both of their languages than do those not immersed. This could possibly be due to the language environment, as they have less people with whom to compare themselves in native language proficiency and can thereby perceive themselves as more proficient than others. Also, since they are immersed in the L2, it is natural for them to believe that they are advanced in the language and consequently rate themselves accordingly. Both groups rated their L1 higher than their L2, showing that they perceived themselves as more proficient in their L1.

Similarly, in the verbal fluency task, the number of words produced in the L1 was significantly greater in the Japan group (M=49.66) and the U.S. group (M=48.19) than in the L2 for the Japan group (M=37.66) and the U.S. group (M=39.46), $F(1,56) = 50.51$, $p<0.01$. Here, however, unlike in the self-ratings, there was almost no difference in performance between the two groups, $F(1,56) = 1.26$, $p>0.27$.

Despite the greater average length of stay in an English-speaking country for the immersed group (M=5.67) compared to the non-immersed group (M=0.68), there was no significant difference between the two groups for self-rated proficiency or performance proficiency, in either language, making the two groups balanced in all aspects other than immersion experience. However, the data did indicate a difference in self-perceived proficiency and actual proficiency in the two languages.

Both groups had significantly lower scores in both the self-ratings and the verbal fluency compared to the monolinguals, which was also expected, and monolinguals rated themselves significantly lower in L2 proficiency (*M*=2.37) than in L1 proficiency (*M*=6.68).

When comparing the two different order groups – those who perform picture naming in English first versus Japanese first – there was no significant difference found, $F(1,83) = 1.11$, $p>0.05$. As such, it is safe to say that any order effects present in the critical picture naming task can be attributed to the order and not differences in the two groups.

Picture Naming

Critical Picture Naming

Table 3 shows the reaction times and accuracy results of the critical picture naming task for the two bilingual groups divided by immersion condition, order of languages for blocked runs, language, and blocked versus mixing. On the whole, the immersed group was slower to name than the non-immersed group in both languages.

***Table 3*. Reaction time (ms) and accuracy (%) results.**

	Immersed group		Non-immersed group	
	L2 first	L1 first	L2 first	L1 first
Blocked				
English (L2)	1049.22 (86.82)	1058.32 (90.00)	1021.82 (84.07)	1039.87 (78.57)
Japanese (L1)	1142.96 (86.92)	1051.76 (86.16)	1000.27 (90.55)	900.89 (91.91)
Mixed				
English (L2)	1224.29 (81.03)	1171.28 (82.05)	1148.59 (82.97)	1164.46 (70.24)
Japanese (L1)	1311.40 (84.10)	1151.43 (83.08)	1130.94 (83.70)	1137.68 (77.39)

Accuracy data (%) is displayed in parenthesis next to reaction times.

Global inhibition

A significant main effect was found for order of language in the two blocked runs, $F(1,54) = 5.40$, $p=0.02$, indicating that response speed was dependent on the language in which participants named first. Figure 2 illustrates the reaction time results for the English and Japanese blocked runs. Consistent with the results from Guo et al. (2011), both groups are slower to name in the L1 after naming in the L2, but are faster at naming the L1 when naming in the L1 first. Also interestingly, reaction times for the L2 in both the immersed and non-immersed groups did not differ greatly with different language order, but the L1 showed drastic changes in reaction time based on which language was used first. This implies that while ability to access L2 is relatively stable, the dominant L1 incurs a cost following the L2, most likely because it is being inhibited.

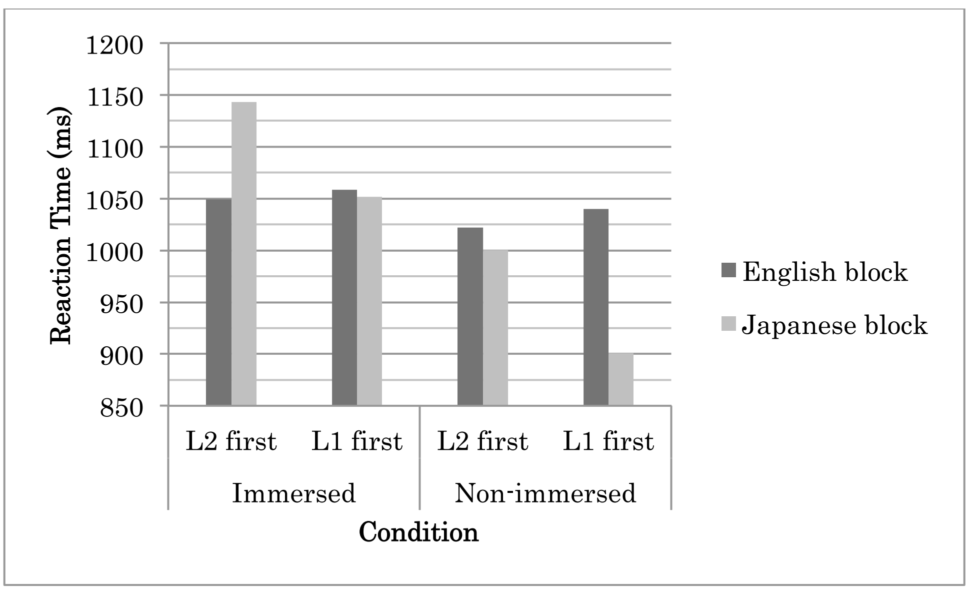

***Figure 2*. Reaction time (ms) data for L1 and L2 blocked naming separated by naming and immersion conditions.**

As hypothesized, participants who named in only the L2 for the first run, compared to those who named in L1, were much slower to name in the L1. Participants immersed in the L2 environment were also not only slower to name on the whole, but they suffered a much larger cost to the L1 after naming in the L2 than did the non-immersed group.

Language context also showed a significant effect, $F(1,54) = 6.99$, $p=0.01$, with the results from the immersed and non-immersed groups differing in both magnitude and direction. The non-immersed group who are living in their L1 environment show very little change in reaction times for L2 naming when they name in the L1 first (M=1039.87) and when they name in L2 first (M=1021.82). However, even though they are clearly more L1 dominant and live in their L1 environment, naming in the L1 becomes much slower following the L2 (M=1000.27) than when it comes first (M=900.89). Similarly, in the L2 immersed group, the L2 reaction times do not differ across language order conditions, but when naming in the L1 after the L2, they are even more drastically affected than the non-immersed group, such that their reaction time for the dominant L1 (M=1142.96) surpasses that of the L2 (M=1049.22). In the L1 first condition, these bilinguals are not much faster at naming in the L1 and appear to be almost balanced bilinguals, which contradicts the verbal fluency and self-rating data.

Although it is clear that immersion does affect performance in the L1 and L2, the fact that these effects are not revealed in the verbal fluency data is indicative of the fact that it is not the sole factor involved in the picture naming results. From the blocked picture naming data only, it is evident that immersed bilinguals are more susceptible to greater global inhibition of the L1 after a prolonged interval of speaking the L2. However, not only can language environment and speaking order make the dominant L1 slower in general, but it can make the L1 slower compared to the L2, reversing the native language advantage that is shown in the verbal fluency data.

Local inhibition

A significant effect of mixing on reaction times was also found in the third run in which participants were cued as to the language in which to name on a trial by trial basis, $F(1,56) = 88.07$, $p < 0.01$. Both groups were slower to name in both languages in the mixed condition than in the blocked condition, showing greater difficulty in naming when one language cannot be globally inhibited. The results again reflect the Guo et al. (2011) results, where an effect of mixing can be observed in both bilingual groups.

Here again, there was an effect of immersion and naming language, with the non-immersed group being significantly more severely affected than the immersed group, $F(1,56) = 4.45$, $p = 0.04$, which also showed a similar trend with less magnitude. While both groups showed larger costs to the L1 than the L2, the difference was smaller for the immersed group than the non-immersed group. Again, however, the immersed group was generally slower at naming overall in both languages, showing that they may be closer to being balanced in their two languages compared to the group living in the L1 environment.

Global effects on local inhibition

Because there is clearly a long-term effect of immersion on performance in inhibition-inducing tasks, we were interested in seeing how the global inhibition from the first two blocked runs could influence the results of the two languages in the third mixed run. If the L1 is less accessible when it is named after the L2, as was shown in the blocked picture naming results, then it is possible that this inhibition will spill over into the mixed picture naming and thereby continue to incur a cost on the L1.

Cognate Picture Naming

The cognate picture naming task, performed in the native Japanese showed no effect on Japanese-English bilinguals in Japan, with cognates (*M*=1052.44) being named with the same latency as non-cognates (*M*=1052.77), but did show a minor non-significant effect on the immersed group, with cognates (*M*=920.92) being named roughly 10 ms faster than non-cognates (*M*=930.55). Although it was not significant, the trend was in support of the cognates. However, since both groups were dominant in the L1, it was hypothesized that the two groups would be completely unaffected by cognates when naming in the L1.

Individual Differences Measures

The operation span task showed no significant difference between the two groups, $F(1,56) = 0.002$, $p>0.05$, indicating no difference in cognitive processes. However, unexpectedly, the Simon task results show a large difference between the immersed (*M*=36.65) and non-immersed groups (*M*=26.90). The reason for this is unknown and it may be beneficial to follow up this study with a study of how performance on individual difference measures, such as Simon, can modulate performance on the language tasks or vice versa.

Chapter 4

Discussion

In the present study, highly proficient Japanese-English bilinguals were tested in two conditions: immersed in the L2 and non-immersed. Compared to the previous research, the bilinguals tested in this study were much more proficient in the L2. As a result, it was possible that after attaining a certain degree of proficiency, they would no longer suffer the same sort of effects that the less proficient immersed bilinguals suffered on their L1 (e.g., Baus et al., 2013; Linck et al., 2009). However, this was not the case and although the two groups showed equal proficiency when allowed to rate themselves or freely produce words in each language, a difference was found when they were given a more restricted speech production task: the picture naming task.

Although from the language history questionnaire and verbal fluency task data alone, it appeared as though these two groups were identical, considering that the verbal fluency task does not put many constraints on the participants as far as actual lexical items produced, we used the picture naming task to look more sensitively at the modulation of the two languages during production. Since immersion seemed to show no effects on language proficiency between the two groups, it was possible that the picture naming task, which is another production task like verbal fluency, would show a similar result as the self-ratings and the verbal fluency. However, we hypothesized that this would not be the case and that while on the surface, the two groups may appear to be the same, when forced into a global or local inhibitory situation, the immersed group would suffer greater costs to the L1 than the non-immersed group. We were interested in seeing how the order of the languages and blocking or mixing the languages would affect performance in the two languages and whether they would exhibit the same effects shown in Guo et al. (2011).

The results of the critical picture naming task, in both accuracy and reaction time, showed that despite the apparent matching characteristics of the immersed and non-immersed groups, when given a forced production task in which lexical items and language to be produced were both specified, there was a clear effect of inhibition that, while generally similar, differed in magnitude between the two groups. The findings were consistent with the results of Guo et al. (2011), which showed that when naming in the blocked conditions, the dominant L1 naming was slower for those who named in L2 before L1, meaning that there was an effect of order on language production. Also, in the blocked compared to mixed conditions, it was shown that mixed naming was much more difficult than blocked naming, indicating that, as was found in Guo et al., mixing the languages requires a heightened amount of inhibition on individual lexical items.

In Kroll and Gollan (in press), a Frequency-lag or Weaker Links hypothesis, in which the bilingual disadvantages found compared to monolinguals are explained to be a result of simply using each individual lexical item less often, was reviewed and explained in contrast with a Competition for Selection hypothesis, which explains this phenomenon as a result of competition between representations of the same item in two languages. Unlike the Weaker Links hypothesis, the Competition for Selection hypothesis is based on the supposition that the bilingual's two languages are constantly concurrently active, which is said to cause the lag in production tasks compared to monolinguals. The results from the present study support the latter hypothesis, showing that when asked to produce a specific lexical item in a specific language, while being unable to predict which language will be required next – mixed – bilinguals take even longer to react than they do when they know what language is required – blocked. This difference in blocked and mixed picture naming suggests that the access to each individual lexical item is not stable and simply weaker than it is in monolinguals, but that depending on the situation, access to each item can change. We explain this as a result of a need for selection where the further delay in mixed naming is a result of not being able to suppress the whole language and thereby having both languages equally active and in competition at each trial.

Chapter 5

Conclusions

The results of the present study are indicative of the possible effects that the linguistic environment can have on a bilingual's two languages. Even in two groups of highly L2 proficient yet highly L1 dominant bilinguals, depending on the context, the L1 can be greatly inhibited. Both the actual speaking conditions – such as speaking only in the L1 or the L2 – and the surrounding linguistic environment can both induce inhibition of the L1, resulting in increased difficulty to speak the more dominant native language. These results suggest the surprising plasticity of language and how performance in two languages that a bilingual is seemingly extremely advanced in using can be easily altered both in the short and the long term, even though different measures may show that the bilingual is unequivocally more proficient in the native language. The fact that bilinguals who are highly dominant in their L1 can be induced to be slower to speak their native language demonstrates that there is remarkable plasticity in the degree to which the native language is modulated to enable bilingual performance.

It also further supports the growing notion that languages are not split entities in the bilingual mind and that they are in fact constantly in competition during production. Immersed bilinguals, who should be more accustomed to switching between their languages, showed a greater impact on the L1 as a result of mixing and speaking the L2 first. This supports the claim, found in the previous literature, that despite high levels of L2 proficiency and being immersed in the L2 environment, bilinguals continue to strongly inhibit the L1 in order to speak the L2.

As the sample tested for this study varied relatively widely in age and number of years spent in an English-speaking country, further investigation of if or how much of these results is dependent on age or length of immersion is necessary. Also, one of the individual differences measures that looked at individual participants' cognitive resources showed an unexpected difference between the two groups. Seeing how individual differences may modulate the differences shown in the picture naming tasks is another topic worth further study.

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- Japanese Friendship Association, President *Spring 2012 – Spring 2014*
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