**Introduction - Linguistic Characteristics of Bilingualism**

Psychological research has revealed that for many populations, the increased use of a certain behavior results in improved skills on related tasks as well as associated brain structure differences. For example, architects outperform non-architects on tasks evaluating visuo-spatial ability (and video game playing was correlated to heightened modification of perceptual-motor ability (Green and Bavelier, 2008). In brain imaging studies, the taxi drivers of London, who must pass strict examinations of their knowledge of the streets of the city, possess more development in the region of the hippocampus associated with spatial navigation (Maguire, Gadian, Johnsrude, Good, Ashburner, Frackowiak, & Frith, 2000). Likewise, bilingual populations have been shown to differ from monolingual counterparts in many different facets, both physiologically and behaviorally.

In terms of linguistic development, bilingualism has been connected to decreased vocabulary size in specific languages (e.g. comparing English vocabulary size of monolingual English speakers and bilingual speakers who speak English and another language) (Bialystok, Luk, Peets, & Yang, 2010; Bialystok & Luk, 2012); slower lexical access in picture-naming tasks (Gollan, Fennema-Nostestine, Montoya, & Jernigan, 2007) and lexical decision tasks (Van Hell & Dijkstra, 2002); and decreased verbal fluency in semantic (or categorical) and phonemic (or letter) fluency tasks (e.g. Gollan, Montoya & Werner, 2002; Rosselli, Ardila, Araujo, Weeks, Caracciolo, Padilla, Ostroski-Solis, 2000; however, compare Bialystok, Craik & Luk, 2008, who matched monolinguals and bilinguals for vocabulary size and observed bilinguals outperform monolinguals). These linguistic differences likely relate to the perpetual activation of both languages, thus causing, for example, competition between first- and second-language forms, which results in slower performance, in a picture-naming task. This perpetual dual-language activation has been attested in behavioral (Kroll & DeGroot, 1997; Francis, 1999; Kroll & Bialystok, 2013; Kroll & Sunderman, 2003), imaging (Martin, Dering, Thomas & Thierry, 2009); and patient data (Abutalebi, Miozzo & Cappa, 2000; Fabbro, Skrap & Aglioti, 2000). Therefore, although the case for bilingualism from a linguistic development standpoint often seems bleak, the cognitive effects associated with this dual-language activation paints a different, more nuanced picture.

**Cognitive Characteristics of Bilingualism**

As mentioned above, the reality of bilingualism is the consistent need to suppress one language according to the context, as a bilingual does not separate the mental lexicons and grammars associated with each language; instead, both languages are active during any language use (Kroll & Bialystok, 2013; Kroll & Sunderman, 2003).

Within Green’s (1998) Inhibitory Control Model, it is cognitive control (CC) that suppresses the competing, undesired linguistic form during language use by bilinguals. That is to say, given two competing linguistic forms, the salient but contextually-infelicitous form is suppressed by CC while the desired form is promoted and thus, produced. This model and much of the early research that followed (see Bialystok, 2007, 2009, for reviews) investigated whether this constant activation of CC led to improved performance of bilinguals on nonlinguistic tasks, much as architects’ more frequent use of visuo-spatial problem-solving correlates to increased performance on such psychometric tests. This association between executive functioning or cognitive control and bilingualism would become known as the bilingual advantage (Bialystok, 2009). The bilingual advantage has subsequently been attested through neuroimaging studies and behavioral studies. In neuroimaging, larger gray matter volume has been observed in brain areas that serve executive functioning (Olulade, Jamal, Too, Perfetti, LaSasso and Eden, 2015). Likewise, the anterior cingulate cortex, a neural structure involved in conflict resolution, the activation of which correlates to poorer performance on conflict tasks, has been observed to be activated more by monolinguals performing such tasks (Abutalebi et al., 2012), and this decreased network activation was replicated by Gold et al. (2013). Likewise, a large effect size was observed in a meta-analysis conducted by Adesope, Levin, Thompson, and Ungerledier, (2010), comparing attentional control of monolingual and bilingual populations, which likewise would suggest a bilingual advantage in terms of executive function.

Despite this, some questions have arisen in the research, such as the extent to which the bilingual advantage is demonstrated by distinct populations of bilinguals (e.g., Torres & Sanz, 2015; Colzato, Bajo, Wildenberg, Poaolieri, Nieuwenhuis, La Heij, & Hommel, 2009; Paap & Greenberg, 2013). One such population of bilinguals that has received particular attention of late is the heritage language user, a population which has often been grouped with other bilinguals despite a unique linguistic profile that merits the separation of heritage bilinguals from both monolinguals and biliterate peers, as discussed below.

**Cognitive Control in Heritage Language Bilinguals**

As Torres & Sanz (2015) address, many studies that consider bilingual speakers may not sufficiently separate distinct language profiles such as heritage language (HL) bilinguals. The bilinguals in some research, such as the Catalonians studied in Costa et al. (2008), for example, are educated in bilingual schools and therefore, possess an inherently different language profile than the Spanish-English bilinguals in the US considered heritage learners. Broadly, these are speakers who have a certain degree of proficiency at an early age but for whom the dominant language shifts to English as they are schooled in US monolingual programs (Polinsky & Kagan, 2007; Torres & Sanz, 2015). Torres & Sanz (2015) are among the very few to have investigated the role of HL bilingualism and its effect on cognition, as most research of this burgeoning field approaches the population from a sociolinguistic perspective (e.g. Potowski, 2016), pedagogy (e.g. Potowski, 2014), or linguistic development and properties of grammar (Benmamoun, Montrul, & Polinsky, 2013; Potowski, 2010). Torres & Sanz (2015), in this first study of cognitive control in HL bilinguals, find no differences for HL bilinguals and late classroom-emerging bilinguals of Spanish in performance on the Attentional Network Task (ANT). While Torres & Sanz (2015) take the important first step to investigate how or whether cognitive differences exist between HL bilinguals and late-L2 bilinguals, differences in the employment of cognitive control during linguistic tasks, such as ambiguity resolution, remains to be understood. Indeed, the participants sampled are at the prime age of cognitive control, and so although the researchers find no differences in performance on the ANT, language processing involves much more coordination, so a linguistic task modulated within the cognitive adaptation paradigm, explained below, may reveal differences in these two populations of young adult bilinguals (heritage and L2) that we cannot observe in strictly nonlinguistic tasks. The current study would use the conflict adaptation paradigm addressed below to observe how the engagement of cognitive control affects conflict resolution for heritage language bilinguals.

**Cognitive Control in L3 learners**

Beyond this increased understanding of how cognitive control plays a role in heritage bilinguals’ language processing and conflict resolution, a gap exists in our understanding of cognitive control and its role in subsequent language learning. While the studies here proposed will provide us with a greater understanding of the role of CC in conflict resolution for heritage bilinguals and L2 learners across the acquisition process, the final study proposed will bring these two phenomena together to account for how CC mediates third language (L3) acquisition. While we know that bilinguals educated in the are more apt for subsequent language learning (Sanz, 2000; Cenoz & Valencia, 1994). The role of cognition has been attributed to this improved language learning, but as Sanz (2000) notes, it is biliteracy in particular that relates directly to the improved L3 learning. The use of the current paradigm allows for causational observations of the role of cognitive control in the use of the L3, specifically during conflictive language parsing. This study will make an important contribution in that it will allow us to get a first glimpse of how (or whether) bilinguals take advantage of their developed CC during the L3 process. This follows from current research that grants insight into exactly *how* cognitive control plays a role in bilingual language processing. Adler (in progress) observed the cognitive control employment by heritage language bilinguals who were dominant in Spanish. The task measured ANT scores following four blocks of reading processing – English, Spanish, English-Spanish alternating trials, and English-Spanish intrasentential code switching – and found that the intrasentential code switching and the English blocks increased reaction times on the incongruent ANT trials, suggesting that intersentential code switching and use of the dominant language is not as cognitively taxing as intrasentential code switching or the use of the non-dominant language. The current study will extend this design to assess in what ways intersentential codeswitching does modulate CC when a third language is involved.

**Conflict Adaptation**

Despite the incredible rate at which language is presented, language users interpret language incrementally as it is presented to them, as opposed to packaging the input as a unit after it has been communicated and interpreting it as a whole. However, there arise cases in which an initial interpretation needs to be re-interpreted, as new information is encountered in the input. For example, as a listener hears the structure in 1, they may initially interpret it as a prepositional phrase expressing the goal of the movement. However, further information, i.e. the remainder of the sentence, informs the listener to re-structure the initial information such that [on the plate] is interpreted as a reduced relative clause providing information distinguishing the target dumpling from other dumplings, as shown in 2.

1. Put the dumpling on the plate…

2. Put the dumpling on the plate into the wok.

Correlational and causation research paradigms have shown that this re-interpretation is related to domain-general cognitive control. Cognitive control is a set of behavioral adjustments that detect and resolve conflict during information processing (Botvinick, Braver, Barca, Carter & Cohen, 2001), including in the context of linguistic mis- or re-analysis, as described in 1-2 (Novick, Trueswell & Thompson-Schill, 2005). The importance of CC in the reanalysis has also been observed in patients with prefontal damage associated with CC deficits, who present difficulty or failure to reanalyze upon reaching the subsequent information that typically leads to reanalysis (Novick, Kan, Trueswell, & Thompson-Schill, 2009), and imaging studies have shown overlapping activity when adults interpret such ambiguities and when they complete tasks such as the Stroop or Flanker tasks, which present nonlinguistic conflict (Fedorenko, 2014; January, Trueswell & Thompson-Schill, 2009; Ye & Zhou, 2009), which suggests that the linguistic and nonlinguistic tasks share resources. Beyond this, Hsu & Novick (2016) investigated whether CC engagement facilitates reinterpretation, building a research paradigm around the important observation that conflict detection triggers the sustained activation of CC, thus reducing the cost of subsequent conflict resolution (Gratton, Coles, & Donchin, 1992; Ullsperger, Bylsma & Botvinick, 2005; Freitas, Bahar, Yang & Banai, 2007; Kerns, Cohen, MacDonald, Cho, Stenger & Carter, 2004), what they call conflict adaptation. By interleaving tasks (Stroop and an online language-comprehension task involving syntactic ambiguity), the researchers observed that participants made significantly fewer mistakes in the behavioral analysis of their data when the preceding trial was an incongruent Stroop trial (thus activating CC), and the researchers observed more accurate online processing following incongruent Stroop trials in their eye-tracking data. In other words, the researchers demonstrated through a cause-effect paradigm that comprehension difficulty, such as temporary ambiguities, recruit CC mechanisms to resolve the conflict.