

## Abstract

Title of dissertation:     LOOKING INTO BILINGUALISM THROUGH THE  
                                  HERITAGE SPEAKER'S MIND

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Due to their unique profile as childhood bilinguals whose first language (L1) became weaker than their second language (L2), heritage speakers can shed light on three key issues in bilingualism - timing, input, and cross-linguistic interaction. The heritage speakers of focus in this dissertation are Korean second generation immigrants mainly exposed to their heritage language (HL) when young but who became more dominant in their L2 later in life. The ability of Korean heritage speakers in both their HL (Korean) and L2 (English), including speech perception, translation priming, and grammatical intuition were examined. Six psycholinguistic tasks, a bilingual experience questionnaire, and Korean and English proficiency tests were administered. Data were collected from 48 Korean heritage speakers, 36 English speakers learning Korean as adults and 36 Korean speakers learning English as adults. The two L2-learner comparison groups also served as native speaker controls for their respective native languages.

The Korean heritage speakers raised in an English-speaking country, despite having been exposed to Korean first and throughout their lives, exhibited significant weaknesses in their Korean competence while exhibiting (near-)native-like competence in English. It is thus argued that the input-dominance switch that occurred before the critical period

ended caused a dramatic reorganization of early/first established linguistic representation, which challenges some previous views on the implasticity of human language representation (e.g., Pallier et al, 1997).

When compared to adult L2 learners of Korean, heritage speakers exhibited a slight advantage in speech perception and translation priming while showing no advantage in the grammaticality judgment of locative alternation. It is therefore suggested here that heritage speakers may have an advantage over adult L2 learners with early-acquired linguistic features and with implicit processing capacity.

Another notable finding is that Korean heritage speakers showed less-than-nativelike performance in locative alternation in both Korean and English, a finding that highlights cross-linguistic interaction in bilingualism. The standard practice of comparing bilinguals to monolingual competence in SLA studies is thus called into question.

Finally, although individual differences among the heritage participants in the current study were best predicted by language aptitude and amount of instruction, no conclusive claim regarding the role of language aptitude or instruction in early bilingualism is proposed here because it is unclear whether such effects influenced the childhood bilingual development or re-learning during adulthood of the current heritage participants.

In short, timing, input, and cross-linguistic interaction all seem to contribute significantly to the development of bilingual competence. The heritage speakers examined in this dissertation turned out to be an excellent testing ground for all three of these ingredients of language acquisition.

LOOKING INTO BILINGUALISM THROUGH THE HERITAGE SPEAKER'S MIND

by

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## Acknowledgement

My friend once said that he always reads the acknowledgements of dissertations. I asked why, and he said just for fun. Even to this day, I don't understand what he meant by "fun." Even on the rare occasion that I have read an acknowledgement, it was not for fun. To be honest, it often was to find my own name or the names of my acquaintances in the dissertations of my friends. And this friend forgot to put my name in his acknowledgement, by the way.

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## Chapter 1. Introduction

Bilingualism in a broader sense describes numerous populations. From students in a foreign language classroom to speakers who have grown up speaking two languages, anybody who can communicate in more than one language at any level of proficiency can fall under this huge umbrella. In this era of rapid globalization, the chances are, you, the reader of this dissertation, are probably standing under this umbrella too.

In a more narrow sense, this dissertation is about “early bilinguals,” people who are exposed to a second language early in life. Over the years, early bilinguals have received increased attention in the field of language acquisition due to their relevance to two important variables identified in the language acquisition outcome: timing and input. Despite this growing interest in early bilinguals, however, critical methodological limitations affect many previous studies: the learner population has typically been limited to bilinguals whose L1 remains dominant throughout their lives, and rarely have two languages spoken by the bilinguals been examined together. These methodological drawbacks significantly limit our understanding of bilingual development (Bylund, 2009b; Grosjean, 2008; Montrul, 2008).

The goal of this dissertation is to build upon previous early-bilingual research through the examination of Korean heritage speakers. It also aims to situate the heritage language acquisition within a larger context of bilingualism. Their linguistic abilities in both Korean and English will be examined, including their ability to distinguish similar but different speech sounds, process vocabulary in real time, and detect grammatical errors. The main purposes of this dissertation are to dissociate the contributions of early exposure and input dominance in bilingualism, to illuminate how the two languages

interact in shaping early bilinguals' linguistic competence. In addition, the bilingual competence of early bilinguals is compared to late bilinguals, and the factors influencing individual differences among heritage speakers are examined.

This brief introduction aims to introduce the key issues in early bilingualism and why heritage speaker research is needed. I begin by introducing the theoretical and empirical discussions on early bilinguals, then turn to the deficiencies that exist in the bilingualism literature. In light of this review of the literature, it will be argued that research on heritage language speakers can fill a gap in bilingualism research and make a unique contribution to a better understanding of human language development.

### *1.1. Theoretical issues in the study of early bilinguals*

For language acquisition to occur, three main ingredients seem necessary: 1) the learner should be equipped with language learning faculty, 2) sufficient linguistic input should be provided, and 3) the input should be provided at the right time. Whether language faculty assumes the existence of innate linguistic knowledge or whether the faculty is language-specific or domain-general (i.e., regardless of how people define “language learning faculty”), learners need to be equipped with some sort of ability to learn a language, an ability unique to humans. Of course, this learning faculty would be of little use without linguistic input. Even the most extreme nativist would not deny the role of input in language development, and in fact, it is only through input that the specifics of individual languages are acquired or triggered. In addition, this input should be provided at the right time: i.e., early enough for first language acquisition to occur. Cases like Genie, a child deprived of language input until the age of nine (Curtiss, 1977)

who was unable to learn a language completely afterward, suggest that early exposure to input is necessary for native-like achievement in first language (L1) acquisition.

Although whether the same is true in second language acquisition (SLA) and what explains this age effect remains debated, the existence of an age effect in SLA is widely accepted: the earlier the L2 exposure starts, the better the outcome, all else being equal. Furthermore, when it comes to bilingualism, cross-linguistic interaction may influence acquisition in significant ways. In adult L2 acquisition, L1 transfer is one of the most frequently cited explanations for non-convergence of adult L2 competence. Likewise, the two languages of early bilinguals may influence each other in shaping the process and outcome of bilingual development. Therefore, in this dissertation, three aspects of early bilingualism will be investigated: timing, input, and cross-linguistic interaction. In particular, the role of early exposure and input dominance as well as the effect of cross-linguistic interaction will be examined in both languages that bilinguals speak.

#### 1.1.1. Timing: Why early exposure?

One of the most obvious yet perplexing phenomena in language acquisition is that children seem to acquire a new language effortlessly and fully, while adults for the most part toil for years while making relatively little progress. Young children, many of whom cannot even tie their own shoes, outperform adults when it comes to learning a new language. This striking contrast between children and adults has drawn great interest in the effect of timing on ultimate attainment. One prominent explanation for the effect of age differences is that people are born with biological clocks that work against language learning. The idea is that there is a critical or sensitive period for language learning in

one's early life, and after this window of opportunity closes, adults can no longer use the impressive language learning ability they once enjoyed during childhood. Early work on this *critical period hypothesis* (CPH) by Lenneberg (1967) suggested that human language acquisition is constrained by biological maturation. During the pre-puberty period, the human brain is highly plastic and displays heightened sensitivity to the linguistic input, rendering language learning effortless. Once the brain matures biologically around puberty, however, language learning becomes challenging and may be accomplished via a different learning process.

This idea of a critical period in language learning has yielded a large body of research both in L1 and L2 acquisition. The CPH was first framed and explored in the context of L1 acquisition, and it generally yielded evidence in support: e.g., Curtiss' (1977) case on *Genie*, the child deprived of linguistic input prior to puberty and Newport's (1990) American Sign Language learners (ASL) of varying age of exposure to ASL. Contrary to the L1 acquisition, the CPH has then been more hotly debated in SLA. Over the years, SLA researchers have been divided into two opposing camps when it comes to whether there is a biologically maturationally determined critical period, and the debate remains intense, despite the large amount of research that has already been conducted on this topic. The significance of the CPH in the field of SLA is reflected both in its prominent role in SLA theories and in the amount of empirical research it has motivated for the past couple of decades.

#### 1.1.1.1. The Critical Period Hypothesis (CPH) in SLA theories

The issue of an age effect is of fundamental importance in the field of SLA because it plays a pivotal role in the formation of SLA theory (Long, 2007). The evident differences between adults and children in SLA rate of acquisition and ultimate attainment have motivated theories that propose fundamentally different processes and mechanisms of language learning between children and adults. Such theories of discontinuity vary from those based on Universal Grammar (UG, innate and language specific learning faculty) to those that posit no language-specific learning mechanism, instead viewing language learning as strictly domain-general learning. The Fundamental Difference Hypothesis by Bley-Vroman (1989; 1990), for example, states that the language-specific innate system of knowledge (i.e., UG) that guides children's language acquisition process is no longer available to adults. Based on the generativist tradition, UG is believed to explain the gap between the input provided to children and the sophisticated and complete knowledge that children develop out of the input. However, Bley-Vroman claims adults no longer have access to UG, so they are faced with greater challenges. Adults would either have to rely on the L1 mechanisms developed during childhood with the guidance of UG, or they would have to rely on fundamentally different cognitive processes to weave their way through the intricacy of language acquisition. This fundamental difference is claimed to explain the differences in the rate and outcome of language learning between the two groups.

A parallel claim regarding child and adult differences can be found in the camp that does not assume an innate language specific learning mechanism. DeKeyser (2000) and Paradis (2004), for example, believe general cognitive learning mechanisms used in other

domains of human cognition are also responsible for language learning and are biologically maturationally constrained. Two major types of learning mechanisms are proposed, implicit vs. explicit learning, that are suited for different types of knowledge. Implicit knowledge is stored in procedural memory whereas explicit knowledge is stored in the declarative memory system. Children learn implicitly, so learning is unconscious, effortless, and highly efficient when learning a complex system like language. However, this implicit learning mechanism is claimed to be impaired as the brain gradually loses its neural plasticity, so adults have to rely on explicit learning mechanisms, which bring about deviant paths and outcomes. Unfortunately for adults, because human language is extremely complex, it is argued to be difficult to master completely only via explicit learning. According to DeKeyser, this use of different learning mechanisms is the reason adult L2A is qualitatively different from child L1A. As a result, adults require explicit instruction to compensate for the deficiency.

Unlike the two proposals depicted above, there are theories that claim the process underlying child and adult SLA are qualitatively similar. Schwartz and Sprouse's (1996) Full Transfer/Full Access (FT/FA) hypothesis, for example, proposed that both children and adults have full access to the innate language learning faculty, but what yields the differences is the initial state: Children start with a clean slate when they begin to learn their L1, whereas adults are already equipped with an L1. Therefore, according to Schwartz, the non-conformity of adult SLA is due to the (negative) influence of the adult's L1 grammar. In other words, Schwartz and Sprouse deny the existence of a critical period in SLA.

As shown, different SLA theories all address age effects but differ in their interpretations of what underlies child-adult differences in SLA. In some cases, age effects are considered a reflection of fundamentally different processes that stem from biological changes during the post-critical period (e.g., Bley-Vroman, 1980; 1990; DeKeyser, 2000; Paradis, 2004). Others attribute child-adult differences to L1 transfer and general aging effects and claim there is no critical period (e.g., Schwartz & Sprouse, 1996).

Much of the debate on the CPH in SLA seems in part to stem from the lack of specification as to exactly what is impaired (or not impaired) from maturation. Second language acquisition involves multiple components and processes. Learning starts from an initial state. Once L2 input is received, it should somehow be processed in real-time, and then matched to the pre-existing representation. The linguistic representation is then reorganized if there is a discrepancy between the L2 input and pre-existing linguistic system. The maturational effect may or may not affect any of these states or stages (the initial state, processing of input, and reorganization mechanism). Likewise, L1 transfer may or may not influence these stages.

The critical period was originally hypothesized as a period of “heightened sensitivity to the input,” but this definition seems rather ambiguous. Is it perceptual sensitivity to input or the ability to use input for reorganization (e.g., inferential capacity) that diminishes due to maturation? Is the impairment made on the processing of the L2 input or in the representations in L2 development? Is it L1 interference or maturational impairment that influences the L2 outcome? Although the current dissertation was not designed to address these questions, it appears that specifying the stage and state at which

the impairment of language acquisition faculty occurs seems necessary if different theories are to better communicate with each other.

All these being said, for the purpose of current dissertation, it is important to note that regardless of the specifics of different theories, the existence of differences in the ultimate attainment of a second language by children and adults has had a great impact on various SLA theories. According to Long (2007), any valid SLA theory, either in support or denial of the CPH, would have to be able to explain these age-related differences (p. 45). This significance is a reflection of how important timing appears to be in SLA.

#### 1.1.1.2. Empirical findings on the CPH in SLA

According to DeKeyser and Larson-Hall (2005), there are over 100 studies on the topic of age effects in language acquisition. Previous empirical studies on age effects attempted to support or dispute the CPH mainly in two different ways. One way was to show a non-linear pattern in the correlation between age of arrival (AoA) and ultimate attainment by varying AoAs among the participants. For example, some studies are based on the assumption that if a disjointed pattern of correlations between AoA and proficiency is found between early vs. late learners, this would be evidence in support of the CPH (e.g., Johnson & Newport, 1989). However, if a gradual decline is found (e.g., Bialystok & Miller, 1990), then this would cast doubt on the existence of a critical period for language learning.

Another method to test the CPH has been to find adults L2 speakers who appear to be native-like in an L2 and then test their level of attainment to see whether they really possess native-like abilities. This approach is based on the notion that after the critical

period, it is impossible for one to achieve native-like proficiency in L2. If one finds a late starter of SLA who achieved native-like proficiency, this would serve as counterevidence to the CPH.

#### 1.1.1.2.1. CPH studies examining correlation between age and proficiency

Studies by Johnson and Newport (1989; 1991) and Johnson (1992) ignited much research on the CPH in SLA. In their studies, English proficiency of Chinese and Korean native speakers whose AoA ranged from 3 to 38 years with at least five years of length of residence (LOR) in the U.S were examined. Using grammaticality judgment tasks (GJT), they tested participant knowledge of various grammatical and morphological rules (e.g., wh-questions; 3<sup>rd</sup> person singular; Subjacency). The results showed, in Johnson and Newport (1989) for example, an overall negative correlation between AoA and test scores ( $r = -.77$ ), and a stronger correlation with participants of AoA below 16 ( $r = -.87$ ), but no correlation with participants of AoA above 16 ( $r = -.16$ ). The strong negative correlation between AoA and scores for younger arrivals but low correlations with adult L2 learners were replicated in subsequent studies (Johnson, 1992; Johnson & Newport, 1991) and were interpreted to mean there is a maturationally delimited critical period of second language acquisition, after which L2 acquisition quickly becomes significantly more difficult.

DeKeyser (2000) found similar correlational patterns between AoA and learner performance. He examined the English proficiency of 57 L1 Hungarian-L2 English bilinguals whose AoA ranged from 1 to 40 years with at least 10 years of residence in the U.S. A GJT based on Johnson and Newport's items as well as some additional items was

administered, and a significant correlation between AoA and test scores was found. Furthermore, when age at testing was partialled out, the inverse correlation between AoA and the test score remained robust ( $r = -.54$ ). On the other hand, when AoA was partialled out, the correlation between age at testing and the test score was statistically non-significant ( $r = -.13$ ), indicating AoA was the major factor predicting level of proficiency. Such findings were replicated in later studies: DeKeyser, Alfi-Shabtay, and Ravid's (2010) study on Russian L1- English L2 bilinguals ( $n=75$ ) found stronger correlation among younger starters ( $AoA < 18$ ,  $r = -.67$ ) than adult learners ( $r = -.36$ ).

Aside from grammatical competence, support for the CPH has also been provided in other linguistic domains. In phonology, for example, Huang (2009) examined 118 Mandarin L1-English L2 bilinguals with AoA ranging from 5 to 27. Ratings of speech sample recordings were judged by native speakers of English for a perceived foreign accent. Among many variables she examined including AoA, LOR, years of education in the U.S., language aptitude, heritage language identification, etc., AoA turned out to be the most powerful predictor of accent rating score ( $\beta = -4.2$ ,  $p < .000$ ). These findings support those of earlier studies by Oyama (1976) and Patkowski (1990) on Italian-English bilinguals, where younger arrivals ( $AoA < 14$ ) performed significantly better than late arrivals ( $AoA > 15$ ) in accent rating tasks. In fact, it is a robust finding in the literature that the later the AoA, the stronger the foreign accent tends to be (e.g., Flege, Munro, & MacKay, 1995; Flege, Yeni-Komshian, & Liu, 1999).

Nevertheless, not every study on age effects has supported the CPH. In fact, quite a few have claimed to refute the existence of a critical period. Bialystok and Hakuta (1994), for example, reanalyzed Johnson and Newport's (1989) data with different cut-

off ages and reported they did not find a distinct difference in the magnitude of correlation between early arrivals and late arrivals. In line with this, Bialystok (1997) also claimed the LOR and the L1 and L2 correspondence in structures used are more important factors affecting acquisition, concluding there is insufficient evidence of a maturational constraint in SLA.

Several replication studies of Johnson and Newport also showed evidence against the CPH (e.g., Bialystok & Miller, 1999; Birdsong & Molis, 2001; Hakuta, Bialystok, & Wiley, 2003). Birdsong & Molis (2001), for example, attempted a replication of Johnson & Newport (1989), using the same methods & materials of the original experiment, but with Spanish native speakers instead of Chinese and Korean speakers. Their results exhibited that L2 attainment negatively correlates with age of learning even if learning commences after the presumed end of the critical period. Importantly, they showed native-like attainment among late learners, and thus claimed there is insufficient data to support the CPH. Instead, they suggested that the outcome of L2 acquisition may depend on L1-L2 pairings & L2 use. Similarly, Bialystok and Miller (1999), who examined Chinese L1 and Spanish L1 speakers who moved to Canada at different ages on their response accuracy and time on a GJT, found an age effect in the Spanish group but not the Chinese group. Furthermore, they reported that AoA influenced all ages tested rather than suggesting a clear demarcation as a result of a critical period. Based on these findings, they claimed that the distance between L1 and L2, the syntactic structures being tested, and the modality in which the materials are presented are more important predictors of learner performance than AoA.

Claims against the CPH have also been made in the domain of phonology (e.g., Flege, 1998; Flege, Frieda, & Nozawa, 1997; MacKay, Flege, & Imai, 2006). These studies in general highlight factors other than AoA that correlate with learner performance. Flege (1998), for example, showed that relatively late AoA is associated with a relatively high self-reported percentage use of the L1 and correspondingly low percentage use of L2 and suggested that the apparent age effect may in fact be due to varying amounts of continued exposure to L1. In this vein, Flege et al (1997) tested Italian-English bilinguals with AoAs of 2:6 to 9:6 and grouped them into two groups that matched in AoA (mean AoA=5:6 vs. 5:9) but not in the continued L1 use (3% vs. 36%). They found that both groups spoke English with a detectable Italian accent, but to a greater degree in the higher L1-use group. MacKay et al (2006) also provided alternative explanations of the seeming AoA effect, including the development of their L1 phonetic system (MacKay et al, 2006) and the quantity and quality of L2 phonetic input bilinguals receive (Flege, 2006). In short, these studies claimed that the age effects observed in the SLA literature are not due to a biologically constrained critical period, but to other factors such as L1 use, transfer, and the quality and quantity of input.

To summarize, the research that has examined the correlation between AoA and learner performance has in general exhibited a robust effect for age. However, researchers disagree on the interpretation of this effect. The debate continues with respect to whether a non-linear relationship between age of onset and L2 attainment is obtained, as well as whether the correlation between AoA and proficiency is maturationally constrained or mediated by other social/psychological/environmental factors entirely.

(See DeKeyser & Larson-Hall, 2005; Long, 1990; 2007; Hyltenstam and Abrahamsson, 2003 vs. Bialystok, 1997; Birdsong, 2005; Jia & Anderson, 2003).

#### 1.1.1.2.2. CPH studies examining ultimate attainment

Pointing out logical problems of some previous studies examining correlation patterns between AoA and proficiency, Long (2007) stated that the linear decline of proficiency with the increase in AoA is not surprising, nor should continued decline among adult L2 learners with increased AoA be considered evidence against the CPH because the “aging” effect in general may have been confounded with age effects in language acquisition (Stevens, 1999, 2004). He then states that less-than-native-like achievement of early starters does not form evidence against the CPH. Instead, he claims that the true counter-evidence of the CPH would be in proving there are L2 speakers who achieved truly native-like proficiency in an L2 with an AoA beginning in adulthood. In this vein, a large number of studies examined advanced adult learners of L2 to examine whether they show native-like performance.

One study that reported native-like achievement by adult L2 learners in the domain of grammar is White & Genesee (1996). Based on the generativist framework, they tested certain principles of UG (Subjacency and Empty Category Principle (ECP)), similarly to Johnson and Newport (1991) but with very advanced French L1-English L2 bilinguals. They then found no significant difference in performance between near-native bilinguals and native English speakers on either task. Based on this, White and Genesee claimed they found no evidence for maturational effects, although their claim is open for debate since the learners may have been accessing their L1 knowledge given that French and

English have the same parameters on Subjacency and ECP (Hyltenstam & Abrahamsson, 2003).

Several other studies have cited evidence of native-like achievement by adult learners in phonology. Abu-Rabia & Kahat (2004)'s case study examined 10 learners who immigrated to Israel between the ages of 11 and 40. Based on interview data and native speaker judgments of the participants' speech samples, they concluded that some of their late learners of Hebrew were native-like in their pronunciation. Bongaerts, Planken, Schils' (1995) and Bongaerts, Mennen, Van der Slik (2000) also reported that some of their Dutch-English late bilinguals were indistinguishable from that of the NS control group. Based on these results, they argued it is possible to master unaccented L2 speech from a related language family even when learners are exposed to an L2 late in life.

However, methodological problems with these early studies have been pointed out by later studies, which present a different picture on the native-likeness of adult L2 learners (e.g., Abrahamsson & Hyltenstam, 2009; Hyltenstam, 1992a; Hyltenstam & Abrahamsson, 2000). One criticism is that previous studies may have used too insensitive a measure to assess native-like proficiency. Abrahamson & Hyltenstam (2009), for example, examined 195 L1 Spanish – L2 Swedish bilinguals whose age of onset ranged from 1 to 47 years with at least 10 years of LOR. They screened their participants for their native-likeness first: these participants all reported that they consider themselves native-like in Swedish. Their Swedish ability was first judged by native speakers of Swedish, and then asked to complete a battery of 10 complex and cognitively demanding tasks and detailed measurements of linguistic performance, representation, and

processing. The results showed that none of the late learners and only a few of early learners performed within the native-speaker range. In other words, even the near-native-like L2 learners fall short of native-like competence when their linguistic abilities are scrutinized closely via highly demanding tasks. In this light, it appears native-like ultimate attainment is extremely hard, if not impossible, to be attained by adult L2 learners, and furthermore much less common than had been previously assumed even among child learners.

As shown, the answers to the question of whether adult L2 speakers can ever achieve native-like competence in an L2 have varied depending on the level of scrutiny of the linguistic examination as well as the definition of native-likeness. More recent research with strict criteria for native-likeness has concluded that it is extremely difficult, if not possible, to find native-speaker-level achievement among adult L2 speakers, which lends support to the CPH. However, an inherent limitation of studies examining ultimate attainment relates to “native-likeness” as a standard of comparison. Because one can never examine the entirety of one’s linguistic competence, no matter how wide the range of tasks is administered in a given a study, the possibility of non-native-likeness can never be excluded. In addition, because the two languages of a bilingual speaker interact with each other, some also argue against applying such strict monolingual-centered criteria of native-likeness for bilinguals (Grosjean, 2008). Therefore, the validity of the CPH in SLA still open for further investigation and discussion.

In sum, a significant amount of empirical research on the CPH has been conducted over the years, and most SLA theories have either explicitly or implicitly addressed the age effect as a core issue when explaining SLA processes. Despite the shared sense of

significance and extensive data available, little consensus among SLA researchers has been reached. Some firmly believe SLA is biologically maturationally constrained (e.g., DeKeyser & Larson-Hall, 2005; Hyltenstam & Abrahamsson, 2003; Johnson & Newport, 1989; Long, 1990, 2003; Newport, 1990), whereas others argue the age effect stems from social/physical/environmental factors (e.g., Bialystok, 1997; Birdsong, 2005; Flege, 1987, 1999). Given this divide, some researchers have started to examine the issue from a fresh perspective, in terms of language attrition. As it turns out, the CPH is as relevant to L1 attrition as L2 acquisition in bilingual development.

#### 1.1.1.3. CPH studies on age effects in L1 attrition

Increasing attention has been paid to the effect of age on L1 attrition (Bylund, 2009a, 2009b; Montrul, 2002, 2005, 2008). Drawing upon the findings obtained from immigrant children (Yukawa, 1997) and immigrants whose age of arrival varies (Bylund, 2009a; Hakuta & D'Andrea, 1992; Silva-Corvalán, 1994; Yeni-Komshian, Flege, & Liu, 2000), this new line of research has demonstrated that age also influences L1 attrition, in fact mirroring the effects on L2 acquisition: the earlier L1 exposure is reduced, the less likely the learner will maintain native-like L1 competence (Bylund, 2009b).

Yukawa (1997), for example, reported an age effect in L1 attrition found in her longitudinal data on the L1 Japanese attrition patterns observed in her two children. Her son, Haruki moved from Japan to English speaking environments at two different points in his life: the first time was to Hawaii at age 5:5, where he stayed for five months, and the second time was to Stockholm, at age 7. Her daughter Shoko was age 3:10 in Stockholm, so she was examined only once.

Yukawa collected data on both receptive and productive skills on the phonological, morphosyntactic, lexical, and pragmatic level, and data collection was conducted before attrition began, during attrition, and in the relearning period that followed. The data showed a great difference in the extent of attrition between the younger and older ages of immigration. At the younger age in Hawaii, Haruki's Japanese experienced attrition in vocabulary and significant loss in morpho-syntax, just like his younger sister in Stockholm, whereas his Japanese was a lot more stable during his later second immigration to Stockholm. This led Yukawa to conclude that L1 attrition occurs more rapidly and profoundly in younger immigrant children.

Studies conducted on adult bilinguals with different ages of immigration also provide support for the age effect in L1 attrition in a variety of linguistic domains ranging from morphology, phonology, syntax and general proficiency, and even event conceptualization. With respect to morpho-syntax, a study by Silva-Corvalán (1994) found age effects in the attrition of L1 Spanish subjunctive mood morphology in a group of Spanish L1- English L2 bilinguals (n=17) with varying age of arrival to the U.S. Participants were divided into three groups: Group 1 with AoA above 11, Group 2 with AoA of 7 and below, and Group 3 born in the U.S. with at least one parent from Group 2. Data elicited from oral interview and written tests revealed that only Group 1 (AoA >11) maintained Spanish native-like tense-mood-aspect, whereas the learners who arrived earlier exhibited a simplification of mood, where the obligatory use of subjunctive mood was greatly reduced. Although this study did not set out to examine the effect of age *per se*, the differential levels of L1 attrition between older arrivals and younger arrivals support the idea there is an age effect in L1 attrition.

In phonology, Yeni-Komshian, Flege, and Liu's (2000) study on 240 Korean-English bilinguals provides evidence of an age effect in the maintenance of L1 pronunciation. They examined the pronunciation of both L1 Korean and L2 English adult immigrants whose AoA ranged from 1 to 23 years. They found that immigrants with  $AoA > 12$  maintained native-like pronunciation in their L1, whereas immigrants with  $AoA$  1 to 9 pronounced English better than Korean.

In terms of general proficiency, Hakuta and D'Andrea (1992) examined L1 Spanish attrition of high school students of Mexican background in the U.S. ( $N = 308$ ). They used GJTs and cloze tests to measure proficiency. Spanish proficiency correlated positively with participants' AoA, with a pattern of gradual increase until age 10 and a plateau thereafter. In terms of self-reported factors affecting L1 maintenance, language practice in the home was the best predictor of L1 proficiency.

Finally, Bylund (2009a) examined attrition with respect to conceptualization patterns. He tested L1 Spanish – L2 Swedish bilinguals in Sweden on their perception of goal-oriented motion events, event conceptualization patterns that are specific to their L1. The results show that only the older bilinguals ( $AoA > 12$ ) consistently maintained their L1 event conceptualization, whereas the early bilinguals were more varied and depended on individual circumstances such as the amount of L1 contact and use. Based on this finding, Bylund claimed that just like formal linguistic features, the effect of age can be found in the language-based event conceptualization patterns in bilinguals, and that his data are consistent with a critical period around age 12.

As shown, emerging studies on age effects in L1 attrition have provided a consistent picture thus far: the earlier L2 exposure begins (and L1 exposure reduces), the less likely learners will maintain native-like L1 competence (Bylund, 2009b).

#### 1.1.1.4. Synthesis: Timing for early bilinguals

A review of the literature in both L2 acquisition and L1 attrition suggests a robust age effect. To explain this phenomenon, proponents of the CPH suggest biologically determined maturational constraints in SLA, while opponents suggest other social, psychological, and environmental factors. Although the exact nature of the role of age may still be debatable, it seems clear age of acquisition predicts ultimate attainment in a second language (Long, 2007; Montrul, 2008). Moreover, recent studies on L1 attrition have consistently illustrated an age effect due to reduced contact with the L1. The rate and extent of attrition is clearly stronger among younger immigrant children, and the level of maintenance of L1 proficiency in adults is also strongly positively correlated with the age at which bilinguals begin getting exposed to the L2. It therefore appears there is a mirroring effect in L2 acquisition and L1 attrition, where an increase in L2 input and a decrease of L1 input at an early age yield a significant impact on one's life-long bilingual competence.

Theoretically, early bilinguals, by virtue of being exposed to two languages early in life, should have the opportunity to become native-like in both languages. However, as shown in L1 attriters (Bylund, 2009) and some early L2 learners (Hyltenstam and Abrahamsson, 2003), early experience in itself does not guarantee native-like achievement. This may be because other factors such as the amount of input and cross-

linguistic interaction can also affect language development; early exposure alone may be insufficient for native-like achievement.

### 1.1.2. Input: What causes incomplete acquisition in early bilinguals?

#### 1.1.2.1. The role of input in bilingualism

As discussed, early exposure is a necessary but insufficient condition for (near)native-like achievement (Hyltenstam & Abrahamsson, 2003: 566). In fact, it is now a well-documented fact that less-than-native-like L2 proficiency is observed even among early bilinguals (Hyltenstam, 1992b; Montrul, 2008). The reason for this phenomenon is often attributed to the “input” factor (Montrul, 2008).

Input is considered vital in the maintenance of L1 competence. Some extreme cases of input susceptibility come from studies of international adoptees (Hyltenstam, Bylund, Abrahamsson, & Park, 2009; Pallier Dehaene, Poline, LeBihan, Argenti, Dupoux, and Mehler, 2003; Ventureyra & Pallier, 2004; Ventureyra, Pallier, & Yoo, 2004). Pallier et al (2003) and Ventureyra et al (2004), for example, demonstrated that Korean born adoptees in France forgot their first language (Korean) completely. In a variety of behavioral and neurological measures including Korean word recognition, language identification, speech segment detection, and fMRI scanning, the adoptees behaved exactly like French native speakers who had no prior exposure to Korean. These participants, despite having been exclusively exposed to Korean up until age 3 to 9, seems to have completely lost their sensitivity to Korean language after being exposed to French exclusively for about 20 years. Therefore, Pallier et al (2003) and Ventureyra et al. (2004) concluded that complete attrition of L1 is possible if the L2 input replaces L1

input completely, and the early/first established representations remain plastic and reversible even up to age 9. Although it is still possible that that some remnants of the early representation may remain (Hyltenstam et al., 2009) and can be “re-activated” if the adoptees try to re-learn Korean as some claim (e.g., Oh, Jun, Knightly, & Au, 2003; Penfield & Roberts, 1959), the extent of language attrition indeed seem quite extensive in the case of international adoptees.

Less extreme, yet robust cases of L1 attrition can be found in children of immigrant families. As summarized in the previous section, age-effect studies on L1 attrition have revealed that, contrary to adult bilinguals whose L1 remains stable, great variation is found in the outcome of L1 competence in early bilinguals (Bylund, 2009a, 2009b; Montrul, 2002, 2005, 2006, 2008; Montrul & Bowles, in press; Montrul, Foote, & Perpiñán, 2008; Polinsky, 2006, 2008a, 2008b, 2008c, 2009). The reason for the variation is in part attributed to the differential ages of reduced exposure to the L1 as extensively discussed in the previous chapter. However, age may not be sufficient to explain all the variations among early bilinguals because even people with the same age of reduced input can show great variations in the level of their L1 maintenance. Therefore, it has been suggested that, for early bilinguals, external factors like the amount and type of input have a great impact on their bilingual development (Montrul, 2008). To put it in Hyltenstam and Abrahamsson (2003) words, maturation and stimulation work together since the “language learning mechanism” is designed in such a way that it requires “immediate triggering from the environment” in order to develop and work appropriately. For early bilinguals, who are exposed to more than one language while their language

learning mechanism actively works, input could become the most important factor that determines ultimate attainment (Montrul, 2008; O’Grady, Lee, & Lee, 2008).

Despite all of these theoretical claims regarding the importance of input, it is still unclear how much and what kind of input is necessary for the achievement of native-like competence. Although there are some studies that have examined a global effect of parental language choices (as explained below), the dearth of research on this topic makes it very difficult to determine how input interacts with timing in early bilingual development.

#### 1.1.2.1.1. Parental input and bilingual competence

In the child bilingualism research, several researchers have examined the parental language use patterns at home and its relevance to the bilingual children’s language use. De Houwer (2007), for example, explored why some children raised in a bilingual setting speak two languages while others do not. He collected survey data on home language use from 3,677 parents and 4,556 children in 1,899 families in Flanders, the officially Dutch-speaking region of Belgium. According to De Houwer, due to the great ethnic variety in Flanders, many young people are essentially second-generation immigrants and parental language input patterns seem to have a significant impact on child minority language use. In particular, De Houwer found that home input patterns where both parents used the minority language and where at most one parent spoke the majority language had a high chance of success. In other words, the “one parent–one language” strategy, commonly recommended to bilingual families, does not provide a necessary nor sufficient input condition to foster children’s minority language use. At least one or both of the parents

should speak only the minority language at home if they want their children to speak the minority language.

De Houwer's finding is consistent with other previous studies on the impact of parental language use on children raised in various bilingual contexts. Portes and Hao (1998), in their examination of the language use of almost 5,000 adolescents from diverse immigrant backgrounds in the United States, found that the rate of minority language retention was highest when both parents used the language at home. Siren (1991), in her study on 600 couples in Sweden, also found that the chances of a child becoming bilingual is much greater if both parents spoke only the minority language. Finally, Yamamoto's (2001) study on English-speaking families residing in Japan reported that more children speak English in families if both of their parents spoke it at home or if both parents spoke English and just one parent spoke Japanese as well.

Taken together, these studies indicate that parental language use has significant consequences for children's language use. More specifically, it appears the minority language should be a main language of communication at home if parents want their children to speak the minority language. This being said, these studies are limited methodologically by the fact that they examined only the reported language use and did not measure proficiency nor examine the bilinguals' linguistic competence systematically, so it is unclear exactly what kind of relationship there is between bilingual children's linguistic competence and the amount and quality of input they receive.

#### 1.1.2.1.2. Quantity and quality of input in bilingual development

To date, little is known about how much and what kind of linguistic input is necessary for proficient language acquisition. In monolingual contexts, Hart and Risley (1995) examined the language input provided to 42 children for a 2.5-year period, starting at age 7-9 months. Along with the children's vocabulary development, they examined the parental speech provided to the children in families of different socio-economic status. Analysis of the tape-recorded spontaneous interactions in each household revealed that children of professionals on average heard 2,153 words per hour, whereas the children of working class heard 1,251 words and children of welfare family heard only 616 words per hour on average; i.e., children of professionals heard 5 million words more than children of working class and 8 million words more than children of welfare family in a year. Importantly, such differences turned out to have a significant impact on the children's vocabulary size. By age 3, the children from professional families had produced 1,100 different words, whereas children of the two less economically favored families produced only 700 and 500 words, respectively. Therefore, from this seminal study of monolingual children, it seems the amount of parental input has a significant effect on the vocabulary development of their children.

Variations in language input also found to have consequences on children's syntax. Huttenlocher, Vasilyeva, Cymerman, and Levine (2002), for example, studied data from 34 children who aged 54 to 60 months and their parents. They found substantial individual differences in children's mastery of multi-clause sentences and number of noun phrases in children's utterances, and they revealed that there is a significant correlation between those differences and the proportion of multi-clause and

number of noun phrases in adult speech. Furthermore, in their examination of 40 classrooms drawn from 17 different preschools in the Greater Chicago area, they found greater syntactic growth over a year of preschool in classes where teachers' speech is more syntactically complex.

Given this significant role of input in monolingual children, one can imagine the challenges confronting bilingual children. Unlike monolingual children, bilingual children necessarily have to divide their time between two different sources of linguistic input. The relative amount of input in each language to bilingual children is necessarily smaller than their monolingual peers, a fact that likely impacts early bilingual development. Furthermore, the quality of the linguistic input may be a factor in development. A study by Paradis and Navarro (2003), for example, scrutinized the quality of parental input with respect to a particular linguistic structure and its link to children's acquisition of the structure. Using spontaneous language data from CHILDES, they examined the use of overt subjects in Spanish by two Spanish monolingual children as well as one Spanish-English bilingual child. In a null-subject language like Spanish, the use or non-use of subjects is linked to the pragmatic/syntactic interface of the grammar. Paradis and Navarro's results show that the parents of the bilingual child, influenced by their L2 English, used more overt subject than parents of the monolingual children. The authors therefore concluded bilingual children's high rate of subjects in their speech appears to be in part due to their parents' high use of subjects. Likewise, some researchers have claimed that the type of input bilingual children receive in linguistic minority communities may be qualitatively different from their monolingual peers and it may in part explain some non-native-like performance in bilingual children.

According to Sorace (2005), for example, the qualitative differences in linguistic input may cause deficiencies in the interface representations because of insufficient evidence for interface mappings.

In summary, existing research indicates the input plays a critical role in bilingual competence and use. Parental language use appears to heavily influence children's language use, where the quantity of vocabulary input correlate to children's vocabulary size, and the quality of parental input seem to influence the quality of children's output.

#### 1.1.2.2. Synthesis: Input for early bilinguals

Among bilingual researchers, the recognition that input plays a central role in language development is prevalent. In Montrul's (2008) words, it in fact is trivial to state input plays a fundamental role in language acquisition. It is only the dearth of research on bilingual input that seems to limit a fuller understanding of the role of input in bilingual development. For early bilinguals in particular, as suggested by the critical period studies reviewed in the previous chapter, the role of input becomes even more important due to their presumably heightened sensitivity and inferential capacity about linguistic input throughout their bilingual development. Because they are assumed to be equipped with a fully functioning language faculty, input must be the determining factor that affects the outcome of their linguistic competence. Given this fact, it is unfortunate that so little is known about exactly how much and what kind of input is necessary for the acquisition and maintenance of native-like proficiency in bilingual speakers. More exploration of the quantity and quality, and even the processing of input is necessary to understand how two languages develop in a bilingual's mind.

### 1.1.3. Cross-linguistic interaction: How to resolve the learnability problem in two languages

Aside from the timing and input, the final key factor that significantly influences early bilingualism seems to be the interaction between the two language systems.

Children growing up in bilingual countries or having immigrated to a country with a different L1 typically get exposed to two languages continuously. Rare exceptions like international adoptees set aside, early bilinguals juggle two languages simultaneously throughout their lives. They experience a fluctuation in the amount and quality of exposure to their two languages, and their proficiency in each may wax and wane (Grosjean, 2008) depending on the fluctuation of the bilingual input. Throughout their trajectory of bilingual development, the two languages they speak seem to interact and mutually influence each other in important ways (Yip & Matthews, 2007).

#### 1.1.3.1. How two languages develop in a bilingual mind

Researchers in the field of bilingualism have proposed different views on how two languages develop in children exposed to two languages simultaneously. Some early studies suggested children begin with a unified language system that gradually separates as the child's language matures (e.g., Fantini, 1985; Redlinger & Park, 1980; Vihman, 1982; Volterra & Taeschner, 1978). This claim is based mainly on the finding that at the earliest stage, bilingual children show evidence of a single lexicon: i.e., children produced mixed language comprising words from both languages with no translation

equivalents. However, later research refuted this claim by demonstrating that bilingual children develop two independent language systems from the outset (De Houwer, 1990; Genesee, 1989; Genesee, Boivin, & Nicoladis, 1996; Meisel, 1994; M. Paradis & Genesee, 1996). Genesee (1989) claimed that the lack of translation equivalents in bilingual child production is not sufficient evidence to claim bilinguals begin with a single lexicon. In addition, studies by Quay (1995) and Vasquez (2001) showed that their English-Spanish bilinguals use translation equivalents even at the earliest stage of production. These researchers, highlighting various ways that bilingual children's language acquisition processes are similar to monolingual children, emphasized that bilingual children develop two independent language systems.

Despite these claims regarding the early separation of two linguistic systems, researchers of today generally agree there is considerable interaction between the two languages (e.g., Döpke, 2000; Grosjean, 2008; Yip & Matthews, 2005, 2007). Although these researchers acknowledge that bilingual children develop two independent languages from the outset, they emphasize that bilingual children often produce some non-target-like forms in each language that appear to stem from the influence of the other language (e.g., Genesee, Paradis, & Crago, 2004).

Indeed, the two languages developing in a bilingual child's mind seem to interact with each other, sometimes yielding divergent outcomes from monolinguals. In phonology, for example, several previous studies have reported that early bilinguals develop an intermediate acoustic quality in their production of phonemes. Kang and Guion (2006) reported that early Korean-English bilinguals' production of Korean stops was not identical to Korean monolinguals, although the difference was smaller than with

the late bilingual speakers. Macleod and Stoel-Gammon's (2005) English-French bilinguals also had at least partially merged the English and French stop systems, and Flege et al (1997) claimed that even early bilinguals are apt to speak their L2 with a foreign accent.

In the syntactic domain, Yip and Matthews (2005, 2009) have suggested there is ample evidence of syntactic transfer and a high degree of interactivity between the two linguistic systems. In their book (2007) on the Cantonese-English bilingual development of their own two children, they observed evidence of cross-linguistic influences in a number of structures including wh-questions, null objects, relative clauses, and prepositional and dative constructions.

Some researchers further suggest that cross-linguistic influence can occur at both the representational level and the processing level. Paradis (1993), for example, proposed two levels of bilingual interference: functional (dynamic) and representational (static). The processing-based account suggests that non-target language influences the selection of target language during online lexical access. The representation-based account suggests that language interference is a product of permanent change to the mental representation.

In Grosjean (2008) words, a bilingual speaker is not two monolingual speakers in one person's body. In other words, it seems likely bilinguals' linguistic systems interact. For early bilinguals in particular, this cross-linguistic influence might be even more pronounced in some cases, as in the resolution of the learnability problem discussed in the next.

### 1.1.3.2. Learnability and cross-linguistic interaction in early bilinguals

The cross-linguistic interaction that takes place in a bilingual's mind raises an important theoretical question with respect to the resolution of *learnability* in bilingualism. The learnability problem (Baker, 1979) or the logical problem of language acquisition (Hornstein & Lightfoot, 1981) refers to the gap between the input available to the learner and the end-state grammar the learner acquires. Children seem to acquire complex knowledge of grammaticality, ungrammaticality, and ambiguity despite the seemingly degenerate nature of the input, which yielded the learnability paradox in L1 acquisition.

In the SLA literature, the learnability problem has been proposed to arise when L2 learners have to learn what is not possible in a second language even though their L1 allows it. For example, L2 learners are likely to assume certain grammatical constructions are correct in their L2 because of their L1 knowledge, so without explicit correction, such mistakes are predicted to persist throughout their language development. In both the L1 and L2 acquisition literature, the learnability problem has received great attention among scholars working within a generative approach to SLA, with the assumption that the learnability problem is resolved with the aid of UG. The argument is that, assuming the learnability problem can be overcome with the aid of UG, it must be that UG is accessible even in L2 acquisition.

However, it is important to note that the learnability problem exists independent of the issue of UG availability in L1 or L2 acquisition (Yip & Matthews, 2007, p. 30). L1 literature shows that children over-generalize some aspects of grammar in the early stages of their development (Goro, 2007; Gropen, Pinker, Hollander, Goldberg, & Wilson,

1989) and yet somehow are able to retract the over-generalizations and converge on a native grammar. UG, the innate knowledge of language available to learners, simply indicates the representation or possible hypothesis space allowed in human languages. Even if learners are equipped with such innate knowledge, they should somehow navigate through the hypothesis space to arrive at a grammar with the exact amount of generalization provided with linguistic input that is seemingly degenerate in scope and quality. In that sense, the nature of the learnability problem is identical in L1 acquisition and L2 acquisition. In both learning contexts, the problem lies in arriving at the restricted grammar from the overgenerating grammar. Whether overgeneration is caused by L1 transfer as in L2 acquisition or by creative use of the initial hypothesis as in L1 acquisition, the nature of the task is the same: retracting from the overgeneralizing grammar.<sup>1</sup>

Characterizing the learning problem in this way reflects some recent approaches to language acquisition that combine linguistic representation (the possible hypothesis spaces) with probabilistic methods (the update procedure) (Valian, 1981; Pearl, 2007). Such approaches recognize that positing an innate structure does not solve the learning problem per se (Viau & Lidz, 2011). Even if learners are equipped with innate knowledge, they still need to learn from linguistic input to identify which hypothesis is the compatible one for the particular language they are learning. In other words, learning

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<sup>1</sup> This is not to say that the L2 and L1 acquisition would be identical in the process and outcome of the learnability resolution. The different nature of overgeneralization (L1 transfer in L2 acquisition vs. a tentative and initial hypothesis in L1 acquisition) is also likely to have effect on the following course of development. For example, the overgeneralization caused by the L1 transfer in L2 acquisition may be more persistent and robust compared to the overgeneralization in L1 acquisition that is caused by the tentative hypotheses language faculty entertains during the learning process.

is not just a triggering process, but involves the domain-general process of induction and categorization, thus making it incremental and probabilistic. At the same time, such an approach constrains the possible combinations of hypotheses that the distributional analyzer must entertain during the inductive learning process, e.g., by positing anchor points such as functional or semantic categories (e.g., Valian, Slot, Stewarts, 2009; Ambridge, Pine, Rowland, Jones, & Clark, 2009). In the end, although scholars may disagree greatly or in part on how learners overcome this putative learnability problem, no one would deny it poses a great challenge to the learners, not to mention to the linguists who aim to explain it.

Assuming language learning involves inductive learning process, the learnability problem could pose an even more severe challenge for bilingual children than monolingual children for two reasons. First, unlike monolingual children, bilingual children necessarily have to divide their time between two different sources of linguistic input, which may provide an insufficient amount of input for each language. For incremental learning to work, a certain threshold of linguistic input might be necessary, especially the threshold of input that is relevant and informative to the structure to be learned. Second, as discussed, there is evidence that bilingual children's two language systems interact (e.g., Döpke, 2000; Genesee, Paradis, & Crago, 2004; Grosjean, 2008; Yip & Matthews, 2005, 2007), which may pose greater challenges to the learnability resolution. In the case of sequential bilinguals, those who learn an L2 after mastering an L1, the pre-existing L1 system may work as a filter during L2 acquisition, making it more difficult to identify relevant information from the input. For both sequential and simultaneous bilinguals, assuming one language influences the other in the child's mind,

input from two languages can sometimes provide ambiguous evidence for two different grammatical hypotheses to the bilingual child. If the input from language A forms a subset of the output that the grammar of language B generates, it can cause a learnability problem when learning language A. Yip and Matthews (2005) demonstrated one such case, where Cantonese-English bilingual input provides ambiguous evidence for object drops. Given the situation where English object drops forms a subset of Cantonese object drops, Cantonese-English bilingual children seem to have more difficulty disallowing object drops in some instances in English compared to monolingual English-speaking children.

Although the learnability problem has generated a lot of discussion in both the L1 and L2 acquisition literature, this issue has rarely been examined with respect to early bilinguals. According to Yip and Matthews (2005), input ambiguity and language dominance play a major role in causing the learnability problem in early bilinguals. However, many questions remain as to whether and how early bilinguals, who develop two languages together, end up resolving the learnability problem. Do bilinguals indeed resolve the learnability problem in both languages in the end? If not, do they resolve it in at least one of the languages? If so, which language, and why? What are the factors involved in the bilingual learnability resolution? As Yip and Matthews (2005) admitted, exactly when, how, and to what extent bilinguals overcome the learnability problem remains a question for further investigation.

In summary, the two languages developing in early bilinguals interact with each other, influencing the respective language's linguistic system. As discussed, such cross-linguistic interaction can potentially cause a great challenge to bilingual development, in

particular on the resolution of the learnability problem. To date, whether and how the early bilinguals resolve the learnability problem in each language is yet unknown, despite its significance to theories of linguistics and language acquisition in general.

#### 1.1.4. Early exposure, input, and cross-linguistic interaction for early bilinguals

Research traditions in both L2 acquisition and L1 attrition highlight the importance of timing in language acquisition and the critical role of early experience, thereby drawing attention to bilinguals who started L2 acquisition early in life. In this chapter, the theoretical issues relevant to early bilinguals have been reviewed. Early bilinguals' learning contexts are characterized by 1) early exposure to two languages during the critical period, 2) variable quantity and quality of linguistic input, and 3) cross-linguistic interaction. Early bilinguals theoretically have many advantages as language learners because their bilingual exposure starts before the window of the critical period closes. However, due to their claimed heightened sensitivity to input, early bilinguals may also be vulnerable to language loss and incomplete acquisition if the input in one or more languages is provided insufficiently. Finally, unlike monolinguals, early bilinguals' linguistic competence in one language may be influenced by the other language because their two developing languages interact with each other. Therefore, a learnability problem may arise more acutely in the bilingual context, and potential bilingual input ambiguity may pose greater challenges in the resolution of the learnability problem.

Despite the theoretical significance of examining the impact of these factors in early bilinguals' linguistic competence, there are several important gaps in the bilingual research that limit understanding of how two languages develop simultaneously in the

early bilingual's mind. To address this gap and to contribute to a better understanding of the role of early exposure, input dominance, and cross-linguistic interaction, the current dissertation examines a particular type of early bilinguals, heritage speakers. In the next section, the definition of heritage speakers is introduced, along with previous research findings on heritage language acquisition. It will be argued that research on heritage speakers can help fill the gap in the existing bilingual research.

## *1.2. Heritage language acquisition*

### 1.2.1. Definition of heritage language speakers

The particular set of bilinguals this dissertation focuses on is so-called *heritage speakers*. Although the set of heritage speakers examined in this dissertation is rather narrowly targeted, more general definitions are reviewed first to better situate the findings of the current study in the larger context of heritage language research.

The definition of heritage speaker differs greatly depending on the research tradition. In sociocultural studies, heritage speakers can include anyone who has a cultural connection to a particular language through family interaction or history (e.g., Van Deusen-Scholl, 2003). In this case, heritage speakers need no proficiency in the language as long as they have a cultural connection to the language. For example, one can be defined as a heritage speaker if he or she has a great-grandfather who spoke the heritage language and so feels a connection to the language. However, such a broad definition based on heritage "motivation," as Polinsky and Kagan (2007) pointed out, is not useful for linguistic research that is examining issues related to heritage language competence. Therefore, many researchers examining heritage language competence use a

narrower definition, e.g., individuals raised in homes where a language other than the language of the community is spoken and who are to some degree bilingual in the heritage language and the language of the community (Valdés, 2000). In another definition, heritage language learners are defined as individuals who are exposed to their native language during childhood, usually at home, but who have not learned the language to full capacity due to an interruption caused by more dominant L2 input (Polinsky & Kagan, 2007). In these definitions, only people who have had some exposure to the heritage language at home and who have maintained some level of proficiency, even if very minimal, are classified as heritage speakers.

Heritage speakers in previous linguistic research appear to have been characterized, either explicitly or implicitly, as sharing three characteristics. First, they are raised in families where a language that is different from the language of the community is spoken. Typically, their parents or caretakers are first-generation immigrants, and these people become the main source of heritage language input to their children. Second, they learn their heritage language at a very young age. For the first few years, when they spend most of their time at home, heritage speakers are mainly exposed to the heritage language. Therefore, they often start out as L1 heritage language speakers, with the exception being a family where one or more caretakers do not speak the heritage language. Third, heritage speakers are educated in the community language, not the heritage language. Therefore, they typically become more proficient in the community language after they start school. In particular, their literacy skills in the community language often far surpass those in the heritage language (e.g., Montrul, 2008, p. 219). It is also common to observe heritage speakers developing different levels of proficiency in different modality and contexts

(e.g., Montrul, Foote, & Perpiñán, 2008; Montrul, Foote, Perpiñán, Thornhill, & Vidal, 2006). For example, they may be more proficient in speaking childhood vocabulary in the heritage language but better at reading newspapers or writing in the community language. Finally, heritage language competence is subject to both language attrition and incomplete acquisition. Due to reduced contact with the heritage language after early childhood, heritage speakers often lose knowledge they had acquired during childhood. In addition to this language attrition, incomplete acquisition may also have occurred: certain features of the heritage language may never have been acquired to a native-like level before input reduction occurred. Setting aside pathological cases, incomplete acquisition is therefore a unique feature of early bilinguals and heritage speakers in the sense that these two groups receive varied linguistic input early, before their linguistic competence in one language is established.

Given these varying definitions and somewhat variable characteristics of heritage speakers, a rather strict definition of heritage speakers is used in this dissertation. First, the focus is on only Korean heritage speakers in the U.S. The combination of Korean and English in bilingual research is desirable because they are typologically very different languages. Because of this great difference, robust learning difficulties are predicted in many areas of linguistic ability, including phonology, morphology, lexicon, and syntax. Furthermore, several linguistic areas predict learning difficulties in both directions ( $K \rightarrow E$  and  $E \rightarrow K$ ). For example, the very different sound systems provide several contrasts that are difficult both for Koreans learning English and for English speakers learning Korean. In this sense, Korean-English bilinguals are ideal participants for a study that examines

the interaction between two languages in a bilingual's mind when faced with situations that would cause learning difficulties for bilinguals.

A further restriction is that only second-generation immigrants born into families where Korean was only or almost exclusively used at home were included in the participant group. Under such circumstances, the participants started out as Korean speakers, but their L1 acquisition was interrupted by the dominant L2 (English). In other words, the earlier-encountered language (Korean) and predominantly encountered language later in life (English) dissociate in this population. This unique language profile allows for the addressing of critical issues in bilingual research as discussed in the following chapter.

#### 1.2.2. Early exposure vs. input dominance in bilingualism: The case for heritage speakers

As reviewed in Section 1.1.1, much attention has been paid to the age of exposure in SLA and bilingual research, with many studies reporting that early bilinguals are more likely to acquire native-like competence than adult learners, which support the critical role of early exposure in bilingualism.

Nevertheless, studies on international adoptees show the other end of the continuum where the first established representation can be replaced completely by the later-learned L2, highlighting the role of input dominance over early experience, in some cases of early bilinguals.

Given these findings, a natural question arises as to how robust the effect of early experience is on bilingual development, and how much change in the input is required for restructuring. In particular, it remains to be seen how early experience and changes in

input dominance affect the early bilinguals who are exposed to both languages relatively early and continuously throughout their lives.

Because of their unique linguistic profiles, heritage speakers are an ideal population to disambiguate the role of early language experience and language dominance in bilingual development. In most SLA and bilingual studies conducted thus far, the typical learner population has been speakers who are more proficient in their L1. However, the Korean heritage speakers who participated in the battery of studies included in this dissertation are different. Although they started out as L1 speakers of Korean, they ended up becoming more proficient in English due to the switch in input dominance. Therefore, by studying heritage speakers as defined in this dissertation, the relative role of these two factors in the bilingual competence of early learners because early exposure (e.g., Korean) and language dominance (e.g., English) can truly be disambiguated.

Despite the unique contributions heritage speakers can make in illuminating the relative contribution of early experience and input dominance, no known previous study has examined heritage speakers for the research purpose as described. That being said, SLA researchers very recently have begun to recognize the unique profile and potential of heritage speakers and have begun investigating their heritage language competence. What follows is brief review of the recent research on heritage speakers, the largest part of which has focused on a comparison of heritage speakers to late learners of L2.

### 1.2.3. Heritage speakers in between L1 speakers and late L2 speakers

Heritage language research thus far has focused mainly on heritage language competence as it relates to late-L2 research findings. Note that heritage speakers share characteristics with both L1 acquirers and L2 acquirers (Montrul, 2008, p. 126). In particular, with respect to the major ingredients of language acquisition discussed in the current dissertation, heritage speakers share the following characteristics illustrated in Table 1.

Table 1. Learning conditions of L1, HL, and L2 acquisition

	L1 Acquisition	HL Acquisition	Adult L2 Acquisition
Language Acquisition Faculty	Functional	Functional	Debated
Age	Early	Early	Late
Input	Sufficient/Homogeneous	Varied	Varied
L1-L2 Interaction	Absent	Present	Present

Like L1 acquirers, heritage speakers are exposed to their heritage language early in life, so they are assumed to have an intact language-learning faculty like monolingual children, be it a language-specific innate learning faculty or a general learning mechanism. Therefore, they should have all the advantages of child acquirers claimed in both L1 and L2 acquisition research. In contrast, the effectiveness of the language-learning faculty of the post-critical period adult L2 learners is debatable. As discussed, while some argue that the language learning faculty that guided the child L1 acquisition remain accessible to adults learning L2s (Schwartz & Sprouse, 1996), others claim children and adults rely on completely different learning mechanisms (Bley –Vroman,

1989; DeKeyser, 2003). Therefore, in terms of age of acquisition and language acquisition faculty, heritage language acquisition is more comparable to L1 acquisition than L2 acquisition.

On the other hand, heritage speakers are more similar to adult L2 speakers from the perspectives of input and cross-linguistic interaction. Both heritage speakers and adult L2 speakers receive a variable amount of input, and perhaps due to this, they demonstrate different degrees of proficiency. In addition, by virtue of being bilingual, both populations are subject to the cross-linguistic interaction. In adult L2 acquisition, language transfer (from L1-to-L2) has been reported to be one of the most prominent features in the interlanguage (Odlin, 1989). For early bilinguals like heritage speakers, a cross-linguistic influence could occur from either direction depending on language dominance (Yip & Matthews, 2007), the subset-superset relation between the two language systems, or markedness relationships (Eckman, 1977). The unique status of heritage speakers, with an intermediate profile between L1 acquirer and adult L2 acquirer, thus provides a useful testing ground for the extent to which factors like age, input, and interaction influence bilingual competence when compared to monolinguals and adult L2 learners.

#### 1.2.3.1. Empirical studies demonstrating HL and L2 similarities

Inspired by the uniqueness of the heritage speaker profile, recent studies have started comparing heritage language competence and L2 competence. At first glance, if the non-native-likeness of adult L2 acquisition is due mainly to delayed exposure to the L2, heritage speakers should have a marked advantage over adult L2 speakers. However,

several studies have reported great similarities between heritage speakers and adult L2 speakers. Montrul (2004), for example, compared Spanish heritage speakers tested in Montrul and Slabakova (2003) and L2 learners of Spanish tested in Montrul (2002) on their knowledge of the Spanish aspectual system. The results showed that heritage speakers and advanced L2 learners did not differ from each other in a statistically significant manner. In addition, despite the high proficiency of the participants, both learner groups were statistically significantly different from the native control group. Furthermore, they both showed similar levels of difficulty across the different conditions, including achievements in the imperfect, states in the preterit, and the preterit in impersonal sentences. Although the findings should be interpreted with caution because they did not attempt to match the proficiency level of the two learner groups, these findings highlight similarities in the developmental errors found among heritage speakers and late L2 speakers.

Additional studies that reported similar types and rate of errors between heritage speakers and adult L2 speakers includes two studies on Korean language acquisition. O'Grady, Lee, and Choo (2003) investigated the relative clause comprehension by late L2 learners enrolled in second- and fourth-semester courses in college and by Korean heritage speakers. The heritage speakers and L2 speakers performed similarly by performing more accurately with subject relative clauses than object relative clauses, which served as a basis for the authors to combine them into a group to report the results. Although the main purpose of the research was not comparing heritage speakers and L2 speakers, it is interesting that the two groups were similar not only in their performance, but also in their error types.

More recently, Kim, Montrul, and Yoon (2009) found similar results in their study on the binding interpretation of Korean long-distance reflexive *caki*. They examined how native speakers of Korean, heritage speakers, and English speaking adult L2 learners of Korean interpret the sentences containing *caki* using a Truth Value Judgment Task. Given that heritage speakers and L2 speakers showed comparable proficiency scores, they performed similarly in the binding interpretation task. Both groups showed less-than-native-like rates of acceptability when *caki* was interpreted to be bound by a long-distance antecedent, which is acceptable in Korean but not in English. Based on this finding, Kim et al. concluded that, just as adult L2 speakers transfer their knowledge of binding from L1-to-L2 comprehension, heritage speakers transfer their dominant-language knowledge to their heritage-language comprehension.

In sum, the studies reviewed in this section suggest that heritage speakers and adult L2 speakers are strikingly similar. The fact that heritage speakers exhibit the same type and rate of errors as L2 speakers despite early exposure to heritage language suggests it cannot be only age differences that cause the gap between the uniform success of child L1 acquisition and the fossilization and incomplete acquisition of an L2. Stated differently, input and cross-linguistic interaction can also have a great influence on bilingual development in that they cause problems for both heritage speakers, i.e., early bilinguals, and adult L2 speakers, i.e., late bilinguals. Nevertheless, there are other studies that highlight the differences between HL and L2 competence, demonstrating how HL speakers have an advantage over L2 speakers in some linguistic domains as reviewed in the following section.

### 1.2.3.2. Empirical studies demonstrating HL and L2 differences

Contrary to the studies that report few differences between heritage and adult L2 speakers, other recent studies provide evidence that heritage speakers indeed have advantages, at least in some domains.

The majority of studies that demonstrate a heritage speaker advantage come from the phonological domain. A series of studies including Au, Knightly, Jun and Oh (2002), Knightly, Jun, Oh, and Au (2003), and Oh, Jun, Knightly, and Au (2003), for example, compared two groups of Korean heritage speakers (childhood over-hearers and childhood speakers), late L2 learners of Korean, and Korean native speakers. Oh et al. (2003), for example, tested the perception and production of Korean three-way stop sound distinctions (plain /t/ and /d/; aspirated /t<sup>h</sup>/ and /d<sup>h</sup>/, and tensed /t'/ and /d'/). In their phonemic perception task, very low proficiency heritage speakers - both childhood speakers and over-hearers - showed native-like performance, whereas L2 learners did not. In the production task, childhood speakers, who spoke Korean until age 5, performed better than the over-hearer, who barely spoke Korean even if they were exposed to Korean when young. In terms of accent rating, native speakers performed best, again followed by childhood speakers, over-hearers, and late L2 learners. In phonology, the advantage was replicated in Au et al. (2003) and Knightly et al. (2003). In the domain of morpho-syntax, however, Au et al. (2002) and Knightly et al. (2003) reported no heritage speaker advantage over L2 speakers. In addition to the phonological tasks and overall proficiency test, their participants took a GJT with 60 grammatical and ungrammatical sentences and aural production tasks examining gender agreement and verbal

morphology. Heritage speakers and late L2 speakers did not perform differently on any of the morpho-syntactic tasks, while both performed significantly worse than the native speakers. Based on these findings, Knightly et al. concluded that a childhood overhearing advantage may be restricted to phonology.

Despite Knightly et al.'s suggestion that heritage speakers may show a selective phonological advantage over L2 speakers, some suggest heritage speakers sometimes show an advantage over L2 speakers in morpho-syntactic features as well. Lee, Moon, and Long (2009), for example, tested 32 heritage speakers, 20 adult L2 learners, and 14 native speakers of Korean on their linguistic competence in Korean. Twenty-one different linguistic features of Korean in the areas of phonology, morphology, syntax, lexis, collocation, and accent detection were tested, and an oral proficiency test (OPI) was conducted to measure the global proficiency. Using the aural modality for all tasks, they found that proficiency-matched heritage speakers performed better than adult L2 learners on many of the linguistic measures including morphology. Taken together, the previous studies that compared heritage speakers and adult L2 speakers thus far have generated varying results.

One factor that may explain this varying result is level of proficiency. Montrul (2005), for example, demonstrated the effect of proficiency in her study on Spanish heritage speakers' knowledge on unaccusativity. The overall results from a GJT containing 110 sentences showed no difference between heritage speakers and L2 speakers: both groups exhibited syntactic knowledge of unaccusativity but some variation and indeterminacy with respect to the semantics of unaccusativity. A difference in performance was found, however, among participants at low levels of proficiency. The

low-level heritage speakers exhibited a significant linguistic advantage over the low-level L2 speakers. Based on these findings, Montrul suggested heritage speakers may have an advantage over late L2 learners in the features that are acquired early in bilingual development.

Another factor that may be relevant to this selective advantage is the effect of task modality. According to Montrul, Foot, and Perpiñán (2008), heritage speakers perform better than adult L2 learners on aural tasks. An example of this is Montrul et al. (2008), where the knowledge of gender agreement in Spanish by Spanish heritage speakers and late L2 learners of Spanish was examined. The study included three different tasks: 1) a picture noun recognition task based on gender agreement marking, 2) a gender marking recognition task based on nouns, and 3) a picture description oral production task.

Interestingly, the adult L2 learners outperformed the heritage speakers on the first two tasks, which were administered in writing, but the heritage speakers outperformed the L2 learners on the third (oral production) task. In other words, heritage speakers appear to have an advantage in oral production, whereas the opposite may be true in written production.

Finally, some studies have reported that heritage speakers show advantages in processing speed. In the second experiment of Montrul, Foote, Perpiñán, Thornhill, and Vidal (2006), for example, the authors investigated accusative object clitics and word order in Spanish and found that heritage speakers are faster in their comprehension of written sentences containing clitics in the visual sentence-picture matching task than age-matching adult L2 learners. Although the two groups' error rates were similar, heritage speakers were significantly faster in their responses. The authors therefore claimed that

heritage speakers have more implicit, automatic, and integrated knowledge of clitics than L2 learners.

To summarize, previous research has shown mixed findings with respect to the heritage speaker's advantage over adult L2 learners. Even among the studies that reported this advantage, emerging evidence suggests that there may be selective advantages depending on the features examined, proficiency level, modality, and the nature of the tasks. Therefore, some interesting empirical questions can arise from this apparent selective advantage. Based on the AoA differences between heritage and L2 speakers, for example, one could hypothesize that the features acquired earlier in life should be advantageous to heritage speakers (e.g., Montrul, 2008, pp. 220-221). Likewise, one could also hypothesize that heritage speakers may have a relative advantage in processing linguistic input in real-time over tasks completed off-line (Montrul, Foote, Perpiñán, Thornhill, and Vidal, 2006). Finally, features that are prone to cross-linguistic interference should be challenging to both heritage speakers and non-heritage speakers.<sup>2</sup> In other words, by comparing heritage speakers and adult L2 learners and identifying the characteristics of the features that distinguish them, it should be possible to illuminate the advantages that stem from early exposure as well as identify the features that are more prone to changes in input and interaction in bilingual development.

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<sup>2</sup> In fact, Montrul (2008, p. 220-221) proposed a few predictions in this respect. She proposed: 1) heritage speakers should have an advantage over L2 learners with early-acquired grammatical knowledge; 2) heritage speakers should be more accurate and faster than L2 learners on oral production and comprehension tasks that minimize metalinguistic knowledge; and 3) if there is a re-exposure effect, heritage speakers should react faster and better to instruction than L2 learners.

#### 1.2.4. Factors that may affect heritage language competence

One significant characteristic of heritage speakers is that there is a great variation in their proficiency. Therefore, researchers have pursued the question of what factors contribute to the differential outcomes of heritage language maintenance/incomplete acquisition (e.g., Abrahamsson & Hyltenstam, 2008; Au, Knightly, Jun, & Oh, 2002; Bylund, 2009b; Montrul & Bowles, 2010; Obregon, 2010; Oh, 2003; Park, 2007; Xie, 2010).

The three most important factors in heritage language development have already been discussed: age of exposure/withdrawal, amount of input, and the effect of cross-linguistic interaction. Aside from these major factors, there are others that have been offered as explanations of the variations in heritage language competence, including language use, family situation, cultural identification, formal education, and language aptitude.

Perhaps the first study to distinguish the role of language use separately from input in the heritage language research was conducted by Au et al (2002). In a series of studies (Au et al., 2002, Knightly et al., 2003, Oh et al., 2003), Au, Knightly, Oh, and Jun classified their heritage speaker participants into two different groups: over-hearers and childhood speakers. Over-hearers were described as adults exposed to Korean aurally during childhood but who hardly spoke it. Childhood speakers, on the other hand, spoke Korean regularly until the age of five, when they became proficient in English (according to Au et al.). Given this distinction, the authors claimed that: 1) overhearing during childhood had a long-term benefit to the phonological perception compared to late bilinguals (Au et al., 2002); and 2) speaking during childhood had a long-term benefit on

speech production compared to just hearing the language (Oh et al., 2003); but 3) early exposure and use of heritage language did not generate long-term benefits in terms of morpho-syntax. These findings call for attention to heritage speaker's early language use as well as language exposure when examining factors contributing to heritage language maintenance/incomplete acquisition.

Another major factor that has been suggested to contribute to heritage language competence is cultural identity and attitude toward the heritage language. Based on the idea that identification with a community is a primary requirement of language acquisition (e.g., Schumann, 1978), several researchers have examined the relationship between the degree of cultural identity and affiliation to the heritage community and heritage language proficiency (Chinen & Tucker, 2005; Cho, 2000; J. Lee, 2002; Xie, 2010). J. Lee (2002), for example, conducted survey research with 40 second-generation Korean Americans in the U.S. Using both quantitative and qualitative methods, she found that bicultural identity and heritage language proficiency were strongly interrelated: the higher the heritage language proficiency, the stronger one identified with both the Korean culture and the American culture. In other words, those who were more proficient in the heritage language tended to be more bicultural. Likewise, Cho (2000) claimed that HL proficiency correlates positively with a well-developed sense of ethnic identity and affiliation with the ethnic group, such that group members have a greater understanding and knowledge of their groups' cultural values, ethics, and manners. The correlation between cultural affiliation and heritage language proficiency has been reported across different ethnic groups in the U.S., including Japanese (Chinen & Tucker, 2005), Chinese (Xie, 2010), and Latinos (Oh & Au, 2005).

The amount of formal instruction may also play a role in heritage language competence. Recent research suggests that formal instruction facilitates re-learning of the heritage language. In Montrul and Bowles' (2010) study, 42 Spanish heritage speakers participated in a pre-test, instructional treatment, and post-test. The instructional treatment consisted of an explicit grammatical explanation of dative case marking in Spanish, followed by three practice exercises accompanied by immediate, explicit feedback on their performance. The heritage speakers who received the instructional treatment showed highly significant gains both in grammatical intuitions and productions of dative case marking. Based on these results, Montrul and Bowles suggested that instruction, including both positive and negative evidence, facilitates classroom heritage language acquisition, at least in the short term. In fact, many Korean heritage speakers in the U.S. receive formal instruction at church or through other Korean ethnic and religious organizations. Although there are insufficient data to confirm whether these weekly heritage language schools generate long-term benefits (Chinen & Tucker, 2005), it is worth examining whether the experience of receiving formal instruction in the heritage language makes a difference to the maintenance of heritage language competence.

The final factor that may have a notable effect on heritage competence is language aptitude. Language aptitude, generally considered innate and relatively fixed (Abrahamsson & Hyltenstam, 2008, p. 485), has traditionally been examined as a diagnostic tool for predicting success in foreign language instructional settings (e.g., Carroll, 1981; Krashen, 1981). Recently, SLA researchers have also examined the role of language aptitude in the achievement of near-native-like proficiency by adult L2 acquirers (e.g., DeKeyser, 2000; Abrahamsson & Hyltenstam, 2008). Based on the CPH,

these researchers hypothesized it would be impossible to find adult learners who have achieved (near)-native-like proficiency in an L2 unless they possess high language aptitude. DeKeyser (2000), in his partial replication of Johnson & Newport (1989), indeed found late learners' performance was predicted by aptitude ( $r=.33$ ;  $p<.05$ ), which may indicate late learners rely on a different learning mechanism from early learners and high learning aptitude adults may be able to compensate for this deficiency.

In addition to late L2 learners, other recent research has suggested that aptitude may play a significant role even among early bilinguals (e.g., Abrahamsson & Hyltenstam, 2008; Bylund et al., 2009b). Abrahamsson & Hyltenstam's (2008) examination on highly proficient L2 speakers of Swedish, for example, revealed that aptitude played a modest but statistically significant role ( $r=.70$ ,  $p<.001$ ). Bylund et al. found further evidence for this finding in their study on 25 L1-Spanish L2-Swedish bilinguals whose AoA for L2 ranged from 1 to 12, where a positive correlation between bilinguals' L1 GJT scores and their language aptitude was found ( $r=0.52$ ,  $p<0.01$ ), indicating high language aptitude may indeed help maintain L1 proficiency among early bilinguals as well as their L2 acquisition. Based on these findings, Abrahamsson & Hyltenstam concluded that language aptitude plays a crucial role not only for adult learners but also for child learners, while Bylund et al. proposed that language aptitude mediates L1 attrition and not just L2 acquisition.

Taken together, it appears that unlike monolinguals (Abrahamsson & Hyltenstam, 2008; Bylund, 2009b), language aptitude appears to play a significant role in both the acquisition of L2 and maintenance of L1 for bilinguals. Furthermore, high language aptitude may play a facilitative role not only for late bilinguals but also for early

bilinguals. If aptitude can play such an important role in early bilinguals, it is highly possible that the heterogeneity among heritage speakers' L1 competence may be related to the different language aptitudes of these learners. In particular, considering that the heritage speakers examined in the current dissertation have more or less the same AoA and yet show a wide variation in heritage language proficiency, it seems feasible that language aptitude (among other factors) may be mediating their heritage language maintenance.

In sum, there appear to be many factors that contribute to the heterogeneity of heritage language competence among early bilinguals, including variations in AoA, the amount and quality of input, language use, cultural identity and level of affiliation, formal instruction, and language aptitude. One of the goals of the current study, therefore, will be to examine how these factors correlate with the bilingual competence of heritage speakers.

### *1.3. Methodological limitations of existing bilingual studies: Motivation for this dissertation*

This section describes how my dissertation is situated in the broader field of bilingual research. Despite ever-increasing attention to bilingual research, several important gaps exist that limit the understanding of how two languages develop simultaneously. What follows is a detailed description of what is absent in the existing bilingualism research, why such gaps are important, and how my dissertation on heritage language acquisition will fill some of these voids.

### 1.3.1. Failure to disambiguate early exposure and input dominance

One gap in the literature relates to the learner population. Despite increasing research in second language acquisition and bilingualism, the learner population has remained relatively narrow in its profile. A majority of the child and adult L2 speakers (i.e., late and early bilinguals) who have been studied previously are speakers who are more proficient in their first language, typically learning a second language as their secondary language of communication. However, with the world becoming more globalized every day, the range of circumstances leading to bilingualism is rapidly increasing. Some of these new bilingual populations can provide invaluable insight into the central issues of bilingualism and language acquisition. One such example is heritage speakers.

Because of their unique linguistic profile, delineated in the previous section, heritage speakers can shed light on the chasm that exists between children and adults (Polinsky, 2008a). One main goal of this dissertation, then, is to disambiguate the role of early language experience and language dominance in bilingual development. Many bilingual researchers have demonstrated that early language experience can have a very robust effect on one's bilingual competence throughout life (Mayberry & Lock, 2003; Pallier, Bosch, & Sebastián-Gallés, 1997; Pallier, Sebastián-Gallés, & Colomé, 1999; Sebastián-Gallés, Echeverría, & Bosch, 2005). However, these studies appear to confound the effects of early/first experience and language dominance because their participants' first language remained the dominant language throughout their lives. Research on heritage speakers, on the other hand, can truly disambiguate these two

factors because early exposure (e.g., Korean) and language dominance (e.g., English) are dissociated in this population.

Despite their potential for providing methodological and theoretical insight, heritage learners have largely been neglected in both L1 and L2 acquisition studies. Only recently have some researchers started describing this population systematically (Montrul, 2008; Polinsky & Kagan, 2007), and very little data exist that can provide a theoretical link to the larger context of language development. Studies on heritage language speakers, like those proposed in this dissertation, can therefore fill a gap in the existing research.

### 1.3.2. Failure to examine both languages simultaneously

Another limitation of previous studies is that both languages have rarely been examined simultaneously. Not surprisingly, second language studies have focused on the development of the L2, while recent studies on L1 attrition have examined L1 competence. In fact, it seems to have become a tradition that bilingual researchers study only the less proficient language of a bilingual, be it the L2 (as in typical adult L2 studies) or the L1 (as in international adoptee studies). This lack of studies examining both sides of a bilingual's linguistic ability imposes an important limitation on understanding the bilingual mind because it provides only a partial picture. Given emerging parallel findings between L2 acquisition and L1 attrition studies (Bylund, 2009; Hyltenstam et al., 2009; Montrul, 2008), it seems likely development of the two languages is interconnected. It is therefore necessary to examine how the two develop and interact within the bilingual mind (Grosjean, 2008; Montrul, 2008).

A bidirectional research design is particularly important when examining early bilinguals, whose linguistic competence in both languages is less stable than for other types of bilinguals. Because early bilinguals are exposed to two languages before one language is established completely, the impact of cross-linguistic interaction can be significant. Furthermore, the learnability problem can arise in both the L1 and L2 of early bilinguals, which calls for a bidirectional examination of bilingual competence.

### 1.3.3. Failure to examine multiple domains of linguistic ability with the same group

Another important gap in the literature is the lack of studies that have examined more than one domain of linguistic ability at a time. Most L2 and bilingual researchers specialize in one aspect of linguistic competence such as phonology, lexicon, or grammar. Even in the case of exceptional researchers who have interest in more than one domain, their studies often limit their scope to one particular domain per paper (e.g., Polinsky, 2008a, 2008b, 2009)<sup>3</sup>. This tradition seems partly due to practicality. Many researchers do not have the resources to conduct large-scale studies that comprise different domains of linguistic competence. Furthermore, current publication conventions encourage focused studies because short reports are easier to review and more cost-effective to publish.

Nevertheless, such traditions limit our holistic understanding of a bilingual's competence. Research has shown that age of exposure does not affect all aspects of language learning equally, and that various aspects of language are acquired at different times/stages (Long, 1990; Newport, 1990). Furthermore, recent L1 attrition research

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<sup>3</sup> An exception would be Flege et al, 1999; Abrahamsson & Hyltenstam, 2009.

suggests some linguistic abilities are more vulnerable to language loss than others (Lardiere, 2000; Müller & Hulk, 2001; Prévost & White, 2000; Tsimpli, Sorace, Heycock, & Filiaci, 2004). In short, some linguistic abilities develop later, are more difficult to acquire, and/or are less stable than others. This raises interesting questions with respect to how a linguistic domain is affected by the interaction of two languages. For example, if phonology is acquired earlier than other areas, does it have an advantage over other linguistic abilities in both L2 acquisition and L1 attrition? Or will the advantage of L2 acquisition yield disadvantages in the form of L1 attrition? In other words, not only the languages themselves but different linguistic domains within the languages may interact in bilingual development. It therefore appears important to examine multiple domains of linguistic competence simultaneously if one wishes to gain a more complete understanding of bilingual development and competence.

To address such gaps, the current dissertation examines three different aspects of linguistic ability: 1) the perception of similar but different speech sounds, 2) the processing of vocabulary words, and 3) the knowledge and intuition of grammaticality.

#### *1. 4. Research questions*

As discussed, research on heritage speakers can provide crucial insight into how the main factors of bilingual language acquisition – timing, input, and cross-linguistic interaction – work together and influence the acquisition, attrition, and ultimate attainment of bilingual proficiency. Furthermore, research on heritage speakers can fill the gaps existing in bilingual research.

Based on a review of the relevant literature, this dissertation will involve an examination of both Korean and English language competence by Korean-English bilinguals. The main goals are: 1) to disambiguate the contributions of early exposure and input dominance in early acquirers' bilingual competence; and 2) to examine whether and how the learnability problem gets resolved by early bilinguals. In addition, to investigate the nature of heritage language competence, it will also 3) investigate whether and in what way early bilinguals are different from L2 speakers and 4) examine what factors affect heritage language maintenance. To that end, it will involve the examination of Korean heritage speakers whose first language is Korean and whose dominant language is English, holding Korean native speakers learning English as a late L2 and English native speakers learning Korean as a late L2 (KSL EngNSs) as comparison groups.

In sum, the research questions to be addressed are:

RQ 1) To what extent do early exposure and input dominance influence early bilinguals' bilingual competence?

RQ 2) Do heritage speakers resolve the learnability problem that arises in each language they speak?

RQ 3) How do heritage speakers differ from late bilinguals in their L1 Korean competence?

RQ 4) How do heritage speakers differ from late bilinguals in their L2 English competence?

RQ 5) What factors of learner history best predict heritage speakers' L1 competence?

Seven experimental tasks have been designed and piloted as part of this dissertation, including three speech-perception tasks, two translation-priming tasks, and two GJTs. In addition, extensive biographical information and aptitude and proficiency test data were collected to obtain a more complete understanding of the heritage speaker bilingual profile.

## Chapter 2. Participants in the current research

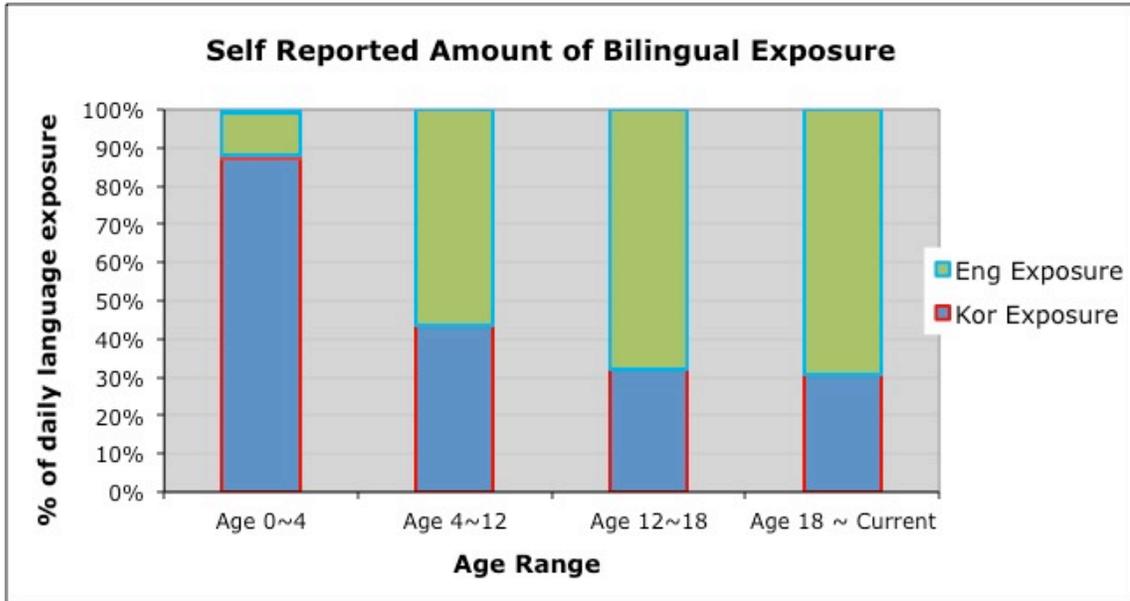
In this dissertation, three different aspects of linguistic competence were examined including speech perception, translation priming, and grammatical intuition on locative alternation. In order to obtain a holistic picture of early bilingualism, the same sets of participants participated in all three different experiments so that results from these different tasks could be compared. Therefore, participant information is first presented in this chapter, including the three participant groups' linguistic profiles as well as proficiency test results.

Forty-eight heritage speakers of Korean were recruited in the U.S. Thirty-six English native speakers learning Korean as a second language (KSL EngNSs) and 36 Korean native speakers learning English as a second language (ESL KorNSs) were also recruited to serve as comparison groups. Late second language (L2) learners were assumed to have intact native language abilities (Bylund, 2009b; Montrul, 2008), so KSL EngNSs served as the control group for the English task while ESL KorNSs served as the Korean task control group. In addition, their performance on the respective L2 tasks was examined to identify the differences between early (i.e., Heritage) and late (i.e., ESL; KSL) bilinguals.

The heritage speaker group consisted of 32 females and 16 males with a mean age of 20.27. All were students at the University of Maryland, College Park. Many of the participants were also enrolled in Korean language classes at the same university, and all were literate in Korean. They were all born in the U.S. and reported that both parents were from Korea. All participants also reported they were exposed mainly to

Korean until age 4, but currently speak English better and more frequently than Korean. According to the self-report questionnaire about their family environments, the mean amount of daily exposure to Korean before age 4, i.e. between birth and the time they started attending school, was 88.73% (11.27% English) and the mean amount of Korean language use was 81.60%. However, at the time of testing, the reported amount of daily exposure to Korean was only 30.45% (69.23%), and daily use of Korean was 30.01% (67.20%). In addition, their self-assessment, which was based on a list of “can-do” statements (see Appendix 2), indicated that all participants were more proficient in English (mean speaking rating 9.25; Reading 9.40) than Korean (Speaking 5.19; Reading 4.81). When asked to identify their first-acquired language and dominant language, the majority of them (40 out of 48) identified Korean as their first-acquired language and English as their dominant language. The eight participants who identified English as their first-acquired language still reported that they were mainly exposed to Korean until age 4, with 66.88% of daily exposure, but they used Korean language very little before age 4, with 21.25% of daily language use. Figure 1 shows heritage speakers’ self-reported amount of bilingual exposure and use throughout their lives. The pattern indicates a switch in language input dominance around the age of 4.

a.



b.

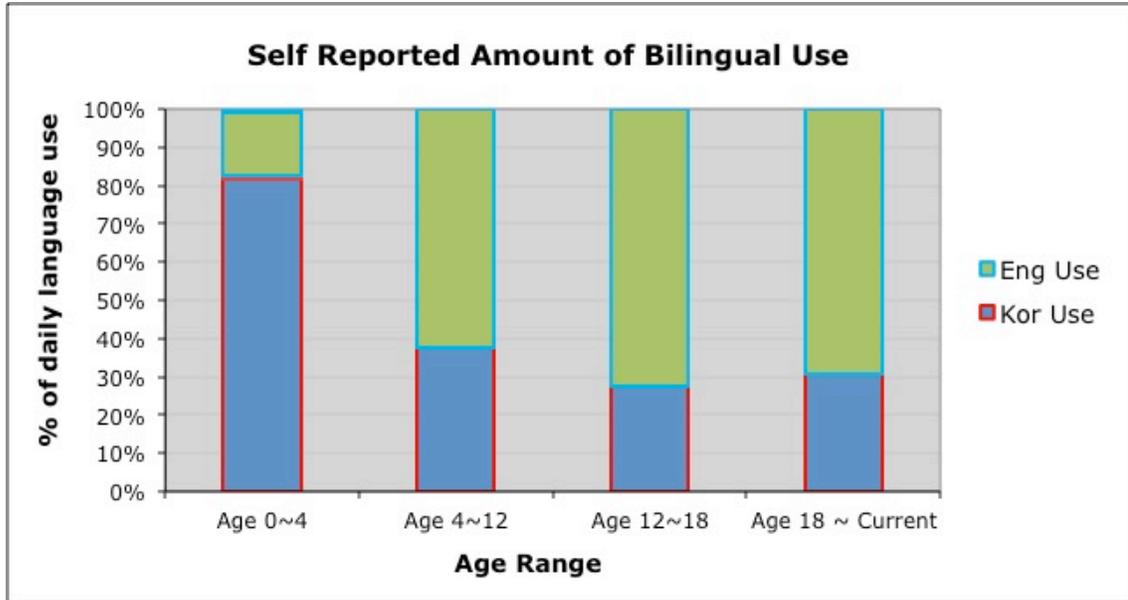


Figure 1. Self-ratings of (a) exposure to and (b) use of each language by heritage speaker participants

Forty-one of the 48 participants had been to Korea for travel, but none stayed more than seven months (Mean 3.97 months). In addition, the majority of participants (43 of 48) had attended Korean language classes at some point in their life, either in Saturday schools at church or in college. The reported mean total hours of instruction is 596 hours. Finally, when asked about their level of cultural identification with Korea and the U.S. (0-no identification; 5-medium; 10-complete identification), they gave higher mean ratings on average to U.S. culture (7.67) than to Korean culture (6.85) although the ratings are fairly balanced. Thirty-two of 48 individuals gave higher cultural identification ratings to U.S. culture while 12 individuals gave higher cultural identification to Korean.

The KorNS group was composed of 36 individuals recruited from Busan National University in Busan, South Korea (27 female, 6 male, mean age = 20.42). All were adult foreign language learners of English: virtually all participants (except one who had been to New Zealand for 6 months at age 16) had no overseas experience, and none started learning English before age 8 (mean Age of exposure (AoE) to English = 10.08). At the time of testing, they had been learning English for 9.53 years and were receiving 2.57 hours of weekly English instruction. Their self-assessment indicated a strong dominance of Korean (Speaking 9; Reading 9.33) over English (Speaking 3.94; Reading 5.72), and their cultural identification indices were also higher for Korea (8.53) than the U.S. (4.86).

Finally, the EngNS group was composed of 36 individuals recruited from the Defense Language Institute in Monterey, CA (6 female, 30 male, mean age = 22.12), where U.S. army personnel are taught foreign languages intensively. Most were first introduced to Korean at the time they arrived at the DLI, with a mean AoE to Korean

being 20.73. At the time of testing, participants had received at least 30 weeks of intensive training in Korean (average 59.24 weeks). They reported that they received 33.94 hours of Korean instruction per week, and they also spent 12.12 hours per week studying Korean outside class. Except for three participants who had been to Korea in the past (one for one year, two for two years), none had been to Korea before. In their self-assessment, they rated their Korean speaking ability 6.18 and reading ability 7.00, which is slightly higher than heritage speaker's self-rating on Korean ability, while their English ability was rated 9.45 for speaking and 9.55 for reading. Finally, their average cultural identification index for Korean culture was 3.94, which is a lot lower than the heritage speaker group, while their U.S. culture identification index was 8.88.

Table 2 displays a summary of the language background questionnaire results for all three groups.

Table 2. Participant language profiles

	EngNS	Heritage	KorNS
Age (SD)	22.12 (4.74)	20.27 (1.84)	20.42 (1.81)
AoE to Korean	20.73 (4.70)	0	0
AoE to English	0	4.6 (1.08)	10.08 (1.95)
Self-assessed Kor Speaking Ability*	6.18 (1.16)	5.19 (1.63)	9.00 (1.07)
Self-assessed Kor Reading Ability*	7.00 (1.39)	4.81 (1.89)	9.33 (0.71)
Self-assessed Eng Speaking Ability*	9.45 (0.71)	9.25 (1.12)	3.94 (1.09)
Self-assessed Eng Reading Ability*	9.54 (0.61)	9.40 (0.83)	5.72 (1.75)
Identification to Korean Culture*	3.94 (1.85)	6.74 (1.80)	8.52 (2.31)
Identification to the U.S. Culture*	8.88 (1.43)	7.63 (1.78)	4.86 (1.53)

\* Scales from 1 to 10

In addition to the “can-do” list self-assessment questionnaire, all participants took an English C-Test and a Korean C-Test as measures of proficiency in each language. In a C-Test, the second half of every second word is deleted, and examinees are asked to fill in the blanks, with the rationale being that languages are naturally redundant, so speakers

of the language can supply missing linguistic items under such conditions. Previous research has shown a high correlation between C-Tests and other institutionalized general proficiency tests (Eckes & Grotjahn, 2006). The English C-Test employed was adopted from Babaii and Ansary (2001) and Klein-Braley and Raatz (1995). The test contained five passages containing 25 blanks in each. The test turned out to be very reliable based on the performance of the L2 learners (i.e., KorNSs), with a Cronbach-alpha coefficient of reliability of .928. The Korean C-Test was adopted from Lee-Ellis (2009). The test contained four passages containing 25 blanks each. The test was previously validated with similar learner profiles, including 37 heritage and L2 learners of Korean. The Cronbach-alpha coefficient of reliability was .954 based on this study's heritage and L2 learner (i.e., EngNSs) populations, indicating the test is very reliable.

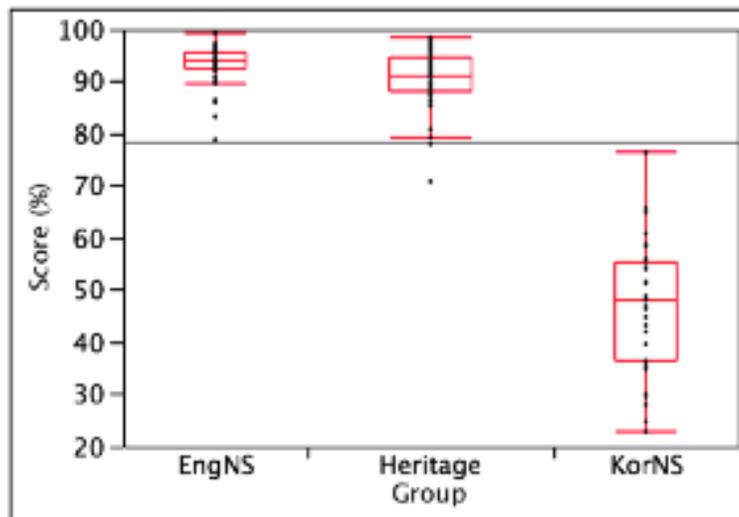
The raw test scores were converted into percentage accuracy scores. Table 3 shows the descriptive statistics of the proficiency test results. Box plots in Figure 2-a (English proficiency test) and Figure 2-b (Korean proficiency Test) represent the proficiency distributions of the three participant groups. On the English proficiency test, the heritage speakers' mean percentage score (90.64%) was not significantly different from EngNSs (93.12%) ( $t=-0.98$ ,  $p=0.16$ ), whereas KorNSs' performance (46.76%) was significantly different from EngNSs ( $t=42.66$ ,  $p<0.01$ ). On the Korean proficiency test, both EngNSs (49.18%) and heritage speakers (42.77%) performed significantly differently from the control KorNSs (99.76%) (both  $p<0.01$ ). On the other hand, the difference in proficiency between EngNSs (49.60%) and heritage speakers (42.77%) did not reach statistical significance ( $t=1.81$ ,  $p=0.07$ ) although one could argue that they are

marginally different. Overall, heritage speakers showed much greater individual variation (SD=21.38) than did the EngNSs (SD=8.50).

Table 3. Participant performance on the English and Korean proficiency test (mean percentage accuracy)

Language	Group	N	Mean	SD
English	EngNS	36	93.12	4.07
	Heritage	48	90.64	5.50
	KorNS	36	46.76	12.40
Korean	EngNS	36	49.60	8.50
	Heritage	48	42.77	21.38
	KorNS	36	99.76	0.527

a.



b.

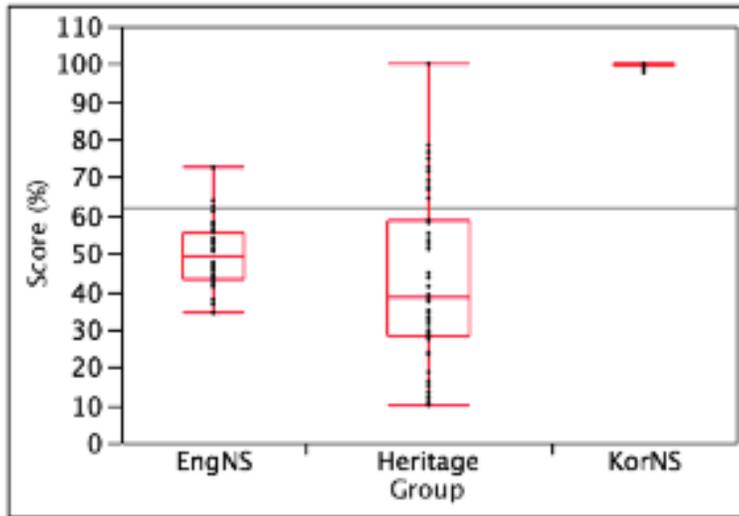


Figure 2. Mean accuracy and distribution of cloze test results (a) in English and (b) in Korean by the three participant groups

## Chapter 3. Speech perception:

### Distinguishing effects of early exposure and language dominance

In this chapter, the three participant groups' phonological sensitivity to English and Korean speech sound contrast is described. Three experimental tasks were developed to examine the ability of listeners to distinguish similar but different speech sounds in both Korean and English. By examining heritage speakers, one of the central issues of bilingual phonological development will be addressed, namely, the extent to which the first established representation influences the subsequent development in speech perception.

#### *3.1. Introduction*

Phonological sensitivity is one of the earliest developing features in one's language development. Studies on cross-language speech perception have shown that the attunement to native speech sounds develops in the first year of life (e.g., Werker & Tees, 1984), and infants seem to be able to differentiate native-language phonotactic patterns from non-native patterns as early as nine months of age (Jusczyk, Luce, & Charles-Luce, 1995). This early-developed native-language phonological sensitivity also affects the perception of non-native sounds. Adult L2 learners, for example, show persistent difficulty with L2 phoneme inventories (e.g., Aoyama, Flege, Guion, Akahane-Yamada, & Yamada, 2004; Best, McRoberts, & Goodell, 2001; Flege, 1999; Flege & MacKay, 2004; Iverson, Eknayake, Hamann, Sennema, & Evans, 2008; MacKay, Meador, & Flege,

2001; Tsukada et al., 2005) and sound combinations (Dehaene-Lambertz, Dupoux, & Gout, 2000; Dupoux, Pallier, Kakehi, & Mehler, 2001; Kabak & Idsardi, 2007) that do not exist in their L1. One's early-established phonological representation seems to remain robust regardless of how much L2 input they receive during adulthood. According to Kuhl (1991), an initially established phonological representation based on one's first language warps the perception of non-native speech. In short, it appears early experience is critical in the development of phonological competence.

When it comes to childhood L2 learners (i.e., early bilinguals), though, it remains unclear how much their linguistic competence is influenced by subsequent changes in the bilingual input. Although some research has shown the early/first established phonological representation remains implastic even with early bilinguals who have regularly been exposed to and have become highly proficient in both their L1 and L2 (e.g., Pallier, Bosch et al. 1997; Pallier, Sebastián-Gallés et al. 1999; Sebastián-Gallés and Soto-Faraco 1999; Pallier, Colomé et al. 2001; Navarra, Sebastián-Gallés et al. 2005), others have demonstrated that a complete replacement of the L1 representation with the L2 representation is possible if L1 input is completely cut off, even as late as age 9 (Pallier, Dehaene et al. 2003; Ventureyra, Pallier et al. 2004). The question addressed in this chapter is the extent of plasticity in the phonological competence of early bilinguals, who are exposed to both languages relatively early and continuously throughout their lives. Its unique contribution to the studies of bilingual speech perception lies in that its research design permits the disambiguation of the contributions of early exposure and language dominance in early bilingualism by examining both languages of a particular set

of bilingual participants (i.e., heritage speakers), whose first exposed language differs from their dominantly exposed second language.

### 3.1.1. Early exposure vs. input dominance in bilingual speech perception

The importance of early exposure in bilingual phonological competence has long been discussed. Many studies report that early bilinguals are more likely to acquire native-like competence in the perception and production of L2 speech sound than late L2 learners. Bilinguals who learned their L2 later in life are notorious for accented speech (Aoyama, Guion, Flege, Yamada, & Akahane-Yamada, 2008; Au, Oh, Knightly, Jun, & Romo, 2008; Flege et al., 2006; Flege et al., 1999; Knightly, Jun, Oh, & Au, 2003; Yeni-Komshian et al., 2000), have been shown to have phonetic features that are in between L1 and L2 phonemes in the production of L2 (Flege, 1991, 1999; Flege et al., 1997; MacKay, Flege, Piske, & Schirru, 2001; Piske, Flege, MacKay, & Meador, 2002; Tsukada et al., 2005), and often show a lack of perceptual sensitivity to L2 speech sounds (Aoyama et al., 2004; Aoyama et al., 2008; Flege, 1995, 1999; Flege & MacKay, 2004; MacKay, Flege et al., 2001; Tsukada et al., 2005). In addition, as detailed in Chapter 1, comparative studies in L2 acquisition between early bilinguals and late bilinguals consistently show the facilitative effect of early exposure (Aoyama et al., 2008; Au et al., 2002; Au et al., 2008; Flege, 1991; Kang & Guion, 2006; Knightly et al., 2003; Oh, Au, & Jun, 2002; Oh et al., 2003; Tsukada et al., 2005). Taken together, these findings support the critical role of early experience in bilingualism.

On the other hand, studies of international adoptees show the other end of the extreme, where the first established phonological representation can be completely

replaced by the later-learned L2. Pallier et al. (2003) and Ventureyra et al. (2004), for example, demonstrated that Korean born adoptees in France forgot their L1 Korean completely. In a variety of behavioral and neurological measures including Korean word recognition, language identification, speech segment detection, and fMRI scanning, the adoptees behaved exactly like French native speakers who have had no prior exposure to Korean in the perception of Korean sounds. These participants, despite having been exposed exclusively to Korean even up until age 3 to 9, seem to have completely lost their sensitivity to Korean after being exposed to French exclusively for about 20 years. Pallier et al. (2003) and Ventureyra et al. (2004) therefore concluded that complete attrition of an L1 is possible if L2 input replaces L1 input completely, and the early/first established representation of a language remains plastic and reversible even up to age 9. Although it is possible some remnants of the early representation may remain (Hyltenstam et al., 2009) and can be “re-activated” if the adoptees try to re-learn Korean, as some claim (e.g., Penfield & Roberts, 1959; Oh et al., 2003), the extent of language attrition seems quite extensive in the case of international adoptees.

Given these findings that both highlight and limit the importance of early experience by late bilinguals and international adoptees, a natural question arises as to how robust the effect of early experience on bilingual development can be on bilingual development, and how much change in bilingual input is required for restructuring. In particular, it remains to be seen how early experience and subsequent changes in linguistic input affect “early bilinguals,” people who are exposed to both languages relatively early and continuously throughout their lives.

At first glance, existing evidence appears to support the critical role of early experience even with early bilinguals. Pallier, Bosch, & Sebastián-Gallés (1997), Pallier, Sebastián-Gallés, & Colomé (1999), Pallier, Colomé, & Sebastián-Gallés (2001), Sebastián-Gallés & Soto-Faraco (1999), and Navarra, Sebastián-Gallés, & Soto-Faraco (2005), for example, examined highly proficient Spanish-Catalan bilinguals who were exposed continually to both languages since young. They then found that even very proficient bilinguals may have difficulty with the Catalan /e/-/ɛ/ distinction if they did not grow up in a Catalan-speaking family. Using tasks/paradigms like the forced choice task (Sebastián-Gallés & Soto-Faraco, 1999), repetition-priming paradigm (Pallier et al., 2001), AX discrimination task (Pallier et al., 1997), and interference-effect task (Navarra et al., 2005; Pallier et al., 1999), these studies all have shown that only Catalan-dominant bilinguals who learned Catalan as their L1 exhibited a significant effect in their sensitivity measures, whereas Spanish-dominant bilinguals who grew up in Spanish-speaking households fail to perceive the Catalan /e/-/ɛ/ distinction. Based on the results, these researchers suggest that very early linguistic experience dramatically influences the way phonemic categories are organized, and that even the achievement of high bilingual proficiency cannot help overcome limitations established by the early formation of phonemic categories.

Although this apparent lack of behavioral plasticity is worth noting, it is questionable whether it was the lack of early experience or the lack of dominant input that prevented Spanish-dominant bilinguals from acquiring/maintaining the Catalan distinction. That is because these results can be equally explainable by a language dominance effect. For example, the participants who were mainly exposed to Spanish

prior to age 3 in Navarra et al. (2005) were also Spanish-dominant bilinguals, while those with early exposure to Catalan reported that they were more dominant in Catalan. With the timing of exposure and language dominance confounded in the participants of those studies, their results do not provide a conclusive answer as to whether Catalan dominant participants' sensitivity to the Catalan sound distinction is due to early exposure or language dominance. In order to claim the rigidity of first language phonological representation in bilingual development unambiguously, one would have to examine early bilinguals whose first exposed languages are different from their dominant language. Studying heritage speakers' phonological competence in both their weak L1 and dominant L2 can provide a unique means of disambiguating the role of early experience and dominant language input.

### 3.1.2. Heritage speech perception

As mentioned, the unique language profile of heritage speakers enables the dissociation of input timing and exposure in early bilinguals. However, little formal investigation of heritage speech perception in particular appears to have been conducted to date. The majority of studies that examined speakers with a similar profile to heritage speakers (although not as narrowly defined as ones in this study) have examined only production (Au et al., 2002; Au et al., 2008; Godson, 2003, 2004; Knightly et al., 2003) with only a few examining perception (Oh et al., 2002; 2003). In addition, since most studies have aimed to show an age effect in L2 acquisition, their research focused on comparing early bilinguals with late bilinguals (Aoyama et al., 2008; Au et al., 2002; Au

et al., 2008; Kang & Guion, 2006; Knightly et al., 2003; Oh et al., 2002; Oh et al., 2003; Tsukada et al., 2005).

Perhaps more importantly, both languages of a bilingual have rarely been examined together, so it remains unclear whether heritage speaker's phonological sensitivity is applicable to both their heritage and dominant languages. In fact, it seems to have become a tradition that bilingual researchers study only the less proficient language of a bilingual, be it the L2 (as in typical adult SLA studies) or the L1 (as in international adoptee studies). However, the lack of studies examining both sides of a bilingual's linguistic ability imposes an important limitation on understanding the bilingual mind because it provides only a partial picture (Grosjean, 2008; Montrul, 2008). Likewise, previous studies on heritage speakers have examined only heritage language competence to the exclusion of the dominant language, so very little is known about their holistic phonological representation. Some researchers (e.g., Polinsky and Kagan, 2007) believe the reason for this lack of heritage speech perception studies is because heritage language learners generally sound native-like when they speak. However, as shown in the case of Spanish-Catalan bilinguals, even very proficient bilinguals may exhibit a different phonological competence from monolingual native speakers. Therefore, the experiments in the current chapter tested the perceptual sensitivity of Korean heritage speakers living in the U.S. on both Korean and English sound distinctions.

### 3.1.3. Korean and English phonotactic patterns and phonological contrasts

The current study used a bi-directional experimental design that tested heritage speakers' sensitivity to phonotactic constraints as well as phonemic contrasts, each of

which exists only in one of the languages of interest (Korean and English). A phonotactic constraint refers to the constraints imposed on possible sound combinations in a language. For example, the basic structure of a Korean syllable is CGVC, where only one or no consonant (C) can exist in the onset position, a glide (G) is part of the nucleus combined with a vowel (V), and only one or no consonant can exist in the coda position, where the coda is further restricted to only one of seven consonants of the nineteen consonantal phonemes (/p, t, k, m, n, N, l/). Consonants other than these seven are neutralized in the syllable-final position except when they are pronounced at the onset of the following syllable via resyllabification. This neutralization process causes fricatives in the coda to be pronounced as stops (e.g., /pis/ → /pit/). As such, fricatives produced in the syllable final position in Korean are illicit.

Given this constraint, Korean speakers have been reported to hear an illusory vowel between the fricative coda and the consonant in the onset position of the next syllable. For example, Kabak and Idsardi (2007) examined the perception of English consonant clusters by Korean speakers. Among the consonant clusters tested in their study was /c<sup>h</sup>m/, which is an illicit sound sequence in Korean. Using a discrimination task of non-word pairs /pac<sup>h</sup>ma/ and /pac<sup>h</sup>ima/, they found that Korean speakers failed to distinguish the non-word pair. Their explanation is that because /c<sup>h</sup>m / is an illicit sound sequence in Korean (i.e., violates Korean phonotactics), Korean speakers perceive a vowel /i/ after the consonant /c<sup>h</sup>/ so the /c<sup>h</sup>/ can be perceived as an onset.<sup>4</sup> Such vowel epenthesis is also a process commonly observed in loan word adaptation in Korean, a

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<sup>4</sup> Comparing these results with the results of other consonant clusters tests, Kabak and Idsardi (2007) also claimed that the specific constraint comes from the syllable final position restriction rather than consonant cluster restrictions.

process that ensures new forms comply with native phonotactic restrictions (Uffmann, 2004; Kang, 2003).

This robust impact of L1 phonotactics on L2 speech perception has also been reported in Japanese listeners engaging in a phoneme identification task (Dupoux, Kakehi, Hirose, Pallier, & Mehler, 1999) and a lexical decision task (Dupoux, Pallier et al., 2001), as well as in those who participated in electrophysiological experiments (Dehaene-Lambertz et al, 2000). Taken together, the native-language based phonotactic constraints seem to influence perception in a significant way. That is, Korean speakers are likely to have difficulty distinguishing sound pairs such as /kasta/ vs. /kasuta/, for example, because they are likely to perceive /kasuta/ upon hearing /kasta/<sup>5</sup>.

In terms of the sound contrast that could be potentially difficulty for EngNSs, there are many Korean phonemic contrasts that do not map with English phonemes exactly. In particular, the Korean lax /s/ vs. tense /s\*/ distinction is absent in English. This sound contrast is phonemic in Korean, so /sada/, for example, means “to buy,” whereas /s\*ada/ means “to wrap.” This sound contrast does not exist in English, in that

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<sup>5</sup> In contrast to Korean, English allows more complex syllable structures, scaling up to CCGVCC. English does not have similar restrictions on final consonants either, allowing consonant clusters in both the onset and coda positions. Although English does have restrictions on consonant clusters in all positions including syllable initial (\*km, \*mr, \*mw), medial (\*pkm, \*kmr, \*tnw), and final (\*pk, \*km, \*tn), most of these restrictions are really only a subset of the Korean restrictions, making most licit Korean sound sequences a subset of licit English sound sequences. In fact, there is only one sound combination that could potentially cause difficulty to English speakers, that being gemination (e.g., consonant clusters like [mm] or [nn]), although this geminate-like effect frequently occurs across boundaries (e.g., *some more*) even though it is not allowed within a word boundary (Kaye, 2005). Furthermore, according to Lee-Ellis, Idsardi, and Phillips (2009), the geminate does not seem to create perceptual difficulty for English speakers: English monolingual speakers were able to distinguish a non-word pair /kama/ and /kamma/ with no difficulty.

there is only one alveolar fricative /s/, and native English speakers learning Korean have often reported the /s/ and /s\*/ distinction to be the most difficult contrast to both produce and perceive. A study by Cheon (2005) examined how Korean speakers and American English speakers perceive and produce Korean and English fricative sounds respectively. In her perception similarity rating data, English speakers rated all three fricatives (i.e., Korean /s/, Korean /s\*/, and English /s/) to be similar to each other, while Korean speakers rated Korean /s/ and Korean /s\*/ as well as Korean /s/ and English /s/ as different from each other (See Table 4).

Table 4. Perceived identity between fricatives before /a/ in Korean and English (Cheon, 2005)

Sound pairs	Similarity Ratings (%)		
	American English (AE) speakers	Korean Speakers	T-test
KO /sa/ vs. EN /sa/	56	6	p<0.05
KO/s*a/ vs. EN /sa/	77	88	n.s.
KO /sa/ vs. KO /s*a/	60	0	p<0.05

In short, it appears English speakers map Korean both /s/ and /s\*/ to English /s/. Therefore, it is predicted that English speakers, when provided with a non-word pair like /saka/ and /s\*aka/, will fail to distinguish them in a perception task.

### 3.1.4. Predictions

Table 5 displays the three contrasts tested along with predictions for each participant group. The control contrast /kada/ vs. /kata/ should be easily differentiated by both native speaker groups. English stimuli should be difficult for Korean speakers but

not for English speakers. Finally, two Korean contrasts absent in English should be difficult for English speaker but not for Korean speakers.

Table 5. Materials and predictions

Group		Sound	Control kada-kata	English kasta-kasuta	Korean saka-s*aka
KorNSs			Easy	Difficult	Easy
EngNSs			Easy	Easy	Difficult
Heritage speakers	Early L1 Exposure		Easy	Difficult	Easy
	L2 Dominance		Easy	Easy	Difficult

In terms of the heritage participants, if early exposure (to L1) impacts their speech perception more, they will behave more like Korean speakers, but if (L2) language dominance has greater impact, then they will behave more like English speakers. One can also imagine a case where heritage speakers develop native-like perception in both languages, thus successfully identifying both Korean and English contrasts. This would show that heritage speakers have an advantage due to both early exposure to Korean and extensive exposure to English. Finally, an unlikely but possible outcome would be that heritage speakers fail to distinguish either Korean or English contrasts. These two latter possibilities will distinguish heritage speakers from both late bilingual groups.

### 3.2. Methods

In order to examine the phonological representation of the participants, three different types of discrimination task were developed. In discrimination experiments, multiple stimuli are presented in a single trial, and the participant's ability to differentiate the stimuli is measured. These designs have been used frequently in previous

phonological research and are considered excellent for exploring the architecture of perceptual space and how it is affected by differences among subject populations or changes due to learning or exposure (McGuire, 2010).

In this dissertation, three discrimination tasks with varying levels of difficulty were employed. The most difficult task was a speeded encoding task, adopted from Dupoux, Pallier, Sebastián-Gallés, & Mehler (1997), the second most difficult task was AX discrimination with speaker variability, and the easiest task was an AX discrimination task with no speaker variability. The motivation for using different levels of tasks was based on a series of studies by Dupoux et al., as well as the author's earlier study that involved 45 participants (15 Korean speakers, 15 English monolinguals, and 15 Korean heritage speakers) with the same sound stimuli.

In the speech perception literature, a simple AX discrimination task is the most commonly used task due to its ease of administration and analysis. In this design, two stimuli are presented in each trial, separated by a specified amount of time (ISI: inter-stimulus interval). The stimuli are paired such that on any given trial they are either the same or different in some way and the subject's task is to identify which was presented. For example, if there are two stimuli, *A* and *B*, then there are two possible *different* pairs, <AB> <BA>, and two *same* pairs, <AA> <BB>.

An important limitation of such a simple task has been noted in a series of experiments that Dupoux and his colleagues conducted (Dupoux, Pallier, Sebastián-Gallés, & Mehler, 1997; Dupoux, Peperkamp, & Sebastián-Gallés, 2001, 2010; Dupoux, Sebastián-Gallés, Navarete, & Peperkamp, 2008). In this series of experiments, Dupoux et al. examined French speakers' perceptual sensitivity to stress using several tasks of

varying difficulty, ranging from the standard AX discrimination task to an ABX discrimination task with talker variation to a speeded identification task up to 6-word-length sequences containing talker variation. They found that French speakers, whose native language does not have a stress contrast, did not show problems in distinguishing different stress patterns in non-words (e.g., píkí vs. píki). However, when the same participants were provided more difficult tasks such as a 4-word-length speeded identification task, French speakers began to exhibit problems with stress unlike the control group. In other words, only when a more demanding task was used, did the native and non-native speakers differ in their performance. Based on these findings, they concluded that tasks that utilize short-term memory like the speeded repetition task with talker variability are more appropriate measures of French learners' phonological representation of stress.

As suggested in Dupoux et al.'s studies, if the two contrasting sounds of an AX discrimination task are very distinct acoustically, even speakers without separate phonological representations for the two sounds can perform the task based on acoustic cues. On the other hand, as Dupoux et al. showed, such reliance on acoustic cues can be prevented by making the task more challenging. For example, by using multiple speakers to record the stimuli, one can reduce the amount of reliable acoustic cues. In addition, presenting multiple sounds rapidly in sequence and asking participants to encode each sound – as in the speeded encoding task - requires listeners to quickly map each sound to their phonological representation. Without distinctive phonological categories, the non-native speakers, on the other hand, are likely to have significant difficulty with such a demanding task.

This being said, the level of difficulty may have to be calibrated carefully when examining bilingual speakers' phonological sensitivity. If the acoustic differences between the two contrasted sounds are small, it is possible the simple AX discrimination task is sufficient to differentiate native and non-native phonological sensitivity. In addition, if a task is made too challenging, e.g., with too much memory burden, it is possible that even native speakers will have a hard time performing the task. Finally, even if one finds a bilingual group performing in non-native-like fashion on a more challenging task, it is possible they may perform like natives on an easier task. In short, it is possible a bilingual speaker may turn out to be different from both the native speaker and the non-native speaker, depending on the level of difficulty of the discrimination task. Therefore, in examining bilingual speaker's phonological sensitivity, it seems desirable to include multiple tasks with varying levels of difficulty and ranging from a simple AX discrimination task to a speeded encoding task. Again, in this study, three different tasks were employed: Dupoux et al's speeded encoding task and two different versions of A/X, one with a speaker variation (i.e., six tokens for each non-word) and the other with no speaker variation (i.e., single token for each non-word). All tasks were created using the latest version of E-prime (2.0).

### 3.2.1. Task 1. Speeded sequence encoding task

Dupoux, Sebastián-Gallés, Navarrete, & Peperkamp (2008) employed a speeded sequence recall task with high phonemic variability. The task used four alternating nonce-word sequences, stimuli that were produced by multiple speakers and an increased presentation speed that was achieved by compressing the stimuli slightly and reducing

ISI, all of which were intended to make the task more challenging. As discussed, the rationale behind the use of such a task is to encourage phonological level processing, so a task of similar design was employed here.

#### 3.2.1.1. Materials

Six different EngNSs (three men and three women) were each recorded citing the English stimuli /kasta/ and /kasuta/, the non-word pairs containing the sound contrast that does not exist in Korean. The Korean stimuli (/saka/ vs. /s\*aka/), which are not contrastive in English, were recorded by six KorNSs. Finally, the control contrast that exists in both languages (i.e., /kada/ vs. /kata/) was recorded by the EngNSs. Out of 10 different tokens recorded by each speaker, a different native speaker selected the clearest sample of the set for inclusion in the test battery. The selected items were then digitized at 16 kHz at 16 bits using *Audacity*.

#### 3.2.1.2. Procedures

For each minimal pair, an introduction block, a warm-up block, and a test block were presented. For example, in the English stimuli introduction blocks, participants were told they would learn two words in a foreign language and that each word is associated with either the keyboard number [1] or [2]. To begin, they pressed [1], which triggered six different speakers saying the nonce word *kasta*, and then they pressed [2] to hear six different speakers saying *kasuta*. They were allowed to listen to the various token sets as many times as they wanted by pressing the associated key. When the participants

indicated they had learned the association between the word and key number, the experimental block containing a warm-up and a test block started.

In the warm-up block, two-word sequences were presented at an interval of 50 ms between each word. Participants were told to press the keys in sequence according to the word sequence they thought they had heard. For example, if they heard *kasuta - kasta*, they were supposed to press [2] and [1] consecutively. Each trial was followed by an “okay” sound, which was used to inhibit the use of echoic memory to perform the task (Dupoux et al, 2008). Participants were instructed that they should press the number key after the “okay” sound. During the warm-up session, an answer key was provided after each trial, and participants could practice for as long as they wanted. Ten warm-up trials were provided to participants in the beginning, and participants were asked if they would like more warm-up practice items. Participants could take as many as 30 warm-up trials if they wanted more practice.

In the test block, participants heard 4-word-length sequences and were asked to press the associated number keys (e.g., 1212 for *kasuta – kasta – kasuta - kasta*). As in the warm-up block, participants had to respond after hearing the “okay” sound. Fourteen combinations of all possible 4-word sequences except 1111 and 2222 were used two times each, creating 28 trials in each test block. Within each trial, recordings from the same speaker were never presented adjacently, and no single token appeared more than once in a sequence. No feedback was provided during the test phase, and a 1500-ms pause was inserted between trials. The speakers and stimuli sequences were randomized in each block, and the order of language blocks was randomized across participants. Participants were allowed to take a break between any two language blocks, but hardly

any participants took a break. The whole experiment including three language blocks lasted about 25 minutes.

### 3.2.2. Tasks 2 and 3: AX discrimination with (Task 2) or without (Task 3) speaker variability

In Tasks 2 and 3, a standard AX discrimination procedure was used to create two additional perception tasks of lower difficulty compared to Task 1. Two non-word stimuli were presented side by side with 100-ms ISI instead of 50 ms, and participants were asked to press the key [s] if the pair sounded the same or [d] if they sounded different. Thirty-two randomly combined and ordered items were tested for each language. In Task 2, the stimuli recorded by six different speakers for Task 1 were used. In Task 3, stimuli recorded by a single speaker were used, thus making the task easiest among the three.

In each task, there were three language blocks (Control, English, and Korean), and each language block contained instructions, practice, and a test block. After the instruction, participants were provided with four practice items at the beginning of each sound-contrast block before beginning the main test block. In Task 2 (i.e., AX discrimination with speaker variation), trials were created by combining randomly chosen tokens from six different speakers' pronunciation, but in a way that no trial contained two tokens from the same speaker. In Task 3 (i.e., the single speaker AX task), two tokens from a single speaker were used in all 32 items. The between-trial interval was kept to 1000 ms, and the trials were set to move to the next if no response was provided within 7000 ms.

### 3.3. Results

#### 3.3.1. Sequence recall task results

As a measure of participant ability to encode sounds in short-term memory, the rate of correct responses was calculated. A particular trial response was considered incorrect when there was an error in the recorded sequence. Figure 3 shows the accuracy rates of the three language groups for each stimulus.

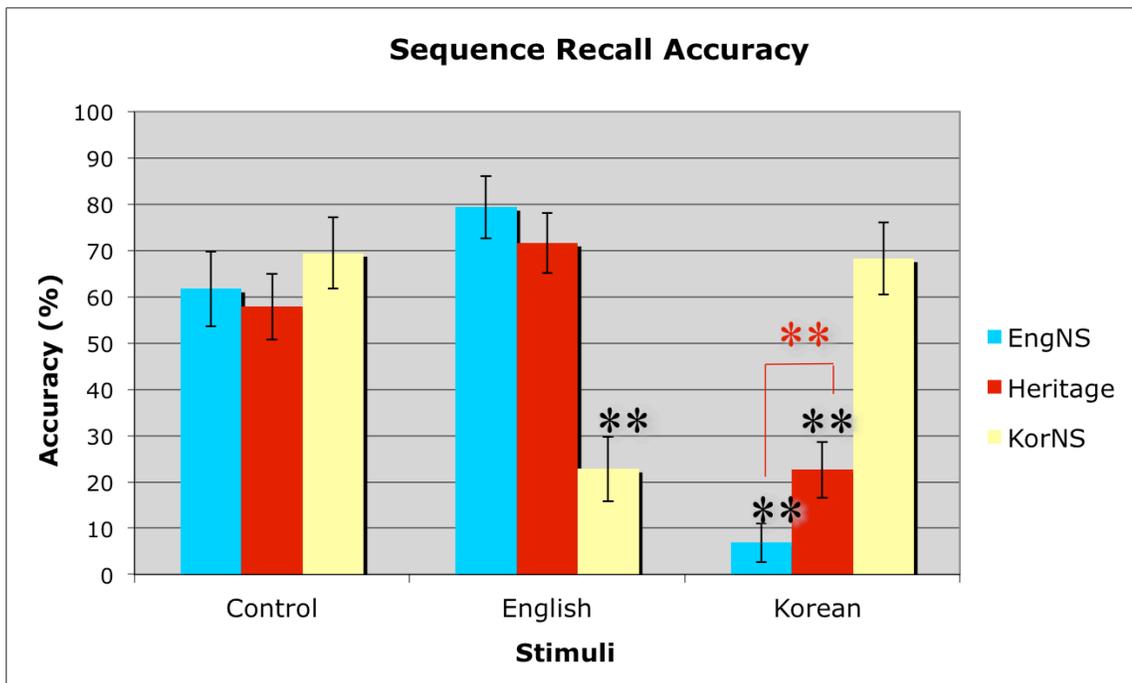


Figure 3. Accuracy rates of the three language groups (EngNS; Her; KorNS)  
Control: kada-kata; English: kasta-kasuta; Korean: saka-s\*aka  
\*\*: significantly different performance from the native control performance at  $p < 0.01$  level

As shown, all participant groups performed equally well on the control stimuli (*kada-kata*). Likewise, native speaker groups performed well on their native language contrasts: EngNSs successfully encoded 79% of the English stimuli (*kasta-kasuta*) and

KorNSs successfully encoded 68% of the Korean stimuli (*saka-s\*aka*). However, they performed with very low accuracy in their respective L2s: Korean speakers performed at 22.8% with the English stimuli and English speakers performed as low as 6.8% with the Korean stimuli. Therefore, the English *kasta-kasuta* and Korean *saka-s\*aka* stimuli sets provide a bidirectional contrast between the two languages, allowing a possible comparison of heritage speaker performance with each native speaker group.

Interestingly, heritage speakers patterned more similarly to EngNSs in all stimulus conditions. Unlike KorNSs, they successfully encoded the English *kasta-kasuta* contrast, but they also show great difficulty encoding the Korean *saka-s\*aka* distinction with an accuracy rate of only 22.6%. That said, it is also notable that heritage performance was slightly better than EngNSs' performance on the Korean *saka-s\*aka* distinction.

To confirm such observations statistically, accuracy rates were fit to a general linear mixed-effects model, considering language groups and stimuli list as fixed effects and controlling for participants and items as random effects. The results showed an overall significant fixed effect of stimuli lists,  $F(2, 81.27)=48.66$ ,  $p<0.01$  and a significant interaction effect  $F(4,9873)=626.89$ ,  $p<0.01$ , but no significant effect of group  $F(2,117)=1.04$ ,  $p=0.36$ .

Separate analyses of each stimulus set were then conducted to examine the group differences in each sound contrast. With the control stimuli, group performance did not significantly differ at the  $p<0.01$  level ( $F(2, 117)=4.08$ ,  $p=0.019$ ). On the other hand, with the English stimuli, a significant fixed effect for group was obtained,  $F(1,117)=103.52$ ,  $p<0.01$ . Planned contrasts among groups were then conducted, and they revealed no statistically significant difference between EngNSs and Heritage speakers ( $p=0.059$ )

while KorNSs were significantly different from both EngNSs ( $p < 0.01$ ) and Heritage speakers ( $p < 0.01$ ). Finally, Korean stimuli also generated a significant fixed effect of group  $F(2, 117) = 114.32$ ,  $p < 0.01$ . Planned contrasts revealed that both English and Heritage speaker performances were different from KorNSs ( $p < 0.01$ ). In addition, EngNSs and Heritage speakers also performed significantly differently from each other with Korean stimuli ( $p < 0.01$ ).

In sum, heritage speakers' performance patterned very closely with that of EngNSs in that they were native-like with the Control and English stimuli but not the Korean stimuli. That said, their performance on the Korean stimuli was statistically significantly better than the English speakers, although it was far from Korean-NS-like performance.

### 3.3.2. Multiple-speaker-recording AX discrimination task results

Recall that in this task, participants were given two stimuli recorded by different speakers in each trial and asked to determine whether they are the same or different words. Each participant's d-prime score, which is based on the latest signal detection theory (Macmillan & Creelman, 2005), was calculated to measure sensitivity to the sound contrast. Figure 4 shows the d-prime score of the three language groups for each stimuli condition in the multiple-speaker recording AX discrimination task.

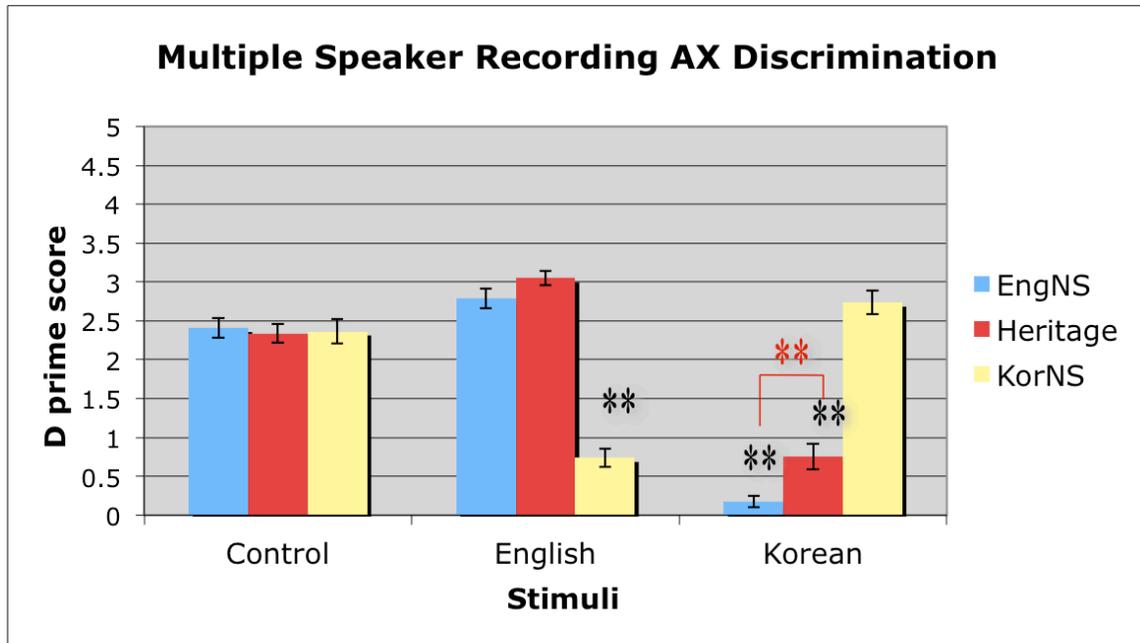


Figure 4. D-prime score of the three language groups (EngNS; Her; KorNS) in the multi-speaker recorded AX discrimination task

Control: kada-kata; English: kasta-kasuta; Korean: saka-s\*aka

\*\* : significantly different performance from the native control performance at  $p < 0.01$  level

Overall, the results exhibit the same pattern to the results of the Speeded Encoding task. Groups performed equally successfully on the control stimuli (*kada-kata*) by group, and EngNSs and KorNSs show very low d-prime scores in their respective L2s (0.18 and 0.74, respectively). Heritage speakers again performed very successfully on the English stimuli ( $d' = 3.05$ ) but not so well on the Korean stimuli ( $d' = 0.75$ ). However, their performance on the Korean stimuli was slightly better than EngNSs (Heritage  $d' = 0.75$  vs. EngNS  $d' = 0.18$ ).

For the statistical analysis, the  $d'$  scores were fit to a general linear mixed-effects model, considering language groups and stimuli list as fixed effects and controlling for participants as a random effect. The results showed an overall significant fixed effect of

stimulus list,  $F(2, 234)=76.86$ ,  $p<0.01$  and a significant interaction effect  $F(4, 234)=107.30$ ,  $p<0.01$  but no significant group effect of  $F(2, 117)=2.4205$ ,  $p=0.09$ .

Separate analyses of each stimulus set were then conducted to examine the group differences for each sound contrast. Group performance on the control stimuli was not significantly different from each other,  $F(2, 117)=0.017$ ,  $p=0.93$ . For the English stimuli, however, a significant fixed effect for group was obtained,  $F(1,117)=103.52$ ,  $p<0.01$ , and when planned contrasts among groups were conducted, no statistically significant difference between EngNS and Heritage speakers ( $p=0.08$ ) was obtained while KorNSs were significantly different from both EngNSs ( $p<0.01$ ) and Heritage speakers ( $p<0.01$ ). Finally, Korean stimuli also generated a significant fixed effect of group  $F(2,117)=114.32$ ,  $p<0.01$ . Planned contrasts revealed that both English and Heritage speaker performances were different from KorNSs ( $p<0.01$ ). In addition, EngNSs and Heritage speakers also performed significantly differently from each other on the Korean stimuli ( $p<0.01$ ).

In sum, the multiple-speaker recording AX discrimination task replicated the findings from the Speeded Encoding task. Heritage speakers performed native-like in English, but non-native-like in Korean. However, when compared to English speakers, Heritage speakers performed better in the perception of Korean contrasts.

### 3.3.3. Single-speaker-recording AX discrimination task results

In this task, participants overall performed better in all stimuli conditions than they did in the multiple-speaker task. In addition, their performance pattern was different from the previous two tasks. As shown below, KorNSs performed native-like even on the English stimuli and heritage speakers performed native-like on the Korean stimuli. The only slightly less-than-native-like performance was observed with EngNSs and the Korean stimuli (See Figure 5).

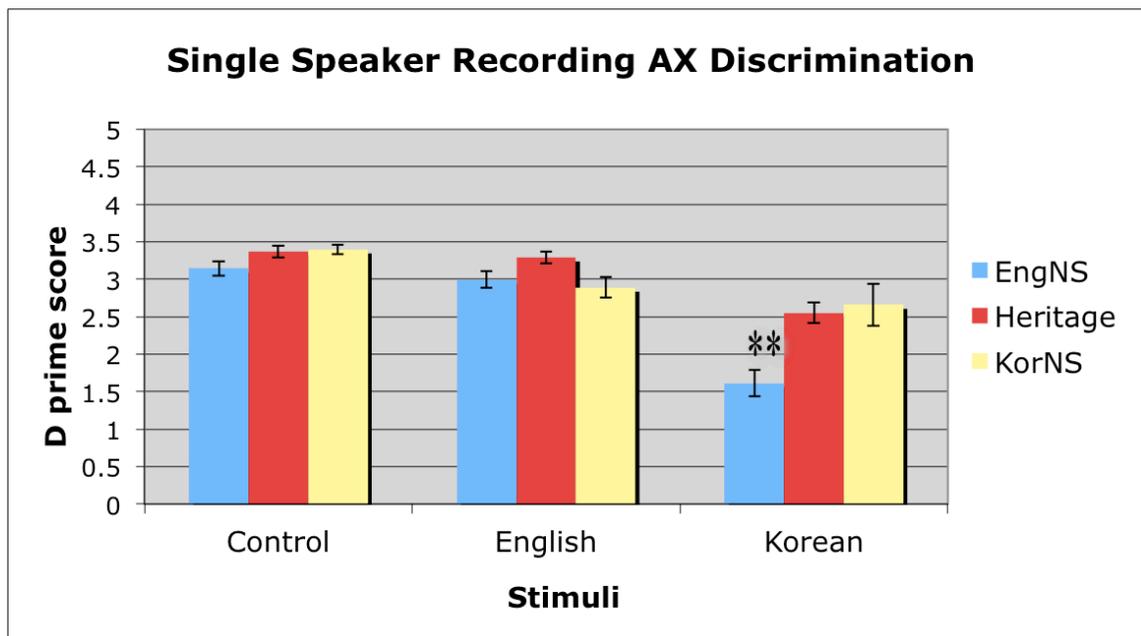


Figure 5. D-prime score of the three language groups (EngNS; Her; KorNS) in the single-speaker-recording AX discrimination task

Control: kada-kata; English: kasta-kasuta; Korean: saka-s\*aka

\*\* : significantly different performance from the native control performance at  $p < 0.01$  level

Statistical analysis found a significant fixed effect for group,  $F(2,117)=7.45$ ,  $p < 0.01$  in addition to a significant fixed effect for stimulus list,  $F(2, 234)=55.17$ ,  $p < 0.01$

and interaction effect  $F(4, 234)=5.71$ ,  $p<0.01$ , suggesting the English speaker group performed differently from the other groups.

As with the other tasks, group performance on the control stimuli did not differ significantly,  $F(2, 117)=2.67$ ,  $p=0.07$ . In addition, no significant fixed effect of group was obtained with English stimuli,  $F(2,117)=4.09$ ,  $p=0.02$ , suggesting all groups including Korean speakers performed native-like with the English stimuli. However, the Korean stimuli generated a significant fixed effect of group  $F(2,117)=7.45$ ,  $p<0.01$ , which according to the planned contrast, is due to significantly worse performance by the native English speakers when compared to the KorNSs ( $p<0.01$ ) and Heritage speakers ( $p<0.01$ ). Heritage speakers, on the other hand, were not different from KorNSs ( $p=0.69$ ).

To summarize, the single speaker AX discrimination task seemed to have been quite easy for all speaker groups, so it did not yield a bidirectional contrast between the two languages, which makes it difficult to interpret heritage speaker performance in comparison to each native speaker group. In other words, it appears the task was too easy so that even non-native speakers could perform the task using acoustic cues and not necessarily relying on their phonological representation.

#### *3.4. Section discussion: Phonological competence in early bilinguals*

The most significant finding of the experiments is that Korean heritage speakers behaved very similarly to EngNSs. In both the speeded-encoding task and the multi-speaker-recording AX-discrimination task, they performed native-like on the English

*kasta-kasuta* distinction, which KorNSs found difficult<sup>6</sup>. On the other hand, they experienced significant difficulty trying to distinguish the Korean stimuli *saka* and *s\*aka*, which EngNSs found very difficult. In other words, the heritage speakers of this experiment seem to have lost their sensitivity to the particular Korean phonemic distinction tested in the current study despite having started as an L1 speakers of Korean and instead have acquired native-like competence in their L2, English.

This finding is significant for two reasons. First, it challenges the claims made in previous Spanish-Catalan bilingual studies (e.g., Pallier et al., 1997; Pallier et al., 1999; Pallier et al., 2001; Sebastián-Gallés & Soto-Faraco, 1999; Navarra et al., 2005), where only Catalan-L1/dominant bilinguals exhibited sensitivity to the Catalan /e/-/ε/ variation while Spanish-L1/dominant bilinguals did not, even though they were highly proficient in both languages and had been exposed to both languages since age 6. The authors claimed this finding illustrated the robust effect of early experience and the inflexibility of first-acquired phonemic categories. However, as discussed, because the L1 remained dominant in these participants, an alternative explanation to Pallier et al.'s finding exists: language dominance determined their participants' bilingual competence. The current results support this alternative interpretation. The Korean heritage speakers tested in this study were not sensitive to the Korean /s/-/s\*/ variation, i.e., early experience had limited sustained effect on the language competence of this population. At the same time, heritage speakers showed native-like perception of the sound combinations only possible in English, their dominant language, (i.e., /*kasta*/), which Korean speakers found very difficult to perceive correctly. Therefore, for early bilinguals who continue to be exposed

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<sup>6</sup> Note that the results from the single-speaker recording AX discrimination task were uninformative because it was too easy, even for non-native speakers.

to two languages early and throughout, it appears that input dominance plays a more significant role in their bilingual competence while early exposure plays a limited role in their long-term bilingual competence.

Another significance of the current finding is that it revealed a particular sound contrast that seems to be quite vulnerable to language loss in the face of reduced input: Korean lax fricative /s/ and tense fricative /s\*/. Despite the difficulties often brought up by L2 learners of Korean, examination of the L2 perception of lax /s/ vs. tense /s\*/ has not appeared in the literature before now.<sup>7</sup> Why then is this distinction so difficult for Korean-English bilinguals? S. Kim's (1999) dissertation research provides some insight. Kim examined this contrast in the context of English-to-Korean loan word adoption. According to him, Korean speakers detect the sub-phonemic variation in the English fricative /s/ and map the loan words containing English /s/ into two Korean phonemes, either /s/ or /s\*/. In the opposite direction, it indicates that Korean /s/ and /s\*/ are phonemically mapped into a single category phoneme in English.

Kim also examined the acoustic qualities of Korean /s/ and /s\*/, and he found that they are different only in frication duration (/s\*/ is slightly longer) in the range that overlaps with English /s/. This high acoustic similarity between Korean /s/ and /s\*/ as well as their mapping relationships with English /s/ seem to make it difficult for English speakers to detect the difference. In Best's (1995) term, this is a case of *Single Category*

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<sup>7</sup> Interestingly, native speakers also performed relatively worse on this contrast, although the difference was statistically insignificant when compared to the control uli. Nevertheless, it is notable this distinction is disappearing in some areas of Korea (i.e., Northern Kyungsang Province). To control for this issue in the current experiment, none of the Korean native speakers or parents of heritage speakers who participated in this study came from Northern Kyungsang Province.

*Assimilation*, the pattern predicted to cause the highest level of discrimination difficulty according to her Perceptual Assimilation Model (PAM).

For all their similarities, it is notable that heritage speakers performed better in the perception of Korean /s/-/s\*/ than the EngNSs. Some remnants of early linguistic representation may have survived, thereby providing an advantage to heritage speakers over late learners. However, before the experiment was conducted, it had been anticipated that heritage speakers would show even greater advantage than what the data reveal. Given that many of these heritage speakers had received Korean input almost exclusively for the first four years of their life and continued to be exposed to Korean thereafter in about 30% of their daily interaction, the minimal advantage they exhibit over late L2 learners is strikingly small. For complete acquisition and maintenance of phonological sensitivity then, a certain threshold of input may be required. In fact, there may be even stricter requirements for the achievement of native-like competence: dominant input in the language may be necessary for some areas of linguistic competence. For those aspects of language, even if a bilingual is continuously exposed to two languages from an early age, if the input of one language is not dominant, he/she may not become native-like in that language. This would explain the results from previous Spanish-Catalan bilingual studies on Catalan /e/-/ɛ/ and the current heritage speaker performance on Korean /s/-/s\*/: early bilinguals develop a native-like competence only in their dominant language. In other words, for some linguistic features, continued input (Flege, 1995) alone may not be sufficient for maintenance of the L1; dominance must occur. Furthermore, the initially established L1 representation may be

restructured to accommodate the L2 if the L2 input is both early enough and sufficiently dominant.

This apparently significant role of language dominance indicates there may be a strong cross-linguistic interaction effect in early bilingualism: it may be that dominant language competence influences the development of the less-dominant language. In SLA, the initially-acquired L1 phonemic categories are argued to warp the perception of L2 speech sounds (Kuhl, 1991), but in the case of early bilinguals, as with those in the current study, language transfer may occur in the opposite direction, depending on which language is dominant. As Grosjean (1982) proposed, there might be a stronger L1 influence on the L2 of late bilinguals but a stronger L2 influence on the L1 of early bilinguals. Such interaction may appear more prominent where the two languages exhibit very similar but different linguistic representations, as is the case with Korean /s/-/s\*/ and its relationship to English /s/.

The finding that input dominance and some interaction effect may be significant for early bilinguals also poses an interesting question with respect to whether a bilingual can be truly native-like in both languages. If dominant - not just sufficient - input is a necessary condition for the achievement of truly native-like competence, it follows that bilinguals will always be non-native-like in some aspects in one or both of the languages they speak. As some researchers have claimed (e.g., Cook, 2003; Flege, 1999; Grosjean, 1998), there may be a tradeoff in trying to maintain complete linguistic competence in two languages. The speech perception experiments of this dissertation add one more piece of evidence that supports this hypothesis.

## Chapter 4. Translation priming:

### Acquisitional sequence vs. Language dominance in the bilingual mental lexicon

Real-time lexical processing is the focus of this chapter. Two translation priming tasks were constructed (Korean to English and English to Korean) to determine in what direction priming effects are found. By examining heritage speakers, an issue that has yet to be examined in current bilingual mental lexicon models (e.g., Kroll & Stewart, 1994) will be addressed: how acquisitional sequence and language dominance influence the organization of one's bilingual mental lexicon/s.

#### *4.1. Introduction*

Over the past years, much bilingual vocabulary processing research has concerned how the two lexicons are represented in the bilingual's mind. Recent development of the bilingual lexical model suggests that bilinguals have a conceptual store that is shared by both languages, although a separate lexical store is maintained for each language (Kroll & Stewart, 1994; Potter, So, Eckardt, & Feldman, 1984). Based on this model, great attention has been paid recently to the asymmetric nature of bilingual lexical links to the conceptual system: the L1 to concept link is strong and direct, whereas the L2 to concept link is weak and indirect (it is linked via the L1).

Despite the interest in this question, the exact source of the asymmetric nature is still unclear because previous studies have examined only bilinguals whose L1 is clearly stronger than their L2. In previous studies that examined adult L2 learners, the L1-to-

concept link may have become strong either because participants' L1 was acquired first (acquisitional sequence) or their L1 was a stronger language (language dominance). Therefore, the current experiment examines heritage speakers, whose L1 is the weaker of the two languages they speak. By doing so, it becomes possible to address whether acquisitional sequence or language dominance is responsible for the asymmetric development of the bilingual mental lexicon.

#### 4.1.1. Bilingual mental lexicon models

A central issue in the study of bilingual mental lexicons is how the two languages are represented in the mind and how they are related to each other. According to Potter et al (1984), two possibilities include concept mediation and word association. The *concept mediation hypothesis* states there is a single storage for concepts, and both the L1 and L2 are directly connected to that storage. Therefore, the translation from one language to another passes through the concept store. The *word association hypothesis*, on the other hand, states that L2 words are accessed only via their L1 translation equivalents. In effect, L2 words are subordinates of (lexically linked to) L1 words, which are associated to the concepts. A more recent model, the *revised hierarchical model* (RHM) by Kroll and Stewart (1994) includes both aspects of word association and concept mediation as shown in Figure 6.

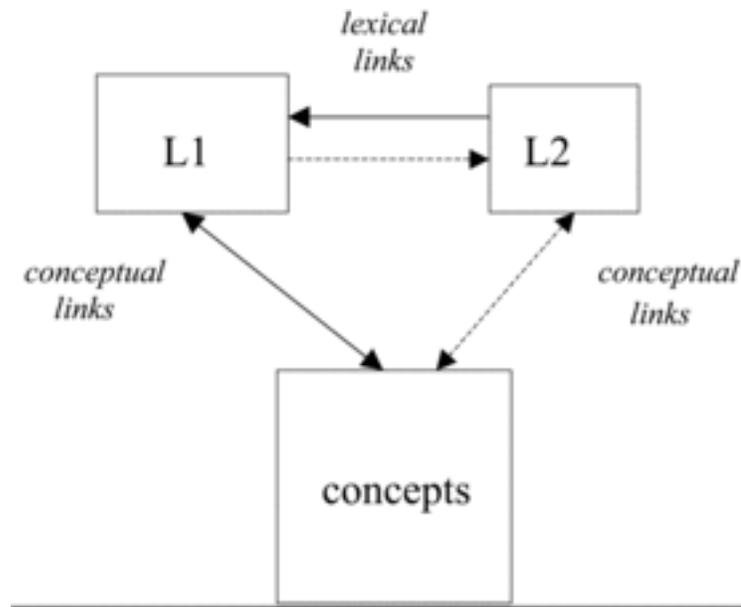


Figure 6. Revised Hierarchical Model (Kroll and Stewart, 1994)

Kroll and Stewart's RHM reflects the asymmetric nature of L1 and L2 mental lexicon both in terms of size (i.e.,  $L1 > L2$ ) and their connections to each other and to the concept of the word. L1 words are more strongly and directly connected to the concept, whereas L2 words are strongly linked to their L1 counterparts at the lexical level. A conceptual link from the L2 to the concept (i.e., concept mediation) as well as a lexical link from the L1 to the L2 (i.e., word association) also exists in the model, but the strength of the L2-to-concept connection is weaker.

Empirical support for RHM can be found in Kroll and Stewart (1994), which revealed that a category interference effect is asymmetric when bilinguals translate words. In other words, when bilinguals translate from their L1 to their L2, they take longer and are affected by how the words are categorized. On the other hand, when they translate words from their L2 to their L1, they perform faster and do not exhibit any

category-interference effect. Based on this finding, Kroll and Stewart suggested that the L1-to-L2 connection involves concept mediation, but the L2-to-L1 connection does not. The explanation given is that when translating from an L1 to an L2, the concept is automatically activated by the L1, so semantic information like category becomes relevant. However, L2-to-L1 translation may be achieved through a direct lexical link without concept mediation, so category information becomes irrelevant.

Kroll and Stewart's RHM is one of the widely discussed models of bilingual mental lexicon and the idea of an asymmetric link between the L1 and L2 lexicons and the conceptual system is appealing to many bilingual researchers.

#### 4.1.2. Directional asymmetry in cross-language priming

Over the past decade, the asymmetric nature of the bilingual mental lexicon has been investigated using a "priming" methodology. In a priming study, two words are presented back to back, and how much the first word (prime) influences the decision task involving the second word (target) is examined. A related prime generally facilitates lexical access to the target word, which is reflected by shorter response times and higher accuracy in the lexical decision of the target word.

In the cross-language priming literature, directional asymmetry in the size or the existence of a cross-language priming effect has been previously reported. Earlier unmasked priming studies found that a translation or semantic priming effect from L1 prime to L2 target is larger than for L2 prime to L1 target (e.g., Altarriba, 1992; Chen & Ng, 1989; de Groot & Nas, 1991; Grainger & Beauvillain, 1988; Keatley & de Gelder, 1992; Keatley, Spinks, & de Gelder, 1994; Williams, 1994). Furthermore, in masked

priming studies, where primes are presented too briefly (e.g., 50 ms) for participants to notice consciously, a priming effect has been obtained only for L1 prime to L2 target, not vice versa (e.g., Gollan, Forster, & Frost, 1997; Grainger & Frenck-Mestre, 1998; Jiang, 1999; Jiang & Forster, 2001; Williams, 1994). Given this robust directional asymmetry, a number of explanations have been proposed, including both representational and processing-based accounts. However, evidence from recent experiments seems to favor a representational account (e.g., Jiang, 1999)<sup>8</sup>. In other words, asymmetry may reflect that L1 lexicons are better established and more strongly connected to the rest of the mental representations, as suggested in the RHM.

According to the RHM, the masked priming effect obtained in the L1-L2 direction is the result of concept mediation, while the lack of a priming effect in the L2-L1 direction is due to the lack of concept mediation from the L2 to the L1. In other words, assuming that masked translation priming is sensitive only to conceptually mediated links between two languages, the lack of a priming effect from an L2 to an L1 should be due to the fact that L2 primes do not activate concepts because they are only lexically linked to L1s.

Jiang and Forster (2001) further claimed the L2-L1 link is episodic in nature because they found that the L2 to L2 within language priming effect is obtained in an episodic word recall task. Based on this, they proposed that L2 words are stored in episodic memory as an associate of an L1 whereas L1 words are stored in the lexical

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<sup>8</sup> In a series of experiments, Jiang (1999) showed that the lack of L2-to-L1 masked priming cannot be due to the difficulties of processing L2 prime: L2-to-L1 priming was not obtained even when L2 primes seem to be recognized, increased SOA for L2 prime was given, and general activation level was inflated. With all the processing accounts failing, it was concluded that representational accounts explain the directional priming asymmetry.

memory. Therefore, their explanation for the lack of a masked priming effect is because L1 and L2 words are stored in separate memory systems. Because the link from episodic memory to lexical memory is not automatic in nature, without the involvement of a higher-level control system, cross-module activation from the L2 in episodic memory to the L1 in lexical memory is not possible.

Setting aside the issue of whether the exact nature of L2-to-L1 connection is lexical or episodic, both RHM and Jiang and Forster's explanations share the intuition about the two different routes of cross-language connection.<sup>9</sup> The L1-to-L2 connection involves concept mediation, thus a priming effect is observed only in lexical decision tasks, whereas L2-to-L1 connection is not mediated by concepts but it involves rather shallow connections either at the lexical level or in the episodic memory system, thus priming effects are not observed.

To summarize, although the exact nature and locus of a masked cross-language priming effect is not entirely understood to this day, the general consensus in the field is

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<sup>9</sup> Aside from RHM and the dual memory account, one other account for the translation priming asymmetry exists, called the Sense Model (Finkbeiner, Forster, Nicol, & Nakamura, 2004). According to the Sense Model, the proportion of shared senses between prime and target words determines the priming effect, and translation priming asymmetry stems from the fact bilinguals are familiar with fewer senses associated with L2 words than with L1 words. Put another way, an L2-to-L1 priming effect is not obtained because bilinguals know fewer senses of L2 words than their L1 counterparts, so L2 primes do not provide sufficient activation of the L1 counterparts. On the other hand, when an L1 word is a prime, multiple senses effectively activate the L2 lexicon. Finkbeiner et al (2004)'s Sense Model has a limitation in that their sense asymmetry effect is found only in within language priming and has not been replicated in a translation priming study. In fact, Chi and Williams (2005) examined translation priming using only one-sense word pairs and still replicated previous translation priming asymmetry: L1-L2 direction showed a robust priming effect while no significant priming effect occurred in the L2-L1 direction. This finding contradicts the prediction of the Sense Model.

that the masked priming effect obtained in the L1-L2 direction is the result of concept mediation. In other words, this directional asymmetry in the masked priming paradigm can be argued to occur because the L1-to-L2 link is conceptually mediated whereas the L2-to-L1 link is not. Assuming that the masked priming effect evident in a lexical decision task is sensitive to the degree of concept mediation, an interesting question arises regarding the role of acquisitional sequences and language dominance in a bilingual's mental lexicon.

#### 4.1.3. Proficiency, dominance, and sequence of acquisition

If priming asymmetry indeed reflects the organization of a bilingual mental lexicon, a subsequent question would be why bilinguals develop an unbalanced connection between the two languages and the concept. One explanation, offered by Kroll & Stewart (1994), is that an L1 develops an initial and strong connection to the concept since L1 is acquired at the same time with the concept. Therefore, the language-to-concept connection should be direct and strong. On the other hand, L2 words are typically acquired after the semantic system and L1 lexical system are already established. Therefore, when learners learn L2 words, there is no need to develop a corresponding concept, so the word is understood through its L1 equivalent (Jiang and Forster, 2001). Kroll and Stewart (1994) also argued that level of proficiency is an important factor in determining the strength of the connection. The more proficient bilinguals become, the more heavily they rely on conceptual mediation between the L2 and the concept. This account implies that a bilingual who achieves a very high proficiency in an L2 may develop a fully conceptually mediated system, which means the previously reported

priming asymmetry may disappear. Furthermore, one could imagine the case where a later-learned language overrides the first language. In other words, when the first acquired language becomes weaker than the later-learned language, would the reported asymmetry reverse its direction?

A surprising gap in the cross-language priming literature exists in that very few studies have examined the cross-language priming effect with different learner populations. Although bilinguals can differ greatly on variables such as proficiency, language-learning history, and language dominance, these variables have not been examined systematically, nor do many studies provide enough information on participant language background or proficiency for subsequent analysis (see Altarriba & Basnight-Brown, 2007 for a related discussion).

Particularly, no study seems to have systematically examined the respective roles of acquisitional sequence and language dominance in cross-language priming. In fact, most of the previous studies examine L2 learners who started learning their L2 after puberty (e.g., Grainger & Frenck-Mestre, 1998; Jiang, 1999; Jiang & Forster, 2001; Williams, 1994). Since late L2 learners are notorious for their limited L2 development or fossilization (e.g., Long, 2003), it is not surprising that they all exhibited directional asymmetry.

Although there are a few studies on early L2 learners who accomplished near-native-like proficiency in their L2, their findings are far from clear. Gollan (1997) and Dudsic (1999), for example, claimed to have replicated priming asymmetry (i.e., only from L1 to L2) even with bilinguals who are highly proficient and were exposed to two languages since an early age. Gollan et al. (1997) examined Hebrew-English bilinguals

who were exposed to both languages from an early age, and found directional asymmetry from the dominant L1 to the less-dominant L2. Similarly, Dudsic (1999), in his examination of three native and two non-native Chinese-English bilinguals, found asymmetry between their L1 and L2 despite their high proficiency in both languages. Based on these results, the authors of both studies concluded that the masked priming effect is independent of proficiency (Gollan et al., 1997) and that the development of symmetrical conceptual mediation between the two languages may not be possible (Dudsic, 1999).

Contrasting results were obtained in a more recent study by Basnight-Brown and Altarriba (2007), who obtained a translation priming effect in both directions, L1-to-L2 and L2-to-L1. According to Basnight-Brown and Altarriba (2007), their Spanish-English bilinguals had very early ages of acquisition (before age 5) and they were highly proficient in each of their languages, with self-reported language background questionnaire indicating they speak their L2 English ( $M=9.3$ ,  $SD=1.4$ ) slightly better than their L1 Spanish ( $M=8.1$ ,  $SD=1.8$ ). Basnight-Brown and Altarriba thus claimed achievement of high proficiency can reverse the masked priming effect, and balanced bilinguals may be able to develop symmetrical conceptual mediation between the two languages.

Aside from the controversies in these findings, note also that these studies do not adequately address the fundamental question of the cause of priming asymmetry: whether acquisitional sequence or language dominance determines the direction. First, in Gollan et al. (1997) and Dudsic (1999), language dominance and acquisitional sequence coincided. The Hebrew-dominant speakers are the L1 speakers of Hebrew, and the

English-dominant speakers learned English first. Similarly, although the Chinese-English bilinguals in Dudsic (1999) are claimed to be well-balanced bilinguals, they seem to have been exposed mainly to Chinese during their early years, which suggests Chinese is likely to be their L1 and dominant language at the same time. In addition, none of these previous studies used materials selected specifically to test the sequence vs. dominance issue. Basnight-Brown and Altarriba's (2007), for example, used the word list from Altarriba (1992), which was prepared for typical bilingual participants, so it is not clear whether these participants learned the words in Spanish first or English first. One can imagine a situation where half of the primed words were learned first in Spanish and half of the primed words were learned first in English. Then the priming effect obtained in both directions may be simply the result of two asymmetric priming effects in each direction based on the first learned words. Furthermore, because they did not have a control group composed of late learners, it is not clear if the same task would have yielded no L2-L1 priming effect with the control group. Therefore, their results cannot be directly compared to the results obtained in the previous cross-language priming tasks, nor can the symmetric priming effect obtained in Basnight and Altarriba be considered evidence of "symmetry" in their participants' bilingual mental lexicon. Given such limitations, the current study aims to test the role of acquisitional sequence and language dominance in bilingual lexical representation by testing heritage speakers using methodologically more rigorous cross-language priming tasks.

#### 4.1.4. Heritage speakers: A case for sequence vs. dominance and methodological considerations

The unique profile of heritage language learners, as described in Chapter 1, provides an interesting case to examine lexical representations in bilingual development because the heritage language context dissociates early language exposure and language dominance. To that end, several questions emerge: can the initial link between an L1 (e.g., Korean) and the concept ever be overridden by a more developed L2 (e.g., English)? If so, would the directional asymmetry disappear, implying completely balanced links to the concept, or would the backward asymmetry from dominant L2 to less dominant L1 be observed?

In designing a masked translation priming experiment with heritage speakers, an important consideration is that heritage speakers often lag behind in literacy because they learn and use their heritage language mainly for oral communication. As a result, it was important in this study to recruit participants who were literate in Korean. Fortunately, this was not a problem because Hangul, the Korean script, is a phonemically based and most Korean heritage speakers are taught to how to read by their parents at home or in Saturday Korean language schools.

Even in cases where literacy is not an issue, lexical processing time in a visual priming experiment could be compromised due to low written proficiency in Korean. In a preliminary study to examine this possibility, a masked translation priming experiment was administered to twenty-four Korean heritage speakers and 24 Korean adult learners of English. Following typical masked priming experiment procedures, primes were presented for 50 ms and completely masked with forward and backward masks. The

heritage speakers were tested in both translation priming (K-E and E-K) and within-language priming (K-K/E-E) experiments at three-week intervals. The results replicated the directional asymmetry in the late ESL Korean speakers (K-E:  $p < 0.05$ , E-K: ns.) found in previous studies, but the heritage-speaker results turned out to be difficult to interpret because they showed no translation priming effect in either direction nor a within-language priming effect in the K-K condition. The only priming effect that approached significance was observed in the E-E priming condition ( $p = 0.052$ ).

The fact that heritage speakers did not show a priming effect in either direction could be potentially interesting, but it is difficult to interpret such results because priming was not obtained in the K-K condition either. Because no within-language priming was detected, it seems possible heritage speakers were not able to process the masked Korean prime words. If so, the lack of translation priming in the K-E condition simply could be because Korean heritage speakers did not have enough time to process the Korean prime, not because the Korean-to-concept link is weak in their mental lexicon. It appears that Korean heritage speakers, due to their limited literacy experience, need more time to process the prime word, such that the priming duration of 50 ms might be too short for them to recognize or process the masked Korean word. A longer prime duration (e.g. from 50 ms to 100 ms) and an increased SOA, but not so long that it could cause a strategic effect (Altarriba & Basnight-Brown, 2007) (e.g., from 150 ms to 200 ms) seems necessary to ensure the participants are able to process the prime even in the masked priming experiment. Therefore, in this study, a longer prime duration of 100 ms was employed in all experiments, and as a result, all participants reported having noticed the existence of prime words.

#### 4.1.5. Predictions

Table 6 displays four different priming conditions along with predictions for each participant group. Based on previous findings (e.g., Jiang 1999), a within-language priming effect should be detected in both languages by all participants, though there could be differences in the size of the effect (i.e., the L1 within-language priming effect is likely to be larger than the L2 within-language priming effect). Obtaining a priming effect in the L2-L2 condition will confirm that the L2 primes are indeed processed by participants.

With respect to cross-language priming, KorNSs and EngNSs should replicate the previous translation priming results by exhibiting a significant priming effect in the L1-L2 direction but not necessarily in the L2-L1 direction, i.e., KorNSs will exhibit a K-E priming effect but not an E-K priming effect, while EngNSs will exhibit E-K priming but not K-E priming. That said, it is possible that an L2-L1 priming effect will be detected in this study given that a longer priming duration of 100 ms will be employed as opposed to the more common 50-ms duration used in masked priming studies. In that case, the L2-L1 priming effect size is predicted to be considerably smaller than the effect obtained in the L1-L2 direction (e.g., Gollan et al., 1997).

Table 6. Experimental conditions and predictions

Priming direction Group		Cross-lg priming		Within-lg priming (Control)	
		K-E	E-K	K-K	E-E
ESL KorNSs		Yes	No (or smaller)	Yes	Yes
KSL EngNSs		No (or smaller)	Yes	Yes	Yes
Heritage speakers	Acquisitional Sequence (L1 Korean)	Yes	No (or smaller)	Yes	Yes
	Language Dominance (L2 English)	No (or smaller)	Yes	Yes	Yes

In terms of the heritage participants, they will behave more like Korean speakers if acquisitional sequence determines asymmetry, exhibiting a priming effect in the K-E direction but not in the E-K direction because they learned Korean first. However, if language dominance influences the asymmetric link between the L1 and L2 and the concept, heritage speakers will behave like English speakers, exhibiting a priming effect in the E-K direction but not in the K-E direction because they are more proficient in English.

#### 4.2. Methods

The current experiment employed a masked translation priming paradigm, but with an increased priming duration (100 ms) for the reasons explained earlier. In addition, the current study included extensive pre-test data collection to select words that are assumed to have been learned by participants in their less-dominant L1 (Korean) first. By using only words that were learned first in Korean, any priming effect detected can be interpreted as support for either sequence or dominance. If a priming effect is obtained in

the E-K direction, for example, it must be because heritage speakers are dominant in English, not because they learned these words first in English. ESL KorNSs and KSL EngNSs served as control groups to demonstrate that traditional directional asymmetry would be detected in the masked priming task with late bilinguals.

#### 4.2.1. Materials

Word characteristics considered important for this experiment include: 1) the words had to have been learned first in Korean; 2) they must have only one translation equivalent; 3) the participants should be familiar with the words. In order to develop appropriate materials, several stages of pre-test data collection took place. First, an initial word list comprising words likely to be known by heritage speakers at age 4 were created. The words in this list were collected from three different sources: high frequency words (log frequency above 2.7) from a Korean corpus (Sejong corpus, size: 1.5 million words); nouns from CHILDES corpus data from a Korean child (Jiwon, age: 2;0 ~ 2;3); and two Korean mothers whose children were 4 years old created lists of words that their children were familiar with through interaction with children's books and everyday objects. From these three methods, 513 words were derived.

This list was then converted into a questionnaire for three different Korean mothers whose children were heritage speakers. These children were born in the U.S. and had very similar profiles to the heritage participants of the current study. For each word in the list, the mothers were asked if their children understand and productively use the word (well-known; two points), comprehend the word (known; one point), or do not know the word at all (unknown). The three mothers' responses were combined and then the words

that scored at least five points out of six were selected. The three mother's estimates showed high concordance, with 50% of the words yielding the same responses from all three.

The revised list that contained 330 words was then tested for translation equivalents. Three late Korean-English bilinguals were first asked to translate the words into English. Only 210 words yielded the same English translation by all three informants. These 210 English words were given to three L2 learners of English, and the words were translated back into Korean. One-hundred-sixty-four translation pairs survived the translation equivalency test.

Finally, the 164 Korean word-pairs were converted into a familiarity questionnaire and administered to five heritage speakers not participating in the study but who have a similar linguistic profile. They rated their familiarity on a scale of 1 (very unfamiliar) to 7 (very familiar). Despite the varying self-reported proficiency, the heritage speakers seemed to be familiar with most of the words. In the end, 96 Korean words with a mean familiarity score of 6.8 out of 7 were included in the list. This final list has a mean frequency of 1.417 per million in Korean and 1.581 per million in English. In sum, these 98 K-E pairs appear to have been learned first in Korean, have only one translation equivalent, are familiar to most heritage speakers, and are considered high-frequency words.

Out of the 96 K-E pairs, 64 were used as translation pairs, and 32 Korean words were used for control primes. Thirty-two English control primes with a similar frequency and length as the English translation were also selected from the CELEX corpus. Finally, 32 Korean and 32 English non-words were included. The non-words matched the test

stimuli in word length and were all orthographically plausible. See Appendix 3 for the complete list of stimuli.

#### 4.2.2. Design

A 2 x 2 x 2 x 2 Latin Squares design was used, including the factors: priming task type (within language vs. translation), priming direction (L1-L2, L2-L2), prime-target relationship (translation, unrelated), and target lexicality (word, nonword).

Two translation priming experimental blocks, one in the K-E direction and the other in the E-K direction were constructed. In each experiment, two counterbalanced lists of items were constructed so that each target would appear only once in the presentation list. For example, there were two lists in the E-K direction block (i.e., EKa and EKb). In one list, the first 16 E-K word pairs were used as translation pairs, and the next 16 E-K word pairs were used as unrelated pairs by substituting the prime with 16 English control primes. In the other list, the second 16 words were used for the translation pairs, and the first 16 words were used as unrelated pairs. Each list also contained 32 non-word filler pairs that were composed of an English word prime and a Korean non-word target. The K-E direction block had the same design (see Table 7).

Table 7. Prime-target pair materials

Prime Direction	Korean-English (Prime-Target)		English-Korean (Prime-Target)	
Counter Balance	List a	List b	List a	List b
Translation (16 pairs)	Item 1~16 사과 (apple) – apple	17~32 새 (bird) – bird	33~48 Book – 책 (book)	49~64 Tree – 나무 (tree)
Control: Unrelated (16 pairs)	17-32 별 (star) – bird	1-16 돼지 (pig) – apple	49-64 mother – 나무 (tree)	33-48 land – 책 (book)
Filler	32 Non-word pairs		32 Non-word pairs	

To create within-language priming blocks, the prime-target pairs used in the translation priming task were converted to within-language pairs by translating the target into the same language as the prime (e.g., E-K became E-E). Therefore, two different lists were created in the within-language priming blocks just as in the translation blocks. The participants were then presented with one translation priming task and one within-language priming task, keeping the language of the target word constant (e.g., KEa and EEb). In this way, participants were given a lexical decision task in one language at a time in each of their two visits.

#### 4.2.3. Procedure

The latest version of E-prime (2.0) was used for material presentation as well as data collection and analysis. The experiment was blocked by the translation direction (K-E and E-K), where half of the participants were presented with K-E first and half were presented with E-K first. Items were presented in random order in each block. The test

instructions were written both in English and Korean and 10 practice items were presented at the beginning of each block.

Each trial included the presentation of a forward mask for 500 ms, a prime for 100 ms, a backward mask for 100 ms, and a target word in the middle of screen. Although primes should be visible with a prime presentation duration of 100 ms, in order to minimize prime visibility and reduce a potential strategic effect, primes were masked with forward and backward masks. For English primes, two lines of hash marks (#####) were used as a forward mask and XYXYXYX was used as a backward mask. For the Korean primes, upside-down Korean non-word characters (궁궁궁궁궁궁궁궁) were used as forward masks and the two lines of hash marks were used as the backward mask because such a combination was deemed to most effectively mask Korean words. Masks were large enough to cover both the prime and target words, and all stimuli were bold-faced except for the prime words, which were italicized.

Participants were instructed to press the “m” key with the right index finger if a word appeared on the screen and the “x” key with the left index finger if a non-word appeared. Participants were told to respond as accurately and quickly as possible. The target word remained on the screen until a response was given or for a maximum of 1,500 ms. Feedback was provided only for incorrect responses.

#### *4.3. Results*

Incorrectly translated words in the post-translation test were excluded from the data analysis. English word translation accuracy by KorNSs was 95.95%, and Korean word translation accuracy by EngNSs and Heritage speakers was 86.2% and 95.25%,

respectively. Only correct responses in lexical decision to the real word targets were analyzed for reaction time (RT) analysis. Because RTs across groups in different priming directions varied greatly (e.g., English speakers were a lot slower in the KK condition than in the EE condition), an outlier analysis of RTs was conducted using the statistical software JMP for each prime-target direction. Because the log RT distribution better fit a normal distribution than the raw RT data, outliers were identified and eliminated from the analysis based on the distribution of log RT data. In the EngNSs data in the KK condition, for example, the high outlier boundary was set at 3.338 (2177 ms) and the low outlier boundary at 2.569 (370 ms). On the other hand, in the EE condition, all log RTs above 3.089 (1227 ms) or below 2.47 (300 ms) were excluded. The low outlier boundary was set at 2.56 (270.4 ms) in the KK condition, and the EE and the high boundary at about 6.9 (992 ms).

Accounting for errors in translation and lexical decision as well as RT outlier trimming, 19.41% of all data were excluded for the EngNS group, 10.94% for the KorNSs, and 11.08% for the heritage speakers.

#### 4.3.1. Within-language priming results

Descriptive statistics of the RTs and error rates of the within-language experiments (E-E and K-K) are presented in Table 8.

Table 8. Response times (ms) and error rates (% in parentheses) in within-language priming condition as a function of language and prime-target relationship by each group

Language	Prime-Target Relation	EngNS	Heritage	KorNS
E-E	Repetition	578 (0.98)	516 (0.65)	629 (1.85)
	Unrelated	640 (2.73)	590 (1.56)	700 (3.31)
	Priming	63 **	74 **	71 **
K-K	Repetition	906 (3.36)	892 (4.89)	486 (1.38)
	Unrelated	998 (4.10)	958 (4.64)	554 (2.54)
	Priming	92 *	66 *	68 **

\* : priming effect statistically significant at  $p < 0.05$ ;

\*\* : priming effect is statistically significant at  $p < 0.01$

As shown, all participant groups showed statistically significant within-language priming effects in both English and Korean pairs, responding faster when the target was a repetition of the prime than when the prime and target were unrelated. In addition, a language effect was found in that Korean and EngNSs exhibited longer RTs and higher error rates in their respective L2s than in their L1s. Heritage speakers, like English speakers, exhibited higher error rates and longer RTs in their less dominant language, Korean.

To confirm such observations statistically, RTs were fit to a general linear mixed-effects model with language and prime-target relation as fixed effects and participants and items as random effects. For each group, results exhibited a significant fixed effect for language (EngNS:  $F(1,105.6)=375.17$ ,  $p < 0.01$ ; Heritage:  $F(1,118.2)=572.27$ ,  $p < 0.01$ ) KorNS:  $F(1,107.7)=189.16$ ,  $p < 0.001$ ), which indicates participants were significantly faster when responding to their native or dominant language than their L2 or less dominant language. A main fixed effect for prime-target relationship was also obtained (EngNS:  $F(1,103.4)=16.67$ ,  $p < 0.01$ ; Heritage:  $F(1,115)=19.61$ ,  $p < 0.001$ ; KorNS:  $F(1,106)=45.20$ ,  $p < 0.001$ ), suggesting participants were faster when responding to

repetitive pairs than unrelated pairs of prime and targets. However, no interaction between language and prime-target relationship was found (EngNS:  $F(1,103.4)=0.49$ ,  $p=0.48$ ; Heritage:  $F(1,115.1)=0.01$ ,  $p=0.93$ ; KorNS:  $F(1,106)=0.18$ ,  $p<0.67$ ). This indicates the priming effect was equally strong regardless of language (i.e., E-E and K-K conditions).

Separate analyses of the priming effect in each language condition by each group were then conducted, and all yielded statistically significant fixed effects for prime-target relationship. As shown in Table 8, all groups exhibited a significant priming effect in their native/dominant languages at  $p<0.01$  level (EngNS EE:  $F(1,61.7)=43.36$ ,  $p<0.01$ ; Heritage EE:  $F(1, 59.08)=138.91$ ,  $p<0.01$ ; KorNS KK:  $F(1,61.46)=113.20$ ,  $p<0.01$ ). In addition, both EngNSs and heritage speakers exhibited a significant priming effect in the KK condition (EngNS KK:  $F(1,54.64)=5.23$ ,  $p=0.026$ ; Heritage KK:  $F(1, 58.59)=6.12$ ,  $p=0.016$ ). Finally, Korean speakers exhibited a significant priming effect in their L2, in the EE condition:  $F(1,59.91)=8.22$ ,  $p<0.01$ .

In sum, the results indicate participants responded faster and more accurately when the prime and the target were identical than when they were unrelated. This priming effect was found across all language and participant group combinations in the within-language priming experiments. These results ensure that not only L1 but also L2 primes have been recognized and processed by participants when masked primes were presented for 100 ms as they were in the current study.

#### 4.3.2. Cross-language priming results

Descriptive statistics of the RTs and error rates in the cross-language experiments

(E-K and K-E) are presented in Table 9.

Table 9. Response times (ms) and error rates (% in parentheses) in cross-language priming condition as a function of priming direction and prime-target relationship by each group

Priming Direction	Prime-Target Relation	EngNS	Heritage	KorNS
E-K	Translation	847 (3.39)	834 (4.04)	540 (0.20)
	Unrelated	1094 (14.66)	1031 (10.72)	564 (1.76)
	Priming	247**	197**	24**
K-E	Translation	662 (1.56)	573 (0.91)	630 (1.81)
	Unrelated	644 (1.95)	587 (1.30)	717 (5.18)
	Priming	-18	14*	87**

\* : priming effect statistically significant at  $p < 0.05$ ;

\*\* : priming effect is statistically significant at  $p < 0.01$

As shown, EngNSs exhibited directional asymmetry in cross-language priming. More specifically, they exhibited a large cross-language priming effect from their L1 English to L2 Korean (247ms) but failed to show a priming effect from their L2-to-L1 (-18ms). Heritage speakers showed a large priming effect in the direction of dominant English to less dominant Korean (197ms). In addition, heritage speakers also exhibited a small but significant priming effect in the K-E direction (14ms). Finally, KorNSs showed a significant priming effect in both directions, K-E and E-K, although the prime effect from their L1-to-L2 (84ms) is larger than the reverse (24ms).

RTs were fit to a general linear mixed-effects model with priming direction and prime-target relationship the fixed effects and participants and items the random effects. For each group, results exhibited a significant fixed effect for priming direction (EngNS:

$F(1,114.9)=288.55, p<0.01$ ; Heritage:  $F(1,121.6)=401.61, p<0.01$ ; KorNS:  $F(1,120.2)=161.00, p<0.01$ ), which indicates participants were significantly faster when responding in the L1-to-L2 direction, or in the case of the heritage speakers, their dominant to less-dominant language direction. A main fixed effect for prime-target relationship was also obtained (EngNS:  $F(1,110.8)=43.70, p<0.01$ ; Heritage:  $F(1,120.1)=38.78, p<0.01$ ; KorNS:  $F(1,116.1)=34.66, p<0.01$ ), suggesting participants were faster when responding to translated pairs than unrelated pairs of prime and targets. Finally, a significant interaction between priming direction and prime-target was also found (EngNS:  $F(1,110.7)=54.52, p<0.01$ ; Heritage:  $F(1,120.1)=27.70, p<0.01$ ; KorNS:  $F(1,116.2)=10.58, p<0.01$ ). This indicates the magnitude of the priming effect was significantly greater in one direction (e.g., L1-to-L2) than the other (e.g., L2-to-L1).

Separate analyses of the priming effect in each language condition by each group were also conducted. As shown in Table 9, English speakers showed a statistically significant priming effect in the E-K direction,  $F(1,56.84)=58.87, p<0.01$ , but not in the K-E direction,  $F(1,60.05)=1.84, p=0.18$ . Heritage speakers showed a statistically significant priming effect in the E-K direction,  $F(1,60.24)=34.89, p<0.01$ , and the K-E direction,  $F(1,60.22)=4.68, p<0.05$ . Finally, the KorNS group results exhibited a statistically significant priming effect in both directions (E-K:  $F(1,59.91)=8.22, p<0.01$ ; K-E:  $F(1,59.36)=27.44, p<0.01$ ).

Given the priming effect obtained in both priming directions by KorNSs and the heritage speakers, the size of the priming effect was compared across directions to examine for each group whether there is a significant difference in the magnitude of the priming effect depending on the priming direction. The priming effect size of each

individual in each priming direction was first calculated by subtracting the mean RT of the translated prime-target condition from the unrelated prime-target condition.

Individual priming effect sizes were then fit to a general fixed-effects model with priming direction the fixed effect and participants as the random effect. Results exhibited a significant fixed effect of priming direction (Heritage:  $F(1,47.85)=104.71$ ,  $p<0.01$ ; KorNSs:  $F(1,31.7)=24.39$ ,  $p<0.01$ ), indicating there was directional asymmetry found in the priming effect sizes. KorNSs yielded a significantly greater priming effect in the K-E direction (87ms) than in E-K direction (24ms), while heritage speakers exhibited a greater priming effect in the E-K direction (197ms) than in the K-E direction (14ms).

Figure 7 illustrates the effect sizes of the priming effect in each priming direction by each participant group. Due to the significant variation in RTs obtained across the different conditions, priming effect sizes were deemed to be more appropriate than raw RT differences as a means of comparing priming effect size across conditions and participant groups.

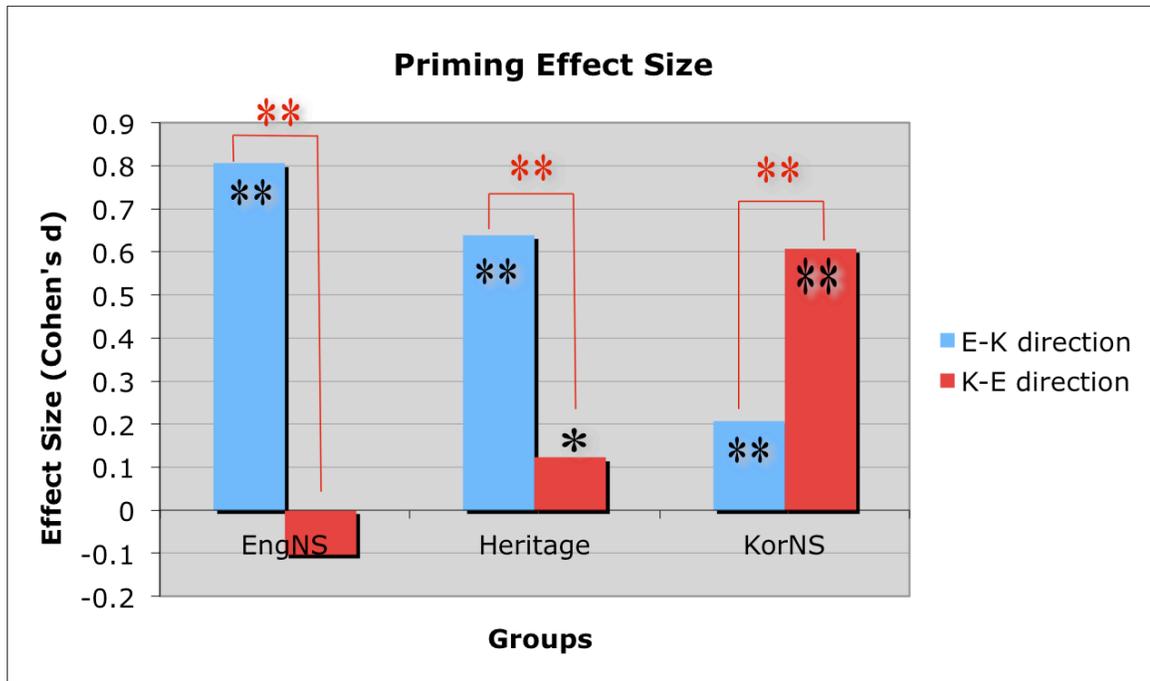


Figure 7. Priming effect size as reflected by Cohen's d in cross-language priming experiments as a function of priming direction and participant group

\* : priming effect statistically significant at  $p < 0.05$ ;

\*\* : priming effect is statistically significant at  $p < 0.01$

In sum, the results of this study replicate the directional asymmetry in cross-language priming found in previous studies (e.g., Gollan et al, 1997; Jiang, 1999, among others). L2-to-L1 priming was either not found or statistically significantly smaller than the L1-to-L2 priming effect, as shown for the EngNS and KorNS groups. Heritage speakers showed directional asymmetry according to their language dominance, not acquisitional sequence, exhibiting a similar pattern of directional asymmetry to the EngNSs. This being said, heritage speakers were different from EngNSs in that they demonstrated a priming effect in the K-E direction, which suggests they may have some advantage over late bilinguals in their heritage language lexical access.

#### 4.4. Section discussion: Early bilinguals' mental lexicon

The current translation priming experiments replicate previous findings regarding the directional asymmetry of the priming effect observed among adult L2 learners. First, KSL EngNSs showed a translation priming effect only from L1-to-L2, as in Jiang (1999) and Jiang & Forster (2001), where a masked translation priming effect was detected only from L1 prime to L2 target but not from L2 prime to L1 target. In addition, results from ESL KorNS also exhibited a greater L1-L2 priming effect than L2-L1 priming effect,<sup>10</sup> results that replicate the findings of Jin (1990) and Keatley & de Gelder (1992).

According to the RHM, these results reflect the organization of the bilingual mental lexicon: for bilinguals, L1 words are more directly associated with their concepts, so L1 prime words automatically activate the commensurate concept, whereas L2 words may not. Assuming L2 words do not activate concepts in a substantial way, an L2-to-L1 priming effect is expected to be small or non-existent.

The important finding then is that the Korean heritage speakers of this study, who learned the words in the current experiments in Korean first, actually exhibited priming asymmetry in the opposite direction of what is expected: they exhibited a significantly larger translation priming effect from L2 English to L1 Korean than from L1 Korean to L2 English. In fact, it appears the current study is the first to reveal such backward asymmetry ( $L2-L1 > L1-L2$ ) in the translation priming literature, including studies that examined early bilinguals. Recall that Gollan et al (1997)'s masked priming study on Hebrew-English bilinguals, who were early learners of both languages, detected only an

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<sup>10</sup> Given that the current study employed an increased prime duration (100 ms) compared to Jiang (1999) and Jiang and Forster (2001), which used prime duration of 50 ms, it is not surprising KorNSs showed a priming effect from L2-to-L1 as well. The asymmetry in this case is detected as the difference in priming effect size.

L1-L2 priming effect. Similarly, Dudsic (1999)'s study on Chinese-English bilinguals, who were also early learners and highly balanced bilinguals, also exhibited an L1-L2 priming effect only. However, as discussed, an alternative explanation exists for the findings of these two studies: the effect of language dominance. Although the participants of Gollan et al (1997) and Dudsic (1999) were highly proficient in both languages, their L1 remained dominant, so the asymmetry found could be because the participants were more proficient/dominant in their L1 rather than because they learned their L1 first. In the current study, Korean heritage speakers were more dominant in their L2, so if it is the case dominant the language develops a stronger connection to the concept than the earlier learned language, it is not surprising these heritage speaker participants exhibited only an L2-L1 priming effect.

The current finding on Korean heritage speakers is also different from Basnight-Brown and Altarriba (2007), who found a symmetric priming effect in their examination of early Spanish-English bilinguals. Although their participant profiles were closest to the current participants in that their participants learned Spanish first but became more dominant in English later,<sup>11</sup> they found no priming asymmetry: Instead, they found an equally strong translation priming in both directions. Given this, they made a similar claim to the current study: they suggested that language dominance may also play an important role in the strength of connection between lexicon and the conceptual system. However, as noted earlier, the significance of their findings is limited because of limitations in the design of their study. Specifically, because the words used in their study were not selected carefully to dissociate the role of acquisitional sequence and language

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<sup>11</sup> In addition, they used the same prime duration (100 ms) as the current study, although they did not use the backward mask and the SOA was only 100 ms.

dominance, it is possible that half of the primed words were learned in Spanish first and half of the primed words were learned in English first. If indeed this is the case, their results can still be interpreted to support the role of acquisitional sequence rather than language dominance. Furthermore, because they did not have a control group of late L2 learners, it is difficult to determine whether the symmetric priming effect detected in the results is unique to their early Spanish-English bilinguals or merely an artifact of the experimental design.

Unlike Basnight-Brown and Altarriba (2007), the current experiments provide unambiguous evidence that support the role of language dominance over acquisitional sequence. All words used in the current study were likely to have been learned first in Korean by the heritage speakers. Nevertheless, they exhibited a stronger priming effect from L2 English to L1 Korean. Furthermore, these heritage speaker results contrast the results from late L2 learner groups, which exhibit traditional priming asymmetry ( $L1 > L2$ ). Therefore, the current findings suggest that in the bilingual mental lexicon, the initial strength of connection between the two lexicons and the conceptual system can be revised as language dominance changes.

Such findings make an important contribution to bilingual mental lexicon models like the RHM. This model, which effectively explains the translation priming asymmetry of late bilinguals found in previous studies, now must explain the role of language dominance in the bilingual mental lexicon. As shown, bilinguals can shift their dominant language, and this shift appears to be able to cause a shift in the strength of the link between the bilingual lexicons and the concept depicted in the RHM. Therefore, what

was explained as the contrast between L1 and L2 in RHM would now have to be revised to the contrast between the dominant language and weaker language as shown in Figure 8.

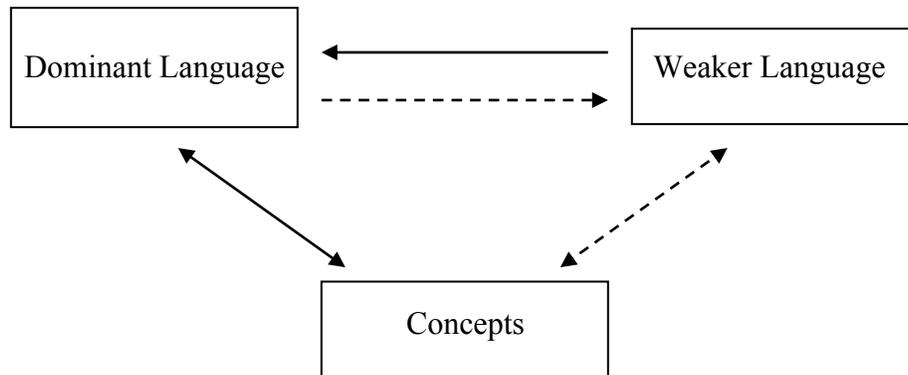


Figure 8. The Re-revised Hierarchical Model

The revisions made to the RHM in Figure 8 (i.e., dominant language in place of L1; weaker language in place of L2) highlight the finding that it is not acquisitional sequence but language dominance that leads to architectural asymmetry in the bilingual mental lexicon.

That said, the current results also suggest there may be some advantage of the earlier-acquired language in terms of its strength of connection to the concept. Note that the heritage speakers of the current study exhibited a priming effect from Korean to English, although the effect was small. This contrasts with the results of the proficiency-matched EngNSs who learned Korean later in life, in that a Korean-to-English priming effect was not detected. Therefore, it seems possible that if a language is learned early in life, it may more readily activate the concept than a later-learned language even if it experiences a significant reduction of activation due to a lack of use.

Alternatively, heritage speakers may have maintained some remnants of the direct connection between Korean and the concept through rare but continuous use of the words. In other words, it is possible that for early bilinguals, both languages may be connected to the conceptual system but the activation strength is determined by the frequency of the use of the routes. On the other hand, in the case of KSL EngNSs, the direct connection between their L2 and the concept may not have developed at all. As the RHM suggests, their L2 Korean words may only be lexically linked to their L1 English counterparts. Figure 9 shows two different scenarios for the bilingual mental lexicon model, one for early bilinguals and the other for late bilinguals.

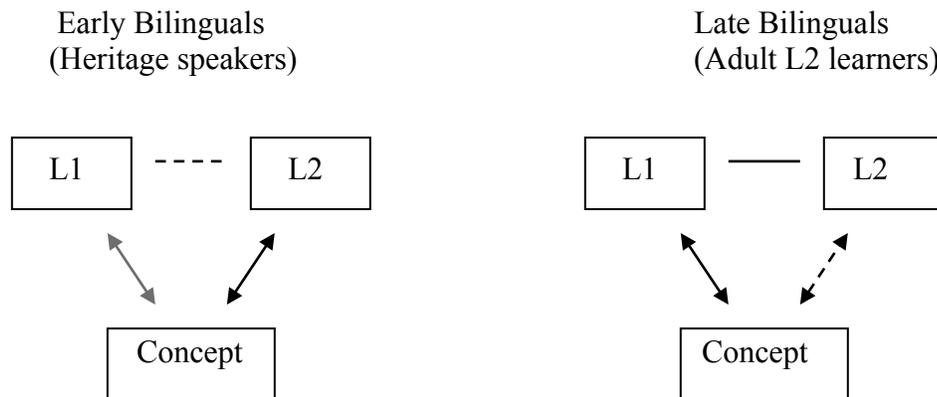


Figure 9. A suggestion for early vs. late bilingual mental lexicons

The two models depicted in Figure 9 highlight the differences in bilingual mental lexicon depending on the age of acquisition. In the case of early bilinguals, the lexical link between the L1 and L2 (shown as a dotted line in Figure 9) are likely to be very weak or non-existent. Because the L2 is introduced before the L1 lexicon is completely

solidified, L2 words may not necessarily rely on L1 words to be understood/acquired. In fact, many researchers in the field of bilingualism claim that even children exposed to two languages simultaneously when young develop two independent language systems from the outset (DeHouwer, 1990; Genesee, 1989; Genesee & Paradis, 1999; Genesee, Boivin, & Nicoladis, 1996; Meisel, 1994). Therefore, it seems plausible both languages of early bilinguals develop direct connections to the concept in the mental lexicon as well. Despite the dual links to the concept, for a particular type of early bilinguals like heritage speakers, the link between L1 lexicon (a grayed-out arrow in Figure 9) and concept may have become weaker than the link between L2 lexicon and concept because their L1 exposure was reduced over the years and their L2 became their more dominant language. The low frequency of the L1-to-concept link activation is likely to have weakened the L1-to-concept link (see the faded line in Figure 8), so access to concept via the L1 may have become more difficult in the case of heritage speakers.

The same is not true for late bilinguals because they learn their L2 later in life, after the L1 system is completely established. As a result, the L2-to-L1 lexical links they develop are strong. It is therefore an empirical question whether the L2-to-concept link will ever become strong in late bilinguals. Considering how difficult it is to find very highly proficient bilinguals among late starters, it seems likely it is very difficult for adult L2 learners to develop a direct/strong connection between their L2 lexicon and the concept.

To conclude, the findings of this study raise important methodological and theoretical issues regarding the study of the bilingual mental lexicon. Various types of bilinguals beyond the typical foreign language learners need to be examined to

understand the nature of the bilingual mental lexicon. Furthermore, the current models of bilingual memory need to become more dynamic in nature (Altarriba, 2003; Basnight-Brown & Altarriba, 2007) if they are to explain data such as the backward asymmetry found in the current study. As discussed in Chapter 1, when given a fluctuation in the amount and quality of exposure, early bilinguals' proficiency in each language often waxes and wanes (Grosjean, 2008). In this era of globalization and cross-cultural and linguistic blending, the diversity among the bilingual population is ever-increasing. Although the field of SLA has steadily expanded its scope of inquiry to various populations over the past decade, little attention has yet been paid to the different learner populations among researchers investigating the bilingual mental lexicon. As shown in the current chapter, this limited range of learner populations may constitute a significant limitation in understanding of the architecture of bilingual mental lexicon. Any valid models of the bilingual mental lexicon must be able to explain the dynamic nature of bilingual competence as in the population examined in the current study.

## Chapter 5. Locative alternation:

### Cross-linguistic interaction and learnability resolution

In this chapter, participants' knowledge of grammatical constraints in both English and Korean are examined using two grammaticality judgment tasks. The Locative alternation was selected as the target structure to examine because it creates a learnability problem in both Korean and English. This grammatical acceptability experiment aims to examine 1) whether heritage speakers can resolve the learnability problem in either language, and 2) if so, what role early experience and cross-linguistic interaction have on resolution of the learnability problem.

#### *5.1. Introduction*

In both L1 and L2 acquisition, much attention has been drawn to the acquisition of locative verbs, in particular to the complex relationship between a verb's meaning and the structures it takes. When learning an L1, a child needs to identify exactly what events the verb refers to while also learning to associate these verbs with their syntactic possibilities. Importantly, because mapping between meaning and syntactic frame is complex and not always transparent for locative verbs (Levin, 1993; Pinker, 1989), children need to learn the appropriate mapping rule by generalizing but not over-generalizing. In monolingual L1 acquisition, it is clear children somehow eventually overcome the difficulty of learning what is possible and not possible in a language by retreating from overgeneralization (i.e., *the learnability problem*, Pinker, 1989). On the

other hand, in L2 acquisition, retreating from the overgeneralization seems to cause a more persistent problem, resulting in varied individual outcomes.

This chapter attempts to address two factors that contribute to the contrast between uniform success of L1 learnability resolution and the varied outcome of L2 acquisition. The cross-linguistic differences between English and Korean will be first reviewed, and the bidirectional learnability problem that arises for Korean-English bilinguals will be demonstrated. It will then be argued that examining early bilinguals like Korean heritage speakers can provide unique insight into the problem by controlling for age and by testing whether cross-linguistic interaction causes a (persistent) learnability problem even for early bilinguals (e.g., Yip & Matthews, 2007).

#### 5.1.1. Locative alternation

Locative verbs (e.g., *fill*, *pile*, *pour*, *paint*) encode the relationship between a moving object (*Figure*) and a location object (*Ground*). Depending on the verb, either the Figure or the Ground can become the direct object of a locative verb. In other words, locative verbs take both Figure and Ground objects, and locative verbs fall into different syntactic sub-classes depending on what kind of locative structures they take (Pinker, 1989). Below are some examples:

- |     |                                     |              |
|-----|-------------------------------------|--------------|
| (1) | a. John poured water into the cup.  | Figure frame |
|     | b. *John poured the cup with water. | Ground frame |

- (2)      a. \*John filled water into the glass.      Figure frame  
             b. John filled the glass with water.      Ground frame
- (3)      a. John sprayed water onto the wall.      Figure frame  
             b. John sprayed the wall with water.      Ground frame

As shown in (1), some locative verbs in English (e.g., *pour*) allow only the Figure frame, where the Figure object is placed in the direct object position and the Ground object is encoded as an indirect object in the prepositional phrase (PP). Verbs like *dribble*, *spill*, *ladle*, *hang*, and *stick* take the same syntactic frame as *pour*. (2) shows that verbs like *fill* occur only in the Ground frame, where the Ground object is the direct object and the Figure object is the indirect object. Verbs like *cover*, *decorate*, *bandage*, and *soak* belong to this category. Finally, (3) illustrates the pattern for other verbs, like *spray*, *pile*, *paint*, *stuff*, and *load*, all of which can take both Figure and Ground frames.

Given the seemingly arbitrary mapping between locative verbs and their syntactic frame, a question that arises is how children determine which verbs take which syntactic structure. In other words, how do children know (1a) and (2b) are possible but not (1b) and (2a)? In particular, once children learn from (3) that some locative verbs can occur in both Figure and Ground frames, how can they learn not to overgeneralize the rule to verbs like those in (1) and (2) without being explicitly taught that sentences like (1b) and (2a) are impossible in English? Such questions of predicted learning difficulty have drawn a great amount of attention in both the L1 and L2 acquisition literature, often under the terminological umbrella of “learnability.”

### 5.1.2. Learnability paradox

According to Baker (1979), the “learnability problem” occurs when a learner has to learn what is not possible in a language, or more specifically, when a learner has to retreat from an overgeneralized grammar. Because negative evidence (e.g., learners are told that “*John filled water into the cup*” is not possible) has been documented to be absent, unreliable, unused, or at best, insufficient for language acquisition (e.g., Braine, 1971; Brown & Hanlon, 1970; Grimshaw & Pinker, 1989; Gordon, 1990; Maratsos, 1976; Morgan & Travis, 1989), it is unclear how a learner develops knowledge of what is not possible in a language.

To resolve the learnability problem, Baker suggested the idea of a conservative learner: children simply learn the possible syntactic frames of a verb only when they actually observe the verb with that structure in the input. If children are not productive but conservative by producing syntactic frames they hear for each verb, they would never overgeneralize to begin with. Therefore, a verb like *fill* will be produced in ground structure only and will never be incorrectly produced in the figure structure at any point. In addition, a locative verb would be identified as an alternating verb (e.g., *pour*) only after they hear positive evidence in both frames. This learning principle, called the Subset Principle (Berwick, 1985; Manzini & Wexler, 1987), states that a learner adopts the smallest possible grammar that is compatible with input at each stage of the learning procedure.

However, evidence from the L1 acquisition literature suggests that a strict form of conservatism cannot be true: children have been empirically shown not to be conservative when learning syntactic frames. According to Bowerman (1982) and Gropen, Pinker, and

Hollander (1991), for example, children at around age 4 or 5 produce ungrammatical sentences like “\**I filled the water into the glass*” or “\**I am going to cover a screen over me*” in both spontaneous speech and in elicited production tasks. In other words, children seem to be liberal learners: they generalize the use of syntactic frames beyond the input they are provided. If children are indeed liberal learners when it comes to the acquisition of locative alternation rules, the learnability problem becomes a paradox (Pinker, 1989). Given that children are productive learners making overgeneralization errors and do not rely on negative evidence, how do children retreat from an overgeneralized grammar in the absence of negative grammar? This seemingly impossible “unlearning” is obviously occurring, however, because every normally developing child ends up achieving adult-like knowledge of locative alternation rules. Therefore, it is a mystery how children overcome the learnability problem. Over the past several years, this learnability paradox has been one of the most popular topics of study in both L1 and L2 language acquisition.

### 5.1.3. Proposals for solving the learnability paradox

To date, the most widely accepted proposal for this learnability paradox is based on the idea that children may be able to take advantage of a complex but consistent syntax-semantics correspondence. According to Pinker (1984; 1989), there is a rather consistent syntax-semantics mapping for locative verbs: verbs taking only the Figure frame such as *pour*, *dribble*, *spill*, *label*, *hang*, and *stick* all share a core semantic meaning of describing manner-of-motion while verbs like *fill*, *cover*, *decorate*, *bandage*, and *soak* all semantically describe the change of state of a Ground object and thus take only the Ground frame.

The alternating locative verbs in (3b) are divided into two sub-classes. Verbs like *spray* and *pile* denote manner-of-motion as basic meaning components, whereas verbs like *stuff* and *load* take change-of-state as their basic meaning. Syntactically, *spray* and *pile* are called Figure-alternating verbs because they take Figure objects as obligatory elements while Ground PP are optional, as in (4). On the other hand, verbs of the latter subclass (e.g., *stuff*, *load*) are called Ground-Alternating verbs because Ground objects are obligatory (5).<sup>12</sup>

- |     |                                           |                    |
|-----|-------------------------------------------|--------------------|
| (4) | a. John piled books onto the shelves.     | Figure frame       |
|     | b. John piled books.                      | Figure object only |
|     | c. John piled the shelves with books.     | Ground frame       |
|     | d. *John piled the shelves.               | Ground object only |
|     |                                           |                    |
| (5) | a. John stuffed feathers into the pillow. | Figure frame       |
|     | b. *John stuffed feathers.                | Figure object only |
|     | c. John stuffed the pillow with feathers. | Ground frame       |
|     | d. John stuffed the pillow.               | Ground object only |

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<sup>12</sup> Wasow (1977) and Levin and Rappaport (1986) exhibit other verb classes based on adjectival passivization. Only Ground objects can become a subject of adjectival passives in Ground-alternating verbs (e.g., *the stuffed pillow*; *\*the stuffed feather*), whereas only Figure objects can become a subject of adjectival passives in Figure-alternating verbs (e.g., *the piled books*; *the piled shelves*).

Taken together, a general syntax-semantics correspondence is found here: locative verbs that specify manner of motion are Figure frame verbs, while locative verbs that specify change of state are Ground frame verbs (6).

- (6)      a. Manner-of-motion meaning – V NP<sub>Figure</sub> PP<sub>Ground</sub>  
          b. Change-of-state meaning – V NP<sub>Ground</sub> PP<sub>Figure</sub>

The idea is that if children know the correspondence in (6), learning locative verbs' meaning and syntax will become much easier. With this knowledge, if children learn either the meaning of a verb or its syntax from the linguistic input, the linking rule will guide them to the knowledge of both. According to Pinker (1984; 1989) and Gleitman (1990), this linking rule is presumably a language universal and innate, so any child learning a language should be able to take advantage of the rule.

Although the supposition that children may be able to make use of the general relationship between the semantics and syntax of locative verbs should certainly help learning, the challenges that learners face remain robust nevertheless. This is because semantic-syntax mapping is far from transparent and not completely consistent across languages.

To explain why some verbs alternate while others do not, Pinker (1989) hypothesizes two types of lexical rules, broad-range rules and narrow-range rules. While the broad-range rule stated in (6) is a transformational rule that applies to all locative verbs, narrow-range rules apply to only a subset of locative verbs that share certain semantic features. In English, for example, a narrow-range rule applies to verbs that

describe motions in which a mass moves via the force of gravity, such as *drip*, *dribble*, *spill*, making them non-alternating Figure-frame verbs. On the other hand, verbs that describe a motion in which a mass is forced into a container against the limits of its capacity (e.g., *stuff*, *pack*, and *jam*) can alternate between both Figure and Ground structures. Therefore, even with universal broad-range rules available, the child would have to learn the specific lexico-semantic properties of individual verbs, somehow extracting relevant semantic features and forming narrow-class categories that are linked to the syntactic frame in which the verbs are used. In other words, innate knowledge of the universal-linking rule would be helpful only after the child discovers either a verb's meaning or syntax.

Recent work by Ambridge and his colleagues (e.g., Ambridge, Pine, Rowland, Jones, & Clark, 2009; Ambridge, Pine, Rowland, & Young, 2008) suggests children acquire the meaning of particular constructions and verbs in an incremental and probabilistic fashion, and restriction of generalization happens when an incompatibility between the meaning of constructions and the meaning of verbs becomes too great. In particular, Ambridge et al (2009) claims that statistical learning operates on verb semantics and not on individual verbs. Such a proposal recognizes the role of statistical learning based on parental input, but at the same time highlights that the knowledge of verb semantics and its linking rule to syntax as the one stated in (6) provides necessary hypothesis space where statistical learning can operate.

All this being said, exactly how children learn to arrive at the exact semantics of verbs and semantic verb classes from the early overgeneralization is still in large part a

mystery. Furthermore, and to make the matters more complicated, cross-linguistic variation is found in locative alternation linking rules, as discussed in the next section,

#### 5.1.4. Cross-linguistic variation

As mentioned, there is cross-linguistic variation in locative alternation. As an example, consider the syntax of the Korean verb “*chaywuta*,” an equivalent of the English verb *fill*:

- (7) a. Younghee-ka mwul-ul khep-ey chaywu-ess-ta.  
Younghee-Nom water-Acc cup-Loc fill-Past-Decl  
“Younghee filled the water into the cup.”
- b. Younghee-ka khep-ul mwul-lo chaywu-ess-ta.  
Younghee-Nom cup-Acc water-with fill-Past-Decl.  
“Younghee filled the cup with water.”
- (8) a. Younghee-ka chayk-ul chayksang-ey ssah-ass-ta.  
Younghee-Nom book-Acc desk-Loc pile-Past-Decl  
“Younghee piled books on the desk,”
- b. \*Younghee-ka chayksang-ul chayk-ulo ssah-ass-ta.  
Younghee-Nom table-Acc book-with pile-Past-Decl  
“Younghee piled the table with books”

As shown in (7), even though change-of-state verbs like *fill* can be used only in the Ground frame in English, its Korean counterpart (*chaywuta*) allows both Ground and Figure frames. Furthermore, verbs like *ssashta* (*pile*) in (8), which allow both Figure and Ground frames in English, appear only in the Figure frame in Korean. On the other hand, the two remaining verb classes including non-alternating Figure verbs and the alternating verbs with basic Ground meaning are syntactically identical in English and Korean (M. Kim, 1999).

According to Kim's (1999) survey research of 24 languages, languages appear to fall into two basic classes. One includes languages like Korean, Japanese, Chinese, Thai and Turkish, which have a relatively simple locative alternation pattern where all locative verbs allow Figure frames, but verbs with change-of-state meaning as a primary meaning component typically allow Ground frames. In other words, non-alternating Ground verbs do not exist in these languages.

The second class of languages, which includes English, French, Spanish, Singapore Malay and Standard Arabic, exhibits a more complex pattern of locative alternation, with both Figure and Ground non-alternating verbs and one or more alternating verb classes. Given this cross-linguistic variation, Kim, Landau and Phillips (1999) proposed a revised universal linking rule for locative verbs' syntax-semantics mapping, as shown in (9):

- (9) Kim et al.'s (1999) revised linking rule
- a. Universal syntax-semantics correspondence  
manner-of-motion meaning → Figure frame
  
  - b. Ground-specific syntax-semantics correspondence  
English-type language: change-of-state meaning → Ground frame  
Korean-type language: all locative verbs → Figure frame  
  
No non-alternating Ground verb

These observed cross-linguistic variations pose challenges to the study of both L1 and L2 acquisition. In L1 development, the existence of cross-linguistic variation in syntax-semantics mapping undermines learning strategies based on the universal linking rule. If the proposed syntax-semantics mapping varies cross-linguistically, language specific rules (i.e., whether the language is a Korean type or English type) still need to be learned somehow. Therefore, the learning task of L1-acquiring children becomes two-fold. First, as discussed previously, they will somehow need to learn the accurate semantics of a verb from the input. Second, they will need to somehow find out what variation of language parameter their specific language adopts in order to use their knowledge of syntax-semantics correspondence despite the problem of cross-linguistic diversity.

To address the problem of cross-linguistic variations in locative alternation, Kim et al (1999) proposed a possible solution based on the observation that V-V compounding

and verb-serialization coincide with locative alternation patterns cross-linguistically. In short, the authors argued children may be able to learn the locative alternation parameter of their native language based on other more transparent and frequent syntactic features that are linked to the locative alternation parameter. Setting aside the validity of their proposal, what is obvious is that the acquisition of locative alternation proposes intricate learning processes. Even if children can take advantage of the innate knowledge of syntax-semantics linking rules, children need to find out the parameters of their specific language in addition to acquiring the exact semantics of verbs. That said, it is important to recall the empirical reality: despite all these seemingly impossible challenges, children successfully reach native-like grammar competence one way or another.

Furthermore, the cross-linguistic differences mentioned above potentially pose a challenge in certain L2 acquisition contexts because a learnability problem can occur when a particular structure is possible in one's L1 but not allowed in L2. One of the major differences between L1 and L2 acquisition is that L2 learners have already acquired an L1, so they often try to apply their L1 knowledge when learning the L2 (i.e., L1 transfer occurs). That is, if L2 learners apply a more-permissible L1 grammar to a more-restricted L2 grammar, the learnability problem will occur. For example, when KorNSs learn English, they are likely to allow the Figure frame for English non-alternating Ground verbs like *fill*, just as they do with their native Korean *chaywuta*. Once they transfer their L1 knowledge, it should be very difficult, if not impossible, to learn that a sentence like "Fill the water into the cup" is not possible in English unless they are provided with negative input. In other words, in L2 acquisition, overgeneralization is clearly expected due to language transfer, so the learnability

problem seems guaranteed to occur. For this reason, cross-linguistic variation in locative alternation has drawn a great deal of attention in L2 acquisition.

#### 5.1.5. Studies of locative alternation in L2 acquisition

L2 studies on locative alternation have generated mixed findings with respect to learnability resolution. Several studies have claimed that, unlike L1 acquirers, adult L2 learners do not overcome the learnability problem while others have claimed native-like-achievement is possible. For example, Juffs (1996) examined ESL Chinese speakers' knowledge of English locative verbs. Because Chinese is more permissive than English in terms of the locative alternation, Juffs hypothesized that Chinese learners will have difficulty with non-alternating locative verbs such as *cover*, *block*, *decorate*, and *stain*. An elicited production task and a grammaticality judgment task (GJT) were administered. Results from the elicited production task showed that the participants produced more Figure frames for alternating verbs than native English speakers. Furthermore, on the GJT, advanced learners accepted Figure frames for non-alternating Ground locative verbs in English, unlike the EngNSs, which was interpreted to mean that ESL Chinese learners did not overcome the learnability problem in the acquisition of English locative alternation.

Bley-Vroman & Joo (2001) and Joo (2003) reported similar results with ESL KorNSs. In their studies using a forced-choice picture-description task and a forced-choice sentence selection task, they found ESL Koreans showed no effect for verb class, unlike the EngNSs. In other words, they did not reject ungrammatical sentences treating all verbs as if they were alternators. Based on these results, the authors claimed ESL

Koreans did not overcome the learnability problem in L2 acquisition of English locative verbs, instead using a different basis for verb classification.

Although these studies highlight the non-convergence of ESL learners to their target language, there are other studies that suggest the learnability problem can be solved, at least among advanced learners of English. For example, Schwartz, Dekydtspotter, and Sprouse (2003) highlighted the experiment design problems and questionable interpretation of the data collected in Bley-Vroman & Joo (2001) and Joo (2003).<sup>13</sup> In addition, they cited findings from Choi (2001), Choi and Lakshmanan (2002), and Sawyer (2002) as evidence that some advanced ESL Koreans do indeed overcome the learnability problem. For example, Choi & Lakshmanan (2002), who summarized Choi (2001), examined 20 ESL Koreans for their interpretation of English locative verbs. Although their main focus was to examine the L2 learners' interpretation of the locative structures in terms of the *holism effect* (i.e., Ground objects are interpreted to be holistically affected by the verb)<sup>14</sup>, they reported that advanced learners of English behave like natives in their grammaticality judgment of the structures. The claim that some of their advanced participants performed like natives on the grammaticality judgment test contradicts Bley-Vroman and Joo's conclusions and suggests at least some advanced L2 learners may be able to overcome the learnability problem.

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<sup>13</sup> The major problems pointed out about Bley-Vroman and Joo's studies were 1) the inclusion of ungrammatical sentences in the interpretation task; 2) inappropriateness of data analysis based on the differential verb class effect between learner and control groups, and 3) the questionable interpretation of their results with respect to the availability of UG.

<sup>14</sup> The holism effect refers to the fact that when presented in a ground structure, native speakers interpret the direct object to be wholly affected. For example, in "*Kim loaded the wagon with hay*," the wagon is interpreted as being completely full (Bley-Vroman & Joo, 2001; Rappaport and Levin, 1985; Pinker, 1989).

In summary, the outcome of adult L2 acquisition is different from child L1 acquisition, and the learnability resolution in L2 acquisition remains an ongoing debate. Although some have claimed the learnability resolution is not possible in L2 acquisition, others claim that advanced L2 learners can overcome the learnability problem. Clearly, the uniform success found in L1 is not guaranteed in the L2. Given these differences, the question becomes what causes the differences in learnability resolution between L1 acquisition and SLA.

#### 5.1.6. Learnability for early bilinguals

Given the varied findings in child L1 and adult L2 acquisition, one supposition to account for the contrast could be age differences, but age alone cannot account for the difference because recent research on early simultaneous bilinguals suggests early bilinguals face greater challenges with learnability resolution than monolingual children (e.g., Yip and Matthews, 2007). As discussed in Chapter 1, although a bilingual child's developing grammar may constitute separate systems, interaction is commonly found at the grammatical level (p. 54). As a result, it has been argued bilingual children face additional challenges in the resolution of the learnability problem.

According to Yip and Matthews (2005; 2007), the learnability problem for bilingual speakers occurs when the input is ambiguous, with two different grammatical hypotheses generated in each language. In the case of locative alternation, the input from English locative alternation is consistent with Korean locative alternation because the input from Ground non-alternators in English is consistent with Korean grammar, which allows all Ground verbs to alternate. Therefore, bilinguals may consider English Ground

verbs to be alternators just as in Korean. Likewise, some Korean Figure non-alternators may well be considered alternators by Korean-English bilinguals if the subclass is an alternating category in English. Given this input ambiguity, it is argued early bilinguals confront a challenge in overcoming the learnability problem.

Early bilinguals' resolution of the learnability problem poses an interesting test case when compared to findings from child L1 and adult L2 acquisition because early bilinguals have all the advantages of language acquisition like L1 learners as early acquirers and yet they are challenged with ambiguous input from two languages. As a result, examining the learnability issue in early bilinguals can shed light on issues that cannot be addressed in traditional L1 and L2 studies, such as how early exposure and cross-linguistic interaction differently influence bilingual grammatical competence.

#### 5.1.7. Korean and English: Bidirectional learnability problems

Korean-English bilinguals are ideal to study learnability of locative alternation because of the cross-linguistic difference between Korean and English. As discussed, while change-of-state verbs like *fill* can be used only in the Ground frame in English, the Korean counterparts like *chaywuta* allows both Ground and Figure frames. In addition, *pile* class-alternates in English, but its Korean counterpart *ssahta* allows only Figure structures. There are also subclasses of locative verbs that match in English and Korean, Figure-only verbs like *pour* (*bwusta*), and alternating verbs like *paint* (*chilhata*). Table 10 illustrates the cross-linguistic similarities and differences between English and Korean.

Table 10. Locative alternation: verbs and their syntactic structures in each language

Verb Type	Type 1 <i>e.g., Fill(E)/ Chaywuta(K)</i>	Type 2 <i>Pile/Ssahta</i>	Type 3 <i>Pour/Pwusta</i>	Type 4 <i>Paint/Chilhata</i>
English	Ground-only	Both	Figure-only	Both
Korean	Both	Figure-only	Figure-only	Both
Difficulty Direction	English L2	Korean L2	No difficulty	No Difficulty

Note: Ground structure: *Pile the table with books*; Figure structure: *Pile books on the table*.

In short, learnability problems are predicted in both directions for Korean-English bilinguals. For example, Korean-English bilinguals are predicted to have difficulty rejecting *fill*-type verbs in Figure frames in English because they are allowed in Korean. Likewise, they are likely to incorrectly allow *pile*-type verbs in Ground frames in Korean due to the influence of English. On the other hand, the two remaining verb types (e.g., *pour*- and *paint*-type) should cause little problem for Korean-English bilinguals because they take the same syntactic frames in Korean and English.

#### 5.1.8. Research questions

In the current experiment, Korean heritage speakers' knowledge of locative alternation in Korean and English is examined. It has been claimed that bilingual children face a greater challenge in the learnability resolution than monolingual children due to the cross-linguistic interaction (Yip and Matthews, 2005). Given the bidirectional learnability problem for Korean-English bilinguals, whether heritage speakers who have been exposed to both Korean and English since young indeed resolved the learnability problem in both languages will be examined. In addition, heritage speaker performance

will be compared to late bilinguals of English and Korean, respectively, to determine whether early exposure to Korean and English (respectively) provides them an advantage in learnability resolution compared to late bilinguals.

## 5.2. Methods

### 5.2.1. Materials and procedures

To investigate the knowledge of locative alternation, an acceptability judgment task with a 6-point scale, with 1 being completely unacceptable and 6 being completely acceptable, was designed for each language. A 2 x 2 x 4 Latin-Squares design was used, with language (English, Korean), syntactic frame (Figure, Ground) and verb categories (4 types) as factors. Four verbs of each type were chosen, as shown in Table 11.

Table 11. Locative verbs in each type

Verb Type	Eng LA	Kor LA	Locative Verbs (English/Korean)
Type 1	Ground -only	Both	fill/chaywuta; cover/tepta; decorate/cangsikhata; soak/ceksita
Type 2	Both	Figure-only	pile/ssahta; load/sitta; spray/ppwulita; inject/cwuiphata
Type 3	Figure-only	Figure-only	pour/pwusta; put/nohta; drop/tteletlita; spill/ssotta
Type 4	Both	Both	paint/chilhata; wrap/ssata; plaster/paluta; rub/pipita

For each locative verb, two events were created to construct sentences to judge (e.g., for the *pour* verb, (1) *John poured water into the bucket.* and (2) *Grandma poured milk into the cup.*) Each event was then expressed in either the Figure frame or Ground

frame (See Table 12). Two counterbalanced tests were created, and in each test, one of the events appeared in the Figure frame while the other event appeared in Ground frame.

Table 12. Examples of item counterbalancing for the *pour* verb in English tests

Syntactic Frame	English Test version 1	English Test Version 2
Figure	John poured water into the bucket.	Grandma poured milk into the cup.
Ground	*Grandma poured the cup with milk.	* John poured the bucket with water.

The Korean tests were translation equivalents of the English tests, and the participants were counterbalanced so that if a participant took English test version 1 during the first session, they would take Korean test version 2 in the second session two weeks later. In this way, no participants took the translation equivalents of the exact same items.

In addition to the 32 items in each language, 32 items designed to assess participant knowledge of quantifier floats were included in the GJT as filler items. Forty ungrammatical Korean filler items and 48 ungrammatical English filler items were also included. The fillers included 32 items that were designed to assess learners' knowledge of floating quantifiers for another study. The others were constructed using various grammatical structures, including case marking, transitivity, causation, passivization, pre-/post-positions, tense marking, and dative marking. Ultimately, two versions of a Korean test containing 80 items each and two versions of an English test containing 72 items each were created. All four versions appear in Appendix 4.

With respect to test administration, the sentences were presented both aurally and in writing. Each participant visited the test site twice, with at least two weeks in between

visits; they took a test on one list in one language during each visit. As mentioned, the orders of languages and lists were counterbalanced throughout data collection.

### 5.3. Results

#### 5.3.1. Data analysis

Mean acceptability ratings were calculated and native speaker performances were first scrutinized to ensure all items functioned as intended. Of the verbs used in the AJT, one English verb (i.e., *soak*) and one Korean verb (i.e., *ssahta*) generated unexpected results. Although the English verb *soak* was deemed to allow only the Ground structure in English, EngNSs rated the sentences with *soak* in the Figure structure as acceptable and gave a mean rating score of 4.17 (SD = 1.52), which is above 3.5, the division between acceptable and unacceptable ratings.<sup>15</sup> Similarly, the Korean Figure-only verb *ssahta* (*pile*) also received a high mean acceptability rating in the Ground structure (Mean = 4.06; SD=1.39).<sup>16</sup> Given these unexpected results, subsequent analysis was conducted excluding the two verbs.

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<sup>15</sup> The EngNS participants in the current study generally accepted sentences like “\**Susan soaked water into the socks.*” or “\**Susan soaked milk into the bread.*” According to post-hoc interviews with several participants and other native speakers of English, it appears the verb *soak*, although claimed to be a Ground-only verb, may become permissible in Figure structures, especially when there is a strong semantic or contextual relationship between the two objects, as is the case with *milk* and *bread*. Such variability appears to reflect the difficulty in assigning semantic structure.

<sup>16</sup> When some KorNSs were consulted post hoc, they said they interpreted the sentence resultatively: e.g., they interpreted the Korean sentence “I piled the table with bricks.” to mean “I made the table by piling bricks.”

One observation relevant to the interpretation of the data is that L2 learners tended to give less extreme ratings than the native speakers in the sentence judgment of their respective L2s. Figure 10, for example, shows the ratings for the Type-3, Figure-only, condition. Because this structure is allowed in both Korean and English, it is expected both KorNSs and EngNSs would rate the structure similarly in terms of acceptability. However, as shown, EngNS rating scores are overall lower than KorNSs. In other words, there is a tendency for L2 learners to avoid extreme ratings when judging L2 sentences, which appears to indicate an overall lack of confidence in L2-sentence ratings. As shown in Figures 11 and 13, a subdued pattern of L2 responses was observed in all conditions, suggesting that L2 learners may be biased against extreme ratings.

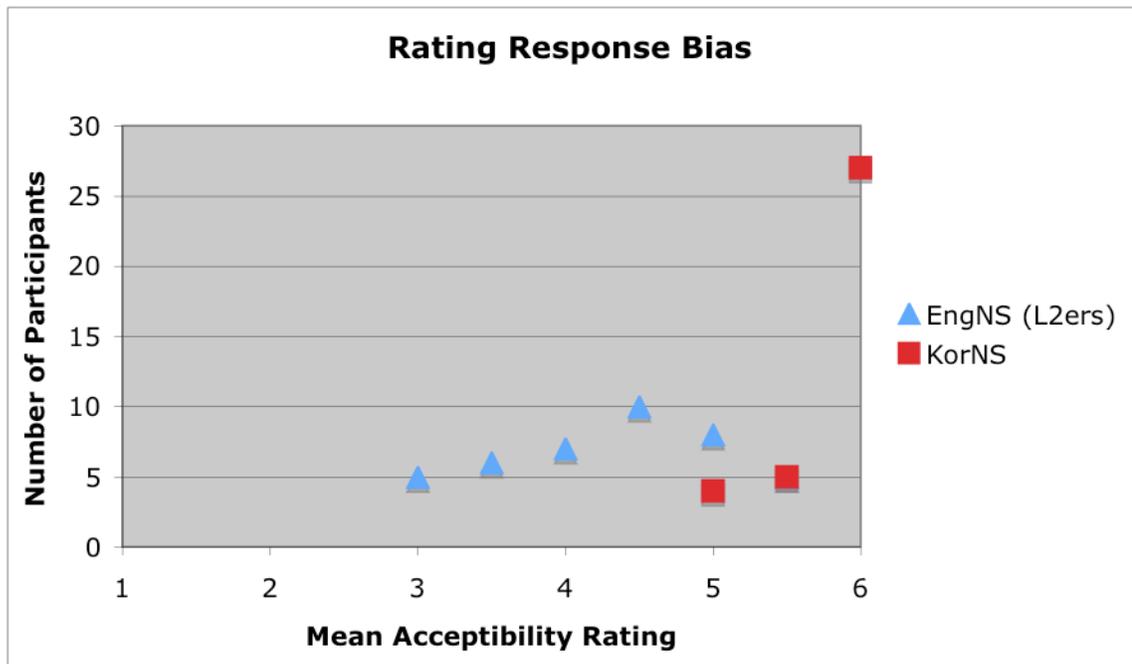


Figure 10. Distribution of mean acceptability rating with Type-3 Figure sentences in Korean (L2 learner response bias against extreme ratings contrasted with native speaker rating patterns)

Given these response biases, caution is required when interpreting L2 learner performance in comparison to native speakers. Making a direct comparison between native speakers and L2 learners in such cases could undermine L2 learner's knowledge in the relevant structure. Therefore, for L2 groups that show a response bias against extreme ratings, it would be more appropriate to compare learner performance at the middle score (i.e., 3.5) of the acceptability judgment. If a group rated a structure below 3.5, it indicates the group found the structure ungrammatical. On the other hand, a structure rated above 3.5 indicates it is considered grammatical. This 3.5-cutoff point describes native speaker response patterns properly because native speakers rated grammatical sentences well above 3.5 and ungrammatical sentences well below 3.5.

### 5.3.2. English AJT results

Figure 11 shows mean acceptability rating scores of English AJT in all verb-type conditions by each group.

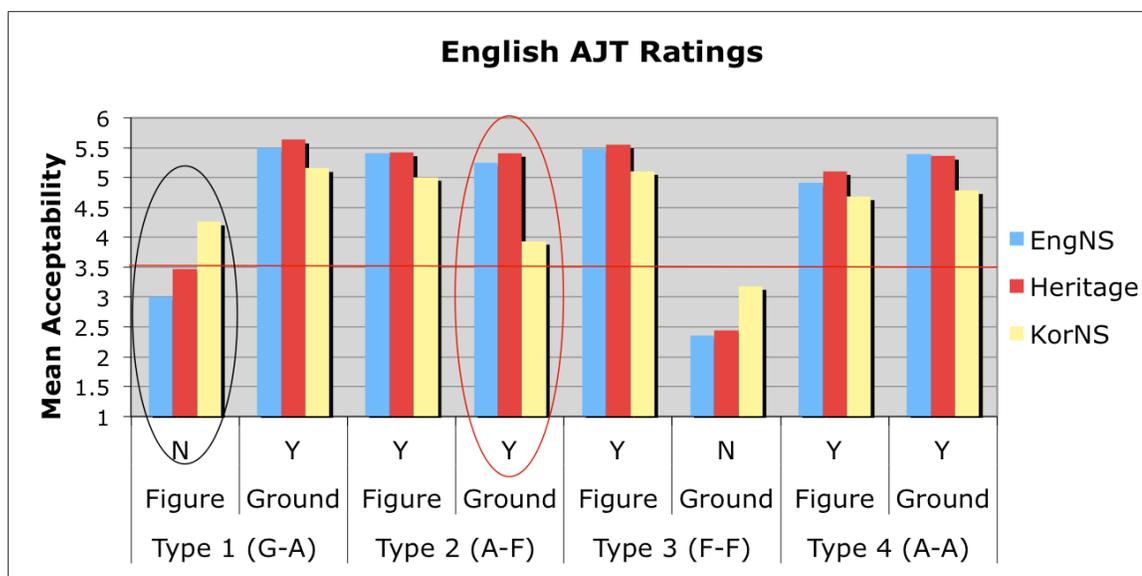


Figure 11. Mean acceptability rating of English AJT

N: Not allowed (No); Y: allowed (Yes)

G-A: Ground-only in English and Alternating in Korean; A-F: Alternating in English and Figure-only in Korean; F-F: English and Korean both Figure-only; A-A: English and Korean both Alternating

EngNSs behaved as predicted. They rated Type-1 verbs in Figure structures and Type-3 verbs in Ground structures, which are disallowed in English, below the scale midpoint, while they rated the other (acceptable) structures above the midpoint. With the control Type-3 and Type-4 verbs, which have the same LA possibilities in English and Korean, all three groups performed in the same fashion, although overall KorNS responses were less extreme. In addition, EngNSs and heritage speakers performed very similarly in most conditions, except on the Type-1 Figure structures.

The rating scores of the Type-1 and Type-2 verbs were fit to a general linear model holding group and verb structure (e.g., Type-1 in Figure structure) as fixed effects and participants and items as random effects. The fixed effect for group was not significant:  $F(2,116.8)=1.52, p=0.22$ . However, the fixed effect for verb-structure was:

$F(3, 21,92)=35.05, p<0.01$ ; the interaction between group and condition was also significant:  $F(6, 1536)=56.92, p<0.01$ , which indicates the magnitude of the difference between group ratings changed depending on the verb structure.

Figure 12 illustrates group-rating score differences from the scale midpoint in two critical conditions: Type-1 Figure and Type-2 Ground. Recall that Type-1 Figure is not allowed in English, whereas it is allowed in Korean. On the contrary, Type-2 Ground is allowed in English but not in Korean.

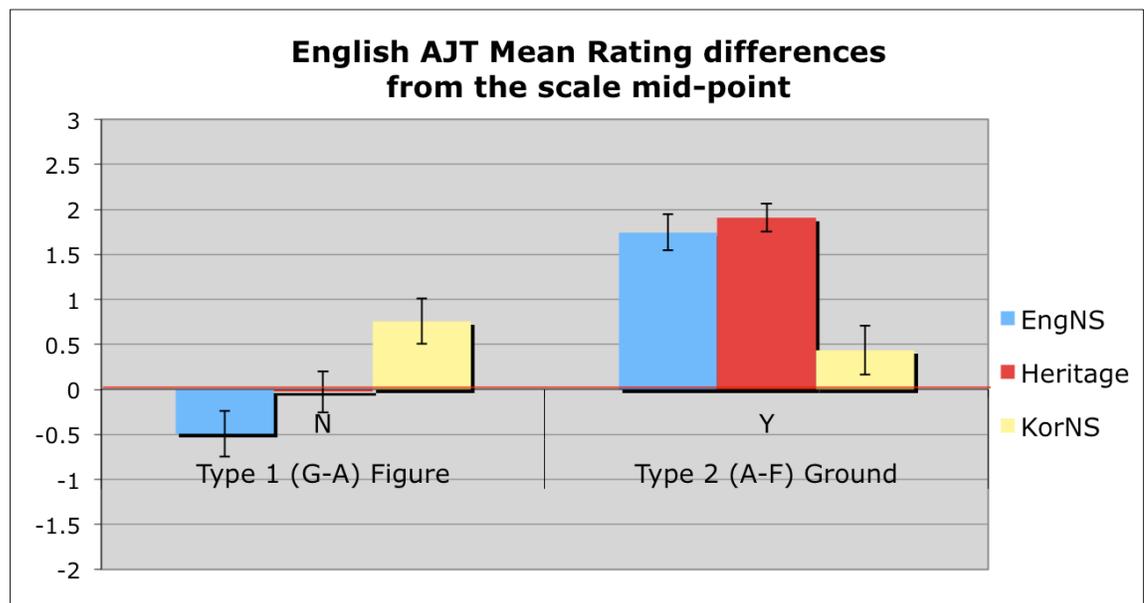


Figure 12. Group English AJT mean rating score differences from the scale midpoint in Type-1 Figure and Type-2 Ground

N: Not allowed (No); Y: allowed (Yes)

G-A: Ground-only in English and Alternating in Korean; A-F: Alternating in English and Figure-only in Korean

As shown, EngNSs rejected Type-1 verbs in Figure structures, exhibiting a mean rating score ( $M=2.62, SD=1.34$ ) significantly lower than the scale midpoint ( $t=-6.83, p<0.01$ ). In contrast, the rating by KorNSs in for Type-1 Figure structures was

significantly higher ( $M=4.41$ ,  $SD=1.41$ ;  $t=6.67$ ,  $p<0.01$ ). In other words, KorNSs incorrectly accepted Type-1 verbs in Figure structures, which suggests they did not overcome the learnability problem in English.

Interestingly, heritage speakers did not perform significantly differently from the midpoint ( $t=-0.99$ ,  $p=0.32$ ). Furthermore, when planned comparisons were conducted, heritage speakers performed significantly differently from EngNSs in this condition:  $F(1,113.85)=8.75$ ,  $p<0.01$ . This suggests even heritage speakers, despite their native-like performance in all other conditions, may not have completely overcome the learnability problem in learning to reject Type-1 verbs in Figure structures.

With respect to Type-2 verbs in Ground structures, all three groups scored significantly higher than the scale midpoint ( $p<0.01$ ). Planned comparisons showed no significant difference between EngNSs and heritage speakers:  $F(1, 117.18)=0.82$ ,  $p=0.37$ . However, KorNS ratings were significantly lower than the other two groups:  $F(1, 116.95)=43.51$ ,  $p<0.01$ . Taken together, these results seem to suggest KorNSs were able to learn Type-2 Ground is possible in English, although their performance is not completely native-like.

In summary, KorNSs failed to reject English Type-1 verbs in Figure structures, indicating they have not overcome the learnability problem in English. On the other hand, they seem to have learned to accept English Type-2 verbs in Ground structures, although not to the same degree as EngNSs. These results suggest it may be easier for L2 learners to learn to accept L2 structures that are not allowed in their L1 (i.e., learning based on positive evidence) than to learn to reject L2 structures that are allowed in their L1 (i.e., the learnability problem). Interestingly, heritage speakers, despite native-like

performance in all other conditions, showed difficulty rejecting Type-1 verbs in Figure structures. Although they performed better than KorNSs, their mean rating score was not only significantly different from the scale midpoint but also different from that of the EngNSs. This result suggests heritage speakers may have persistent difficulty with the learnability problem even in their dominant language, English.

### 5.3.3. Korean AJT results

Figure 13 shows mean acceptability rating scores of Korean AJT in all Verb Type conditions by each group.

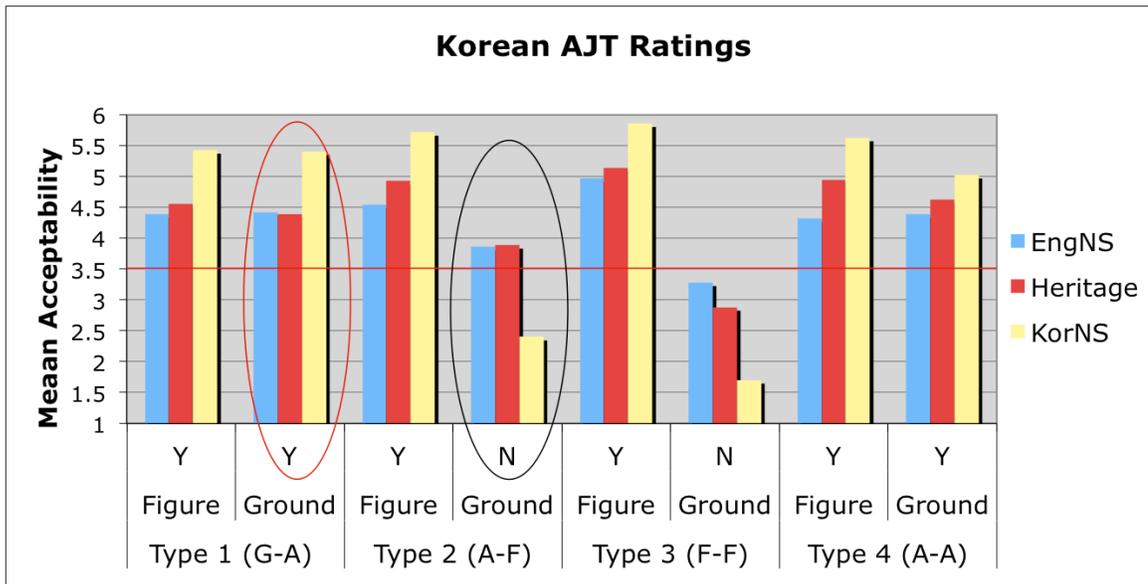


Figure 13. Mean acceptability rating of Korean AJT

N: Not allowed (No); Y: allowed (Yes)

G-A: Ground-only in English and Alternating in Korean; A-F: Alternating in English and Figure-only in Korean; F-F: English and Korean both Figure-only; A-A: English and Korean both Alternating

KorNSs behaved as predicted. They rated below the scale midpoint for Type-2 and Type-3 verbs in Ground structures, which are disallowed in Korean, while rating all other structures above 3.5. With the control Type-3 and Type-4 verbs, which have the same LA possibilities in English and Korean, all three groups performed in the same fashion, although both EngNSs and heritage speakers exhibited less extreme ratings compared to KorNSs.

The rating scores of Type-1 and Type-2 verbs were fit to a general linear model holding group and verb structure (e.g., Type-1 in Figure structure) as fixed effects and participants and items as random effects. The fixed effect for group was not significant:  $F(2, 118.3) = 2.14, p = 0.12$ . However, the fixed effect for verb structure was:  $F(3, 10.06) = 29.74, p < 0.01$ ; moreover, the interaction between group and condition was also significant:  $F(6, 1537) = 65.20, p < 0.01$ , which indicates the magnitude of group ratings changed depending on the verb structure.

Figure 14 illustrates group rating-score differences from the scale midpoint in the two critical conditions, Type-1 Figure and Type-2 Ground. Recall that Type-1 Figure structures are allowed in Korean but not in English. On the contrary, Type-2 Ground structures are not allowed in Korean while English allows them.

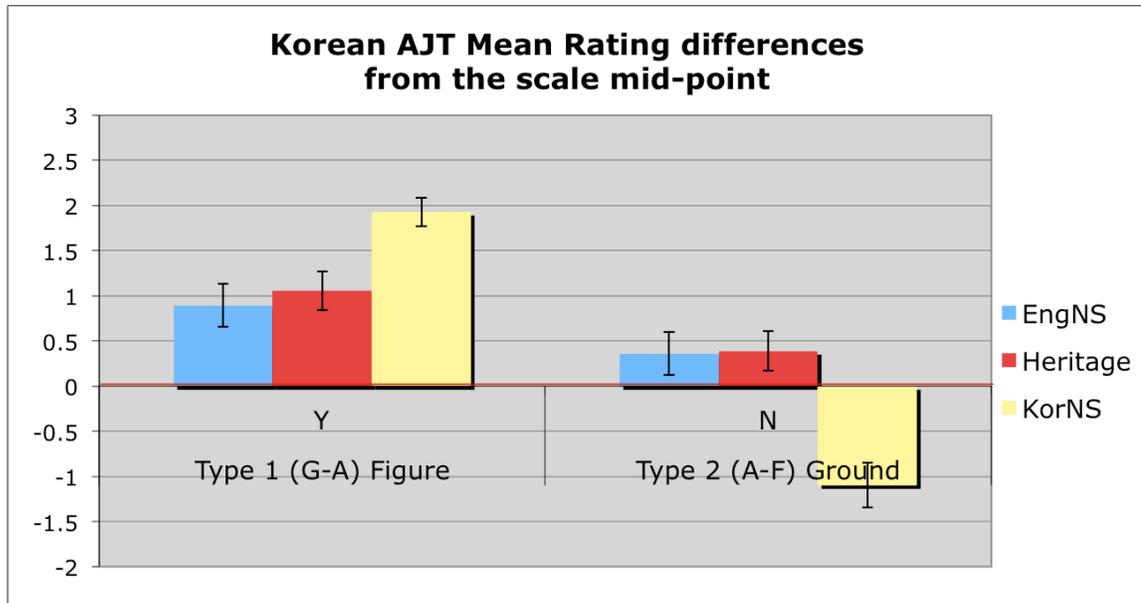


Figure 14. Group Korean AJT mean rating score differences from the scale midpoint in Type-1 Figure and Type-2 Ground

N: Not allowed (No); Y: allowed (Yes)

G-A: Ground-only in English and Alternating in Korean; A-F: Alternating in English and Figure-only in Korean

As shown, KorNSs accepted Type-1 verbs in Figure structures with a mean rating score ( $M=5.43$ ,  $SD=0.96$ ) well above the scale midpoint ( $t=24.18$ ,  $p<0.01$ ). EngNS and heritage speaker ratings for Type-1 Figure structures were also significantly higher rating than the midpoint (EngNS  $M=4.40$ ,  $SD=1.45$ ;  $t=7.39$ ,  $p<0.01$ ; heritage:  $M=4.56$ ,  $SD=1.51$ ;  $t=9.70$ ,  $p<0.01$ ). Therefore, both EngNSs and heritage speakers, although their rating was less extreme than KorNSs, seem to have successfully acquired the knowledge that Type-1 verbs are allowed in Figure structures in Korean.

On the other hand, the learner groups behaved differently from KorNSs in the Type-2 Ground condition. Although KorNSs rejected Type-2 verbs in Ground structures ( $M=1.85$ ,  $SD=0.95$ ), both EngNSs and heritage speakers incorrectly accepted such structures (EngNS  $M= 3.90$ ,  $SD=1.42$ ; heritage  $M= 3.84$ ,  $SD=1.53$ ). When compared to the scale mid-point of 3.5, both groups were statistically significantly different from it

(EngNS  $t=2.89$ ,  $p<0.01$ ; heritage  $t=2.67$ ,  $p<0.01$ ), indicating they incorrectly accepted the sentences. Finally, when planned comparisons were conducted, EngNSs and heritage speakers did not differ from each other:  $F(1, 117.62)=0.08$ ,  $p=0.77$ . Taken together, these results suggest both late learners (EngNSs) and heritage speakers of Korean have difficulty overcoming the learnability problem in Korean.

In sum, as with the results of the English AJT, both learner groups of Korean (EngNSs and heritage speakers) were able to successfully acquire what is possible in Korean. Their ratings on Type-1 Figure structures were well above the scale midpoint, although their rating scores were not as high as KorNSs. On the other hand, they showed persistent difficulty in learning to reject ungrammatical sentences – Type-2 verbs in Ground structures – in Korean. Furthermore, this persistent learnability problem was observed in both the late learners and heritage speakers to a similar degree.

#### *5.4. Section discussion: Early bilinguals' grammatical learnability resolution*

The first major finding of the current experiment is that late bilinguals (i.e., adult L2 learners) overall showed a persistent learnability problem. ESL KorNSs failed to reject Type-1 verbs in Figure structures in English, which is not allowed. In addition, KSL EngNSs failed to reject Type-2 verbs in Ground structures in Korean, structures not allowed in Korean. This supports previous claims that adult L2 learners have difficulty learning what is not possible in their L2 when their L1 allows the structure. On the contrary, these late bilinguals showed successful acquisition of what is possible in their L2 when their L1 disallows it. Although their ratings were overall lower than NSs, KorNSs learned to allow Type-2 verbs in Ground structures in English, and EngNSs also

allowed Type-1 in Figure structures in Korean despite the fact that these structures are now allowed in their native languages. Finally, learners showed no problem at all with Type 3 and 4 verbs that possess the same LA possibilities in English and Korean, which suggests that learners do transfer their L1 knowledge to their L2.

Synthesis of these results supports the classic learnability argument that learning to reject a certain structure in L2 should be a lot more challenging, if not impossible, than learning based on positive evidence.<sup>17</sup> In addition, these results are in line with previous studies that highlighted the persistent learnability problem in the acquisition of LA in adult SLA (Bley-Vroman & Joo, 2001; Joo, 2003). Adult L2 learners seem to transfer their L1 knowledge of LA possibilities into L2 sentence judgments, causing non-native-like performance. Moreover, this learning difficulty remains persistent when the L2 grammar is more restrictive than the L1 grammar. Nevertheless, it should be noted that learners' L2 knowledge overall develops in the right direction. Recall that when the acceptability ratings of their L1 and L2 judgments of structures that cause L2 learnability problem are compared, learners showed a lot lower rating in their L2 than in their L1. This indicates that although the learners performed non-native-like in their L2, they are developing separate grammars for their L1 and L2 and their L2 grammars are developing in the right direction. Therefore, it is possible that if more advanced learners had been tested, the results could have shown successful resolution of the learnability problem even by the L2 learners (Choi & Lakshmanan, 2002; Schwartz et al., 2003).

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<sup>17</sup> Of course this assumes that the relevant structure is not explicitly taught. According to previous research, locative alternation rules are rarely explicitly taught in L2 classes (Juffs, 1988; Joo, 2003).

With respect to the nature of such L2 knowledge, one can imagine three different kinds of knowledge that L2 learners should acquire: knowledge of different grammatical parameters between English and Korean; language specific narrow-range syntax-semantics mapping rules; and the exact semantics of individual verbs.

At the grammatical parameter level, the KSL EngNSs' grammar may appear to conform to the Korean parameter because their L2 grammar allows the Figure structure in all structures, just as in Korean: importantly, they no longer have non-alternating Ground verbs (recall that they learned to accept the Figure structure with Type-1 verbs). Therefore, some may argue that the EngNSs acquired a Korean-like parameter. In fact, this seems to be the kind of acquisition scenario that previous L2 studies on LA have assumed: they viewed the task of LA acquisition as a task of grammatical parameter re-setting. Therefore, the learnability problem was considered to arise only when KorNSs learn English but not when EngNSs learn Korean: because the Korean LA parameter is a superset (i.e., Figure only or Alternating verbs) of the English LA parameter (Figure only, Alternating, and Ground-only verbs), it was assumed that EngNSs would be able to reset to the Korean parameter with positive evidence alone. However, such a hypothesis greatly simplifies the learning problem because it does not take into account the LA possibilities of the equivalent locative verbs in participants' L1s. As demonstrated, the learnability problem can and does occur even when EngNSs learn Korean because of the mismatches in the narrow-range mapping rules: with Korean Type-2 verbs, EngNSs need to learn to reject the Ground structure because they are Figure-only verbs in Korean. Therefore, although KSL EngNSs may appear to have switched to the Korean LA parameter at the level of grammatical principles and parameters because they no longer

have non-alternating ground verbs, it is important to note that their interlanguage grammar does not conform to the Korean grammar (i.e., they still failed to reject the Ground structure of Korean Type-2 verbs), and shows a persistent learnability problem, just like ESL KorNSs.

The locus of learning difficulties observed in this current study should then lie either in the acquisition of language-specific narrow-range semantics-syntax mapping rules in L2 or in the acquisition of the semantics of individual verbs.<sup>18</sup> It is possible that the L2 learners and heritage speakers may never have acquired the exact semantics of each verb. They may have just mapped their existing L1 word's semantics to the equivalent L2 words, and this semantic transfer may have caused the non-native-like performance. Alternatively, it may be that L2 learners acquired the exact semantics of individual verbs but haven't learned the language-specific syntax-semantics mapping rule.

In short, it is still unclear exactly what causes cross-linguistic variation and what gets transferred in L2 acquisition. However, considering the learning difficulty is isolated in Type-1 verbs in L2 acquisition of Korean and Type-2 verbs in L2 acquisition of English, it seems clear that cross-linguistic transfer is the major cause of the learning difficulty. What seems impossible to determine, however, is whether what gets transferred is the semantics of individual verbs or the language specific syntax-semantics mapping rule.

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<sup>18</sup> When the learner's responses to individual verbs were examined, few differences were found nor was any difference related to the frequency of the verbs in a meaningful way (e.g., EngNS performed less native-like with the most frequent Korean Type-1 verb *ppwulita*.)

Another major finding of the current study is that the heritage speakers performed very similarly to the late learners of Korean. They exhibited persistent difficulty rejecting Type-1 verbs in Figure structures in Korean while they learned to allow Type-2 verbs in Figure structures, just like the late L2 learners of Korean. The fact these early bilinguals performed very similarly to late L2 learners suggests age itself cannot explain the discrepancy between children and adults in the learnability resolution. Korean heritage speakers, even though they have been exposed to Korean since young, well before the critical period ends, exhibited no advantage in the acquisition of LA rules in Korean over proficiency-matched adult L2 learners of Korean. Rather, both early and late bilinguals show the language transfer effect. For late bilinguals, the language transfer effect occurs from L1-to-L2, and for early bilinguals, it occurs from the dominant language to the weaker language (Yip and Matthews, 2007). In sum, the cross-linguistic interaction/language transfer effect appears to influence the non-native-like development of bilingual language competence in both early and late bilinguals.

That said, an alternative explanation is that the heritage speakers and L2 learners may simply have received insufficient input. It may require a great amount of input and time for learners to learn that a particular type of verb does not occur in a particular frame. Because Korean in this case is the non-dominant language for both the adult L2 learners and the heritage speakers, the learners may have ended up with incomplete knowledge simply due to the insufficient input from their less dominant language. Considering that the acquisition of LA involves the acquisition of non-transparent semantics and syntax-semantics mapping rules, this appears to be a plausible explanation. Although dominant language transfer would exacerbate the learnability problem, it may

not be the sole factor that explains the incomplete resolution of the learnability problem by L2 learners and heritage speakers.

A final surprising finding of the current study then is that the heritage speakers did not completely overcome the learnability problem even in their dominant language, English. Unlike EngNSs, who rejected Type-1 verbs in Figure structures in English, the acceptability rating of the heritage speakers was not different from the scale mid-point. Contrary to the results from all other conditions in English, their ratings were statistically significantly different from EngNSs in this learnability condition. In fact, this seems to be the first study that has reported an incomplete acquisition of the dominant language by heritage speakers, perhaps because virtually no other study exists that examined the dominant language of heritage speakers.

This finding highlights the role of cross-linguistic interaction among early bilinguals. It appears that exposure to two languages, before any one language gets established completely, may influence both languages that early bilinguals develop simultaneously. In other words, the cross-linguistic interaction effect at an early age may have long-term consequences for both the weak and dominant languages of the early bilingual. Despite this surprising finding, previous research on L2 acquisition has already suggested that exposure alone may be insufficient for the attainment of native-like proficiency even though exposure to a given language before puberty is a crucial condition. Findings from, e.g., Ruben (1999) and Hyltenstam et al (2009) indicate that even minimal delays in language exposure from birth may compromise native-like-ness. Therefore, lack of exposure to English during the first four years could have resulted in the less-than native-like acquisition of some features of English.

In conclusion, the interaction between the two developing languages can be so significant that bilinguals may develop different linguistic systems for both languages from monolingual speakers. Although bilingual children differentiate their languages and show independent linguistic representations from the outset of syntactic acquisition (De Houwer, 1990; Genesee, 1989; Genesee et al., 1996; Meisel, 1994; M. Paradis & Genesee, 1996), the developing languages still influence each other in significant ways (Yip and Matthews, 2005; 2007). The current study shows that this cross-linguistic influence can be bidirectional such that even the dominant language may not develop to the same degree as the monolingual grammar. Such findings have a significant implication with respect to the notion of native-likeness in the ultimate attainment studies of SLA. If bilinguals are not native-like in some aspects of their bilingual competence, even in their dominant language, the practice of comparing L2 learners' competence to that of the monolingual speaker becomes unreasonable. As Grosjean (1989) stated, bilinguals are not two monolingual speakers in one mind; it may be a myth that bilinguals have equal and perfect knowledge of both languages (Grosjean, 2008). More bidirectional research on early bilinguals like the heritage speakers of this study will help illuminate whether and how bilinguals resolve learnability problems in both of their languages, which ultimately can inform the field about how the language acquisition device processes input from simultaneously learned languages.

## Chapter 6. Individual differences among heritage speakers

Using the data obtained from the language learning history questionnaires administered in this study, the aim of this chapter is to examine to what degree extra-linguistic factors can account for the variation in Korean proficiency among heritage speakers. For this purpose, a stepwise multiple regression was conducted.

In Chapter 1, six different extra-linguistic factors that have been suggested to determine the variability among individual heritage learners were identified: 1) age of reduced exposure to Korean; 2) the amount of linguistic input; 3) the amount of language use; 4) the level of cultural affiliation; 5) the amount of formal instruction; and 6) language aptitude. In this study, heritage speakers had very little variation in the age of reduced L1 input. All participants were born in the U.S. and began to receive extensive exposure to English/reduced input to Korean around the age of 4 (Mean = 4.6). In other words, any potential age effect was controlled (in fact, intentionally so for the purpose of disambiguating the roles of early exposure and input dominance.) For this reason, the current analysis did not include the age of reduced L1 contact as a factor in the regression.

Four of the five remaining factors were examined given the information collected from the language background questionnaire (Appendix 2). The amounts of Korean language input and Korean language use were based on self-reflection. Participants were asked to reflect on their family situation and daily activities, and to estimate to the best of their ability how much exposure they received in Korean and English throughout their lives. They were asked to fill out the amount of language exposure in four different age

bands: between Age 0 to 4; between Age 4 to 11; between Age 12 to 18; and Age 18 to current. Among these age bands, there was little variation and skewed distribution of data in the Age 0 to 4 band (According to Shapiro-Wilk W test  $w=0.74$ ,  $p<0.01$ ) because all participants reported to have been exposed to Korean more dominantly than English before age 4, whereas the other three age bands all showed normal distributions. Given this, the amount of continued exposure to Korean was calculated by averaging the remaining three age bands excluding the band from age 0 to 4.<sup>19</sup> Likewise, the amount of continued use of Korean was calculated based on the data from the age bands 4 to 11, 12 to 18, and 18 to current.

To measure the level of cultural affiliation, participants were asked to rate the extent to which they identify with Korean culture and the U.S. culture. The scales ranged from 0 (no identification) to 10 (complete identification) with 5 being labeled as having moderate identification.

For the amount of formal instruction, participants were asked to state when and how long (in months) they received Korean language instruction, and how many hours per week they attended the instruction. The obtained figures were then used to calculate total contact hours.

Language aptitude was measured using an aptitude test called LLAMA (Meara, 2005). LLAMA is composed of a set of exploratory tests designed to assess aptitude for

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<sup>19</sup> The averages of the 0-4 age band and the rest of the age bands showed marked differences, but not among the rest of the age bands, so it was decided that averaging the remaining three age bands is appropriate. In fact, such averaging was necessary to reduce the number of variables to run the multiple regression in order to obtain reliable results. If exposure and use in each age band is input as a separate variable, there would be too many variables compared to the number of participants.

learning a foreign language. Four modules of the test included a vocabulary task, a phonetic memory task, a sound-symbol mapping task, and a grammatical inference task. The vocabulary task was designed to measure participants' ability to learn new vocabulary in a relatively short period of time. The phonetic memory task was to measure the ability to hear new words just once and remember them. The sound-symbol mapping task was designed to measure the ability to quickly learn the alphabet of a new language. The grammatical inference task was designed to measure the ability to infer the grammatical system of a new language based on some example sentences. Ultimately, data derived from the sound-symbol mapping task were excluded from the analysis because they exhibited a ceiling effect and a skewed distribution. Administered on PCs, the LLAMA test took participants about 30 minutes to complete.

Finally, heritage speaker proficiency in Korean (the dependent variable) was measured using the C-test described in Chapter 2. Recall that unlike the adult EngNSs learning Korean, heritage speakers' Korean C-Test results exhibited great variation, with a mean score of 44.77 and standard deviation of 21.38. The Shapiro-Wilk goodness of fit test confirmed that the scores were generally normally distributed ( $w=0.97$ ,  $p=0.17$ ).

As mentioned, multiple regression analysis was conducted with six predictors (i.e., Continued Korean language exposure, Continued Korean language use, Formal instruction, Cultural affiliation, Vocabulary aptitude, Phonetic memory aptitude, and Grammatical aptitude). Table 13 summarizes the descriptive statistics and analysis results. As shown in Table 13, the grammatical aptitude had significant positive regression weights, indicating participants with higher scores on the LLAMA's grammatical inference task had higher proficiency scores (as measured by the C-Test)

after controlling for the other variables in the model. In addition, the influence of formal instruction approached significance, indicating that heritage speakers who received more hours of instruction had higher levels of proficiency. On the contrary, the other variables did not vary systematically with proficiency.

Table 13. Summary statistics from the regression analysis

Variable	Mean (SD)	Multiple regression weights		Weight Significance (p)
		b	$\beta$	
Korean Exposure	35.95 (15.20)	-.002	-.001	.996
Korean Use	31.74 (16.64)	-0.68	-.054	.838
Cultural Affiliation	6.82 (1.73)	-.473	-.037	.810
Formal Instruction	596.28 (1416.62)	.004	.281	<b>.071</b>
Llama-Vocabulary	64.02 (18.37)	.027	.023	.875
Llama-Phonetic Memory	37.93 (13.23)	.270	.167	.262
Llama-Grammar	58.70 (25.26)	.296	.349	<b>.020*</b>

\* Statistically significant at  $p < 0.05$ .

The most significant finding of the regression analysis is that one of the language aptitude measures influenced the heritage speaker proficiency in the L1. This finding is interesting because language aptitude traditionally has been proposed as one of the major factors that contribute to individual variation among adult L2 learners. DeKeyser (2000), for example, claimed high language aptitude is a necessary condition for adult L2 learners to achieve native-like proficiency in an L2 whereas early bilinguals may not necessarily need high aptitude for native-like proficiency. The idea is that adults lose their implicit learning ability around puberty and start relying on explicit learning mechanisms such as conscious reflection on linguistic structures. Therefore, for adults to accomplish near-native-like proficiency in an L2, a high degree of language aptitude is required.

Although no one would deny the role of language aptitude in the success of adult L2 learners, language aptitude may also play an important role in the development of early bilinguals. In fact, this is a replication of recent research on the role of language aptitude among early bilinguals, which proposed that language aptitude plays a facilitative role for both L2 acquisition (Abrahamsson & Hyltenstam, 2008) and L1 maintenance (Bylund et al, 2009).

In addition to the aptitude, the hours of formal instruction appears to have helped Korean heritage speakers maintain or reacquire Korean proficiency. These findings are consistent with Montrul & Bowles (2010), who showed heritage speakers benefit greatly from instructional treatment targeted to specific structures. The fact that language aptitude and formal instruction exhibited near-significant influence on proficiency is also interesting because these two variables are generally considered to facilitate adult SLA. It appears that the variables that accounts for heritage speakers' individual variations in the current study are strikingly similar to the case of adult L2 learners.

There are two possible explanations for such results. First, it could indeed be the case that high language aptitude and instructional assistance is helpful for early bilinguals as it is for heritage speakers. Although monolingual children do not need high language aptitude or instructional treatment in their native language, bilingual children may benefit from both because they face greater challenges in language acquisition. The amount of language exposure to each language is likely to be less than the amount of exposure monolingual children receive in their native language as discussed in Chapter 1. Furthermore, cross-linguistic influences may pose challenges in the acquisition of certain unique features as discussed in Chapter 5. Given these challenges, early bilinguals

learning L2 may benefit from high language aptitude, which presumably helps the grammatical inferencing of L2, as suggested by Abrahamsson & Hyltenstam (2008). Moreover, high aptitude may also help L1 maintenance as Bylund et al (2009) report. Likewise, formal instruction could help early bilinguals acquire structural properties that are particularly challenging (e.g., locative alternation, as described in Ch 5). In fact, Montrul (2008, p. 221) hypothesizes that heritage speakers would react faster and better to instruction than L2 learners. That is, because heritage speakers are interrupted L1 learners who received input during their critical period, instruction should conceivably be able to turn “incomplete” native speakers into “complete” native speakers given optimal types and amounts of input and sufficient time to develop the underdeveloped skills.

Another possible explanation that aptitude and instruction may affect L1 proficiency can be derived from the attrition or re-learning of Korean during the post-puberty period. Because the heritage speakers in this study were all adults at the time of the experiment (Mean age 20.7), a sizable amount of Korean language attrition and/or learning could have happened between puberty and adulthood (i.e., post-critical period). In fact, the majority of heritage speakers who participated in the current study either had taken or were taking Korean language courses at the University of Maryland. Therefore, it is possible they benefited from the instruction during their adulthood. Furthermore, learners of higher aptitude could have benefited more while re-learning Korean as adults than lower aptitude learners. If so, the aptitude and instructional effects observed in the current study would not be different from the aptitude and instructional effects observed in adult L2 acquisition. In other words, because heritage speakers tested in the current dissertation were all adults at the time of testing, it is impossible to tell whether the

aptitude and instructional effect played a role in their childhood or adulthood. If one aims to disambiguate these two effects, he or she would have to compare heritage speakers and L2 learners who are pre-pubescent.

Although potentially important in their implications, it is important to note the limitations of these findings. First, the dependent variable, Korean language proficiency, was measured using a Korean C-Test, which may favor classroom language learners who have received explicit instruction. In addition, it may not be surprising that a fill-in-the-blank test like the Korean C-Test correlated highly with the aptitude for grammar inference component of the aptitude test. In the future studies, it would be more desirable to include a more implicit measure of language proficiency. Second, it is possible the measures used for some or all of these six factors were not sensitive or accurate enough to capture their effect. In fact, it is surprising that language exposure and language use did not correlate highly with proficiency given that many previous studies have claimed that it is the major factor in the heritage language maintenance (Montrul, 2008; O'Grady et al, 2008; Au et al, 2002, Knightly et al, 2003; Oh et al, 2003). Likewise, previous studies that included a more extensive survey of cultural identification yielded a positive correlation between the degree of cultural identification and L1 proficiency (Xie, 2010; Cho, 2000, Chinen & Tucker, 2005, Lee, 2002). Because the current study used self-reported data based on memory, it is very possible the measure was not well suited to capture variations accurately. To examine the effects of language exposure and language use on heritage language maintenance, the bilingual input in bilingual families would need to be examined directly. In addition, to better understand the variation in bilingual

competence observed in early bilinguals, longitudinal studies that document detailed information on home language input and use is greatly needed.

Despite these limitations, it should be noted it is quite interesting anything was statistically significant because the participants recruited in the current study were relatively narrow in profile compared to the heritage speaker population at large. First, only literate heritage speakers were recruited because some tasks required reading capability, so the variation of Korean proficiency observed in the current study must be smaller than the one among heritage speakers at large. Second, all heritage speakers were recruited at the University of Maryland, which resulted in similar educational levels and age. Many of them also were also taking Korean language classes at the University of Maryland at the time of testing. Finally, because the current dissertation specifically aimed to dissociate the effects of early exposure and input dominance, the recruited heritage speakers had very similar profiles in terms of their early experience: all heritage speakers were born in the U.S. and mainly exposed to Korean before age 4. Therefore, the effects of language aptitude and formal instruction on heritage language proficiency found in the current study indeed seem significant and might have become more pronounced if more heterogeneous groups of heritage speakers had been recruited. Nevertheless, future studies that aim to investigate variation among levels of heritage speaker proficiency should include a wider variety of heritage speakers to confirm such findings.

## Chapter 7. General discussion

In this dissertation, three different linguistic abilities were examined: speech perception, lexical access, and grammatical intuition. All three experiments also examined both Korean and English language abilities of Korean heritage speakers: a population whose L1 is Korean but whose dominant language is English. By examining aspects of the phonology, lexicon, and grammar of heritage speakers enabled the pursuit of a more complete understanding of bilingual competence. In this chapter, the findings from all three studies will be synthesized and their implications with respect to heritage language acquisition will be discussed.

To summarize the findings, Korean heritage speakers performed native-like in the perception of English sound contrast (*kasta-kasuta*) while performing non-native-like with the Korean sound contrast (*saka-s\*aka*). They exhibited a significant amount of attrition in their ability to perceive the Korean lax /s/-tense /s\*/ distinction in particular, although their performance was slightly better than the proficiency-matching late learners of Korean. The heritage speakers also exhibited a significantly greater priming effect from their dominant language English to their L1 Korean than vice versa. This finding is in contrast to the two late-bilingual groups, who both exhibited a greater priming effect from their L1s to their L2s. In addition, while the EngNSs learning Korean did not exhibit a priming effect from their L2 Korean to L1 English, heritage speakers exhibited a priming effect from their weak L1 Korean to dominant L2 English, although the priming effect size was very small. Finally, heritage speakers performed similarly to EngNSs in their judgment of Korean sentences containing locative alternation. They

failed to reject Type-2 verbs in Ground structures, a structure unacceptable in Korean but acceptable in English. On the other hand, they successfully learned to accept Type-1 verbs in Figure structures in Korean. The performance of heritage speakers and the EngNSs (i.e., late bilinguals) was not significantly different from each other in these structures. Moreover, Korean heritage speakers exhibited less-than native-like performance in English: they failed to reject Type-1 verbs in Figure structures in English. In short, when compared to native speakers, Korean heritage speakers overall performed like English speakers by performing native-like in English but non-native-like in Korean. One exception was with English locative alternation, where heritage speakers performed slightly less-than-nativelike in English. When compared to L2 speakers of Korean, heritage speakers showed slight advantages over adult L2 learners in speech perception and translation priming but not in locative alternation of Korean. Table 14 summarizes the findings of the current study.

Table 14. Heritage speaker performance in the three experiments compared to native-speaker and adult-L2 learner comparison groups

Studies	Korean	English
Speech Perception	Non-native-like Slight advantage over adult L2 learners	Native-like
Translation Priming	Non-native-like Slight advantage over adult L2 learners	Native-like
Grammar	Non-native-like No advantage over adult L2 learners	Native-like except for the structure causing the learnability problem

The findings in common indicate for early bilinguals, their early experience has a limited role while input dominance as a significant influence in shaping their bilingual

competence. Although all of the heritage speakers were mainly exposed to Korean before age 4, their performance in Korean seems to have been significantly compromised in all three linguistic domains. Conversely, they achieved native-like or near-native-like competence in their L2, English.

Despite the clarity of this general finding, somewhat different patterns were also observed across the three studies. For example, in the case of speech perception and translation priming, heritage-speaker performance was slightly better than the proficiency-matching adult L2 speakers even though they performed far from native-like in Korean. On the other hand, heritage speakers did not exhibit an advantage over the late learners in the locative alternation acceptability judgment.

One potential explanation for such cross-task differences is that heritage speakers may exhibit an advantage over L2 learners with early-acquired linguistic features. Montrul (2008), for example, proposed a hypothesis stating that heritage speakers should have an advantage over L2 learners with early-acquired linguistic knowledge. According to her, if heritage speakers' knowledge of the language has been acquired implicitly and primarily through the access of the Universal Grammar in childhood, they should have implicit knowledge of core aspects of phonology and morphosyntax which emerge very early in childhood (p. 220). Because features like phonology, core functional projections, and basic word order develop relatively early and do not depend on a significant amount of sustained input, heritage speakers should have an advantage over L2 learners in learning such features considering that the access to UG in adult L2 acquisition is debated. In contrast, aspects of language that are context-dependent and/or acquired later (e.g., after age 5) should be either missing or remain imperfectly acquired depending on

the input received during childhood, so heritage speakers may not necessarily be better than L2 speakers in learning these features.

The phonological distinction and the lexicon tested in the current dissertation are likely to have been acquired before age 4. Previous bilingual studies have found that native-like phonological sensitivity is established very early in life, even for bilinguals, typically in the first year of the life (e.g., Werker and Tees 1984), so it is highly likely the heritage speakers in this study acquired Korean phonemic distinctions before age 4.<sup>20</sup> The lexical items used in the translation priming studies were also very likely to have been acquired before age 3 because they were selected based on survey research conducted with mothers of three-year-old children. On the other hand, locative alternation (LA) rules seem to be relatively late-acquired features with some children reportedly having shown overgeneralization errors up until age 4 or 5 (Bowerman, 1982; Gropen, Pinker, and Hollander, 1991). Therefore, Montrul's (2008) hypothesis properly explains the data patterns found in the current dissertation: these heritage speakers exhibited an advantage over late L2 learners in the early-acquired features, including the phonological contrasts and lexical items tested in this dissertation, but not in the later-acquired features like locative alternation.

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<sup>20</sup> With respect to the Korean /s/-/s\*/ distinction, because there are no previous empirical data on monolingual or heritage speaking infants/children's acquisition of Korean lax /s/ and tense /s\*/, it is impossible to confirm whether the distinction was acquired prior to age 4. However, in general, native language specific sensitivity is typically acquired during the first year of life. Research has shown that even simultaneous bilinguals who receive more balanced input typically develop sensitivity to the phonological inventory of both languages within the first year and half (e.g., Bosch & Sebastián-Gallés, 2003). It therefore seems more likely that the current group of heritage speakers, having received mainly Korean input before age 4, had learned the Korean /s/ vs. /s\*/ distinction and lost it rather than having never acquired it at all.

One other possible explanation of the differential heritage-speaker advantage may rest in the difference between simultaneous bilingualism and sequential bilingualism. A relevant concept in heritage language acquisition is attrition and incomplete acquisition (Polinsky, 2000; Montrul, 2008). *Attrition* refers to the case where bilingual children once acquired accurate knowledge of the language but later lost this ability or had it weakened due to reduced input and use of the heritage language. On the other hand, *incomplete language acquisition* occurs when children switch from their heritage language to their dominant language without having fully mastered the first language. Heritage language development in this case is interrupted or delayed as a result of dominant language replacement at an early age. Considering the likely acquisitional timing of the three linguistic features examined in this study, the Korean phonological distinction and Korean lexical items in the first two experiments are likely to have been acquired and then attrited while the Korean LA rules are likely to be the result of both attrition and incomplete acquisition. In other words, the heritage speakers in this study appear to have acquired the lexicon and phonological sensitivity in one language (Korean) after the other (English), whereas locative alternation patterns may have been developed simultaneously, at least in part. Therefore, it is possible learning two languages with competing linguistic hypotheses simultaneously is more challenging than learning one language system after another, even among early bilinguals. As Montrul (2008) hypothesized, if L1 attrition occurs in early (pre-puberty) bilingualism, it may be more severe in simultaneous bilinguals (p. 98). Although her hypothesis was meant to compare different learner profiles in terms of timing of acquisition, the same logic may apply to different linguistic features acquired by a single learner. If the interruption by L2

input occurs before the L1 grammatical system fully develops and stabilizes, bilingual children may face greater interference, resulting in deviant grammar in both their L1 and L2. This may also be related to why the heritage speakers examined in this study performed non-native-like in locative alternation not only in their heritage language Korean but also in their dominant language English.

Potential evidence of an advantage in sequential bilingualism over simultaneous bilingualism among early bilinguals comes from Flege, Yeni-Komshian and Liu (1999) and Yeni-Komshian, Flege, and Liu (2000). The main aim of these studies was to examine the effect of age of L2 onset on the L1 and L2 pronunciation and morphosyntactic proficiency of Korean heritage speakers living in the U.S. In their examination of 240 heritage speakers with AoAs ranging from 1 to 23 years, they found L2 proficiency negatively correlated with AoA whereas L1 proficiency positively correlated with AoA. In particular, only 37 of the participants exhibited above-average pronunciation in both Korean and English. In addition, while none of these 37 participants scored within the range of scores given to native-control participants, two participants whose AoAs were 5 and 8 did qualify as native-like in both Korean and English. Perhaps the interesting finding of the study, though, is that bilingual competence seemed to achieve its greatest balance when AoA was between age 9 and 11. Put another way, it appears sequential bilinguals who establish their L1 first (until age 9) but then become exposed to their L2 early enough (before age 11) get the best results for both L1 and L2 proficiency. Nevertheless, any elements of acquisition never fully solidified appear to have long-lasting effect. This would explain the lack of advantage in LA scores achieved by heritage speakers relative to the adult L2 learners. That is, the heritage

speakers in this study never fully acquired Korean LA rules, unlike their perception of sound contrasts and direction of translation priming, thus maintained no advantage over adult L2 learners.

Hypotheses aside, it is impossible at this point to state with certainty whether the linguistic features examined in this series of experiments were acquired prior to age 4 or not because there are no existing data on monolingual or heritage speaking infants'/children's development of them. To better understand the nature of heritage language development, a comparison of Korean L1 learners and young Korean heritage speakers on various linguistic aspects must occur. Although the current discussion was based on the assumption that phonological sensitivity and the particular lexical items tested are typically acquired before age 4 and that grammatical knowledge of LA is not, these assumptions should be verified empirically in future research.

Another possible explanation for the cross-task difference may be found in the nature of the tasks. In the speech perception and translation priming studies, real-time psycholinguistic tasks were used. In the speech perception experiments, both the speeded encoding task and the two AX discrimination tasks required on-line processing of speech sounds, asking participants to respond as quickly and as accurately possible. Moreover, the speeded encoding task was specifically designed to be challenging to the participants, with the rationale that when given such a demanding task, only native speakers who have a separate phonological representation for each sound contrast should be able to perform effectively. Such a methodological choice turned out to be effective in discriminating the native and non-native speakers and may also explain the difference obtained between

heritage speakers and adult L2 learners: i.e., heritage speakers may have an advantage over adult L2 learners in the on-line processing of stimuli.

Likewise, the dependent variable of the translation-priming experiment was reaction-time difference, which measures the facility of processing vocabulary in real-time. On the contrary, the locative-alternation study adopted an off-line grammaticality judgment task. Participants rated each sentence after listening and reading it at the same time. Although participants were encouraged to rely on their intuition, they could take as much time as they like. Because of the off-line nature of the task, it is possible that participants paid explicit attention to forms and even tapped into their metalinguistic knowledge. Therefore, it seems possible that heritage speakers have an advantage over adult L2 learners in the processing of their heritage language, but not necessarily in the off-line tasks that may allow explicit attention to forms.

This raises an interesting question as to the nature of the linguistic competence that heritage speakers and adult L2 speakers possess. Although both heritage speakers and adult L2 learners performed non-native-like in all tasks, their knowledge may be quite different. In fact, their language acquisition contexts are different. Heritage speakers acquired Korean via extensive exposure to Korean, probably implicitly. However, adult L2 learners acquired Korean in a classroom and thus are likely to have acquired it using both explicit and implicit learning mechanisms. Although learning process and knowledge should not be confounded (e.g., one may be able to acquire implicit knowledge via explicit learning processes and vice versa.) it seems possible that due to different learning contexts, heritage speakers have developed more implicit, automatic,

and integrated knowledge of the language compared to adult L2 learners (e.g., Montrul, Foote, Perpiñán, Thornhill, & Vidal, 2006)

Finally, cross-study differences may have been observed simply because some linguistic features are more prone to attrition. The linguistic distance between L1 and L2 counterparts of particular features may vary, or the level of cross-linguistic influence of a particular feature may be greater on one language than the other. In fact, even within the same domain (e.g., phonology), some non-native sound contrasts seem to cause more difficulty either to L2 learners or heritage speakers. In a preliminary follow-up study on the perception of the Korean contrasts /s/-/s\*/ and /t/-/t\*/ by heritage speakers varying in age of arrival to the U.S. (Ahn & Lee-Ellis, 2009), the /s/-/s\*/ distinction turned out to be the most difficult contrast to perceive. The emerging data on the perception of varying sounds seem to suggest not only the acoustic but also perceptual distance between /s/ and /s\*/ appears to be extremely small to speakers of English. Therefore, it is possible that a majority of the variation in attrition could be attributed to the particular linguistic feature being examined.

Whatever the reason(s), the great variation in levels of proficiency among heritage speakers remains an interesting area of research. As shown in Chapter 5, although all of the heritage speakers in this study had the same AoA (i.e., born in the U.S.), their heritage language proficiency varied greatly. This great variation is one of the major findings consistently replicated in heritage language research (e.g., Montrul, 2005), and typically such variation has been attributed to the input factor (e.g., O'Grady et al., 2008). The belief is that heritage speakers receive varying amounts and quality of continued input in their heritage language throughout their lives, so their non-native-like competence as well

as the variations in their levels of competence are the product of reduced and varied amounts of input. However, there really is no empirical data or research demonstrating how variation in the input causes variation in the outcome of heritage language acquisition.

The attempt made in this dissertation to address the factors that cause heritage variation is far from conclusive; instead, it appears to raise more questions. For example, while no effect of language input or language use was found, language aptitude and instruction did exhibit an effect. However, as discussed, self-reported data may be an unreliable means of operationalizing language exposure and language use. In addition, the observed effect of language aptitude and amount of instruction may have stemmed from the re-learning of the heritage language by the participants during their adulthood. Without question, more systematic investigation of the factors that may cause individual variation among heritage speakers is needed.

The experiments employed in this dissertation, designed to examine the bilingual competence of heritage speakers, provide a fresh perspective from which to view the role of the critical period in bilingual development. As shown in all three studies, when heritage speakers are contrasted with post-critical period adult L2 learners, they exhibit a noteworthy advantage in their L2 English. According to the CPH (e.g., Johnson & Newport, 1989; Lenneberg, 1967; Newport, 1990), there is a maturationally-determined window of opportunity for language acquisition in early childhood. In L2 acquisition, this means L2 learning should start before the critical period ends to have a chance of becoming (near)-native-like in an L2. Although the exact nature or even existence of a critical period is still being debated in SLA (e.g., Bialystok, 1997; Long, 1990;

DeKeyser, 2012; Ferman & Karni, 2010), no one doubts that that age effects exists. This could explain how the heritage speakers of this study were able to achieve native-like competence in their L2 English as opposed to the Korean speakers who started learning English later in life.

On the other hand, this age effect argument may appear to contradict the fact that the heritage speakers in this study did not achieve native-like competence in Korean. They were exposed to Korean even earlier than English and have continued to be exposed to it throughout their lives. If early exposure alone were what it took to achieve native-like proficiency, then these learners should have become native-like in Korean. However, it is important once again to note that early exposure does not guarantee native-like attainment and other factors like the amount of input and cross-linguistic interaction can also affect language development. Non-native-like proficiency among early bilinguals has been reported before (e.g., Hyltenstam, 1992; Flege, 1999; Grosjean, 1989), and increasing evidence suggests that early exposure is a necessary but ultimately insufficient condition for the achievement of native-like competence (Hyltenstam & Abrahamsson, 2003). This seems true even among bilinguals who continue to be exposed to the language like the ones who participated in this dissertation, not to mention the international adoptees who are completely deprived of relevant linguistic input.

The critical period is not only the optimal period for human beings to learn languages, but also the period that is most susceptible to language loss in the absence of sustained optimal levels of input (Montrul, 2008; p. 262). In the case of early bilinguals, the developing linguistic system during the critical period remains flexible, so it is influenced by the quantity and quality of input (Flege, Yeni-Komshian & Liu, 1999;

O'Grady et al, 2008). If one considers the original notion of the critical period as “a temporal span of heightened sensitivity<sup>21</sup> to environmental stimuli,” it seems natural that the earlier the decrease in L1 input starts, the more substantial the attrition will be. Heritage speakers, whose dominant input switches from L1-to-L2 before the critical period ends, can be understood to have gone through a significant language loss in their heritage language.

Finally, aside from the role of age and input, the findings of the current dissertation highlight the cross-linguistic interaction effect in bilingualism. In particular, heritage speakers' less-than-nativelike performance with English locative alternation reveals that it cannot be only age nor insufficient input that causes incomplete acquisition. Therefore, when less-than-nativelike performance is observed either in early or late bilinguals, one must consider the possibility that at least part of the “incompleteness” stems from just “being a bilingual” because bilinguals are not two monolinguals in one mind (Grosjean, 2008).

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<sup>21</sup> The nature of “heightened sensitivity” to input in itself should be a topic for future research. In essence, it should relate to the learner's ability to utilize the linguistic input to form and revise linguistic hypothesis. Such ability could range from the ability to notice the gap in the input (e.g., Schmidt's (1990) noticing hypothesis) to the increased inferential capacity that help link input data to developing linguistic representation.

## Chapter 8. Conclusion

The aim of this study was to examine several of the core issues of bilingualism (i.e., timing, input and cross-linguistic interaction) via a particular type of early bilingual, that of the heritage speaker. Based on the results from experiments that examined the phonological sensitivity, lexical access, and grammatical knowledge of Korean heritage speakers growing up in the U.S., both in their weaker L1 (Korean) and more-dominant L2 (English), it is concluded here that for early bilinguals, it is mainly input dominance that shapes their linguistic competence in adulthood while their linguistic experiences during childhood have a very limited role long-term. In this particular case, Korean heritage speakers raised in an English-speaking country developed (near-)native-like competence in English while showing significant weakness in certain aspects of their Korean competence despite being exposed to Korean first and throughout their lives.

Nevertheless, these findings should not be interpreted as evidence of the unimportance of timing in bilingualism because it is the “earliness” of the input-dominance shift from Korean to English (i.e., around age 4) that appears to have caused such a dramatic reorganization of their linguistic representation. In a sense, these speakers changed their native language, which was possible only because their language-input switch occurred early enough (before their critical period for language learning ended). Likewise, cross-linguistic interaction that occurs between two languages at an early age seems to have long-lasting consequences, sometimes resulting in non-native-like features in both languages.

In sum, timing, input, and cross-linguistic interaction all contribute significantly to the development of bilingual competence. Moreover, their effects seem to synergize with other factors. The heritage speakers who participated in this set of experiments turned out to be a population that served as an excellent testing ground for all three of these ingredients of language acquisition, each of which makes a significant and dynamic contribution to early bilingual competence.

The findings described in this dissertation have important implications in that they challenge existing views regarding the implasticity of human language representation (e.g., Pallier et al, 1997). It is argued here that the early/first established linguistic representation can be reshaped and replaced by later experience, a hypothesis that is consistent with recent findings that suggest that L1 attrition in bilingual children can be a lot more extensive than it is in adults. In other words, native languages may not be as robust as previously assumed. At least in the case of early bilinguals, input dominance is able to reshape their initial linguistic representation so drastically that their early L1 experience yields only a limited advantage over people who are not exposed to the language until adulthood (post critical period).

Such remarkable L1 instability suggests the need to reconsider some of the common assumptions of bilingual competence. Current models of bilingual mental lexicons, for example, should be revised to take into account the role of language dominance in the strength of connection between a lexicon and mental representation. It also suggests linguistic domains generally considered to be resistant to attrition (e.g., phonology) should be reexamined to determine the extent of their plasticity (Ventureyra et al., 2004, p. 89). There is also the need to further research the amount and quality of

linguistic input required to maintain an initially acquired language. In short, the results described in this dissertation suggest that continued input may be necessary but can still be insufficient for language maintenance (c.f., Flege & MacKay, 2004).

One other point to consider is the interaction of a bilingual's two languages, something that has long-term consequences for both languages. As evidenced through the learnability resolution of locative alternation by the participants of this study, a bilingual speaker's weaker language and more dominant language both can differ from the respective monolingual's linguistic competence. This finding supports the idea that bilinguals develop an intermediate value in their linguistic representation. Therefore, future research on bilingualism needs to consider this finding when comparing bilingual competence to native-like-ness that is defined by monolingual linguistic performance.

Findings aside, this dissertation is not without limitation and in fact casts more doubt than certainty regarding the development of early bilingual competence. First, due to the paucity of first language acquisition research on the topic, it is difficult to gauge whether the loss of heritage language competence observed in this study is a result of language attrition or incomplete acquisition. To better understand the nature of heritage language competence, future studies should compare Korean first language learners, young Korean heritage speakers, and adult Korean heritage speakers. Second, because the participants of the current dissertation are heritage speakers born in the U.S., the effect of early English exposure cannot be completely discounted. Although many efforts were made to control for this possibility, it nevertheless remains possible that participants had considerable English input before the age of 4. It would therefore be informative to test true early L2 learners, immigrants who arrived in the U.S. at age 4 without any previous

exposure to English. The comparison of U.S.-born heritage speakers and Korean-born early L2 learners would provide a clearer picture of the effects of language-dominance switches as well as cross-linguistic interaction in early bilingualism.

Looking forward, several additional questions should be addressed in future research. First, whether early-bilingual linguistic knowledge disappears or remains but is difficult to access should be considered. One means of addressing the question would be to conduct training studies that offer the re-learning of Korean to heritage speakers and matching adult L2 learners. These relearning studies could also include heritage speakers of varying ages to further explore the relationship between age and relearning effect. Second, in order to understand exactly how bilingual experience influences the development of two languages, it is critical to understand how bilingual input during childhood influences the development of two languages in the heritage speaker's mind. To date, virtually no study has been conducted on exactly *how much* and *what kind of* input is necessary for balanced bilingual development, yet such research is greatly needed to further the field's understanding. Likewise, longitudinal studies that examine varying profiles of early bilinguals would greatly benefit our understanding of the effects of age, input sensitivity, and cross-linguistic interaction. The plasticity of human language capacity as exhibited by the early bilinguals of this study reveals how intricately all these factors interact in shaping the bilingual mind.

## Appendices

### Appendix 1. Proficiency tests

#### Appendix 1-a. Korean C-Test

Participant #:

Date:

#### **Korean Proficiency Test**

This is a test of how well you comprehend and produce written Korean. You will read five texts. In each, parts of some words are missing. Study each text and write in the missing letters. Each line represents one syllable. No negative point will be deducted for a wrong answer. Spelling will not be assessed as long as the words are identifiable.

Example:     안녕\_\_\_. 제 이 \_\_ 김철수입니다. ....

Your job is to complete the test as:

안녕 하 세 요. 제 이 름 은 김철수입니다. ....

Notice that partial points are available. If you know only part of the missing parts, fill in the part that you know instead of skipping the entire words/phrases. (e.g., “제 이? 은 김철수입니다.” will receive partial credit.)

You will be given 30 minutes to complete the test. This test is designed for all ranges of proficiency (i.e., from beginning to near-native), so it will seem challenging to many of you. However, please do your best until the end, and make sure you work on all five texts if you have time.

#### Passage 1

안녕하세요. 제 이름은 김철수입니다. 저는 대학 \_\_ 다닙니다. 아침에 일어 \_\_ 학교 체육 \_\_ 갑니다. 체육 \_\_ 운동을 합 \_\_. 운동을 한 다 \_\_ 아침을 먹습니다. 아침은 기숙 \_ 식당에서 먹습니다.  
저는 대학 \_\_ 한국어를 배 \_\_. 한국어 수 \_\_ 매일 오 \_ 10 시에 시작 \_\_. 한국어는 쓰 \_\_ 말하기가 어 \_\_. 그렇지만 듣 \_\_ 읽기는 쉽 \_\_. 한국어 배 \_\_ 것이 참 재미 \_\_.  
주말에는 친 \_\_ 같이 극 \_\_ 영화를 봅니다. 영화를 \_ 후에 한국 식당에서 저 \_\_ 먹습니다. 한국 식 \_\_ 극장 바 \_ 옆에 있습니다. 불고 \_\_ 맛있습니다. 김치찌개는 맵습니다.

### Passage 2

올 여름에는 가족들과 함께 제주도에 여행을 가려고 해요. 제주도는 한반  
\_\_ 남쪽에 있 \_\_ 섬이에요. 한국의 하와이라 불 \_\_ 제주도는 자 \_\_  
아름다워서 신혼 \_\_ 장소로 인 \_\_ 굉장히 많 \_\_. 오늘은 여행 \_\_ 전화를  
걸 \_\_ 서울에서 제주도 \_\_ 왕복 비행 \_\_ 네장 예 \_\_\_\_. 여행 \_\_  
호텔도 소개 \_ 주었지만 호텔은 아직 안 정 \_\_\_\_. 인터넷으로 정 \_\_ 더  
찾아 보 \_ 어느 호텔이 좋 \_ 지 알아 보 \_\_ 해요. 요 \_\_ 인터넷이 있 \_\_  
호텔 뿐 아 \_\_ 유명한 관 \_ 명소와 맛 \_\_ 식당도 찾아 볼 \_ 있어서 참  
편리해요.

### Passage 3

안녕하세요. 서울역 앞에 위치한 서울 백화점입니다. 저희 백화점 \_\_\_  
겨울철을 맞 \_ 겨울옷과 난 \_ 제품을 세일 \_\_ 있습니다.  
직장 여 \_\_ 위한 여성복 코너 \_\_ 여성 정 \_ 과 겨울 속 \_\_ 50 프로  
세일하고 있 \_\_, 삼층 아동 \_ 코너에서도 코 \_\_, 목도리, 장 \_ 등의 겨 \_  
상품이 각 30프로씩 할 \_\_ 가격에 판 \_\_ 있습니다. 칠 \_에서는 집안을  
따 \_\_ 해 줄 전 \_ 히터와 가스 난 \_ 등 다양 \_ 난방용 가 \_ 제품을 특가판  
\_\_\_ 있습니다. 저 \_ 서울 백화점과 함 \_ 겨울나기 준 \_\_ 시작하세요. 고객  
여러분의 많은 성원 부탁드립니다. 감사합니다.

### Passage 4

도시의 가장 큰 문제점이라면 뭐니뭐니해도 교통 문제가 제일 크다.  
도로에서는 교 \_ 체증으로 인 \_\_ 에너지와 시 \_\_ 낭비된다.  
특히 출 \_\_ 시간에는 한꺼 \_\_ 차량이 일제 \_ 몰려서 도 \_\_ 아주  
복 \_\_. 게다가 뉴욕 같은 대도 \_\_ 주차난은 매 \_ 심각한 수준 \_\_. 자동 \_  
\_ 점점 많아 \_\_ 반면 주 \_ 공간은 제 \_\_ 있기 때 \_\_ 주차난이 생 \_\_.  
주차장이 부족하면 사람 \_\_ 주택가 골 \_ 이나 도로에까지 주차를 하 \_  
경우가 많다. 이렇게 불 \_ 으로 주 \_\_ 차량은 또 다시 교통 혼 \_\_ 원인이 되  
\_ 더 심 \_\_ 교통 체증을 일으킨다. 따라서 교통 문제를 해결하기 위해서는  
자가용보다는 버스나 지하철을 많이 이용해야 할 것이다.

Appendix 1-b. English C-Test

Participant #:

Date:

**English Proficiency Test**

**Directions**

The following tests have been developed by removing the second half of every second word in a text. You are supposed to reconstruct the texts.

**Example:** My name is Tom. I'm t\_\_ oldest ch\_\_ in m\_\_ family. I ha\_\_ a sister a\_\_ two brot\_\_.

**Answer:** My name is Tom. I'm the oldest child in my family. I have a sister and two brothers.

**Text 1**

The representation of thought was achieved by means of oral signs, mutually understood by the group who recognized the same system of representation. This or\_\_ manifestation w\_\_ later o\_\_ preserved i\_\_ the fo\_\_ of draw\_\_ and writ\_\_, so th\_\_ each comm\_\_ left beh\_\_ a record o\_\_ its cul\_\_. But wri\_\_ is n\_\_ only a w\_\_ to pres\_\_ memory; i\_\_ is al\_\_ the sym\_\_ of a cul\_\_. This c\_\_ be cle\_\_ observed i\_\_ the sys\_\_ of wri\_\_, which were historically developed. Writing was later developed into artistic and aesthetic forms of knowledge and communication.

**Text 2**

Postcards always spoil my holidays. Last sum\_\_, I we\_\_ to It\_\_. I vis\_\_ museums, a\_\_ sat i\_\_ public gar\_\_. A frie\_\_ waiter tau\_\_ me a f\_\_ words o\_\_ Italian. H\_\_ lent m\_\_ a bo\_\_. I re\_\_ a f\_\_ lines, b\_\_ I d\_\_ not under\_\_ a wo\_\_. Every d\_\_ I tho\_\_ about post\_\_. My holi\_\_ passed qui\_\_, but I did not send any cards to my friends. On the last day I made a big decision. I got up early and bought thirty-seven cards. I spend the whole day in my room, but I did not write a single card!

**Text 3**

Some people believe that cigarette smoking is dangerous and should be considered a health hazard. They wa\_\_ their gover\_\_ to cre\_\_ antismoking prog\_\_. People dif\_\_ as t\_\_ how st\_\_ these antis\_\_ campaigns sho\_\_ be. So\_\_ of the stro\_\_ campaigns wo\_\_ try t\_\_ completely elim\_\_ cigarette smo\_\_. Supporters o\_\_ these prog\_\_ would t\_\_ to b\_\_ cigarette smo\_\_ completely i\_\_ public pla\_\_. Others wo\_\_ try on\_\_ to rest\_\_ the number of places where people could smoke. Such restrictions would not try to eliminate public smoking completely, but only to curb smoking by reducing cigarette consumption.

#### Text 4

Recent studies indicate that grandparents and grandchildren are better off when they spend large amounts of time together. Grandparents give children love of affection with numerous attachments, and thus children make the grandparents feel loved and needed at a time when the society may be telling old people that they are a burden. Grandparents are a source of strength and wisdom and help ease the pressure between children and their parents.

#### Text 5

Is astrology a science? It certainly claims to be otherwise. We know that astrologers commit themselves to predictions based on an alleged connection between the positions of the stars and human lives. People born under a certain sign of the zodiac are supposed to be of a certain temperament. Whenever one planet is near another this is supposed to mean that the time is favourable for love, or war, or business deals. But does astrology make good its claims to predict the future with reasonably consistent success?

Appendix 2. Language background questionnaires

Appendix 2-a. Language background questionnaire for heritage speakers

## Language History Questionnaire

This information will be kept confidential.

Participant ID #		Group	Heritage	Today's Date (m/d/y)	
Age		Gender			
Place of Birth		If born in Korea, when did you come to the U.S.?			

1. List all the languages you know in the order of dominance/fluency.

Language A	Language B	Language C	Language D	Language E

2. List all the languages you know in order of acquisition (first learned to last).

Language A	Language B	Language C	Language D	Language E

3. Please list what percentage of time you have **been exposed to (heard)** Korean and English. Consider your daily language interaction and what you hear from family, friends, school, community, church, TV, newspaper, and etc.

Age Band	Korean (%)	English (%)	Total (Should be 100 unless another language is acquired)
Before Age 4			0
Age 5~12			0
Age 13~18			0
Age 19~Current			0

4. Please list what percentage of time you have **used (spoken in)** Korean and English. Consider your daily language interaction and what you speak to family, friends, school, community, church, TV, newspaper, and etc.

Age Band	Korean (%)	English (%)	Total (Should be 100 unless another language is acquired)
Before Age 4			0
Age 5~12			0
Age 13~18			0
Age 19~Current			0

5. When did you start being extensively exposed to English and how? (e.g., Age 4, Attended a day care; Age 5, Attended an elementary school, etc)

Age	Context

6. Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to which you identify with each culture.

Culture	Korean	American	Other:
Rating	<a href="#">Click here for scale*</a>	<a href="#">Click here for scale</a>	<a href="#">Click here for scale</a>

\* See Scale Below

7. Have you lived in or visited Korea before? If so, at what age & how long?

Age		Length (Months)	
Age		Length (Months)	
Age		Length (Months)	
Total Months	0		

8. Have you had formal language instructions in Korean before?

Beginning Age		Hours/week		How long (Months)	
Beginning Age		Hours/week		How long (Months)	

Beginning Age		Hours/week		How long (Months)	
Total Hours	0				

9. Please rate your ability to **SPEAK** in **KOREAN**. Also, how much/often do you speak in Korean?

Choose the highest level description that you can complete with not much difficulty.

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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10. Please rate your ability to **READ** in **KOREAN**. Also, how much/often do you read in Korean?

Choose the highest level description that you can complete with not much difficulty.

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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11. Please rate your ability to **SPEAK** in **ENGLISH**. Also, how much/often do you speak in English?

Choose the highest level description that you can complete with not much difficulty.

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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12. Please rate your ability to **READ** in **ENGLISH**. Also, how much/often do you read in English?

Choose the highest level description that you can complete with not much difficulty.

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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## Family History

1. Where are your parents/caregivers from? In what language do they speak to you?

	Country	City/Province	Korean (%)	English(%)	Total (100%)
Mother					0
Father					0
Grand parents (if you live together)					0

2. How well do they speak **ENGLISH**? How much/often do they speak in English?

*Choose the highest level description that you can complete with not much difficulty.*

	Speaking Ability	Speaking Amount
Mother	<a href="#">Click here for scale</a>	<a href="#">Click here for scale</a>
Father	<a href="#">Click here for scale</a>	<a href="#">Click here for scale</a>
Grand parents	<a href="#">Click here for scale</a>	<a href="#">Click here for scale</a>

3. Do you have siblings? How many? What order are you among siblings?

# of siblings		Your Order	
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4. What languages do your siblings speak with you & parents? At what percentage?

	Korean (%)	English (%)	Total (100%)
With you			0
With parents			0

## Language History Questionnaire Scales

### Q 6. Cultural Identification Scale

- 0 - No identification
- 1 - Very low identification
- 2
- 3
- 4
- 5 - Moderate identification
- 6
- 7
- 8
- 9
- 10 - Complete identification

### Q 9. Korean Speaking Ability Scale

- 0 - Cannot speak Korean at all.
- 1 - Can count 10 in Korean.
- 2 - Can say hello and introduce myself.
- 3 - Can order a meal at a Korean restaurant.
- 4 - Can describe my present job, studies, or major life activities in detail.
- 5 - Can describe my latest travel experience accurately and in detail.
- 6 - Can report an event or news happened around me (e.g., crime, sports event).
- 7 - Can describe and discuss the U.S. educational system in detail.
- 8 - Can state and support with examples/reasons of my position on controveral topics (e.g., birth control, enviromental issues)
- 9 - Can construct a structural hypothesis on an abstract issue (e.g., globalization and ethnic identify) and discuss the topic knowledgably.
- 10- Can discuss highly technical or cultural topics with an appropriate level of speech, sophistication, and nuances.

Q 9. Korean Speaking Amount Scale

- 0 - Don't speak in Korean at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

Q 10. Korean Reading Ability Scale

- 0 - Do not know Korean Script at all.
- 1 - Can read Korean script.
- 2 - Can read menu items at a restaurant.
- 3 - Can read and understand simple biographical information.
- 4 - Can read and understand a description of daily schedule.
- 5 - Can read and understand a travel diary posted on a personal website.
- 6 - Can read and understand the summary story line of Korean drama.
- 7 - Can read and understand survey result reports on diets of children.
- 8 - Can read and understand news reports about recent North Korean refugees.
- 9 - Can read and understand editorial articles on global warming or free trades.
- 10 - Can read technical and abstract prose such as legal document or philosophical texts.

Q 10. Korean Reading Amount Scale

- 0 - Don't read in Korean at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

Q 11. English Speaking Ability Scale

- 0 - Cannot speak English at all.
- 1 - Can count 10 in English.
- 2 - Can say hello and introduce myself.
- 3 - Can order a meal at a restaurant.
- 4 - Can describe my present job, studies, or major life activities in detail.
- 5 - Can describe my latest travel experience accurately and in detail.
- 6 - Can report an event or news happened around me (e.g., crime, sports event).
- 7 - Can describe and discuss the U.S. educational system in detail.
- 8 - Can state and support with examples/reasons of my position on controveral topics (e.g., birth control, enviromental issues)
- 9 - Can construct a structural hypothesis on an abstract issue (e.g., globalization and ethnic identify) and discuss the topic knowledgably.
- 10- Can discuss highly technical or cultural topics with an appropriate level of speech, sophistication, and nuances.

Q 11. English Speaking Amount Scale

- 0 - Don't speak in English at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

Q 12. English Reading Ability Scale

- 0 - Do not know English Script at all.
- 1 - Can read English script.
- 2 - Can read menu items at a restaurant.
- 3 - Can read and understand simple biographical information.
- 4 - Can read and understand a description of daily schedule.
- 5 - Can read and understand a travel diary posted on a personal website.
- 6 - Can read and understand the summary story line of English drama.
- 7 - Can read and understand survey result reports on diets of children.
- 8 - Can read and understand news reports about recent North English refugees.
- 9 - Can read and understand editorial articles on global warming or free trades.
- 10 - Can read technical and abstract prose such as legal document or philosophical texts.

### Q 12. English Reading Amount Scale

- 0 - Don't read in English at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

### Family History Scales

#### Q 2. Family English Speaking Ability Scale

- 0 - Cannot speak English at all.
- 1 - Can count 10 in English.
- 2 - Can say hello and introduce myself.
- 3 - Can order a meal at a restaurant.
- 4 - Can describe my present job, studies, or major life activities in detail.
- 5 - Can describe my latest travel experience accurately and in detail.
- 6 - Can report an event or news happened around me (e.g., crime, sports event).
- 7 - Can describe and discuss the U.S. educational system in detail.
- 8 - Can state and support with examples/reasons of my position on controversial topics (e.g., birth control, environmental issues)
- 9 - Can construct a structural hypothesis on an abstract issue (e.g., globalization and ethnic identify) and discuss the topic knowledgably.
- 10- Can discuss highly technical or cultural topics with an appropriate level of speech, sophistication, and nuances.

Q 2. Family English Speaking Amount Scale

0 - Don't speak in English at all.

1 - less than 1 hour/month

2 - 1~3 hour/ month

3 - 1 hour/week

4 - 2~4 hours/week

5 - 4~6 hours/week

6 - 1 hour/day

7 - 2 hours/day

8 - 3~4 hours/day

9 - 5~6 hours/day

10 - more than 6 hours/day

Appendix 2-b. Language background questionnaire for KSL English native speakers

## Language History Questionnaire

Participant ID #		Group	KSL EngNS	Today's Date (m/d/y)	
Age		Gender		Place of Birth	

1. List all the languages you know in the order of dominance/fluency.

Language A	Language B	Language C	Language D	Language E

2. List all the languages you know in order of acquisition (first learned to last).

Language A	Language B	Language C	Language D	Language E

3. How long have you been learning Korean in the DLI program?

Weeks in DLI	
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4. How many hours do you spend learning Korean per WEEK?

Instructional Hours		Outside Class	
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5. Have you learned Korean or been exposed to Korean before coming to the DLI? If so, at what age? How? (e.g., age 12~18, Foreign language at school OR since birth, Family spoke Korean at home)

Age		Context	
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6. Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to which you identify with each culture.

Culture	Korean	American	Other:
Rating	<a href="#">Click here for scale*</a>	<a href="#">Click here for scale</a>	<a href="#">Click here for scale</a>

\* See scale below

7. Please rate your ability to **SPEAK** in **KOREAN**. Also, how much/often do you speak in Korean?

*Choose the highest level description that you can complete with not much difficulty.*

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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8. Please rate your ability to **READ** in **KOREAN**. Also, how much/often do you read in Korean?

*Choose the highest level description that you can complete with not much difficulty.*

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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9. Please rate your ability to **SPEAK** in **ENGLISH**. Also, how much/often do you speak in English?

*Choose the highest level description that you can complete with not much difficulty.*

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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10. Please rate your ability to **READ** in **ENGLISH**. Also, how much/often do you read in English?

*Choose the highest level description that you can complete with not much difficulty.*

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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## Language History Questionnaire Scales for KSL EngNSs

### Q 6. Cultural Identification Scale

0 - No identification

1 - Very low identification

2

3

4

5 - Moderate identification

6

7

8

9

10 - Complete identification

#### Q 7. Korean Speaking Ability Scale

- 0 - Cannot speak Korean at all.
- 1 - Can count 10 in Korean.
- 2 - Can say hello and introduce myself.
- 3 - Can order a meal at a Korean restaurant.
- 4 - Can describe my present job, studies, or major life activities in detail.
- 5 - Can describe my latest travel experience accurately and in detail.
- 6 - Can report an event or news happened around me (e.g., crime, sports event).
- 7 - Can describe and discuss the U.S. educational system in detail.
- 8 - Can state and support with examples/reasons of my position on controversial topics (e.g., birth control, environmental issues)
- 9 - Can construct a structural hypothesis on an abstract issue (e.g., globalization and ethnic identify) and discuss the topic knowledgably.
- 10- Can discuss highly technical or cultural topics with an appropriate level of speech, sophistication, and nuances.

#### Q 7. Korean Speaking Amount Scale

- 0 - Don't speak in Korean at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

#### Q 8. Korean Reading Ability Scale

- 0 - Do not know Korean Script at all.
- 1 - Can read Korean script.
- 2 - Can read menu items at a restaurant.
- 3 - Can read and understand simple biographical information.
- 4 - Can read and understand a description of daily schedule.
- 5 - Can read and understand a travel diary posted on a personal website.
- 6 - Can read and understand the summary story line of Korean drama.
- 7 - Can read and understand survey result reports on diets of children.
- 8 - Can read and understand news reports about recent North Korean refugees.
- 9 - Can read and understand editorial articles on global warming or free trades.
- 10 - Can read technical and abstract prose such as legal document or philosophical texts.

#### Q 8. Korean Reading Amount Scale

- 0 - Don't read in Korean at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

#### Q 9. English Speaking Ability Scale

- 0 - Cannot speak English at all.
- 1 - Can count 10 in English.
- 2 - Can say hello and introduce myself.
- 3 - Can order a meal at a restaurant.
- 4 - Can describe my present job, studies, or major life activities in detail.
- 5 - Can describe my latest travel experience accurately and in detail.
- 6 - Can report an event or news happened around me (e.g., crime, sports event).
- 7 - Can describe and discuss the U.S. educational system in detail.
- 8 - Can state and support with examples/reasons of my position on controversial topics (e.g., birth control, environmental issues)
- 9 - Can construct a structural hypothesis on an abstract issue (e.g., globalization and ethnic identify) and discuss the topic knowledgably.
- 10- Can discuss highly technical or cultural topics with an appropriate level of speech, sophistication, and nuances.

#### Q 9. English Speaking Amount Scale

- 0 - Don't speak in English at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day

Q 10. English Reading Ability Scale

- 0 - Do not know English Script at all.
- 1 - Can read English script.
- 2 - Can read menu items at a restaurant.
- 3 - Can read and understand simple biographical information.
- 4 - Can read and understand a description of daily schedule.
- 5 - Can read and understand a travel diary posted on a personal website.
- 6 - Can read and understand the summary story line of English drama.
- 7 - Can read and understand survey result reports on diets of children.
- 8 - Can read and understand news reports about recent North English refugees.
- 9 - Can read and understand editorial articles on global warming or free trades.
- 10 - Can read technical and abstract prose such as legal document or philosophical texts.

Q 10. English Reading Amount Scale

- 0 - Don't read in English at all.
- 1 - less than 1 hour/month
- 2 - 1~3 hour/ month
- 3 - 1 hour/week
- 4 - 2~4 hours/week
- 5 - 4~6 hours/week
- 6 - 1 hour/day
- 7 - 2 hours/day
- 8 - 3~4 hours/day
- 9 - 5~6 hours/day
- 10 - more than 6 hours/day



7. 본인의 **영어 말하기** 수준을 가장 잘 묘사한 것을 보기에서 골라 주세요. 영어를 일주일에 얼마나 말하는 지도 골라 주세요.

*아래 묘사된 레벨 중에서 여러분이 어려움을 많이 느끼기 시작하는 레벨이 있다면 그 레벨 바로 밑의 레벨을 선택하시면 본인의 레벨이 됩니다.*

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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8. 본인의 **영어 읽기** 수준을 가장 잘 묘사한 것을 보기에서 골라 주세요. 영어를 일주일에 얼마나 읽는 지도 골라 주세요.

*아래 묘사된 레벨 중에서 여러분이 어려움을 많이 느끼기 시작하는 레벨이 있다면 그 레벨 바로 밑의 레벨을 선택하시면 본인의 레벨이 됩니다.*

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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9. 본인의 **한국어 말하기** 수준을 가장 잘 묘사한 것을 보기에서 골라주세요. 한국어를 일주일에 얼마나 말하는 지도 골라 주세요.

*아래 묘사된 레벨 중에서 여러분이 어려움을 많이 느끼기 시작하는 레벨이 있다면 그 레벨 바로 밑의 레벨을 선택하시면 본인의 레벨이 됩니다.*

Speaking Ability	<a href="#">Click here for scale</a>	Speaking Amount	<a href="#">Click here for scale</a>
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10. 본인의 **한국어 읽기** 수준을 가장 잘 묘사한 것을 보기에서 골라 주세요. 한국어를 일주일에 얼마나 읽는 지도 골라 주세요.

*아래 묘사된 레벨 중에서 여러분이 어려움을 많이 느끼기 시작하는 레벨이 있다면 그 레벨 바로 밑의 레벨을 선택하시면 본인의 레벨이 됩니다.*

Reading Ability	<a href="#">Click here for scale</a>	Reading Amount	<a href="#">Click here for scale</a>
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## Language History Questionnaire Scales for ESL KorNSs

### Q 6. Cultural Identification Scale

0 - 전혀 동질감 느끼지 않는다.

1 - 아주 낮은 동질감

2

3

4

5 - 보통의 동질감

6

7

8

9

10 - 완전한 동질감

### Q 7. English Speaking Ability Scale

- 0 - 영어를 전혀 말할 줄 모른다.
- 1 - 영어로 10 까지 셀 수 있다.
- 2 - 영어로 인사하고 자기소개를 할 수 있다.
- 3 - 미국 식당에서 음식을 주문할 수 있다.
- 4 - 내 직업, 공부하는 것, 일상 생활등에 대해 자세히 이야기 할 수 있다.
- 5 - 최근 여행 경험을 자세하고 정확하게 이야기할 수 있다.
- 6 - 범죄사건이나 스포츠 경기등 내 주변에서 최근 일어날 사건을 설명할 수 있다.
- 7 - 미국과 한국 교육 제도나 문제에 대해서 영어로 자세히 비교 설명할 수 있다.
- 8 - 사회적으로 이슈가 되는 내용 (예: 낙태, 환경문제) 등에 대해 나의 의견을 피력하고 논리적 근거를 들며 주장을 뒷받침할 수 있다.
- 9 - 추상적이고 국제적인 내용에 대해 (예: 세계화와 민족정체성)에 대해서 체계적이 가설을 세우고 유식하게 토론할 수 있다.
- 10- 어떤 추상적/기술적/문화적인 내용에 대해서도 상황에 맞는 뉘앙스를 적절히 써가며 세련된 어법으로 이야기할 수 있다.

### Q 7. English Speaking Amount Scale

- 0 - 영어를 전혀 말하지 않는다
- 1 - 한달에 한시간 이하
- 2 - 한달에 1~3 시간
- 3 - 일주일에 한시간
- 4 - 일주일에 2~3 시간
- 5 - 일주일에 4~6 시간
- 6 - 하루에 한시간
- 7 - 하루에 두시간
- 8 - 하루에 3~4 시간
- 9 - 하루에 5~6 시간
- 10 - 하루에 6 시간 이상

### Q 8. English Reading Ability Scale

- 0 - 영어 알파벳을 전혀 모른다
- 1 - 영어 알파벳을 읽을 줄 안다
- 2 - 레스토랑에서 메뉴를 읽을 수 있다
- 3 - 간단한 자기 소개를 읽고 이해한다.
- 4 - 일상 일과를 읽고 이해할 수 있다.
- 5 - 개인 웹사이트에 올라온 여행 일지를 읽고 이해할 수 있다.
- 6 - 미국 드라마의 내용 설명을 읽고 이해할 수 있다.
- 7 - 최근 미국 어린이 식생활에 대한 신문 기사를 읽고 이해할 수 있다.
- 8 - 이라크 전쟁에 대한 신문 기사 내용을 읽고 이해할 수 있다.
- 9 - 세계 온난화나 자유무역등에 대한 논평을 읽고 이해할 수 있다.
- 10 - 철학서나 법률문서등 추상적이거나 상당히 기술적인 내용을 글을 읽고 이해할 수 있다.

### Q 8. English Reading Amount Scale

- 0 - 영어를 전혀 읽지 않는다.
- 1 - 한달에 한시간 이하
- 2 - 한달에 1~3 시간
- 3 - 일주일에 한시간
- 4 - 일주일에 2~3 시간
- 5 - 일주일에 4~6 시간
- 6 - 하루에 한시간
- 7 - 하루에 두시간
- 8 - 하루에 3~4 시간
- 9 - 하루에 5~6 시간
- 10 - 하루에 6 시간 이상

### Q 9. Korean Speaking Ability Scale

- 0 - 한국어를 전혀 말할 줄 모른다.
- 1 - 한국어로 10 까지 셀 수 있다.
- 2 - 한국어로 인사하고 자기소개를 할 수 있다.
- 3 - 한국 식당에서 음식을 주문할 수 있다.
- 4 - 내 직업, 공부하는 것, 일상 생활등에 대해 자세히 이야기 할 수 있다.
- 5 - 최근 여행 경험을 자세하고 정확하게 이야기할 수 있다.
- 6 - 범죄사건이나 스포츠 경기등 내 주변에서 최근 일어날 사건을 설명할 수 있다.
- 7 - 미국과 한국 교육 제도나 문제에 대해서 한국어로 자세히 비교 설명할 수 있다.
- 8 - 사회적으로 이슈가 되는 내용 (예: 낙태, 환경문제) 등에 대해 나의 의견을 피력하고 논리적 근거를 들며 주장을 뒷받침할 수 있다.
- 9 - 추상적이고 국제적인 내용에 대해 (예: 세계화와 민족정체성)에 대해서 체계적이 가설을 세우고 유식하게 토론할 수 있다.
- 10- 어떤 추상적/기술적/문화적인 내용에 대해서도 상황에 맞는 뉘앙스를 적절히 써가며 세련된 어법으로 이야기할 수 있다.

### Q 9. Korean Speaking Amount Scale

- 0 - 한국어를 전혀 말하지 않는다
- 1 - 한달에 한시간 이하
- 2 - 한달에 1~3 시간
- 3 - 일주일에 한시간
- 4 - 일주일에 2~3 시간
- 5 - 일주일에 4~6 시간
- 6 - 하루에 한시간
- 7 - 하루에 두시간
- 8 - 하루에 3~4 시간
- 9 - 하루에 5~6 시간
- 10 - 하루에 6 시간 이상

**Q 10. Korean Reading Ability Scale**

- 0 - 한글을 전혀 읽을 줄 모른다.
- 1 - 한글을 읽을 수 있다.
- 2 - 한국 식당에서 메뉴를 읽을 수 있다.
- 3 - 간단한 자기 소개를 읽고 이해한다.
- 4 - 일상 일과를 읽고 이해할 수 있다.
- 5 - 개인 웹사이트에 올라온 여행 일지를 읽고 이해할 수 있다.
- 6 - 한국 드라마의 내용 설명을 읽고 이해할 수 있다.
- 7 - 최근 한국 어린이 식생활에 대한 신문 기사를 읽고 이해할 수 있다.
- 8 - 최근 탈북 난민에 대한 신문 기사 내용을 읽고 이해할 수 있다.
- 9 - 세계 온난화나 자유무역등에 대한 논평을 읽고 이해할 수 있다.
- 10 - 철학서나 법률문서등 추상적이거나 상당히 기술적인 내용을 글을 읽고 이해할 수 있다.

**Q 10. Korean Reading Amount Scale**

- 0 - 한국어를 전혀 읽지 않는다
- 1 - 한달에 한시간 이하
- 2 - 한달에 1~3 시간
- 3 - 일주일에 한시간
- 4 - 일주일에 2~3 시간
- 5 - 일주일에 4~6 시간
- 6 - 하루에 한시간
- 7 - 하루에 두시간
- 8 - 하루에 3~4 시간
- 9 - 하루에 5~6 시간
- 10 - 하루에 6 시간 이상

Appendix 3. Translation priming experiment materials

Appendix 3-a. Word stimuli used in translation priming experiments

E-K List A				E-K List B			
Translation Pairs		Unrelated Pairs		Translation Pairs		Unrelated Pairs	
Prime	Target	Prime	Target	Prime	Target	Prime	Target
scissors	가위	grave	양말	pants	바지	yard	칼
baby	아기	heart	불	train	기차	city	아기
rain	비	bath	손가락	newspaper	신문	food	머리
tiger	호랑이	water	얼굴	fire	불	pigeon	깃솔
school	학교	thumb	꽃	desk	책상	green	새
knife	칼	needle	감자	finger	손가락	country	학교
hanger	옷걸이	group	아침	flower	꽃	clam	옷걸이
hand	손	afternoon	소리	potato	감자	dog	비
toothbrush	칫솔	wall	시험	clothes	옷	earth	편지
summer	여름	woman	돈	sound	소리	ginger	가위
bird	새	board	옷	socks	양말	knowledge	여름
ice	얼음	pocket	기차	face	얼굴	brain	얼음
letter	편지	trap	바지	pig	돼지	powder	공주
music	음악	step	신문	sleep	시험	bank	음악
head	머리	weight	책상	money	돈	place	손
princess	공주	guest	돼지	morning	아침	feather	호랑이

KE List A				KE List B			
Translation Pairs		Unrelated Pairs		Translation Pairs		Unrelated Pairs	
Prime	Target	Prime	Target	Prime	Target	Prime	Target
의자	chair	옥수수	skirt	이름	name	안경	onion
어깨	shoulder	병원	soap	바람	wind	우유	room
시간	time	친구	wind	비누	soap	모자	towel
오늘	today	곰	shoes	신발	shoes	수영장	notebook
복숭아	peach	거울	laundry	연필	pencil	점심	book
책	book	비행기	teacher	빵	bread	코	time
문	door	나비	bread	산	mountain	재미	chair
수건	towel	눈물	umbrella	선생님	teacher	일기장	peach
개구리	frog	생일	sea	바다	Sea	침대	shoulder
오이	cucumber	노래	house	집	house	고양이	sky
몸	body	아들	mountain	목	neck	콩	today
양파	onion	가방	tree	빨래	laundry	새우	cucumber
방	room	치약	ear	우산	umbrella	달	body
공책	notebook	토끼	name	귀	Ear	사과	mouth
하늘	sky	별	pencil	치마	skirt	꿀	door
입	mouth	사탕	neck	나무	tree	당근	frog

Appendix 3-b. Word stimuli used in within-language priming experiments

KK List A				KK List B			
Repeated Pairs		Unrelated Pairs		Repeated Pairs		Unrelated Pairs	
Prime	Target	Prime	Target	Prime	Target	Prime	Target
개구리	개구리	치약	귀	귀	귀	당근	개구리
공책	공책	가방	나무	나무	나무	수영장	공책
몸	몸	사탕	목	목	목	달	몸
문	문	생일	바다	바다	바다	꿀	문
방	방	친구	바람	바람	바람	우유	방
복숭아	복숭아	병원	비누	비누	비누	일기장	복숭아
수건	수건	거울	빨래	빨래	빨래	모자	수건
시간	시간	나비	빵	빵	빵	코	시간
양과	양과	아들	산	산	산	안경	양과
어깨	어깨	비행기	선생님	선생님	선생님	침대	어깨
오늘	오늘	곰	신발	신발	신발	콩	오늘
오이	오이	별	연필	연필	연필	새우	오이
의자	의자	눈물	우산	우산	우산	재미	의자
입	입	토끼	이름	이름	이름	사과	입
책	책	노래	집	집	집	점심	책
하늘	하늘	옥수수	치마	치마	치마	고양이	하늘

EE List A				EE List B			
Repeated Pairs		Unrelated Pairs		Repeated Pairs		Unrelated Pairs	
Prime	Target	Prime	Target	Prime	Target	Prime	Target
baby	baby	afternoon	sound	clothes	clothes	bank	music
bird	bird	bath	finger	desk	desk	brain	ice
hand	hand	board	clothes	face	face	city	baby
hanger	hanger	grave	socks	finger	finger	clam	hanger
head	head	group	morning	fire	Fire	country	school
ice	ice	guest	pig	flower	flower	dog	rain
knife	knife	heart	fire	money	money	earth	letter
letter	letter	needle	potato	morning	morning	feather	tiger
music	music	pocket	train	newspaper	newspaper	food	head
princess	princess	step	newspaper	pants	pants	ginger	scissors
rain	rain	thumb	flower	pig	Pig	green	bird
school	school	trap	pants	potato	potato	knowledge	summer
scissors	scissors	wall	test	sleep	sleep	pigeon	toothbrush
summer	summer	water	face	socks	socks	place	hand
tiger	tiger	weight	desk	sound	sound	powder	princess
toothbrush	toothbrush	woman	money	train	train	yard	knife

Appendix 3-c. Translation task for KSL EngNSs and heritage speakers

**Translation Task**

**Participant #**

**Date**

Please translate the following Korean words into English.

Item#	KEa KKa	Translation	KEb KKb	Translation	EK a & b	Translation
1	시간		집		학교	
2	방		선생님		손	
3	책		이름		칼	
4	입		우산		머리	
5	문		바다		아기	
6	하늘		바람		음악	
7	수건		나무		편지	
8	어깨		산		비	
9	복숭아		목		옷걸이	
10	오이		귀		칫솔	
11	개구리		빵		가위	
12	공책		신발		공주	
13	양파		치마		호랑이	
14	오늘		빨래		얼음	
15	의자		연필		새	
16	몸		비누		여름	
17	노래		코		돈	
18	가방		우유		얼굴	
19	아들		점심		소리	
20	눈물		고양이		아침	
21	생일		꿀		불	
22	친구		사과		옷	
23	비행기		모자		시험	
24	토끼		침대		신문	
25	사탕		일기장		꽃	
26	치약		새우		손가락	
27	나비		당근		책상	
28	꿈		수영장		기차	
29	옥수수		콩		바지	
30	거울		안경		돼지	
31	별		재미		감자	
32	병원		달		양말	

Appendix 3-d. Translation task for KSL EngNSs and heritage speakers

**Translation Task**

**Participant #**

**Date**

**Please translate the following English words into Korean.**

Item#	KEa KEb	Translation	EKa EEa	Translation	EKb EEb	Translation
1	time		school		money	
2	room		hand		face	
3	book		knife		sound	
4	mouth		head		morning	
5	door		baby		fire	
6	sky		music		clothes	
7	towel		letter		sleep	
8	shoulder		rain		newspaper	
9	peach		hanger		flower	
10	cucumber		toothbrush		finger	
11	frog		scissors		desk	
12	notebook		princess		train	
13	onion		tiger		pants	
14	today		ice		pig	
15	chair		bird		potato	
16	body		summer		socks	
17	house		woman		country	
18	teacher		water		place	
19	name		afternoon		yard	
20	umbrella		group		food	
21	sea		heart		city	
22	wind		board		bank	
23	tree		wall		earth	
24	mountain		step		dog	
25	neck		thumb		clam	
26	ear		bath		pigeon	
27	bread		weight		ginger	
28	shoes		pocket		powder	
29	skirt		trap		feather	
30	laundry		guest		brain	
31	pencil		needle		green	
32	soap		grave		knowledge	

*Appendix 4. Locative alternation experiment materials*

Appendix 4-a. Locative alternation acceptability judgment task English version 1.

Name:

Date:

Time:

Please rate whether the following sentences sound grammatical.

Depending on the degree of acceptability, your answer can vary from 1 (completely ungrammatical) to 6 (completely grammatical).

This is not a test of vocabulary knowledge or the plausibility of events described. So feel free to ask vocabulary questions.

Item	English List 1	<b>Completely ungrammatical</b>		<b>Completely grammatical</b>			
				<----- ----->			
				-->			
		1	2	3	4	5	6
1	The life vests all successfully floated in the water.	1	2	3	4	5	6
2	The runners all drank water before the race.	1	2	3	4	5	6
3	Robert rubbed his back against the wall.	1	2	3	4	5	6
4	Sam soaked the bread with milk.	1	2	3	4	5	6
5	She rubbed her face with her right hand.	1	2	3	4	5	6
6	Susan soaked water into the socks.	1	2	3	4	5	6
7	Dad decorated a star onto the Christmas tree.	1	2	3	4	5	6
8	The twin brothers bought snacks both at the gas station.	1	2	3	4	5	6
9	Dad wrapped paper around the fish.	1	2	3	4	5	6

<b>10</b>	The professor piled the desk with books.	1	2	3	4	5	6
<b>11</b>	The two participants' interest both disappeared.	1	2	3	4	5	6
<b>12</b>	The kids played all in the living room.	1	2	3	4	5	6
<b>13</b>	The nurse injected the arm with insulin.	1	2	3	4	5	6
<b>14</b>	The painter sprayed paint onto the wall.	1	2	3	4	5	6
<b>15</b>	Grandma poured the cup with milk.	1	2	3	4	5	6
<b>16</b>	The students all gave up their dream after graudation.	1	2	3	4	5	6
<b>17</b>	The racers ran the park.	1	2	3	4	5	6
<b>18</b>	The twins enjoyed Korean food both at the party.	1	2	3	4	5	6
<b>19</b>	The kid spilled the book with coke.	1	2	3	4	5	6
<b>20</b>	Tim jogged at this morning.	1	2	3	4	5	6
<b>21</b>	The accident was injured two people.	1	2	3	4	5	6
<b>22</b>	The kids all made loud noise in the house.	1	2	3	4	5	6
<b>23</b>	The students' dream in the class is all to become a rockstar.	1	2	3	4	5	6
<b>24</b>	Mom put her gloves on the countertop.	1	2	3	4	5	6
<b>25</b>	The twins ran both in the race.	1	2	3	4	5	6

26	Mary both asked John whether his kids will come home for Christmas.	1	2	3	4	5	6
27	Shannon put the desk with her bag.	1	2	3	4	5	6
28	Tom all reported that Koreans at the party enjoyed the Korean food.	1	2	3	4	5	6
29	The kids in the room all disappeared suddenly.	1	2	3	4	5	6
30	The females in my department came all to the party.	1	2	3	4	5	6
31	Jameson bought Christmas gifts to his kids.	1	2	3	4	5	6
32	The driver and the passanger both pushed the car after the accident.	1	2	3	4	5	6
33	The two guests' money was both stolen.	1	2	3	4	5	6
34	He loaded the car with luggage.	1	2	3	4	5	6
35	The handyman painted the chair with oil-paint.	1	2	3	4	5	6
36	The workers loaded sand into the truck.	1	2	3	4	5	6
37	Mary painted nail polish onto her nails.	1	2	3	4	5	6
38	The ice cream cones all melted before the party.	1	2	3	4	5	6
39	Mr. Kim all said his students have learned Korean before.	1	2	3	4	5	6
40	The housewife decorated the door with flowers.	1	2	3	4	5	6

41	Mary plastered the wall with newspapers.	1	2	3	4	5	6
42	She plastered wall paper onto the door.	1	2	3	4	5	6
43	The couple both walked to the campus.	1	2	3	4	5	6
44	The parents read magazines both at the waiting room.	1	2	3	4	5	6
45	The teacher dropped the floor with a pencil.	1	2	3	4	5	6
46	He piled bricks on the table.	1	2	3	4	5	6
47	John all said the guests are waiting outside.	1	2	3	4	5	6
48	The teacher put a book.	1	2	3	4	5	6
49	The new engine is consumed less fuel.	1	2	3	4	5	6
50	Sandy filled water into the jar.	1	2	3	4	5	6
51	The trees in the backyard fell all in the storm.	1	2	3	4	5	6
52	He sprayed the ground with water.	1	2	3	4	5	6
53	The couple's desire was both ignored by the counselor.	1	2	3	4	5	6
54	The guys all hung out at my place.	1	2	3	4	5	6
55	The lady dropped her purse on the ground.	1	2	3	4	5	6
56	The farmer injected anti-biotics into the chicken	1	2	3	4	5	6

57	The couple both died last year.	1	2	3	4	5	6
58	The guests arrived late all to the party.	1	2	3	4	5	6
59	The girl covered the stain with a napkin.	1	2	3	4	5	6
60	Tim spilled coffee onto the newspaper.	1	2	3	4	5	6
61	The audiences laughed hard the comedy.	1	2	3	4	5	6
62	The babies slept all in the room.	1	2	3	4	5	6
63	The kids in the team all swam fast.	1	2	3	4	5	6
64	The girls watched the TV all in the living room.	1	2	3	4	5	6
65	The audiences all laughed very hard.	1	2	3	4	5	6
66	John gave money for Mary.	1	2	3	4	5	6
67	The babies cried all really hard.	1	2	3	4	5	6
68	Jane poured water into the bucket.	1	2	3	4	5	6
69	The movers wrapped the vase with paper.	1	2	3	4	5	6
70	Nanny filled the cup with orange juice.	1	2	3	4	5	6
71	Their children were born all in this house.	1	2	3	4	5	6
72	She covered her leg with a blanket.	1	2	3	4	5	6

Appendix 4-b. Locative alternation acceptability judgment task English version 2.

Participant #

Date:

Time:

Please rate whether the following sentences sound grammatical.

Depending on the degree of acceptability, your answer can vary from 1 (completely ungrammatical) to 6 (completely grammatical).

This is not a test of vocabulary knowledge or the plausibility of events described. So feel free to ask vocabulary questions.

Item	English List 2	Completely ungrammatical		<----- ----->	Completely grammatical		
		1	2	3	4	5	6
1	The couple walked both to the campus.	1	2	3	4	5	6
2	The teacher put a book.	1	2	3	4	5	6
3	The accident was injured two people.	1	2	3	4	5	6
4	She plastered the door with wall paper.	1	2	3	4	5	6
5	Tom all reported that Koreans at the party enjoyed the Korean food.	1	2	3	4	5	6
6	The farmer injected the chicken with anti-biotics.	1	2	3	4	5	6
7	Sam soaked milk into the bread.	1	2	3	4	5	6
8	Mom put the countertop with her gloves.	1	2	3	4	5	6
9	The handyman painted oil-paint onto the chair.	1	2	3	4	5	6
10	The painter sprayed the wall with paint.	1	2	3	4	5	6

11	The babies all slept in the room.	1	2	3	4	5	6
12	Shannon put her bag onto the desk.	1	2	3	4	5	6
13	The guests all arrived late to the party.	1	2	3	4	5	6
14	The kids in the team swam all fast.	1	2	3	4	5	6
15	Dad wrapped the fish with paper.	1	2	3	4	5	6
16	Tim spilled the newspaper with coffee.	1	2	3	4	5	6
17	The new engine is consumed less fuel.	1	2	3	4	5	6
18	Nanny filled organge juice into the cup.	1	2	3	4	5	6
19	The girls all watched the TV in the living room.	1	2	3	4	5	6
20	He loaded the luggage onto the car.	1	2	3	4	5	6
21	Mr. Kim all said his students have learned Korean before.	1	2	3	4	5	6
22	The teacher dropped a pencil onto the floor.	1	2	3	4	5	6
23	The movers wrapped paper around the vase.	1	2	3	4	5	6
24	The two guests' money was both stolen.	1	2	3	4	5	6
25	He piled the table with bricks.	1	2	3	4	5	6
26	Sandy filled the jar with water.	1	2	3	4	5	6

27	Grandma poured milk into a cup	1	2	3	4	5	6
28	The couple's desire was both ignored by the counselor.	1	2	3	4	5	6
29	John all said the guests are waiting outside.	1	2	3	4	5	6
30	The students slept the class.	1	2	3	4	5	6
31	The two participants' interest both disappeared.	1	2	3	4	5	6
32	The twins both enjoyed Korean food at the party.	1	2	3	4	5	6
33	Tim jogged at this morning.	1	2	3	4	5	6
34	The twin brothers both bought snacks at the gas station.	1	2	3	4	5	6
35	The guys hung out all behind the store.	1	2	3	4	5	6
36	Mary both asked John whether his kids will come home for Christmas.	1	2	3	4	5	6
37	John asked money to Mary.	1	2	3	4	5	6
38	Mary painted her nails with nail polish.	1	2	3	4	5	6
39	Jane poured the bucket with water.	1	2	3	4	5	6
40	Mary plastered newspapers onto the wall.	1	2	3	4	5	6
41	The runners drank water all before the race.	1	2	3	4	5	6

<b>42</b>	The twins gave up their dreams both after the graduation.	1	2	3	4	5	6
<b>43</b>	Dad decorated the Christmas tree with a star.	1	2	3	4	5	6
<b>44</b>	The kids made loud noise all in the house.	1	2	3	4	5	6
<b>45</b>	She covered blanket onto her leg.	1	2	3	4	5	6
<b>46</b>	The females in my department all came to the party.	1	2	3	4	5	6
<b>47</b>	the driver and the passenger pushed the car both after the accident.	1	2	3	4	5	6
<b>48</b>	The kids all played in the living room.	1	2	3	4	5	6
<b>49</b>	The babies all cried really hard.	1	2	3	4	5	6
<b>50</b>	The workers loaded the truck with sand.	1	2	3	4	5	6
<b>51</b>	Their children were all born in this house.	1	2	3	4	5	6
<b>52</b>	She rubbed her right hand onto her face.	1	2	3	4	5	6
<b>53</b>	The audiences laughed all very hard.	1	2	3	4	5	6
<b>54</b>	The girl covered a napkin onto the stain.	1	2	3	4	5	6
<b>55</b>	The ice cream cones melted all before the party.	1	2	3	4	5	6
<b>56</b>	The trees in the backyard all fell in the storm.	1	2	3	4	5	6

57	The students' dream in the class is all to become a rockstar.	1	2	3	4	5	6
58	The couple died both last year.	1	2	3	4	5	6
59	The audiences laughed hard the comedy.	1	2	3	4	5	6
60	The life vests successfully floated all after the accident.	1	2	3	4	5	6
61	Jameson bought Christmas gifts to his kids.	1	2	3	4	5	6
62	The housewife decorated flowers onto the door.	1	2	3	4	5	6
63	Robert rubbed the wall with his back.	1	2	3	4	5	6
64	The nurse injected insulin into the arm.	1	2	3	4	5	6
65	The kid spilled coke onto the book.	1	2	3	4	5	6
66	The lady dropped the ground with her purse.	1	2	3	4	5	6
67	Susan soaked the socks with water.	1	2	3	4	5	6
68	The parents both read magazines at the waiting room.	1	2	3	4	5	6
69	He sprayed water onto the ground.	1	2	3	4	5	6
70	The kids in the room disappeared all suddenly.	1	2	3	4	5	6
71	The professor piled books onto the desk.	1	2	3	4	5	6
72	The twins both ran in the race.	1	2	3	4	5	6

Appendix 4-c. Locative alternation acceptability judgment task Korean version 1.

Participant #:

Date:

Please rate whether the following sentences sound grammatical.

Depending on the degree of acceptability, your answer can vary from 1 (completely ungrammatical) to 6 (completely grammatical).

This is not a test of vocabulary knowledge or the plausibility of events described. So feel free to ask vocabulary questions.

Finally, note that the plural marking has not been used in all the sentences (e.g., **학생** instead of **학생들**), which is acceptable in Korean.

Item	Korean List 1	Completely ungrammatical		<----->		Completely grammatical	
		1	2	3	4	5	6
1	아가씨가 바닥에 지갑을 떨어뜨렸어요.	1	2	3	4	5	6
2	그 사람이 닭에 항생제를 주입했어요.	1	2	3	4	5	6
3	친구가 두명 작년어 죽었어요.	1	2	3	4	5	6
4	엄마가 동생을 울렸어요.	1	2	3	4	5	6
5	동생이 우유로 컵을 부었어요.	1	2	3	4	5	6
6	나는 어제 영희가 영화를 보았어요.	1	2	3	4	5	6
7	선생님께서 열명 나에게 올해 자기 학생이 대학에 갔다고 말씀하셨습니다.	1	2	3	4	5	6
8	여자가 꽃으로 문을 장식했어요.	1	2	3	4	5	6

9	남자가 천장에 벽지를 발랐어요.	1	2	3	4	5	6
10	동생이 크리스마스트리에 별을 장식했어요.	1	2	3	4	5	6
11	아저씨가 트럭에 모래를 실었어요.	1	2	3	4	5	6
12	아빠를 오빠가 야단맞았어요.	1	2	3	4	5	6
13	엄마가 술로 병을 채웠어요.	1	2	3	4	5	6
14	남학생이 운동장에서 네명 뛰었어요.	1	2	3	4	5	6
15	철수는 영어책을 어려워요.	1	2	3	4	5	6
16	여자가 종지로 꽃병을 썼어요.	1	2	3	4	5	6
17	남자가 페인트로 의자를 칠했어요.	1	2	3	4	5	6
18	손님의 돈이 두명 없어졌어요.	1	2	3	4	5	6
19	아기가 이 집에서 세명 태어났어요.	1	2	3	4	5	6
20	형이 동생을 아파요.	1	2	3	4	5	6
21	부자는 돈이 열심히 모아요.	1	2	3	4	5	6
22	철수가 양말에 물을 적셨어요.	1	2	3	4	5	6
23	아줌마가 생선에 종이를 썼어요.	1	2	3	4	5	6
24	아이가 콜라로 테이블을 쏟았어요.	1	2	3	4	5	6

25	아이가 오른손으로 얼굴을 비볐어요.	1	2	3	4	5	6
26	아저씨가 네명 술을 마셨어요.	1	2	3	4	5	6
27	학생이 잡지를 다섯명 읽었어요.	1	2	3	4	5	6
28	내가 테이블에 벽돌을 쌓았어요.	1	2	3	4	5	6
29	여자가 극장에서 세명 울었어요.	1	2	3	4	5	6
30	선생님의 약속이 두명 취소되었어요.	1	2	3	4	5	6
31	아저씨가 담배를 두명 샀어요.	1	2	3	4	5	6
32	선생님께서 우리들을 사랑 받았어요.	1	2	3	4	5	6
33	오빠가 벽에 페인트를 뿌렸어요.	1	2	3	4	5	6
34	선생님께서 여섯명 철수에게 학생이 한국어를 공부한다고 말하셨어요.	1	2	3	4	5	6
35	친구가 어제 영화가 보았어요.	1	2	3	4	5	6
36	아기가 그 방에서 세명 잤어요.	1	2	3	4	5	6
37	학생이 연필로 바닥을 떨어뜨렸어요.	1	2	3	4	5	6
38	나는 텔레비전을 집에 봤어요.	1	2	3	4	5	6
39	내가 신문지로 벽을 발랐어요.	1	2	3	4	5	6
40	선수가 한명 공을 찼어요.	1	2	3	4	5	6

41	철수는 한명 영희에게 친구가 올해 결혼하냐고 물었어요.	1	2	3	4	5	6
42	친구에게 우리 집에 만나자고 했어요.	1	2	3	4	5	6
43	엄마가 얼룩에 화장지를 덮었어요.	1	2	3	4	5	6
44	영희가 우유로 빵을 적셨어요.	1	2	3	4	5	6
45	아이가 한명 갑자기 사라졌어요.	1	2	3	4	5	6
46	학생이 책으로 책상을 쌓았어요.	1	2	3	4	5	6
47	아이가 통에 물을 부었어요.	1	2	3	4	5	6
48	여자가 세명 부엌에서 크게 웃었어요.	1	2	3	4	5	6
49	아이스크림이 세개 차 안에서 녹았어요.	1	2	3	4	5	6
50	아가씨가 다리에 이불을 덮었어요.	1	2	3	4	5	6
51	여자의 가방이 두명 도둑맞았어요.	1	2	3	4	5	6
52	아침에서 일찍 일어났어요.	1	2	3	4	5	6
53	남자가 두명 차를 밀었어요.	1	2	3	4	5	6
54	학생이 두명 가방을 밖으로 던졌어요.	1	2	3	4	5	6
55	여학생이 TV 를 두명 봤어요.	1	2	3	4	5	6
56	아저씨가 물로 땅을 뿌렸어요.	1	2	3	4	5	6

57	학생이 두명 캠퍼스에서 걸었어요.	1	2	3	4	5	6
58	손님이 김밥을 세명 먹었어요.	1	2	3	4	5	6
59	할아버지께서 집에 가지자고 했어요.	1	2	3	4	5	6
60	학생이 가방으로 책상을 놓았어요.	1	2	3	4	5	6
61	아이가 다섯명 집에서 놀았어요.	1	2	3	4	5	6
62	학생의 가방이 두명 교실에 있어요.	1	2	3	4	5	6
63	연필이 바닥에 두개 떨어졌어요.	1	2	3	4	5	6
64	학생이 학교에 두명 도착했어요.	1	2	3	4	5	6
65	영희는 배가 아프세요.	1	2	3	4	5	6
66	여자가 백화점에 세명 왔어요.	1	2	3	4	5	6
67	운동는 몸에 좋아요.	1	2	3	4	5	6
68	얼음이 다섯개 물위에 떠올랐어요.	1	2	3	4	5	6
69	아빠가 신문에 커피를 쏟았어요.	1	2	3	4	5	6
70	손님이 계산대에 장갑을 놓았어요.	1	2	3	4	5	6
71	아줌마가 네명 백화점에서 돌아다녔어요.	1	2	3	4	5	6
72	내가 그릇에 물을 채웠어요.	1	2	3	4	5	6

73	영희가 철수때문에 얼굴을 빨개요.	1	2	3	4	5	6
74	꼬마가 거실에서 다섯명 놀았어요.	1	2	3	4	5	6
75	간호사가 인슐린으로 팔을 주입했어요.	1	2	3	4	5	6
76	언니가 손톱에 메니큐어를 칠했어요.	1	2	3	4	5	6
77	동생이 엄마한테서 야단쳤어요.	1	2	3	4	5	6
78	영희는 두명 철수에게 손님이 거실에서 기다린다고 말했어요.	1	2	3	4	5	6
79	오빠가 짐으로 차를 실었어요.	1	2	3	4	5	6
80	남자가 벽에 등을 비볐어요.	1	2	3	4	5	6

Appendix 4-d. Locative alternation acceptability judgment task Korean version 2.

Name:

Date:

Please rate whether the following sentences sound grammatical.

Depending on the degree of acceptability, your answer can vary from 1 (completely ungrammatical) to 6 (completely grammatical).

This is not a test of vocabulary knowledge or the plausibility of events described. So feel free to ask vocabulary questions.

Finally, note that the plural marking has not been used in all the sentences (e.g., **학생** instead of **학생들**), which is acceptable in Korean.

Item	Korean List 2	Completely ungrammatical		<----->		Completely grammatical	
		1	2	3	4	5	6
1	철수는 영어책을 어려워요.	1	2	3	4	5	6
2	엄마가 화장지로 얼룩을 닦았어요.	1	2	3	4	5	6
3	학생이 가방을 두명 던졌어요.	1	2	3	4	5	6
4	영희는 두명 철수에게 손님이 거실에서 기다린다고 말했어요.	1	2	3	4	5	6
5	연필이 두개 바닥에 떨어졌어요.	1	2	3	4	5	6
6	남자가 벽지로 천장을 발랐어요.	1	2	3	4	5	6
7	선생님께서 우리들을 사랑 받았어요.	1	2	3	4	5	6
8	학생이 바닥에 연필을 떨어뜨렸어요.	1	2	3	4	5	6
9	아기가 세명 그 방에서 잤어요.	1	2	3	4	5	6

10	남자가 의자에 페인트를 칠했어요.	1	2	3	4	5	6
11	아침에서 일찍 일어났어요.	1	2	3	4	5	6
12	엄마가 병에 술을 채웠어요.	1	2	3	4	5	6
13	나는 어제 영희가 영화를 봤어요.	1	2	3	4	5	6
14	아이가 갑자기 한명 사라졌어요.	1	2	3	4	5	6
15	부자는 돈이 열심히 모아요.	1	2	3	4	5	6
16	아줌마가 백화점에서 네명 돌아다녔어요.	1	2	3	4	5	6
17	학생의 가방이 두명 교실에 있어요.	1	2	3	4	5	6
18	여학생이 두명 TV 를 봤어요.	1	2	3	4	5	6
19	내가 벽돌로 테이블을 쌓았어요.	1	2	3	4	5	6
20	친구에게 우리 집에 만나자고 했어요.	1	2	3	4	5	6
21	아이가 얼굴에 오른손을 비볐어요	1	2	3	4	5	6
22	꼬마가 다섯명 거실에서 놀았어요.	1	2	3	4	5	6
23	오빠가 차에 짐을 실었어요.	1	2	3	4	5	6
24	아기가 세명 이 집에서 태어났어요.	1	2	3	4	5	6
25	학생이 책상에 책을 쌓았어요.	1	2	3	4	5	6

26	아줌마가 종이로 생선을 썼어요.	1	2	3	4	5	6
27	아저씨가 모래로 트럭을 실었어요.	1	2	3	4	5	6
28	영희가 빵에 우유를 적셨어요.	1	2	3	4	5	6
29	학생이 두명 학교에 도착했어요.	1	2	3	4	5	6
30	아이가 집에서 다섯명 놀았어요.	1	2	3	4	5	6
31	아저씨가 두명 담배를 샀어요.	1	2	3	4	5	6
32	남자가 등으로 벽을 비볐어요.	1	2	3	4	5	6
33	아가씨가 지갑으로 바닥을 떨어뜨렸어요.	1	2	3	4	5	6
34	영희는 배가 아프시어요.	1	2	3	4	5	6
35	아빠를 오빠가 야단맞았어요.	1	2	3	4	5	6
36	아저씨가 술을 네명 마셨어요.	1	2	3	4	5	6
37	간호사가 팔에 인슐린을 주입했어요.	1	2	3	4	5	6
38	학생이 다섯명 잡지를 읽었어요.	1	2	3	4	5	6
39	아빠가 커피로 신문을 쏟았어요.	1	2	3	4	5	6
40	여자의 가방이 두명 도둑맞았어요.	1	2	3	4	5	6
41	할아버지께서 집에 가지자고 했어요.	1	2	3	4	5	6

42	아이가 테이블에 콜라를 쏟았어요.	1	2	3	4	5	6
43	내가 물로 그릇을 채웠어요.	1	2	3	4	5	6
44	동생이 별로 크리스마스트리를 장식했어요.	1	2	3	4	5	6
45	엄마가 동생을 울렸어요.	1	2	3	4	5	6
46	그 사람이 항생제로 닭을 주입했어요.	1	2	3	4	5	6
47	얼음이 물 위에 다섯개 떠올랐어요.	1	2	3	4	5	6
48	손님이 장갑으로 계산대를 놓았어요.	1	2	3	4	5	6
49	선생님의 약속이 두명 취소되었어요.	1	2	3	4	5	6
50	내가 벽에 신문지를 발랐어요.	1	2	3	4	5	6
51	여자가 세명 극장에서 울었어요.	1	2	3	4	5	6
52	아가씨가 이불로 다리를 덮었어요.	1	2	3	4	5	6
53	여자가 꽃병에 종이를 찼어요.	1	2	3	4	5	6
54	친구가 어제 영화가 봤어요.	1	2	3	4	5	6
55	학생이 캠퍼스에서 두명 걸었어요.	1	2	3	4	5	6
56	나는 텔레비전을 집에 봤어요.	1	2	3	4	5	6
57	형이 동생을 아파요.	1	2	3	4	5	6

58	손님의 돈이 두명 없어졌어요.	1	2	3	4	5	6
59	운동는 몸에 좋아요.	1	2	3	4	5	6
60	아이스크림이 차 안에서 두개 녹았어요.	1	2	3	4	5	6
61	손님이 세명 김밥을 먹었어요.	1	2	3	4	5	6
62	아이가 물로 통을 부었어요.	1	2	3	4	5	6
63	철수는 한명 영희에게 친구가 올해 결혼하냐고 물었어요.	1	2	3	4	5	6
64	학생이 책상에 가방을 놓았어요	1	2	3	4	5	6
65	아저씨가 땅에 물을 뿌렸어요.	1	2	3	4	5	6
66	철수가 물로 양말을 적셨어요.	1	2	3	4	5	6
67	남학생이 네명 운동장에서 뛰었어요.	1	2	3	4	5	6
68	언니가 메니큐어로 손톱을 칠했어요.	1	2	3	4	5	6
69	남자가 차를 두명 밀었어요.	1	2	3	4	5	6
70	선생님께서 여섯명 철수에게 학생이 한국어를 공부한다고 말씀하셨어요.	1	2	3	4	5	6
71	영희가 철수때문에 얼굴을 빨개요.	1	2	3	4	5	6
72	여자가 부엌에서 세명 웃었어요.	1	2	3	4	5	6

73	친구가 작년에 두명 죽었어요.	1	2	3	4	5	6
74	선수가 공을 한명 찼어요.	1	2	3	4	5	6
75	오빠가 페인트로 벽을 뿌렸어요.	1	2	3	4	5	6
76	동생이 컵에 우유를 부었어요.	1	2	3	4	5	6
77	선생님께서 열명 나에게 올해 자기 학생이 대학에 갔다고 말씀하셨습니다.	1	2	3	4	5	6
78	동생이 엄마한테서 야단쳤어요.	1	2	3	4	5	6
79	여자가 문에 꽃을 장식했어요.	1	2	3	4	5	6
80	여자가 세명 백화점에 왔어요.	1	2	3	4	5	6

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