Bilingual Cognitive Control and Perspective-Monitoring in Dialogue

A Dissertation Presented

by

Karla Maria Batres

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Experimental Psychology

Stony Brook University

August 2013

Stony Brook University

The Graduate School

Karla Maria Batres

We, the dissertation committee for the above candidate for the

Doctor of Philosophy degree, hereby recommend

acceptance of this dissertation.

Dr. Susan E. Brennan - Dissertation Advisor
Professor, Department of Psychology

Dr. Arthur G. Samuel - Chairperson of Defense
Professor, Department of Psychology

Dr. Antonio L. Freitas
Associate Professor, Department of Psychology

Dr. Marie K. Huffman
Associate Professor, Department of Linguistics

This dissertation is accepted by the Graduate School

Charles Taber
Interim Dean of the Graduate School

Abstract of the Dissertation

Bilingual Cognitive Control and Perspective-Monitoring in Dialogue

by

Karla Maria Batres

Doctor of Philosophy

in

Experimental Psychology

Stony Brook University

2013

The bilingual experience is fundamentally different from the monolingual experience. This is due in part to the bilingual's need to be ready to process multiple languages, while at the same time, needing to choose which language to speak while keeping in mind which language(s) the addressee understands. As a result of these demands on bilingual language comprehension and production, some have claimed that bilinguals have enhanced cognitive control when compared to monolinguals (e.g., Bialystok, 2009). Bilinguals may have more experience in adapting to a partner's perspective (as advantage in perspective-taking has been established for bilingual children, e.g., Goetz, 2003 and for bilingual adults, e.g., Rubio-Fernández & Glucksberg, 2012).

The present set of studies used a series of interactive referential communication tasks designed to test the relationship between cognitive control and perspective-taking in 48 English monolinguals and in 48 bilinguals who learned both Spanish and English early in life. All subjects did all tasks. Subjects first completed a set of cognitive control measures (i.e., Stroop, Trail-Making Test, Berg's Card Sorting Task, Attentional Blink) as well as demographic and

proficiency questionnaires, and then participated as either director or matcher in collaborative tasks with confederate partners. In Study 1(language comprehension), subjects took on the matcher role and received instructions on how to arrange a set of tangrams. Their reaction times in interpreting referring expressions for the tangrams were measured, including when the confederate departed from their previously-introduced terminology by introducing a new label (i.e., breaking a *conceptual pact*, e.g., Metzing & Brennan, 2003). In Study 2A (language production), subjects entrained on same or different labels (e.g., *couch* versus *sofa*) with two confederates, and then took on the director role and referred to the pictures while working with only one partner at a time (perspective-blocked) or while working with both partners simultaneously (perspective-mixed). Which label subjects chose and their speaking latencies were measured. Study 2B extended the perspective-switching comparison to between-language switching; the bilinguals again took on the director role and referred to pictures that they had either shared with only one partner and in only one language, or that they had shared with both partners across both languages, with partner perspective either blocked or mixed.

The predictions were that bilinguals would show advantages over monolinguals in both cognitive control and perspective-taking in dialogue. Instead, the sample of bilinguals was overall slower and in some cases performed worse on the typical cognitive control tasks than the monolingual sample. This may be due in part to variability in age of second language acquisition and English proficiency, as well as external factors such as socioeconomic status, which differed between the monolingual and bilingual samples. Bilinguals were also slower than monolinguals to refer to targets during the matching tasks, and they were especially slow when they needed to switch between both partner and language.

For both bilinguals and monolinguals, there was a positive relationship between cognitive control and perspective-taking during language comprehension, so that individuals with higher cognitive control overall (as measured by performance on the Trail-Making Test) were faster at recovering from and making a perspective-switch after the partner broke a conceptual pact. These individuals with higher cognitive control were also more likely to show partner-specific adaptation during language production and reuse the consistent label with a given partner, even when they were working with two partners simultaneously and there was competition (i.e., they had used different terms with different partners), requiring a switch between partner perspectives.

This is the first set of studies to compare the same bilingual and monolingual individuals in both comprehension and production tasks. The findings, which link cognitive control and perspective-taking in dialogue, suggest a more complex relationship between bilingual experience and cognitive abilities than has been previously supposed. Theoretical and methodological implications are discussed.

Table of Contents

List of Figures

List of Tables

Acknowledgments

This dissertation would not have been possible without the help and encouragement of many. I'd like to first thank my advisor Dr. Susan Brennan for her support and guidance over the last several years, and for being flexible enough to allow me to work in an area outside of her focus. She has inspired me in both my academic life and in my personal life, and I owe her my deepest gratitude. I'd also like to thank Dr. Arthur Samuel, Dr. Antonio Freitas, and Dr. Marie Huffman for serving on my committee. Their insight has been invaluable in shaping this thesis. I greatly appreciate your encouragement, the hours we spent discussing this project, and your advice for the future.

I owe much to my army of research assistants for helping me with set-up, data collection, and coding: Anton C., Susan Chang, Lilibeth Chauca, Maria Chu, Daniel Davis, Gabriela Espinal, Farhana Faroqui, Xuan Guan, Kristina Kuznetsova, Maria Malamud, Stephanie O'Brien, Kimberly Paredes, and Jonathan Sem. Each was a complete joy to work with, and I wish them all well on their chosen paths. Thanks also go to Glenn Hudson and Ralph Hudson for having programmed the software for my dissertation studies. This wouldn't have been possible without them.

I am also grateful to my parents, Carlos and Ana Gomez, for always believing in me and for the pride they show in my accomplishments. And finally, I'd like to thank my husband Felix for his unwavering love and support, as well his immense patience for late nights, long commutes, and life changes put on hold. I couldn't ask for a better life partner.

Chapter 1. Introduction

A big part of successful communication is the ability to take a partner's perspective. This involves keeping in mind what has been previously discussed, what information an addressee does and does not have, and what the addressee needs. For example, if I am telling a story, I may keep in mind whether the addressee knows the characters in the story. If they do, they may not need as much information. If they don't, I may need to explain that when I refer to Tricia, I am referring to a coworker. Perhaps I need to keep in mind that if I don't clarify that I am talking about Tricia the coworker, my addressee may think I am referring to Tricia our mutual friend.

This sort of perspective-taking can help guide language comprehension and production in order to make achieving mutual goals easier. If I know my friend isn't good at directions, I may make sure that I include plenty of landmarks to make finding her intended location easier. In order to achieve successful perspective-taking people have to somehow suppress their own perspective in order to avoid making egocentric decisions and assumptions. This is a skill that we must learn in early childhood. What cognitive skills underlie perspective-taking ability? If perspective-taking involves resolving competition between one's own perspective and an addressee's perspective, then mechanisms that help us resolve competition, such as cognitive control, are likely recruited.

Does this mean that people who deal with more competition are better at perspective-taking? For example, bilinguals must deal with competition every time they speak. In order to produce speech in their intended language, they must somehow manage competition from their unintended language. Furthermore, bilinguals have more experience in perspective-taking. If they know their addressee speaks only one language, it would be infelicitous for them to choose to speak another. Therefore, it is possible that bilinguals may be better than monolinguals at resolving competition and thus also be better at taking a partner's perspective.

This dissertation aims to examine the relationship between cognitive control and perspective-taking in dialogue, and to extend this to a possible bilingual advantage. If people who are better at resolving competition are better at taking a partner's perspective, then they should be better at using this perspective to guide language comprehension and to adapt to a partner's needs during production. If bilinguals have more experience in resolving competition and perspective-taking, then they should be even better than monolinguals at using partner perspective.

Chapter 2. Bilingualism Shapes Cognition: Theoretical Background

When bilinguals speak, they have the option of using either of their languages. Because bilinguals have at least two lexical items (i.e., translation equivalents) associated with many of their conceptual representations (Tokowicz, Kroll, De Groot, & Van Hell, 2002), they have great flexibility in the choices they can make to lexicalize their intentions (e.g., *dog* or *perro*). Unimodal bilinguals (as opposed to those bilingual in a spoken and a signed language) cannot produce both lexical items at the same time, but rather are forced to make a choice as to which item to produce. In order for communication to be effective, the choice of language has to be appropriate for the intended audience, so in planning speech, bilinguals must consider whether or not their addressee speaks the same two languages they do, or is monolingual and able to understand only if the language chosen is appropriate. Furthermore, when bilinguals interact with others who are similarly bilingual, they must also be ready to process either language (or both simultaneously) when spoken to. These demands upon bilingual language comprehension and speech production necessarily dictate the way in which bilinguals interact with the world, which in turn changes their cognitive functioning.

Bilinguals must have some way to manage their two languages in order to prevent significant interference from one language into the other (Costa, La Heij, Navarette, 2006; Finkbeiner, Gollan, & Caramazza, 2006; Green, 1998; Kroll, Bobb, Misra, & Guo, 2008; La Heij, 2005; Macnamara & Kushnir, 1971, Meuter & Allport, 1999). Bilinguals may choose to mix their languages if they speak to another bilingual (i.e., code-switching; e.g., Myers-Scotton, 2002; Poplack, 1980), but frequently they must communicate in what is essentially a "monolingual mode" (Costa, La Heij, Navarette, 2006). One possibility is that bilinguals have a language "switch" that can turn a language on or off depending on their intentions to speak in one or the other language (e.g., Macnamara & Kushnir, 1971). The idea that there could be a language switch is attractive; however, there is little if any evidence from behavioral studies suggesting that a switch exists. Studies have found that rather than being switched on and off, a bilingual's languages are activated in parallel both during comprehension (Marian & Spivey, 2003; Spivey & Marian, 1999; Van Heuven, Dijkstra, & Grainger, 1998) and during production (Colomé, 2001; Costa, Miozzo, & Caramazza, 1999; Kroll, Bobb, & Wodniecka, 2006). Furthermore, research using more advanced neuroimaging techniques has failed to find a brain area dedicated to a language switch (e.g., Wang, Xue, Chen, Xue, & Dong, 2007).

Whereas parallel activation makes sense for comprehension, because in essence a bilingual is always ready to understand either language, it poses a puzzle in terms of production because it is the speaker who chooses the language intended for communication. Yet, lexical items in the unintended language are still activated to some level during production (Kroll et al., 2008). This creates what has been labeled the "hard" problem in bilingualism research (Finkbeiner, Gollan, & Caramazza, 2006; Kroll et al. 2008): if lexical items in the unintended language are activated (at least partially), how do bilinguals choose the correct lexical item, thereby achieving fluent speech in their intended language? As others have noted (Finkbeiner et al., 2006), this is a problem only from a modeling perspective, because in reality bilinguals manage it very well. Much research in recent decades has been aimed at understanding the dynamics of lexical access in bilingual language production in response to the "hard" problem.

Bilingualism Shapes Cognitive Control

This question of lexical access is made especially interesting because it appears that some bilinguals develop enhanced cognitive control abilities. Some bilinguals have been shown to perform better or faster than monolinguals on tasks requiring resolution of conflicting information, for example the Stroop task, which requires the inhibition of an automatic response to correctly produce a less automatic response (i.e., ignoring the color word to name the font color the word is written in), or in the Simon or flanker tasks, which require ignoring incongruent spatial cues in order to produce a correct response (i.e., ignoring the conflicting spatial location of a target on a screen in order to correctly decide what color the target is, or ignoring incongruent flanking arrows to correctly decide what direction a central arrow is pointing in; e.g., Bialystok et al., 2005; Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok, Craik, & Luk, 2008; Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Costa, Hernández, & Sebastián-Gallés, 2008). This advantage is present from childhood, with bilingual children performing better than monolingual children (e.g., Bialystok, 1999; Bialystok & Martin, 2004; Bialystok & Shapero, 2005; Carlson & Metlzoff, 2008; Martin-Rhee & Bialystok, 2008), and it has been established in bilingual children as young as 7 months of age (Kóvacs & Mehler, 2009). The gap between bilinguals and monolinguals only increases across the lifespan, not just because bilinguals maintain higher cognitive functioning, but also because monolinguals do worse (e.g., Bialystok et al.; Bialystok, Craik, & Luk; Bialystok, Craik & Ryan, 2006). This finding is supported by statistics that show bilinguals who develop symptoms of dementia, do so about four years later than monolinguals (e.g., Bialystok, Craik, & Freedman; 2007), suggesting that there is something about being bilingual that may help slow cognitive degeneration due to aging (e.g., Bialystok & Craik, 2010; Bialystok, Craik, & Freedman; Bialystok, Craik, & Luk; Bialystok et al.). Most researchers have attributed this benefit to the constant level of attention bilinguals presumably use to manage their two languages and achieve production only in the intended language (e.g., Bialystok, 2005; 2009; Kroll et al., 2008).

With this in mind, there is still much debate as to the exact mechanisms at play in bilingual language production, including whether or not lexical items in the unintended language actually compete for selection even though they receive residual activation (e.g., Costa, La Heij, Navarette, 2006; Costa, Miozzo, & Caramazza, 1999; Finkbeiner, Gollan, & Caramazza, 2006), and if they do compete for selection, what method is used to assure only items in the intended language are produced (e.g., Costa & Santesteban, 2004; Costa, Santesteban, & Ivanova, 2006; Green, 1998; Kroll et al., 2008, La Heij, 2005; Meuter & Allport, 1999). Furthermore, there has been a push to use these mechanisms in order to explain enhanced cognitive control abilities in bilinguals (Abutalebi & Green, 2007; Bialystok, 2009; Emmorey, Luk, Pyers, & Bialystok, 2008; Kroll et al., 2008). The assumption is that bilingual language production may involve some of the same resources used in a more domain-general cognitive control system (Bialystok & Craik, 2010; Hernández, Costa, Fuentes, Vivas, & Sebastián-Gallés, 2009). One suggestion is that when faced with translation equivalents competing for selection, bilinguals resolve this conflict by recruiting a separate inhibitory control system (e.g., language task schema, a system that corresponds to a specific language and can recognize lexical items in the intended and unintended language using "language tags") to actively suppress lexical items in the unintended language (e.g., Green, 1998; Meuter & Allport, 1999; Kroll et al., 2008).

Researchers have generally used the phrase *bilingual advantage* in tasks requiring conflict resolution (e.g., Stroop task) to mean that bilinguals excel in inhibiting information that is irrelevant to the task or goal (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok, Craik, & Luk, 2008; Costa, Hernández, & Sebastián-Gallés, 2008). However, this advantage is actually two distinct effects: 1) the conflict effect (i.e., the RT difference between congruent and incongruent trials), which is smaller for bilinguals, so that incongruent distractors *sometimes* produce less conflict for bilinguals than for monolinguals, and 2) the fact that bilinguals are faster overall (Costa et al., 2009). Bilinguals are faster not only on incongruent trials where there is conflicting information, but also on congruent trials where there is no conflicting information (and therefore no conflict resolution, e.g., Bialystok, 2006; Bialystok et al., 2004; 2005; 2006; Costa et al., 2008; Martin-Rhee & Bialystok, 2008; Costa et al., 2009).

This finding has prompted the question of whether enhanced cognitive control abilities in bilinguals can be attributed exclusively to inhibitory control in conflict resolution (e.g., Bialystok, Craik & Ryan, 2006; Costa et al., 2009; Hernández et al., 2010). In addition, the bilingual advantage in conflict resolution (i.e., a reduction in the conflict effect) is in reality difficult to replicate (Colzato et al., 2008; see Costa et al., 2009 for a summary). While most studies looking at cognitive control in bilinguals have found a bilingual advantage in overall reaction time for tasks requiring conflict resolution, not all have found a reduction in the magnitude of a conflict effect for bilinguals compared to monolinguals (e.g., Bialystok et al., 2006; Bialystok, Martin, & Viswanathan, 2005; Martin-Rhee & Bialystok, 2008; Morton & Harper, 2007). It should also be noted that a bilingual advantage in conflict resolution has never been found in the absence of an advantage in overall reaction time (Costa et al., 2009). In examining some of the factors that could be driving the presence or absence of an advantage in cognitive control, Costa et al. demonstrated that the bilingual advantage in overall reaction time disappears when the task is either very easy (8% congruent trials) or very difficult (92% congruent trials). Bilinguals were overall faster than monolinguals when there was low predictability in trial type (50% and 75% congruent trials); however bilinguals showed an advantage in conflict resolution (i.e., a reduced conflict effect) only in the 75% congruent trials condition (see Figure 1 below).

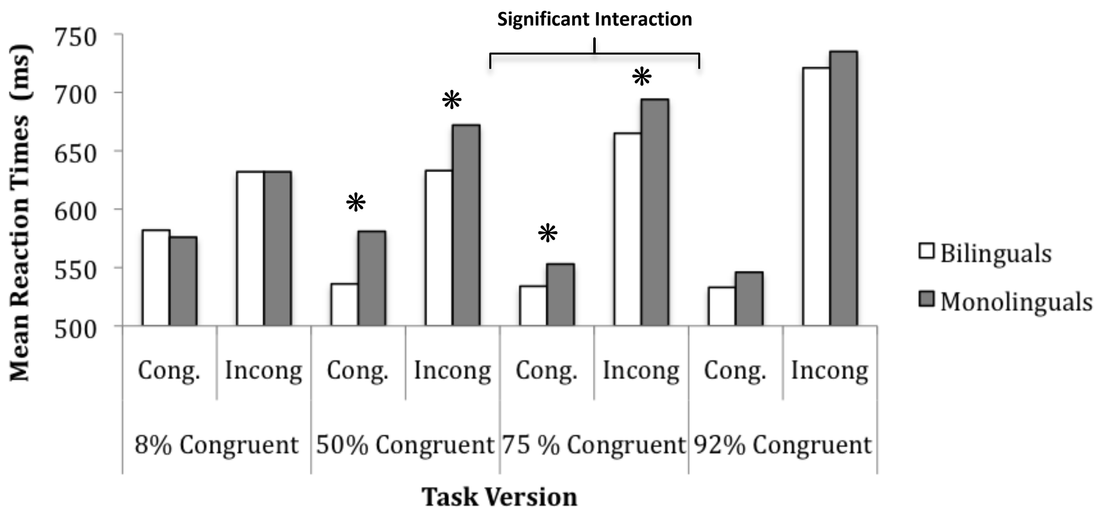


Figure 1. Performance by bilinguals and monolinguals across task versions in Costa et al. (2009). This figure was created by combining Panels A and B of Figure 2 in Costa et al.

A bilingual advantage in conflict resolution could result from more than just an enhanced ability to inhibit conflicting information (e.g., Costa et al., 2009). This advantage could also result from other aspects of the bilingual experience, perhaps from the need to monitor unpredictable linguistic situations in order to best allocate cognitive control resources as needed (Hernández, et al., 2010; Costa et al., 2009). Costa et al. remark that bilinguals often engage in bilingual conversations where they may be simultaneously using both their languages with different interlocutors, and they must keep track of which language they are addressing to whom. The authors speculate that these sorts of linguistic situations may recruit conflict-monitoring processes from a domain-general cognitive control system, and that bilinguals may be demonstrating an advantage in monitoring for conflict. This monitoring system would be responsible for deciding whether conflict resolution is needed, and for deciding what strategy to apply on a trial-by-trial basis, whether that be blocking or unblocking information (see Figure 2 below). For example, when faced with an incongruent Stroop trial, the conflict monitoring system would be responsible for detecting that there is conflict between the desired response (as in *name the blue font color*) and a more dominant response (*read the word red*), and deciding what strategy to apply to resolve this conflict (*do I need to block or unblock the conflicting information?*). Conflict resolution would be the act of suppressing the competing information so that the desired response can be executed, either through inhibition, or by applying whatever strategy is appropriate for the type of conflict.

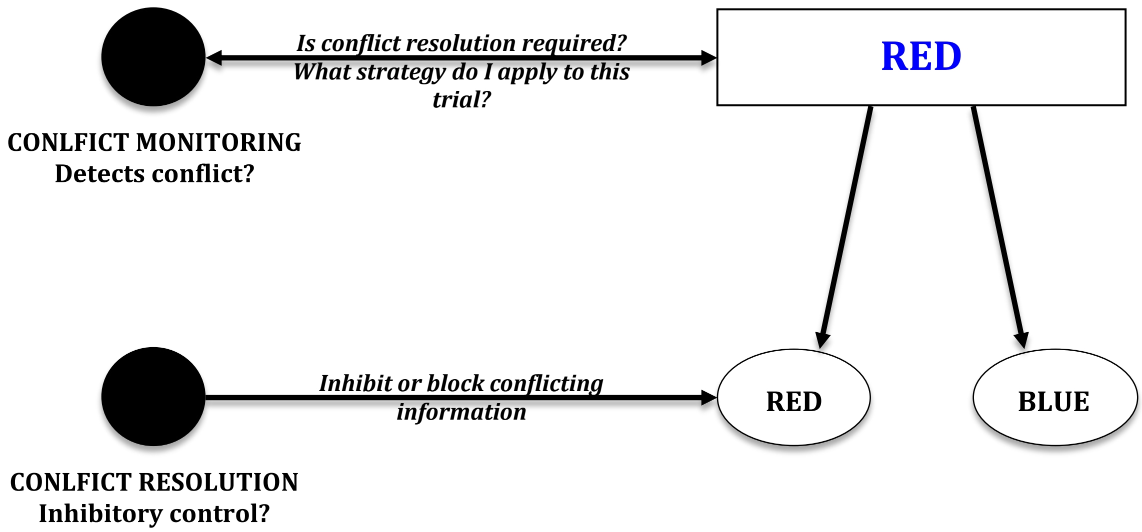


Figure 2. A possible implementation of the conflict-monitoring system as proposed by Costa et al. (2009).

It could be that the detectability of a bilingual advantage in conflict resolution depends on task difficulty, or it could be that any advantage in conflict resolution is a by-product of a bilingual advantage in some other executive process (e.g., conflict monitoring; Costa et al., 2009). Whether bilinguals do show an advantage in conflict resolution, or whether any advantage is due to the impact of other executive processes is still an open question.

Bilingualism Shapes Other Aspects of Cognitive Control

More recent efforts have concentrated on attempting to determine exactly what cognitive control processes are influenced by bilingual experiences, usually by comparing bilinguals and monolinguals on a variety of tasks that are assumed to tap into different aspects of cognitive control. For instance, bilingual children show an advantage in processing complex stimuli on a global-local task that requires identifying either the small symbols that make up a big symbol, or the big symbol itself (e.g., a big H made of little Hs or little Ss). Bilingual children are faster than monolingual children, even on congruent trials when there is no conflict between the global and local information (Bialystok, 2010). They also outperform monolingual children on the Trails B trials in the Trail-Making Test task, which doesn't require inhibition but rather flexibility for task-switching (connecting letters and numbers in an alternating sequence, i.e., 1-A-2-B-3-C, etc.; Bialystok, 2010). Bialystok proposed that bilinguals may be showing an advantage in updating and switching (both of which help keep goal related information active, e.g., *what symbol am I looking for next?*), and that because bilinguals demonstrate advantages beyond those of inhibitory control, the source for these advantages may be more than just the need to inhibit the non-target language.

It is also possible to tap into different components of cognitive control in bilinguals by determining not just what tasks they excel at, but also for what tasks they may be at a disadvantage. Recall that the bilingual advantage in conflict resolution has usually been attributed to an advantage in inhibitory control. However, it is possible to distinguish between conflict resolution through *active* inhibition, which recruits a separate inhibitory control system (e.g., a language task schema; Green, 1998), and conflict resolution through *reactive* inhibition, which suppresses noise by utilizing local mutually inhibitory links between target and competitor

(Colzato et al., 2008). Colzato et al. suggested that rather than be good *active* inhibitors (see below Figure 3, Route c), bilinguals may engage in conflict resolution by strengthening the target code that is most consistent with task goals, which in turn laterally inhibits any competition or noise using local connections (i.e., *reactive* inhibition, Figure 3, Routes a and b, see also Dijkstra & Van Heuven, 1998).

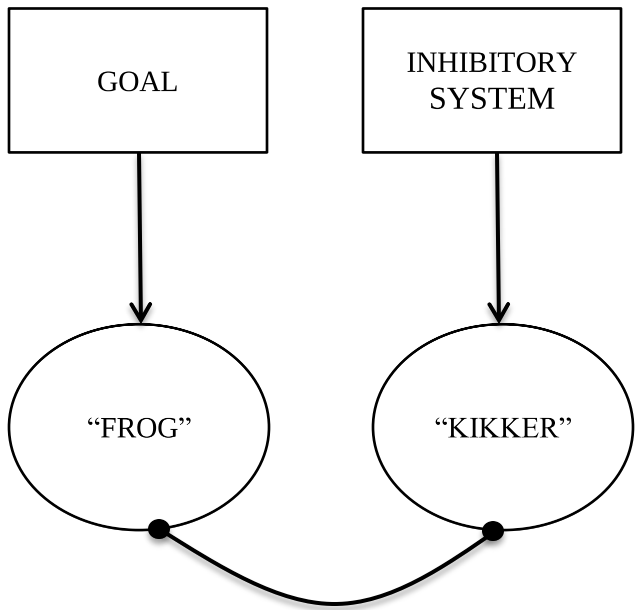


Figure 3. Adapted from Colzato et al. (2008). Routes a and b reflect conflict resolution by strengthening the target code and laterally inhibiting noise (reactive inhibition), while route c reflects the recruitment of a separate inhibitory control system to actively suppress noise (active inhibition).

To test this idea, Colzato et al. compared bilinguals and monolinguals on three tasks: the Stop Signal task, an Inhibition of Return (IOR) task, and an attentional blink task. Since the Stop Signal task requires that a response be aborted after is has been initiated, it is considered to be indicative of active inhibition skills. Bilinguals did not outperform monolinguals on this task, suggesting that bilinguals do not have an advantage when it comes to overt response suppression when there is no conflict (see also Carlson & Meltzoff, 2008 and Martin-Rhee & Bialystok, 2008 for similar findings). The IOR task is also taken to be related to inhibitory control mechanisms because when the location of a target is cued, performance in detecting a target initially improves However, when the lag between the cue and the target is increased, performance suffers, presumably because there is a bias against returning to previously searched locations when trying to find a target. Bilinguals showed more cuing costs than monolinguals (more IOR); nonetheless, Colzato et al. considered the evidence from this task to be inconclusive since it could be explained by both active and reactive inhibition. On the attentional blink task, bilinguals showed a bigger dip than monolinguals in second target reporting at short lags between the two targets. Colzato et al. considered the attentional blink to be a better indicator of reactive inhibition skills reasoning that in attempting to report two targets displayed in succession, there is no reason to want to purposely inhibit the second target, as this would impair performance. However, if devoting more attention to processing a target (strengthening the target code) laterally inhibits noise, then stronger reactive inhibition predicts impaired performance in reporting a second target (a bigger attentional blink). Taken together, the results from these studies suggest that bilinguals may be advantaged in reactive inhibition (that is using cues to activate relevant information more strongly thereby laterally suppressing irrelevant information) rather than in active inhibition (actively suppressing irrelevant information; Colzato et al., 2008).

Beyond Competition in Lexical Access: Bilinguals and Perspective-Taking

Whatever advantages in cognitive control bilinguals may have, the locus for these effects is likely more than just a process achieved via competition during lexical access; other aspects of the bilingual experience may come into play. For instance, bilingual children have been found to develop theory of mind earlier than their monolingual counterparts (Kovács, 2009), usually performing better on appearance-reality, perspective-taking, and false-belief tasks (Goetz, 2003), as well as on spatial perspective taking tasks (Greenberg, Bellana, & Bialystok, 2013). This result has been explained by some as being a by-product of inhibitory control abilities that develop from bilinguals resolving competition at the lexical level. However, it is possible that a bilingual advantage in inhibitory control could stem from the additional practice bilingual children receive in inhibiting their own perspective (or keeping a partner's perspective in mind) early on because they must do so in order to establish effective communication with individuals who are not similarly bilingual (ibid). In monolingual children, cognitive control goes hand in hand with development of theory of mind, so that inhibitory control ability predicts performance on appearance-reality and false-belief tasks (Carlson & Moses, 2001; Carlson, Moses, & Breton, 2002). Perhaps bilingual children learn the value of inhibiting their own perspectives or taking a partner's early on, as it has been noted that even very young bilingual children (one- to two-years of age) will use the appropriate language with conversational partners when necessary (e.g., Goetz, 2003; Genesee, Bovin, & Nicoladis, 1996; King and Fogle, 2006; Lanza, 1992). Recently, the perspective-taking advantage has also been extended to bilingual adults using eye-tracking. Bilingual adults have been found to have an advantage in false-belief tasks, so that they experienced less interference from their own perspective when reasoning about the other's perspective (Rubio-Fernández & Glucksberg, 2012). Furthermore, this advantage was related to individual differences in cognitive control.

In adults, individual differences in inhibitory control have also been found to affect perspective-taking abilities in monolinguals. An eye-tracking study done with native English speakers found that inhibitory control ability predicted ability to use a partner's perspective and suppress inappropriate interpretations of questions made about a set of animals (i.e. referring expressions; Brown-Schmidt, 2009). People who did better on a Stroop task were better able to keep track of whether they had successfully communicated information about a privileged referent (that only they could see) to a partner, measured by whether the partner's linguistically ambiguous referring expression caused them to look only at a mutually visible referent or else at the competitor referent. Since inhibitory control ability affects ability to take another's perspective, bilinguals may have a greater need for effective inhibitory control since it is more imperative that they engage in perspective-taking.

Interim Summary

Bilinguals outperform monolinguals on tasks that require conflict resolution. Even though the exact locus of this advantage is still under debate, it seems as if bilinguals are better at recruiting conflict-monitoring processes when needed, and that they are better at updating and switching between task rules, all of which help keep information relevant to a task or goal active. Bilinguals may also excel at reactive inhibition, with which they might be better at strengthening target codes that coincide with goals and laterally suppressing competition or noise. The focus of most of the work looking at bilingual advantages in cognitive control has been to establish that bilingualism has effects that extend beyond language.

Although bilingual language production is assumed to be at the core of the bilingual advantage, no studies have really established whether bilinguals exhibit advantages in language comprehension and production in dialogue, which is the focus of the current dissertation. Whether it's because bilinguals are better at inhibiting their own perspective or because they are better at keeping goal–related information active, it's possible that bilinguals are more sensitive to those contextual cues that people use during natural conversation (i.e., partner specific cues, common ground, etc.). Bilinguals may also be better than monolinguals at paying any costs associated with switching between partners (and therefore partner perspectives). This project seeks to directly test if a bilingual advantage is present in pragmatic, interactive tasks that require perspective-taking.

Next, I will briefly review theories of bilingual language comprehension and speech production. Then I will comment on how studies looking at perspective-taking in language processing and dialogue fit into these models, and how cognitive control may come into play when bilinguals use contextual cues both when processing and producing language. Finally, I will propose three studies that compare bilinguals and monolinguals on the use of perspective in language comprehension and production, and I will offer predictions about where bilinguals may be advantaged or disadvantaged.

Language Comprehension and Speech Production in Bilinguals

Much of the work done on bilingual language comprehension and production has focused on whether words from the two languages are stored together or separately in memory and whether a bilingual can "turn off" a language when it's not in use. As mentioned previously, there is evidence that a bilingual's languages are activated in parallel, causing interference (or with cognates, facilitation) in both comprehension (e.g., Spivey & Marian, 1999) and production (e.g., Colomé, 2001). Although the representation of languages in a bilingual is moderated by individual differences such as age of acquisition (e.g., Silverberg & Samuel, 2004), fluent bilinguals do not completely deactivate a language, even when it is not in use. How bilinguals handle this interactivity between languages, especially when attempting fluent speech in a single language, is still an open question.

For this reason, many have turned to language production in order to find the locus of the bilingual advantage in cognitive control abilities, as it has been assumed that the explanation lies in the necessity of managing attention to two languages activated simultaneously. The models that propose selection-by-competition accounts of bilingual language production argue that when translation equivalents are activated in parallel, they both compete for selection, creating conflict. On these models, in order for selection to proceed in the intended language, lexical items in the unintended language are actively inhibited (e.g., Green, 1998; Kroll et al., 2008). It has been proposed that it is this constant need to ensure correct production in the intended language that is at the core of enhanced cognitive control abilities in bilinguals (e.g., Kroll et al., 2008, Bialystok, 2009; Bialystok et al., 2004).

Supporting evidence for the use of inhibitory control in bilingual language production comes from the use of paradigms like cued language switching. For example, when completing a digit- or picture-naming task in two languages, bilinguals will sometimes show greater language switching costs when switching *back* into a more dominant language. The switching cost itself is taken as evidence that one language must be inhibited to produce the other, and asymmetrical switching costs have been interpreted as the need to inhibit a dominant language in order to produce the less dominant language (e.g., Meuter & Allport, 1999).

Additional evidence for inhibitory control in bilingual language production comes from studies looking at differences in cognitive control abilities among different populations of bilinguals. Unimodal bilinguals (those bilingual in two spoken languages) outperform bimodal bilinguals (those bilingual in a spoken and signed language) on a flanker task, with the bimodal bilinguals performing similarly to monolinguals (Emmorey et al., 2008). Unimodal bilinguals can produce only one lexical item at a time (they must choose which language to produce), whereas bimodal bilinguals can produce lexical items simultaneously (they can speak and sign a word at the same time). This is taken as further evidence that it is the competition between lexical items that produces enhanced cognitive control abilities in bilinguals (Ibid).

However, there are problems with the feasibility of inhibition as a mechanism for lexical selection in bilingual language production. One issue is the inconclusive evidence coming from studies using switching and other paradigms. Firstly, not all populations of bilinguals show asymmetrical switch costs. Although inhibition may be a possibility for second language learners for whom a native language poses massive interference (Costa & Santesteban, 2004; Linck, Kroll, & Sunderman; 2009), more proficient bilinguals show symmetrical switch costs (Costa & Santesteban; Costa, Santesteban, & Ivanova, 2006, but see Kroll et al., 2008 for counter-arguments). Secondly, switching studies have usually used color or similar cues to elicit switching. This kind of artificially elicited switching is divorced from the mechanisms at play in natural code-switching, because language choice is usually a result of a complex combination of factors such as topic, partner, and environment, etc. (Fishman, 2000). When subjects are given the choice to voluntarily switch languages during a picture-naming task (still far more natural code-switching), even older, unbalanced bilinguals (those more dominant in one language) produce symmetrical switch costs (Gollan & Ferreira, 2009). Lastly, it is possible that switch costs may result not from inhibition, but from the bivalent nature of one set of stimuli being paired with two distinct responses. For instance, one study gave bilinguals a standard digit-naming task to be done in both languages, but interspersed a picture-naming task to be completed only in one language. They found no language-switching costs for the picture-naming task (although there was a *task* switching cost), with naming latencies being identical regardless of the language used in the previous trial, although they did find the typical asymmetrical switching costs for the digit-naming task (Finkbeiner, Almeida, Janssen, & Caramazza, 2006).

Another issue with inhibition as a mechanism for lexical selection is that it arises from the assumption that items in the unintended language compete for selection. Whereas parallel activation is now generally accepted for both comprehension (e.g., Spivey & Marian, 1999) and production (e.g., Colomé, 2001, although Costa, La Heij, & Navarette, 2006 consider the evidence for parallel activation in production to be premature), it is possible that lexical items in the unintended language are themselves not candidates for selection. One option is that a language cue is included as part of a conceptual message, and only candidates that fit the criteria are considered for selection (e.g., La Heij, 2005; Costa, Miozzo, & Caramazza, 1999). Another option is that translation equivalents are not activated to the same level because the intention to speak in one or the other language (or other environmental and contextual cues) may activate the target language more (or lower threshold for selection), therefore the first item to reach a certain threshold for selection is produced (i.e., differential activation; Finkbeiner, Gollan, & Caramazza, 2006).

In sum, the current debate centers on how bilinguals resolve conflict in order to be able to produce fluent speech in the intended language. While it is possible that bilinguals may use inhibitory control to actively suppress the unintended language, it is also possible that bilinguals resolve competition through reactive inhibition, where activation is higher for items in the intended language, which in turn laterally suppresses items in the unintended language. An advantage in cognitive control has also been reported for bilinguals, and it is possible that the source of this advantage may lie in how bilinguals manage both their languages. One factor that needs to be considered is the need for perspective-taking when bilinguals produce language, as they must adapt to the languages their addressees understand. Therefore, it is also possible to probe the role that social and contextual factors may play in bilingual language production, especially when it comes to using perspective to guide production.

Chapter 3. Partner-Specific Adaptation in Dialogue

There is a large body of evidence that documents the importance of context on language comprehension within a single language. Constraint-based models of language processing propose that there are multiple, partial constraints that guide comprehension. These constraints can be guided by perceptual cues that can act to constrain comprehension. Such cues include those associated with immediate context in a story (e.g., Nieuwland & Van Berkum, 2006), common ground with a conversational partner (either visual or linguistic; e.g., Brennan & Hanna, 2009; Brown-Schmidt, 2009; Metzing & Brennan, 2003, Hanna & Tanenhaus, 2004), stereotypes about speakers (e.g., Van Berkum, Van den Brink, Tesink, Kos, & Hagoort, 2008) and personal beliefs (e.g., Van Bekum, Holleman, Nieuwland, Otten, & Murre, 2009). In fact, the same utterance spoken by different conversational partners may be processed differently, depending on the common ground with a particular partner (Metzing & Brennan, 2003). Common ground may even result in a basic level term taking longer to process than an alternative expression (van Der Wege, 2009). Given that bilinguals seem to develop theory of mind earlier than monolinguals, it makes sense to examine whether bilinguals have an advantage over monolinguals in using partner-specific contextual cues such as partner perspective and common ground when both processing and producing language.

A role for contextual cues has also been documented for bilingual language processing, although the focus has been on cues like physical environment or cultural knowledge rather than partner specific cues. For example, Soares & Grosjean (1984) determined that there was interference from the lexicon of the non-target language when bilinguals took longer than monolinguals to reject nonwords in a lexical decision task, the rationale being that they had to search two lexicons in order to reject the nonwords. However, a recent study by Dunn & Fox

Tree (in press) found that this was true only when bilinguals were in a bilingual context. When they were completely embedded in a monolingual context, bilinguals performed the same as monolinguals. In addition, there is evidence that the processing of code-switched sentences can be facilitated by sociocontextual triggers (i.e., culturally relevant references before a switch between languages, e.g.Witteman & van Hell, 2009). Although the importance of partner specific cues in bilingual language processing has not yet been investigated, it's likely that such cues can be just as useful as in monolingual language processing. Furthermore, it's possible that because partner specific cues can guide comprehension, bilinguals may be more sensitive to those partner cues that usually come into play in natural dialogue because they can use them to strengthen those alternatives (i.e., information in common ground) that are consistent with a task or goal (i.e., processing what the partner is saying) and to suppress noise (i.e., competing alternatives).

It is likely that partner specific cues also guide linguistic choices for speakers (both monolingual and bilingual) during language production (e.g., Horton & Gerrig, 2005a, 2005b; Lockridge & Brennan, 2002). Language choice is likely one constraint, and would arise from a bilingual speaker's goal to communicate with a partner in the appropriate language (e.g., what language have I spoken to this person in the past?). A production model in which partner-specific cues can act to constrain lexical selection in bilinguals (and monolinguals!) is to some extent language specific. Following Colzato et al. (2008), bilinguals could excel at strengthening activation of target codes that are consistent with goals, in this case strengthening and choosing those lexical items that are consistent with the speaker's goal of communication in the appropriate language, thereby laterally inhibiting the competing translation equivalents.

It may be that bilinguals get more practice than monolinguals in applying inhibitory control because they often need to suppress a language schema inappropriate to the goal of communicating with a particular partner (e.g., Costa et al., 2009). In other words, constraint arises from goals rather than solely from competition at the lexical level. This is supported by results from language-switching studies where even arbitrary color cues can be used to initiate inhibition. Such cues can facilitate language switches when they are presented sufficiently in advance of an item to be named, perhaps so that an entire language set can be inhibited in advance (Meuter, 2005). It's possible that the natural contextual factors usually at play in dialogue (e.g., partner specific cues, topic, physical environment) can provide even more facilitation than artificial cues for language switching in bilinguals, and that bilinguals are better than monolinguals at exploiting these cues.

Implications: Are Bilinguals Better at Perspective-taking?

The studies in this dissertation directly test for a bilingual advantage in cognitive control in pragmatic dialogue tasks that require perspective-taking in a social context. Although the bilingual advantage in cognitive control ability has been attributed to the circumstances of bilingual language production, previous experimental studies have not looked at how bilinguals use language in the real world. Previous work has examined bilingual language production in isolation from some of the contextual factors (e.g., partner cues and common ground) that come into play in natural conversation. It's possible that a bilingual advantage in cognitive control could translate into an advantage in using some of the partner specific cues that have been shown to guide both comprehension and production. Bilinguals may be better than monolinguals at tracking sources of information (i.e., partner perspective and common ground) and using those cues to resolve conflict both within and between languages (either through active or reactive inhibition). This means that bilinguals will be more flexible than monolinguals when partner cues can facilitate a switch between partners or languages.

In order to compare bilinguals and monolinguals on their ability to use partner cues while processing and producing language in an interactive task, I used methods synthesized from Metzing and Brennan (2003) and Van Der Wege (unpublished manuscript). In order to extend some of the past findings of bilingual advantages in cognitive control to dialogue, I used a referential-communication task (in this case, a matching task). Referential communication tasks have been used extensively for studying language-use in interactive settings, so I sought to build on well-established results in order to test a new population. One such result is the finding that dialogue history with a specific partner matters (e.g., Brennan & Clark, 1996; Horton & Gerrig, 2005b; Metzing & Brennan, 2003; Van Der Wege, unpublished manuscript).

Lexical entrainment refers to the repeated use of expressions to refer to items in conversation (e.g., Barr & Keysar, 2002; Brennan & Clark, 1996; Metzing & Brennan, 2003) and it results when conversational partners reach a temporary and flexible agreement to view a referent in a certain way (i.e., a conceptual pact; e.g., Brennan & Clark, 1996; Metzing & Brennan). Metzing and Brennan (2003) had matchers complete a matching task with a confederate director, in which they entrained on certain descriptions when referring to targets in sets of objects (i.e., a conceptual pact; e.g., *the shiny cylinder*). On the last round of each set, they had the subjects interacting with either the same partner or a different partner. That partner would either continue to use the same referring expression (i.e., the lexical precedent; e.g., *the shiny cylinder*), or a new, equally appropriate referring expression (e.g., *the silver pipe*) to refer to the target object. Subjects took longer to look at the target object when the original partner departed from lexical entrainment and used a new expression instead of the lexical precedent than when it was a new partner who introduced the new expression. These findings suggest that when people entrain on a term, they don't just map that term onto a referent, they also encode partner specific information in those representations.

If bilinguals are better at tracking sources of information by strengthening those representations that best coincide with task goals (i.e., *what label/language have I used with this partner in the past?*) and by updating and switching between task rules (i.e., *which partner am I talking to now?*), then bilinguals should be better at exploiting partner specific cues in dialogue situations. This means that they should be better at using dialogue history to resolve within-language conflict and paying any costs associated with switching between partners or languages (Studies 2A and 2B) when those switches are logical. Furthermore, individual differences in cognitive control should correlate with the ability to resolve conflict in comprehension and production for both bilinguals and monolinguals.

On the other hand, an advantage in tracking sources by keeping goal-related information (e.g., partner's perspective and common ground) in mind also means that bilinguals might be at a disadvantage when faced with disruptions caused by speakers behaving badly[1] (Study 1). If bilinguals exploit partner cues (through reactive inhibition) to activate a target representation more strongly (i.e., partner's perspective), thereby laterally suppressing any noise or competition (i.e., other perspectives), bilinguals should take longer than monolinguals to recover from any interference caused when a speaker inexplicably uses a new referring expression instead of the lexical precedent previously established with that addressee to refer to a previously mentioned item (i.e., breaking a conceptual pact; e.g., Metzing & Brennan, 2003). Furthermore individual

---

[1] Phrase introduced by Gerrig, Brennan, & Ohaeri (2001).

differences in cognitive control should correlate with sensitivity to broken conceptual pacts for both bilinguals and monolinguals.

Overall, the following studies speak not only to a possible bilingual advantage in use of partner cues like perspective and common ground in dialogue, but also to the presumed mechanisms underlying bilingual language processing and production. My findings should also provide further insight into the factors that could be responsible for a bilingual advantage in cognitive control. Such insight would have implications beyond the current experiments. Since this advantage may be associated with slowing or mitigation in cognitive decline, pinpointing these factors could further our understanding of how experiences shape cognitive functioning, especially across the human lifespan.

Chapter 4. General Design and Procedure

The following studies were designed to compare bilinguals and monolinguals on the ability to take a partner's perspective and use partner-specific cues to guide language comprehension (Study 1) and language production (Study 2A). They also sought to relate this perspective-taking ability to individual differences in cognitive control. Furthermore, these studies sought to compare perspective-switching costs in bilinguals when switching partner perspectives both within and between-languages (Studies 2A and 2B). To do this, I chose to use a matching game as the main task, as it is an interactive task that is well established in the referential communication literature (e.g., Clark & Wilkes-Gibbs,1986). The goal of the matching game is for the person in the role of matcher to arrange a set of objects or pictures according to instructions by the person acting as director.

In this set of studies, partner perspective refers specifically to the dialogue history the subject has with a given partner, which in this case is the label (and in Study 2B, the language) that has been previously established with that partner when referring to a particular item. The need to address a different partner at a given moment may require a switch in labels and/or a switch in languages. The assumption is, if different labels or different languages have been used with two partners when referring to a particular item, then subjects must monitor for partner perspective and resolve any conflicts. In order to control which labels/languages were introduced and used with specific items, I had subjects complete all versions of the matching game with two confederate partners. Although subjects were aware at the onset that their partners were research assistants in the lab, they were not told that the labels their partners used for the items were chosen ahead of time.

4.1 Research Questions and Hypotheses

Individual Differences Measures (Cognitive Control). These individual differences measures were included in order to assess the impact of bilingualism and cognitive control ability on perspective monitoring in referential communication.

Hypothesis 1: Bilinguals will be faster and more accurate than monolinguals on the typical measures of cognitive control, indicating an advantage in cognitive control ability (smaller reaction times and a smaller conflict effect on the Stroop Task, a smaller reaction time difference on the Trail Making Test, and better accuracy on Berg's Card Sorting Task).

Hypothesis 2: Bilinguals will show a greater attentional blink, indicating an advantage in *reactive inhibition* (reduced reporting of the second target at intermediate lags on the attentional blink task).

Study 1 (Comprehension): This study compares bilinguals and monolinguals in the matcher role on their use of partner cues (i.e., perspective and common ground) when interpreting old labels (lexically entrained) or new labels to refer to previously mentioned items with old or new confederate directors. This study was done completely in English.

Hypothesis 1: Both bilinguals and monolinguals will be fastest at finding the target when a partner uses the old label to refer to that item (shorter responses latencies in old partner, old label condition and new partner, old label condition).

Hypothesis 2: Both bilinguals and monolinguals will be sensitive to the breaking of a conceptual pact. They will be slower at finding a target when it is the old partner rather than a new partner that inexplicably introduces a new label instead of a lexical precedent to refer to a that item (longer response latencies in old partner, new label condition than in the new partner, new label condition).

Hypothesis 3: Bilinguals may more sensitive than monolinguals to the breaking of a conceptual pact, which could be related to *reactive inhibition* (i.e., strengthening their partner's perspective thereby laterally suppressing other perspectives). Bilinguals will be even slower than monolinguals at finding a target when it is the old partner that inexplicably introduces a new expression instead of the lexical precedent to refer to that item (longer response latencies than monolinguals in old partner, new label condition).

Hypothesis 4: Alternatively, bilinguals may be better than monolinguals at recovering from a broken conceptual pact (shorter response latencies in old partner, new label condition) perhaps because they are more flexible (better task-switching ability).

Hypothesis 5: Bilinguals and monolinguals with higher cognitive control may be *slower* to recover from a broken conceptual pact (negative correlation between cognitive control ability and interference in old partner, new label condition), possibly because cognitive control may suppress competing perspectives either through inhibitory control or reactive inhibition.

Hypothesis 6: Alternatively, bilinguals and monolinguals may be faster to recover from a broken conceptual pact (positive correlation between cognitive control ability and interference in old partner, new label condition), possibly because cognitive control may enable flexibly switching to a new perspective**.**

Study 2A (Production, English-only): This study will compare bilinguals and monolinguals in the director role on their ability to resolve within-language conflict during language production in English and direct the appropriately-entrained-upon labels to each of two confederates serving as matchers.

Hypothesis 1: As a result of the competition produced by having entrained on distinct referring expressions (and mapping two distinct labels) with different partners for the same item, both bilinguals and monolinguals will show longer speaking latencies when referring to items shared with both partners using different labels (e.g., *couch* and *sofa*), than for items shared with each partner using the same label, or for items shared with only one partner (and only one label).

Hypothesis 2: Both bilinguals and monolinguals will show longer speaking latencies for items shared with both partners (using different labels) when they must frequently switch between partners than when partners are blocked.

Hypothesis 3: Bilinguals will be better than monolinguals at paying any costs associated with switching partners, so they will show shorter speaking latencies than monolinguals for items shared with both partners (using different labels) when they must switch between partners (when partners are in the mixed condition).

Hypothesis 4: Both bilinguals and monolinguals will show a positive correlation between cognitive control ability and ability to switch between partners (difference in mean speaking latencies for switch and non-switch trials in the partner mixed condition).

Study 2B: (Production, Spanish and English): This study extends Study 2A to look at between-language switching in bilinguals to allow a comparison of switching costs within and between languages.

Hypothesis 1: As a result of the conflict produced by having entrained upon lexical translation equivalents for the same conceptual item with the two different partners, bilinguals will show longer speaking latencies for items shared with both partners (and labeled in both languages) than for items shared with only one partner (and labeled in only one language).

Hypothesis 2: Frequent switching between perspectives will be more costly than no switching. Bilinguals will show longer speaking latencies for items shared with both partners when they must switch between partners (and therefore switch between languages) than when the partner variable is blocked (no language switching).

Hypothesis 3: Bilinguals may not show a cost when switching between languages (i.e., no increase in speaking latencies when the language for a given trial is different from the previous trial than when it is the same as for the previous trial) if switching between languages based on naturally occurring cues to their partner's identity facilitates the switch (in contrast to the typical language-switching cost associated with switching based on external cues such as color, e.g., Meuter & Allport, 1999).

Hypothesis 4: Alternatively, bilinguals may still show a cost when switching between languages (i.e., an increase in speaking latencies when the language for a given trial is different from the previous trial than when it is the same as for the previous trial) if switching between languages based on naturally occurring cues to their partner's identity does not facilitate the switch.

Hypothesis 5: Bilinguals will show a positive correlation between cognitive control ability and the ability to switch between partners (and therefore switch between languages, i.e., difference in mean speaking latencies for switch and non-switch trials in mixed condition).

Hypothesis 6: Switching between languages (Study 2B) may be no more costly than switching between partner perspectives (Study 2A) if the presence of a switching cost is about competition between lexical items and not inhibition of the unintended language (no difference in reaction time for switch trials between Studies 2A and 2B).

Hypothesis 7: Alternatively, switching between languages (Study 2B) may be costlier than switching between partner perspectives (Study 2A) if the presence of a switching cost is not just about competition between lexical items, but also the need to inhibit lexical items in the unintended language.

4.2 Subjects

In order to maximize the efficient recruitment of the bilingual population on campus and to minimize individual differences to allow for cross-experiment analyses, the same subjects were used across all relevant studies. Monolingual subjects came in for a total of two sessions, while bilingual subjects came in for a total of three sessions (for an overview of the experimental sessions and task-completion order, see Figure 4 below). The majority of sessions were completed only a couple of days apart, but in a few cases because of scheduling issues, the sessions were spread out across a few weeks.

Monolinguals. Forty-eight English monolinguals from Stony Brook University were recruited for this set of studies through flyers posted around the university campus or through SONA, the Psychology Department's online subject pool website. Subjects were considered English monolinguals if: 1) they did not grow up in a household that spoke more than one language on a regular basis, 2) they themselves did not use a second language on a regular basis either growing up or as an adult, and 3) they had never acquired a second language to a level of significant fluency. It is important to note that most monolingual subjects grew up in the United

	Monolinguals	**Bilinguals**
Session 1 (≈ 2 hrs)	Stroop Task Attentional Blink Task Language/Demographic Questionnaires Boston Naming test Trail Making Test Berg's Card Sorting Task	Stroop Task Attentional Blink Task Language/Demographic Questionnaires Boston Naming test Trail Making Test Berg's Card Sorting Task
Session 2 (≈ 1 hr)	Tangram Matching Task (Study 1) Picture-Matching Task (Study 2A)	Tangram Matching Task (Study 1) Picture-Matching Task (Study 2A)
Session 3 (≈ 30 min)		Bilingual Picture-Matching Task (Study 2B)

Figure 4. Schedule for experimental sessions. This figure outlines the schedule for completion of studies and tasks for both monolingual and bilingual subjects.

States where some form of second language instruction is an established part of public school curricula and therefore all subjects had some exposure to a second language. All confirmed that they had never really mastered the languages they had studied in school and did not consider themselves bilingual.

Sixteen other subjects were excluded because they either did not meet the criteria for English monolinguals (e.g., grew up in a bilingual household), failed to follow instructions, or did not return for the subsequent experimental session. An additional subject was excluded because he turned out to be an acquaintance of one of the confederate partners working with him for that session. These subjects were replaced until I reached the target sample of 48 monolinguals. Of the 48 monolinguals, 35 were compensated one research credit per hour (3 credits total), 10 were paid $8 per hour ($24 total), and 3 were compensated with a combination of cash and research credit.

Bilinguals. Forty-eight bilinguals who had acquired both Spanish and English early in life were also recruited from Stony Brook University through flyers and the SONA system website. Subjects were considered early Spanish-English/English-Spanish bilinguals if: 1) they acquired both Spanish and English before age seven, 2) they grew up hearing both Spanish and English on a regular basis, 3) they themselves used both Spanish and English on regular basis as children and as adults, and 4) they were recognizably fluent in both Spanish and English (at least in speaking and understanding). Although all bilingual subjects were fluent in both Spanish and English, most were English dominant, even in cases were Spanish was the first language. Only five subjects considered themselves Spanish dominant (however, only two of these subjects scored higher on the Spanish portion of the Boston Naming Test than on the English portion).

Eleven other bilingual volunteers were excluded either because they did not meet the criteria for bilinguals (e.g., they acquired either English or Spanish too late in life), they failed to follow instructions, or they did not return for the subsequent experimental sessions. These subjects were replaced until I reached the target sample of 48 bilinguals. Of the 48 bilingual subjects, 8 were compensated with one research credit per hour (4 credits total), 34 were paid $10 per hour ($40 total), and 6 were compensated with a combination of cash and research credit

Confederate Partners. A total of nine undergraduates (three males and six females) working as research assistants in the lab participated in this set of studies as confederate partners. Eight out of the nine were either native speakers of English or spoke English with native-like fluency (i.e., they were either English monolinguals or were bilingual but acquired English early, were English dominant, and spoke English with no discernible accent). The ninth was a Spanish-English bilingual who was fluent in English, but acquired it later in life and spoke it with a slight accent. However, this confederate participated only in Study 2B as the partner the subject used Spanish with. For the six confederate partners participating in Studies 1 and 2A (English only), three were male and three were female. The remaining three females participated exclusively in

Study 2B (both Spanish and English) and were all Spanish-English bilinguals (the confederate discussed previously and the two other early bilinguals).

Two confederate partners participated in each session, and they were always matched by gender. The subjects were always introduced by name to the confederate partners they would be working with on the matching tasks. The physical characteristics of all confederate partners were distinct enough from each other that they would not be easily confused.

4.3 General Apparatus

All three versions of the matching task were completed using three 15.6" Dell LED screen laptop computers connected by a local area network (see Figure 5 below for set up). The director sat facing the matcher(s), and when there were two matchers in the room (half of the critical rounds for Studies 2A and 2B), the matchers sat side-by-side.

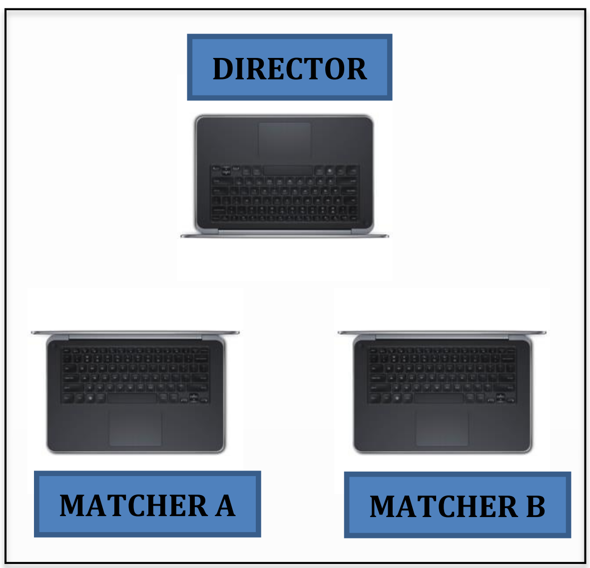


Figure 5. Computer set-up for the matching tasks.

The programs running the matching tasks were written using C++, and compiled and developed in Borland C++ Builder (Version 5). Although the director's display varied slightly by study, the basic set up was the same. The director would see the target card in either an array at the bottom of the screen (arranged in the desired order) or alone in the center of the screen and would describe or label the card. The matcher would choose a card that matched that description or label from a randomly ordered array at the bottom of their screen by clicking on the card. The card would then move into the next available slot at the top of the screen on all displays, allowing the director to either 1) confirm a correct choice or 2) note that an error was made and undo the action to allow the matcher to make another choice. The programs recorded the click time and the card chosen by the matcher for each trial, including for any errors that were later undone by the director. The programs also made an audio recording of the entire verbal interaction between director and matcher(s) for each round of the matching tasks.

Chapter 5. Individual Differences Measures

5.1 Demographics and Language Proficiency Measures

All three questionnaires were administered electronically on a laptop computer.

Demographics Questionnaire. To measure socioeconomic status and other factors that may partially account for differences among subjects, all subjects completed a short demographics questionnaire. This questionnaire consisted of nine items that asked about family income, number of siblings, total household size, parent education, racial/ethnic background, and places of residence and birth (see Appendix A).

Language Experience and Proficiency Questionnaire. To assess proficiency and language history (again to partially account for differences among subjects), all subjects completed the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, Blumenfeld, & Kaushanskaya, 2007). This measure contains a general language experience questionnaire consisting of nine items that ask about the context of language exposure, including languages known, order of language acquisition, order of dominance, percentage of time exposed to each language in conversation and in text, as well as the cultures identified with. The measure also contains items asking about disabilities and level of education. These nine items were followed by a 7-item measure that asks subjects to self-report on their level of proficiency in each of the language skills and context of acquisition and use for each language on a 10-point scale. Monolingual subjects were asked to include this information for whatever second language they had been exposed to in school or other environments.

Language-Use Questionnaire. To measure exposure to and experience with code-switching, bilingual subjects completed an additional 6-item language-use questionnaire created for these dissertation studies. The measure asked subjects to rate on a 10-point scale how often they themselves code-switched or heard other people code-switching in certain contexts (e.g., home), or how often they themselves code-switched or heard other people code-switching with certain people (e.g., friends). The measure also asked subjects to rate how prevalent and how normal they considered code-switching to be (see Appendix B).

Boston Naming Test. The Boston Naming Test (BNT) was included, as in the past it has been considered a standard in the bilingualism literature for objectively measuring language proficiency (for a recently normed alternative to the BNT, see Gollan et al., 2012). The test consists of 60 black and white pictures, mostly of household and other common objects that are organized from easiest (e.g., pencil) to most difficult (e.g., trellis) to name. The pictures were presented one at time in a binder by the experimenter, and subjects were given 20 seconds to name each item out loud, or the option to move on. Monolinguals completed the BNT in English, while bilinguals completed the test in both Spanish and English, with language order counterbalanced across bilingual subjects.

5.2 Cognitive Control Tasks

Each of the following measures was included to measure some aspect of cognitive control. The Stroop Task (inhibitory control), the Trail Making Test (task-switching and flexibility), and Berg's Card Sorting Task (set-shifting ability and perseverative thinking) are all typical measures of cognitive control that have been used extensively by researchers, including with bilinguals (e.g., Bialystok, 2010; Bialystok, Craik, & Luk, 2008; Bialystok & Martin, 2004). The attentional blink task (reactive inhibition), although not typically considered a cognitive control task, was included to further test the reactive inhibition hypothesis proposed by Colzato et al. (2008).

Stroop Task. All subjects completed a Stroop task (adapted from Bialystok et al. 2008) as a measure of *conflict resolution* and *inhibitory control*. The Stroop task was run on a 13" MacBook computer using SuperLab experiment software (Version 4.5.1). Subjects completed two blocks in each of four conditions (eight blocks total): a word control condition, a color control condition, a congruent condition, and a Stroop condition. Each block consisted of 24 trials, making a total of 192 trials (48 per condition).

In the word control condition, subjects saw color words (e.g., red) in black font and were instructed to read each word out loud as quickly as possible. In the color control condition, subjects saw a string of six Xs (i.e., XXXXXX) and were instructed to name the font color the Xs were written in as quickly as possible. In both the congruent and Stroop conditions, subjects were instructed to name the font color of the color word as quickly as possible. In the congruent condition, the color word and the font color were the same (e.g., the word "red" in red font), while in the Stroop condition the color word and the font color were different (e.g., the word "red" in blue font). The Stroop condition is considered the typical measure of conflict resolution.

On each trial, subjects saw a fixation cross in the center of the screen for 300 ms, followed by a 300 ms beep indicating the trial was coming. The beep was included to indicate the beginning of each trial on the audio recording, so that later coding of the recording for accuracy would be easier. The target appeared and remained on the screen until the subject responded out loud. The SuperLab software recorded verbal response latencies, while actual verbal responses were recorded using Audacity, a free audio editing program (Version 1.3.13), and were later coded for accuracy.

Attentional Blink Task. All subjects completed a basic Rapid Serial Visual Processing (RSVP) task in order to measure individual differences in *reactive inhibition* (Colzato et al., 2008), as measured by performance in reporting two targets (two digits in a stream of letters) in succession (i.e., Attentional Blink). The Attentional Blink task was run on a Dell laptop using the SuperLab experiment software.

Subjects completed the task in a total of five blocks: one practice block of 24 trials and four critical blocks of 60 trials each (240 critical trials total). Each trial of the RSVP task consisted of a fixation cross presented for 2000 ms, followed by 20 items (18 letters and 2 digits) presented for 40 ms each with an interstimulus interval of 40 ms. Position of the first target (T1) varied between positions 7, 8, and 9 of the stream, and the number of distractors (letters from the alphabet) between T1 and T2 varied between 0, 2, 4, and 7 distractors (Lags 1, 3, 5, 8 from T2). Subjects attempted to report the two targets (digits drawn from 1-9) by typing their responses into a text box after each trial. Proportion of correct reporting for both targets was measured at all lags.

Trail Making Test. Following Bialystok (2010), subjects were administered the Trail Making Test (TMT) to measure individual differences in *task-switching ability* and *flexibility*, which is another component of cognitive control (Stuss et al., 2001). In a typical TMT, subjects have to connect a series of dots in sequential order as quickly and as accurately as they can. The test is divided into two types of trials: Trails A (25 dots) and Trails B (26 dots). Trails A is typically the baseline condition, as all the targets are numbers (i.e., 1, 2, 3, etc.), however, for the Trails B trials the targets are both numbers and letters (i.e., 1, A, 2, B, 3, C, etc.). The Trails B trials are the measure of task-switching ability, as subjects must alternate between rules.

This version of the TMT was taken from the Psychology Experiment Building Language (PEBL; Mueller, 2012) and was run on a Dell laptop computer. Subjects completed four Trails A (25 dots) trials and four Trails B (26 dots) trials, for a total of eight trials. The dot pattern was randomly generated by the program on every trial. All subjects were told that they could study each display for as long as they wanted, and that timing would begin with the first click. The first target (always the dot numbered 1) was highlighted on every trial. Subjects were told to use the attached mouse to complete the task, and to work as quickly and as accurately as possible. The program recorded median click time per “dot”, total completion time, and overall accuracy for each trial type (the number of clicks for completion).

Berg’s Card Sorting Task. All subjects completed an electronic version of Berg’s Card Sorting Task (BCST; Berg, 1948), a freely available version of the Wisconsin Card Sorting task a measure of *set-shifting ability* and *perseverative thinking*. In this task, the subject is presented with four “piles” of cards, each having three features: 1) color (red, green, yellow, and blue), 2) shape (triangle, star, cross, and circle), and 3) number (one, two, three, and four). On each trial, they are then presented with a new card and are told that they must sort the card into a pile according to a rule (i.e., color, shape, or number). The subject is not told what rule they should use, but rather must figure it out through trial and error using the feedback they receive after each decision (i.e., correct or incorrect). In order to measure task or “set- shifting” ability, the rule changes after a predetermined number of correct sorts, so that the subject must again figure out what rule they should be using. This allows for a measure of the number and type of errors (e.g., perseverative) made for subsequent trials. However, it is likely that this task also involves taxing working memory, given the memory load involved in remembering the current rule, the previous rule, and the types of sort attempted when determining the new rule to use.

This version of the BCST was also taken from the PEBL and was run on a Dell laptop computer. The program used a 64-card deck, and subjects ran through the deck twice (with a different order for the two runs). Subjects had to correctly sort 10 cards before moving on to the next rule. The program calculated the number of correct responses, as well as the number and type of errors made.

5.3 Results and Discussion

Demographic and Proficiency Measures. Bilinguals differed from monolinguals on several key demographic and proficiency measures (see Table 1 below). For example, bilinguals were less likely to have been born in the US, and therefore reported less time in the US overall. However, the most important differences come when looking at socio-economic status and language proficiency. Bilinguals as a group had lower socio-economic status than monolinguals, so that their parents were less educated on average and there annual family income was significantly lower, even though the average household size was the same for both subject groups.

Bilinguals were also less proficient than monolinguals in English. Scores on the BNT were adjusted using the suggested practice of giving bilinguals credit for the first 30 items, and then to add a point for every item correctly named of the second 30 items (Kohnert, Hernandez, & Bates, 1998). Their performance on the English portion of the BNT was significantly lower, naming about 6 items fewer on average, even though 86% classified themselves as English dominant (note that English was the second language for the majority of bilinguals). They also self-reported scores similar to those reported by monolinguals on English speaking and understanding, suggesting a disconnect between perceived proficiency and actual proficiency. These bilinguals were also fairly unbalanced, despite reporting speaking both languages on a regular basis. They performed worse on the Spanish portion of the BNT than on the English portion, and on average they self-reported lower speaking and understanding scores in Spanish.

Table 1.

Subject Characteristics

Measure	Monolinguals	Bilinguals
Average Age (years)	20.69 (4.01)	19.71 (1.69)
Proportion Born in US**	.98	.79
Average Length of Time in US (years)**	18.25 (3.43)	16.34 (4.24)
Average Household Size	4.03 (1.43)	4.23 (1.22)
Average Annual Family Income (thousands)**	81.49 (31.21)	51.06 (31.08)
Median Annual Family Income (thousands) +	90.00	40.00
Average Mother Education (years)**	14.96 (2.85)	12.40 (2.82)
Average Father Education (years)**	15.09 (3.12)	12.44 (3.54)
Proportion English is L1+	1.00	.19
Proportion Spanish is L1+	-	.81
Proportion English is Dominant+	1.00	.86
Proportion Spanish is Dominant+	-	.14
Average L2 Age of Acquisition (years) +	-	3.53 (2.25)
Average L2 Speaking Self-Reported Score (LEAP-Q) +	-	9.06 (1.04)
Average L2 Understanding Self-Reported Score (LEAP-Q) +	-	9.31 (.80)
Average Adjusted English Score (BNT)**	55.33 (2.70)	49.75 (5.42)
Average Adjusted Spanish Score (BNT) +	-	42.00 (4.77)
Average English Speaking Self-Reported Score (LEAP-Q)	9.58 (.58)	9.35 (.81)
Average English Understanding Self-Reported Score (LEAP-Q)	9.56 (.54)	9.42 (.74)
Average Spanish Speaking Self-Reported Score (LEAP-Q) +	-	8.06 (1.52)
Average Spanish Understanding Self-Reported Score (LEAP-Q)+	-	8.96 (.97)

Note: *p < .05, **p < .01, + No *t*-test performed. SD in parentheses.

These characteristics of the bilingual sample may partially account for some surprising findings that will be discussed presently. It is important to keep in mind not only how these bilinguals differed from the monolingual sample, but also how they might differ from previously studied bilinguals.

Cognitive Control Tasks

Contrary to predictions and to previously reported results (e.g., Bialystok, 2009) bilinguals performed *worse* than monolinguals on most of the cognitive control measures. This may be due in part to systematic differences between the two groups on socio-economic status and language proficiency, although some researchers have found evidence that factors such as socio-economic status do not outweigh the advantage in cognitive control afforded by bilingualism (e.g., Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012; see discussion below).

Stroop Task. I ran an ANOVA to examine the effect of subject type and task condition on speaking latency for correct trials (see Figure 6 and Table 2 below). Bilinguals had significantly longer speaking latencies in the Stroop task (Mdiff = 38.62), indicating that they were overall slower than the monolinguals $F(1,94) = 7.82$, $p < .05$. In order to quantify how much interference each group experienced when there was conflict between the color they had to name and the color word on the screen (i.e., Stroop condition), I subtracted the speaking latencies in the Congruent condition from the speaking latencies in the Stroop condition (i.e., the conflict effect). Bilinguals did not differ from monolinguals in the amount of interference they experienced from the conflict in the Stroop condition, suggesting that they did not have an advantage over monolinguals in inhibitory control ability, $t(94) = .31$, $p = .76$.

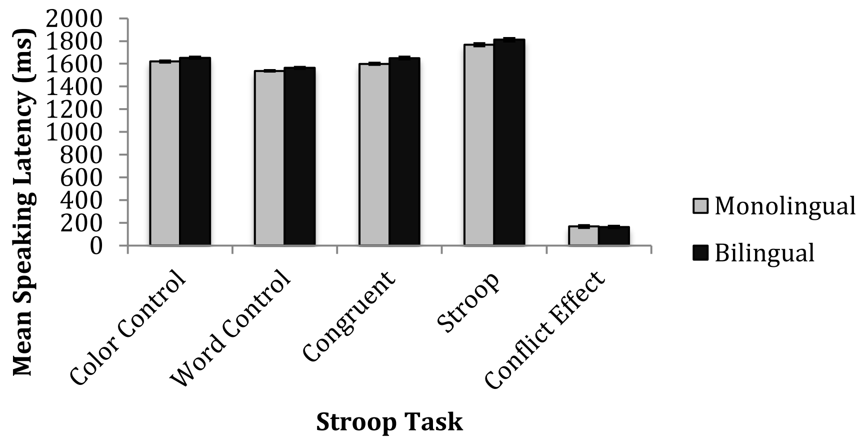


Figure 6. Mean Speaking Latency in the Stroop task by condition and by subject.

Table 2.

Descriptive Statistics for Speaking Latencies in Stroop Task (in ms)

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Color Control	1619.79	63.03	1653.25	71.75	1636.52	69.25
Word Control	1537.75	48.65	1563.39	65.46	1550.57	58.79
Congruent	1599.32	68.62	1649.67	88.67	1624.49	82.83
Stroop	1767.33	100.42	1812.37	105.57	1789.85	104.95
All Conditions	1631.05	61.44	1669.67	73.39	1650.36	-
Conflict Effect	168.01	85.88	162.71	80.47	165.36	82.82

Bilinguals also committed more errors (either complete misses or disfluencies) than monolinguals in the Stroop task overall (Mdiff = .25), $F(1, 94) = 6.02$, $p < .05$ (see Figure 7 and Table 3 below). However, there was also a significant interaction between condition and subject type, $F(3, 282) = 5.35$, $p < .05$, indicating that although bilinguals performed significantly worse in all conditions except the color control condition where they were the same as monolinguals, the difference in accuracy between bilinguals and monolinguals was much greater in the Stroop condition than in all the other conditions, *F*(1, 94) = 6.35, *p* < .05 .

Speaking latencies also varied by condition, *F*(3, 282) = 44.791, *p* < .05 (see Figure 6 above and Table 2 above). I replicated the typical Stroop Effect, so that people were fastest when they just had to read the words on the screen (i.e., Word Control condition) and slowest when there was conflict between the color word on the screen and the color they had to name (i.e., Stroop condition). People were also faster when the color word matched the color they had to name (i.e., Congruent condition) than when they had to name the color from a series of Xs (i.e., Color Control condition), indicating that having the matching color word present gave people a slight reading advantage. When looking at errors, there was also a significant effect of condition, *F*(3, 282) = 44.75, *p* < .05 (see Figure 7 and Table 3 below), so that people committed the most errors in the Stroop condition and the least number of errors when they were reading the words on the screen (Word Control) and when the word on the screen matched the font color (Congruent condition).

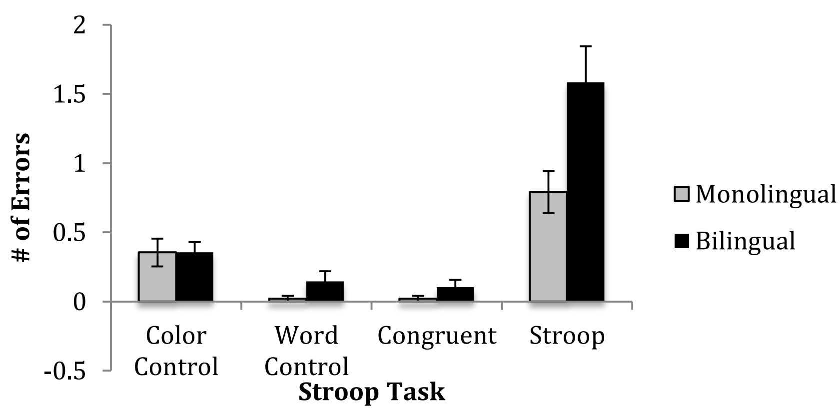


Figure 7. Mean number of errors in the Stroop task by condition and by subject.

Table 3.

Descriptive Statistics for Errors in Stroop Task

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Color Control	.35	.70	.35	.53	.35	.62
Word Control	.02	.14	.15	.50	.08	.37
Congruent	.02	.14	.10	.37	.06	.28
Stroop	.79	1.05	1.58	1.81	1.19	1.52
All Conditions	.30	.45	.55	.08	.43	-

Attentional Blink Task. Bilinguals did not differ from monolinguals in the proportion of time they reported both targets in the Attentional Blink task, $F(1, 94) = .03$, $p = .87$ (see Figure 8 and Table 4 below). This indicates that unlike in Colzato et al. (2008), bilinguals did not have an increased attentional blink when compared to monolinguals, which in turn appears to indicate that bilinguals do not have an advantage in reactive inhibition.

There was a significant effect of Lag condition, which only partially replicates the typical attentional blink effect, $F(3, 282) = 152.18$, $p < .05$ (see Figure 8 and Table 4 below). People were better at reporting both targets at Lag 5 than earlier lags, $F(1, 95) = 254.77$, $p < .05$, and they were even better at Lag 8 than at previous lags, $F(1, 95) = 275.70$, $p < .05$. This is consistent with the typical finding that as the lag between targets increases, people are more likely to see and report both targets. However, unlike the typical attentional blink effect, there was no difference in the proportion of time people reported both targets at Lags 1 and 3, $F(1, 95) = 1.39$, $p = .241$. Usually performance is better when one target appears directly after the other, and then drops at intermediate lags. It is unclear why my results do not replicate the typical finding.

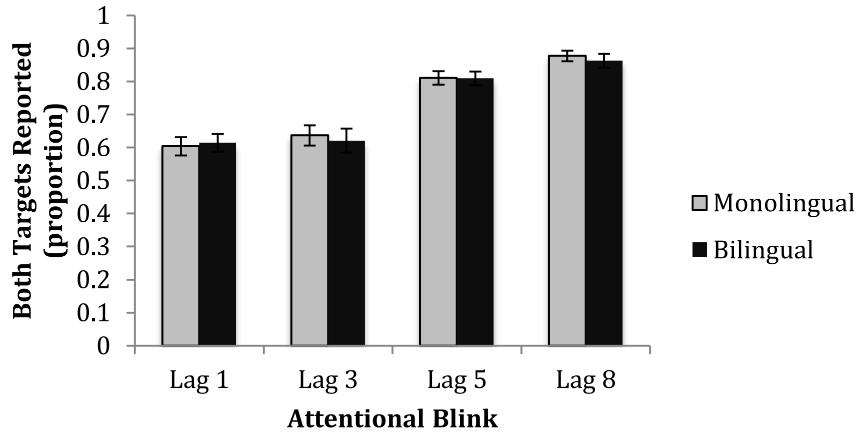


Figure 8. Proportion of trials both targets were reported in the Attentional Blink task by lag condition and by subjects.

Table 4.

Descriptive Statistics for Proportion of Correct Reporting of Both Targets in The Attentional Blink Task.

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Lag 1	.61	.18	.60	.19	.61	.19
Lag 3	.62	.25	.64	.21	.63	.23
Lag 5	.81	.14	.81	.14	.81	.14
Lag 8	.86	.14	.88	.11	.87	.13
All Lags	.73	.15	.73	.16	.73	-

Trail Making Test. Bilinguals were again slower (Mdiff = 55.94) than monolinguals (i.e., longer median reaction times on average) when completing the Trail Making Test, $F(1, 94) = 5.33$, $p < .05$ (see Figure 9 and Table 5 below). All subjects were slower in Trails B, when they were required to quickly switch between rules (i.e., numbers and letters) than in Trails A, when they only had one rule (i.e., only numbers), $F(1, 94) = 331.46$, $p < .05$. However, there was also a significant interaction of trial type by subject type, $F(1, 94) = 7.61$, $p < .05$, so that bilinguals were even more slowed down in Trails B trials than monolinguals,), $F(1, 94) = 7.61$, $p < .05$. This was also evident in that the average difference in median reaction time for both trial types (i.e., average of median RT in Trails B minus median RT in Trails A) was significantly larger in bilinguals than in monolinguals, indicating that they experienced more conflict and were slower and less flexible when switching rules, $t(94) = 2.76$, $p < .05$.

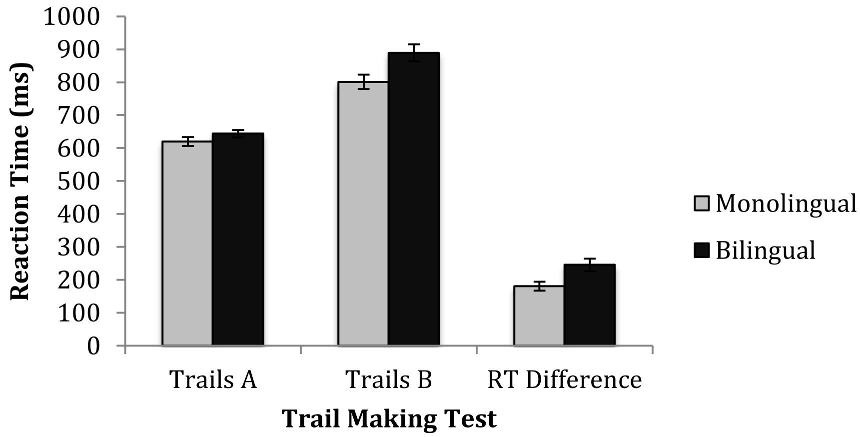


Figure 9. Mean RT in the Trail Making Test by trial type.

Table 5.

Descriptive Statistics for Reaction Time in the Trail Making Test

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Trails A	620.02	92.76	643.67	77.73	631.85	85.95
Trails B	800.89	151.04	889.12	179.04	845.01	170.62
All Trial Types	710.46	116.11	766.40	121.23	738.43	-

I also found a significant effect of trial type on accuracy, such that people made significantly more mistakes (Mdiff = .02) when they had to switch between rules (Trails B) than when they had only one rule (Trails A), $F(1, 94) = 30.45$, $p < .05$ (see Figure 10 and Table 6 below). Although the difference in accuracy between bilinguals and monolinguals did not reach significance, bilinguals did appear to be marginally less accurate $F(1, 94) = 3.11$, $p = .08$.

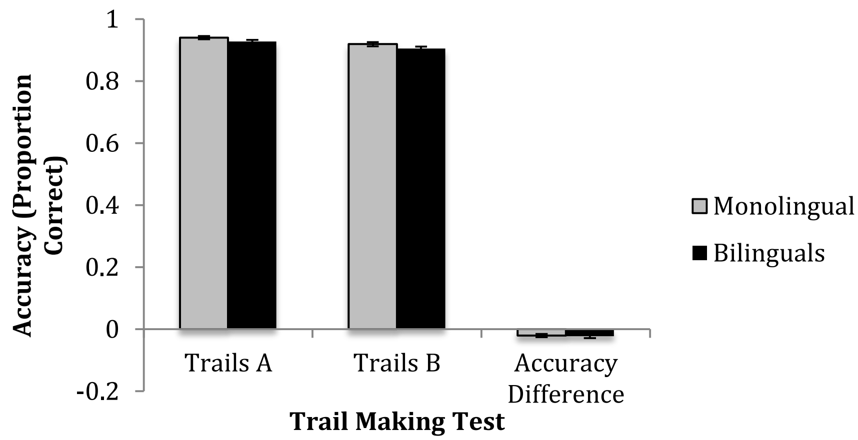


Figure 10. Mean accuracy in the Trail Making Test by trial type.

Table 6.

Descriptive Statistics for Accuracy in the Trail Making Test (dots/clicks to complete task)

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Trails A	.94	.04	.93	.04	.93	.04
Trails B	.92	.05	.90	.05	.91	.05
All Trial Types	.93	.04	.92	.04	.93	-

Berg's Card-Sorting Task.

I ran an independent sample *t*-test comparing bilinguals and monolinguals on the percent of cards that were sorted correctly for Berg's Card-Sorting Task (see Figure 11 and Table 7 below). Bilinguals were marginally less accurate than monolinguals (Mdiff = 3.59), indicating that on average they sorted slightly fewer cards correctly, $t(94) = 1.75$, $p = .08$. Another independent samples *t*-test on the percent of perseverative errors committed revealed that bilinguals did not differ from monolinguals, $t(94) = .62$, $p = .54$ (see Figure 12 and Table 7 below).

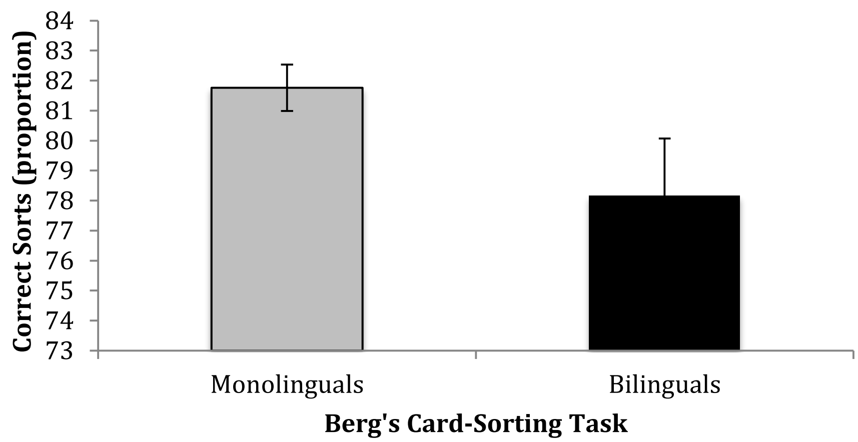


Figure 11. Mean proportion of correct sorts in the Berg's Card-Sorting Task by subject type.

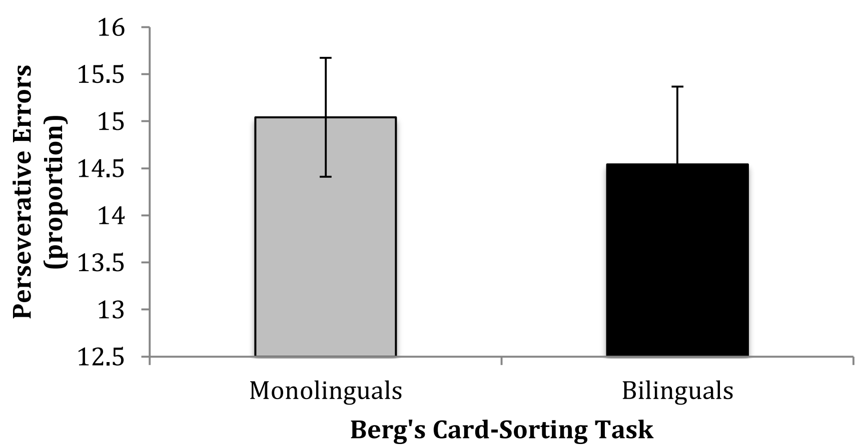


Figure 12. Mean proportion of perseverative errors in the Berg's Card-Sorting Task by subject type.

Table 7.

Descriptive Statistics for Accuracy in Berg's Card-Sorting Task (percent)

	Monolinguals		Bilinguals		Collapsed	
	M	*SD*	*M*	*SD*	*M*	*SD*
Correct Sorts	81.76	5.34	78.17	13.19	79.96	10.17
Perseverative Errors	12.01	3.19	11.53	4.39	11.77	3.82

Relationships Among Measures.

I ran a series of correlations with both bilinguals and monolinguals included, in order to assess the relationships between the measured demographic and proficiency variables and performance on the different cognitive control tests. These analyses revealed some interesting (and potentially explanatory) relationships, and I will make note of the most significant of these.

Concerning the correlations among the demographic and proficiency measures (see Table 8 below), it appears that there is a relationship between age and household size, so that the older the person, the smaller the household size. This is probably because younger subjects are more likely to still live at home with family. There is also a relationship between annual family income and years in the US, as well as between annual family income and household size. That is the larger the family and the more time in the US, the higher the family income. It's possible that family income may be higher the more time spent in the US because: 1) subjects are more likely to be older and therefore more likely to make more money and/or 2) the more time since a family has established itself in the US, the likelier that they make more money.

However, perhaps of more significance are the relationships between English proficiency (as measured by the BNT), age of second language acquisition (for bilinguals), years in the US, and more importantly, annual family income. That is the more time in the US, the higher the English proficiency, and in turn the higher the family income. For bilinguals, the later the age of second language acquisition, the lower the English proficiency, and in turn, the lower the family income. Note that for bilinguals, there are no significant relationships between Spanish proficiency (as measured by the BNT) and any other measures. This suggests that it is English proficiency that matters.

Concerning the relationships between the demographic/proficiency measures and the Stroop task (see Table 9 below), the most significant of the correlations are again between English proficiency and performance in the Stroop condition, which is the typical test of conflict resolution. People with higher English proficiency had lower reaction times in the Stroop Task and also made fewer errors. It's possible that people with lower English proficiency may have lower conflict resolution abilities. However, people who were higher in English proficiency also made fewer errors in the Congruent condition, so given that the Stroop task is a linguistic task, it may just be what it seems: bilinguals just had more trouble with English.

There were no significant relationships between any of the demographic/proficiency measures and performance on the Attentional Blink Task (see Table 10 below). However, there were several interesting relationships between some of the demographic/proficiency measures and performance on the Trail Making Test (see Table 11 below). There were significant correlations between English proficiency and reaction time, so that people who were lower in English proficiency were slower on Trails A, Trails B, and more important, showed a bigger reaction time difference between Trails A and Trails B, indicating that they were less flexible and had a harder time switching rules in Trails B. People who were lower in English proficiency were also less accurate on Trails B. In bilinguals, age of second language acquisition was also related to reaction time on Trails B and to the reaction time difference between Trails A and Trails B, probably because of the relationship between age of acquisition and English proficiency.

However, most interesting was the relationship between reaction time on Trails B and annual family income, as well as the reaction time difference between Trails A and Trails B and annual family income. It appears that people who were of lower socio-economic status (as measured by annual family income) were also less flexible when shifting between rules and experienced more interference on Trails B and were slowed down more than people of higher socio-economic status. Since these are correlations, it's isn't clear whether this relationship is really about socio-economic status or about the relationship between socio-economic status and English proficiency, but it is still worth noting.

I also ran correlations between the demographic/proficiency measures and performance on Berg's Card-Sorting Task (see Table 12). The only relationships of note are again between English proficiency and accuracy, so that people higher in English proficiency made more correct card sorts overall. Interestingly, for bilinguals there was a relationship between age of second language acquisition and the percent of perseverative errors, so that bilinguals with lower English proficiency made more perseverative errors. This suggests that the later bilinguals acquire a second language, the more trouble they may have shifting sets.

Finally, I ran correlations among the different cognitive control measures. The most significant relationships were between performance on the TMT and performance on the other tasks (see Table 13). People who were more flexible and better at rule-switching (smaller RT difference between Trails A and Trails B) were faster overall in all conditions of the Stroop Task. These people also made fewer errors in the Stroop condition, indicating that they were perhaps better at conflict resolution. People who had smaller reaction time difference in the TMT were also better at reporting both targets at all lags on the Attentional Blink task, indicating that they had less pronounced attentional blinks. This was also true of people who were more accurate in the TMT, as they reported both targets more often at later lags. There were no significant relationships between the TMT and performance on Berg's Card Sorting Task.

Discussion.

Bilinguals performed worse than monolinguals on most of the cognitive control tasks. This goes against both my earlier predictions about a bilingual advantage in cognitive control and previously reported results (e.g., Bialystok, 2009). It isn't clear exactly why these bilinguals not only didn't show the advantage in cognitive control, but rather showed a clear disadvantage when compared to monolinguals. Although surprising, this does speak to the complex relationship between experience and the development of certain abilities such as cognitive control, as it is likely that the answer lies in some of the key differences between the samples. It is also possible that this sample of bilinguals is different from previously studied bilinguals in subtle ways.

The biggest differences between the monolingual and bilingual samples lie in socio-economic status, as measured by annual family income and parent education, and in English proficiency, as measured by performance on the BNT. Bilinguals had a much lower average annual family income (and surprisingly, median family income was even more skewed) and their parents were less educated overall. These bilinguals were also less proficient in English, likely because more were born outside of the US and acquired English as a second language. English proficiency was related to annual family income and to all of the cognitive control measures except the attentional blink. The TMT was also related to annual family income.

It is possible that the disadvantage in cognitive control demonstrated by these bilinguals could be due to these differences in socio-economic status and proficiency. Note that previous researchers have argued against socio-economic status as a confounding factor, as it appears that bilingualism gives some low-income minority children an advantage (e.g., Engel de Abreu et al. 2012). So it is possible that the main factor driving this effect is lack of English proficiency. However, it is simply not possible to rule out the influence of socio-economic status in this study. The effect of English proficiency is somewhat puzzling, because not only were all of the bilinguals college students, but most of them considered themselves English dominant and were more proficient in English than in Spanish (as measured by BNT). What is clear is that the relationship between bilingualism and cognitive control is a complex one.

Of all the cognitive control measures, it appears that the TMT was most representative of cognitive control ability. Unlike the Stroop task, the TMT is non-linguistic, and therefore the measure of cognitive control ability is not confounded with linguistic ability. Furthermore, the TMT is the one measure that was related not only to many of the demographic and proficiency measures, but also to performance on the other cognitive control tasks. The TMT was also correlated with many of the dependent measures from the referential communication tasks that will be discussed presently. Therefore, it will be the TMT that will be used as a covariate in upcoming analyses, and to represent individual cognitive control ability.

Table 8.

Correlations Among Demographic and Proficiency Measures

	Years in US	Household Size	Annual Income	L2 AoA	BNT English Adjusted	BNT Spanish Adjusted
Age	0.09	-0.28**	-0.09	0.02	0.18	0.11
Years in US	-	-0.01	0.22*	-0.20	0.23*	-0.20
Household Size	-	-	0.20*	0.21	-0.12	-0.07
Annual Income	-	-	-	-0.06	0.31**	0.20
L2 AoA	-	-	-	-	-0.31*	0.01
BNT English Adjusted	-	-	-	-	-	0.23
BNT Spanish Adjusted	-	-	-	-	-	-

Note: *p < .05, **p < .01. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Table 9.

Correlations Between Demographic/Proficiency Measures and Stroop Task (Mean RT).

	Congruent RT	Stroop RT	Conflict Effect	Congruent Errors	Stroop Errors
Age	-0.05	-0.06	-0.01	-0.05	0.03
Length of Time in US	0.15	0.12	0.01	0.02	0.03
Household Size	0.07	0.05	-0.01	-0.05	0.02
Annual Income	-0.19	-0.04	0.14	-0.14	0.13
L2 Age of Acquisition	-0.32*	-0.07	0.26	-0.20	0.01
BNT English Adjusted	-0.18	-0.21*	-0.08	-0.21*	-0.27**
BNT Spanish Adjusted	-0.28	-0.26	-0.03	-0.08	-0.05

Note: *$p < .05$, **$p < .01$. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Table 10.

Correlations Between Demographic/Proficiency Measures and Attentional Blink Task (Proportion of Correct Reporting of Both Targets).

	Lag 1	Lag 3	Lag 5	Lag 8
Age	0.12	-0.01	0.00	0.04
Length of Time in US	-0.14	-0.19	-0.17	-0.17
Household Size	-0.09	0.09	0.07	0.04
Annual Income	-0.18	-0.04	-0.07	-0.01
L2 Age of Acquisition	-0.08	-0.08	-0.12	-0.11
BNT English Adjusted	0.04	0.10	0.05	0.09
BNT Spanish Adjusted	0.05	-0.05	0.17	0.22

Note: *p < .05, **p < .01. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Table 11.

Correlations Between Demographic/Proficiency Measures and Trail Making Test (Average Median RT and Accuracy).

	Trails A RT	Trails B RT	TMT RT Diff	Trails A Accuracy	Trails B Accuracy	TMT Acc Diff
Age	-0.03	-0.04	-0.04	0.12	0.14	0.06
Length of Time in US	-0.07	0.00	0.05	-0.04	0.05	0.10
Household Size	0.05	-0.01	-0.05	-0.24*	-0.18	0.00
Annual Income	-0.16	-0.23*	-0.22*	0.07	0.02	-0.05
L2 Age of Acquisition	0.25	0.36*	0.34*	-0.20	-0.24	-0.10
BNT English Adjusted	-0.30**	-0.40**	-0.36**	0.20	0.25*	0.13
BNT Spanish Adjusted	-0.19	-0.20	-0.16	0.24	0.33*	0.17

Note: *p < .05, **p < .01. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Table 12.

Correlations Between Demographic/Proficiency Measures and Berg's Card Sorting Test (Percent).

	Correct	Perseverative Errors
Age	-0.04	-0.07
Length of Time in US	-0.02	0.02
Household Size	0.00	0.15
Annual Income	0.17	-0.02
L2 Age of Acquisition	0.00	0.29*
BNT English Adjusted	0.33**	0.11
BNT Spanish Adjusted	0.02	-0.05

Note: *p < .05, **p < .01. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Table 13.

Correlations Between Trail Making Test and Other Cognitive Control Measures

Task	Measure	TMT RT Diff	TMT Acc Diff
Stroop Task	Color Control RT	0.35**	-0.02
	Word Control RT	0.40**	-0.02
	Congruent RT	0.28**	-0.07
	Stroop RT	0.33**	0.03
	Stroop Conflict RT	0.14	0.10
	Color Control Errors	0.18	-0.16
	Word Control Errors	-0.08	0.09
	Congruent Errors	0.02	-0.11
	Stroop Errors	0.25**	-0.03
Berg's Card-Sorting Task	Correct Sorts (%)	-0.02	-0.10
	Perseverative Errors (%)	0.11	-0.14
Attentional Blink Task	Lag 1 (% Both Targets)	-0.35**	0.19
	Lag 3 (% Both Targets)	-0.36**	0.22*
	Lag 5 (% Both Targets)	-0.40**	0.28**
	Lag 8 (% Both Targets)	-0.37**	0.24*

Note: *p < .05, **p < .01. Correlations with age of second language acquisition and adjusted Spanish scores on the BNT are for bilinguals only. All others include only monolinguals.

Chapter 6: Study 1- Perspective Monitoring in Language Comprehension

This study was designed to compare bilinguals and monolinguals on their ability to track a partner's perspective when interpreting referring expressions during an interactive referential communication task. It directly examined how bilinguals and monolinguals are able to update and change perspectives using old and new labels to refer to items with either the old or a new partner. It also tested whether an enhanced ability to update and maintain goal-related information (e.g., partner perspective) by bilinguals also means a greater sensitivity to broken conceptual pacts (departure from lexical entrainment). Finally, it examined whether individual differences in cognitive control correlate with sensitivity to broken conceptual pacts for both bilinguals and monolinguals.

I expected that both bilinguals and monolinguals would be fastest when a partner (either old or new) used the old label to refer to a target item, and that both bilinguals and monolinguals would be sensitive to the breaking of a conceptual pact, so that they would be slowest when it was the old partner rather than a new partner who inexplicably introduced a new label to refer to a target item. I also expected that bilinguals would either be more sensitive than monolinguals to the breaking of a conceptual pact, which could be related to *reactive inhibition,* or better than monolinguals at recovering from a broken conceptual pact perhaps because they are more flexible. Finally, I expected people with higher cognitive control overall to show the same pattern as bilinguals, so either be more sensitive to a broken conceptual pact or else be better at recovering from a broken conceptual pact.

Subjects

The 48 monolinguals and 48 bilinguals described in Chapter 4 participated in this study.

Confederates

Six of the confederates (3 males and 3 females) described in Chapter 4 participated in this study as confederate partners.

Materials and Design

Metzing and Brennan (2003) had subjects moving relatively large sets of real objects consisting of unique toys and pieces of hardware. They used referring expressions that were different, but equally good descriptions of target objects (e.g., *the silver pipe* or *the shiny cylinder*). Moving from an old to a new label involved initially entraining on one description (e.g., *the silver pipe*) and then switching to another (e.g., *the shiny cylinder*; the switch in label suggests a change in perspectives, the idea being that people mark the belief that they are referring to the same object (and have established a pact on how to conceptualize it) by using consistent terminology.

In order to adapt this paradigm to a computerized version of the task, I used geometric figures called tangrams, as they require that people negotiate and achieve a shared perspective and settle on a label for it in order to refer to a given figure (e.g., "*the barbell*"). A total of 72 tangrams were used for this version of the matching task. Of these, 5 tangrams were taken from Wilkes-Gibbs & Kim (1991) and normed by Lockridge (2007, unpublished dissertation). Another 3 were normed using Lockridge's method of obtaining two labels (e.g., "*the barbell*" or "*the dog bone*") that are matched on approximate goodness of fit (i.e., how easy to "see" a particular perspective is for a given tangram), in order to get 8 critical items for use in this study. An additional 40 tangrams were normed in order to obtain one good label (i.e., an average rating of at least 3.5 on a 5 point scale on how easy it is to see a particular perspective, ibid).

These 48 tangrams were divided into four sets of 12 tangrams each, with two in each set being critical items (8 critical items total). Subjects completed five rounds of the matching task for every set of 12 tangrams, with the first four rounds establishing entrainment and the fifth round always being the critical round. In order to test for sensitivity to broken conceptual pacts (new label from an old partner), for two of the four tangram sets, the matcher switched to a new partner for the fifth (critical) round. For the two remaining tangram sets, the matcher stayed with the old partner for the fifth (critical) round. For these fifth critical rounds the partner (new or old) used a lexical precedent (old label) for one of the two critical items, and a new label for the other critical item (i.e., a broken conceptual pact when used by the old partner; see Figure 13 below for a summary of the experimental design). Therefore, as in Metzing & Brennan (2003) there were two critical items per cell of the design (i.e., old partner/old label; old partner/new label; new partner/old label; and new partner/new label) with a total of only two "broken pacts" per partner (for a list of the critical tangrams and the perspectives used, see Appendix C).

The remaining 24 tangrams were chosen to be intentionally difficult and were assigned two different labels (i.e., perspectives) in order to serve as filler items in the task. The need for these difficult filler items became apparent during a pilot test of the tangram-matching task. Since all items except the critical items had only one label, the lack of variability made the label switches too conspicuous. So I created two filler sets of 12 tangrams each, to be interspersed into the task and to add some variability. Like the target sets above, these filler sets were matched for five rounds each, with the first four being entrainment rounds and the fifth round always consisting of a partner switch (new partner). The new partner would then introduce new labels for half of the items in each of these filler sets (note it was always a new partner in the critical rounds of the filler sets). All subjects saw the filler items (see Table 14 below).

	First Four Rounds	Critical Fifth Round	
			
	Old Label	Old Label	New Label
Old Partner	*"the barbell"*	*"the barbell"*	*" the dog bone"*
New Partner		*"the barbell"*	*" the dog bone"*

Figure 13. Design for Study 1.

In total, subjects completed 30 rounds of the tangram task (five rounds for each of six tangram sets), with 4 of the 30 rounds being critical rounds (4 fifth rounds) with two critical items each. The condition in which subjects saw the critical items (old versus new label and old versus new partner) was counterbalanced, as was the label assigned to be "old" and "new for each item, so there were a total of 8 lists. However, all subjects saw the sets and the tangrams within a set in a fixed order. Each confederate partner completed 3 of the 6 sets as old partners. See an example of an order in which the subjects completed the 30 rounds of the tangram-matching task below (Table 14).

Procedure.

Once subjects had completed the informed consent process, they were introduced by name to the two confederate partners they would be working with. They were told that the confederate partners were research assistants who would be completing the matching tasks with them. The subject would then be seated in the matcher chair, while the confederate

Table 14.

Example of one order in which subjects completed the entrainment and critical rounds with each partner for Study 1.

Set	Round #	Round Type	Subject	Partner	Critical Item 1	Critical Item 2
Set 1	Rounds 1-4	Entrainment	Matcher	Old	"arch"	"monk praying"
Set 1	Round 5	Critical	Matcher	Old	*"legs"*	"monk praying"
Set 2	Rounds 6-9	Filler	Matcher	Old	-	-
Set 2	Round 10	Filler	Matcher	New	-	-
Set 3	Rounds 11-14	Entrainment	Matcher	Old	"dagger"	"swan"
Set 3	Round 15	Critical	Matcher	New	*"necktie"*	"swan"
Set 4	Rounds 16-19	Entrainment	Matcher	Old	"viking ship"	"arch"
Set 4	Round 20	Critical	Matcher	Old	*"swimmer"*	"arch"
Set 5	Round 21-24	Filler	Matcher	Old	-	-
Set 5	Round 25	Filler	Matcher	New	-	-
Set 6	Rounds 26-29	Entrainment	Matcher	Old	"camel"	"angel"
Set 6	Round 30	Critical	Matcher	New	"camel"	*"super hero"*

Italics indicate a switch to a new referring expression for critical items.

Note: Each of the sets consisted of 12 tangrams. The 4 target sets contained 2 critical items. The 2 filler sets had no critical items.

partner assigned to the first round would sit facing the subject in the director chair (see Figure 5). Both partners would then receive instructions on how to complete the task.

The subjects were told that the task was about how well they followed instructions from different partners, and that they would be matching sets of geometric figures known as tangrams. The partners were told that the goal was for the subject (in the matcher role) to arrange the tangrams (seen in a random order at the bottom of their screen) in a specific order according to instructions by the confederate partner (in the director role) who had the tangrams in the desired order at the bottom of their screen. Subjects would then be told that in order to "move" a tangram they had to click on it and that the tangram would move into the next available spot at the top of all screens so that the director could confirm the correct choice or undo an incorrect choice. They were informed that they could speak and ask questions freely during the task. The subject was then told that they would be switching partners (in the director role) for some rounds. After making sure the subject was clear on the task and had no questions, I would leave the room so that the partners could begin.

Subjects were unaware that the confederate partners had pre-assigned labels (i.e., perspectives) for each of the tangrams. These labels were present in the tangram pictures the confederate partner saw when giving instructions to the subject. However, as in Metzing and Brennan, the rest of the confederate partner's dialogue was unscripted as to retain a measure of spontaneity in the referential communication task, although all confederates had previously practiced describing the tangrams. This allowed the confederate partners to remain active participants in the task, as subjects are sensitive to the changes in discourse that can come from having an overly experienced partner (Kuhlen & Brennan, 2013). The only other instructions the confederate partners received were to use indefinite articles (e.g., *looks like a man swimming*) and hedges (e.g., *sort of like*) while describing the tangrams in the first round of each set, as directors tend to do naturally when describing each picture to matchers for the first time. In subsequent rounds, the confederate partner would usually switch to using a definite article (e.g., *the* swimming man) when referring to the tangrams. Most of the description occurred in the first round, although the confederate partners were instructed to describe the tangram again if the subjects seemed hesitant or unsure of what the label was referring to. Matchers usually responded quickly and reliably to given labels by the third round.

In order to track the rounds and instructions for leaving the room when necessary, the confederate partners had a clipboard with a checklist that they used to check off rounds as they were completed. So as to not give the subject the idea that they were reading off of the clipboards, the confederate partner would check the clipboard and mark off the end of each round, and would then place the clipboard face-down next to them on the table before beginning the subsequent round. On rounds where a partner switch was required, the old partner would leave the room with the clipboard and hand it over to the new partner who would take the old partner's place.

After completing all the rounds of the matching task for Study 1, the subject would then move on to Study 2A.

Coding. The audio files recorded by the program were annotated by hand in order to insert timestamps at the onset of each tangram label uttered by the confederate director. These timestamps allowed me to measure matcher reaction time from the moment the target label was initiated. In order to calculate these reaction times, I subtracted the speech onset time for the target item from the time the matcher responded and clicked on the correct tangram. This was done to get reaction times for all 8 critical items, 2 in each of the four conditions (see Figure 14 below). Only trials in which the correct choice was made on the first try were included. Two monolinguals were excluded from the analyses for Study 1 due to a program error in recording their reaction times.

		Partner	
		Old	**New**
Label	**Old**	Lexical Entrainment n = 2	Lexical Precedent n = 2
	New	Broken Conceptual Pact n = 2	Perspective Change n = 2

Figure 14. Design and number of critical items per condition of Study 1.

Results and Discussion.

To assess the impact of condition (old versus new label & old versus new partner) and subject-type (monolingual versus bilingual), I ran a mixed model ANOVA with partner and label as within-subject factors and subject type as a between-subjects factor. Bilinguals had longer reaction times than monolinguals (Mdiff = .37 secs) for the tangram-matching task, indicating that they were overall slower when reacting to the tangram labels uttered by their confederate partners, $F(1, 92) = 6.25$, $p < .05$ (see Figure 15 below). However, there was no significant partner by label interaction, $F(1, 92) = 1.49$, $p = .23$, and no significant partner by label by subject type interaction, $F(1, 92) = .43$, $p = .51$. There was a significant main effect of partner, indicating that people were overall slower with the old partner than with the new partner (Mdiff = .45 secs), $F(1, 92) = 10.76$, $p < .05$, as well as a significant main effect of label, indicating that people were significantly slower when responding to a new label than when responding to an old label (Mdiff = .95 secs), $F(1, 92) = 10.76$, $p < .05$.

Although Metzing and Brennan's (2003) broken conceptual pact effect did not reach statistical significance for this analysis, a visual inspection of the means (see Figure 15 below) suggests that bilinguals and monolinguals may be reacting differently to hearing a new label. Although the broken conceptual pact difference (RT in old partner, new label minus RT in new partner, new label) is not significant for monolinguals, $t(45) = 1.28$, $p = .21$, it is significant for bilinguals, $t(47) = 2.08$, $p < .05$. However, it seems as if bilinguals are overall slower in responding to new labels, as the RT difference between labels from a new partner (RT in new partner, new label minus RT in new partner, old label) is also significant for bilinguals, $t(47) = 2.08$, $p < .05$ (and not significant for monolinguals, $t(47) = 1.28$, $p = .21$).

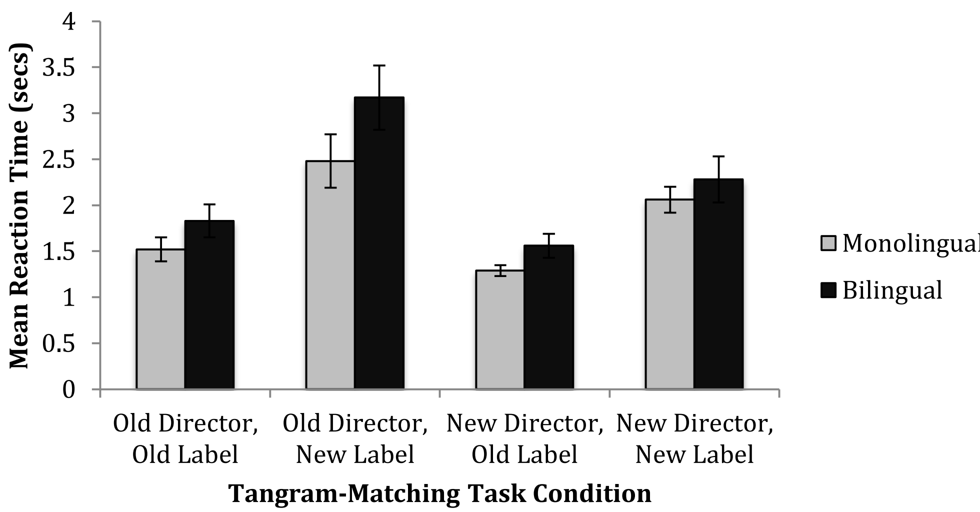


Figure 15. Mean reaction time in the Tangram-Matching Task by condition and subject type.

In order to assess the impact of cognitive control on perspective-taking in referential communication, I included reaction time difference on the TMT (RT in Trails B minus RT in Trails A; with TMT being the most representative of the cognitive control tasks, see Chapter 5 for more information) as a covariate in a repeated-measures ANCOVA. Because performance on the TMT was correlated with subject type, I collapsed across subjects so as to be able to include

TMT as a covariate in the analysis. When TMT was included, there was a significant partner by label interaction, $F(1, 92) = 4.61$, $p < .05$ (see Figure 16 below). This replicates Metzing and Brennan's broken conceptual pact effect. It appears that how slow people were in the old partner, new label condition was significantly predicted by task-switching ability and flexibility in the TMT.

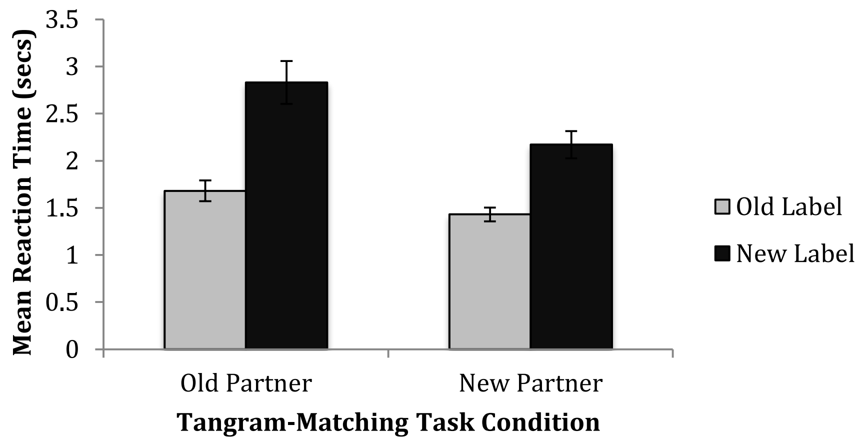


Figure 16. Mean reaction time in the Tangram-Matching Task by condition and collapsed across subjects.

In order to check the direction of this effect, we correlated the amount of interference experienced in the TMT task (RT difference) with the amount of interference experienced by broken conceptual pacts (RT in old partner, new label minus RT in new partner, new label). There was a significant correlation between cognitive control (RT difference in TMT) and sensitivity to broken conceptual pacts, so that people that were higher in cognitive control (smaller RT difference in TMT) were more flexible and faster at recovering from broken conceptual pacts (smaller broken conceptual pact RT), $r = .22$, $p < .05$ (see Figure 17 below).

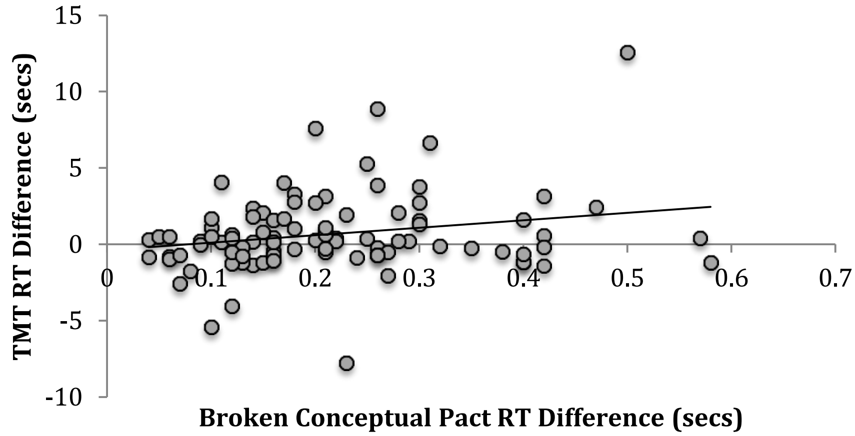


Figure 17. Mean reaction time in the Tangram-Matching Task by condition and collapsed across subjects.

Overall, it appears that bilinguals were slower than monolinguals, and they were even slower when there was novelty (i.e., hearing a new label from any partner). When cognitive control (i.e., performance on TMT) was included in the analysis, I replicated the broken conceptual pact effect such that people were slowest when hearing a new label from an old partner. Cognitive control predicted how people reacted to broken conceptual pacts, and rather than show more sensitivity, people with higher cognitive control were actually more flexible and recovered faster.

Chapter 7. Study 2- Perspective Monitoring in Language Production

7.1 Study 2A- Use of Partner Cues in Monolingual Language Production

While Study 1 focused on comprehension, Study 2A focused on production. The present study was designed to compare bilinguals and monolinguals on the ability to use partner-specific cues such as dialogue history and partner perspective to guide language production in only one language (i.e., English only) during an interactive referential communication task. It tested how well bilinguals and monolinguals are able to track and use partner cues by reusing the consistent label for target pictures with a given partner when there is competition from using different labels with different partner (e.g., *couch* versus *sofa*), and when there is a need to switch between partner perspectives because they are working with both partners simultaneously. It also sought to relate individual cognitive control ability to the ability to use these partner cues to guide partner adaptation in production.

According to Bialystok's (2009) reported bilingual advantage in cognitive control, bilinguals should be faster and more consistent in maintaining partner-specific perspectives than monolinguals overall. They should be especially consistent when working with two partners simultaneously and a switch in perspective is required, particularly when there has been a different dialogue history with the two partners, with two different labels for the same item. This should be the case if higher cognitive control results in an advantage not only in representing multiple possibilities (e.g., distinct dialogue histories, distinct partner perspectives, etc.), but also in using a partner cue to recall the correct perspective while suppressing either one's own or another recently used perspective. These abilities should be better developed in bilinguals, but overall individuals with higher cognitive control should also be faster and more accurate in the matching task.

Subjects

The same 48 monolinguals and 48 bilinguals from Study 1 participates in Study 2A.

Confederates

The same six confederates from Study 1 also participated in Study 2A. Note that subjects worked with the same two confederates for both studies.

Materials and Design

In order to compare this study to previous studies looking at switching in bilinguals, I used pictures of common objects rather than tangrams. When naming common objects, the process of agreeing on how to conceptualize and refer to an item is much easier because there is a highly available basic level term that will usually be quickly accepted. With tangrams the lack of a conventional, lexicalized basic level term makes the process more difficult. Therefore, for this study a switch in partner perspective is really the use of a partner-specific cues to access the appropriate label to use with a given partner based on dialogue history with that partner.

For this matching task, line drawings were chosen from the International Picture Naming Project (IPNP, Bates et al., 2003) and other sources based on the following criterion: the pictured object should have two relatively common labels (e.g., couch or sofa). The labels chosen were also matched for approximate frequency using CELEX, so that their frequencies weren't too disparate. The synonym label pairs were normed by having a group of 32 subjects respond as quickly as possible as to whether a given label fit a picture. From an initial pool of 54 label pairs, 36 pairs that did not have significantly different reaction times between the synonym labels were chosen (for label pairs see Appendix D).

Four sets of 12 critical items each were created using the 36 pictures: two sets to be completed with confederate Partner A and two sets to be completed with confederate Partner B.

Each set of 12 items consisted of 6 items that the subject shared with only one confederate partner (Unique items) and 6 items that the subject shared with both confederate partners (therefore appearing in two different sets, once with each partner). For four of the six items to be shared with both confederate partners, each partner introduced a different label for the items (i.e., Shared Different items, e.g., “couch” with confederate Partner A and “sofa” with confederate Partner B), while for the remaining two items, both partners used the same label for the items (i.e., Shared Same items, e.g., “rug” with both confederate Partners A and B). The introduction of the Shared Same items was to break the correlation between sharing an item with both partners and also having a different label for an item. So of the 36 critical items, a total of 12 were uniquely shared with Partner A, 12 were uniquely shared with Partner B, 8 were shared with both Partners A and B using different labels (e.g., “couch” and “sofa”), and 4 were shared with both Partners A and B using the same labels (e.g., “rug”; for a summary of the design see Figure 18 below). The items shared with one or both partners, as well as the labels used, were counterbalanced across subjects.

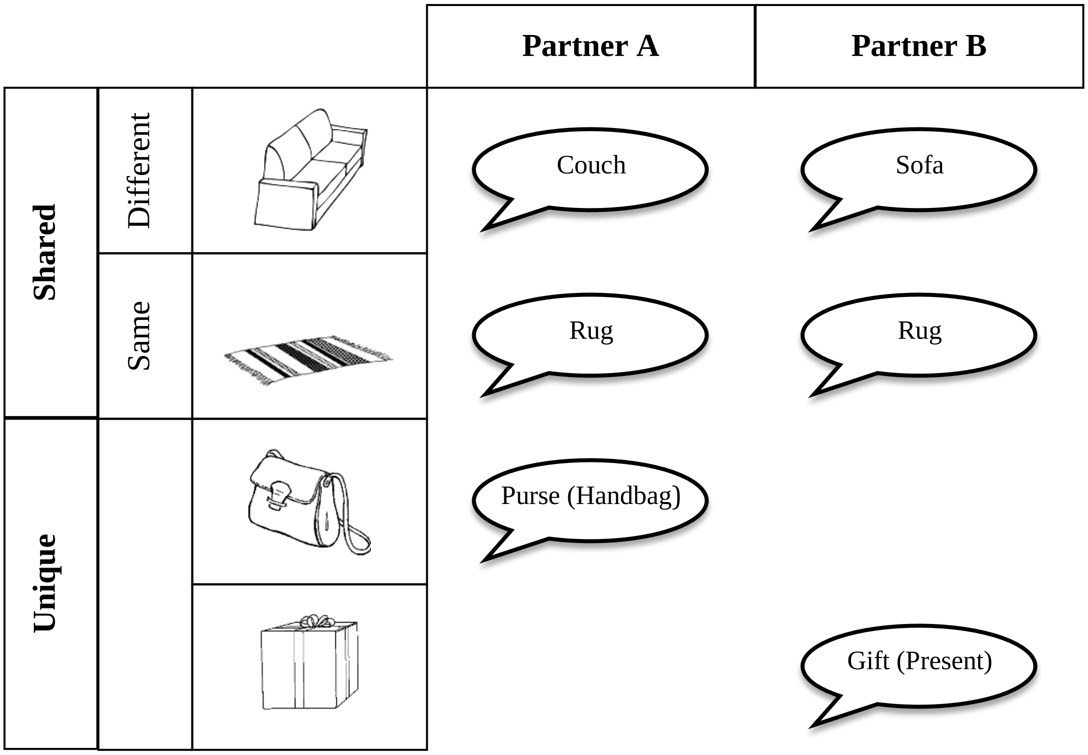


Figure 18. Design for Study 2A.

In order to allow the confederate partners to introduce the desired label for each given picture, subjects first completed four entrainment rounds of a picture set as matcher. So that they weren't in the role of director only during critical rounds, they completed the fifth entrainment round as director. The sixth round for a given picture set was always the critical round and the subject was again in the director role. This pattern held for all four picture sets, for a total of 24 rounds.

In order to compare the ability of monolinguals and bilinguals to resolve conflict and track/switch between partner perspectives, all subjects completed two critical rounds working with only one partner at a time (partner/perspective blocked condition) and two critical rounds working with both partners simultaneously (partner/perspective mixed condition). So that subjects had plenty of experience with a given partner before the partner/perspective mixed critical rounds, they always completed the partner/perspective blocked critical rounds first (for an example of *one* order in which subjects completed all rounds of the picture matching task for Study 2A, see Table 15 below). To ensure that subjects entrained on *both* labels for the Shared Different items *before* the critical rounds, subjects first completed all the entrainments rounds for one set with one partner and then all the entrainment rounds for the corresponding set with the other partner. Subjects then took on the role of director and completed the two critical rounds for those sets.

Because of the uneven number of items per condition in each set, it was only possible to counterbalance so that of all items in the Unique condition, all but one appeared in the Shared Different condition, and so that about half appeared in the Shared Same condition in order to maintain a reasonable number of lists. I also counterbalanced what label was introduced first for the Shared Different items. In total, subjects saw one of a possible 16 lists.

Table 15.

Example of one order in which subjects completed the entrainment and critical rounds with each partner for Study 2A.

Round #	Set	Round	Subject	Confederate	Unique	Shared
Rounds 1-4	Set 1	Entrainment	Matcher	Director A	“purse”	“couch”
Rounds 5	Set 1	Entrainment	Director	Matcher A	“purse”	“couch”
Rounds 6-9	Set 2	Entrainment	Matcher	Director B	“gift”	“sofa”
Rounds 10	Set 2	Entrainment	Director	Matcher B	“gift”	“sofa”
Round 11	Set1	Blocked	Director	Matcher A	“gift”	“couch”
Round 12	Set 2	Blocked	Director	Matcher B	“purse”	“sofa”
Rounds 13-16	Set 3	Entrainment	Matcher	Director B	“town”/ “woods”	“taxi”/”cook”
Rounds 17	Set 3	Entrainment	Director	Matcher B	“town”/ “woods”	“taxi”/”cook”
Rounds 18-21	Set 4	Entrainment	Matcher	Director A	“pipe”/”cop”	“cab”/”chef”
Rounds 22	Set 4	Entrainment	Director	Matcher A	“pipe”/”cop”	“cab”/”chef”
Round 23	½ Sets 3 & 4	Mixed	Director	Matchers A & B	“box”/“sneaker	“taxi”/”chef
Round 24	½ Sets 3 & 4	Mixed	Director	Matchers A & B	“pants/“cottage”	“cab”/”cook”

Note: In the mixed critical rounds (Rounds 23 and 24), both confederate partners were present as matchers and working on a single arrangement. Each set of 12 critical items consisted of 6 items shared with only one partner and 6 items shared with both partners (4 with different labels and 2 with the same labels). Shared items appeared only once per round, so that the subject-director never uttered “couch” and “sofa” in the same round. Unique items were always intended for the partner with which they were entrained. Note that Director A was the same person as Matcher A, but in a different role. The same holds for Director/Matcher B.

Procedure

Study 2A was always completed in the same experimental session as Study 1, and subjects continued working with the same confederate partners as previously. Subjects were told that they would be completing another matching task and started the session by sitting in the matcher chair with the confederate assigned to the first set facing them in the director chair. In the entrainment rounds and in the blocked partner/perspective critical rounds, only one confederate partner was in the room with the subject for the given round. In the mixed partner/perspective critical rounds, both confederate partners sat in matcher chairs facing the subject (see Figure 5).

The subjects again received instructions on completing the task and were told that the purpose was still to see how well they followed instructions from different people. They were told that they would be matching sets of pictures, and that the goal was still for the matcher in a particular round to arrange the pictures (seen in a random order at the bottom of their screen) in a specific order according to instructions by director who saw the pictures appear one at a time in the center of their screen. Note that for this production study, each picture to be named appeared one at a time in the center of the screen in order to enable measuring the director's speaking latency as precisely as possible. The partners were also told that the matcher was to "move" a picture by clicking on it, and that the picture would move into the next available spot at the top of all screens so that the director could confirm the correct choice or undo an incorrect choice.

Subjects were informed that they could speak and ask questions freely during the task. They were also told that they would be switching partners for some rounds and that they would be working with both partners simultaneously in others. After making sure the subject was clear on the task and had no questions, I would leave the room so that the partners could begin.

Subjects were again unaware that the labels the confederate partners would be introducing when in the director role were scripted. In order to control these labels, the confederate partner saw the scripted labels under each picture when in the director role during the entrainment rounds. The rest of the confederate partner's dialogue was again unscripted. The labels were not present when the subject was in the director role.

However, in rounds where the subject was in the director role and working with both confederate partners (mixed partner/perspective rounds), the matchers sat side by in front of their individual screens and would be working on one arrangement simultaneously (when Matcher A clicked on picture it would also move on Matcher B's screen), with half of the rounds addressed to each. In order to specify who a given trial was intended for, the subject would see either "Matcher A" or "Matcher B" under each picture. This was used instead of the confederate partners' names so that the subjects could not just read the names off, but rather would have to think about which partner a given trial was directed at. This was done for all trials during the mixed rounds, even when the picture had only been shared with one partner. The prompt was also always directed at a partner the picture had been shared with. Note that shared items appeared only once in each of the mixed partner/perspective rounds so that a subject would never have to use both labels for a picture in the same round. If a shared item was directed at Partner A in the first of the mixed partner/perspective rounds, it would be directed at Partner B in the second (again, see Table 15 for a schematic of how the rounds were ordered and the items distributed).

The confederate partners again used a clipboard on which they would check off at the end of each round before placing it facedown beside them. On rounds where a partner switch was required, the old partner would leave the room with the clipboard and hand it over to the new partner who would take the old partner's place. On rounds where both partners needed to be in the room, they would both re-enter and take seats.

After completing all the rounds of the matching task, monolingual subjects were debriefed. Bilingual subjects were not debriefed until after they completed Study 2B in a third experimental session (see section 7.2).

Coding

The audio files recorded by the program for the critical rounds were annotated by hand in order to insert timestamps at the onset of the picture label uttered by the subject. These timestamps allowed me to measure speaking latency from the moment the picture appeared on the screen. In order to calculate these reaction times, I subtracted the speech onset time for the target item from the time the matcher responded and clicked on the previous picture (as the next picture appeared as soon as the matcher clicked on the picture for a trial). See Figure 19 below for how items were distributed in the design). Four of the items uniquely shared with one partner were excluded from analyses for each subject, because they were the first item in each of the critical rounds. For these items, speaking latency was not representative because of the tendency for side conversations when starting a new round (e.g., *are you ready?).* Therefore, only 32 items were included in all analyses.

The audio recordings were also coded for the labels used by the subjects when addressing the confederate partner(s). Labels were coded in the following way: 1) consistent label used (the subject used the label introduced by a given partner with the correct partner), 2) synonym used (the subject inconsistently used the other label in use in the experiment, 3) both labels used (the subjects used both the consistent label and the synonym when addressing a given partner), or 4) other label used (the subject used another label not used in the experiment). Note that using a synonymous, inconsistent, or entirely new label could occur not only for Shared Different items for which both labels had been heard, but also for Shared Same and Unique items. Using an inconsistent label was more common for some items than others, perhaps because the two labels were seen as being more similar (see Tables 16 and 17 for a frequency count of types of referring expressions by condition). Only trials in which the matcher made the correct choice on the first try were included in all analyses (errors were negligible).

		Partner Blocked		**Partner Mixed**	
		Shared with Both Partners	Shared with One Partner	Shared with Both Partners	Shared with One Partner
Label	**Same**	n = 2 (x2 observations)	n = 12	n = 2 (x2 observations)	n = 12
	Different	n = 4 (x2 observations)		n = 4 (x2 observations)	

Figure 19. Number of critical items per condition of Study 2A.

Table 16.

Frequency of Type of Referring Expression For Blocked Partner/Perspective Rounds

	Monolinguals			Bilinguals		
	Unique	Shared Different	Shared Same	Unique	Shared Different	Shared Same
Consistent	358	191	152	351	197	154
Synonym	92	162	32	95	36	170
Other	12	15	1	27	13	1
Both	0	0	0	3	1	0

Table 17.

Frequency of Type of Referring Expression For Mixed Partner/Perspective Rounds

	Monolinguals			Bilinguals		
	Unique	Shared Different	Shared Same	Unique	Shared Different	Shared Same
Consistent	344	190	161	361	193	146
Synonym	96	162	22	95	174	35
Other	10	15	1	16	6	6
Both	1	1	0	2	6	2

Results

To assess consistency in perspective-taking for the picture-matching task, I ran a mixed model ANOVA looking at the effect of blocking, item condition, and subject on the proportion of trials for which the consistent label was used with a given partner (that is, the label the subjects had entrained on with that partner). Bilinguals did not appear to use the correct label any more or less than monolinguals overall, $F(1, 85) = .09$, $p = .77$. There was a significant three-way interaction between blocking, item condition, and subject type, indicating that bilinguals and monolinguals show different patterns of consistency in perspective-taking, $F(2, 170) = 3.25$, $p < .05$ (see Figure 20 below for results for this analysis). Contrasts revealed that bilinguals were slightly less consistent than monolinguals for Unique items and slightly more consistent for Shared Same items than monolinguals during the blocked rounds, but that this pattern reversed completely during the mixed rounds, $F(1, 85) = 5.19$, $p < .05$.

Surprisingly, there was no effect of blocking on consistency in perspective-taking so that people were just as likely to use the consistent label when working with only one partner at a time (partner/perspective blocked) than when working with two partners simultaneously (partner/perspective mixed), $F(2, 170) = .003$, $p = .96$. However, there was a significant effect of item condition, $F(2, 170) = 204.58$, $p < .05$, so that people were less likely to use the consistent label when they had entrained on two different labels with two different partners for the same item, $F(1, 85) = 439.64$ $p < .05$, and more likely to use the consistent label when they had entrained on only one label for an item, but with both partners (i.e., more practice), $F(1, 85) = 23.31$, $p < .05$.

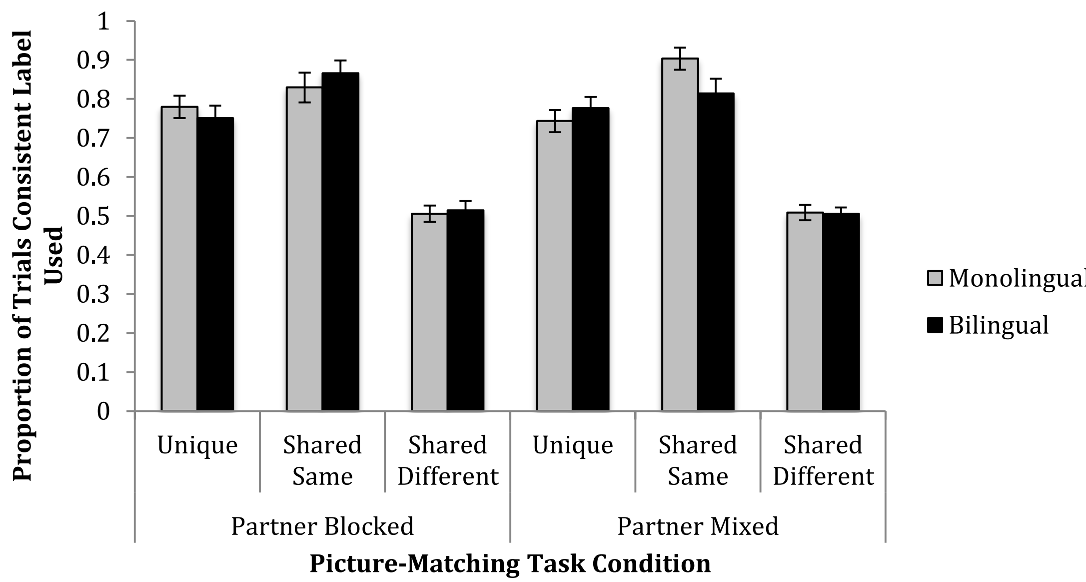


Figure 20. Proportion of trials in which the consistent label was used with a given partner by condition and by subject.

A mixed-model ANOVA looking at the effect of partner blocking, item condition, and subject type on speaking latency revealed that instead of being faster, bilinguals were instead marginally slower than monolinguals when completing the picture-matching task in one language, $F(1, 85) = 2.83$, $p = .10$ (see Figure 21 below). As predicted, people were faster when working with only one partner at a time (partner/perspective blocked) than when working with two partners simultaneously (partner/perspective mixed), $F(1, 85) = 486.35$, $p < .05$. However, given that consistency in perspective-taking did not change as a function of blocking, it suggests that this increase in speaking latency is likely a result of having to decide who a trial is intended for and then specifying that addressee by saying their name, pointing, or looking. There was also a significant main effect of item condition, $F(2, 170) = 3.33$, $p < .05$, so that people were fastest when an item was shared with both partners using the same label, $F(1, 85) = 5.46$, $p < .05$.

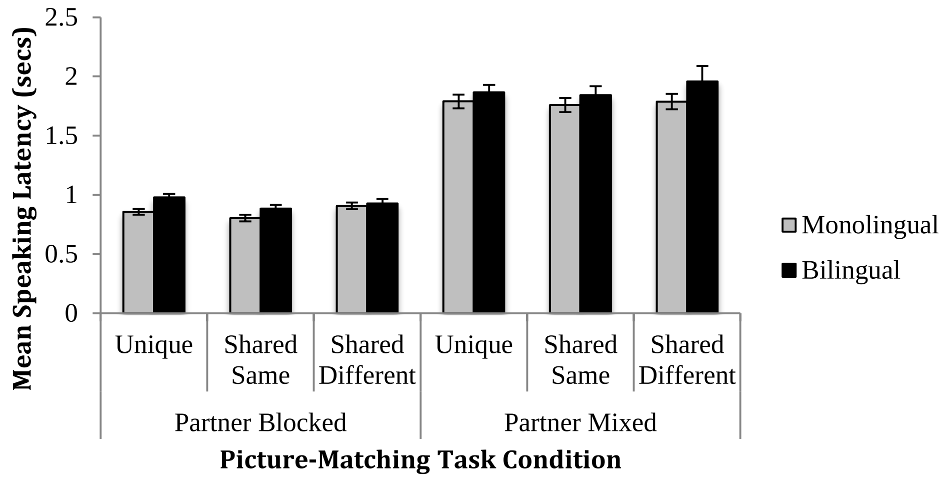


Figure 21. Mean speaking latency in the Picture-Matching Task by condition and subject type for Study 2A.

I ran correlations between cognitive control as measured by reaction time difference in the Trail Making Test (recall from Chapter 5 that TMT appeared to be the most meaningful cognitive control measure), and the proportion of time the consistent label was used in each condition. There were significant small to medium correlations between cognitive control and consistency in perspective-taking for the Shared Different items in the partner/perspective blocked rounds (see Table 18 below) and for all item conditions in the partner/perspective mixed rounds (see Table 19 below). It appears that cognitive control was significantly correlated with the ability to use partner cues to produce the consistent label when there was competition (as for the Shared Different items) and with the need to track and switch between partner perspectives (as for the partner/perspective mixed critical rounds), so that people with higher cognitive control were better at maintaining consistency in perspective taking under these conditions when there was more need to handle competition.

Table 18.

Correlations between Trail Making Test and using the correct label the Partner/Perspective Blocked rounds of Study 2A

	Unique	Shared Same	Shared Different
TMT RT Diff	-0.06	0.05	-0.23*

Note: *p < .05, **p < .01

Table 19.

Correlations between Trail Making Test and using the correct label the Partner/Perspective Mixed rounds of Study 2A

	Unique	Shared Same	Shared Different
TMT RT Diff	-0.28**	-0.22*	-0.29**

Note: *p < .05, **p < .01

Discussion

Bilinguals did not differ from monolinguals in how well they used partner cues to guide monolingual language production, although on average they were slightly slower). As expected, people were slower when they had to track perspectives for two distinct partners than when they had to track perspective for only one partner. However, their speaking latency did not differ according to how they shared a particular item, so having two different labels for an item did not slow them down, and getting more practice with one label did not speed them up.

How they shared a patricular item did matter for consistency in perspective-taking, so that people were more likley to produce the consistent label with a given partner when they had more practice, that is when they shared an item with both partners using the same label. They were least likely to use the consistent label with a given partner when they had shared an item with both partners using different labels. In fact, for the items shared with different labels, people used the consistent label only about half the time. This may be due in part to viewing the synonym labels as being relatively interchangeable for achieving the goal of completing the picture-matching task once they had been exposed to both labels. Note that the synonym labels used in this task were in fact chosen because of their similar frequency.

In sum, the predicted differences between bilinguals and monolinguals did not emerge. However, concerning the relationship between cognitive control ability and the tendency to use the consistent label with a given partner, there was a significant correlation between performance on the TMT and perspective consistency in addressing a partner when different labels had been entrained upon with the two partners. That is, the faster people were at switching between rules in Trails B (shown by RT difference between the two trial types), the more likely they were to maintain consistency in perspective-taking when they had shared an item using two different labels. It’s possible that people with higher cognitive control are better at keeping multiple possibilities in mind (e.g., multiple partner perspectives based on dialogue history) and at switching between “goals” by adapting to particular partner’s perspective depending on contextual cues (i.e., *who am I talking to right now?*). This is also evident in that there was a significant correlation between cognitive control and accuracy for all the item conditions in the rounds where they had to work with two partners simultaneously. In other words, there is a relationship between cognitive control ability and the ability to adapt to a particular partner's perspective. This correlation was only present for the Shared Different items in the blocked partner/perspective condition, suggesting that the partner cues may have been much more prominent (or needed) when both partners were present.

So far, this project has looked at bilinguals in non-bilingual situations. That is they have only worked in one of their languages. Study 2B looks at the same bilinguals in a bilingual situation, which allows me to extend findings in 2A to bilingual language production, and possibly to make comparisons to previous studies looking at language switching.

7.2 Study 2B - Use of Partner Cues in Bilingual Language Production

Study 2B extended Study 2A, similarly testing the relationship between cognitive control and the use of partner-specific cues to guide language production, but when bilinguals use *both* their languages. This study directly tested whether there is a cost associated with language-switching when the switch is based on internal motivations such as a switch in partner-perspective and not on external motivations such as color cues (used in other, less naturalistic tasks, e.g., Meuter & Allport, 1999). Finally, it enabled direct comparison of the cost of a perspective-switch within a language (Study 2A) to the cost of a perspective-switch between languages (Study 2B).

Bilinguals with higher cognitive control should be faster at referring to pictures when working with two partners simultaneously and a switch in perspective and language is required, especially when the same item has been shared with both partners, but in different languages. In addition, if between-language switching is just as easy as within-language switching, than there should be no additional cost associated with switching between perspectives and languages then when just switching between perspectives.

Subjects

The same 48 bilinguals from Studies 1 and 2A also participated in Study 2B.

Confederates

Study 2B was completed in a separate experimental session from Studies 1 and 2A, and subjects worked with two of the three Spanish-English bilingual confederates described in Chapter 4.

Materials and Design

For this task, 36 additional line drawings of common objects were chosen from the IPNP project (Bates et al., 2003) such that none of these stimuli had cognate names (e.g., tiger-tigre, see Appendix E for list of translation pair labels). The translation pairs were chosen using norming data from the IPNP, so that the percent agreement on target names (the proportion of subjects that used a specific label when naming a given picture) was above 80% and was comparable between languages. All chosen items also had high response rates in both languages, so that at least 94% of subjects produced a codeable name in each language.

Four sets of 12 items each were created using the 36 critical items: two sets to be completed in English with Partner A and two sets to be completed in Spanish with Partner B. For each set of 12 items, 6 were uniquely shared with only one partner (and therefore named in only one language) and 6 were shared with both partners (therefore appearing in two sets, once per partner, and named in both languages). Note that Study 2B did not have any Shared Same items, as you can't have the same label when using different languages.

Of the 36 critical items, a total of 12 were uniquely shared with Partner A in English, 12 were uniquely shared with Partner B in Spanish, and 12 were shared with both Partners A and B in both English and Spanish (for a summary of the design see Figure 22 below). Note that the subject worked with a given partner in only one language. The items shared with one or both partners, as well as language used, were counterbalanced across subjects.

As in Study 2A, subjects first completed four entrainment rounds as matcher for a picture set. So that they weren't only in the role of director during critical rounds, they completed the fifth entrainment round as director. The sixth round for a given picture set was always the critical round and the subject was again in the director role. This pattern held for all four picture sets, for a total of 24 rounds. Subjects again first completed all the entrainments rounds for one set with one partner and then all the entrainment rounds for the corresponding set with the other partner before taking on the director role and completing the two critical rounds for those sets.

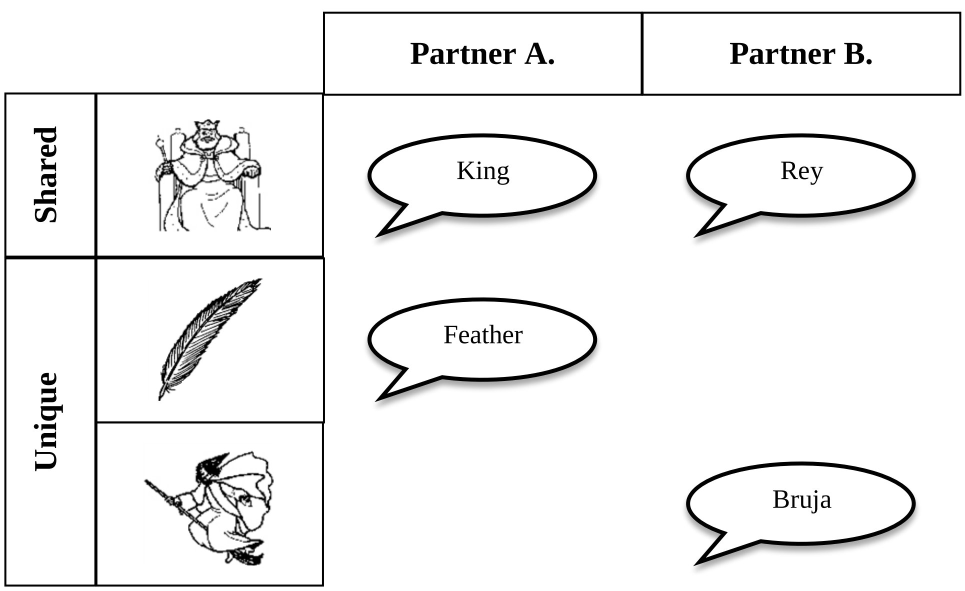


Figure 22. Design for Study 2B.

In order to compare the cost of perspective-switching in only one language (Study 2A) to the cost of perspective-switching when also switching between languages (Study 2B), I had all bilinguals complete two critical rounds working with only one partner and in one language at a time (language/perspective blocked condition) and two critical rounds working with both partners and in both languages simultaneously (language/perspective mixed condition). They always completed the language/perspective blocked critical rounds before completing the language/perspective mixed critical rounds. I counterbalanced the conditions each item appeared in, as well as the language an item was shared in. In total, each subject saw 1 of 12 lists (for an example of *one* order in which subjects completed all rounds of the picture matching task for Study 2B, see Table 20 below).

Procedure

Bilingual subjects completed Study 2B in their third experimental session, so when they came to the lab they again provided informed consent and then were introduced by name to the two Spanish-English bilingual confederates they would be working with for the picture-matching task. It was always emphasized that their partners were similarly bilingual.

The set-up and procedure for Study 2B were identical to Study 2A.

Table 20.

Example of <u>one order</u> in which subjects completed the entrainment and critical rounds with each partner for Study 2B.

Round #	Set	Round	Subject	Confederate	Unique	Shared
Rounds 1-4	Set 1	Entrainment (English)	Matcher	Director A	"feather"	"king"/ "bird"
Rounds 5	Set 1	Entrainment (English)	Director	Matcher A	"feather"	"king"/ "bird"
Rounds 6-9	Set 2	Entrainment (Spanish)	Matcher	Director B	*"bruja"*	*"rey"/"pájaro"*
Rounds 10	Set 2	Entrainment (Spanish)	Director	Matcher B	*"bruja"*	*"rey"/"pájaro"*
Round 11	Set1	Blocked Critical (English)	Director	Matcher A	"feather"	"king"/"bird"
Round 12	Set 2	Blocked Critical (Spanish	Director	Matcher B	*"bruja"*	*"rey"/"pájaro"*
Rounds 13-16	Set 3	Entrainment (Spanish)	Matcher	Director B	"*novia*"/"*peine*"	"*iglesia*"/"*escoba*"
Rounds 17	Set 3	Entrainment (Spanish)	Director	Matcher B	"*novia*"/"*peine*"	"*iglesia*"/"*escoba*"
Rounds 18-21	Set 4	Entrainment (English)	Matcher	Director A	"dress"/"scarf"	"church"/"broom"
Rounds 22	Set 4	Entrainment (English)	Director	Matcher A	"dress"/"scarf"	"church"/"broom"
Round 23	½ Sets 3 & 4	Mixed Critical (Both)	Director	Matchers A & B	"dress"/"*peine*"	"church"/"*escoba*"
Round 24	½Sets 3 & 4	Mixed Critical (Both)	Director	Matchers A & B	*"novia/"*scarf"	"*iglesia*"/"broom"

Italicized words: *bruja* = witch, *rey*= king, *pájaro* = bird, *novia* = bride, *iglesia* = church, *escoba* = broom

Note: Blocked critical rounds were completed in one language, while mixed critical rounds were completed in both languages. During the mixed rounds, subjects were predicted to choose languages based on partner cues (i.e., common ground, including the language in which they had entrained on labels with a given partner). Both matchers in mixed critical trials were present and worked on a single arrangement. Each set of 12 critical items consisted of 6 items shared with only one partner (and in only one language) and 6 items shared with both partners (and in both languages, one addressed to each partner). Shared items appeared only once per mixed critical round (e.g., so that the Director never uttered "*rey*" and "king" in the same round.

Coding

As in Study 2A, the audio files recorded by the program for the critical rounds were annotated by hand in order to insert timestamps at the onset of the picture label uttered by the subject. I calculated speaking latency for each item by subtracting the speech onset time for the target item from the time the matcher responded and clicked on the previous picture (the next picture appeared as soon as the matcher clicked on the picture for a trial). See Figure 23 below for item distribution across conditions). Again, 4 of the items uniquely shared with one partner were excluded from analyses because they were the first item in each of the critical rounds, leaving data from 32 items for the analyses.

The audio recordings were also coded for the referring expressions used by the subjects when addressing the confederate partner(s). Labels were coded in the following way: 1) consistent label in the consistent language used (the subject used the label introduced by a given partner in the consistent language with a given partner), 2) consistent label in the other language used (the subject used the consistent label but in the other language, with the consistent label meaning the label in use in the experiment), 3) other (the subjects used another label either in the consistent language or in the other language. The last condition was extremely rare (see Tables 21 and 22 for a frequency count of types of referring expressions by condition). Only trials in which the confederate matcher made the correct choice on the first try were included in all analyses (errors were negligible).

Language Blocked		Language Mixed	
Shared with Both Partners (Two Languages)	Shared with One Partner (One Language)	Shared with Both Partners (Two Languages)	Shared with One Partner (One Language)
n = 6 (x2 observations)	n = 12	n = 6 (x2 observations)	n = 12

Figure 23. Number of critical items per condition of Study 2B.

Table 21.

Frequency of Type of Referring Expression For Blocked Language /Perspective Rounds

	Unique	Shared
Consistent Language & Consistent Label	467	556
Consistent Language & Inconsistent Label	1	2
Inconsistent Language & Consistent Label	2	5
Inconsistent Language & Inconsistent Label	0	0

Table 22.

Frequency of Type of Referring Expression For Mixed Language /Perspective Rounds

	Unique	Shared
Consistent Language & Consistent Label	456	544
Consistent Language & Inconsistent Label	6	15
Inconsistent Language & Consistent Label	1	3
Inconsistent Language & Inconsistent Label	2	0

Results

I ran a repeated-measures ANOVA to compare consistency in perspective-taking within a language (as evidenced by using the consistent label with a given partner) to between languages (as evidenced by using the consistent label in the consistent language with a given partner) by blocking and item condition (see Figure 24 below for this analysis). There was a significant effect of study, so that bilinguals showed much more perspective consistency (Mdiff = .35) when working in two languages (Study 2B) than when working in only one language (Study 2A), $F(1, 46) = 440.74$, $p < .05$. This suggests that using the consistent language with a partner when you can choose to use either is seen with less flexibility than using a consistent label with a partner when it is in the same language and might even by viewed as a synonym.

There was no significant effect of blocking condition, $F(1, 46) = .29$, $p < .59$, suggesting again that people are equally consistent when working with two partners simultaneously than when working with only one partner. There was a significant effect of item condition, so that bilinguals were much more likely to be consistent for items that they uniquely shared with one partner than with items they shared with both partners (Mdiff = .12), $F(1, 46) = 90.23$, $p < .05$. However, this effect appears to be driven by an interaction between study and item condition, so that bilinguals appeared to be much less consistent with Shared items than with Unique items when working in only one language (Study 2A), but were about equally consistent with Unique and Shared items when working in two languages (Study 2B). This reinforces the idea that bilinguals may have seen referring expressions in the same language as being much more synonymous, especially once they had been exposed to both labels as with the Shared Different items.

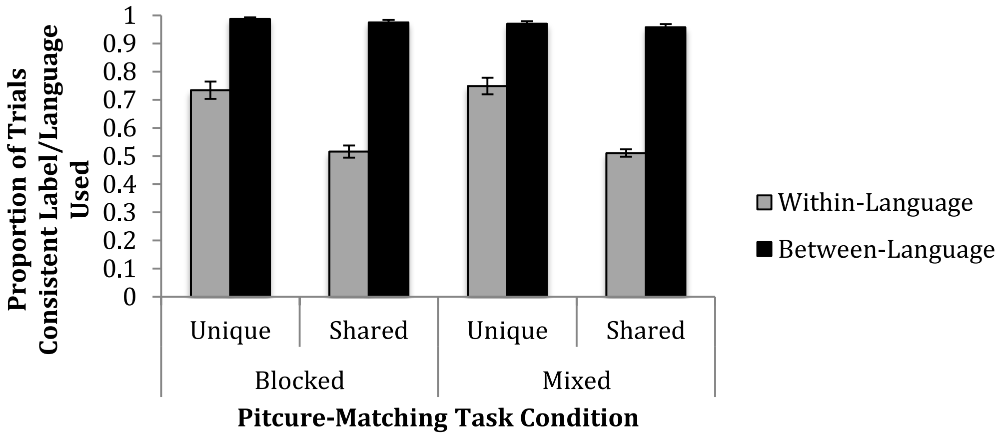


Figure 24. Proportion of trials in which the consistent label/language was used, by blocking and item condition when working in only one language (Study 2A) and when working in two languages (Study 2B).

I also ran a repeated-measures ANOVA to see the effect of blocking and item condition on speaking latency when bilinguals used both their languages in the picture-matching task. There was a main effect of language blocking, so that bilinguals were slower when they had to use both languages simultaneously than when they used only one language at a time (Mdiff=1.10), $F(1, 46) = 164.76$, $p < .05$ (see Figure 25 below for results of this analysis). There was also a significant effect of how items were shared, so that bilinguals were faster when referring to items they had shared with only one partner and in only one language, than when referring to items they had shared with both partners and in both languages (Mdiff=.11), $F(1, 46) = 6.88$, $p < .05$. The presence of a cost when using both languages suggests that basing a language switch (i.e., using a different language than on a previous trial) on partner perspective is not enough to eliminate the switching costs that have been found in studies using external color cues (e.g., Meuter & Allport, 1999).

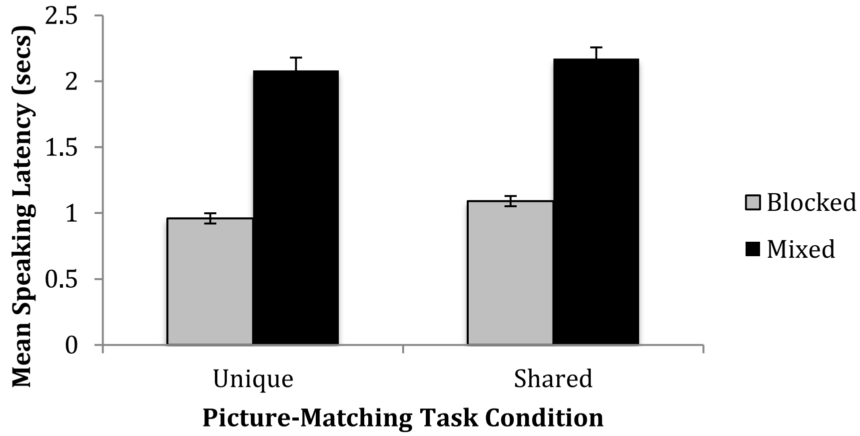


Figure 25. Mean speaking latency in the Picture-Matching Task by language blocking and item condition for Study 2B.

Although there still appears to be a cost associated with needing to use both languages, the question remains whether actually switching between languages (i.e., addressing a different partner and therefore using a different language on a trial than on a previous trial) is costlier than switching within a language (i.e, addressing a different partner and using a different label on a trial than on a previous trial, but still in the same language . In order to compare between and within-language switching, I ran a repeated measures ANOVA comparing speaking latencies in Study 2A to speaking latencies in Study 2B by blocking and item condition (see Figure 26 below). Note that the Shared Same items were left out of all the subsequent analyses, because there is no equivalent condition in Study 2B.

There was a significant difference between RTs across the two studies (choosing between synonyms vs. between translation equivalents), with bilinguals initiating speaking more slowly when working in both languages than when working in only one language (Mdiff =.18), $F(1, 46) = 13.76$, $p < .05$. They were also slower when working with two partners simultaneously (perspective/partner or perspective/language mixed) than when working with only one partner at a time (Mdiff = 1.00), $F(1, 46) = 254.19$, $p < .05$, and when referring to items shared with both partners (different label or different language) than when referring to items shared with only one partner (one label or one language, Mdiff = .15), $F(1, 46) = 3.98$ $p < .05$, Therefore, it appears that working in both languages was slower than working in only one.

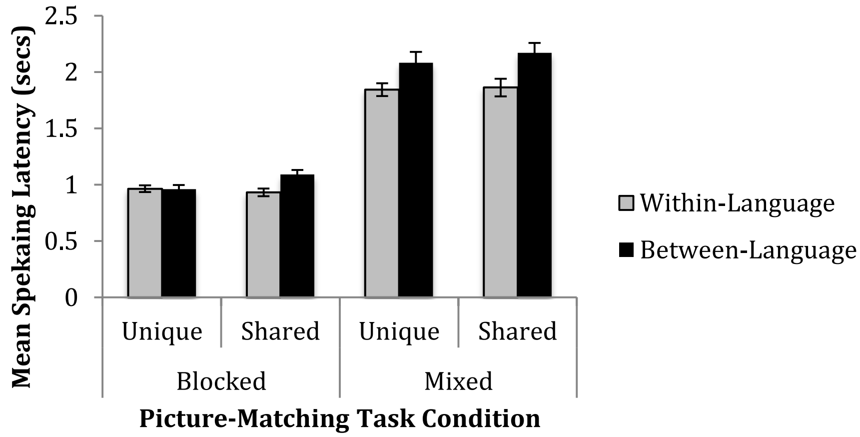


Figure 26. A comparison of mean speaking latency by blocking and item condition when working in only one language (Study 2A) to when working in both languages (Study 2B).

To further compare between and within-language switching, I ran a repeated measures ANOVA looking at mean speaking latency for switch versus non-switch trials in both Studies 2A and 2B (see Figure 27 below). A switch trial was a trial in which the subject needed to address a different confederate partner than on a previous trial. For Study 2A, this meant a switch in partner perspective. For Study 2B, a switch in partner perspective was also a switch in language. There was a main effect of study, so that again bilinguals were slower when working in two language than when working in one (Mdiff = .24), $F(1, 45) = 9.47$, $p < .05$, and there was a main effect of switching, so that people were slower on trials where a switch (either perspective or language and perspective) was required than when no switch was required , $F(1, 45) = 6.76$, $p < .05$. However, it is important to note that there was no interaction between study and trial type, so that switch trials did not take longer when the switch was between language and perspective (a switch in partners) versus just a switch in perspective (but still a switch in partners), $F(1, 45) = 1.12$, $p = .30$.

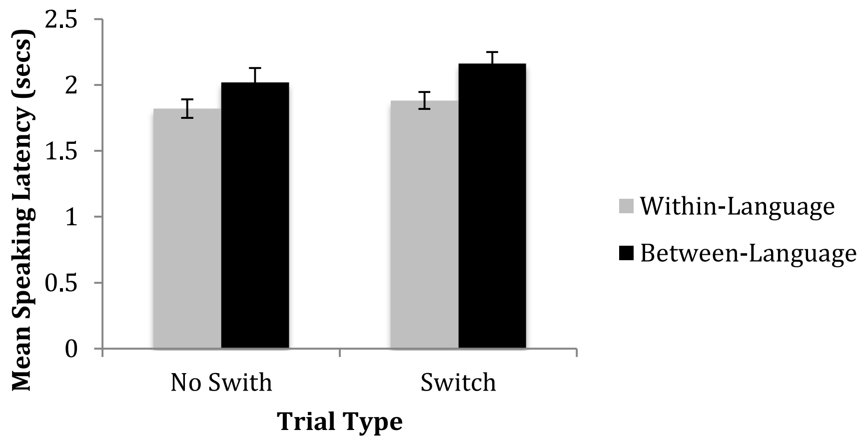


Figure 27. A comparison of switching costs when switching only between perspectives (Study 2A) to when switching between both language and perspective (Study 2B).

Discussion.

Bilinguals maintained perspective consistency much more when working in two languages than when working in only one language. This suggests that tracking language choice was either more imperative or easier than tracking lexical perspective. Given that a given language was used with only one partner, it is likely that this made partner a very strong cue for language choice, making it easier to track than lexical perspective. It is also possible that a change in lexical choice in the same language is viewed as more easily recovered from than a change in language choice.

This study also extended Study 2A to compare switching costs when working in only one language to those when working in two languages. Overall, it appears that bilinguals were slower when they were required to work in both their languages than when they worked only in one. However, it is interesting to note that switching did not take significantly longer when a switch in partners required a switch in both language and perspective. It is possible that bilinguals were slower when working in both languages because of their unbalanced proficiency in Spanish and English. As was mentioned previously, although Spanish was the native language, English appeared to be the dominant language for most of these bilinguals. Perhaps the difference between working in one versus working in two languages would have been reduced if the population of bilinguals had been balanced in their proficiency. However, balanced bilinguals are rare. The other possibility is that bilinguals were paying a cost for consistency when working in two languages. They maintained perspective-consistency much more when working in both languages, so bilinguals may have been slowed down by the need to make the appropriate language choice.

In sum, switching, either between partner perspective or both language and partner perspective, appears to be costlier than not switching. This is likely because the switching cost is not about having to actively inhibit the unintended language, but about resolving competition between similar lexical competitors. Although it appears that bilinguals closely track partner-specific factors in their choices concerning what language to direct toward an addressee but don't keep such close track of within-language labels resolving competition between translation equivalents seems to be similar to resolving competition between competitors within a language.

Chapter 8. General Discussion

Given previous findings (e.g., Bialystok, 2009), I expected bilinguals to show an advantage over monolinguals in cognitive control, and furthermore, to also show an advantage in perspective monitoring. Instead, the bilingual subjects performed worse than the monolingual subjects on typical cognitive control tasks such as the Stroop Task, the Trail Making Test, and Berg's Card Sorting Test, suggesting that as a group they had lower cognitive control ability. It's possible that the bilingual sample recruited for this set of studies is different in many ways from previously studied bilingual samples. For example, there was a large gap in socioeconomic status between bilinguals and monolinguals (e.g., annual family income), and a relationship between cognitive control ability and annual family income, so that the higher the family income, the better the performance on the TMT (smaller RT difference). Bilinguals overall had lower family income than monolinguals (but see Engel de Abreu et al., 2012).

There was also a relationship between cognitive control ability and language proficiency. Although all bilinguals acquired their second language (in most cases English) before the age of seven, the later the age of second language acquisition, the lower the English proficiency demonstrated on the BNT, and the worse the performance on the TMT. What is surprising is that Spanish was the first native language for most of the bilinguals, but English was the dominant language by far. So another possibility is that despite my attempts to recruit balanced bilinguals, these bilinguals were less balanced than previously studied bilinguals.

I also predicted that bilinguals would show a greater attentional blink than monolinguals as a result of greater reactive inhibition (Colzato et al., 2008). However, bilinguals did not show impaired reporting of second target at any lag of the RSVP, indicating that their attentional blink was the same as for monolinguals. This suggests that these bilinguals did not have an advantage over monolinguals when resolving competition between lexical competitors by activating the intended item more and laterally inhibiting all other using local connections.

Bilinguals not only had lower cognitive control ability, they were also slower than monolinguals when interpreting referring expressions in the tangram matching task (Study 1), and they were marginally slower when referring to items in the picture-matching task (Study 2A). The previously reported bilingual advantage in cognitive control goes hand-in-hand with an advantage in reaction time (Costa et al., 2009). Given that I did not find an advantage in cognitive control, it makes sense that bilinguals would also be slower overall, adding to a growing body of evidence that bilinguals do not always show an advantage in cognitive control tasks, even when socioeconomic status has been controlled for (e.g., Kirk, Scott-Brown, & Kempe, 2013).

Part of the framing for this dissertation was that given the constant need for bilinguals to take into account the language(s) their addressees do and do not understand, bilinguals would show an advantage over monolinguals in perspective-monitoring. I also hypothesized that this may contribute to the reported bilingual advantage in cognitive control. However, in addition to showing a disadvantage in cognitive control, bilinguals also did not appear to have an advantage in monitoring partner perspective, as they did not use the consistent label with a given partner more often than monolinguals (Study 2A). It was hypothesized that an advantage in perspective-monitoring would result in either more sensitivity to what Metzing and Brennan (2003) call "broken conceptual pacts" (e.g., more interference because of greater commitment to a partner's perspective) or more flexibility in considering multiple possibilities (Study 1). Bilinguals just seemed to be slower than monolinguals when processing a new label for a previously referred to item overall, whether that new label had come from an old or new partner.

Concerning how bilinguals switch between languages based on dialogue history with a given partner, results were consistent with previous findings on language-switching based on external cues such as color (e.g., Meuter & Allport): Switching to another language results in delayed speaking (a switching cost) as compared to not switching, even when the switch is presumably based on internal motivations like the need to adapt to a partner's perspective. Bilinguals were slower when working in both languages than when working in only one language. However, switching to a different language (Study 2B) took no longer than switching to a different partner's perspective in the same language (Study 2A). Interestingly, contrary to predictions, switching costs were not related to cognitive control ability for bilinguals. This is puzzling, as many models of bilingual language production suggest that cognitive control is recruited to manage competition between languages, and that the unintended language must be actively suppressed in order to produce the intended language (e.g., Green, 1998). This could be evidence that language switching costs could be due more to the bivalent nature of a task rather than the need to recruit inhibitory control to suppress items in the unintended language (Finkbeiner et al., 2006).

It is possible that working in two languages may take longer because bilinguals are paying a cost for maintaining consistency in perspective-taking, as they are much less likely to use the inconsistent language than they are to use an inconsistent label within the same language, suggesting that language choice is more subject to cognitive control (or audience design) than is lexical perspective. This is noteworthy as it was emphasized to the subjects that both their confederate partners were bilinguals. However, they worked with a given partner in only one language, so it is possible that the partner's identity easily allowed them to not only cue, but also reconstruct, which language to use. The orthogonal mapping of language to partner would make it easier to choose the right language with each partner, as it reduces memory demands (Horton & Gerrig, 2005a, 2005b). It's also possible subjects thought it was less important to be consistent when working in only one language than when working in two languages. I may have seen more perspective consistency when working in only one language if the stimuli had lent themselves to more challengingly different perspectives (as did the tangrams in Study 1).

Although cognitive control was not related to switching costs for bilinguals, overall there did appear to be a small but significant relationship between cognitive control ability and perspective-monitoring for individual participants, regardless of whether they were bilingual or monolingual. Of all the tasks, the TMT appeared to be the most distinguishing measure of cognitive control ability. Not only was it correlated with many of the demographic and proficiency measures, but it was also correlated with performance on the Stroop Task and the Attentional Blink, as well as with some of the measures for the referential communication tasks. For the tangram-matching task (Study 1, comprehension), when TMT was included as a covariate, results were consistent with Metzing & Brennan (2003), in that people were much slower to interpret a referring expression when it was an old partner breaking a conceptual pact by introducing a new label for a previously discussed item with entrained-on label and perspective, than when a new partner introduced a new label. This suggests that how people reacted to the broken conceptual pact was related to cognitive control ability, which is consistent with the finding that the higher the cognitive control ability, the *less* interference was experienced from a broken conceptual pact. This supports the prediction that people higher in cognitive control may be more flexible overall as opposed to taking longer to recover from a broken conceptual pact.

However, the question is how cognitive control results in more flexibility. It's possible that people higher in cognitive control may be better at managing competition while still keeping multiple options active, therefore enabling them to abandon an old perspective and evoke a new one more easily. It is also possible that people higher in cognitive control are better at monitoring for conflict and at recognizing when an adjustment is needed. It's also possible that both of the above are true. This does go against the prediction that in committing to a partner's perspective all other perspectives or possibilities are unilaterally inhibited, either through overt suppression (see Route C in Figure 3, Colzato et al. 2008) or through reactive inhibition (see Routes A and B in Figure 3), at least if a person is high in cognitive control. Perhaps people with lower cognitive control ability do suppress other perspectives, or perhaps are simply unable to entertain multiple possibilities as well as people with high cognitive control.

People who are higher in cognitive control are also better at adapting to a partner's perspective (Study 2A). Performance on the TMT is related to the tendency to use a consistent label with a given partner when there is competition (i.e., when a speaker has entrained on different labels with different partners for the same item), and when there is a high need to monitor and switch between partner perspectives (i.e., when working with two partners simultaneously). That is, people who are higher in cognitive control are more likely to use a consistent label with a given partner under these circumstances. As predicted, it does take longer to work with two partners simultaneously than to do the same task with only one partner at a time, but the ability to use a perspective-consistent label is not impaired when working with two partners simultaneously (blocked versus mixed conditions). This suggests that increased speaking latencies may simply be a result of the need to determine, plan for, and address the intended addressee.

As I predicted, the ability to monitor for and adapt to a partner's perspective in dialogue is related to individual differences in cognitive control ability. The higher the cognitive control ability, the better the ability to use partner cues such as dialogue history to guide language production. It also seems that higher cognitive control ability affords more flexibility when reacting to the unexpected, such as recovering from a broken conceptual pact. Furthermore, although as predicted, working with two partners simultaneously results in longer speaking latencies, it does not result in the reduced use of perspective-constant labels. Although I expected that bilingualism would result in a cognitive control advantage, the relationship between life experiences and cognitive control appears to be more complex. Bilingualism alone may not be enough when there are demographic factors at work.

Chapter 9. Conclusions and Directions for Future Research

This project has shown that bilingualism does not always result in a cognitive control advantage. Not only did this sample of bilinguals show impaired cognitive control ability on typical cognitive control tasks, but other studies suggest that the bilingual advantage in cognitive control is not as consistent a finding as was previously believed (Kirk et al, 2013; Morton & Harper, 2007; Paap & Greenberg, 2013; Ryskin & Brown-Schmidt, 2012). It is apparent that the characteristics of the particular sample of bilinguals must be considered, both how the sample may be different from the monolingual sample it is being compared to and from other bilingual samples that have been previously studied. The bilinguals in my dissertation studies were disadvantaged compared to monolinguals both in proficiency and socio-economically, which may be related to their lower performance in cognitive control, and to some extent the delay in comprehending referring expressions (Study 1) and initiating speaking (Study 2A).

I found a significant relationship negative between cognitive control and socio-economic status. The gap in annual family income between the bilinguals and monolinguals in this project was substantial. However, other researchers have argued that low socio-economic status does not cancel the advantages offered by bilingualism, but that for low-income minority children, it's better to be bilingual than not to be (e.g., Engel de Abreu et al., 2012). Given the relationship between socio-economic status and English proficiency in the current sample, it is likely that a disadvantage in cognitive control is related to a lack of balance in the bilinguals. In a quasi-experimental design it is difficult to determine what may be causing certain effects, and it is possible that this bilingual sample was far from ideal. Moreover, there may be other factors at play that were not measured in this study. What is definitive is that these bilinguals not only did not show an advantage, but also were at a disadvantage when compared to the monolingual sample. Although difficult, a future study could compare Spanish-English bilinguals and English monolinguals that have been matched on socio-economic status to see if the disadvantage in cognitive control persists (note that Kirk et al, 2013 found no advantage for Gaelic-English bilinguals when controlling for socio-economic status).

It is also possible that the disadvantages shown by this bilingual sample may bring into play other social factors. For example, these bilinguals were explicitly recruited as bilinguals, and their bilingualism was made salient by the need to measure their language proficiency and by placing them in situations where they used both their languages. Most of these bilinguals spoke a variety of Spanish that is stigmatized in the US (i.e., most were from the Caribbean, Central America, and Mexico), and by making their bilingualism salient, I may have inadvertently set up a situation in which they felt at risk of confirming negative stereotypes about their “group (i.e., Stereotype Threat, e.g., Steele & Aronson, 1995). It would be interesting to rerun the monolingual portions of the study with a group of bilinguals that is not aware of being recruited for their bilingualism, in order to see if bilingual performance improves.

Bilinguals also did not show an advantage in perspective-monitoring in dialogue, even though an advantage in Theory of Mind has been established for bilingual children (Goetz, 2003; Kovács, 2009) and for bilingual adults (Rubio-Fernández & Glucksberg, 2012). Given the circumstances of bilingual language processing (e.g., the need to make appropriate language choices), bilinguals presumably have more experience in considering their partners’ language perspectives. However, given that there is also a relationship between cognitive control and perspective-taking (e.g., Carlson & Moses, 2001), the lack of an advantage in perspective-taking with respect to lexical choices within a single language could again be due to these bilinguals having a disadvantage in cognitive control compared to the monolinguals.

The relationship between cognitive control and perspective-monitoring was apparent in that people higher in cognitive control were both more flexible when reacting to an unexpected perspective change (i.e., broken conceptual pact) and better at adapting to a partner's perspective when there was high competition and frequent perspective switching. Although it isn't completely clear how cognitive control may underlie perspective-monitoring, it is evident from the relationship between cognitive control and partner-adaptation (i.e., using a perspective consistent label, Study 2A), that cognitive control allows for a better ability to track sources of information. Higher cognitive control may allow for keeping more information or more options active when considering what cues are relevant for the current goal of communicating with a given partner. In turn this may result in a faster switch in perspectives. People who are higher in cognitive control also may be better at recognizing when there is conflict or when the current perspective is no longer valid.

I also looked at how partner cues such as dialogue history and partner perspective would guide language-switching (Study 2B), and whether it would be enough to eliminate switching costs when the switch was internally motivated. Although it appears that any switching is costly, it is interesting that within- and between-language switching costs did not differ for speaking latencies. This speaks to the idea that switching costs may depend more on the amount of competition between lexical choices than on the need to inhibit the unintended language or lexical choice (bivalent stimuli; Finkbeiner et al., 2006).

Although bilinguals were slower when working in both languages, they were also consistent (i.e., virtually always addressed their partners consistently, using the language they had entrained in), suggesting that increased speaking latencies may be a cost paid for maintaining a perspective-consistent language choice. It is possible that the study set up the expectation that using the consistent language was necessary, even though subjects were aware that their partners (for Study 2B) were bilingual. Future work could include running a version of the language-switching matching task in which the bilinguals use both languages with both partners, requiring them to track language perspective on an item-by-item basis. We may see more flexibility in language choice (even when language would be inconsistent on a given trial), but also lower speaking latencies.

The setup for these studies allowed me to study the relationship between perspective-monitoring and cognitive control in a controlled environment, but it also came with a few limitations. For one, the lack of variance in the tangram-matching task (Study 1) made the label switches very obvious, despite the inclusion of the filler sets. Metzing and Brennan (2003) had subjects working with large sets of items, and not all item were used in all trials, making the label switches less conspicuous. A similar problem occurred with Studies 2A and 2B where it was obvious that many of the items were shared with both partners and that for most of those items they used a different label or language with each partner. During the debriefing, many of the subjects commented on this fact and speculated that this set-up was somehow related to the purposes of the study. This may very well have set expectations that do not occur in spontaneous dialogue and subjects may have acted differently as a result. For example, this may have caused bilinguals to think they had to use the consistent language with a given partner. One solution would be to introduce more variance by having larger sets of items and less overlap between sets.

Another limitation is that despite being more like spontaneous code-switching than what has been previously studied, the language-switching that occurred (Study 2B) still does not quite approximate the code-switching that happens outside the lab. While they switched languages appropriately given the dialogue history with a partner, they did not use both languages with a single person, as nothing would have been expressibly gained by code-switching. Although these results are consistent with the idea of language choice as relying on partner cues such as dialogue history with a given partner, they do not account for the creativity in language choice that bilinguals demonstrate when speaking to others who are similarly bilingual.

Although this dissertation was initially framed as a dissertation about bilingualism that sought to extend the previously reported bilingual advantage in cognitive control to perspective-monitoring in dialogue, it evolved into a study of the relationship between cognitive control and perspective-taking, both in a single language and across two languages. Ultimately, it looked at the relationship between cognitive control and partner adaptation in both comprehension and production. These studies have made headway into understanding the relationship between cognitive control and the ability to monitor and adapt to a partner's perspective, as well as the ability to be flexible and abandon it when it is no longer valid. These studies also demonstrated that perspective-consistency is greater when working in two languages than when working in only one, which suggests that tracking language choice may be different from tracking lexical perspective.

Furthermore, I found that there is no difference in switching cost when switching within- and between-languages. This speaks strongly against the need to recruit a separate inhibitory control system to suppress the unintended language. Rather, it is very likely that the mechanisms that manage competition between languages are very similar to the mechanisms that manage competition within a language. Finally, this dissertation adds to a growing body of research that suggests that bilingualism need not always result in a cognitive advantage. It may be that how bilinguals communicate can shape cognition, but it is important to remember that the bilingual experience is not a uniform experience, and therefore no two bilinguals are alike.

References

Abutalebi, J. & Green, D. (2007). Bilingual language production: The neurocognition of language representation and control. *Journal of Neurolinguistics, 20*, 242 – 275.

Bates, E., D'Amico, S., Jacobsen, T., Szekely, A., Andonova, E., Devescovi, A., … Tzeng, O. (2003). *Psychonomic Bulletin & Review, 10*, 344-380.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70*, 636–644.

Bialystok, E. (2005). Consequences of bilingualism for cognitive development. In J.R. Kroll & A. de Groot (Eds.), *Handbook of Bilingualism: Psycholinguistic Approaches* (pp. 417-432). Oxford: Oxford University Press.

Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language & Cognition, 12*, 3-11.

Bialystok, E. (2010). Global-local and trail making tasks by monolingual and bilingual children: Beyond inhibition. *Developmental Psychology, 46*, 93-105.

Bialystok, E., & Craik, F.I.M. (2010). Cognitive and linguistic processing in the bilingual mind. *Current Directions in Psychological Science, 19*, 19-23.

Bialystok, E., Craik, F.I.M., & Freedman, M. (2007). Bilingualism as a protection against the onset of symptoms of dementia. *Neuropsychologia, 45*, 459–464.

Bialystok, E., Craik, F.I.M., Grady, C., Chau, W., Ishii, R., Gunji, A., et al. (2005). Effect of bilingualism on cognitive control in the Simon task: evidence from MEG. *NeuroImage, 24*, 40 – 49.

Bialystok, E., Craik, F. I. M., Klein, R. & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon Task. *Psychology and Aging, 19*, 290 – 303.

Bialystok, E., Craik, F. I. M. & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34 (4),* 859 – 873.

Bialystok, E., & Martin, M.M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental Science, 7*, 325–339.

Bialystok, E., Martin, M. M. & Viswanathan, M. (2005). Bilingualism across the lifespan: The rise and fall of inhibitory control. *International Journal of Bilingualism, 9 (1),* 103 – 119.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19,* 290–303.

Bialystok, E., Craik, F.I.M., & Ryan, J. (2006). Executive control in a modified anti-saccade task: Effects of aging and bilingualism. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32,* 1341-1354.

Bialystok, E., & Shapero, D. (2005). Ambiguous benefits: The effect of bilingualism on reversing ambiguous figures. *Developmental Science, 8*, 595–604.

Brennan, S. E., & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 1482–1493.

Brennan, S. E. & Hanna, J. E. (2009). Partner-specific adaptation in dialogue. *Topics in Cognitive Science (Special Issue on Joint Action), 1,* 274-291.

Brown-Schmidt, S. (2009). The role of executive function in perspective-taking during on-line language comprehension. *Psychonomic Bulletin and Review, 16*, 893-900.

Carlson, S.M., & Meltzoff, A.N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11*, 282–298.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032-1053.

Carlson, S. M., Moses, L. J., & Breton, C. (2002). How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory. *Infant and Child Development. Special issue: Executive function and its development, 11*, 73-92.

Clark, H.H., & Wilkes-Gibbs, D. (1986). "Referring as a collaborative process." *Cognition*, 22, 1-39.

Colomé, A. (2001). Lexical activation in bilinguals' speech production: Language-specific or language indpendent? *Journal of Memory & Language, 45*, 721-736.

Colzato, L. S., Bajo, M. T., van den Wildenberg, W., Paolieri, D., Nieuwenhuis, S., La Heij, W. & Hommel, B. (2008). How does bilingualism improve executive control? A comparison of active and reactive inhibition mechanisms. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34 (2),* 302 – 312.

Costa, A., Hernandez, M., Costa-Faidella, J., Sebastian-Galles, N. (2009). On the Bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition, 113,* 135-149

Costa, A., Hernández, M. & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition, 106,* 59 – 86.

Costa, A., La Heij, W., & Navarrete, E. (2006). The dynamics of bilingual lexical access. *Bilingualism: Language and Cognition, 9*, 137–151.

Costa, A., Miozzo, M. & Caramazza, A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection? *Journal of Memory and Language, 41,* 365 – 397.

Costa, A., & Santesteban, M (2004). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language, 50,* 491-511

Costa, A., Santesteban, M. & Ivanova, I. (2006). How do highly-proficient bilinguals control their lexicalization process? Inhibitory and language-specific selection mechanisms are both functional. *Journal of Experimental Psychology: Learning, Memory and Cognition, 32,* 1057 – 1074.

Dijkstra, T., & Van Heuven, W. J. B. (1998). The BIA-model and bilingual word recognition. In J. Grainger & A. M. Jacobs (Eds.), Localist connectionist approaches to human cognition (pp. 189-225). Mahwah, NJ: Lawrence Erlbaum Associated Inc.

Dunn, A. L. & Fox Tree, J. E. (in press). More on language mode. *International Journal of Bilingualism.*

Emmorey, K., Luk, G., Pyers, J., & Bialystok, E. (2008). The source of enhanced cognitive control in bilinguals: Evidence from bimodal bilinguals. *Psychological Science, 19*, 1201–1206

Engel de Abreu, P.M.J., Cruz-Santos, A., Tourinho, C.J., Martin, R., & Bialystok, E. (2012). Bilingualism enriches the poor: Enhanced cognitive control in low-income minority children. *Psychological Science, 23,* 1364 – 1371.

Finkbeiner, M., Almeida, J., Janssen, N., & Caramazza, A. (2006). Lexical selection in bilingual speech production does not involve language suppression. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 32,* 1075-1089.

Finkbeiner, M., Gollan, T.H., & Caramazza, A. (2006). Lexical access in bilingual speakers: What's the (hard) problem? *Bilingualism: Language & Cognition, 9*, 153-166.

Fishman, Joshua. (2000). Who speaks what language to whom and when? In Li Wei (Ed.), *The Bilingualism Reader* (2nd ed., pp. 55-70). New York: Routledge.

Genesee, F., Boivin, I. & Nicoladis, E. (1996). Bilingual children talking with monolingual adults: A study of bilingual communicative competence. *Applied Psycholinguistics, 17,* 427-442.

Gerrig, R. J., Brennan, S. E., & Ohaeri, J. O. (2001). What can we conclude from speakers behaving badly? *Discourse Processes, 29*, 173–178.

Goetz, P.J. (2003). The effects of bilingualism on theory of mind development. *Bilingualism: Language and Cognition, 6*, 1–15.

Gollan, T.H., & Ferreira, V.S. (2009). Should I stay or should I switch: A cost-benefit analysis of voluntary language-switching in young and aging bilinguals. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 35,* 640-665.

Green, D.W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Langauge & Cognition, 1,* 67-81.

Greenberg, A., Bellana, B., & Bialystok, E. (2013). Perspective-taking ability in bilingual children: extending advantages in executive control to spatial reasoning. *Cognitive Development, 28,* 41-50.

Hanna, J. E., & Tanenhaus, M. K. (2004). Pragmatic effects on reference resolution in a collaborative task: Evidence from eye movements. *Cognitive Science, 28,* 105–115.

Hernández, M., Costa, A., Fuentes, L. J., Vivas, A. B., & Sebastián-Gallés, N. (2010). The impact of bilingualism on the executive control and orienting networks of attention. *Bilingualism: Language and Cognition*.

Horton, W. S., & Gerrig, R. J. (2005a). Conversational common ground and memory processes in language production. *Discourse Processes*, *40,* 1-35.

Horton, W. S., & Gerrig, R. J. (2005b). The impact of memory demands on audience design during language production. *Cognition, 96,* 127-142

King, K. A. & Fogle, L. (2006). Bilingual parenting as good parenting: Parents' perspectives on family language policy for additive bilingualism. *International Journal of Bilingual Education and Bilingualism*, *9*(6), 695-712.

Kirk, N. W., Scott-Brown, K. C., & Kempe, V. (2013). Do older Gaelic-English bilinguals show an advantage in inhibitory control? In M. Knauff, M. Pauen, N. Sebanz, & I. Wachsmuth (Eds.), Proceedings of the 35th Annual Conference of the Cognitive Science Society (pp. 782-787). Austin, TX: Cognitive Science Society.

Kohnert, K., Hernandez, A.E., & Bates, E. (1998). Bilingual performance on the Boston Naming Test: Preliminary norms in Spanish and English. *Brain and Language*, *65*, 422-440.

Kovács, Á.M. (2009). Early bilingualism enhances mechanisms of false-belief reasoning. *Developmental Science*, 12, 48-54.

Kovács, Á.M., & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. *Proceedings of the National Academy of Sciences of the United States of America*, *106*, 6556–6560.

Kroll, J.F., Bobb, S.C., Misra, M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica*, *128*, 416 -430.

Kroll, J. F., Bobb, S. C., & Wodniekca, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition*, *9*, 119–135.

Kuhlen, A.K., & Brennan S.E. (2013). Language in dialogue: When confederates might be hazardous to your data. *Psychonomic Bulleting & Review, 20*, 54-72.

La Heij, W. (2005). Selection processes in monolingual and bilingual lexical access. In J. F. Kroll & A. M. B. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 289–307). New York: Oxford University Press.

Lanza, E. (1992). Can bilingual two-year-olds code-switch? *Journal of Child Language, 19,* 633–658.

Linck, J, Kroll, J.F. & Sunderman, G. (2009). Losing access to the native language while immersed in a second language: Evidence for the role of inhibition in second language learning. *Psychological Science, 20*, 1507-1515.

Lockridge, C. B. (unpublished dissertation). Impact of working memory span on referring in conversation.

Lockridge, C. B., & Brennan, S. E. (2002). Addressees' needs influence speakers' early syntactic choices. *Psychonomic Bulletin and Review, 9*, 550-557.

Macnamara, J., & Kushnir, S. (1971). Linguistic independence of bilinguals: The input switch. *Journal of Verbal Learning & Verbal Behavior, 10*, 480-487.

Marian, V., Blumenfeld, H., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. Journal of Speech, Language, and Hearing Research, 50, 4, 940-967.

Marian, V. and Spivey, M. (2003). Competing activation in bilingual language processing: within and between-language competition. *Bilingualism: Language and Cognition, 6,* 97-115.

Martin-Rhee, M.M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition, 11,* 81-93.

Meuter, R.F.I. (2005). Language selection in bilinguals: Mechanisms and processes. In J. F. Kroll & A. M. B. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 349–370). New York: Oxford University Press.

Meuter, R.F.I., & Allport, A. (1999). Bilingual language-switching in naming: Asymmetrical costs of language selection. *Journal of Memory & Language, 40*, 25-40.

Metzing, C., & Brennan, S. E. (2003). When conceptual pacts are broken: Partner-specific effects on the comprehension of referring expressions. *Journal of Memory and Language, 49*, 201- 213.

Morton, J.B. & Harper, S.N.(2007). What did Simon say? Revisiting the bilingual advantage. *Developmental Science, 10*, 719-726.

Myers-Scotton, C. (2002). *Contact linguistics: Bilingual encounters and grammatical outcomes*. Oxford: Oxford University Press.

Nieuwland, M. S., & Van Berkum, J. J. A. (2006). When peanuts fall in love: N400 evidence for the power of discourse. *Journal of Cognitive Neuroscience, 18(7),* 1098-1111.

Paap, K.R. & Greenberg Z.I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology*, *66*, 232-58.

Poplack, S. (1980). Sometimes I'll start a sentence in English Y TERMINO EN ESPANOL: Toward a typology of code-switching. *Linguistics, 18*, 581-618.

Rubio-Fernández, P., & Glucksberg, S. (2012). Reasoning about other people's beliefs: Bilinguals have an advantage. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38*, 211-217.

Ryskin, R. A., & Brown-Schmidt, S. (2012a). A bilingual disadvantage in linguistic perspective adjustment. Paper presented at the annual meeting of the Psychonomic Society, Minneapolis, MN.

Silverberg, S., & Samuel, A.G. (2004). The effect of age of second language acquisition on the representation and processing of second language words. *Journal of Memory & Language, 51,* 381-398.

Soares & Grosjean 1984)

Spivey, M.J., & Marian, V. (1999). Cross talk between native and second languages: Partial activation of an irrelevant lexicon. *Psychological Science, 10,* 281-284.

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 28,* 643-662.

Tokowicz, N., Kroll, J. F., De Groot, A. M. B., & Van Hell, J. G. (2002). Number-of-translation norms for Dutch-English translation pairs: A new tool for examining language production. *Behavior Research Methods, Instruments, and Computers, 34,* 435-451.

Van Berkum, J. J. A., Holleman, B., Nieuwland, M., Otten, M., & Murre, J. (2009). Right or wrong? The brain's fast response to morally objectionable statements. *Psychological Science, 20,* 1092 -1099.

Van Berkum, J. J. A., Van den Brink, D., Tesink, C. M. J. Y., Kos, M., & Hagoort, P. (2008). The neural integration of speaker and message. *Journal of Cognitive Neuroscience, 20(4),* 580-591.

Van Der Wege, M. M. (2009). Lexical entrainment and lexical differentiation in reference phrase choice. *Journal of Memory and Language, 60,* 448-463.

Van Der Wege, M.M. (unpublished manuscript). Comprehension of contrasting conceptualizations in conversational reference.

Van Heuven, W. J. B., Dijkstra, T., & Grainger, J. (1998). Orthographic neighborhood effects in bilingual word recognition. *Journal of Memory and Language*, *39*, 458-483.

Wang, Y., Xue, G., Chen, C., Xue, F., Dong, Q. (2007). Neural bases of asymmetric language switching in second-language learners: an ER-fMRI study. *Neuroimage*, *35,* 862-870.

Wilkes-Gibbs, D., & Kim, P. H. (1991). *Discourse influences on memory for visual forms*. Paper presented at the 1991 meeting of the Psychonomic Society, San Francisco, CA.

Witteman, M.J., & van Hell, J.G. (2009). Triggered codeswitching: An experimental test of the triggering hypothesis. Paper presented at 7th International Symposium on Bilingualism, Utrecht, Netherlands.

Appendix A
Demographic Questionnaire

Last Name		First Name		Today's Date	
Age		Date of Birth		Male ☐	Female ☐

1) Where were you born (City/State, Country)?

2) How long have you lived in the United States?
   - ☐ 0-5 years
   - ☐ 6-11 years
   - ☐ 12–17 years
   - ☐ 18 years or more

3) In what City/State have you lived the longest?
   For how long?

4) What is your ethnic/racial background?
   - ☐ African-American, Black
   - ☐ Chinese
   - ☐ Filipino
   - ☐ Indian
   - ☐ Japanese
   - ☐ Korean
   - ☐ Southeast Asian
   - ☐ White Caucasian (Non-Hispanic)
   - ☐ Hispanic or Latino
   - ☐ Mexican
   - ☐ American Indian, Alaskan Native
   - ☐ More than one race
   - ☐ Unknown or not reported
   - ☐ Decline to answer

   Other:

5) Do you have siblings? ☐ Yes ☐ No
   If yes, how many?

6) Including yourself, what is the size of your household?

7) What is the current annual income for your household?
   - ☐ $0 - $10,000
   - ☐ $10,001 - $20,000
   - ☐ $20,001 - $30,000
   - ☐ $30,001 - $40,000
   - ☐ $40,001 - $50,000
   - ☐ $50,001 - $60,000
   - ☐ $60,001 - $70,000
   - ☐ $70,001 - $80,000
   - ☐ $80,001 - $90,000
   - ☐ $90,001 - $100,000
   - ☐ $100,001 - UP

8) What is the highest degree or level of education obtained by your MOTHER?
   - ☐ Less than High School
   - ☐ High School
   - ☐ Professional training
   - ☐ Some college

☐ Two-year college degree (AA) ☐ Four-year college degree (BA or BS)
☐ Masters ☐ Ph.D./M.D./J.D.
☐ Don't know

9) What is the highest degree or level of education obtained by your FATHER?

☐ Less than High School ☐ High School
☐ Professional training ☐ Some college
☐ Two-year college degree (AA) ☐ Four-year college degree (BA or BS)
☐ Masters ☐ Ph.D./M.D./J.D.
☐ Don't know

Appendix B

Bilinguals Language-Use Questionnaire

Code-switching is when bilinguals switch between languages in the same sentence or conversation when speaking to other bilinguals.

1) On a scale from zero to ten, please rate how often you find **yourself** code-switching in the following contexts:

Home	(click here for pull-down scale)
Work	(click here for pull-down scale)
School	(click here for pull-down scale)

2) On a scale from zero to ten, please rate how often you hear **other people** code-switching in the following contexts:

Home	(click here for pull-down scale)
Work	(click here for pull-down scale)
School	(click here for pull-down scale)

3) On a scale from zero to ten, please rate how often you find **yourself** code-switching with the following people:

Parents	(click here for pull-down scale)
Siblings	(click here for pull-down scale)
Other family members	(click here for pull-down scale)
Friends	(click here for pull-down scale)
Professors/Classmates	(click here for pull-down scale)
Boss/Coworkers	(click here for pull-down scale)
Strangers (e.g., clerks, bank tellers, etc.)	(click here for pull-down scale)

4) On a scale from zero to ten, please rate how often you hear the **following people** code-switching:

Parents	(click here for pull-down scale)
Siblings	(click here for pull-down scale)
Other family members	(click here for pull-down scale)
Friends	(click here for pull-down scale)
Professors/Classmates	(click here for pull-down scale)
Boss/Coworkers	(click here for pull-down scale)
Strangers (e.g., clerks, bank tellers, etc.)	(click here for pull-down scale)

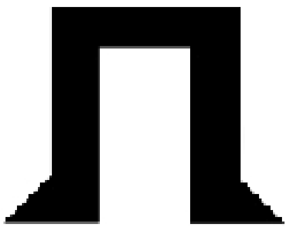
5) On a scale from zero to ten, please rate how **prevalent** you believe code-switching to be among bilinguals:

   (click here for pull-down scale)

6) On a scale from zero to ten, please rate how **normal** you believe code-switching to be:
   (click here for pull-down scale)

Appendix C

Critical Tangram Stimuli (Study 1) and Normed Labels



Arch/

Legs

Barbell/

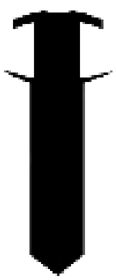
Dog Bone

Cowboy Hat/

Mountain Range

Viking Ship/

Swimmer



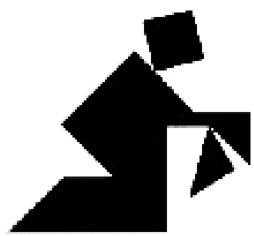
Dagger/

Necktie

Bridge w.

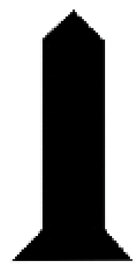
Underpasses/

Letter M



Monk Praying/

Person Cleaning



Rocket/

Tower

Appendix D

Synonym Pairs for Study 2A

LABEL A	LABEL B
Automobile	Car
Backpack	Bookbag
Block	Cube
Bug	Insect
Bush	Shrub
Cab	Taxi
Cap	Hat
Carpet	Rug
Chef	Cook
Cloak	Cape
Coat	Jacket
Dish	Plate
Gift	Present
Infant	Baby
Pail	Bucket
Picture	Painting
Pillar	Column
Pipe	Tube
Pistol	Gun
Policeman	Cop
Prison	Jail
Purse	Handbag
Restroom	Bathroom
Sea	Ocean
Serpent	Snake
Ship	Boat
Shore	Beach
Sofa	Couch
Store	Shop
Stove	Oven
Stream	River
String	Yarn
Thief	Burglar
Town	City
Trash	Garbage
Woods	Forest

Appendix E

Translation Pairs for Study 2A

ENGLISH	SPANISH
arrow	*flecha*
balloon	*globo*
beard	*barba*
bird	*pájaro*
bone	*hueso*
boy	*niño*
bride	*novia*
bridge	*puente*
broom	*escoba*
chain	*cadena*
church	*iglesia*
clock	*reloj*
comb	*peine*
dress	*vestido*
feather	*pluma*
fireman	*bombero*
hose	*manguera*
king	*rey*
leaf	*hoja*
mirror	*espejo*
mouse	*ratón*
nail	*clavo*
needle	*aguja*
nurse	*Enfermera*
octopus	*Pulpo*
pillow	*Almohada*
rain	*Lluvia*
rainbow	*arco iris*
scarf	*Bufanda*
shovel	*Pala*
spider	*Araña*
strawberry	*Fresa*
tie	*Corbata*
wig	*Peluca*
window	*Ventana*
witch	*Bruja*