

ABSTRACT

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FACTORS IN HERITAGE LANGUAGE ACQUISITION

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This dissertation aims to understand the maturational and non-maturational aspects of early bilingualism and language attrition in heritage speakers who have acquired their L1 incompletely in childhood. The study highlights the influential role of age and input dynamics in early L1 development, where the timing of reduction in L1 input and the quality of L1 input largely determine ultimate L1 attainment.

Ninety heritage speakers of Korean in the United States who took part in this study showed great variability in their knowledge of L1, depending on the age at which L1 exposure was reduced and on the types of L1 knowledge tested. A multivariate regression analysis explored to what extent such L1 variability can be explained by maturational and non-maturational factors, in order to provide rational explanations for the divergent L1 outcomes in heritage language acquisition. It also examined how different types of L1 knowledge are selectively affected by each factor. The results showed that the maturational factor accounted for the largest variance in

their ultimate L1 outcomes, but that non-maturational factors aided in further explaining the L1 variance. The multivariate model was able to predict not only the degree of incomplete L1 knowledge among heritage speakers, but also the types of L1 knowledge that they are likely to acquire incompletely.

The current study suggests that variability in ultimate L1 outcomes among heritage speakers can largely be understood as a function of the age at which their exposure to the L1 was reduced and the nature of L1 input they received in childhood. It is argued that lack of exposure to the L1 in childhood has a long-lasting effect on heritage speakers' L1 grammar and that, in this input-constrained context, non-maturational factors come into play, where language aptitude compensates for reduced L1 input, and language attitude allows for prolonged L1 input.

MATURATIONAL AND NON-MATURATIONAL FACTORS
IN HERITAGE LANGUAGE ACQUISITION

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Chapter 1: Introduction

1.1 Rationale

Heritage language acquisition is not fully explained by theories in first language acquisition or second language acquisition. The L1 experience of heritage speakers is intricate, since the processes they undergo in early bilingualism or language attrition are not uniform. It is thus not surprising that a cross-sectional investigation of heritage language grammar is a challenging task, due to great heterogeneity among the population, as well as the practical difficulty in quantifying numerous variables involved in L1 development. We are faced with a methodological dilemma, where only longitudinal case studies can portray what heritage speakers go through during their L1 development, but the case studies of a few individuals are not generalizable, due to tremendous variability among individuals and heritage populations alike. For this reason, heritage speakers, who have been studied extensively in the context of L2 acquisition, have drawn less attention in the area of L1 acquisition. The study of heritage language acquisition, however, has gained increasing attention in recent years, not only with the goal of identifying the linguistic and pedagogical needs of heritage speakers, but also to contribute to our current understanding of the language acquisition processes involved. In this vein, the present study aims to provide a psycholinguistic account of the variability in ultimate L1 outcomes in heritage speakers and to reveal what this unique population can contribute to our understanding of maturational and non-maturational aspects of language acquisition.

1.2 Scope of the Study

This dissertation aims to investigate the nature of heritage language acquisition and heritage language grammar. Heritage speakers are incomplete acquirers of L1, which is, or has become, a minority language in childhood and is fossilized to varying degrees in adulthood with the establishment of a dominant language. During this process, individual heritage speakers often experience early bilingualism and/or L1 attrition, leading to incomplete L1 outcomes. What, however, determines the different paths heritage speakers take with regard to their L1 development? Previous studies lend support to the primacy of the maturational factor in heritage language acquisition. While the age effect on ultimate L2 outcomes has been widely documented among immigrant populations, a more integrated picture of how age is causally related to language learning throughout an individual's lifetime requires an investigation of how their L1 is lost or remains incomplete after the native-like or near-native attainments in L2 acquisition. In addition, how non-maturational factors interact with maturational factors in the processes involved in heritage speakers' early L1 development is indicative of the nature of the language learning mechanism for the duration of the critical period.

To address these issues, the current study investigated to what extent L1 is incompletely acquired among heritage speakers of Korean in the United States and to what extent the variability in their ultimate L1 attainment can be explained by both maturational and non-maturational variables. Drawing on previous theories and empirical findings, the study explored the effects of four major explanatory variables, i.e. age, input, language aptitude, and language attitude. First examined was the

pattern of nonconvergence in the L1 grammar of heritage speakers with regard to the age at which L1 exposure was reduced. The study then explored how much the variance in L1 outcomes could be explained by the maturational and non-maturational factors. Furthermore, the study examined what types of L1 knowledge constitute the core of heritage language grammar and what aspects are particularly sensitive to each identified factor.

The dissertation is organized as follows. The second chapter is devoted to defining heritage speakers and the processes involved in their L1 development. The third chapter summarizes the linguistic characteristics of heritage speakers' end-state L1 grammar and the four major explanatory variables for their ultimate L1 attainment on both theoretical and empirical grounds. The fourth chapter reports the major findings from three pilot studies of Korean heritage speakers and describes the scope of the current study. The fifth chapter introduces the design of the current study and methodological procedures involved. The sixth chapter summarizes the results. The last chapter discusses the results in light of the research questions and summarizes the major findings and arguments of the dissertation.

Chapter 2: Heritage Language Acquisition

This chapter first reviews the linguistic construct of heritage speakers and the significance of studying heritage speakers, and then reviews the major processes of L1 development in heritage speakers as child L1 acquirers, early bilinguals, L1 attriters, and adult L1 relearners.

2.1 Heritage Speakers

2.1.1 Defining Heritage Speakers

Heritage speakers, in a broad sense, are speakers of a minority language at home who have maintained contact with the language through cultural connection, including family and communities. Valdés (2005) argued for a linguistically-defined concept of heritage speakers as individuals who are raised in a home where a minority language is spoken, and are to some degree bilingual, being able to speak or at least understand the language. Heritage speakers typically consist of second-generation immigrants or children of first-generation immigrants, who are in a contact situation with a new dominant language. Prior studies report that heritage speakers lose their L1 to varying degrees, and that this is true even among those who maintained constant contact with the language at home and in their communities (Kondo-Brown, 2006). Montrul (2008) described heritage speakers as adult early bilinguals of a minority language, who never fully acquired or lost aspects their L1 in childhood.

There are two major accounts for such incomplete L1 outcomes in heritage speakers. On the one hand, heritage speakers seem to undergo an L1 attrition process. In this context, one may question whether these speakers had acquired a stable L1 prior to the onset of the attrition. If this is true, drawing a line at the point where L1

reaches maturation becomes an issue. If not, discerning the language they had acquired in the first place and has subsequently been lost poses another issue. On the other hand, heritage speakers also appear to develop the L1 as a weaker language in early bilingualism. In other words, heritage speakers do not necessarily experience attrition processes, but may continuously be involved in L1 acquisition processes under the influence of L2, until the L1 is fossilized. Therefore, both these aspects of heritage language acquisition, that is, L1 attrition and early bilingualism, need to be taken into account when defining heritage speakers. In the present study, heritage speakers are viewed as incomplete L1 acquirers who experience language attrition and/or early bilingualism.

2.1.2 Significance of Studying Heritage Speakers

In recent years, the field of second language acquisition has directed attention to the study of heritage speakers for both linguistic and pedagogical reasons. Montrul (2008) emphasized that the importance of studying heritage speakers lies not only in explaining and making predictions about the nature of heritage language development via existing theories of language acquisition, but also in evaluating current claims about language acquisition (Montrul, 2008). Building on this idea, it is also a primary goal of the current study to highlight what heritage language acquisition can lend to our understanding of general language acquisition processes in the context of maturation.

Numerous studies of maturational constraints in second language acquisition originate from the idea that there is a critical period beyond which an individual is unable to acquire L1 from mere exposure and without conscious effort (Lenneberg,

1967). While this theory also refers to learning deficits in adult L2 acquisition, it is important to note that the concept of a critical period is focused on the fundamental change in human language learning mechanisms that occur around puberty. Heritage speakers thus exemplify purely implicit learners of the L1, who were exposed to the language for the duration of a critical period, with little effect of instruction or literacy. From this perspective, heritage language grammar is not affected by a large number of nuisance variables that could potentially weaken theoretical claims about its linguistic nature. Rather, it reveals about what is ultimately attained through mere exposure, which constitutes the core of early-acquired language behaviors. If it is true that what is available exclusively in childhood is a capacity for implicit language learning, then adult heritage speakers should retain some aspects of early-acquired language behaviors that adult L2 learners would fail to achieve. Due to a unique learning experience, heritage speakers tend to have only receptive L1 knowledge and lack L1 literacy skills, but appropriate measures can elucidate what truly constitutes their L1 grammar. In addition, the study of heritage speakers is useful in determining the role of early exposure in L1 maturation, having significant implications for understanding differences in early and late bilingualism.

Furthermore, the study of heritage language grammar is of great pedagogical significance. It provides theoretical and empirical evidence on the issue of whether to support separate instructional tracks for adult heritage speakers and L2 learners at universities and to develop specialized curricula and materials for the two learner populations. Furthermore, the research will aid in designing more effective bilingual education for immigrant children around the globe. Early bilingualism is known to be

a significant asset in the development of metalinguistic skills among fully balanced bilinguals (Cromdal, 1999). However, it is also known that a minimal level of bilingual competence is required to avoid cognitive and academic deficits (Cummins, 1979). In fact, numerous immigrant children exhibit incomplete bilingualism, which may negatively influence their identity construction. In light of these findings, current bilingual education models for heritage speakers around the globe that place these learners at risk, given the other potential deficits they face, could benefit from an alternative theoretically and empirically grounded model.

2.2 Processes Involved in Heritage Language Acquisition

In order to understand the nature of heritage language grammar, it is necessary to follow the particular developmental path of the L1 in heritage speakers, which leads to incomplete acquisition. There are largely four aspects of language acquisition processes that may influence the ultimate L1 outcome in heritage speakers, including child language acquisition, early bilingualism, language attrition, and late L1 relearning.

2.2.1 Child Language Acquisition

One of the major issues in the study of heritage language acquisition to date has been whether and to what extent heritage speakers share the linguistic advantages of child L1 acquirers. Heritage speakers resemble child L1 or L2 acquirers in that they are first exposed to the L1 in a naturalistic setting and during the time they have the capacity for implicit language learning. For many decades, the long-term advantage of children over adults in language learning has led many researchers to hypothesize the existence of a biologically determined period for language acquisition.

There has been a great body of empirical data showing a decline in ultimate L2 outcomes with the age of L2 onset (see, e.g., DeKeyser, 2011). In addition, the scrutiny of successful L2 learners has proven false the claim that native-like L2 attainment is possible among late starters (Abrahamsson & Hyltenstam, 2009).

Some accounts have taken a cognitive approach to understanding why child language acquisition is qualitatively different from adult language acquisition. First, the generative account appeals to the concept of Universal Grammar (UG), the assumption of which was motivated by the need to explain successful acquisition in spite of insufficient input in L1 acquisition. The Fundamental Difference Hypothesis (Bley-Vroman, 1989) claims that adult L2 learners, unlike child L1 learners, have no access to UG, and thus, what they know of language universals is constructed only through their L1. Therefore, late bilingualism is characterized by limited access to UG, which results in incomplete grammar or divergent grammar (Schachter, 1990; Sorace, 1993). The indications of L1 nonconvergence in heritage speakers seem to contradict this idea, since they would have full access to UG in childhood. Montrul (2009), however, claimed that her observations of adult heritage speakers who outperformed L2 learners at the same proficiency level lend support to the Fundamental Difference Hypothesis.

Another explanation concerns a maturational change in the language learning mechanism. DeKeyser (2000, 2003) claimed that the implicit learning capacity becomes less available after a critical period, and, thus, successful late L2 learners who perform to native-like standards possess a high language aptitude that comes to play a role in explicit learning. Paradis (2009) also suggested that there is an optimal

period, during which individuals must be exposed to language interaction if they are to acquire implicit linguistic competence, but that declarative memory which sustains explicit knowledge will play an increased role in later learning. This idea is based on an earlier distinction he made between two different types of linguistic information stored in long-term memory; 1) Declarative memory sustains explicit knowledge, often accessible to conscious awareness, while 2) procedural memory sustains implicit knowledge, generally not available to conscious access (Paradis, 2004). If it is true that children largely rely on implicit learning, then a language aptitude that benefits explicit learning may not be directly responsible for the early development of their L1 or L2. However, Abrahamsson and Hyltenstam (2008) identified a small, yet significant effect language aptitude had on L2 GJT performance among early bilinguals, using the Swansea language aptitude test. Using the same measure, Bylund, Abrahamsson, and Hyltenstam (2009) also found a significant correlation between L1 GJT performance and language aptitude among early bilinguals in the context of L1 attrition.

There is yet another explanation which concerns the role of working memory. A decrease in language learning ability in adults is due to an increase in working memory capacity; children, who take in smaller chunks of input, are better able to detect patterns of covariation in input by focusing on details (Newport, 1990; Elman, 1993; Kareev, 1995). There is empirical evidence that indicates there is an advantage gained when starting with simple input in the initial stages of learning morphology (Pitts Cochran et al., 1999; Kersten & Earles, 2001), which disappears when the network involves processing semantic information (Rohde & Plaut, 1999).

Now, aside from the question about its causes, what distinguishes learning during the critical period? Lenneberg (1967) proposed several criteria which set apart early-acquired language: 1) emergence of the behavior without any conscious decision making, 2) emergence not triggered by external events, but an environment rich enough for the behavior to develop adequately, 3) little effect of direct teaching and intensive practice, 4) a regular sequence of milestones observable, and possibly correlated, with age and other levels of development, 5) a period after which the behavior can no longer be acquired. We may then question whether the L1 behaviors of heritage speakers largely exemplify the above criteria.

Empirical studies have shown that heritage speakers benefit from their early exposure to the L1 and thus converge with native speakers in some areas of L1 grammar. Ample evidence suggests that heritage speakers retain the core aspects of L1 grammar acquired in childhood, not only in phonology (Oh, Jun, Knightly, & Au, 2003), but also in morphosyntax (Au, Knightly, Jun, Oh, & Romo, 2008; Montrul, 2005, 2006). For instance, low-proficiency heritage speakers were able to make a syntactic distinction between unaccusative and unergative verbs (Montrul, 2005), and intermediate-proficiency heritage speakers had all aspects of the null-subject parameter in place (Montrul, 2006). Au et al. (2008) also found that early exposure had extensive effects in different aspects of heritage speakers' L1 grammar, including syntax, lexical semantics, and inflectional morphology. The findings from the first pilot study also suggested that heritage speakers, unlike L2 learners, largely retain near-native competence in the area of L1 morphosyntax, regardless of proficiency level (see Section 4.1.1 for more details). Furthermore, heritage speakers demonstrate

an advantage over L2 learners in online tasks, such as oral production or processing tasks, but the same does not hold true for offline written tasks (Matsunaga, 2003; Montrul, Foote, & Perpiñán, 2008). The differential behaviors observed may arise from the different memory structures involved in language learning, where online tasks are more representative of implicit and automatically processed linguistic knowledge (Ellis, 2005). In addition, such task dependency may also be explained by heritage speakers' lack of literacy skills and experience with written tasks in the L1.

2.2.2 Early Bilingualism

The next dimension of heritage language acquisition to be addressed is early bilingualism. A majority of heritage speakers experience a language shift in childhood soon after first contact with a majority language. While this process takes place, heritage speakers often become non-balanced and passive bilinguals, who develop the L1 as a weaker language to varying degrees. The L1 is often further weakened after being replaced with a dominant language, the process of which is mainly characterized by language attrition. According to Meisel (2007), a weaker language is a less structurally developed language in terms of length of utterance, morphosyntactic features, word types, and functional elements. This phenomenon also reflects a degree of language mixing, which derives from the developing L2 grammar and the attriting L1 grammar. Defined this way, such a term is highly descriptive of the state of heritage speakers' childhood L1 grammar. According to Polinsky (2008), heritage speakers' L1 is not fossilized as a weaker language in childhood, but rather goes through the restructuring processes, even in light of the impoverished input and L2 interference. In this sense, heritage speakers are not

simply attriters of the childhood language, but speakers who acquired some aspects of the language incompletely in early bilingualism.

Numerous empirical studies have shown that heritage speakers have acquired their childhood language incompletely. Song, O'Grady, Cho, and Lee (1997) studied Korean-English bilingual children born and raised in the United States, and found evidence of incomplete L1 grammar in case marking and reflexive pronouns. Kim and Seligman (2006) observed that Korean-English bilingual children largely converged with monolingual counterparts for L1 word order, but displayed a different developmental path with regard to L1 case marking. Blake (1983) found that Spanish-English bilingual children are most incomplete in their L1 knowledge of the subjunctive among other mood forms. Case studies of Spanish child immigrants who arrived in the United States before the start of L1 schooling (Andersen, 1999, 2001; Silva-Corvalán, 2003) also showed that L1 grammar for these children largely converged with monolingual counterparts for L1 gender agreement and tense-aspect distinctions, but that knowledge of L1 person-number and mood morphology gradually declined or remained incomplete. In these studies, early bilinguals of a heritage language were either simultaneous or sequential bilinguals in early childhood, who developed L1 as a weaker language, rather than attriters of a stabilized L1 grammar. Montrul (2008) attempted to trace the weaker language, not only in early childhood, but even through the school age period up until at least the age of 10. In this narrow sense, all heritage speakers, ranging from simultaneous bilinguals to late childhood bilinguals, can be characterized as early bilinguals who have acquired the L1 incompletely. As these findings suggest, heritage speakers do not seem to undergo

uniform paths of L1 development and subsequent attrition in childhood. Individual experience in early bilingualism is varied, to a great extent, and a bit of a black box. What we do know about heritage speakers is limited to their end-state L1 grammar. In this regard, the current study also aims to infer the processes involved in early L1 development of heritage speakers from their ultimate L1 outcomes (see Chapter 3 for more details).

The major issue pertaining to L1 developmental processes in heritage speakers' early bilingualism is cross-linguistic influence. Both the early development and attrition of the L1 are known to be largely influenced by the interference of the new dominant language in childhood (see Section 2.2.3, for more details in the context of L1 attrition). Kaufman and Aronoff (1991), who longitudinally studied the development of a bilingual child (L1 Hebrew; L2 English), witnessed a creative interplay between L1 and L2, as the child was exposed to both languages during a critical period. They showed the process of disintegration and reconstruction of the L1 system with regard to phonology, morphology, syntax, and lexicon, in which the change in L1 grammar was largely induced by the influence of the L2. In addition, L1 restructuring may also take place among heritage speakers when they engage in the L1 relearning process later in life. How this process differs from early L1 development is discussed in a separate section (see Section 2.2.4).

2.2.3 Language Attrition

The most pertinent aspect of heritage language acquisition is language attrition. Language attrition is understood as a biological and cognitive process rooted in memory (see Köpke, 2007 for review). In a narrow sense, language attrition is

defined as the non-pathological decline in a language that was previously acquired by an individual (Köpke & Schmid, 2004). There are second-generation immigrant children (i.e., simultaneous bilinguals), who are exposed simultaneously to the L1 and a majority language and grow up experiencing early bilingualism. These individuals do not experience true L1 attrition, in the sense of attrition after acquisition. In a broad sense, however, language attrition is also defined in terms of the interference phenomenon, as any L2-induced L1 change or restructuring of an individual grammar in a contact situation with a dominant L2 (Pavlenko, 2000; Schmid, 2010; Sharwood Smith, 1983). Since all heritage speakers experience the restructuring of L1 grammar to some extent in childhood, all heritage speakers are, in a broad sense, L1 attriters.

Some ideas have been proposed to explain why L1 attrition occurs in heritage speakers. First, the Interference Hypothesis (Pallier, 2007; Pallier et al., 2003; Ventureyra & Pallier, 2004), which was proposed to explain L1 attrition among adopted children, holds that language attrition is not a consequence of a loss of neural plasticity after a critical period, but of a stabilization of neural connections which results from the language learning process itself. According to this position, language attrition is inherently a loss of memory, owing to the influence of newly acquired language that interferes with the recall of previously learned information (Köpke & Schmid, 2004). According to Paradis (2004), explicit knowledge is more vulnerable to attrition than implicit knowledge, since declarative memory is more susceptible to interference than procedural memory. If this is true, then what is retained in heritage language grammar should be more implicit in nature than what has been lost. Empirical data have shown that heritage speakers' L1 restructuring is largely the

effect of cross-linguistic influence (Sharwood Smith, 1983). The evidence for the L2 encroachment on L1 grammar was found among L1 Italian bilingual children (Kupisch & Pierantozzi, 2010), in which L1 bare plurals in generic contexts were over-accepted, due to the influence of L2 German. Similarly, transfer effects from L2 English were also found among Spanish heritage speakers, in the interpretation of L1 definite articles in generic contexts (Montrul & Ionin, 2010).

Second, the Activation Threshold Hypothesis (Paradis, 2004) posits that language attrition is the result of frequency effects or long-term lack of neural stimulation via input in a given language. That is to say, an item is activated when a sufficient number of positive neural impulses have reached its neural substrates, and every time it is activated, its threshold is lowered and fewer impulses are required to reactivate it. According to this idea, more frequently used elements can replace their lesser used counterparts and production will require more frequent activation than comprehension of a language. Montrul (2008) suggested that the findings of Hulsen (2000) are largely compatible with this hypothesis: Dutch immigrants in New Zealand showed frequency effects in the speed and accuracy of lexical retrieval and performed better in recognition tasks than in production tasks. Both hypotheses are able to explain why heritage speakers experience the loss of their early-acquired L1 grammar, partly due to increasing L2 interference, and partly due to decreasing L1 input or an increased threshold for L1 activation.

Other ideas have been proposed mainly to explain L1 attrition in heritage speakers. It has been largely agreed upon that the language attrition process is selective, with some linguistic features more immune to language attrition than others

(Andersen, 1982; Schmid, 2010; Seliger, 1989). Empirical studies have shown that syntax is generally more stable than phonology and lexicon (Altenberg, 1991; Schmid, 2002). However, relative stability in syntax was shown to be compromised for features at the interface between syntax and discourse (Sorace, 2004) or for features that are similar in two competing languages (Schmid, 2010; Sharwood Smith, 1983). The oldest model to explain such selectivity in language attrition is the Regression Hypothesis, which posits that attrition is simply the mirror image of acquisition, and, thus, structures acquired last will be first to attrite (Andersen, 1982; Berko-Gleason, 1982; Jakobson, 1941). Keijzer (2010) empirically tested this hypothesis with Dutch immigrants in Canada and found supporting evidence in the domain of morphology, but not in syntax, which was mostly characterized by L2 influence. Selective language attrition among and within different grammatical domains has also been portrayed within the theory of UG. The Parameter Hypothesis (Schmid, 2002; Sharwood Smith & Van Buren, 1991) holds that language attrition involves the unmarking of parameters that have been set to marked values, and thus marked values of parameters should persist in the face of reduced input. How heritage language grammar is selectively affected by language attrition is further discussed in Chapter 3.

2.2.4 Language Relearning

When heritage speakers are involved in the relearning process in adulthood, the effect of formal instruction on L1 restructuring needs to be distinguished from L1 restructuring that takes place in early bilingualism. Given this distinction, it becomes theoretically interesting to observe how these late relearners, who are early bilinguals of the L1, perform differently from late bilinguals in language classrooms. If heritage

speakers benefit from later instruction, as argued by Polinsky and Kagan (2007), the question arises as to whether these early bilinguals are involved in explicit learning processes similar to those of L2 learners or whether they rely on their access to early-acquired grammar. This line of research on the L1 relearning effect will allow an answer to the question of whether heritage speakers lose the L1 system or just simply L1 access and control (Pallier et al., 2003; Ventureyra & Pallier, 2004).

Empirical data suggest that heritage language grammar may be both reactivated and reshaped through formal instruction that takes place after a critical period for language learning. Song, O'Grady, Cho, and Lee (1997) ascribed the highly significant gains Korean heritage speakers demonstrated in learning word order to the fact that they were sensitive to corrective feedback and able to recall complex aspects of morphosyntax acquired in childhood. Kang (2010) also reported that Korean heritage speakers may benefit from explicit negative feedback in classrooms. Montrul and Bowles (2010) documented the effect of explicit classroom instruction on the comprehension and production of dative case marking among Spanish heritage speakers. Among the few studies that have compared heritage speakers and L2 learners in classrooms, Kanno et al. (2007) found that Japanese heritage speakers showed an advantage over L2 learners in their knowledge of vocabulary and collocations. Our own second pilot study, discussed below, which investigated the pattern of progressive marking with regard to lexical aspect in Korean heritage speakers, also revealed that later instruction allowed them to further stretch their use of the progressive marker in a native-like manner (see Section 4.1.2 for details). While formal instruction seems to play a role in heritage speakers' L1

restructuring in adulthood, whether such a relearning process is aided by their early-acquired L1 knowledge or is governed by a different learning mechanism that comes into play later in life remains controversial. Therefore, in an investigation of heritage language grammar shaped by mere exposure in childhood, a group of relearners need to be analyzed apart from purely implicit acquirers of the L1.

2.2.5 Summary

Heritage language grammar may be shaped by varied experiences with L1, including child language acquisition, early bilingualism, L1 attrition, and L1 relearning experience in adulthood. Since heritage speakers reflect diverse individual learning experiences, it would be difficult to conclude what specific aspects of L1 learning processes make the greatest contribution to their ultimate L1 outcomes. However, examining the linguistic characteristics of their end-state L1 grammar enables us to see what constitutes the core of their L1 grammar shaped by mere exposure in childhood. The next chapter is therefore devoted to reviewing earlier investigations of the nature of the end-state L1 grammar of adult heritage speakers.

Chapter 3: Heritage Language Grammar

This chapter largely reviews earlier investigations of the end-state L1 grammar of adult heritage speakers and explanatory variables for their ultimate L1 attainment. Some studies report to what extent heritage speakers show convergence or nonconvergence in L1 knowledge for a particular linguistic feature. Other studies report a comprehensive picture of heritage speakers' L1 grammar in one particular language. For instance, Polinsky (2006) depicted L1 morphological and syntactic deficits of Russian heritage speakers, and how they correlate with L1 lexical knowledge. Similarly, in a comparison with L2 learners and native speakers, Lee, Moon, and Long (2009) developed L1 linguistic portraits of Korean heritage speakers in terms of phonology, morphology, syntax, and lexis. In section 3.1., the end-state L1 grammars of heritage speakers from different L1 backgrounds are reviewed for each of the four linguistic domains, i.e., phonology, morphology, syntax, and lexis. In section 3.2., both maturational and non-maturational variables that are responsible for variability in their ultimate L1 attainment are reviewed.

3.1 The End-State L1 Grammar of Heritage Speakers

3.1.1 Phonology

There has been a line of research into L1 speech perception among Korean and Spanish heritage speakers, whose L1 exposure was reduced at the earliest stages of childhood (Au et al., 2002; Knightly et al., 2003; Oh et al., 2003). These studies revealed that heritage speakers generally had a native-like control of L1 phonemic contrasts and that they may phonologically benefit from the L1 relearning process. This remained true even though they had only passive exposure to the L1 in

childhood, which was accessed after a long period of non-use. This tendency was expressed more clearly in Spanish heritage speakers than in Korean heritage speakers, as even low-proficiency bilinguals with L1 Spanish showed native-like voice onset times for voiceless stops. However, some evidence suggests that native-like accent may be affected by language attrition even among late bilinguals (de Leeuw, Schmid, & Mennen, 2010): Adult German immigrants, who were limited in code-mixing, were perceived to have a foreign accent.

3.1.2 Morphology

Investigations of L1 morphology, the most widely examined area in the L1 attrition literature, have brought to light evidence for significant nonconvergence in heritage language grammars. In her review of L1 attrition studies, Gürel (2008) aimed to identify morphosyntactic features that are likely to be acquired incompletely. First, heritage speakers are known to have incomplete knowledge of L1 case marking. A study of Hungarian heritage speakers revealed that they lacked native-like knowledge of optional case marking and differential object marking (de Groot, 2005). Similarly, a study of Spanish heritage speakers found that they incompletely acquired L1 optionality and differential object marking, where semantic distinctions were involved (Montrul & Bowles, 2009). Second, heritage speakers are more likely to retain native-like tense and aspect distinctions, but not mood distinctions. For instance, Spanish heritage speakers made more frequent errors in subjunctive marking than in tense and grammatical aspect marking in both production and interpretation (Montrul, 2009). On the other hand, in a recent investigation of aspectual categories, Russian heritage speakers showed decreased sensitivity to L1 lexical or clausal

determinants of aspect, particularly at the level of pragmatic interpretation (Laleko, 2010). Lastly, heritage speakers, who largely converge with native speakers in verbal morphology, were shown to make systematic errors in nominal morphology, with regard to definiteness agreement in L1 Hungarian (Bolonyai, 2007) and gender agreement in L1 Spanish (Montrul, Foote, & Perpiñan, 2008). Another study of 11 Brazilian Portuguese heritage speakers who arrived in the United States in early childhood found that they lacked native-like knowledge of inflected infinitives (Rothman, 2007).

To sum up, heritage speakers seem to be particularly vulnerable with respect to L1 morphosyntactic features that are optional or those that demand complex semantic distinctions or interpretation. The most plausible explanation for such selective knowledge of L1 morphology among adult heritage speakers is that some morphological information, like mood distinctions, is not fully acquired in early bilingualism, even through the school-age period (Gupol, 2009). Thus, those aspects of L1 grammar remains incomplete, while other morphological information, like tense and grammatical aspect, develops fully during this period (Bar-Shalom & Zaretsky, 2008), and is thus retained in adulthood. Therefore, the issue here is not limited to what features are least likely to attrite, but also to what types of L1 knowledge are likely to be acquired fully in early bilingualism. The latter question may also depend on the context of early exposure to the L1, since a grammatical feature may not develop at the same rate among a group of heritage speakers with the same L1 background. For instance, Albirini, Benmamoun, and Saadah (2011) found that L1 agreement features were better retained among early Palestinian Arabic

bilinguals than among early Egyptian Arabic bilinguals in the United States, as individuals in the former group were brought up in different L1 environments from those in the latter group and adopted more positive attitudes toward L1 maintenance.

3.1.3 Syntax

Unlike in the area of morphology, heritage speakers were shown largely to have native-like control of syntax. Spanish heritage speakers had an advantage over late bilinguals in L1 word order and adverbial placement (Bruhn de Garavito, 2002) as well as in the L1 resolution of anaphoric dependencies (Keating, Jegerski, & VanPatten, 2011). Empirical data also indicate heritage learners' advantage over L2 learners in relative clause constructions, not only among Korean heritage speakers (Lee-Ellis, 2011; O'Grady, Lee, & Choo, 2001), but also among Russian heritage speakers (Polinsky, 2011). Kim, Montrul, and Yoon (2010), who investigated L1 binding interpretations in Korean heritage speakers, found that heritage speakers retain native-like control of the syntactic properties concerning local and long distance anaphors in Korean, although simultaneous bilinguals exhibited a simplified L1 grammar for the anaphoric form. On the other hand, there is other evidence which suggests that heritage speakers consistently omit null subjects or objects and replace them with overt nominal expressions, due to the difficulty in identifying the reference of the null pronominal (Sorace, 2004; Sorace & Serratrice, 2009). According to this position, L1 attrition is likely to occur only at the interface between syntax and discourse (e.g., syntax-pragmatics, syntax-semantics).

3.1.4 Lexicon

Finally, the attributes of L1 attrition in heritage speakers proved most evident

in the area of L1 lexical knowledge. Evidence for language attrition among early bilinguals has been found mainly in the area of the lexicon (Keijzer, 2010; Pavlenko, 2004; Weltens & Marjon, 1993), while it proved particularly apparent in formulaic lexis, as opposed to non-formulaic lexis among Hebrew-English bilingual children (Berman & Olshtain, 1983). Polinsky (1997, 2006) claimed that the degree of L1 lexical attrition in Russian heritage speakers is also significantly correlated with the degree of L1 morphosyntactic attrition.

A major concern regarding L1 attrition in the area of the lexicon, however, has been whether the loss of L1 lexis in heritage speakers is largely an issue of lexical access. The Activation Threshold Hypothesis suggests that any difficulty heritage speakers experience in lexical access or retrieval is caused by decreased input frequency. The study of the lexical development of Korean heritage speakers by O'Grady et al. (2009), as a part of the Hawai'i Assessment of Language Access (HALA) project, also reported that the speed of bilingual word naming is strongly correlated with relative language strength in both languages. More recently, Bardovi-Harlig and Stringer (2011) empirically investigated how computational and psycholinguistic models of lexical activation and inhibition can explain the drastic loss or disuse of L1 lexical items, which was recovered in situations of re-immersion. While these studies suggest that a decrease in the L1 lexicon, particularly among late attriters, is mainly due to reduced accessibility, whether a lack of lexical knowledge among early attriters is also merely a processing issue has not been firmly established. To minimize processing load and to argue that the evidence of nonconvergence in heritage speakers' L1 lexis is due to reasons beyond their failure to process it, the

current study measures receptive knowledge of L1 lexis.

3.1.5 Summary

The end-state L1 grammar of heritage speakers seems to vary to a great extent, depending upon the linguistic domain, where their knowledge of L1 morphology or lexis are more likely to be acquired incompletely than their knowledge of L1 syntax or phonology. Empirical data also suggested that their knowledge of the L1 may vary within a linguistic domain, where some linguistic features (e.g., optional case marking) are more likely to be acquired incompletely than others (e.g., tense marking) in early bilingualism. In addition to the selectivity in heritage speakers' L1 grammar, other evidence suggests that their ultimate L1 attainment may also vary at the individual level, depending on the age at which they experienced reduced exposure to the L1 or the types of L1 environment they were exposed to in childhood. The next section mainly deals with the issue of which factors are responsible for such individual variability in the ultimate L1 attainment in heritage language acquisition.

3.2 Explaining L1 Outcomes of Heritage Speakers

It was noted earlier that heritage speakers may end up with an incomplete L1 grammar in certain domains or features. The primary concern of the current study is to what extent such divergent outcomes in heritage language acquisition can be accounted for. Researchers have attempted to find a link between ultimate L1 outcomes in heritage speakers and the linguistic or extralinguistic variables involved in their early L1 development. Based on the previous findings, it is hypothesized that there are four major explanatory variables, including both maturational and non-maturational factors, which play a role in heritage language acquisition.

3.2.1 Age Variables

The idea that there is a qualitative change in the language learning mechanism around puberty not only applies to maturational constraints in L2 learning, but also to the susceptibility to change in the L1 before it is stabilized. Empirical data have shown severe L1 attrition among those who experienced reduced L1 contact before puberty (Kaufman, 2001; Selinger, 1989), even to the extent of complete replacement, as documented among early-adopted children (Pallier et al., 2003; Ventureyra & Pallier, 2004). Therefore, it has been largely agreed upon that the same biological or cognitive mechanisms that account for age effects in L2 acquisition also govern age effects in L1 attrition (Bylund, 2009a; Köpcke & Schmid, 2004; Montrul, 2008; Pallier, 2007). Bylund (2009a) claimed that the age at which there is a reduction in contact with the language determines susceptibility to L1 attrition, and that the period for which this is true largely ends around the offset of the critical period.

There are at least two issues to be clarified regarding age differences in heritage language acquisition. Unlike in studies of age effects in L2 acquisition, where age and input are independent constructs, they have high interdependence for the duration of L1 attrition processes. Therefore, the age factor that predicts L1 outcomes in heritage speakers needs to be carefully construed. Previous investigations of immigrant populations have used different measures of the age construct, including age of arrival, age of L2 acquisition, age of onset of bilingualism, and age of reduced L1 contact and use. Although these concepts are related to each other, we need to identify the specific aspect of age that is most directly responsible for the L1 outcome. For instance, the dimensions of L1 reduction versus L2

acquisition, reduced L1 exposure versus L1 use, or L2 onset versus L2 stabilization can be considered. For this reason, a factor analysis of different dimensions of the age factor was conducted in this study, to reveal the dimension truly responsible for the outcome variable.

Another issue concerns whether there is a sudden cut-off point for L1 stabilization or a gradual offset of susceptibility to L1 attrition. Some researchers argued that there is a change in susceptibility to L1 attrition at around age 9 (Harley & Wang, 1997; Köpcke & Schmid, 2004), while others have shown that language loss may occur even through the early school-age period, and that those past the age of around 12 become largely invulnerable to attrition or L2-induced changes in L1 grammar (Bylund, 2009b; Hakuta & D'Andrea, 1992; Jia & Aaronson, 2003; Pires & Rothman, 2009; Yeni-Komshian et al., 2000). While the degree of deterioration in L1 grammar has been widely documented, how age effects in language attrition interact with different types of L1 knowledge has been less researched. Yeni-Komshian, Flege, and Liu (2000), who studied the L1 pronunciation of 240 heritage speakers of Korean, found that those who started learning the L2 after age 12 performed to native-like standards. Khattab (2002), who studied the developmental change in vowel onset time (VOT) of three English-Arabic bilingual children over a period of 18 months, also found a stronger correlation between age of L2 acquisition and VOT differences than in monolingual children. In a study of 39 heritage speakers of Spanish, Montrul (2002) showed the effect that age of onset of bilingualism had on L1 tense and aspect distinctions, in which simultaneous bilinguals and early child bilinguals displayed a noticeable L1 nonconvergence with native speakers. A more

recent investigation of 31 heritage speakers of Spanish by Bylund (2009b) also found that only those who started learning the L2 after the age of 12 converged with native speakers for L1 event conceptualization patterns.

3.2.2 Input Variables

Numerous studies have shown that the amount of L1 contact and use is also a significant predictor of L1 proficiency in heritage speakers (de Bot & Weltens, 1991; Francis, 2005; Schmid, 2007). Schmid (2007), who found that both active and passive L1 exposure significantly contributed to L1 outcomes among late German immigrants, held that the L1 activation threshold is largely dependent upon the amount and type of input. According to Montrul (2008), bilingual balance in heritage speakers fluctuates in childhood to the rhythm of abrupt changes in input, so that the early onset of acquisition, which alone is a sufficient condition for L2 success, is not sufficient for heritage speakers' L1 retention. This claim is corroborated by the study of Pires and Rothman (2009), who investigated the L1 development of inflected infinitives among Portuguese-English immigrant children. In a comparison with age-matched monolingual children or balanced bilingual children, they observed that L1 variability in bilingual children was largely due to quantitative and qualitative properties of the input they received. On the other hand, the role of input becomes negligible in late bilingualism, at least for grammar, as shown by the null effect of length of residence on L2 outcomes (DeKeyser, 2000; Johnson & Newport, 1989). Therefore, heritage speakers, whose exposure to the L1 is reduced after the offset of a critical period, would be less affected by the input factor. However, some evidence from late bilingualism suggests that there are persistent effects of input in learning formulaic

lexical entries (Durrant & Schmitt, 2010; Flege et al., 1999).

To address the role of input in L1 maturation, Lenneberg (1969) described how an individual may interact with an environment during a critical period. He explained that, although the environment is not constant, a growing individual is capable of accepting specific input at each stage of maturation, which breaks down and resynthesizes in such a way that another stage is ushered in with new input. He added that since individuals may be susceptible to an infinite variety of input at various stages within a determined finite period of time, their developmental history may vary with the nature of the input accepted. Such an explanation is, in fact, in accord with the claim that heritage language development may rely, not only on the amount of input or the time at which input is reduced, but also on the quality of input. However, as pointed out by Schmid (2007), previous studies have often failed to distinguish among different types and contexts of L1 input. Schmid and Dusseldorp (2010), who investigated the role of multiple extralinguistic factors in late L1 attrition, revealed that it was only the use of the L1 for professional purposes that contributed to their multivariate regression model. While this study targeted those who immigrated in late adolescence, the same approach is appropriate for investigating a heritage language in early bilinguals. The current study thus distinguished among different types and contexts of L1 exposure and contexts in which it occurs, in order to isolate which aspects of L1 input are strongly predictive of heritage speakers' L1 outcomes.

3.2.3 Cognitive Variables

Although language aptitude has been investigated more often in the context of

L2 learning, its potential relevance to language attrition has also been brought to light (Bylund et al., 2009; Köpke, 2007). It has been suggested that language aptitude is a significant predictor of L2 learning success in late bilingualism (DeKeyser, 2000; DeKeyser, Alfi-Shabtay, & Ravid, 2010). Ross, Yoshinaga, and Sasaki (2002), who examined aptitude-exposure interaction effects, also found that language aptitude was the only predictor of L2 outcomes for late starters, while the amount of exposure played a greater role for early starters. However, it is interesting to note that Abrahamsson and Hyltenstam (2008) identified small, yet significant aptitude effects in child L2 acquisition, although none in adult L2 acquisition. In addition, Bylund, Abrahamsson, and Hyltenstam (2009) found that language aptitude also had a significant effect on L1 attrition, which compensated for the reduced contact among early attriters. Concerning the origin of language aptitude, Carroll (1973) suggested earlier that L2 aptitude may be a residual effect of early learning capacity as shown by individual differences in the rate of L1 acquisition. This idea was empirically supported by the significant correlations witnessed between the rate of L1 development and language aptitude (Skehan, 1989; Skehan & Duroquest, 1988).

It is important to understand that language aptitude is not a unitary concept, but consists of several cognitive abilities, such as phonetic coding ability, grammatical sensitivity, inductive learning, and associative memory. Instead of constructing one aptitude battery to be used as a single predictor, the role of different components of language aptitude has also been explored. For instance, Harley and Hart (1997, 2002) found that analytical ability was a strong predictor of L2 outcomes in both immersion and classroom contexts, and was a stronger predictor of classroom

learning success than memory ability for adolescent learners. Skehan (2002) has hypothesized that phonemic coding ability and the executive component of working memory are important at the input stage, while grammatical sensitivity and inductive ability are crucial at the patterning stage, and other memory abilities gain significance at the output stage of language learning. Such an investigation of aptitude components is also crucial in understanding how language aptitude specifically benefits heritage language development.

There is no empirical evidence that working memory is directly responsible for heritage language outcomes. However, empirical data have shown that working memory occupies a significant role in L1 child processing or early bilingualism. The role of working memory in L1 attrition is also one of the oldest theoretical issues, although it lacks empirical evidence (Köpke & Schmid, 2004). Working memory refers to the active maintenance of information in the face of ongoing processing and/or distraction (Conway et al., 2005). Since there has been a shift in our concept of unitary short-term memory to working memory, working memory has been understood as a multicomponent system (Baddeley, 2007): 1) The phonological loop has the functions of temporary storage and rehearsal of phonological information, while 2) the visuospatial sketch pad serves similar functions with visual and spatial information, and 3) the episodic buffer integrates phonological, visual, and spatial information into a unitary episodic representation. 4) On the other hand, the central executive, the important component that distinguishes working memory from short-term memory, functions to suppress irrelevant information and coordinate cognitive processes by focusing, switching, and dividing attention.

Observations made of language-impaired patients initially drew attention to the function of the phonological loop, or phonological memory, as a language learning device; it was shown to play a particular role in vocabulary learning, in L1 children (Gathercole et al., 1992), early bilinguals (Masoura & Gathercole, 2005; French, 2006), and late bilinguals (Service & Kohonen, 1995; Speciale, Ellis, & Bywater, 2004). In addition, the function of phonological memory was found in sentence processing, in children's L1 spoken comprehension (Adams, Bourke & Willis, 1999; Adams & Gathercole, 1996; Willis & Gathercole, 2001) and in adults' L2 oral fluency (O'Brien et al., 2007). However, the role of phonological memory as it relates to grammar learning seems somewhat weaker, although it may also benefit L2 grammar learning (French & O'Brien 2008; Williams & Lovatt, 2003). For instance, French (2006) reported that phonological memory significantly predicted vocabulary gains, but not grammatical gains in early bilinguals.

On the other hand, working memory, in the sense of both the phonological loop and the central executive components, has been shown to have a broader impact on language development. The role of working memory has been well established in the context of L2 learning, including reading skills (Harrington & Sawyer, 1992), the ability to transfer L1 processing skills (Walter, 2004), simultaneous interpretation (Christoffels, de Groot, & Kroll, 2006), the ability to notice and benefit from L2 interactional feedback (Mackey et al., 2002), and the ability to gain from an L2 immersion experience (Sunderman & Kroll, 2009). However, working memory is also a potential contributing factor to reduced susceptibility to L1 attrition in heritage speakers, in that it may help retain L1 features in the presence of competing L2

counterparts. Cognitive control becomes increasingly important in bilingual processing, since bilinguals are in need of suppressing interference from a dominant language, as two languages become concurrently active (Dijkstra, van Jaarsveld, & Ten Brinke, 1998). It is also known that cognitive demands arising from reduced access to the less-used L1 and its competition with the more-accessible L2 place strong demands on the executive control mechanism, which results in processing difficulties and inability to activate automatic procedures (Norman & Shallice, 1986). In this context, the variability in the degree of lexical retrieval difficulty heritage speakers experience may partly be explained as a function of working memory capacity.

Based on previous empirical evidence, the current study proposes that the role of working memory in heritage language acquisition may be twofold: 1) Phonological memory largely contributes to L1 lexical development, while 2) executive control reduces L1 attrition susceptibility, which compensates for reduced L1 exposure. The issue of whether language aptitude is responsible for either heritage speakers' development of L1 grammar in early bilingualism or the reduction in their susceptibility to L1 attrition is further explored in this study.

3.2.4 Affective Variables

A significant link between emotion and language acquisition has also been claimed (Köpke, 2007; Paradis, 2004; Schumann, 1997). There are largely three affective variables that may influence the L1 development of heritage speakers, i.e., language attitude, motivation, and ethnic identity: 1) Language attitude often refers to internal values attributed to a language by individuals or social environments,

including families and communities, while 2) motivation derives primarily from external factors, such as socio-economic status or educational level (Ben-Rafael & Schmid, 2007). 3) Ethnic identity relates to the idea of how individuals identify or affiliate themselves with their ethnic group, which largely shapes or is shaped by their language proficiency. When language plays an important role in defining identity, one's identity becomes ethnolinguistic (Hamers & Blanc, 2000). These variables are likely indirectly to affect L1 proficiency, as well as L1 relearning success, among heritage speakers. Both quantitative and qualitative studies have been conducted with the aim of finding a link between affective factors and heritage language development. Ben-Rafael and Schmid (2007), who compared two groups of immigrants with different L1 backgrounds in Israel, found that their attitude and motivation towards the use of Hebrew and their L1s largely determined the degree of L2 interference in spontaneous L1 oral production (i.e., greater in Francophone speakers than in Russian speakers). Most recently, Wu (2011) conducted a case study of Chinese immigrant families in the United States through interviews, observations, and journals, and found that both children and parents' attitudes influenced the degree of L1 retention among immigrant children, as measured by self-reported L1 proficiency. However, there is a less consensus on the role of ethnic identity in heritage language acquisition. Some of the earlier quantitative studies failed to demonstrate a significant correlation between ethnic identity and L1 outcomes among immigrant populations (Hulsen, 2000; Yağmur, 1997; Waas, 1996). However, more recent evidence suggests otherwise. Phinney and Ong (2007) found that ethnic identity measures largely predicted L1 proficiency among immigrant adolescents. Chinen and Tucker (2005)

also observed positive gains in Japanese bilingual children with a strong heritage identity in the L1 relearning process. A recent case study of three Korean immigrant children by Ro (2011), which examined their bilingual and biliteracy development over a period of six years, revealed that their L1 literacy practices were largely influenced by their socio-cultural and educational experiences, as well as their ethnic identity. However, whether ethnic identity is also significantly correlated with their ultimate L1 proficiency is in need of further investigation, and this topic is pursued in the present study.

The most critical issue in the study of affective variables in heritage language acquisition may be the conceptual and methodological underpinnings of the measures involved. Most quantitative studies have relied on the attitude and motivation test battery developed by Gardner (1985). However, considering that the test was mainly developed to assess L2 learning outcomes, it is questionable whether its use is appropriate in testing the L1 attainment of heritage speakers. The construct of language attitudes for L2 learning may not correspond to the construct of language attitudes towards L1 retention. The same can be said of the ethnicity measures. Phinney and Ong (2007) employed the multigroup ethnic identity measure (Phinney, 1992), which exemplifies one valid and reliable measure of heritage identity. They reported that it has subsequently been used in dozens of studies and has consistently demonstrated good reliability, with alphas above .80 across a wide range of ethnic groups and ages. In addition, they conducted a factor analysis with a large sample of adolescents, and extracted two dimensions: 1) ethnic identity search (i.e., a developmental and cognitive component) and 2) affirmation, belonging, and

commitment (i.e., an affective component). Interestingly, the study suggests that, even within the construct of ethnic identity, multiple dimensions may be involved. The current study thus explores the underlying components of the affective factor, with regard to heritage speakers' attitude towards L1 retention or ethnic affiliation towards the L1 group.

3.2.5 Summary

Empirical evidence suggests that the earlier contact with the L1 is reduced, the more likely heritage speakers are to end up with an incomplete L1 grammar, as is the case with pre-school-age child immigrants. In addition to the age effect, some evidence also suggests a significant link between heritage speakers' L1 outcomes and non-maturational factors, including input, language aptitude and language attitude. However, few studies have looked into the relationship among these different factors or the effect of non-maturational factors on heritage speakers' L1 proficiency, above and beyond the effect of the maturational factor. In line with the literature, the present study proposes a multivariate predictive model for heritage language acquisition, in an attempt to find a rational and comprehensive account of variability in ultimate L1 attainment among adult heritage speakers.

Chapter 4: The Current Study

The current study investigated the ultimate L1 outcomes among Korean heritage speakers, in order to explain the selective nature of their L1 grammars and the variability in their ultimate L1 attainment. The major findings from three pilot studies that investigated Korean heritage speakers from different perspectives contributed to the formation of the current research questions, and are therefore reported in the following section.

4.1 Pilot Studies with Korean Heritage Speakers

The first pilot study reports part of the major findings from the Linguistic Correlates of Proficiency (LCP) project at the University of Maryland (Long, Gor., & Jackson, 2012), which set out to provide empirically based linguistic portraits of heritage speakers and proficiency-matched L2 learners in less-commonly taught languages in the United States. The second pilot study reports to what extent the pattern of heritage speakers' use of an L1 morphological marker converges with that of native speakers, and whether the native-like pattern can be relearned through formal instruction in adulthood. The last pilot study attempted to find a rational explanation for the divergent L1 outcomes in heritage speakers.

4.1.1 Heritage Advantage in L1 Morphosyntax

In this study, heritage speakers of Korean were compared to proficiency-matched L2 learners of Korean in their knowledge of L1 morphosyntax. A total of 28 heritage speakers and 13 L2 learners of Korean in the United States, varying in their proficiency in Korean (i.e., ILR 2, 2+, 3), were administered a four-hour test battery made up of eight measures of L1 receptive knowledge and eight measures of L1

productive knowledge, in phonology, morphology, syntax, and lexis. Their proficiency in Korean was measured using the ACTFL oral proficiency interview. The result of the testing of their receptive knowledge in morphosyntax, as measured by a 166-item auditory grammatical judgment test (GJT), is reported here (see Lee, Moon, & Long, 2009, for the original report on Korean). The seven target structures tested in the GJT consisted of tense dependency, past tense in relative clauses, particle stacking, locative verbs, negation, conjunction, and apperceptive marking in Korean.

The results showed that heritage speakers outperformed L2 learners of equivalent Korean proficiency on most of the target structures. Heritage speakers showed a stabilized pattern in L1 performance from ILR 2 through ILR 3, scoring above 75% throughout the proficiency range. Conversely, L2 learners demonstrated a steady development in L1 performance with increasing proficiency, 58% at ILR 2, 65% at ILR 2+, and 75% at ILR 3. Therefore, the heritage advantage over L2 learners at lower proficiency levels disappeared at around ILR 3. The GJT performance was further analyzed across different structures. Overall, heritage speakers showed less structure dependency than L2 learners. Heritage speakers performed equally well across all structures, showing native-like knowledge in locatives as early as at ILR 2, in negation at ILR 2+, and in conjunction at ILR 3. L2 learners, on the other hand, performed like native speakers in negation and close to heritage speakers in tense dependency and past tense in relative clauses, only on reaching ILR 3. The disparity in performance between the two groups disappeared at this level, except for apperceptive marking and particle stacking, and both groups still struggled with tense

dependency and past tense in relative clauses, the two structures that clearly set them apart from native speakers.

Based on the findings, heritage language grammar, unlike L2 grammar, seems largely to converge with native grammar in purely syntactic structures, regardless of measured oral proficiency. However, heritage speakers' L1 knowledge of some features remained incomplete even among highly proficient learners. Such unique linguistic profiles of heritage speakers, in comparison with L2 learners, were revealing about the nature of heritage language grammar shaped by early exposure, not necessarily reflected in global proficiency ratings, and about the nature of selectivity in heritage language grammar. The current dissertation further examines what makes certain L1 features more acquirable than others in heritage speakers. While comparative studies of heritage speakers and L2 learners have revealed some important aspects of heritage language grammar, there remains a methodological challenge in equating the two populations at the level of a global proficiency. If these two types of learners have truly undergone different learning paths, it is rather doubtful that their proficiency can be equated in the first place, be it at the level of representation or at the level of processing. For this reason, the current dissertation does not attempt to compare heritage speakers with L2 learners to show the effect of early exposure on their L1 outcomes, but focuses instead on examining when heritage speakers fail to converge with native speakers in their knowledge of the L1 and why they exhibit great individual variability in their ultimate L1 outcomes, beyond the issue of whether they benefit from early exposure.

4.1.2 L1 Progressive Marking in Heritage Speakers

This study investigated whether and to what extent Korean heritage speakers, whose L1 grammar is largely shaped by early exposure to the target input, exemplify native-like patterns in morphological marking. The progressive marker in Korean, *-ko iss-*, was chosen as the target structure for a number of reasons: 1) optional marking (i.e., progressive reading of the present tense), 2) opaque form-meaning mapping (i.e., progressive and/or resultative meaning), 3) negative L2 transfer (i.e., progressive marking not allowed with stative verbs in English), 4) testing of the Aspect Hypothesis (Sugaya & Shirai, 2007), and the claim that the distributional pattern in tense and aspect marking with regard to the lexical aspect is driven by input. Forty second-generation Korean heritage speakers, who were born in the United States to Korean-speaking parents, took part in the study, of whom 20 were instructed re-learners of L1 in college. Twenty native speakers of Korean also took part in the study to provide the baseline data. They were tested on the use of *-ko iss-* with four different verb types (i.e., activity, accomplishment, achievement, state) using both a written cloze passage and a spontaneous oral narrative of silent video clips.

The results showed that heritage speakers generally produced the target form less frequently than native speakers in both tasks, but that the distributional pattern of the form with regard to lexical aspect was similar in both groups. In the written task, the pattern of heritage speakers (activity (65%) > accomplishment (49%) > achievement (36%) > state (19%)) resembled that of native speakers (activity (83%) > accomplishment (76%) > achievement (56%) > state (36%)). The oral production data, however, revealed that native speakers were somewhat different from heritage

speakers in the unbiased use of *-ko iss-* with both activity (44%) and accomplishment (41%), followed by achievement (15%) and state (11%). Interestingly, such a pattern was witnessed among the instructed heritage speakers, i.e., activity (48%) > accomplishment (46%) > achievement (12%) > state (2%), but not among the uninstructed counterparts, i.e., activity (35%) > accomplishment (28%) > achievement (10%) > state (2%). A post-experimental sentence-interpretation test was also administered to examine whether heritage speakers had native-like sensitivity to progressive aspect in the absence of overt marking, given the same 32 items used in the cloze passage. Heritage speakers showed near-native knowledge in optional marking (49%), when compared to the native speakers (59%), suggesting that both groups relied on the progressive interpretation of the present tense to a large extent.

To sum up, heritage speakers, who were largely exposed to the L1 in childhood, retained the native-like pattern of progressive marking with regard to lexical aspect, as well as native-like knowledge of its optional marking. The study supported the claim that multiple factors, including input frequency and instruction, contribute to the acquisition pattern of tense and aspect marking (Sugaya & Shirai, 2007). The results from this study led to a question as to the types of linguistic features more likely to be influenced than others by the amount of input or by any specific factor that is potentially relevant to heritage language acquisition. Furthermore, the study suggested that a group of relearners needs to be excluded from the current investigation of heritage speakers' L1 grammar shaped by mere exposure in childhood, since their L1 can be relearned or reshaped through later instruction.

4.1.3 Predicting L1 Variability in Korean Heritage Speakers

The last pilot study investigated the potential predictors of L1 proficiency among adult heritage speakers of Korean in the United States, in order to explain why they end up with divergent outcomes in L1 proficiency, although they maintain relatively regular and substantial contact with the L1 through extended family and large communities in the country. Twenty-five heritage speakers of Korean in college, ranging in age at immigration from birth to 14, were measured on their L1 proficiency by means of a 180-item auditory grammaticality judgment test (GJT) on seven major structures in Korean. The potential predictors of L1 proficiency were examined, including age of arrival, the amount L1 exposure at home, the amount of L1 media exposure, the amount of early L1 tutoring, and the strength of ethnic identity.

The results showed that the effect of age of arrival (AOA) was significant, $r(23) = .61$, $p < .001$, where the performance of the early arrivals (AOA < 4) was considerably divergent, scoring as low as 40% and as high as 80% on the GJT. On the contrary, the late arrivals (AOA > 9) scored above 80% on the GJT, without any exception. The amount of L1 use at home as well as the amount of L1 media exposure were also significantly correlated with L1 performance, $r(23) = .46$, $p < .001$, and $r(23) = .35$, $p = .035$, respectively. On the other hand, the amount of early L1 tutoring and the strength of heritage identity were not a significant predictor of L1 performance, $r(23) = -.11$, $p = .17$ and $r(23) = .08$, $p = .35$. However, those who had a stronger affiliation with heritage identity showed a unique tendency of exclusively socializing with heritage or L1-speaking peers. The finding suggested an

indirect link of ethnic identity to the L1 outcome through the increased amount of L1 use with peers and exposure to the L1-spoken communities. As for instructional variables, the amount of early L1 tutoring or late L1 instruction correlated negatively with other language experience variables, as those who were enrolled in Korean classes belonged to the low identity group.

Despite the small sample size, the study revealed that the age and input factors, together, were mostly responsible for heritage speakers' knowledge of L1 morphosyntax, while instructional and affective variables were not necessarily correlated with the outcome variable. Notably, the performance of the 18 early attriters (AOA < 4), quite similar to each other in terms of AOA and amount of L1 exposure, displayed tremendous L1 variability, which was neither explained by the amount of L1 instruction nor the degree of L1 affiliation. The finding thus left open the role of cognitive factors in heritage language acquisition, such as language aptitude, working memory, and literacy skills, which was not examined in the pilot study. The study also observed the interaction of multiple factors at play in predicting L1 proficiency, which called for the need to conduct a multivariate study with an increased sample size.

4.1.4. Summary

The three pilot studies investigated different aspects of the L1 development of adult heritage speakers of Korean. First, the comparison of the end-state L1 grammar of heritage speakers with the ultimate L2 outcomes of learners, revealed that heritage speakers largely benefit from their early exposure to the L1 in childhood, and that they retain some linguistic features better than other features. In fact, other empirical

evidence has also shown that heritage speakers are selective in their knowledge of the L1. In the current study, therefore, the question has become not whether heritage speakers have an advantage over L2 learners, but under what conditions they acquire the L1 incompletely. The study investigates their L1 outcomes in the areas of morphology and lexicon, in particular, for they have been shown to be more vulnerable than the area of phonology and syntax in the literature. The second observation on the pattern of L1 progressive marking in heritage speakers suggested that their native-like use of the progressive marker is largely shaped by input frequency, and that it may also be reshaped by later instruction. The results led to a question as to whether certain linguistic features are particularly affected by one factor over another in developing the L1 grammar of heritage speakers. In this vein, the current study examines multiple factors that contribute to L1 outcomes and the unique contributions of each factor. In addition, the study strictly controls for the relearning effect in heritage speakers, in order to make predictions about the nature of their L1 grammar as shaped by mere exposure. Finally, the investigation of the relationship between predictor variables and ultimate L1 outcomes in heritage speakers showed that the maturational factor largely accounts for their L1 variability, but that it is not enough to account for the variance among early arrivals. Therefore, the current study further investigates the roles of language aptitudes and attitudes in heritage language acquisition, which were not examined in the pilot study. The study also examines which variables constitute each factor and how they are related to one another.

4.2 The Scope of the Current Study

The major goal of the current dissertation is to understand the nature of heritage language acquisition by investigating the end-state L1 grammar of Korean heritage speakers. More specifically, the study investigates which factors primarily account for the ultimate L1 proficiency of heritage speakers and the types of L1 knowledge they are likely to acquire incompletely, and why that is so. In line with the literature and earlier pilot findings, the current study aims to find the answers to the four research questions as summarized below.

4.2.1 Research Questions

1. To what extent do heritage speakers of Korean show incomplete knowledge in L1 morphosyntax, collocation, and lexis?

The first research question addresses the nature of the end-state L1 grammar of heritage speakers. It was seen earlier that phonology and syntax are more stable than morphology and lexicon. In this study, heritage speakers were measured on their knowledge of L1 morphosyntax and lexis, to investigate which features are likely to be acquired incompletely within each linguistic domain. Previous studies also suggested that the evidence for L1 nonconvergence is particularly compelling among pre-school-age immigrants, whose L1 was incompletely acquired in early bilingualism, and which further deteriorates or remains incomplete through adulthood.

The present study thus examined whether the same pattern of L1 nonconvergence is replicated among five different groups of heritage speakers, varying in the age at which L1 exposure was reduced and L1 status defined with regard to literacy skills and the amount of L1 schooling completed.

2. Which of the measured variables constitute each of the four hypothesized explanatory factors in heritage language acquisition?

The second research question relates to identifying the internal structure of each explanatory factor proposed, including 1) age, 2) input, 3) aptitude, and 4) affect. A factor analysis was conducted on all measured items for each latent variable, to avoid treating all items as a single factor and to see if they truly represent a single construct. Since there is no strong theoretical grounds on the basis of which to argue for the components of each proposed explanatory variable, an exploratory factor analysis was performed to detect the underlying structure of each factor. Here are all the measured variables for each hypothesized factor:

- 1) Age at immigration (AI), age of onset of L2 acquisition (AO), age of reduced L1 contact (ARC), and age of reduced L1 use (ARU) measured the age factor.
- 2) The amount of L1 exposure at home in childhood (Home 1) and in adulthood (Home 2), L1 media exposure in childhood (Media 1) and in adulthood (Media 2), L1 use with peers in childhood (Peer 1) and adulthood (Peer 2), L1 exposure for work and other extracurricular activities in childhood (Work 1) and in adulthood (Work 2) measured the input factor.

- 3) Five measures of language aptitude (i.e., PLAB 4 & 5, LLAMA B, D, & F) and the four measures of working memory span (i.e. nonword span, digit span, counting span, operation span) measured the aptitude factor.
 - 4) Three measures of language attitude (i.e., learner attitude, motivation, parental attitude) and the three measure of ethnic identity (i.e., ethnic affiliation, ethnic identity search, and ethnic pride) measured the affective factor.
3. How much variance in heritage speakers' L1 attainment can be explained by each maturational or non-maturational factor?

This is the most crucial research question, which was addressed to explain the variability in heritage speakers' L1 outcomes. Previous studies have shown that incomplete L1 acquisition can be attributed to multiple factors. Primarily, the age factor, or the age and input factors together, are significantly correlated with heritage speakers' ultimate L1 proficiency, while some aspects of language aptitude and language attitude may also be responsible for their ultimate L1 proficiency. In this study, the principal factors were sequentially entered into a multiple linear regression model in order of hypothesized importance. The sequential regression model was conducted for the outcome variable, i.e., L1 proficiency, as measured by the GJT, the collocation test, and the receptive vocabulary size test. The age factor was entered first, followed by the input factor, to see how much these two major factors account for the total variance in the L1 outcome, and whether the input factor makes any unique contribution to the model after controlling for the age factor. The aptitude

factor was entered in the next step, to see whether it accounts for any significant additional variance in the model after controlling for the age and input factors. Finally, the attitude factor was entered in the last step, to see whether it increases the predictive power of the model further, after controlling for the age, input, and cognitive factors.

4. What types of L1 knowledge are most affected by each hypothesized factor?

The last research question was posed to further explain the phenomenon of selectivity in heritage language grammar. We saw earlier that some linguistic features are more likely to be acquired incompletely than others, both within and across linguistic domains. The present study aims to demonstrate whether such selectivity in heritage speakers' L1 grammar can partly be ascribed to the unique contribution of each identified factor in their L1 outcomes. In each step of the multivariate regression analysis, therefore, it was questioned whether the effect size of each identified explanatory factor (i.e., age, input, aptitude, affect) is largely the same or different for the various types of L1 knowledge.

Chapter 5: Methodology

5.1 Participants

Adult heritage speakers of Korean in the United States were recruited at universities in the Washington, D.C. region through flyers and personal contacts. Heritage speakers in this study were limited to those who were born to Korean immigrant parents or who immigrated in before the age of 16. Careful screening of participants in terms of their language experience background was necessary. The following information was requested through email communication before inviting them to participate in the study: 1) Age at immigration, 2) Total length of stay in Korea since immigration, and 3) The number of semesters enrolled in Korean classes in college. Those who had arrived in the United States after the age of 16 or those who had returned to Korea for a stay longer than three months were excluded. In addition, those who received more than two semesters of formal instruction in Korean or participated in summer exchange programs in Korea were considered L1 relearners and excluded from the study. As a result, a total of 90 heritage speakers of Korean took part in the study. The participants comprised 51 female and 39 male undergraduate or graduate students in various majors at the universities. Their average age was 22, with a range of 18 to 32. In addition, 20 native speakers of Korean were recruited to provide L1 baseline data. They were undergraduate or graduate students at the same institutions, who had arrived in the United States after turning 18 and had resided here for less than four years.

Heritage speakers were divided into five groups for comparison, according to the age at which their L1 contact was reduced (ARC). At the beginning of the

recruitment phase, most of the participants belonged to heritage groups with ARC < 4, so recruitment continued until a comparable number of participants from other heritage groups had been reached. Extra time and effort were required to reach out to heritage speakers with ARC between the ages 5 and 12, in particular. As shown in Table 1, each group also varied in their L1 literacy and amount of L1 schooling completed before the ARC. Defining their true ARC was not a simple task. Since participants had L1-speaking parents in childhood, their ARC did not necessarily match their age at immigration or age of onset of L2 learning. For instance, if they had an exclusively Korean-speaking caregiver and first been exposed to the L2 during the preschool years, we can say that they had reduced L1 contact at the age they started schooling. Therefore, the age at which participants first experienced a drastic reduction in L1 contact, due to increasing contact with L2, was determined in the language background survey through the following items:

- 1) When and where were you born?
- 2) What language did your caregiver(s) speak when you were an infant?
- 3) At what age did you/your parent(s) come to live in the U.S.?
- 4) At what age did you first attend preschool/kindergarten in the U.S., if ever? And what was the language spoken at the preschool/kindergarten?
- 5) At what age were you first exposed to Korean and to English?
- 6) At what age were you first drastically reduced in your exposure to Korean?

Table 1 Types of heritage speakers

Group (Bilingual type)	ARC	L1 shift	L1 schooling	L1 literacy	L1 self-rating*
1 Simultaneous (N=20)	0-1	Yes/No	No	Yes/No	5.23
2 Pre-school (N=19)	2-4	Yes	No	Yes/No	5.78
3 Early childhood (N=19)	5-8	Yes	Yes (K-G1)	Yes	4.97
4 Late childhood (N=15)	9-12	Yes/No	Yes (G2-6)	Yes	7.95
5 Adolescence (N=17)	13-15	No	Yes (G7-9)	Yes	9.13

*Self-rated mean fluency in four major skills, where 0 is none, and 10 is native-like.

Group 1 (ARC < 2) consisted of simultaneous bilinguals, who were born to Korean-speaking parents in the United States and were exposed to both L1 Korean and L2 English at the earliest stages of their childhood. Although they were more dominantly exposed to the L1 than to the L2 at birth, they were exposed to the L2 at the same time, through L2-speaking caregivers. This group reported that there had been no obvious language shift in childhood, since they had never fully acquired the L1 before acquiring the L2, their new L1. However, the age at which they stabilized in the L2 varied to a great extent, from 3 to 10, with a mean of 6. In addition, this group reported that they never fully acquired L1 literacy skill, although many of them reported that they had learned to read and write at some point in childhood. On average, their self-rated L1 proficiency was moderate, but their L1 literacy skills were poor (see Figure 1).

Participants in Group 2 (ARC 2-4), pre-school bilinguals, were reduced in their contact with the L1 in early childhood, between the ages of 2 and 4, before receiving any type of L1 schooling or acquiring L1 literacy skills. This group consisted mostly of heritage speakers who had been born in the United States, but had exclusively been exposed to the L1 until they started L2 schooling. There are two ways in which this group was distinct from the simultaneous bilingual group. First, all heritage speakers in this group reported that they had experienced a somewhat clear L1 shift in childhood, between the ages 5 and 11 (mean 6). Unlike the simultaneous bilingual group, they resembled L1 monolingual children in early childhood, until interrupted by the new dominant language. Second, all heritage speakers in this group reported that they had started learning L2 English around age 3 or later, unlike simultaneous bilinguals who had started learning both languages from birth. However, this group, on average, also rated themselves moderate in terms of L1 proficiency, although they gave higher ratings for their L1 literacy skills than the simultaneous bilingual group (see Figure 1).

Group 3 (ARC 5-8) was made up of early childhood bilinguals, who had experienced reduced contact with the L1 between the ages of 5 and 8, after receiving some type of L1 schooling (i.e., K-grade1) and had acquired basic L1 literacy skills. This group reported that they had experienced an L1 shift in childhood, between ages 6 and 14 (mean age 8), except for one participant who had an ARC of 8 and whose acquisition remained incomplete in both languages. On average, their self-rated L1 proficiency was moderate, similar to the first two groups (see Figure 1). In fact, there were three participants who rated their L1 proficiency as very poor and reported

being barely literate in the L1. Heritage speakers belonging to this group were hard to recruit, partly because they tended to be less involved in L1-related organizations or communities and socialized less with native or heritage speakers of Korean.

Group 4 (ARC 9-12), late childhood bilinguals, experienced a reduction in L1 contact between the ages of 9 and 12, had received a substantial amount of L1 primary education (i.e., G3-6), and were highly literate before the reduction in L1 contact. This group was of particular interest, since earlier studies suggested that there is a significant change in attrition susceptibility around age 9, leveling off around age 12. In fact, as many as six participants in this group rated themselves as native-like in the L1, with no experience of a L1 shift. The remaining nine participants reported that they were fluent in the L1, but not native-like, and that they had experienced L1 shift between age 10 and 15 (average 13). Interestingly however, there were as many seven participants in this group who rated themselves as non-native in both L1 Korean and L2 English. On average, this group rated their L1 proficiency as near-native, and their L1 literacy skills to be advanced (see Figure 1). Heritage speakers belonging to this group were also hard to recruit, partly because many of them considered themselves Koreans, rather than heritage speakers of Korean.

Group 5 (ARC 13-15), adolescent bilinguals, experienced reduced L1 contact between the ages of 13 and 15, after completing primary education and acquiring full literacy in the L1. Without exception, this group reported no L1 shift, although more than half of these participants (i.e., nine participants) rated themselves as near-native in the L1, but not native-like in either language. Such results based on self-ratings seemed to contradict the earlier evidence that heritage speakers with $ARC > 12$

converge with native speakers in L1 grammar. In fact, there was a surprisingly large number of heritage speakers in this study, 17 participants in total, with ARC ranging from 8 to 15, who reported that they were unbalanced bilinguals with incomplete knowledge of either language. Although such self-report data may not be entirely reliable, whether it truly reflected their L1 proficiency and how we should interpret these results, are discussed later in the next chapter (see Section 6.1).

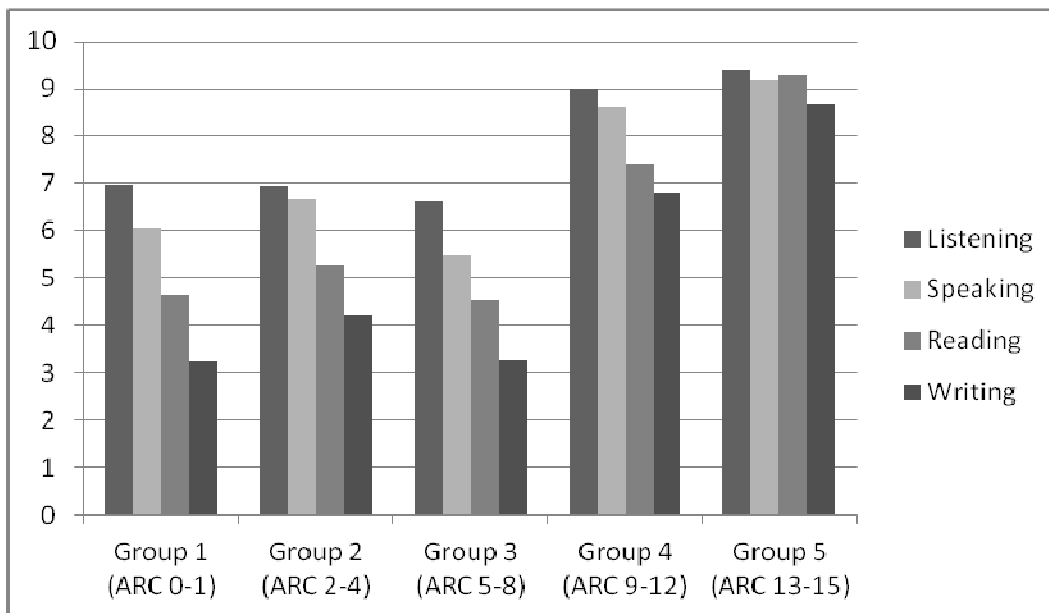


Figure 1 Heritage speakers' self-rated L1 proficiency by groups

(Rating scale: 0 = none, 1 = low elementary, 2 = elementary, 3 = high elementary, 4 = low intermediate 5 = intermediate, 6 = high intermediate, 7 = advanced, 8 = high advanced, 9 = near-native, 10 = native-like)

5.2 Instrumentation

5.2.1 Language Background Questionnaire

A language background questionnaire was designed largely to elicit information regarding the age factor, input factor, and affective factor. It required participants to reflect on their past language history and to self-rate on multiple questions related to each construct of interest (see Appendix A).

First, there were 10 items in the survey relating to the age factor, which elicited data on the four age variables: 1) Age at immigration (AI), 2) Age of onset of L2 acquisition (AO), 3) Age of reduced L1 contact (ARC), 4) Age of reduced L1 use (ARU). Second, there were eight items in the survey eliciting information regarding the input factor: 1) L1 exposure at home in childhood (Home 1), 2) L1 exposure at home in adulthood (Home 2), 3) L1 media exposure in childhood (Media 1), 4) L1 media exposure in adulthood (Media 2), 5) L1 use with peers in childhood (Peer 1), 6) L1 use with peers in adulthood (Peer 2), 7) L1 use for work in childhood (Work 1), 8) L1 use for work in adulthood (Work 2). As for the affective factor, a set of 12 items elicited participants' self-ratings on language attitude, motivation, and parental attitude toward L1 retention, while another set of 12 items elicited their self-ratings on sense of belonging to the ethnic group, search for ethnic identity and ethnic pride. These questions were partly adapted from the Multigroup Ethnicity Identity measure developed by Phinney (1992).

In addition, the questionnaire included other language-relevant information, such as all types and amount of L1 schooling and instruction received, as well as their

self-ratings on the four major skills (i.e., listening, speaking, reading, and writing) in both L1 and L2, and on their parents' and siblings' L1 and L2 proficiency.

5.2.2 L1 Proficiency Measure: Grammaticality Judgment Test (GJT)

A 120-item auditory GJT was designed to measure heritage speakers' receptive knowledge of L1 morphosyntax. The test was able to show what types of L1 morphology are more likely to be incompletely acquired by heritage speakers of Korean. Previous studies have shown that heritage language grammar largely converges for L1 verbal morphology, but not optional case marking or the features involving semantic distinctions. Second, heritage speakers' grammatical sensitivity, in terms of both accuracy and latency, to L1 morphological error was measured through ungrammatical items. Heritage speakers of Korean often omit or misuse L1 inflectional morphology in their speech, and thus it was questioned whether they lack native-like knowledge of this feature, fail to process it, or simply avoid its use.

Given the great variability in L1 literacy skills among heritage speakers, all test items were presented both visually and auditorily. In addition, the test was designed as a timed online task, which enabled the researcher to elicit automatic responses. The test was developed with the software program DMDX (Forster & Forster, 2003), which allowed each test item to be presented visually along with the concurrent auditory stimulus, and measured accuracy and response time of participants' responses automatically. The test consisted of 120 items, of which half were grammatical and half ungrammatical. Of the 60 ungrammatical items, half contained semantic errors and half morphophonological errors. Participants were instructed to listen to each sentence and determine whether it was grammatical or not

by pressing ‘yes’ or ‘no’ buttons, as quickly and accurately as possible. Feedback on the correctness, as well as the reaction time for each item, was provided on a computer screen after each response.

Participants were tested on six major structures in L1 morphology, in which ten items involved target-like use and the other ten items involved non-target-like use of each structure. All items were pre-tested on ten native speakers of Korean, and any item which elicited deviant responses from two or more native speakers was discarded (see Appendix B for the final item list). The target structures were composed of the features that are optional or demand complex semantic distinctions or interpretation, as well as the features that are simply challenging in terms of allomorphic distinction, as follows: 1) case marking - the use of nominative *-i/ka* versus accusative *-ul/lul* requires syntactic knowledge and is optional in native speech. 2) tense marking - the use of the present tense *-e/a-* or past tense *-ess/ass* requires difficult allomorphic distinctions. 3) aspect marking - the use of the progressive *-ko iss-* versus the resultative *-e/a iss-* requires difficult semantic distinctions, 4) passive and causative constructions - the use of passive *-i/hi/li/ki* or causative *-i/hi/li/ki* involves challenging allomorphic distinctions. 5) relative clause constructions - the use of the subject *-n/un/nun* versus the object *-un/nun* requires syntactic knowledge, including word order and tense, and confusing allomorphic distinctions, and 6) conjunctive constructions - the use of the causal *-ese/ase* versus the intensive *-(u)le/(u)lyeko* involves semantic distinctions, where the former suffix marks the cause, while the latter suffix marks the intention.

Two conditions were created for the ungrammatical items: 1) a morphological error arising from use of a different morpheme, which is semantically determined (e.g., nominative *-i* in place of accusative *-ul*) or 2) a morphological error due to the choice of a different allomorph, which is phonologically determined (nominative *-i* in place of *-ka*). To counterbalance the effect of the different items used for each of the two conditions, two lists were created. The 30 items that appeared in one list in the first condition appeared in the other list for the second condition and vice versa (half of the participants were randomly assigned to the first list, and the other half to the second list).

5.2.3 L1 Proficiency Measure: Collocation Test

The participants were given a 100-item auditory collocation test. They were tested on the native-like use of five different types of formulaic constructions in the L1 lexicon, including collocations (see Appendix C for the item list). Participants were instructed to listen to each sentence containing a formulaic expression and determine, as quickly and accurately as possible, whether the use of the expression in the sentence was acceptable to native speakers by pressing ‘yes’ or ‘no’ buttons. Participants were provided with 10 target-like uses and 10 non-target-like uses of each structure. The non-target-like items were used to determine whether participants were simply familiar with lexical items or whether they were acquainted with the formulaic expressions. The same software used for the GJT was used to design this test, which presented the items as both auditory and visual stimuli, followed by automatic feedback.

The five target structures were as follows: 1) Wear-verbs - In Korean, there

are over a dozen different ways of expressing the concept of ‘to wear,’ depending on the object of attire, and these items often cannot be used interchangeably. For instance, any footwear goes with the verb, *sin-ta*, but any headwear with the verb, *ssu-ta*.

2) Ideophones - Korean language abounds in four-letter ideophones that are used with certain verbs to describe a sound, shape, or action vividly and often cannot be used interchangeably. For instance, Koreans depict strong beating of the heart using the expression, *kong-dak-kong-dak*, and the way babies walk as *a-cang-a-cang*.

3) Numerals - There are two distinct counting systems in Korean, one uses native terms, and the other relies on terms that originated in Chinese. For instance, classifiers for certain nouns (e.g., cups, books, age) always take the native numerals, while numeric units (e.g., years, minutes, prices) take the Chinese-derived numerals. Therefore, the nature of the unit will determine which of the two numeric systems is used to modify it, and again, they are rarely used interchangeably.

4) Classifiers – Korean dictates specific ways of counting certain objects using classifiers, depending on the nature of the objects. For instance, Koreans would use the counter *kwon* to count how many books there are, but *te* to describe how many cars or pianos one owns.

5) Serial predicates - In Korean, some verb phrases have become idiomatic expressions, as exemplified by the English expression, ‘go see’ someone. For instance, the expression *cap-a-ka-ta* in Korean, which literally means ‘catch and go’ has become an idiomatic phrase meaning ‘to arrest.’ All items were pre-tested on ten native speakers of Korean, and any item which elicited a deviant response from two or more native speakers was discarded.

5.2.4 L1 Proficiency Measure: Receptive Vocabulary Size Test

Adult L2 receptive vocabulary size has often been measured through the Eurocentres Vocabulary Size test (Meara & Jones, 1990) or Vocabulary Levels test (Meara & Miralpeix, 2006). More recently, a 140-item receptive vocabulary size test (Beglar, 2010; Nation, 2006) was developed to provide a more reliable and accurate measure of adult L2 vocabulary size in English. The test employs a written format, where each item is placed in a non-defining context, and multiple choices for possible definitions that are substitutable in the sentence are given. An adapted version of this test in Korean was used in this study. The test consisted of a total of 140 items, where each set of 10 items was drawn from the first 1000 to the fourteenth 1000-word frequency levels based on the Sejong corpus data (see Appendix D, for the item list). Unlike the original test, each item was presented on a computer screen, with both visual and auditory input, for those who lack L1 literacy skills. Participants were asked to click on the closest meaning of the word among the four given choices in English. Feedback on the correctness of the answer was also provided after each response.

The Sejong project (1998-2007) compiled the most representative and balanced corpora of Korean language to date, consisting of various genres of both spoken and written data. The 140 items, originally drawn from the total pool of 14000 words in the native corpus, were regrouped into two categories according to lexical frequency. The 60-item high-frequency lexicon size, drawn from the first 6000 words, was composed of words frequently used in the daily lives by Korean native speakers. On the other hand, the 80-item low-frequency lexicon, drawn from the remaining

8000 words, was made up of words less frequently encountered in native speech and less likely to be used in casual conversation at home. All items were pre-tested with 10 native speakers of Korean, and any item, which two or more native speakers was not familiar with, was replaced. Thus, the 140 items in this study represented the vocabulary size of native speakers, which was compared to that of heritage speakers.

5.2.5 Cognitive Ability Measure: Language Aptitude Tests

Language aptitude components were measured by five subtests from two different aptitude batteries. First, the two subtests of the Pimsleur Language Aptitude Battery (PLAB) were chosen for the high reported reliability and the use of a language unlikely to be known to participants: 1) PLAB 4, a 15-item language analysis task, was used by Harley and Hart (1997, 2002) to measure analytical ability. This task measured participants' ability to induce grammatical patterns of the unknown language such as word order and agreement features, when given sample sentences with translations. Participants were asked to translate each English sentence given into the new language and match it with one of the four possible choices provided within the 10-minute time frame. 2) PLAB 5, a 30-item sound discrimination task, measured participants' phonological sensitivity to distinguish similar sounds in the unknown language. Participants were trained to make phonetic distinctions among three words that are very similar in sound and then asked to recognize each sound in different contexts. While PLAB 4 involved the analysis of syntactic features, PLAB 5 required the analysis of phonetic features, and neither task was designed to measure the memory dimension of language aptitude.

The three subtests of the LLAMA language aptitude battery (Meara, 2005)

were selected for the use of picture stimuli and a language unknown to any participants. The battery was a revised version of the Swansea Language Aptitude Test, which was used by both Abrahamsson and Hyltenstam (2008) and Bylund, Abrahamsson, and Hyltenstam (2009). Since there are no reliability reports on these tests, each participant was given a retest on one of the subtests, for the purpose of reporting the test-retest reliability. 1) LLAMA B, a vocabulary learning task, involved learning the associations between 20 new words, accompanied by pictures, in a span of two minutes. 2) LLAMA D, a sound recognition test, involved listening to a series of 10 new words and then recognizing the sound of each word, instantly after the stimuli. Both LLAMA B and D were designed largely to predict vocabulary learning ability and required short-term storage of phonological information. 3) LLAMA F, a grammatical inferencing task, similar to PLAB 4, measured participants' ability to induce the grammatical patterns of the unknown language. Unlike PLAB 4, however, LLAMA F provides participants with 20 sample sentences alongside matching pictures and allows them to take notes, while trying to induce the grammatical rules. All three subtests were administered on a computer, and participants responded to each prompt by clicking on the corresponding icon.

5.2.6 Cognitive Ability Measure: Working Memory Span Tasks

In addition to the language aptitude subtests, four different working memory span tasks, which are known to be reliable and valid measures of working memory capacity (Conway et al., 2005), were employed in the study. First, the forward digit span and serial nonword recognition tests were used to measure participants' phonological memory. In the forward digit span task, participants were asked to recall

and type each list of digits in order; the digits were presented audiovisually on the computer screen at a rate of one per second. If they recalled those of the previous length correctly twice, they were then presented with stimuli of greater length. In addition, serial nonword recognition was chosen over serial nonword recall to minimize the effect of lexicality and the demands on speech output. The 88 nonwords used in this task were drawn from Gathercole et al. (2001), and each pair of nonwords, at the lengths of 4, 5, 6, and 7, was recorded using a computer generated voice. A total of 16 pairs of nonword strings were presented auditorily, where half of the items were given in the identical condition and the other half of the items in the non-identical condition. In the non-identical condition, the second presentation of a string contained the same nonwords, but the order of two adjacent items was reversed. For instance, participants listened to “*chim bop gok mal* [pause] *chim gok bop mal*,” and had to respond as to whether the two word strings were the same or different, by pressing the ‘yes’ or ‘no’ key on the computer.

Counting span and operation span tasks tapped the capacity for both storage and executive control of information. Both versions of the span tasks were designed to be taken on a computer (Unsworth et al., 2005). In the counting span task, participants were asked to count the total number of dark blue squares among distracting shapes in a series of visual display at lengths of 2, 3, 4, 5, and 6 items, and they had to recall and write the total counts from each display in serial order. For the automated operation span task, participants were asked to solve a series of math operations by clicking true or false responses, each followed by a letter, and then to recall the letters in serial order.

5.3 Procedure

The experiment took place in a language lab at the University of Maryland. Participants were provided with a consent form, and once they agreed to participate, they were tested individually in a sound-proof room equipped with laptop computers. Twenty native speakers of Korean were tested prior to heritage speakers. The native speakers took part in the L1 proficiency assessment only, which took approximately 30 minutes. They either volunteered or received five dollars for their participation. Ninety-four heritage speakers took part in a two-hour test battery, consisting of a series of Korean proficiency and language aptitude tests. Since the experiment was taxing in terms of time and cognitive load, the heritage speakers completed two sessions, each scheduled for different days within a period of one month. They were requested to complete a language background survey and return it on the second session. It was emphasized that the survey included information crucial to the explanatory variables of this study, and thus required the utmost accuracy.

In the first session, participants completed the L1 auditory GJT and the collocation test, followed by the five language aptitude subtests. For each test, participants were provided with detailed instructions in English and were guided through practice trials. The L1 proficiency section took about 25 minutes, and the language aptitude part took approximately 35 minutes. In the second session, participants were given the L1 receptive vocabulary size test, the four working memory span tasks, and one LLAMA aptitude retest for the reliability measure (i.e., 30 participants randomly assigned to one of the three subtests). The L1 proficiency component took around 15 minutes, and the language aptitude component

approximately 40 minutes. After the experiment, participants were given a brief follow-up interview, when necessary, to clarify information that was missing or unclear in the language background survey. After each session, they were compensated for their participation with ten dollars and refreshments.

5.4 Analysis

The independent variables included the four major explanatory variables pertaining to the age, input, aptitude, and attitude factors, while the outcome variable was participants' receptive knowledge in L1 morphosyntax, lexis, and collocation. Prior to the inferential statistical procedures, which assumed a normal distribution, the distribution of all measured variables in the study was first tested for normality. If the data exhibited any significant skewness or kurtosis, as indicated by Q-Q plots, a log-transformation was applied to normalize the data. In addition, the internal consistency or test-retest reliability of all measures was reported (see Section 6.1). Two primary approaches were employed to analyze participants' L1 performance. First, a multivariate analysis of variance (MANOVA) was conducted on the outcome variable for different test types to find group effects. In this approach, the five qualitatively distinguished groups of heritage speakers were compared to a native control group. Due to the unequal population variances, however, the comparison of groups for each test type relied on a planned paired comparison, for which equal variance was not assumed. Second, a multiple linear regression analysis was conducted to test our hypotheses sequentially on the contribution of identified factors as continuous variables on the outcome variable.

Prior to running the multiple linear regression analysis, it was necessary to detect the structure of each latent variable and to reduce a large number of observed variables into a smaller set of true factors. A principal components analysis was first performed on all explanatory variables to examine linear combinations of the measures of the four hypothesized factors, relating to age, input, aptitude, and attitude, which contain both common and unique variance. The analysis took into account all variability in the variables to express as much of the total variance in the data as possible. An exploratory factor analysis was then performed on all measures of the hypothesized factors, to identify the latent variables that were contributing to the common variance in the data, or to estimate how much variability can be explained by common factors only. The maximum likelihood extraction method was used to observe the significance of loadings and correlations among factors and to determine the number of factors to retain with regard to goodness-of-fit values. The number of factors to be extracted was determined by a scree plot test, which examines the graph of the eigenvalues and looks for the natural break-point in the curve. The number of factors was then selected with regard to those showing the cleanest factor structure with the best fit to the data (e.g., few cross-loadings or under-loaded factors). An oblique rotation method was chosen, since the variables in this study were, by nature, inter-correlated. The analyses produced a pattern matrix, which showed the squared loadings of extracted factors for all variables, indicating the extent to which a variable's total variance could be uniquely explained by each factor, unshared by other factors. The variables that failed to load highly on any factor, had small

loadings ($< .30$) on proper factors, or had large loadings on the wrong factor, were eliminated.

A multiple linear regression analysis was then conducted to determine how much each hypothesized factor could account for the variance in the outcome variable and how much total variance in the outcome variable could be accounted for by the combination of these variables. A hierarchical model was chosen, which allows to enter independent variables in an order based on theoretical or empirical reasoning and tests for a significant increase in the predictive power of the model upon entry of each additional of variable. The order of entry was as follows: 1) age factor, 2) input factor, 3) aptitude factor, 4) affective factor, and 5) instructional factor. For each step, the squared correlation coefficient (R^2) and the change in F values were reported. The data were analyzed by the forced-entry method for each factor, where the forward-stepwise selection was chosen for each factor. That method was able to show the effect of each factor in the hypothesized order, while excluding unrelated variables within each factor. If two sets of variables were highly correlated, entering one after the other would result in failure to report true predictability, since standardized beta coefficients (β) of each variable were computed while statistically controlling for the variable entered beforehand. For this reason, the squared semipartial correlation coefficients (sr^2) were also reported, in addition to the β coefficients, which indicate unique contributions of each variable to the overall R^2 , as well as the effect size for percentage of variance accounted for after controlling for the effects of other variables in the equation. Finally, the multicollinearity among explanatory variables was observed by means of variance inflation factor (VIF) estimates.

Chapter 6: Results

This chapter reports the results of the present study. The first section summarizes the outcome variable, or L1 proficiency of Korean heritage speakers, as measured by three different tests (i.e., GJT, collocation test, vocabulary size test). The next section describes the components underlying each hypothesized explanatory factor (i.e., age, input, aptitude, attitude) for the outcome variable. The last section presents the predictive model for the variability in the L1 outcomes and the relationship between each explanatory factor and the outcome variable.

6.1 The Outcome Variable

The dependent variables in this study were heritage speakers' ultimate L1 outcomes in the area of L1 morphosyntax as well as L1 formulaic and non-formulaic lexicon. The participants' knowledge of L1 morphosyntax was measured by the 120-item GJT ($\alpha = .90$), while their knowledge of L1 formulaic lexicon was measured by the 100-item collocation test ($\alpha = .93$) and their knowledge of L1 lexicon was measured by the 140-item receptive vocabulary size test ($\alpha = .98$). All three tests showed high internal consistency with Cronbach's alpha values $\geq .90$. Their L1 performance on three different test types was compared among five different groups of heritage speakers, varying in ARC. Figure 1 illustrates how five different groups of heritage speakers performed on each test type.

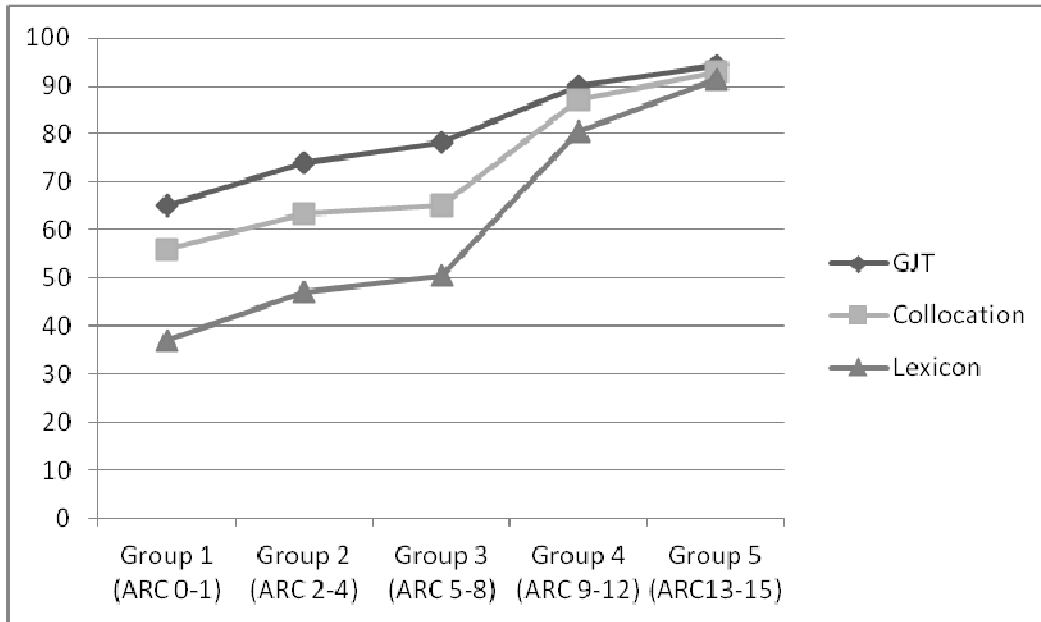


Figure 2 The comparison of L1 performance by groups and test types

Overall, the evidence for L1 nonconvergence was evident among heritage speakers with the $ARC < 9$ (i.e., Groups 1 through 3), particularly in the area of lexicon. Late attriters (i.e., Groups 4 and 5), with the $ARC \geq 9$, greatly outperformed early attriters (i.e., Groups 2 and 3), demonstrating a sizeable advantage in their knowledge of L1 collocation and lexicon. On the other hand, simultaneous bilinguals (i.e., Group 1) performed most poorly on all test types. A MANOVA conducted on five heritage groups and three test types showed that there was a significant group effect in the GJT performance, $F(5, 104) = 11.09, p < .001$, collocation test performance, $F(5, 104) = 7.38, p < .001$, and receptive vocabulary size, $F(5, 104) = 8.33, p < .001$. Since Levene' test of equality of error variances suggested that such statistical analysis was not appropriate due to the unequal group variances, a planned paired-group comparison was conducted for each test type, with equal variances not assumed. The following sections report how each group of heritage speakers

performed for each test type and condition and to what extent they performed differently from each other and from native speakers.

6.1.1 Heritage Speakers' Knowledge of L1 Morphosyntax

The participants' performance on the 120-item timed GJT measured their knowledge of six major structures in L1 morphosyntax. Their performance in the ungrammatical condition was of a particular interest, which measured their sensitivity to L1 morphological error. Their performance on 60 ungrammatical items was further analyzed by two different types of L1 morphological error. The two lists created to counterbalance the effect of different item conditions showed no significant difference in the mean accuracy scores, between one list ($M = 72.41$, $SD = 14.07$) and the other ($M = 70.76$, $SD = 12.31$), $t(46) = .40$, $p = .69$. How each group of heritage speakers performed in both grammatical and ungrammatical conditions in the GJT is first presented in Figure 3.

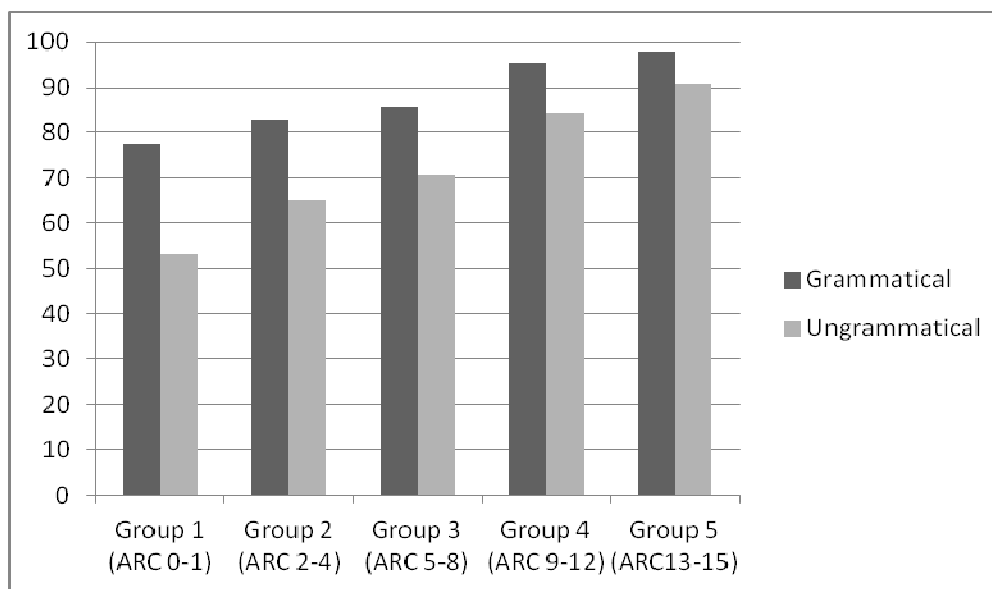


Figure 3 Heritage speakers' L1 performance (%) on the GJT by conditions

In the grammatical condition, all heritage groups performed very high, above 75% on average. However, their accuracy scores dropped sharply when analyzed by the ungrammatical items only. In the ungrammatical condition, heritage speakers with $ARC < 9$ (i.e., Groups 1-3), in particular, performed poorly, with accuracy scores below 70%. On the other hand, heritage speakers with $ARC \geq 9$ (i.e., Groups 4-5), performed native-like in the grammatical condition, while only those with $ARC > 12$ (i.e., Group 5) converged with the native group in the ungrammatical condition, $t(26) = 2.00, p = .56$. All heritage groups performed differently from one another, but for Group 2 ($ARC = 2-4$) and Group 3 ($ARC = 5-8$), $t(30) = 1.13, p = .27$. Therefore, the analysis by the ungrammatical condition suggested that heritage speakers who had reduced L1 exposure before age 12 failed to show native-like sensitivity to L1 morphological error.

The participants' performance in the ungrammatical condition was further analyzed by the two item conditions, i.e., the 30 items containing semantically-determined morphological errors (named C1 hereafter) and the 30 items containing phonologically-determined morphological errors (named C2 hereafter). Table 2 summarizes how each group performed on two different item conditions. As shown by the standard deviations, there was great individual variation within early attriters (i.e., Groups 1-3), whereas late attriters (i.e., Groups 4-5) performed within a smaller range of deviation from the mean. In the C1, all heritage groups performed differently from one another, except for Group 2 ($ARC 2-4$) and Group 3 ($ARC 5-8$), as well as Group 4 ($ARC 9-12$) and Group 5 ($ARC 13-15$), $t(35) = 1.01, p = .32$ and $t(28) = 1.73, p = .095$, respectively. Interestingly, even Group 5 ($ARC 13-15$) performed

significantly poorer than native speakers in this condition, $t(17) = 5.88, p < .001$. In the C2, all heritage groups performed differently from one another, except for Group 1 (ARC 0-1) and Group 2 (ARC 2-4), as well as Group 2 (ARC 2-4) and Group 3 (ARC 5-8), $t(36) = 1.70, p = .098$ and $t(26) = 1.13, p = .27$, respectively. Unlike in the C1, Group 5 (ARC 13-15) performed like native speakers in this condition, $t(28) = .51, p = .612$. Therefore, heritage speakers who had reduced L1 exposure after age 12 showed native-like sensitivity to L1 allomorphic error, but not to L1 morphological error arising from the lack of semantic distinctions.

Table 2 The mean percentage accuracy (SD) on L1 GJT by groups

	Group 1 (ARC 0-1)	Group 2 (ARC 2-4)	Group 3 (ARC 5-8)	Group 4 (ARC 9-12)	Group 5 (ARC 13-15)	Native
G	77.38 (6.06)	82.92 (11.87)	85.61 (10.49)	95.55 (5.29)	97.96 (3.17)	98.48 (2.04)
C1	50.30 (14.21)	63.81 (16.60)	68.81 (13.92)	83.24 (8.49)	88.18 (7.60)	99.13 (1.19)
C2	55.87 (19.56)	66.54 (21.38)	72.69 (10.47)	85.70 (8.00)	93.59 (5.59)	94.41 (3.82)

(G = Grammatical condition, C1 = Semantically-determined error condition, C2 = Phonologically-determined error condition)

The participants' performance was also compared between item conditions within each group, in terms of both accuracy scores and response times. All heritage groups generally scored lower in the C1 than in the C2, while native speakers scored

higher in the C1 than in the C2. However, a significant difference in their accuracy scores between item conditions was not found in any group. Thus, the participants' sensitivity to L1 morphological error did not differ significantly by types of error within each group, although they generally found the L1 morphological error occurring at a semantic level more challenging. The analysis of their response times between item conditions suggested otherwise. Interestingly, all groups, except Group 1 (ARC 0-1), responded faster in the C1 than in the C2, while native speakers responded slower in C1 than in C2. A significant difference in response time between item conditions was found only in Group 1 (ARC 0-1), $t(19) = 2.32, p = .031$ and Group 5 (ARC 13-15), $t(14) = -3.27, p = .005$. Therefore, simultaneous bilinguals (i.e., Group 1) were more hesitant about the semantically-determined error, while the late attriters (i.e., Group 5) were more hesitant about the phonologically-determined error, although they performed native-like in this condition, but not in the other condition. The analysis by both accuracy and latency suggests that heritage speakers are generally less sensitive to the morphological errors occurring at a semantic level than to the errors occurring at a phonological level, while native speakers are more attentive to the errors occurring at a semantic level than to the morphological errors occurring at a phonological level.

Finally, the participants' L1 performance in the ungrammatical condition was analyzed by the six target structures, as visually presented in Figure 4. Overall, late attriters with $ARC \geq 9$ (i.e., Groups 4-5) greatly outperformed early attriters (i.e., Groups 1-3), scoring above 80% on all structures. On the other hand, the early attriters, who scored below 80% on all structures, showed structure-dependency to a

great extent. They performed poorer on case marking, aspect marking, and relative clause construction than on tense marking, passive and causative construction, and conjunctive construction. In particular, Group 2 (ARC 2-4) and Group 3 (ARC 5-8), who performed very similarly and scored above 60% on all structures, greatly outperformed the simultaneous bilinguals (ARC 0-1), who hardly scored above 60% on all structures.

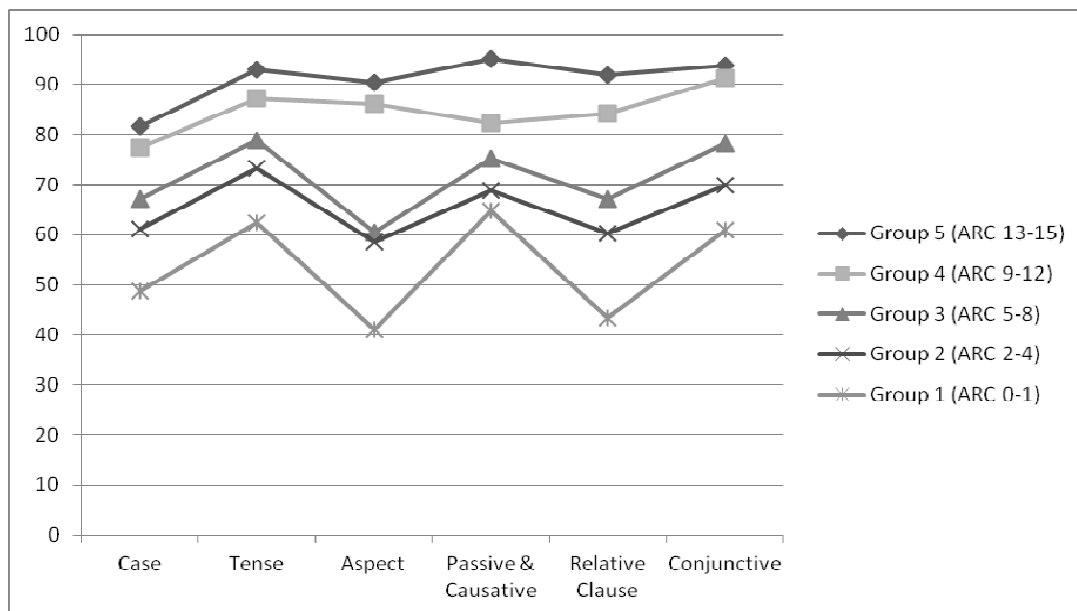


Figure 4 Heritage speakers' L1 grammatical sensitivity (%) by structures

In L1 optional case marking, all heritage groups scored relatively low, where even late attriters (ARC 9-15) failed to perform like native speakers, $t(49) = 2.06, p = .042$. 2). In L1 tense marking, all heritage groups performed relatively well, and Group 5 (ARC > 12) converged with native speakers, $t(28) = 1.64, p = .112$. In L1

aspect marking involving complex semantic distinctions, Group 4 (9-12), by far, outperformed Group 3 (ARC 5-8), $t(28) = 4.62, p < .001$, although the late attriters (ARC 9-15) failed to perform like native speakers, $t(48) = 3.32, p = .002$. In L1 passive and causative marking involving complex allomorphic distinctions, Group 5 (ARC 13-15) greatly outperformed Group 4 (ARC 9-12) and performed like native speakers, $t(35) = .84, p = .41$. In L1 relative clause constructions, all heritage groups performed differently from one another ($p < .05$), where only Group 5 (12-15) performed in the range of native speakers, $t(35) = 1.38, p = .18$. In L1 conjunctive constructions, all heritage groups scored relatively high, where the late attriters (ARC 9-15) performed like native speakers, $t(49) = 1.11, p = .28$. To sum up, heritage speakers showed a greater degree of incomplete L1 knowledge in features involving optional marking (i.e., case marking) or ambiguous semantic distinction (i.e., aspect marking) than in overt and less complex features (i.e., tense marking, conjunctive constructions), where even those who experienced reduced L1 exposure past the age 12 failed to perform like native speakers.

6.1.2 Heritage Speakers' Knowledge of L1 Collocations

The 100-item collocation test measured the participants' knowledge of five major structures in L1 formulaic lexicon. Like in the GJT, their acceptability judgment on 50 non-target-like items was of a particular interest, which reflected their accurate knowledge of L1 formulaic lexicon beyond mere familiarity with L1 lexis. Therefore, their performance on the L1 collocation test was first compared between the two item conditions, i.e., target-like (TL) condition and non-target-like (NTL) condition, as shown by Figure 5.

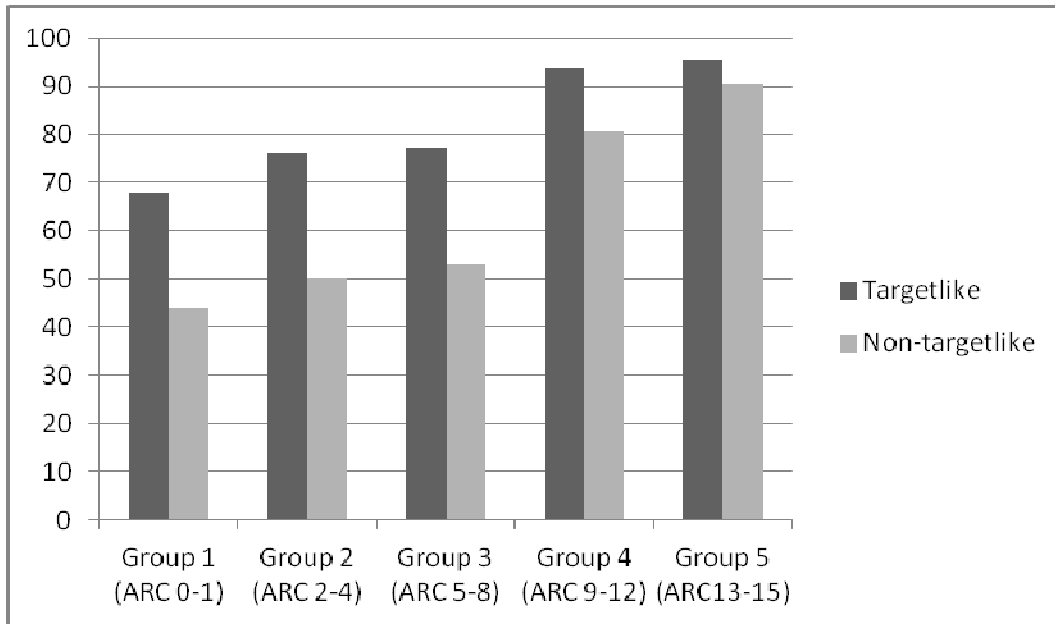


Figure 5 Heritage speakers' L1 performance (%) on collocation test by conditions

In the TL condition, all heritage groups performed very high, scoring above 65% on average. In the NTL condition, however, their accuracy scores dropped significantly. Heritage speakers with $ARC < 9$ (i.e., Groups 1-3), in particular, performed very poorly in the NTL condition, with accuracy scores barely above 50%. They were greatly outperformed by heritage speakers with $ARC \geq 9$, who scored above 80% on both conditions. Table 3 summarizes how each group performed on both conditions, which was compared to the native control group. As shown by the standard deviations, there was great individual variation among early attriters ($ARC < 9$), particularly in the NTL condition, whereas Group 5 (ARC 13-15) and native speakers performed within a small range of deviation from the mean.

Table 3 The mean percentage accuracy (SD) on L1 collocation test by groups

	Group 1 (ARC 0-1)	Group2 (ARC 2-4)	Group 3 (ARC 5-8)	Group 4 (ARC 9-12)	Group 5 (ARC 13-15)	Native
TL	67.93 (6.39)	76.41 (12.65)	77.18 (9.85)	93.61 (7.07)	95.42 (3.59)	96.81 (2.07)
NTL	44.02 (14.33)	50.32 (16.01)	53.14 (17.73)	80.59 (11.03)	90.53 (5.96)	94.99 (3.52)

(TL = Target-like use condition, NTL = Non-target-like condition)

All heritage groups scored poorer on the NTL condition than on the TL condition, but native speakers did not show such difference between the TL condition ($M = 96.62$, $SD = 4.55$) and the NTL condition ($M = 94.04$, $SD = 3.33$), $t(16) = .198$, $p = .85$. In the TL condition, Group 4 (ARC 9-12) and Group 5 (ARC 13-15) performed alike, $t(26) = 1.75$, $p = .09$, although only Group 5 performed native-like, $t(35) = 1.16$, $p = .25$. In the NTL condition, however, Group 4 and Group 5 performed differently from one another, $t(18) = 2.85$, $p = .011$, and both groups failed to converge with native speakers, $t(16) = 3.97$, $p = .001$ and $t(24) = 2.64$, $p = .014$, respectively. Therefore, heritage speakers who had reduced L1 exposure after age 12 converged with native speakers in their familiarity with L1 collocation, but did not show native-like acceptability judgment on the NTL items.

In order to reveal what types of knowledge in L1 collocation the participants found challenging, their performance on the L1 collocation test was further analyzed by five target structures, as presented by Figure 6. Overall, late attriters ($ARC \geq 9$),

by far, outperformed early attriters (ARC < 9), who scored below 70% on most structures. Like in the GJT, the early attriters showed a great structure-dependency. In the L1 collocation test, however, Group 2 (ARC 2-4) and Group 3 (ARC 5-8) were not clearly distinct from the simultaneous bilinguals (ARC 0-1).

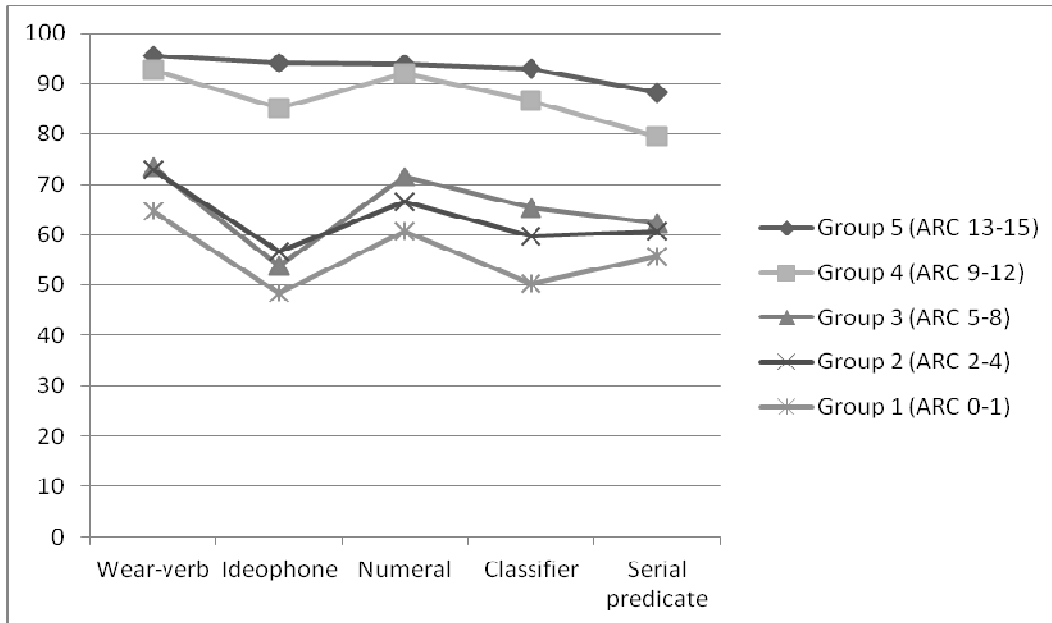


Figure 6 Heritage speakers' L1 collocational knowledge (%) by structures

In L1 wear-verbs, all heritage groups performed relatively high, although only Group 5 (ARC 13-15) performed native-like, $t(24) = 1.16, p = .26$. In L1 ideophones, early attriters (ARC < 9) scored lowest and Group 4 (ARC 9-12) performed significantly poorer than Group 5 (ARC 13-15), $t(20) = 2.80, p = .011$, who alone performed native-like, $t(22) = 1.97, p = .06$. In L1 numeral constructions, all heritage groups performed relatively well, but interestingly, even Group 5 (ARC 13-15) failed to converge with native speakers, $t(24) = 2.19, p = .039$. In L1 classifiers, heritage

groups scored relatively low, where Group 2 (ARC 24) and Group 3 (ARC 5-8) significantly outperformed the simultaneous group (ARC 0-1), $t(33) = 2.25, p = .03$ and only Group 5 (ARC 13-15) performed native-like, $t(35) = 1.14, p = .26$. In L1 serial predicates, all heritage groups scored very low and Group 4 (ARC 9-12) performed significantly poorer than Group 5 (ARC 13-15), $t(28) = 2.20, p = .036$, although Group 5 (ARC 13-15) also failed to converge with native speakers, $t(20) = 2.19, p = .04$. To sum up, heritage speakers with $ARC < 9$ showed an extensive degree of incomplete knowledge in L1 collocation than those with $ARC \geq 9$, where they generally had a greater familiarity with L1 wear-verbs and numerals than with L1 ideophones, classifiers, and serial predicates. Heritage speakers with ARC 9-12 failed to converge with native speakers in all structures ($p < .05$), while those with $ARC > 12$ performed native-like in all structures, but for numerals and serial predicates.

6.1.3 Heritage Speakers' Knowledge of L1 Lexicon

Finally, the participants' L1 lexical knowledge was measured by their performance on the 140-item L1 receptive vocabulary size test. Their mean accuracy scores represented the size of their L1 lexicon, compared to that of native lexicon (e.g., the lexicon size of 60% meaning 60% of native speakers' size). The size of L1 lexicon was compared among five different groups of heritage speakers, as summarized in Table 4. Their L1 lexicon size was also compared between the two item conditions, i.e., the high-frequency condition containing 60 items from the most-frequent 6000 words and the low-frequency condition containing 80 items beyond the first 6000 words.

Table 4 The mean percentage accuracy (SD) on L1 vocabulary size test by groups

	Group 1 (ARC 0-1)	Group 2 (ARC 2-4)	Group 3 (ARC 5-8)	Group 4 (ARC 9-12)	Group 5 (ARC 13-15)
Lexicon	37.11 (6.77)	47.03 (15.66)	50.56 (14.55)	80.52 (11.54)	91.34 (5.96)
High	47.42 (11.51)	60.18 (17.77)	62.19 (19.33)	90.22 (8.94)	96.47 (4.16)
Low	29.38 (5.34)	37.17 (15.16)	41.84 (12.68)	73.17 (14.31)	87.50 (7.54)

Overall, heritage groups with $ARC < 9$ had no more than half the size of native lexicon, while heritage groups with $ARC \geq 9$ had over 80% of the native lexicon. As shown by the standard deviation, there was a great individual variation in L1 lexicon size among all heritage groups, but for the simultaneous group (ARC 0-1) and Group 5 (ARC 13-15). All heritage groups differed significantly from one another in L1 lexicon size ($p < .05$), but for Group 2 (2-4) and Group 3 (ARC 5-8). All heritage groups, however, showed a substantial decrease in their L1 lexicon when analyzed by low-frequency items. Group 5 (ARC 13-15), who had the native-like L1 lexicon size in high-frequency items, failed to converge with native speakers L1 lexicon size in low-frequency items, $t(16) = 6.84$ $p < .001$. The comparison of the participants' L1 lexicon size by groups between the high-frequency condition and the low-frequency condition is visually presented in Figure 7.

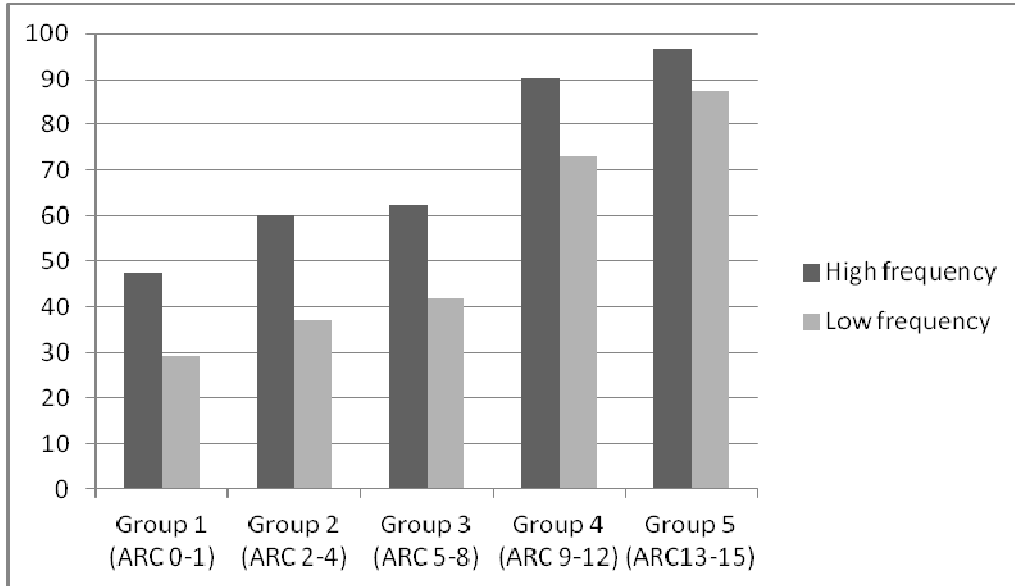


Figure 7 Heritage speakers' L1 vocabulary size (% of native size) by frequency

In the high-frequency condition, late attriters ($ARC \geq 9$) had over 90% of the native lexicon, while early attriters ($ARC < 9$) had less than 60% of the native lexicon. In the low-frequency condition, however, all heritage groups sharply decreased in their L1 lexicon size, particularly among the early attriters, who barely knew more than 40% of the native lexicon. Like in L1 collocation, therefore, there was a significant change taking place around the age 9 in heritage speakers' L1 lexical development. The results suggest that heritage speakers' lexical knowledge is largely limited to high-frequency lexicon (i.e., the most-frequently used 6000 words in native speech), which is particularly true for those who had reduced L1 exposure in early childhood

6.1.4 Summary

The analysis of heritage speakers' L1 performance by groups, varying in ARC,

revealed that the degree of their L1 nonconvergence depends on the linguistic domain tested. There was a particular leap in L1 proficiency between heritage speakers with $ARC < 9$ to those with $ARC \geq 9$, although only those with $ARC > 12$ showed native-like knowledge for most of the structures. This pattern was more obvious in L1 collocation and lexicon than in L1 morphosyntax. When analyzed according to item condition, however, even those with $ARC > 12$ showed some signs of incomplete L1 acquisition, in their grammatical sensitivity to semantically-determined morphological error (i.e., case marking, aspect marking), in their knowledge of certain formulaic lexicon (i.e., numeral constructions, serial predicates), and in their knowledge of low-frequency lexicon. Therefore, they had near-native, but not native-like proficiency in the L1, as they had indicated in the self-assessment of their L1 proficiency. The analysis of participants' ultimate L1 attainment suggests that a significant change in L1 attrition susceptibility starts to take place around age 9, but that it does not necessarily end around age 12. Among the early attriters of the L1, the sequential bilinguals (ARC 2-8) outperformed the simultaneous bilinguals (ARC 0-1), but a few years of early L1 schooling (ARC 5-8) did not make any significant difference to the L1 outcomes. Furthermore, considerable individual variance in L1 proficiency was found among the early attriters, which called for other explanations beyond structure-dependency. To this effect, the second section deals with all the explanatory variables of the participants' L1 variability, which were measured in the present study for their potential contribution to heritage speakers' early L1 development.

6.2 The Explanatory Variable

There were four hypothesized explanatory variables of the L1 outcomes in heritage speakers: the factors of 1) age, 2) input, 3) aptitude, and 4) attitude. A principal components analysis was conducted on all explanatory variables to reveal the relationship among the four age variables (i.e., AI, AO, ARC, ARU), eight input variables (i.e., Home 1/2, Media 1/2, Peer 1/2, Work 1/2), two aptitude variables (i.e., language analysis, working memory), and five attitude variables (i.e., attitude, parent, pride, affiliation, search). An exploratory factor analysis was also conducted on the items measured for each proposed factor, to identify the components of each construct of interest in this study. Such analyses were necessary to determine how the hypothesized factors should be entered into the multiple regression model predicting the outcome variable.

6.2.1 The Relationship among Explanatory Variables

This section reports the relationship among all explanatory variables in this study. A principal component analysis of all explanatory variables on data gathered from 90 participants ($KMO = .77$) produced the correlation matrix of all explanatory variables (see Table 5). In addition to the four constructs of interest in this study (i.e., age, input, aptitude, attitude), two early L1 instructional variables were also included in the analysis: 1) the length of L1 schooling ($M = 3.04$, $SD = 3.86$) and 2) the length of L1 tutoring ($M = 2.10$, $SD = 3.36$).

Table 5 The correlation matrix for all explanatory variables

	AI	AO	ARC	ARU	Home 1	Home 2	Media 1	Media 2
AI								
AO	.74**							
ARC	.94**	.72**						
ARU	.69**	.59**	.69**					
Home 1	.46**	.39**	.48**	.44**				
Home 2	.56**	.50**	.56**	.57**	.58**			
Media 1	.35**	.19*	.36**	.28**	.47**	.24**		
Media 2	.64**	.55**	.59**	.55**	.47**	.67**	.46**	
Peer 1	.53**	.32**	.52**	.44**	.55**	.33**	.72**	.49**
Peer 2	.82**	.64**	.76**	.58**	.49**	.66**	.36**	.84**
Work 1	.22*	.13	.25**	.08	.29**	.09	.35**	.11
Work 2	.83**	.65**	.79**	.63**	.47**	.57**	.23*	.61**
Schooling	.97**	.69**	.94**	.69**	.47**	.55**	.37**	.63**
Tutoring	-.48**	-.32**	-.40**	-.28**	-.18*	-.21*	-.18*	-.31**
Analysis	.38**	.31**	.39**	.32**	.20*	.43**	.11	.25**
WM	.19*	.06	.13	.26**	.17	.21**	.14	.15
Attitude	.34**	.23*	.31*	.27**	.40**	.29**	.64**	.60**
Parent	-.17	-.06	-.15	-.02	.18*	-.01	.20*	.12
Pride	.10	.15	.08	.11	-.05	.09	.17	.07
Affiliation	.11	.12	.18*	.10	.09	.11	.35**	.14
Search	.09	-.07	.03	.01	.06	.03	.26**	.23*

*Significant at the .05 level

**Significant at the .01 level

(Table 5 continued)

	Peer 1	Peer 2	Work 1	Work 2	Schooling	Tutoring	Analysis	WM
AI								
AO								
ARC								
ARU								
Home 1								
Home 2								
Media 1								
Media 2								
Peer 1								
Peer 2	.53**							
Work 1	.46**	.16						
Work 2	.41**	.80**	.19*					
Schooling	.56**	.80**	.29**	.80**				
Tutoring	-.18*	-.38**	.11	-.29**	-.46**			
Analysis	.19*	.35**	-.10	.35**	.36**	-.16		
WM	.10	.12	-.06	.11	.24**	-.05	.30**	
Attitude	.71**	.37**	.42**	.26**	.34**	-.13	.08	.05
Parent	.15	.12	.29**	-.09	-.15	.18*	-.15	.03
Pride	.10	.10	.07	-.02	.07	-.14	.13	-.09
Affiliation	.36**	.14	.09	.13	.10	-.01	.16	-.14
Search	.29**	.15	.23*	.02	.10	-.13	.04	-.08

*Significant at the .05 level

**Significant at the .01 level

(Table 5 continued)

	Attitude	Parent	Pride	Affiliation	Search
AI					
AO					
ARC					
ARU					
Home 1					
Home 2					
Media 1					
Media 2					
Peer 1					
Peer 2					
Work 1					
Work 2					
Schooling					
Tutoring					
Analysis					
WM					
Attitude					
Parent	.47**				
Pride	.37**	.28**			
Affiliation	.56**	.28**	.47**		
Search	.41	.40	.40**	.43**	

*Significant at the .05 level

**Significant at the .01 level

First, all age variables were highly correlated with all input variables, and were more strongly correlated with the L1 input in adulthood (ranging from .49 to .83) than with the L1 input in childhood (ranging from .19 to .55). Second, all age variables were significantly correlated with language-analytical ability (ranging from .31 to .39), suggesting that late arrivals generally had higher language aptitude than early arrivals in this study. Working memory, however, was only significantly correlated with the aspect of the ARU (.26). Therefore, the two types of language aptitudes, analytical ability and working memory, had differential relationships with the age factor, although they were significantly correlated with one another (.30). There are two possible accounts for the results. One interpretation is that language aptitude is not a static trait over time, but it may be influenced by early language learning experiences, where late bilingualism develops analytical ability, while active bilingualism or the active use of the L1, as opposed to passive bilingualism, benefits working memory capacity. Another possibility is that early arrivals and late arrivals among Korean heritage speakers in this study constituted distinct populations, where the late arrivals generally had higher language aptitude than the early arrivals. Third, all age variables were also correlated with L1 attitude (ranging from .23 to .34), but not with other affective variables. However, a significant link was witnessed between early L1 input variables and other aspects of the affective factor, in addition to L1 attitude: 1) between Media 1 and ethnic affiliation (.35) or ethnic identity search (.26), 2) between Peer 1 and ethnic affiliation (.36) or ethnic identity search (.29), and 3) between Work 1 and parental attitude (.29). Therefore, the results implied an indirect link between the age variables and attitudinal variables, through early L1 input

variables. Finally, all age variables were highly correlated with the amount of L1 schooling (ranging from .69 to .97), but negatively correlated with the amount of L1 tutoring (ranging from -.28 to -.48). The most plausible account is that late arrivals are likely to have received more L1 schooling in Korea, while early arrivals are likely to have received more L1 tutoring in childhood, presumably due to lack of L1 proficiency. Interestingly, the length of L1 schooling was significantly correlated with learner attitude (.34), while the length of L1 tutoring was correlated with parental attitude (.18).

The analysis extracted four principal components, as shown by Table 6. The first component, which accounted for 34% of the total variance, was made up of all age variables (i.e., AI, AOA, ARC, ARU), some input variables (i.e., Home 1/2, Media 2, Peer 2, Work 2), and early L1 instructional variables (i.e., L1 schooling, L1 tutoring). Interestingly, the amount of L1 input in adulthood and instructional variables constituted the same component as the age variables. The second component, explaining 13% of the variance, consisted of all affective variables (i.e., learner attitude, parental attitude, ethnic pride, ethnic affiliation, ethnic identity). The third component, explaining 8% of the variance, was composed of the measures of language aptitude (i.e., PLAB 4, PLAB 5, LLAMA F) and working memory (digit span, counting span, operation span). However, LLAMA B and LLAMA D had factor loadings less than .30. 4) The fourth component, which explained an additional 7% of total variance, consisted of three L1 input variables in childhood (Media 1, Peer 1, Work 1). In addition, the learner attitude towards L1 retention, which loaded onto the second component consisting of affective variables, also loaded onto the fourth

component with the early L1 input variables.

Table 6 Factor loadings for all explanatory variables

	Component 1	Component 2	Component 3	Component 4
Peer 2	.90			
AI	.89			
Work 2	.88			
ARC	.88			
Schooling	.85			
AO	.84			
Media 2	.76			
ARU	.74			
Home 2	.70			
Home 1	.52			
Tutoring	-.47			
Belong		.80		
Pride		.77		
Search		.66		
Attitude		.49		.54
Parent		.43		
Ospan			.72	
Dspan			.68	
PLAB 4			.67	
PLAB 5			.64	
LLAMA F			.59	
Cspan			.41	
Work 1				.74
Media 1				.68
Peer 1				.68

Factor loadings above .30 are listed above.

The analysis largely produced the four principal components that are hypothesized earlier in this study. However, the relationship between the age factor and the input factor required some interpretations. The age factor and the input factor were shown to be highly correlated with one another. Interestingly, it was specifically the late L1 input factor that grouped with the age factor. However, the late L1 input factor was distinguished from the early L1 input factor, although they were also correlated with one another. In addition, the early instructional factor also clustered with the late L1 input factor and the age factor. Therefore, how much L1 heritage speakers are exposed to in adulthood seemed to be largely determined by the age factor and the amount of L1 schooling, although it was not necessarily associated with the amount of their L1 exposure in childhood. An exception was the amount of L1 exposure at home, which seemed to remain relatively constant throughout life, which clustered with the late L1 input factor. On the other hand, the early L1 input factor, consisting of Media 1, Peer 1, Work 1, clustered with learner attitude towards L1 retention. Such a link suggested that heritage speakers who have a positive attitude towards L1 retention are more likely to maintain a great amount of L1 exposure in childhood or vice versa. In this study, the unique function of the early L1 input factor was of a particular interest, as the late L1 input factor could largely be the effect of the age factor. In addition, the unique function of the late L1 input factor beyond the age factor was hard to conclude from the study, since the two factors were inter-related, in nature.

In the following sections, an exploratory factor analysis was conducted on the measures of each hypothesized factor to identify the specific dimensions that are contributing to the common variance in the data. Such analysis was necessary to reveal what variables constitute each factor and to avoid treating all variables as single factor in predicting the outcome variable.

6.2.2 The Age Factor

There were four types of information elicited from the survey, which concerned the age factor: age at immigration (AI), age of onset of L2 acquisition (AO), age of reduced L1 contact (ARC), and age of reduced L1 use (ARU): 1) AI ($M = 5.23$, $SD = 5.81$), 2) AO ($M = 4.88$, $SD = 3.97$), 3) ARC ($M = 6.82$, $SD = 4.69$), and 4) ARU ($M = 9.93$, $SD = 4.25$).

A factor analysis of the four age items, with an oblique rotation, yielded a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of .80. The analysis produced only one factor, where all variables were highly correlated: between AI and AO ($r = .74$), between AI and ARC ($r = .94$), between AI and ARU ($r = .69$), between AO and ARC ($r = .74$), between AO and ARU ($r = .59$), and between ARC and ARU ($r = .69$). The communalities were very high, the one for ARC being the highest (.89) and the one for ARU the lowest (.50). The four items together were responsible for 80% of the total variance. The analysis, therefore, suggested that the four variables constituting the age factor contributed to the large portion of the common variance in the data.

6.2.3 Input Factor

There were eight items measuring four different aspects of L1 contact and use

in the survey, i.e., L1 exposure at home (Home), L1 media exposure (Media), L1 use with peers (Peer), and L1 use for work (Work). For each response type, participants were asked to rate input frequency on a 10-point scale, for both their past experience in childhood (labeled as 1) and their current experience in adulthood (labeled as 2):

1) Home 1 ($M = 8.07$, $SD = 1.98$), 2) Home 2 ($M = 8.50$, $SD = 1.88$), 3) Media 1 ($M = 5.94$, $SD = 2.97$), 4) Media 2 ($M = 6.36$, $SD = 3.64$), 5) Peer 1 ($M = 4.38$, $SD = 3.28$), 6) Peer 2 ($M = 5.46$, $SD = 3.88$), 7) Work 1 ($M = 2.14$, $SD = 2.68$), 8) Work 2 ($M = 4.46$, $SD = 4.33$).

A factor analysis conducted on all 8 input items ($KMO = .78$) extracted two factors. The first factor, which explained 54% of total variance, was composed of the four types of the L1 input in adulthood (i.e., Home 2, Media 2, Peer 2, Work 2). All four variables had high loadings above .60. The correlations among different types of L1 input in adulthood were high, ranging from $r = .61$, between Media 2 and Work 2, to $r = .84$, between Peer 2 and Media 2. The second factor, which explained an additional 18% of the variance, consisted of the four types of the L1 input in childhood (i.e., Home 1, Media 1, Peer 1, Work 1). The four variables had loadings above .40. The correlations among different types of L1 input in childhood were high, ranging from $r = .35$, between Media 1 and Work 1, to $r = .72$, between Media 1 and Peer 1. Notably, the amount of L1 media exposure was very highly correlated with the amount of L1 use with peers, in both childhood and adulthood. Interestingly, the analysis showed that the eight input variables represented two different timings of L1 input, although the two dimensions were highly correlated with one another ($r = .47$). Since the late input factor was highly correlated with the age factor (see Table 5), the

contribution of the early input factor (i.e., Home 1, Media 1, Peer 1, Work 1), above and beyond the late input factor, to the outcome variables was of a particular interest in this study.

6.2.4 Aptitude Factor

Participants' cognitive abilities related to language learning were assessed by means of 5 language aptitude subtests and 4 working memory span tasks. The three LLAMA subtests had moderate test-retest reliability, LLAMA B ($r = .78$), LLAMA D ($r = .64$), and LLAMA F ($r = .69$), while the two PLAB subtests had moderate internal consistency, $\alpha = .61$ for PLAB 4 and $\alpha = .76$ for PLAB 5. In addition, all working memory span tasks had high internal consistency ($\alpha > .75$), except for serial nonword recognition ($\alpha = .51$), which was presumably due to high item difficulty. Therefore, the scores on the serial nonword recognition test were not used for further analyses involving the aptitude factor. A factor analysis was thus performed on a total of eight cognitive ability measures: 1) PLAB 4 ($M = 85.41$, $SD = 13.35$), 2) PLAB 5 ($M = 80.67$, $SD = 12.95$), 3) LLAMA B ($M = 63.94$, $SD = 19.72$), 4) LLAMA D ($M = 33.33$, $SD = 12.15$), 5) LLAMA F ($M = 57.78$, $SD = 26.72$), 6) Operation span ($M = 4.59$, $SD = 1.36$), 7) Counting span ($M = 7.53$, $SD = 1.65$), 8) Digit span ($M = 7.37$, $SD = 1.15$).

The analysis produced two factors (KMO = .72): 1) The first factor, explaining 34% of the variance, consisted of PLAB 4, PLAB 5, and LLAMA F. These variables all had loadings above .60, while LLAMA B and LLAMA D did not load significantly onto the factor, with factor loadings of below .30, and thus were excluded for further analyses involving the aptitude factor. The correlations among

these variables were moderately high, between PLAB 4 and LLAMA F ($r = .53$), between PLAB 5 and LLAMA F ($r = .50$), and between PLAB 4 and PLAB 5 ($r = .41$). 2) The second factor, explaining an additional 15% of the variance, was made up of all three working memory span tasks: operation span, counting span, and digit span. All three variables had loadings above .50. All three tasks were moderately correlated with one another, operation span and counting span ($r = .29$), counting span and digit span ($r = .37$), and operation span and digit span ($r = .38$). The first factor was named analysis, after the three subtests measuring ability to analyze grammatical and phonological information, i.e., PLAB 4 (language analysis), PLAB 5 (sound discrimination), and LLAMA F (grammatical inferencing). The second factor was named working memory (WM), after the three tasks measuring working memory capacity. Therefore, there were largely two components in the aptitude factor, language-analytical ability and working memory capacity, contributing to the common variance in the data

6.2.5 Affective Factor

There were 24 items on the questionnaire that measured affective variables related to language attitude and ethnic identity. For each item, participants were asked to rate their strength or degree of agreement on a 10-point scale. The self-rating scores on these items showed a high internal consistency ($\alpha = .87$). More specifically, the 12 items relating to language attitude measured two dimensions (KMO = .80, Chi-square = 5.59, $p = .35$): 1) Learner attitude ($M = 7.09$, $SD = 1.75$), accounting for 41% of the variance, measured participants' attitude and motivation towards L1 retention for the purpose of being connected to their heritage group (i.e., integrative

motivation), 2) Parental attitude ($M = 7.53$, $SD = 2.19$), accounting for an additional 15% of the variance, measured parents' attitude towards and support for retaining L1 for identity construction, family connection, cultural connection, socializing with the heritage group. Learners' attitude and parental attitude were correlated with one another ($r = .47$) and all items had a loading above .50 on their respective factors. On the other hand, the 12 items relating to ethnic identity measured three dimensions (KMO = .80): 1) Ethnic pride ($M = 8.61$, $SD = 1.52$), accounting for 36% of total variance, 2) Ethnic affiliation ($M = 7.47$, $SD = 1.77$), accounting for 13% of total variance, 3) Ethnic identity search ($M = 6.75$, $SD = 1.79$), accounting for 13% of total variance. All items had high loading of above .40 for respective factors and the correlations among the factors were high, between ethnic affiliation and ethnic search ($r = .43$), between ethnic affiliation and ethnic pride ($r = .47$), and between ethnic search and ethnic pride ($r = .40$).

A factor analysis was thus conducted on the five affective variables, i.e., learner attitude, parental attitude, ethnic pride, ethnic affiliation, and ethnic search (KMO = .77). As a result, only one factor was extracted, in which the five variables together accounted for 41% of the common variance. All variables had high communalities, learner attitude (.43) being the highest and ethnic pride (.27) being the lowest, and they were highly correlated with one another, learner attitude and ethnic affiliation (.56), in particular. Therefore, the analyses showed that the affective factor consisted of five different components in language attitude and ethnic identity, which, to some extent, contributed to the common variance in the data.

6.2.6 Summary

All explanatory variables measured in this study largely represented the four hypothesized factors. The analysis thus suggested that each factor should be entered as a block of relevant variables, in order of the predictive power to explain the variance in the data. 1) The age factor, consisting of AI, AO, ARC, ARU, explained the greatest portion of the common variance in the data (80%), followed by 2) the input factor, consisting of Home 1/2, Media 1/2, Peer 1/2, Work 1/2 (72%), 3) the aptitude factor, consisting of language-analytical ability and working memory capacity (49%), and 4) the attitude factor, consisting of learner attitude, parental attitude, ethnic affiliation, ethnic identity search, ethnic pride (41%). Although the instructional factor, consisting of L1 schooling and L1 tutoring, was not hypothesized earlier in this study and was highly correlated with the age factor and the late input factor, it was entered in the last step to see if it had any predictive power, above and beyond the hypothesized factors.

Therefore, based on the results from the analyses of the hypothesized factors of the study, all explanatory variables were grouped into five blocks, to be entered in the following order in the multiple linear regression analysis:

1. Block 1 (Age factor) = {AI, AO, ARC, ARU}
2. Block 2 (Input factor) = {Home 1/2, Media 1/2, Peer 1/2, Work 1/2}
3. Block 3 (Aptitude factor) = {Analytical ability, Working memory}
4. Block 4 (Attitude factor) = {Attitude, Parent, Belonging, Search, Pride}
5. Block 5 (Instruction factor) = {L1 Schooling, L1 Tutoring}

6.3 The Multivariate Predictive Model

A multiple linear regression analysis was now performed to investigate how much variance in the L1 outcomes of 90 heritage speakers can be explained by the four identified factors above. As explained earlier, the age factor was entered in the first step, the input factor in the second step, the aptitude factor in the third step, and the affective factor in the fourth step, and the instructional factor in the last step. Both enter and forward-stepwise selection methods were used to see if different selection methods produce the same results. The forward selection method was particularly useful in investigating which specific components of each factor had the highest impact on the outcome variable at each step of the analysis. The same procedure was repeated for the analysis of heritage speakers' L1 performance on three test types, the GJT, collocation test, and vocabulary size test. The analysis shows the relationship between the explanatory variables and the three outcome variables, as reported in the next section.

6.3.1 The Relationship between Explanatory and Outcome Variables

The multiple regression analysis produced the correlation matrix between all explanatory variables and each outcome variable (see Table 7). For the L1 grammaticality judgment and collocation tests, the analyses of participants' performance on the ungrammatical condition and on the non-target-like use (NTL) condition, respectively, are reported separately. Similarly, their performance on the L1 receptive vocabulary size test was also analyzed by both high-frequency lexicon and low-frequency lexicon.

Table 7 The correlation matrix for all explanatory variables and outcome variables

Variables	GJT (Ungrammatical)	Collocation (NTL)	Lexicon (High, Low)
AI	.70** (.66**)	.79** (.73**)	.83** (.75**, .86**)
AO	.62** (.60**)	.64** (.56**)	.63** (.60 **, .62**)
ARC	.79** (.73**)	.82** (.75**)	.85** (.77**, .87**)
ARU	.64** (.62**)	.68** (.64**)	.71** (.67**, .71**)
Home 1	.57** (.54**)	.60** (.55**)	.59** (.56**, .58**)
Media 1	.47** (.40**)	.56** (.56**)	.55** (.55**, .53**)
Peer 1	.56** (.52**)	.64** (.67**)	.66** (.62**, .66**)
Work 1	.18* (.22*)	.25* (.31**)	.27** (.20*, .31**)
Home 2	.49** (.48**)	.58** (.55**)	.56** (.52**, .57**)
Media 2	.54** (.47**)	.65** (.61**)	.63** (.64**, .60**)
Peer 2	.62** (.59**)	.70** (.68**)	.73** (.69**, .73**)
Work 2	.61** (.57**)	.68** (.65**)	.73** (.69**, .74**)
Analysis	.40** (.42**)	.40** (.39**)	.40** (.38**, .41**)
WMC	.18* (.21*)	.26** (.30**)	.26** (.25*, .26**)
Attitude	.37** (.33**)	.50** (.54**)	.48** (.44**, .48**)
Parent	-.03 (.00)	.02 (.05)	-.04 (-.04, -.04)
Affiliation	.19* (.12)	.28** (.25*)	.27** (.25*, .27*)
Search	.01 (-.01)	.09 (.12)	.10 (.08, .11)
Pride	-.03 (.00)	.08 (.07)	.03 (-.01, .05)
Schooling	.72** (.67**)	.81** (.76**)	.85** (.77**, .88**)
Tutoring	-.25* (-.21*)	-.30** (-.24*)	-.30** (-.27**, -.31**)

*Significant at the .05 level

**Significant at the .01 level

(NTL = Non-target-like, High = High-frequency, Low = Low-frequency)

Overall, both the age and input factors were highly correlated with participants' performance in each L1 domain and condition. The age factor and the amount of L1 schooling, in particular, appeared to be most significantly related to their L1 performance among all other variables. The input factor, both in childhood and in adulthood, gained a greater significance in their L1 performance in collocation and lexicon tests than in the GJT. Interestingly, significant correlations were also observed between language aptitudes, both language-analytical ability and working memory capacity, and their L1 performance, where working memory capacity was more closely related to their L1 performance on the collocation and lexicon tests than on the GJT. Furthermore, a significant link between their L1 performance and the affective factor was also witnessed, for learner attitude and ethnic affiliation, but not for parental attitude, ethnic pride, and ethnic identity search. A multiple linear regression analysis conducted for each linguistic domain was able to show to what extent each maturational or non-maturational factor accounted for the variance in heritage speakers' L1 performance, after controlling for other factors, as reported in the following sections.

6.3.2 Explaining Variance in L1 Morphosyntactic Knowledge

A hierarchical multiple linear regression analysis was first performed on the participants' L1 performance on the total 120-item GJT ($M = 79.46$, $SD = 13.72$). The analysis showed that the four components in the age factor (i.e., ARC, ARU) and the early input factor (i.e., Media 1, Home 1), accounted for total 71% of the variance in their GJT performance, as shown by Table 8.

Table 8 Multiple linear regression analysis: GJT

	R^2	ΔF	<i>Sig. ΔF</i>	β	<i>VIF</i>
ARC	.62	144.34	.000	.79**	1.00
ARU	.64	4.27	.042	.19*	1.93
Media 1	.69	10.64	.002	.21**	1.15
Home 1	.71	4.73	.032	.16*	1.54

*Significant at the .05 level

**Significant at the .01 level

In the first step, the first entry of the age factor accounted for 64% of the variance in the GJT performance, where both the ARC and ARU appeared as significant predictors, $\beta = .79$, $t(88) = 12.01$, $p < .001$ and $\beta = .19$, $t(87) = 2.07$, $p = .042$, respectively. In the next step, the second entry of the input factor predicted an additional 7% of the variance in the GJT performance, above and beyond the age factor. Among the input factor, both Media 1 and Home 1 made a significant contribution, $\beta = .21$, $t(86) = 3.26$, $p = .002$ and $\beta = .16$, $t(85) = 2.18$, $p = .032$, respectively. However, the entry of subsequent factors (i.e., aptitude, attitude, instruction) did not add any significance to the L1 predictive model for GJT.

The analysis was next performed for the 60 items in the ungrammatical condition separately, testing for their grammatical sensitivity to L1 morphological error. Interestingly, the analysis revealed that the four components from the three factors, including the age factor (i.e., ARC, ARU), the input factor (i.e., Home 1), and

the aptitude factor (i.e., analysis), accounted for total 62% of the variance in their sensitivity to L1 morphological error (see Table 9).

Table 9 Multiple linear regression analysis: GJT (ungrammatical condition)

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.54	101.84	.000	.73**	1.00
ARU	.56	4.93	.029	.22*	1.93
Home 1	.60	7.40	.008	.22**	1.34
Analysis	.62	4.70	.033	.16*	1.19

*Significant at the .05 level

**Significant at the .01 level

The first-entered age factor predicted 56% of the variance in the participants' sensitivity to L1 morphological error, in which both the ARC and ARU made significant contributions, $\beta = .73$, $t(88) = 10.09$, $p < .001$ and $\beta = .22$, $t(87) = 2.22$, $p = .029$, respectively. The second-entry of the input factor predicted an additional 4% of the variance in their sensitivity to L1 morphological error, where only Home 1 added significance to the model, $\beta = .22$, $t(86) = 2.72$, $p = .008$. The third-entry of the aptitude factor also had a small, yet identifiable effect on their sensitivity to L1 morphological error by 2%, where language-analytical ability was shown to have the significant predictive power, $\beta = .16$, $t(85) = 2.17$, $p = .033$. However, the entry of

subsequent factors (i.e., attitude, instruction) did not bring about any significant change in the *R*-squared values, after controlling for all above factors.

In order to further investigate the role of the non-maturational factors in heritage speakers' sensitivity to L1 morphological error, a multiple regression analysis was now performed for the two ungrammatical conditions, i.e., C1 containing 30 items with semantically-determined errors ($M = 69.51$, $SD = 18.60$) and C2 containing 30 items with phonologically-determined errors ($M = 73.58$, $SD = 19.94$). As shown by Tables 10 and 11, the variance in the participants' L1 performance in both conditions was largely explained by three factors, including the age factor, the input factor, and the aptitude factor, total 61% in C1 and total 55% in C2. However, there were some differences in the components within each factor that predicted their sensitivity to the two different types of L1 morphological error.

Table 10 Multiple linear regression analysis: C1 (semantically-determined error)

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.55	105.68	.000	.74**	1.00
Home 1	.59	9.93	.002	.25**	1.31
Analysis	.61	4.16	.045	.15*	1.18

*Significant at the .05 level

**Significant at the .01 level

Table 11 Multiple linear regression analysis: C2 (phonologically-determined error)

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.46	73.91	.000	.68**	1.00
ARU	.49	6.15	.015	.26*	1.93
Media 1	.51	5.57	.021	.19*	1.15
Analysis	.55	4.46	.038	.17*	1.19

*Significant at the .05 level

**Significant at the .01 level

The first-entry of the age factor explained 55% of the variance in C1 and 49% of the variance in C2. In C1, it was only the ARC among age variables that significantly predicted the participants' sensitivity to semantically-determined L1 morphological error, $\beta = .72$, $t(88) = 10.28$, $p < .001$. In C2, it was both the ARC and ARU that significantly predicted their sensitivity to phonologically-determined L1 morphological error, $\beta = .68$, $t(88) = 8.60$, $p < .001$ and $\beta = .26$, $t(87) = 2.48$, $p = .015$, respectively. The second-entered input factor explained an additional 4% of the variance in C1 and an additional 2% of the variance in C2. Interestingly, the amount of early L1 exposure at home made a significant contribution in C1, $\beta = .25$, $t(87) = 3.15$, $p = .002$, while the amount of early L1 media exposure made a difference in C2, $\beta = .19$, $t(86) = 2.36$, $p = .021$. Therefore, different aspects of the early L1 input seemed to benefit heritage speakers' semantic versus phonological sensitivity to L1 morphological error. Lastly, the third-entered aptitude factor explained an additional

2% of the variance in C1 and an additional 4% of the variance in C2. Both in C1 and C2, it was language-analytical ability that had the significant power to predict the participants' sensitivity to L1 morphological error, $\beta = .15$, $t(86) = 2.04$, $p = .045$ and $\beta = .17$, $t(85) = 2.11$, $p = .038$, respectively. In other words, language-analytical ability was beneficial for heritage speakers in making both semantic and phonological distinctions involved in L1 morphology. No subsequent factors (i.e., attitude, instruction) added significance to the model.

Overall, the largest proportion of the variance in heritage speakers' GJT performance was accounted for by the age at which the learners experienced a drastic reduction in L1 contact and use. Additionally, the amount of L1 exposure at home or L1 media exposure in childhood explained a significant proportion of the variance, above and beyond the age factor. Interestingly, language-analytical ability also made a small, yet significant contribution to heritage speakers' performance in the ungrammatical condition, beyond the age and input factors.

6.3.3 Explaining Variance in L1 Collocational Knowledge

A hierarchical multiple linear regression analysis was next conducted on the participants' L1 performance on the 100-item collocation test ($M = 71.57$, $SD = 16.69$). Similar to their GJT performance, the analysis showed that as much as 80% of the variance in L1 collocation test performance was explained by the four components from the two factors, the age factor (i.e., ARC, ARU) and the input factor (i.e., Media 1, Home 1), as shown in Table 12.

Table 12 Multiple linear regression analysis: Collocation test

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.68	185.11	.000	.82**	1.00
ARU	.70	7.10	.009	.22**	1.93
Media 1	.78	31.36	.000	.30**	1.15
Home 1	.80	5.77	.018	.15*	1.54
Analysis	.81	4.29	.041	.11*	1.19

*Significant at the .05 level

**Significant at the .01 level

The first-entered age factor accounted for 70% of the variance, in which both the ARC and ARU significantly predicted the participants' L1 collocation test performance, $\beta = .82$, $t(88) = 13.61$, $p < .001$ and $\beta = .22$, $t(87) = 2.66$, $p = .009$, respectively. The second-entered input factor added a great significance to the L1 predictive model, explaining an additional 10% of the total variance, where both Media 1 and Home 1 contributed to the model, $\beta = .30$, $t(86) = 5.60$, $p < .001$ and $\beta = .15$, $t(85) = 2.40$, $p = .018$, respectively. Therefore, the age and early input factors, together, were enough to account for a large variance in heritage speakers' L1 collocation test performance. No other factors (i.e., aptitude, attitude, instruction) added significance to the L1 predictive model, above and beyond the age and input factors.

A further analysis was performed on the participants' L1 performance on the 50 items in the non-target-like (NTL) condition ($M = 62.01$, $SD = 22.70$), which

produced somewhat different results. The analysis showed that total 74% of the variance in their L1 performance in the NTL condition was explained by all four hypothesized factors, that is, the age factor, the input factor, the aptitude factor, and the attitude factor, as shown in Table 13.

Table 13 Multiple linear regression analysis: Collocation test (NTL condition)

	R^2	ΔF	<i>Sig. ΔF</i>	β	<i>VIF</i>
ARC	.56	112.9	.000	.75**	1.00
ARU	.59	5.71	.032	.23*	1.93
Peer 1	.68	25.37	.000	.36**	1.40
Media 1	.70	5.07	.027	.19*	2.10
Working memory	.73	7.37	.008	.16**	1.10
Learner attitude	.74	4.22	.043	.17*	2.18

*Significant at the .05 level

**Significant at the .01 level

The first-entered age factor accounted for 59% of the total variance in their L1 collocation performance in the NTL condition, where both the ARC and ARU made significant contributions, $\beta = .75$, $t(88) = 10.63$, $p < .001$ and $\beta = .23$, $t(87) = 2.39$, $p = .019$, respectively. The second-entered input factor also greatly increased the predictive power of the model by an additional 11% of the total variance. Interestingly, it was Peer 1 that significantly predicted the participants' L1 performance on the NTL condition, $\beta = .36$, $t(86) = 5.04$, $p < .001$, followed by

Media 1, $t(85) = 2.25, p = .027$. The third-entered aptitude factor also added significance to the model by explaining an additional 3% of the total variance. Unlike the role of language-analytical ability in the GJT performance in the ungrammatical condition, it was the aspect of working memory that significantly predicted the participants' L1 collocation test performance in the NTL condition, above and beyond the age and input factors, $\beta = .16, t(84) = 2.71, p = .008$. The fourth-entry of the attitude factor also had a small, yet identifiable effect on the L1 predictive model. However, the entry of the instructional factor did not make any difference to the model, after controlling for all hypothesized factors.

To sum up, heritage speakers' familiarity with L1 formulaic lexicon had a higher predictability than their knowledge of L1 morphosyntax. The age and early L1 input factors, again, explained a great portion of their L1 variability, 80% of the variance in their collocation test performance and 70% of the variance in their performance on the NTL items. In the NTL condition, however, a greater number of non-maturational variables were involved, such as the amount of childhood L1 use with peers, working memory capacity, and learner attitude towards L1 retention. Unlike heritage speakers' performance on the TL items, which measured mere familiarity with formulaic expressions in Korean, their performance on the NTL items revealed that their accurate knowledge of formulaic expression depends on a greater number of variables to be explained.

6.3.4 Explaining Variance in L1 Lexical Knowledge

A hierarchical multiple linear regression analysis was finally performed on the participants' performance on the 140-item receptive vocabulary size test ($M = 59.22$,

$SD = 23.33$). Their L1 lexicon size was as highly predictable as their performance on L1 collocation test. Unlike their L1 performance on the GJT and collocation test, the aptitude factor also significantly explained the variability in L1 lexicon size, above and beyond the age and input factors. In total, 83% of the total variance in their L1 lexicon size was accounted for by the five components from the three factors, the age factor (i.e., ARC, ARU), the input factor (i.e., Media 1, Work 2), and the aptitude factor (i.e., working memory), as shown by Table 14.

Table 14 Multiple linear regression analysis: Vocabulary size test

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.71	219.70	.000	.85 **	1.0
ARU	.74	9.75	.002	.24**	1.93
Media 1	.80	29.03	.000	.27**	1.15
Work 2	.82	4.59	.035	.17*	2.78
Working memory	.83	4.20	.043	.10*	1.09

*Significant at the .05 level

**Significant at the .01 level

The first-entered age factor alone explained 74% of the total variance in the participants' L1 lexicon size, where both the ARC and ARU were significant predictors, $\beta = .85$, $t(88) = 14.82$, $p < .001$ and $\beta = .23$, $t(87) = 3.12$, $p = .002$, respectively. The second-entered input factor explained an additional 8% of the total

variance in L1 lexicon size, where Media 1 was the most significant predictor, $\beta = .27$, $t(86) = 5.39$, $p < .001$. Interestingly, the participants' L1 lexicon size was also significantly explained by their amount of L1 use for work in the adulthood, $\beta = .17$, $t(85) = 2.14$, $p = .035$. Finally, the third-entered aptitude factor also had a small, yet significant effect on the predictive model for L1 lexicon size. As in their L1 collocation test performance in the NTL condition, it was working memory capacity that made a difference in their L1 lexicon size, $\beta = .10$, $t(84) = 2.05$, $p = .043$. However, the effect of the attitude factor or the instructional factor was not found in the predictive model for L1 lexicon size.

The participants' performance on the L1 vocabulary size test was further analyzed by lexical frequency, which showed the distinct patterns between the 60 high-frequency items ($M = 69.27$, $SD = 23.17$) and the 80 low-frequency items ($M = 51.68$, $SD = 24.48$). As shown by Tables 15 and 16, the low-frequency lexicon size was more predictable than the high-frequency lexicon size, and it involved a greater number of variables to explain the L1 variability. Overall, 73% of the variance in the participants' high-frequency L1 lexicon size was explained by three factors, including the age factor, input factor, and affective factor, while 87% of the variance in their low-frequency L1 lexicon size was explained by all of the four hypothesized factors, including the age factor, input factor, aptitude factor, and affective factor.

Table 15 Multiple linear regression analysis: High-frequency lexicon

R^2	ΔF	Sig. ΔF	β	VIF
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ARC	.59	125.65	.000	.77**	1.0
ARU	.62	7.85	.006	.26**	1.93
Media 1	.70	23.40	.000	.31**	1.15
Work 2	.72	4.70	.033	.21*	2.78
Ethnic pride	.73	4.32	.041	-.12*	1.06

*Significant at the .05 level

**Significant at the .01 level

Table 16 Multiple linear regression analysis: Low-frequency lexicon

	R^2	ΔF	<i>Sig.</i> ΔF	β	<i>VIF</i>
ARC	.75	269.45	.000	.87 **	1.0
ARU	.77	9.15	.003	.21**	1.93
AI	.78	5.39	.023	.34*	8.64
Media 1	.83	26.30	.000	.24**	1.15
Peer 1	.84	4.34	.040	.14*	2.59
Working memory	.85	4.71	.033	.10*	1.14
Ethnic affiliation	.86	4.39	.039	.10*	1.32
Ethnic pride	.87	6.74	.011	-.12*	1.36

*Significant at the .05 level

**Significant at the .01 level

The first-entered age factor accounted for 62% of the total variance in high-frequency L1 lexicon size and 78% of the total variance in low-frequency L1 lexicon

size. In the high-frequency condition, both the ARC and ARU significantly predicted L1 lexicon size, $\beta = .77$, $t(88) = 11.21$, $p < .001$ and $\beta = .26$, $t(87) = 2.80$, $p = .006$, respectively. In the low-frequency condition, the ARC, ARU, and AI significantly predicted L1 lexicon size, $\beta = .87$, $t(88) = 16.42$, $p < .001$, $\beta = .21$, $t(87) = 3.03$, $p < .001$, and $\beta = .34$, $t(86) = 2.32$, $p = .006$, respectively. Due to relatively high multicollinearity as shown by the size of VIF, the effect of AI, however, needs to be interpreted with caution. The second-entered input factor accounted for an additional 10% of the variance in the low-frequency condition and an additional 6% of the variance in the high-frequency condition. Media 1 made the notable contribution on L1 lexicon size, among other input variables, in both conditions, $\beta = .31$, $t(86) = 4.84$, $p < .001$, and $\beta = .24$, $t(85) = 5.13$, $p < .001$, respectively. However, Work 2 also uniquely contributed to the high-frequency condition, $\beta = .21$, $t(85) = 2.17$, $p = .033$, whereas Peer 1 made a difference in the low-frequency condition, $\beta = .14$, $t(84) = 2.08$, $p = .04$. The third-entered aptitude factor added significance to the model in the low-frequency condition only. As in L1 collocation test in the NTL condition, it was working memory which had a significant effect on L1 lexicon size, $\beta = .10$, $t(83) = 2.17$, $p = .033$. The last-entered affective factor, relating to ethnic identity, also added a small, yet identifiable significance to the predictive power of the model for both conditions. The aspect of ethnic affiliation significantly predicted the low-frequency L1 lexicon size, $\beta = .10$, $t(82) = 2.10$, $p = .039$, while ethnic pride was negatively predictive of L1 lexicon size in both high and low-frequency conditions, $\beta = -.12$, $t(84) = -2.08$, $p = .041$, and $\beta = .24$, $t(81) = -2.60$, $p = .011$, respectively. The

effect of the instructional factor on L1 lexicon size was not found, after controlling for all hypothesized factors.

To sum up, the variance in the participants' receptive L1 vocabulary size was very highly predictable, as it was the case with their L1 collocation. Their L1 lexical knowledge of low-frequency items, in particular, called for numerous non-maturational explanations, although the maturational factor alone explained a great portion of the variance. As in the GJT and collocation test, the amount of L1 input in childhood had unique contributions to the predictive model, above and beyond the age factor. Interestingly, however, the amount of L1 input from work in adulthood was also able to predict heritage speakers' L1 lexicon size among high-frequency items. Such result implies that heritage speakers may relearn the early-acquired L1 vocabulary through their work-related experiences outside the classrooms later in life. In addition, evidence for the role of working memory in low-frequency L1 lexicon, in addition to L1 formulaic lexicon, suggests that working memory may compensate for low exposure and help develop or retain less-frequently encountered lexicon in early bilingualism. Finally, while language attitude was related to performance on L1 formulaic usage, some aspects of ethnic identity were related to performance on other parts of the L1 lexicon in heritage speakers.

6.3.5 The Effect Size of the Explanatory Variables

The multiple linear regression analyses on heritage speakers' L1 performance revealed that each explanatory variable does not have the same predictive power for different linguistic domains. In other words, some types of their L1 knowledge seemed to be more sensitive to a certain variable than other types of L1 knowledge.

Therefore, the effect size of all explanatory variables at each step of the analyses was observed by semipartial correlation coefficients (sr^2), which demonstrated the unique contribution of each variable to the L1 outcomes. Table 17 summarizes the effect size of all significant explanatory variables within each factor (i.e., age, input, aptitude, and attitude), which was entered sequentially into the model in the hypothesized order, in predicting the participants' L1 scores for all test types and conditions.

Table 17 The effect size (sr^2) of explanatory variables for L1 outcomes

	GJT	C1	C2	Collocation	NTL	Lexicon	High	Low
<i>Age</i>								
ARC	.79	.74	.68	.82	.75	.85	.77	.87
ARU	.13		.19	.16	.16	.17	.19	.15
AI								.12
<i>Input</i>								
Peer 1					.31			.09
Media 1	.20		.18	.28	.13	.26	.28	.22
Home 1	.13	.22		.12				
Work 2						.10	.13	
<i>Aptitude</i>								
Analysis		.14	.15	.10				
Working memory					.16	.09		.09
<i>Attitude</i>								
Learner attitude					.12			
Ethnic affiliation								.09
Ethnic pride						-.12		-.10

(C1 = Semantically-determined error, C2 = Phonologically-determined error,

NTL = Non-target-like, High = High-frequency, Low = Low-frequency)

Among age variables, ARC, the age when heritage speakers had reduction in L1 contact, was the most representative predictor of the L1 outcomes in all three linguistic domains, which explained the greatest portion of the variance in L1 lexicon. Within L1 morphosyntax, the features that required semantic distinctions were more sensitive to ARC than the features that required morphophonological distinctions, which were uniquely affected by ARU, the age when heritage speakers had reduction in L1 use. The effect of ARU was also found in their knowledge of L1 collocation and lexicon, above and beyond the effect of ARC. However, AI, age at immigration, made an additional contribution to their knowledge of low-frequency L1 lexicon only, while AO, the age of onset of L2 acquisition, showed no unique contribution to any domain, on top of other age variables. Among input variables, L1 input in childhood was shown to be a significant predictor in all linguistic domains, but not L1 input in adulthood (except Work 2 in high-frequency lexicon). Interestingly, Peer 1, the amount of childhood L1 use with peers had the greatest effect on heritage speakers' knowledge of L1 collocation, in particular. On the other hand, Media 1, the amount of childhood L1 media exposure, which had the greatest impact on all three domains, played a greater role in their knowledge of L1 collocation and lexicon than in their knowledge of L1 morphosyntax. Within L1 morphosyntax, their sensitivity to semantically-determined features was significantly correlated with Media 1, whereas their sensitivity to phonologically-determined features was significantly correlated with Home 1, the amount of childhood L1 exposure at home. However, Home 1 was

not enough to explain the variance in their L1 lexical knowledge. Among aptitude variables, language-analytical ability uniquely predicted heritage speakers' sensitivity to L1 morphological error, but not their L1 collocation and lexical knowledge, whereas working memory capacity significantly predicted their L1 collocation and lexical knowledge, but not their L1 morphosyntactic. Finally, among affective variables, learner attitude made a small contribution to L1 collocations, while ethnic affiliation and ethnic pride significantly predicted L1 lexicon in heritage speakers. The results will be further discussed in the next chapter, in light of our research questions.

6.3.6 Summary

The multiple regression analysis on the participants' L1 performance revealed to what extent the maturational and non-maturational factors accounted for the variance in the L1 outcomes among heritage speakers. The maturational factor alone accounted for a large portion of their L1 variability in all linguistic domains involved, i.e., morphosyntax, collocations, and lexicon. However, some components of the non-maturational factors additionally explained a significant portion of their L1 variability, above and beyond the age factor. First, the amount of L1 input in childhood was shown to be a significant predictor of the L1 outcomes: 1) In L1 morphosyntax, the amount of childhood L1 exposure at home and L1 media exposure significantly predicted their sensitivity to L1 morphological error. 2) In L1 collocation, the amount of childhood L1 use with peers and L1 media exposure significantly predicted their native-like knowledge of L1 formulaic expressions. 3) In L1 lexicon, the amount of childhood L1 media exposure largely predicted their knowledge of high and low-

frequency lexicon. Second, certain aspects of language aptitude also made a significant contribution to the predictive model: 1) In L1 morphosyntax, language-analytical ability significantly predicted heritage speakers' sensitivity to L1 morphological error. 2) In L1 collocation, it was working memory capacity, which significantly predicted their knowledge of L1 collocation. A significant effect of language-analytical ability was found for their familiarity with formulaic expressions, but not for their knowledge of native-like constructions (NTL condition). 3) In L1 lexicon, working memory also significantly predicted their L1 lexical knowledge, low-frequency lexicon, in particular. Finally, some affective variables also predicted heritage speakers' L1 collocation and lexical knowledge, but not their L1 morphosyntactic knowledge. Learner attitude significantly predicted their knowledge of L1 collocations, while ethnic affiliation significantly predicted their knowledge of low-frequency lexicon. However, the amount of instruction before and after ARC (i.e., L1 schooling, L1 tutoring, respectively) did not have any predictive power, after controlling for all above variables.

Chapter 7: Discussion and Implications

The last chapter summarizes the major findings of the study and discusses the results in light of the research questions. The first section mainly relates to the issue of how L1 is acquired incompletely in heritage speakers; this is followed by a section dealing with the issue of how such L1 outcomes are interrelated with the maturational and non-maturational variables involved in their L1 development. In addition, the issues remaining from the current study are reviewed, to suggest future directions for investigations on heritage speakers. Finally, conclusions are drawn about the nature of heritage language acquisition, as well as heritage language grammar, and its general implications for human language learning.

7.1 Incomplete L1 Acquisition in Heritage Speakers

The first research question was concerned with the extent to which heritage speakers of Korean showed incomplete L1 knowledge. Previous studies of heritage speakers' end-state L1 grammar have shown that incomplete acquisition is more likely to occur in some linguistic domains (e.g., morphology, lexicon) than others (e.g., syntax, phonology) in early bilingualism. Within an individual linguistic domain, some linguistic features (e.g., mood morphology) were more likely to be acquired incompletely than others (e.g., tense and aspect marking). Such indications of incomplete L1 acquisition were found, particularly among early attriters, although some features were still shown to be vulnerable among late attriters. The results of the current study also suggest that a degree of L1 nonconvergence in Korean heritage

speakers does not only depend on the age at which contact with L1 was reduced (ARC), but also on the types of L1 knowledge.

The analysis of heritage speakers' L1 receptive performance by different ARC groups first revealed that heritage speakers who had reduced L1 contact before the age of 9, having little or no L1 exposure in educational settings, had, without exception, incomplete knowledge of L1 morphosyntax, as well as L1 formulaic and non-formulaic lexis. They performed poorly, particularly with regard to optional L1 morphosyntactic features (e.g., case marking) or require complex semantic distinctions (e.g., aspect marking, relativizers). They also possessed a very small L1 lexicon and low familiarity with L1 formulaic expressions (e.g., ideophones, classifiers). Therefore, failure to acquire these L1 features may be largely due to the difficulty posed by optionality or semantic complexity and to the lack of input frequency. This pattern of L1 nonconvergence among heritage speakers was most evident among simultaneous bilinguals (ARC 0-1), who performed significantly poorer than early attriters (ARC 2-8) in L1 morphosyntax. The finding is consistent with earlier evidence of incomplete L1 grammar among child bilinguals in Korean and English (Kim & Seligman, 2006; Song et al., 1997). However, nominal exposure to L1 in an educational setting did not make any significant difference to ultimate L1 attainment among early attriters. These results seem to suggest that heritage speakers who experienced reduced L1 contact in early childhood acquired the L1 incompletely in childhood and that their L1 knowledge remained incomplete or attrited throughout adulthood.

Late attriters, who had reduced L1 contact after the age of 9, greatly outperformed early attriters. The pattern of L1 nonconvergence witnessed across different ARC groups supports the argument that a significant change in susceptibility to L1 attrition takes place at around age 9 (Harley & Wang, 1997; Köpke & Schmid, 2004). Evidence for a leap in L1 proficiency at around age 9 was more apparent for some features than others. With respect to L1 morphosyntax, late attriters showed marked differences from early attriters in aspect marking and relativizers, and converged with native speakers in tense marking and conjunctive constructions. In L1 collocations, they had native-like knowledge of wear-verbs and numerals, which are both frequently used in native speech on a daily basis. Late attriters also had a nearly native-sized lexicon among high-frequency lexical items. Thus, heritage speakers who had reduced L1 contact in late childhood were able to retain native-like knowledge of some L1 features, but not for all features. However, whether they failed to acquire them or simply lost access to these features is beyond the scope of the current study.

Interestingly, even heritage speakers with $ARC > 12$ were shown to be lacking native-like knowledge of L1 grammar in some areas. The results were congruent with their earlier self-reports that they had near-native, but not native-like L1 proficiency. For instance, they failed to converge with native speakers in their sensitivity to semantically determined morphological errors, as opposed to phonologically determined morphological errors; they lacked native-like knowledge of optional case marking, in particular. As shown by the earlier pilot study on the optional progressive marker in Korean (see Section 4.1.2), heritage speakers may not necessarily lack

knowledge of such optional markers, but optionality may cause the learner difficulty, due to reduced input of the target form and deliberate avoidance of its use.

Furthermore, they also lacked native-like knowledge of formulaic constructions of serial predicates in Korean as well as a native-sized lexicon among low-frequency items (i.e., beyond the first 6000 words). Therefore, the results contradict earlier studies which suggest that L1 attrition susceptibility ends around age 12 (Bylund, 2009b; Hakuta & D'Andrea, 1992; Jia & Aaronson, 2003; Pires & Rothman, 2009; Yeni-Komshian et al., 2000). The current study found evidence for incomplete L1 grammar even among heritage speakers with ARC past age 12, in some types of L1 knowledge, either because the features were incompletely acquired or had attrited.

Based on our findings, we may conclude that heritage speakers have incomplete grammatical competence because they developed a weaker language in early bilingualism (particularly among early attriters with $ARC < 9$) and/or they experienced language attrition, in a broad sense (particularly among late attriters with $ARC \geq 9$). Heritage language grammar is not only characterized by the benefit of early exposure to the L1, but also by the lasting consequences of reduced exposure during the critical period in language learning. Although heritage speakers may retain a core of early-acquired L1 grammar, and, thus, are fundamentally different from late bilinguals, the current study suggests that they are also distinguished from normal child L1 acquirers or balanced early bilinguals with regard to reduced L1 input in childhood. Lenneberg (1967) argued that the emergence of early acquired implicit language behaviors is triggered by an environment rich enough for the behavior to develop adequately, and, thus, early developmental history may vary according to the

nature of the input received at the time. Heritage speakers are one type of early bilingual who do not develop the L1 adequately, due to a decrease in the quantity and quality of input in childhood. In this sense, the evidence of incomplete knowledge in L1 morphosyntax and lexicon among heritage speakers may result largely from the input they received during childhood, the nature of which is directly responsible for their inadequate development of optional or semantically-complex morphological features and low-frequency lexical items.

How, then, do we explain the variance in L1 outcomes for each heritage group within the same range of ARC, where an explanation referencing structure-dependency alone is insufficient? As we witnessed earlier, heritage speakers who had reduced L1 contact in early childhood, in particular, displayed tremendous individual variation in their ultimate L1 outcomes. Thus, the next section discusses the second possible explanation for variability in heritage speakers' L1 competence in terms of the role of maturational and non-maturational variables at play in their early L1 development.

7.2 Maturational and Non-Maturational Explanations

The primary research question the current study is concerned with is to what extent the variability in L1 performance among Korean heritage speakers can be explained by maturational and non-maturational variables. The study first investigated the specific variables that constitute each construct of interest (i.e., age, input, aptitude, affect), in order to understand what aspects of each factor make unique contributions to ultimate L1 attainment. The multivariate predictive model was able to show how nonmaturational variables add significance to predicting such

L1 outcomes, above and beyond maturational variables. The study then questions whether the phenomenon of selectivity in heritage speakers' L1 grammar can also be partly explained by the multivariate predictive model, that is, whether certain types of L1 knowledge are particularly sensitive to one factor more than another. The results for the four hypothesized explanatory factors are discussed in the following sections.

7.2.1 The Age Effect

As shown in the literature and in the preliminary analysis of L1 performance by different ARC groups, the multivariate analysis also revealed that the age factor alone explained a large portion of the variance in heritage speakers' L1 performance. Previous studies of age effects in L1 attrition have often employed the same age construct used in studies of age effects in L2 acquisition, that is, the age of onset of L2 acquisition (AO). However, the results of the current study suggested that it was specifically the age when speakers had reduced exposure (ARC) and reduced use of the L1 (ARU) that significantly predicted L1 outcomes, rather than AO. One possible interpretation is that heritage speakers' AO, or the onset of bilingualism, is insufficient to explain L1 variance, since it does not necessarily co-occur with the reduction in L1 input, which was shown to play a critical role in early bilingualism. As shown by a wide range in the age of L1 shift even among simultaneous bilinguals, some heritage speakers seem to experience immediate L1 replacement in the face of L2 interference, while others seem to enjoy a more prolonged status of balanced bilinguals. Interestingly, it was the timing of reduced L1 input that brought about such differences in the speed of L1 replacement among these early bilinguals. The results, therefore, suggest that the age affect on ultimate L1 outcomes in heritage

speakers can largely be explained by the frequency of input for the duration of a critical period in which the L1 is learned implicitly via mere exposure. The next step in the analysis of the input factor was further able to show the specific aspects of such early L1 input that play a critical role in heritage speakers' early L1 development.

Then, does the age effect also explain the selectivity in heritage speakers' L1 knowledge? Within L1 morphosyntax, the effect size of ARC was found to be greater in making semantic distinctions than in making phonological distinctions in detecting L1 morphological errors. On the other hand, the effect of the ARU was demonstrated only in speakers' sensitivity to phonologically determined morphological errors. The results imply that L1 exposure is related to the acquisition of semantic features beyond heritage speakers' receptive skills, whereas phonological features are fully developed when they actually make use of the target features. In other words, early exposure may benefit heritage speakers in developing native-like sensitivity to different functions of L1 morphological marking, but mere exposure is insufficient to retain native-like control of the complex allomorphs involved unless they continue to be used actively. The role of ARU also proved to be important in the domains of L1 collocation and lexis, which suggests that the aspect of L1 use, in addition to the aspect of L1 exposure, is intertwined with the age effect in developing L1 lexical items. Within the L1 lexicon, the effect size of ARC was greater for low-frequency items than for high-frequency items, which implies that the heritage lexicon is often limited to high-frequency items, largely due to a lack of exposure to low-frequency items in early bilingualism.

Therefore, the current study is revealing about the aspects of the age factor that predict heritage speakers' L1 outcomes, and how they selectively affect their L1 knowledge. To what extent the quantity and quality of L1 input heritage speakers receive in childhood influence their ultimate L1 attainment is examined further in the next section.

7.2.2 The Input Effect

The results showed how the input factor relates to the age factor in heritage language acquisition. The analysis of all explanatory variables revealed that the amount of input heritage speakers are exposed to in childhood was distinct from the amount of L1 input in adulthood, while the latter was strongly correlated with age variables and the amount of L1 schooling. The multiple regression analysis further revealed that it was the amount of L1 input in childhood that made an additional contribution to explaining L1 outcomes, above and beyond the age effect, but not the amount of L1 input in adulthood. The most plausible interpretation for such results is that the amount of L1 input in adulthood is largely a function of age and the amount of early L1 schooling, whereas the amount of L1 input in childhood has a more direct and unique contribution to early L1 development, beyond the age factor. Simply put, heritage speakers who had reduced L1 exposure later in life, having received a substantial amount of L1 schooling, are more likely to be proficient in the L1, and, thus, are more likely to have maintained their use of the L1 to date. On the other hand, heritage speakers who experienced somewhat reduced L1 exposure earlier in life, but still managed to maintain a sufficient amount of L1 input in childhood, are able to compensate for age effects.

More specifically, the effect of early L1 use at home was found in native-like semantic distinctions in the use of L1 morphology and passive familiarity with L1 collocations, but not in L1 vocabulary size. The effect L1 home use in childhood has on learning native-like functions of L1 morphological marking may arise from the fact that children are likely to receive corrective feedback from their parents on the L1 morphological errors they make. Frequency of L1 use with peers in childhood was shown to have the greatest effect on heritage speakers' knowledge of L1 collocations. The results suggest that, contrary to the common perception that L1 use at home is largely responsible for their L1 development, heritage speakers do not receive sufficient L1 input from communication with family alone. The amount of exposure to L1 media in childhood had the most pervasive effect in all linguistic domains, particularly in phonological sensitivity to making native-like allomorphic distinctions, as well as in knowledge of collocations and low-frequency lexical items. This finding is in line with the results of the pilot study on the effect of L1 media on heritage speakers' L1 proficiency (see Section 4.1.3). It is natural that those who are exposed to more numerous and diverse forms of L1 media in childhood, and from different sources, including Internet, television, books, and magazines, are more likely to receive a higher quality of L1 input than those who receive L1 input exclusively at home. Interestingly, however, the effect of L1 media exposure was not observed for grammatical sensitivity to L1 morphological error, implying that passive exposure is not sufficient to acquire native-like sensitivity to L1 morphological error, but that actual use of target forms, and presumably feedback from parents may really be what benefits the specific aspect of L1 knowledge. Finally, the amount of L1 use for work

and other activities did not appear to be significant predictors of L1 outcomes, although most heritage speakers reported early use of L1 due to church involvement. However, the late input factor related to work was an exceptional predictor of the size of their L1 lexicon. One possible explanation is that heritage speakers who find themselves in L1-speaking work environments as adults may be able to recall their childhood L1 vocabulary.

To sum up, in addition to the age factor, the variability in heritage speakers' L1 outcomes can be explained by early input, which encompasses not only the quantity, but also the quality of input that they receive in childhood: 1) ARC and early L1 use at home, together, predicted grammatical sensitivity to semantic features, 2) ARC, ARU, and early L1 media exposure predicted grammatical sensitivity to morphophonological features, as well as L1 collocation and lexical knowledge, and 3) ARC, ARU, and early L1 use with peers made a great contribution to their knowledge of L1 collocations. Therefore, the current study suggests that ultimate L1 attainment of heritage speakers can only be understood via the joint effect of age and the early input variables.

7.2.3 The Aptitude Effect

Certain aspects of language aptitude accounted for an additional portion of the variance in heritage speakers' L1 attainment, above and beyond age and input factors. Thus, the results from the multivariate predictive model were congruent with the earlier evidence for the effect of language aptitude in GJT performance among early bilinguals (Abrahamsson & Hyltenstam, 2008; Bylund, Abrahamsson, & Hyltenstam,

2009). The current study was further able to show the specific function of language aptitude components in heritage speakers' L1 development.

On the one hand, the ability to analyze and induce grammatical rules, as measured by subtests of both LLAMA and PLAB, predicted heritage speakers' grammatical sensitivity to L1 morphological errors with a high degree of accuracy. A small, yet significant effect of such language-analytic ability was also found in their familiarity with L1 collocations and high-frequency lexical items. On the other hand, working memory, that is, the capacity for the storage and attentional control of phonological information, showed a strong correlation with heritage speakers' knowledge of L1 formulaic and non-formulaic lexis. There may be two possible explanations for the role of working memory as it relates to heritage speakers' L1 lexical knowledge: 1) The specific function of phonological memory in early vocabulary learning (French, 2006; Gathercole et al., 1992; Masoura & Gathercole, 2005) helps them grow the L1 lexicon, even with reduced L1 input, 2) the central executive system may help to retain already-acquired lexical items in the face of L2 interference by lowering the L1 threshold, which in turn compensates for reduced L1 input. In addition, it may be the role of working memory at the time of testing, rather than at the time of learning, since working memory was correlated with performance in the NTL condition, but not in the TL condition in L1 collocation test.

Therefore, the current study revealed that some aspects of language aptitude may bring about individual differences among heritage speakers in developing L1 grammar with reduced input, as well as reducing L1 attrition susceptibility in early bilingualism. Although the magnitude of the effect of language aptitude was not as

great as that of the age and input factors on their ultimate L1 attainment, such aptitude differences partly explained the tremendous variation among early attriters, who were relatively comparable in terms of age and input. The study also revealed that other non-maturational variables, like language aptitude, may come into play in the context of heritage language acquisition, characterized by reduced L1 exposure, although mere exposure in childhood is sufficient for the L1 to develop in a normal setting. The next section discusses how another non-maturational variable, language attitude, may play a role in the context of heritage language acquisition.

7.2.4 The Attitude Effect

The affective factor made the last small contribution to predicting heritage speakers' L1 outcomes, above and beyond age, input, and aptitude. The results showed that some components of the affective factor (i.e., attitude towards L1 retention, sense of belonging to the L1 group) were indirectly linked to L1 outcomes, by influencing the early input factor.

On the one hand, the effect of L1 attitude and motivation was found in the participants' knowledge of L1 formulaic lexical entries. Such a link between language attitude and L1 collocations was best explained by the fact that their positive attitude towards L1 retention was highly correlated with the timing of their reduction in L1 contact and use, as well as the amount of their early L1 use with peers. In other words, the effect of language attitude was indirectly contributing to their L1 outcomes by delaying the age at which heritage speakers reduce their L1 use and increasing the amount of L1 use with peers in childhood (as shown by its significant correlations with ARU and Peer 1), both aspects that are more closely relevant to their early L1

development. On the other hand, heritage speakers' sense of belonging to their heritage group, i.e., ethnic affiliation, was uniquely accounting for the size of their low-frequency L1 lexicon. One possible explanation is that heritage speakers with a strong heritage identity are more likely to be closely affiliated with L1 speakers and frequently exposed to L1 media (as shown by its significant correlations with ARC and Media 1), from which they receive an increased amount of diverse L1 lexical items.

If the role of language aptitude resided largely in compensating for reduced L1 input during childhood, the role of language attitude was found in increasing the amount of L1 input during childhood. The multivariate predictive model was able to show the differential role of non-maturational variables in heritage language acquisition. Although no effect of the early L1 instruction factor (i.e., L1 schooling, L1 tutoring) on heritage speakers' L1 outcomes was found after accounting for the effect of other non-maturational factors, the relationship between the instructional factor and the attitude factor was observed earlier. More specifically, the amount of L1 schooling before the ARC largely determined their attitude towards L1 retention, while parental attitudes towards L1 retention largely determined the amount of their L1 tutoring after the ARC in childhood. However, both instructional variables failed to predict ultimate L1 attainment. Since the effect of late L1 instruction in adulthood was not investigated in this study for theoretical reasons (see Section 3.2.2.), whether the late instructional factor may significantly predict L1 outcomes is unknown.

7.3 Summary of Major Findings

The major findings, stemming from the investigation of ultimate L1 outcomes in Korean heritage speakers in the United States, are summarized below:

1. Heritage speakers acquire some aspects of their L1 grammar incompletely, largely due to reduced exposure to the L1 in childhood (i.e., before the offset of a critical period of language learning).
2. Heritage speakers develop a weaker L1 in early bilingualism (particularly among early attriters with $ARC < 9$) and/or they experience language attrition in a broader sense (particularly among late attriters with $ARC \geq 9$).
3. Although individual heritage speakers undergo different L1 acquisition processes in childhood, their ultimate L1 attainment can be predicted to a great extent.
4. Heritage language grammar is not only characterized by L1 behavior acquired early from mere exposure, but also by the lasting consequences of reduced L1 exposure during a critical period of language learning.
5. Heritage speakers tend to acquire the L1 incompletely with respect to those features involving optional marking or semantic complexity, as well as low-frequency lexical entries.
6. Variability in ultimate L1 outcomes among heritage speakers can largely be understood as a function of the age at which L1 exposure was reduced and the nature of L1 input received in childhood (between-subject variance).
7. Selectivity in heritage speakers' L1 grammar across and within linguistic domains can also partly be explained by the age of reduced L1 exposure and the nature of L1 exposure received in childhood (within-subject variance).

8. The age at which heritage speakers' L1 contact and use is reduced accounts for a considerable portion of the variance in ultimate L1 proficiency, given that a significant change in vulnerability to L1 attrition takes place around age 9, although some areas of L1 grammar are still affected even past age 12.
9. As shown by the effect of ARC and ARU, some types of knowledge in L1 morphology develop adequately with passive exposure to the L1 in childhood, while other types of knowledge of L1 collocation or lexis are only acquired with both exposure to, and active use of, the L1 in childhood.
10. In addition to the age effect, the quantity and quality of L1 exposure heritage speakers receive in childhood make a difference in ultimate L1 outcomes: 1) early L1 use at home helps heritage speakers to acquire the function of L1 morphology, 2) early L1 media exposure helps them to acquire the allomorphic distinctions involved in L1 morphology, as well as L1 collocation and lexis, and 3) early L1 use with peers greatly benefits the development of L1 collocation.
12. Therefore, mere exposure to a language, the sufficient condition for L1 development in childhood, is not sufficient for heritage speakers in the context of reduced exposure to the L1 in childhood, in which other non-maturational factors come into play.
13. Some aspects of the aptitude factor, which allow heritage speakers to develop the L1 with impoverished input or to retain the L1 in the face of L2 interference, may compensate for reduced L1 input in childhood: 1) Analytical ability predicts their sensitivity to L1 morphological error, while 2) working memory predicts the size of their L1 collocational knowledge and lexicon.

14. Some aspects of the affective factor may influence the amount of L1 contact and use in childhood, which is predictive of heritage speakers' L1 outcomes: 1) Language attitude towards L1 retention is correlated with ARU and the amount of early L1 use with peers, which predicted their L1 collocational knowledge, while 2) ethnic affiliation is correlated with ARC and the amount of early L1 media exposure, which explain their L1 lexical knowledge.
15. The amount of early L1 instruction (i.e., L1 schooling, L1 tutoring) is also significantly correlated with the affective factor, but does not predict heritage speakers' L1 outcomes above and beyond other non-maturational variables.

7.4 Remaining Issues

This section deals with the following issues remaining from the study, and which need further investigation: 1) The role of input in heritage speakers' L1 development, 2) the relationship between L1 and L2 development in heritage speakers' early bilingualism, and 3) the nature of the relearning process when heritage speakers reach adulthood.

First, the current study argued that incomplete L1 outcomes in heritage language acquisition can largely be explained by both the age factor and the input factor. The late input factor clustered with the age factor, while the early input factor remained an independent factor. This study argued, therefore, that it is specifically the early input factor that has the power to predict L1 outcomes, above and beyond the age factor. The study of 90 Korean heritage speakers revealed that the amount of L1 contact and use was not a stable variable throughout their L1 development, although they seemed to maintain relatively stable and constant L1 contact and use at home up

to young adulthood. More interesting was the role of L1 media exposure or L1 use with peers in childhood, which explained the variance in their L1 outcomes, above and beyond the age factor and the late input factor. Whether such a tendency is representative of heritage language acquisition in general or is specific to Korean heritage speakers needs further investigations. Thus, the role of different types of L1 input in heritage language acquisition needs to be investigated with different populations of heritage speakers.

Another issue concerns the interaction between L1 and L2 development in heritage language acquisition. The surprising number of heritage speakers who had reduced L1 contact, as early as ages 8 through 15, reported that they lacked native-like proficiency in both L1 Korean and L2 English. In other words, unbalanced bilingualism was relatively prevalent among attriters of the L1 in late childhood. Such a phenomenon suggests that all heritage speakers, early or late attriters, are not only vulnerable to L2-induced change in their L1 grammar, but also to the lasting effect of reduced L1 exposure, taking place before the offset of the critical period, on their ultimate bilingual status. Although the current study did not measure participants' L2 proficiency and relied only on self-assessment to determine their present bilingual status, the relationship between L1 and L2 proficiency is a topic for further examination in future studies. Specifically, whether the unique experience of unbalanced early bilingualism in heritage speakers is mainly the effect of L2 interference or largely a function of reduced L1 exposure in childhood needs to be clarified.

Finally, the effect of late instruction in adulthood on heritage speakers' L1 grammar needs to be further investigated to understand the nature of the heritage speakers' relearning process. More specifically, whether L1 relearning success is limited to those with exceptional language aptitude that comes into play during explicit learning in classrooms or is truly a product of the inherent advantage heritage speakers possess to bring back early-acquired L1 knowledge needs to be clarified. In addition to measuring language aptitude, it is important to conduct a carefully designed pre- and post-instruction study in order to argue that a L1 relearning effect is found for L1 features learned in classrooms. Also, it would be advantageous to test the effect of classroom instruction on different types of L1 knowledge to see whether heritage speakers relearn early-acquired L1 features or features that are incompletely acquired in childhood.

7.5 Conclusion

This dissertation investigated the ultimate L1 outcomes among Korean heritage speakers in the United States, in order to better understand the nature of heritage language grammar and the L1 acquisition processes involved. Although it is hard to know what L1 processes these individuals underwent in childhood, the nature of their end-state L1 grammar revealed elements this unique population shares in early L1 development. Through an analysis of the relationship between maturational and non-maturational explanatory variables and the L1 outcome variables, the study suggested that there is a dynamic interplay between the age and input factors during the childhood of heritage language speakers, largely influencing the degree to which L1 acquisition is incomplete. The sufficient condition for L1 acquisition in childhood,

mere exposure to the L1, proved to be a necessary, but not sufficient, condition for L1 acquisition among heritage speakers, due to the reduction in L1 exposure, before the offset of a critical period. As a result, other types of non-maturational variables impacted L1 development. Where language aptitude compensated for reduced L1 input, language attitude was an added hindrance at the stage of reduced L1 input. Therefore, the tremendous variability in heritage speakers' L1 outcomes, particularly witnessed among early attriters of a comparable age when L1 exposure is reduced, can be explained by the non-maturational variables largely interacting with the input factor in early bilingualism.

One of the most significant contributions the current study makes to the knowledge of language acquisition pertains to the role of input in early L1 development. The lack of sufficient input before the offset of a critical period for language learning was shown to have a long-lasting effect on heritage speakers' L1 grammar, resulting in incomplete L1 acquisition. If the previous literature on heritage speakers from the perspective of L1 attrition focused on the aspect of L2-induced changes in L1 grammar, the current study highlighted the importance of age and L1 input dynamics these individuals experience in early bilingualism. The empirical evidence suggested that it is the timing of reduction in L1 input, as well as the quality of L1 input, that largely determines heritage speakers' end-state L1 grammar. Furthermore, the evidence for unbalanced bilingualism witnessed among heritage speakers with ARC 8-15 suggested that there is a narrow window (i.e., between the ages 0 and 7) where a mere change in the language environment would cause L1 shift to occur without exception. While the previous literature on age effects in native-like

L2 attainment among immigrants was focused on the L2 acquired in place of, or in addition to, the L1, the current study found evidence for incomplete L1 outcomes, with or without native-like L2 attainment, among the same population. Therefore, the current study proposes that a critical period for human language learning is not only a narrow window of success for L2 learning, given the ability to acquire a language with mere exposure, but is also a narrow window of success for L1 stabilization, given insufficient exposure.

In addition, the study contributed to the current understanding of the nature of heritage language grammar. The multivariate predictive model provided rational explanations regarding divergent L1 outcomes among heritage speakers, that is, to what extent L1 variability can be explained by non-maturational variables, above and beyond maturational variables. If previous studies on heritage learners' advantage over L2 learners focused on how heritage speakers' L1 grammar benefits from early exposure to the L1, the current study further revealed what specific aspects of the age and early input factors selectively affect their L1 grammar. Furthermore, the multivariate predictive model suggested that the selective outcomes in heritage speakers' L1 grammar observed within individual learners are not attributable to random variance, but are also a function of maturational and non-maturational variables. Therefore, the current study concludes that the degree of incomplete L1 knowledge in heritage speakers, as well as the types of L1 knowledge that heritage speakers are likely to acquire incompletely, are to a great extent, predictable and explainable.

The linguistic portraits of heritage speakers' L1 grammar will also be of a great pedagogical significance. They will serve a useful purpose for educators or curriculum developers for heritage languages in understanding the weaknesses and strengths in heritage speaker's L1 grammar, as well as in developing separate tracks for heritage speakers at universities. Textbooks for heritage speakers should also be developed based on such understanding of their L1 grammar and linguistics needs. Many college language classrooms for heritage speakers may focus on reading and writing skills, as an attempt to supplement their lack of literacy, but more emphasis should be placed on eliciting oral production, which enables them to push beyond their receptive skills in an early-acquired language. Furthermore, heritage speakers will benefit greatly from learning and practicing the target-like use of morphology that involves optional marking and semantic ambiguity, and of low-frequency lexis, introduced through authentic tasks. Teachers need to be attentive to their frequent morphological or lexical errors for the purpose of providing corrective feedback in class. Needless to say, the linguistic portraits of heritage speakers' L1 grammar will also benefit heritage speakers themselves, as well as the parents of early bilingual speakers of a heritage language, who are typically not informed of the processes and outcomes involved in heritage speakers' early experience with their childhood language.

Appendices

Appendix A. The language experience questionnaire

1. Questions related to the age variables:

- 1) When and where were you born?
- 2) What language did your caregiver(s) speak when you were an infant?
- 3) At what age did you/your parent(s) came to live in the U.S.?
- 4) At what age did you first attend preschool/kindergarten in the U.S., if ever?
- 5) And what was the language spoken at the preschool/kindergarten?
- 6) At what age were you first exposed to Korean? And to English?
- 7) At what age did you become fluent in Korean? And in English?
- 8) At what age did you begin to read and write in Korean? And in English?
- 9) At what age were you first drastically reduced in exposure to Korean?
- 10) At what age were you first drastically reduced in the use of Korean?
- 11) At what age did you become more fluent in English than in Korean, if ever?

2. Questions related to the input variables:

- 1) List all the country/city you have resided in order and the duration of your residence.
- 2) List the time/duration of your visit to Korea.
- 3) Rate the amount of your exposure to Korean at home, in childhood and at present.
- 4) Rate the amount of your use of Korean at home, in childhood and at present.
- 5) Rate the amount of your Korean media exposure (e.g., internet, TV, music, news, radio), in childhood and at present.
- 6) Rate the amount of your use of Korean with peers, in childhood and at present.
- 7) Rate the amount of your use of Korea for study/work, in childhood and at present.
- 8) Rate the amount of your use of Korean for other activities (e.g., church), in childhood and at present.

(Rating scale 0-10: 0 = none, 2 = seldom, 5 = half of the occasions, 8 = often, 10 = always)

3. Questions related to language learning variables

- 1) What is your native language?
- 2) List all other languages you speak in order of fluency.
- 3) Rate your fluency in both Korean and English, in each of the four major skills, i.e., listening, speaking, reading, and writing.
- 4) Rate your father's fluency in both Korean and English.
- 5) Rate your mother's fluency in both Korean and English.
- 6) Rate all your sibling's fluency in both Korean and English
- 7) List all types and duration of schooling in Korea, if any.
- 8) List all types and duration of Korean Sunday schools in the U.S., if any.
- 9) List all types and duration of other Korean tutoring in the U.S., if any.
- 10) List all types and duration of Korean instruction in college, if any.

(Rating scale: 0 = none, 1 = low-elementary, 2 = elementary, 3 = high-elementary, 4 = low-intermediate, 5 = intermediate, 6 = high-intermediate, 7 = advanced, 8 = high-advanced, 9 = near-native, 10 = native-like)

4. Questions related to the attitudinal variables:

- 1) Rate your attitude towards retaining Korean for identity construction.
- 2) Rate your attitude towards retaining Korean for family connection.
- 3) Rate your attitude towards retaining Korean for cultural connection.
- 4) Rate your attitude towards retaining Korean for socializing.
- 5) Rate your parental attitude towards retaining Korean for your identity construction.
- 6) Rate your parental attitude towards retaining Korean for your family connection.
- 7) Rate your parental attitude towards retaining Korean for your cultural connection.
- 8) Rate your parental attitude towards retaining Korean for your socializing.
- 9) Rate the importance of speaking Korean for your communication with family.
- 10) Rate the importance of speaking Korean for your communication with peers.
- 11) Rate the importance of speaking Korean for your future career.
- 12) Rate the importance of speaking Korean for your future family.

(Rating scale 0-10: 0 = very negative, 2 = negative, 5 = neutral, 8 = positive, 10 = very positive)

5. Questions related to the ethnic identity variables:
- 1) I have a clear sense of my ethnic background as Korean and what it means for me.
 - 2) I am active in Korean organizations or social groups that include mostly members of my own ethnic group (e.g., small group bible study, fraternities).
 - 3) I like to hang out with members of my own ethnic group.
 - 4) I prefer to date or marry someone who belongs to the same ethnic background.
 - 5) I like to participate in Korean cultural practices, regarding food, customs, and manners.
 - 6) I have often talked to other people about my ethnic background, to learn more about it.
 - 7) I have spent time trying to learn more about Korean history, traditions, and culture.
 - 8) I have been trying hard to maintain my heritage language and identity.
 - 9) I feel good about having Korean cultural or ethnic background.
 - 10) I am proud to belong to Korean ethnic group
 - 11) I am confident to tell a stranger that my parents are from Korea.
 - 12) Given another chance, I wish to be born as Korean again.

(Rating scale 1-6: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = somewhat agree, 5 = agree, 6 = strongly agree)

Appendix B. The item list for grammaticality judgment test

Target features	Grammatical items	Ungrammatical items	
		Condition 1 <i>Semantic error</i>	Condition 2 <i>Morphophonological error</i>
<p>Case marking:</p> <p><i>nominative (N)</i> -이가 <i>accusative (A)</i> -을/를</p>	<p>언니가 중국에서 일해요. N 이 초코렛 누가 줬어? N 하루 종일 비가 왔어요. N 난 빵보다 밥이 좋아. N 훌륭한 사람이 되고 싶어. N 맵고 짠 음식을 싫어해. A 아이들에게 사탕을 줬어요. A 주말에 드라마를 봐요. A 주로 한국 가요를 들어요. A 학원에서 골프를 가르쳐요. A</p>	<p>어제 친척들을 집에 왔어요. N 제 눈이 똑바로 보세요. A 그는 유명한 작가를 되었어요. N 요즘 어떤 음악이 들어요? A 전 고기를 정말 좋아요. N</p>	<p>제 친구이 식당에서 일해요. N 전 소주를 참 싫어해요. A 착한 아이에게 상을 줘요 A 하얀 눈가 펄펄 왔어요. N 학생들에게 영어을 가르쳐요 A</p>
<p>Tense marking:</p> <p><i>present (R)</i> 어/아 <i>past (A)</i> 았/았/했</p>	<p>아침에 씨리얼을 먹어요. R 비 오는 거리를 자주 걸어요. R 우리 강아지가 목욕을 해요. R 요즘 스트레스를 많이 받아. R 시원한 음료수를 마셔요. R 형이 스무디를 만들었어요. A 백화점에서 구두를 샀어요. A 그 책을 벌써 다 읽었어요. A 어릴 적에 수영을 배웠어요 A 부엌에서 딸기를 씻었어요. A</p>	<p>누나는 아까 아침을 먹어요. A 전 아직도 만화책을 읽었어요. P 어제 친구와 공원을 걸어요. A 지난 학기에 을 A 를 받아요. A 전 매일 아침에 물을 마셨어요. P</p>	<p>보통 시장에서 과일을 사어요. P 자기 전에 숙제를 다 했어요. A 종이로 컵을 만들었어요. A 요즘 친구와 요가를 배와요. P 손을 항상 깨끗이 씻어요 P</p>
<p>Aspect marking:</p> <p><i>progressive (P)</i> 고 있 <i>resultative (R)</i> 어/아 있</p>	<p>긴 치마를 입고 있어요. P 까만 모자를 쓰고 있어요. P 바구니를 들고 있어요. P 내 손을 꼭 잡고 있어. P 동생이 인형을 안고 있어요. P 그 자리에 가만히 서 있어. R 지금 바닥에 누워 있어요. R 먼저 저 쪽에 가 있어. R 문이 반쯤 열려 있어요. R 다리가 항상 부어 있어요. R</p>	<p>파란 셔츠를 입어 있어요. R 빨 테 안경을 써 있어요. R 무거운 가방을 들어 있어요. R 뺨줄을 잡아 있어요. R 사람들이 서로 안아 있어요. R</p>	<p>사람들이 모두 서아 있어요. P. 아프면 가만히 누와 있어요. .P 거기에 먼저 가어 있어요. P 캔 뚜껑이 열라 있어요. P 얼굴이 퉁퉁 부아 있어요. P</p>

<p>Passive and causative construction:</p> <p><i>passive (P)</i> 이/히/리/기 <i>causative (C)</i> 이/히/리/기</p>	<p>별이 아주 잘 보여요. P 문이 저절로 닫혔어요. P 전 모기한테 잘 물려요. P 옆집에서 싸우는 소리가 들려. P 달려가 엄마 품에 안겼어요. P 아기에게 분유를 먹여요. C 엄마가 용돈을 반으로 줄였어. C 이 책을 아이에게 읽히세요. C 나라에서 세금을 또 올렸어요. C 책장을 책상 옆으로 옮겨. C</p>	<p>오늘 따라 책이 술술 읽어요. P 개한테 뼈다귀를 물어요 C 바다 같은 제 품에 안으세요 P 바람에 창문이 그만 닫았어요. P 바지 길이를 조금 줄었어요. C</p>	<p>니모가 상어한테 잡아먹겼어. P 멀리서 두 사람이 보려요. P 네가 만든 음악을 들려줘. C 더우면 머리를 옮기세요. C 누나가 감기를 나한테 옮겼어. C</p>
<p>Relative clause construction:</p> <p><i>present (P)</i> 니/은/는 <i>past (A)</i> 니/은</p>	<p>아침을 먹는 습관을 들이세요. R 제가 아는 식당으로 가요. R 여기가 내가 다니는 학교야. R 난 머리가 좋은 사람이 부러워. R 키가 큰 아저씨를 봤어요. R 제가 산 목걸이가 없어졌어요. A 마신 컵은 제 자리에 두세요. A 작년에 받은 생일 선물이야. A 어제 본 걸 다 말해 봐요. A 예전에 잠시 만난 친구예요. A</p>	<p>다 먹는 음식을 치우세요. A 어제 사는 옷을 바꾸러 가요. A 지금 다닌 회사가 어디야? R 내가 어릴 때 받는 상장이야. R 전 마당이 크는 집에 살아요. R</p>	<p>아직 안 사람이 별로 없어. R 술을 마시은 다음날은 힘들어. A 성격이 좋은 남자를 만나세요. R 이 영화 이미 보은 사람 있니? A 홍콩에서 만나은 친구들이야. A</p>
<p>Conjunctive construction:</p> <p><i>causal (C)</i> 어/아서 <i>intensive (I)</i> 으/러 으/려고</p>	<p>눈이 많이 와서 집에 있어요. C 하루 종일 일해서 피곤해요. C 아이가 울어서 사탕을 줬어요. C CF를 찍어서 부자가 됐어요. C 길을 몰라서 많이 헤맸어. C 책을 빌리러 도서관에 왔어요. I 이를 닦으러 화장실에 가요. I 널 주려고 이걸 만들었어. I 도움을 받으려고 찾아왔어요. I 지금 그 말 하려고 온 거야? I</p>	<p>비가 오려고 가방이 젖었어요. C 눈물을 닦아서 수건을 꺼내요. I 많이 울으러 눈이 부었어요. C 칭찬을 받으러 기분이 좋아. C 부모님을 이해해서 노력했어요. I</p>	<p>전 아침 일찍 일해러 가요. I 시간을 내 주아서 고마워. C 사진을 찍려고 디카를 샀어요. I 답을 물러서 찢찢맸어요. C 의자를 빌리으러 옆집에 가요. I</p>

Appendix C. The item list for collocation test

Target features	Items	Contexts	Target-like condition	Non-target-like condition
Wear-verbs	두르다 걸치다 쓰다 입다 신다 끼다 매다 차다 달다 꽂다	Apron Outwear Hat Pants Shoes Glasses Belt Watch Ribbon Pin	앞치마를 둘러요. 코트를 걸쳐요. 가발을 써요. 치마를 입어요. 스타킹을 신어요. 렌즈를 끼요. 넥타이를 매요. 시계를 차요. 리본을 달아요. 머리 핀을 꽂아요.	잠바를 둘러요. (→ 입다) 렌즈를 걸쳐요. (→ 끼다) 양말을 써요. (→ 신다) 벨트를 입어요. (→ 매다) 장갑을 신어요. (→ 끼다) 모자를 끼요. (→ 쓰다) 반지를 매요. (→ 끼다) 안경을 차요. (→ 쓰다) 스카프를 달아요. (→ 매다) 목걸이를 꽂아요. (→ 하다)
Ideophonic words	고래고래 재잘재잘 보글보글 쿵닥쿵닥 쌩득쌩득 쌌근쌌근 무럭무럭 아장아장 데굴데굴 보슬보슬	to shout to talk to boil to beat to cut to sleep to grow to walk to roll to fall	고함을 고래고래 질러요. 아이들이 재잘재잘 얘기해요. 찌개가 보글보글 끓어요. 가슴이 쿵닥쿵닥 뛰어요. 머리를 쌩득쌩득 잘라요. 갓난 아기가 쌌근쌌근 자요. 키가 무럭무럭 자라요. 우리 아이가 아장아장 걸어요. 길에서 데굴데굴 굴러요. 비가 보슬보슬 내려요.	소리를 펄럭펄럭 질러요. (펄럭펄럭 is for flying) 그는 항상 어적어적 얘기해요. (어적어적 is for eating) 물이 와들와들 끓어요. (와들와들 is for shivering) 제 심장이 깜빡깜빡 뛰어요. (깜빡깜빡 is for blinking) 형짚을 속닥속닥 잘라요. (속닥속닥 is for whispering) 오빠가 쿨럭쿨럭 자요. (쿨럭쿨럭 is for coughing) 나무가 주룩주룩 자라요. (주룩주룩 is for raining) 언니가 강총강총 걸어요. (강총강총 is for jumping) 바닥에서 개굴개굴 굴러요. (개굴개굴 is for croaking) 눈이 반짝반짝 내려요. (반짝반짝 is for twinkling)
Numeral construction	Native# 살 Native# 시/분 Native# 달 Native# 시간	Age Time Month Hour	저희 선생님은 마흔 두 살이에요. 지금 파리는 두 시 반이에요. 이사는 지 석 달이 되었어요. 세 시간 반 만에 다 했어요.	저는 올해 십 구 살이에요. 두 시 열한 분에 미팅이 있어. 여기서 산 지 십 달 됐어요. 그를 팔 시간 동안 기다렸어요.

	Native# 번 Sino# 년 Sino# 월/일 Sino# 동/호 Sino# 번 Sino#원	Time Year Date Address Number Price	전 그 영화를 네 번 봤어요. 영어를 공부한 지 육 년 됐어. 시월 구 일은 한글의 날이에요. 전 이 동 백삼 호에 살아요. 핸드폰에 칠 번을 누르세요 정장을 십만 원 주고 장만했어.	전 유럽에 삼 번 가봤어요. 외국에서 일곱 년을 살았어요. 생일이 일월 스물 이 일이에요. 전 열 다섯 동으로 이사가요. 문제 두 번이 제일 어려워요. 그릇 하나가 일곱 만 원이에요.
Classifier construction	컬레 권 잔 송이 대 명 병 마리 장 그릇	Pair Book Cup Flower Piano Person Bottle Animal Paper Dishes	운동화 두 컬레를 샀어요. 책 아홉 권을 빌렸어요. 여기 커피 세 잔 주세요. 장미꽃 열 송이를 선물 받았어. 어제 피아노 여덟 대를 팔았어. 여자 친구가 여섯 명 있었어요. 혼자서 물 다섯 병이나 마셨어. 예전에 토끼 네 마리를 키웠어. 기말 보고서 열 네 장을 썼어요. 짜장면 세 그릇을 먹었어요.	내 양말 두 패를 가져갔다. 책상에 잡지 네 장이 있어요. 소주 다섯 컵을 주문했다. 장미꽃 한 개비가 예쁘게 폈어. 주차장에 차 아홉 채가 있어요. 여학생이 네 분 있어요. 슈퍼에서 맥주 다섯 갑을 샀어. 미나는 고양이 세 컷을 키워요. 종이 두 쪽만 주세요. 국을 한 공기도 안 먹었어.
Serial predicates	집어먹다 따라붙다 파묻다 때려부수다 잡아가다 쫓아오다 뛰어내리다 올라타다 사주다 돌아보다	Pick eat Follow stick Dig bury Hit destroy Catch go Chase come Jump fall Climb ride Buy give Turn see	과일을 집어먹어요. 파파라치가 자꾸 따라붙어요. 시체를 땅에 파묻었어요. 오래 된 집을 때려부쉬요. 사람들이 그를 잡아가요. 누가 날 계속 쫓아와요 저 밑으로 뛰어내리세요. 그가 구름 위에 올라타요 남친한테 초코릿을 사줬어. 어린 시절을 돌아봐요.	어서 저 차를 붙어따라 돈을 여기다 퍼묻자. 건물을 모두 부숴대려요. 어서 차에 타올라요. 그냥 손으로 집어먹어. 경찰이 도둑놈을 잡아가요. 차 한 대가 쫓아와요. 높은 데서 뛰어내렸어요. 나 이거 한 개만 줘사. 뒤를 한번 봐돌아요.

Appendix D. The item list for receptive vocabulary size test

1000-word level	Target items	English meaning	Sample sentences
1	관계 관심 부작용 영향 문화 요구하다 진지하다 솔직하다 변하다 빌리다	relationship interest side effects influence culture to demand to be serious to be honest to change to borrow	관계가 좋아지다 관심을 보인다 부작용이 없다 영향을 받다 문화를 공부하다 돈을 요구하다 사람이 진지하다 넌 참 솔직하다 성격이 변하다 책을 빌리다
2	평균 표정 정보 피해 상대적 비판하다 실수하다 복잡하다 궁금하다 참신하다	average expression information damage relative to criticize to make a mistake to be complicated to be curious to be creative	평균을 내다 표정을 짓다 정보가 많다 피해가 크다 행복은 상대적이다 정부를 비판하다 큰 실수하다 생각이 복잡하다 장학금을 신청하다 생각이 참신하다
3	무대 흥미 두려움 한창 속도 식상하다 감당하다 위반하다 편집하다 개발하다	stage interest fear at the peak speed to be a cliché to handle to violate to edit to develop	무대에 서다 흥미를 잃다 두려움을 끼다 한창 뜨고 있다 속도를 내다 내용이 식상하다 모든 걸 감당하다 신호를 위반하다 사진을 편집하다 도시를 개발하다

4	증세 주의 체중 시차 줄거리 흐뭇해하다 특이하다 초대하다 싹트다 탓하다	symptom attention weight time difference synopsis to be content to be unique to invite to sprout to blame	증세가 나타나다 주의를 기울이다 체중이 늘다 시차가 난다 줄거리를 모른다 무척 흐뭇해하다 버릇이 특이하다 집으로 초대하다 사랑이 싹트다 남을 탓하다
5	열의 후식 산상품 중고차 자유 과대평가하다 버벅거리다 응원하다 후련하다 증가하다	passion dessert new product used car freedom to overestimate to stutter to cheer to be relieved to increase	열의가 넘친다 후식을 먹다 신상품이 나왔다 중고차를 샀다 자유를 되찾다 실력을 과대평가하다 말을 버벅거리다 우리나라를 응원하다 속이 후련하다 인구가 증가하다
6	목숨 서서히 선택 사흘 명령 진실 편리하다 담당하다 돌보다 기여하다	life slowly choice the fourth day order truth to be convenient to take charge of to take care of to contribute	목숨을 걸다 서서히 변하다 선택에 달리다 사흘 걸린다 명령을 내리다 진실을 밝히다 사용이 편리하다 업무를 담당하다 남을 돌보다 사회에 기여하다

7	무료 벌금 핑계 자신감 재능 인정받다 반복되다 속이다 싱싱하다 그립다	free of charge fine excuse confidence talents to be recognized to repeat to deceive to be fresh to miss	입장이 무료다 벌금을 내다 핑계를 대다 자신감을 갖다 재능이 많다 사람들에게 인정받다 실수가 반복되다 자신을 속이다 야채가 싱싱하다 옛날이 그립다
8	단백질 치아 미혼이다 대안 결실 요약하다 계획하다 공경하다 칭찬하다 금지하다	protein teeth single alternative outcome to summarize to plan to respect to compliment to ban	단백질이 부족하다 치아가 고르다 아직 미혼이다 대안을 찾다 결실을 맺다 읽고 요약하다 여행을 계획하다 부모를 공경하다 남을 칭찬하다 사용을 금지하다
9	소지품 자격증 두통 미모 지진 고백하다 목격하다 붐비다 지도하다 거르다	possessions certificate headache beauty earthquake to confess to witness to be crowded to supervise to skip	소지품을 챙기다 자격증을 따다 두통이 심하다 미모가 뛰어나다 지진이 일어나다 사랑을 고백하다 현장을 목격하다 사람들로 붐비다 학생을 지도하다 식사를 거르다

10	경비 과장 게시판 귀가 고난 저장하다 침착하다 기증하다 변경하다 타락하다	security guard exaggeration board going home suffering to save to be calm to donate to alter to be corrupt	경비를 부르다 과장이 심하다 게시판에 올리다 귀가할 시간이다 고난을 겪다 문서를 저장하다 항상 침착하다 간을 기증하다 날짜를 변경하다 세상이 타락하다
11	사투리 식욕 결말 연민 장모님 보수적 흡사하다 주저하다 닿다 거슬리다	dialect appetite the ending sympathy mother-in-law □conservative to resemble to hesitate to be worn to be irritating	사투리가 심하다 식욕이 왕성하다 결말을 모르다 연민을 느끼다 장모님을 뵈다 생각이 보수적이다 매우 흡사하다 잠시 주저하다 물건이 닿다 눈에 거슬리다
12	공백 조언 면접 유죄 실마리 은퇴하다 정복하다 무례하다 투덜거리다 외출하다	time gap advice interview guilt clue to retire to conquer to be rude to grumble to go out	공백이 길다 조언을 해주다 면접을 보다 유죄로 판결 나다 실마리를 찾았다 곧 은퇴한다 땅을 정복하다 너무 무례하다 항상 투덜거리다 오늘 외출한다

13	작별 설계도 경사 모녀 막바지 추측하다 되뇌다 초과하다 수집하다 뒤처지다	farewell blueprint good news mother-daughter the very last to predict to remind to exceed to collect to lag behind	작별을 고하다 설계도를 그리다 경사가 났다 모녀 지간이다 막바지에 이르다 결과를 추측하다 혼자 되뇌다 무게를 초과하다 음반을 수집하다 실력이 뒤처지다
14	신분증 실업자 의사소통 가전제품 열량 비겁하다 배달하다 예약하다 낭비하다 오해하다	ID unemployed person communication electronics calories to be a coward to deliver to reserve to waste to misunderstand	신분증을 보여주다 실업자가 늘었다 의사소통이 안된다 가전제품을 구입하다 열량을 소모하다 넌 정말 비겁하다 음식을 배달하다 자리를 예약하다 물을 낭비하다 자주 오해하다

Bibliography

- Abrahamsson, N., & Hyltenstam, K. (2008). The robustness of aptitude effects in near-native second language acquisition. *Studies in Second Language Acquisition, 30*, 481-509.
- Abrahamsson, N. & Hyltenstam, K. (2009). Age of acquisition and nativelikeness in a second language: Listener perception vs. linguistic scrutiny. *Language Learning, 59* (2), 249-306.
- Adams, A. M., Bourke, L., & Willis, C. (1999). Working memory and spoken language comprehension in young children. *International Journal of Psychology, 34*, 364-373.
- Adams, A.-M. & Gathercole, S. E. (1996). Phonological working memory and spoken language development in children. *Quarterly Journal of Experimental Psychology, 49*, 216-233
- Albirini, A., Benmamoun, E., & Saadah, E. (2011). Grammatical features of Egyptian and Palestinian Arabic heritage speakers' oral production. *Studies in Second Language Acquisition, 33*, 273-303.
- Altenberg, E.P. (1991). Assessing first language vulnerability to attrition . In H. W. Seliger & R. M. Vago (Eds.), *First language attrition* (pp. 189-206). Cambridge: Cambridge University Press.
- Andersen, R. W. (1982). Determining the linguistic attributes of language attrition. In R. D. Lambert and B. F. Freed (Eds.), *The loss of language skills* (pp. 83-117). Rowley, MA: Newbury House.
- Anderson, R. W. (1999). Noun phrase gender agreement in language attrition.

- Preliminary results. *Bilingual Research Journal*, 23, 318-37
- Anderson, R. W, (2001). Lexical morphology and verb use in child first language loss. A preliminary case study investigation. *International Journal of Bilingualism*, 5, 377-401.
- Au, T, Knightly, L. Jun, S. & Oh, J. (2002). Overhearing a language during childhood. *Psychological Science*, 13, 238-243.
- Au, T., Knightly, L., Jun, S., Oh, J., & Romo, L (2008). Salvaging a childhood language. *Journal of Memory and Language*, 58, 998-1011.
- Baddeley, A. D. (2007). *Working memory, thought, and action*. Oxford Psychology Series, Oxford University Press.
- Bardovi-Harlig, K., & Stringer, D. (2011). The lexicon in second language attrition: What happens when the cat's got your tongue? In J. Altarriba and L. Isurin (Eds.), *Memory, language, and bilingualism: Theoretical and applied approaches*. Cambridge: Cambridge University Press.
- Bar-Shalom, E. & E. Zaretsky. (2008) . Selective attrition in Russian-English bilingual children: preservation of grammatical aspect. *International Journal of Bilingualism* 12, 281-302.
- Beglar, D. (2010). A Rasch-based validation of the vocabulary size test. *Language Testing*, 27, 101-118.
- Ben-Rafael, M. & Schmid, M. S. (2007). Language attrition and ideology: Two groups of immigrants in Israel. In Köpke, B., Schmid, M. S., Keijzer, M., and Dostert, S., (Eds), *Language attrition: Theoretical Perspectives*, Amsterdam/Philadelphia: John Benjamins, 205-226.

- Berko-Gleason, J. (1982). Insights from child language acquisition for second language loss. In R.D. Lambert & B. F. Freed (Eds.), *The loss of language skills*. Rowley, MA: Newbury House
- Berman, R. A. & Olshtain, E. (1983). Features of first language transfer in second language attrition. *Applied Linguistics*, 4, 222–234.
- Blake, R. (1983). Mood selection among Spanish-speaking children, ages 4 to 12. *The Bilingual Review* 10, 21–32.
- Bley-Vroman, R. (1989). ‘What is the logical problem of foreign language learning?’ in Gass S. and J. Schachter (eds): *Linguistic Perspectives on Second Language Acquisition*. Cambridge University Press, pp. 41–68.
- Bolonyai, A. (2007). (In)vulnerable agreement in incomplete bilingual L1 learners. *The International Journal of Bilingualism* 11, 3–21.
- Bruhn de Garavito, J. (2002). Verb raising in Spanish, a comparison of early and late bilinguals. *Proceedings of the 26th Annual Boston University Conference on Language Development* (pp. 84–94). Somerville: Cascadilla Press.
- Bylund, E. (2009a). Maturation constraints and first language attrition. *Language Learning*, 59, 3, 687-715
- Bylund, E. (2009b). Effects of age of L2 acquisition on L1 event conceptualization patterns. *Bilingualism: Language and Cognition*, 12, 305-322.
- Bylund, Abrahamsson, & Hyltenstam, (2009). The role of language aptitude in first language attrition: The case of pre-pubescent attriters. *Applied Linguistics*, 1-22
- Carroll, J. B. (1973). Implications of aptitude test research and psycholinguistic

- theory for foreign language teaching. *Linguistics*, 112, 5-13.
- Chinen, K. & Tucker, G. R. (2005). Heritage language development: Understanding the roles of ethnic identity and Saturday school participation. *Heritage Language Journal*, 3, 27-59.
- Christoffels, I.K., de Groot A.M.B., & Kroll, J.F. (2006). Memory and language skills in simultaneous interpreting: Expertise and language proficiency. *Journal of Memory and Language*, 54, 324-345.
- Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review*, 12, 769-786.
- Cromdal, J. (1999). Childhood bilingualism and metalinguistic skills: Analysis and control in young Swedish-English bilinguals. *Applied Psycholinguistics*, 20, 1-20.
- Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research*, 49, 222-251.
- de Bot, K. & Weltens, B. (1991). Recapitulation, regression, and language loss. In H.Seliger & R.Vago (Eds.), *First language attrition: Structural and theoretical perspectives* (pp. 31-51). Cambridge: Cambridge University Press.
- de Groot, C. (2005). The grammars of Hungarian outside Hungary from a linguistic typological perspective. In A. Fenyvesi (Ed.), *Hungarian language contact outside Hungary* (pp. 351-370). Amsterdam: John Benjamins.
- de Leeuw, E., Schmid, M., & Mennen, I. (2010). The effects of contact on native language pronunciation in an L2 migrant context. *Bilingualism: Language and*

Cognition, 13, 33–40.

- DeKeyser, R. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition* 22, 499–534.
- DeKeyser, R. (2003). Implicit and explicit learning. In C. Doughty & M. Long (Eds.), *The handbook of second language acquisition* (pp. 313–348). Malden, MA: Blackwell.
- Dijkstra, A.F.J., Van Jaarsveld, H.J., & Ten Brinke, S. (1998). Interlingual homograph recognition: Effects of task demands and language intermixing. *Bilingualism: Language and Cognition*, 1, 51-66.
- Dörnyei, Z. and Skehan, P. (2003). Individual differences in second language learning. In Doughty C. and M. Long (eds): *Handbook of Second Language Acquisition*. Blackwell, pp. 612–30.
- Durrant, P. & Schmitt, N. (2010). Ault learners' retention of collocations from exposure. *Second Language Research* 26, 163-188.
- Ellis, N. C. (2005). At the interface. Dynamic interactions of implicit and explicit language knowledge. *Studies in Second Language Acquisition*, 27: 305-352.
- Ellis, N. C., & Sinclair, S. (1996). Working memory in the acquisition of vocabulary and syntax. *Quarterly Journal of Experimental Psychology*, 49, 234-250.
- Elman, J. L. (1993). Language and development in neural networks: The importance of starting small. *Cognition*, 48, 71-99.
- Flege, J. E., Yeni-Komshian, G. H., and Liu, S. (1999). Age constraints on second-language acquisition. *Journal of Memory and Language*, 41, 78-104.
- Francis, N. (2005). Research findings on early L1 attrition: Implications for

- discussion on critical periods in language acquisition. *Language Learning*, 55, 491-531.
- French, L. (2006). *Phonological working memory and second language acquisition: A developmental study of Francophone children learning English in Quebec*. Lewiston, NY: Edwin Mellen Press.
- French, L., & O'Brien, I. (2008). Phonological memory and children's second language grammar learning. *Applied Psycholinguistics*, 29(3), 463-487.
- Gardner, R. C. (1985). *Social psychology and second language learning: The role of attitudes and motivation*. London: Edward Arnold.
- Gathercole, S. E., Pickering, S. J., Hall, M., & Peaker, S. M. (2001). Dissociable lexical and phonological influences on serial recognition and serial recall. *Quarterly Journal of Experimental Psychology*, 54, 1-30.
- Gathercole, S. E., Willis, C. S., Emslie, H., & Baddeley, A. D. (1992). Phonological memory and vocabulary development during the early school years: A longitudinal study. *Developmental Psychology*, 28, 887-898.
- Gupol (2009). The acquisition of Russian verbal morphosyntax in Russian Hebrew bilingual children. (Unpublished doctoral dissertation). Bar-Ilan University.
- Gürel, A. (2008). Research on first language attrition of morphosyntax. *Second Language Research*, 24, 431-449.
- Hakuta, K. & D'Andrea, D. (1992). Some properties of bilingual maintenance and loss in Mexican background high-school students. *Applied Linguistics*, 13, 72-99.
- Hamers, J. F. and Blanc, M. H. A. (2000). *Bilinguality and Bilingualism* (2nd edition)

Cambridge: Cambridge University Press

- Harley, B. and D. Hart. (1997). Language aptitude and second language proficiency in classroom learners of different starting ages. *Studies in Second Language Acquisition*, 19, 379-400.
- Harley, B. and D. Hart. (2002). Age, aptitude, and second language learning on a bilingual exchange in Robinson P. (Ed.): *Individual Differences and Instructed Language Learning*. John Benjamins, pp. 302–330.
- Harley, B., & Wang, W. (1997). The critical period hypothesis: Where are we now? In A. de Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 19–51). London: Lawrence Erlbaum.
- Harrington, M.W., & Sawyer, M. (1992). L2 working memory capacity and L2 reading skills. *Studies in Second Language Acquisition*, 14, 1, 25-38.
- Hulsen, M. (2000). Language loss and language processing. Three generations of Dutch migrants in New Zealand. (Unpublished doctoral dissertation). University of Nijmegen, The Netherlands.
- Hummel, K.M. (2009). Aptitude, phonological memory, and second language proficiency in nonnovice adult learners. *Applied Psycholinguistics*, 30, 225-249.
- Jakobson, R. (1941). *Child Language, Aphasia and Phonological Universals*, The Hague: Mouton.
- Jia, G, & Aaronson, D. (2003). A longitudinal study of Chinese children and adolescents learning English in the United States. *Applied Linguistics*, 24, 131-161.

- Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*, 21, 60-99.
- Kanno, K., T. Hasegawa, K. Ikeda, Y. Ito, & Michael H. Long. (2007). Relationships between prior language-learning experience and variation in the linguistic profiles of advanced English-speaking learners of Japanese. In: D. Brinton, O. Kagan, and S. Bauckus (eds.). *Heritage Language Education: A New Field Emerging*, 165-180. New York: Routledge.
- Kang, H.-S. (2010). Negative evidence and its explicitness and positioning in the learning of Korean as a heritage language. *The Modern Language Journal*, 94, 582-599.
- Kareev, Y. (1995). Through a narrow window: Working memory capacity and the detection of covariation. *Cognition*, 56, 263-269.
- Kaufman, D. (2001). Tales of L1 attrition – Evidence from pre-puberty children. In T. Ammerlaan, M. Hulsen, H. Strating, & K. Yağmur (Eds.), *Sociolinguistic and psycholinguistic perspectives on maintenance and loss of minority languages*, (pp. 185-202). Münster: Waxman
- Kaufman, D., & Aronoff, M. (1991). Morphological disintegration and reconstruction in first language attrition. In H.W. Seliger & R.M. Vago (Eds.), *First language attrition* (pp. 175-188). Cambridge: Cambridge University Press.
- Keating, G., Jegerski, J., & VanPatten, B. (2011). Who was walking on the beach? Anaphora resolution in Spanish heritage speakers and adult second language learners. *Studies in Second Language Acquisition* 33, 193-221.

- Keizer, M. (2010). The regression hypothesis as a framework for first language attrition. *Bilingualism: Language and Cognition*, 13, 9-18 .
- Kersten, A.W., & Earles, J. L. (2001). Less really is more for adults learning a miniature artificial language. *Journal of Memory and Language*, 44, 250-273.
- Khattab, G. (2002). VOT Production in English and Arabic bilingual and monolingual children. In D. Parkinson and E. Benmamoun (Eds.), *Perspectives on Arabic linguistics* (pp. 1-38). Amsterdam: John Benjamins.
- Kim, J.-H., Montrul, S. & Yoon, J. (2010). Dominant language influence in acquisition and attrition of binding, Interpretation of the Korean *caki*. *Bilingualism: Language and Cognition*, 13, 73-84
- Kim, S. E., & Seligman, L. D. (2006). The influences of cultural values, ethnic identity, and language use on the mental health of Korean American college students. *Journal of Psychology*, 140, 499-511.
- Knightly, L., S. Jun, J. Oh, and T. Au. (2003). Production benefits of childhood overhearing. *Journal of the Acoustic Society of America*, 114, 465–474.
- Kondo-Brown, K. (Ed.). (2006). *Heritage Language Development. Focus on East Asian Immigrants*. Amsterdam: John Benjamins.
- Köpke, B. (2007). Language attrition at the crossroads of brain, mind, and society. In B. Köpke, M. Schmid, M. Keijzer, & S. Dostert (Eds.), *Language attrition: Theoretical perspectives* (pp. 9–38). Amsterdam: Benjamins.
- Köpke, B. & Schmid, M. S. (2004). First language attrition: The next phase. In M. S. Schmid, B. Köpke, M. Keijzer & L. Weilemar (Eds.), *First Language Attrition: Interdisciplinary perspectives on methodological issues* (pp. 1-43).

Amsterdam: John Benjamins.

- Kupisch, T. & C. Pierantozzi. (2010). Interpreting definite plural subjects: A comparison of German and Italian monolingual and bilingual children. In K. Franich et al. (Eds.). *The Boston University Conference on Language development*, 245-254. Boston: Boston University Press.
- Laleko, O. (2010). *The syntax-pragmatics interface in language loss: Covert restructuring of aspect in Heritage Russian*. (Unpublished doctoral dissertation). University of Minnesota.
- Lee, S.-Y., J. Moon & M. Long. (2009). Linguistic correlates of proficiency in Korean as a second language. *Language Research*, 45, 319-48.
- Lenneberg, E., H. (1967). *Biological foundations of language*. New York: Wiley & Sons.
- Lenneberg, E., H. (1969). On Explaining Language. *Science*, 164, 635-643.
- Long, M. H., Gor, K., & Jackson, S. (2012). Linguistic correlates of proficiency. Proof of concept with ILR 2-3 in Russian. *Studies in Second Language Acquisition*, 33, 4, 2011.
- Mackey, A., Philp, J., Egi, T., Fujii, A., & Tatsumi, T. (2002). Individual differences in working memory, noticing interactional feedback and L2 development. In P. Robinson (Ed.), *Individual differences and instructed language learning* (pp. 181–209). Philadelphia, PA: John Benjamins.
- Masoura, E. V., & Gathercole, S. E. (2005). Phonological short-term memory skills and new word learning in young Greek children. *Memory*, 13, 422-429
- Matsunaga, S. (2003). Instructional needs of college-level learners of Japanese as a

- heritage language: Performance-based analyses. *Heritage Language Journal*, 1, 1.
- Meara, P. (2005). *Llama Language Aptitude Tests. (The Manual)*, University of Wales, Swansea.
- Meara, P. and Johns, G. (1990). Eurocentres vocabulary size test, *Version E1.1/K10*. Zurich: Eurocentres Learning Service.
- Meara, P. & Miralpeix, I. (2006). *Y_LEX: the Swansea Advanced Vocabulary Levels Test. v2.05* Swansea: Lognostics.
- Meisel, J. (2007). The weaker language in early child bilingualism: Acquiring a first language as a second language? *Applied Psycholinguistics*, 28, 495-514.
- Montrul, S. (2002). Incomplete acquisition and attrition of Spanish tense/aspect distinctions in adult bilinguals. *Bilingualism: Language and Cognition* 5, 39-68.
- Montrul, S. (2005). Second language acquisition and first language loss in adult early bilinguals: Exploring differences and similarities. *Second Language Research*, 21, 199-249.
- Montrul, S. (2006). Incomplete acquisition as a feature of L2 and bilingual grammars. In R. Slabakova, S. Montrul, & P. Prévost (Eds.), *Inquiries in linguistic development. In Honor of Lydia White* (pp. 335–360). Amsterdam: John Benjamins.
- Montrul, S. (2008). *Incomplete acquisition in bilingualism. Re-examining the age factor*. Amsterdam: John Benjamins.
- Montrul, S. (2009). Re-examining the Fundamental Difference Hypothesis: What can

- early bilinguals tell us? *Studies in Second Language Acquisition*, 31, 2, 225-257.
- Montrul, S. and Bowles, M. (2010). Is grammar instruction beneficial for heritage language learners? Dative case marking in Spanish. *Heritage Language Journal*, 7, 47-73.
- Montrul, S., Foote, R., and Perpiñán, S. (2008). “Knowledge of wh-movement in Spanish L2 learners and heritage speakers.” In M. Almazán, J. Bruhn de Garavito, and E. Valenzuela (Eds.), *Selected Papers from the 8th Hispanic Linguistics Symposium* (pp. 93-106). Somerville, MA: Cascadilla Press.
- Montrul, S. & T. Ionin. (2010). Transfer effects in the interpretation of definite articles by Spanish heritage speakers. *Bilingualism: Language and Cognition*, 13, 449-473.
- Nation, I. S. P. (2006). How large a vocabulary is needed for reading and writing? *Canadian Modern Language Review*, 63, 59-82.
- Newport, E. (1990). Maturation constraints on language learning. *Cognitive Science*, 14, 11-28.
- Norman W, Shallice T. (1986). Attention to action. In: Davidson, R. J., Schwartz, G.E., & Shapiro, D (Eds). *Consciousness and self regulation: Advances in research and theory*, vol. 4. New York: Plenum, p 1–18.
- Norton, B. (2000). *Identity and language learning: Gender, ethnicity, and educational change*. New York: Pearson Education.
- O’Brien, I., Segalowitz, N., Freed, B, & Collentine, J. (2007). Phonological memory predicts second language oral fluency gains in adults. *Studies in Second*

Language Acquisition 29, 557–581.

- O'Grady, W., Lee, M., & Choo, M. (2001). The acquisition of relative clauses by heritage and non-heritage learners of Korean as a second language. A comparative study. *Journal of Korean Language Education*, 12, 283-294.
- O'Grady, W., Schafer, A. J., Perla, J., Lee, O.-S., & Wieting, J. (2009). A psycholinguistic tool for the assessment of language loss: The HALA project. *Language Documentation & Conservation*, 3, 100-112.
- Oh, J., Jun, S.-A., Knightly, L., & Au, T. (2003). Holding on to childhood language memory. *Cognition*, 86, 53-64.
- Pallier, C. (2007). Critical periods in language acquisition and language attrition. In B. Köpcke, M. S. Schmid, M. Keijzer, & S. Dostert (Eds.), *Language attrition: Theoretical perspectives* (pp. 135-153). Amsterdam/Philadelphia: John Benjamins.
- Pallier, C., Dehaene, S., Poline, J.-B., LeBihan, D., Argenti, A.-M., Dupoux, E. & Mehler, J. (2003). Brain imaging of language plasticity in adopted adults: Can a second language replace the first? *Cerebral Cortex*, 13, 155–161.
- Paradis, M.(2004). *A Neurolinguistic Theory of Bilingualism*. Amsterdam: John Benjamins.
- Paradis, M. (2009). *Declarative and Procedural Determinants of Second Languages*. Amsterdam: John Benjamins.
- Park, H (2011). Linguistic minority children's heritage language learning and identity struggle. (Doctoral dissertation). The University of Wisconsin-Madison, Wisconsin. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3314220).

- Pavlenko, A. (2004). L2 influence and L1 attrition in adult bilingualism. In M. S. Schmid, B. Köpke, M. Keijzer & L. Weilemar (Eds.), *First Language Attrition: Interdisciplinary perspectives on methodological issues* (pp. 47-59). Amsterdam: John Benjamins.
- Pavelenko, A., and Lantolf, J. P (2000). Second language learning as participation and the (re) construction of selves. In J. P. Lantolf (ed.), *Sociocultural Theory and Second Language Learning* (pp. 155-177). Oxford: Oxford University Press.
- Phinney, J. S. (1992). The multigroup ethnic identity measure: A new scale for use with diverse groups. *Journal of Adolescent Research*, 7, 156-176.
- Phinney, J. S., & Ong, A. D. (2007). Conceptualization and measurement of ethnic identity: Current status and future directions. *Journal of Counseling Psychology*, 54, 271-281.
- Pires, A., & Rothman, J. (2009). Acquisition of Brazilian Portuguese in late childhood: Implications for syntactic theory and language change. In Pires, A. & Rothman, J. (Eds.), *Minimalist inquiries into child and adult language acquisition: Case studies across Portuguese*. Berlin/New York: Mouton DeGruyter, pp. 129-154.
- Pitts Cochran, B, McDonald J. L., & Parault, S. J. (1999). Too smart for their own good: The disadvantage of a superior processing capacity for adult language learners. *Journal of Memory and Language*, 41, 30-58.
- Polinsky, M. (2006). Incomplete acquisition: American Russian. *Journal of Slavic Linguistics* 14, 191-262.

- Polinsky, M. (2008). Heritage language narratives. In D. Brinton, O. Kagan, & S. Bauckus (Eds.), *Heritage language education: A new field emerging* (pp. 149-164). New York: Routledge
- Polinsky, M. & Kagan, O. (2007). Heritage languages: In the 'wild' and in the classroom. *Language and Linguistics Compass*, 1, 368-395.
- Ro, Y. (2011). Navigating a bilingual/biliterate childhood: A longitudinal study of three second generation young learners in the U.S. (Doctoral dissertation). University of Illinois at Urbana Champaign, Illinois. Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3430897).
- Rohde, D. L. T., & Plaut, D. C. (1999). Language acquisition in the absence of explicit negative evidence: how important is starting small? *Cognition*, 72, 67-109.
- Ross, S., N. Yoshinaga, & M. Sasaki. (2002). Aptitude-exposure interaction effects on Wh-movement violation detection by pre and post-critical period Japanese bilinguals. In Robinson P. (Ed.), *Individual differences and instructed language learning* (pp. 267-99). John Benjamins.
- Rothman, J. (2007). Heritage speaker competence differences, language change, and input type: Inflected infinitives in heritage Brazilian Portuguese. *The International Journal of Bilingualism* 11, 359-389.
- Schachter, J. (1990). On the issue of completeness in second language acquisition. *Second Language Research* 6, 93-124.
- Schmid, M.S. (2002). *First language attrition, use, and maintenance. The case of German Jews in anglophone countries*. Amsterdam/Philadelphia: John

Benjamins.

Schmid, M. S. (2007). The role of L1 use for L1 attrition. In: B. Köpcke, M. S. Schmid, M. Keijzer and S. Dostert (eds): *Language attrition: Theoretical perspectives* (pp. 135-153). Amsterdam/Philadelphia: John Benjamins.

Schmid, M. S. (2010). Languages at play: The relevance of L1 attrition to the study of bilingualism. *Bilingualism: Language and Cognition*, 13, 1-7.

Schmid, M. S. and Dusseldorp, E. (2010). Quantitative analysis in a multivariate study of language attrition: The impact of extralinguistic factors. *Second Language Research*, 26, 125-160.

Schumann, J. H. (1997). *The Neurobiology of Affect in Language*. Malden, MA: Blackwell.

Seliger, H.W. (1989). Deterioration and creativity in childhood bilingualism. In K. Hyltenstam and L.K. Obler (Eds.), *Bilingualism Across the Lifespan* (pp. 173-184). Cambridge: Cambridge University Press.

Service, E., & Kohonen, V. (1995). Is the relationship between phonological memory and foreign language learning accounted for by vocabulary acquisition? *Applied Psycholinguistics*, 16, 155–172.

Sharwood Smith, M.A. (1983). On first language loss in the second language acquirer. In S. Gass and L. Selinker (Eds.), *Language transfer in language learning* (pp. 222 – 231). Rowley: Newbury House.

Sharwood Smith, M., & van Buren, P. (1991). First language attrition and the Parameter setting model. In H.W. Seliger & R.M. Vago (Eds.), *First language attrition* (pp. 17-30). Cambridge: Cambridge University Press.

- Silva-Corvalán, C. (2003). Linguistic consequences of reduced input in bilingual first language acquisition. In S. Montrul & F. Ordóñez (Eds.), *Linguistic theory and language development in Hispanic languages*. Somerville, MA: Cascadilla
- Skehan, P. (1989). *Individual Differences in Second Language Learning*. London: Edward Arnold.
- Skehan, P. (2002). Theorizing and updating aptitude in Robinson P. (ed.): *Individual differences and instructed language learning*. John Benjamins, pp. 69–93.
- Skehan, P., & Ducroquet, L. (1988). A comparison of first and foreign language ability (Working documents No. 8). London: ESOL Department, Institute of Education, London University.
- Song, M., O’Grady, W., Cho, S. & Lee, M. (1997). The learning and teaching of Korean in community schools, *Korean Language in America 2*, 111–127.
- Sorace, A. (1993). Incomplete vs. divergent representations of unaccusativity in native and non-native Italian grammars of Italian. *Second Language Research*, 9, 22-47.
- Sorace, A. (2004). Native language attrition and developmental instability at the syntax-discourse interface: data, interpretations and methods. *Bilingualism: Language and Cognition*, 7, 143-145.
- Sorace, A., & Serratrice, L. (2009). Internal and external interfaces in bilingual language development: Beyond structural overlap. *International Journal of Bilingualism*, 13, 195-210.
- Speciale, G., Ellis, N. C., & Bywater, T. (2004). Phonological sequence learning and

- short-term store capacity determine second language vocabulary acquisition. *Applied Psycholinguistics*, 25, 293–321.
- Sunderman, G. & Kroll, J.F. (2009). When study abroad experience fails to deliver: The internal resources threshold effect. *Applied Psycholinguistics*. 30, 1-21
- Sugaya, N., & Y. Shirai. (2007). The acquisition of progressive and resultative meanings of the imperfective aspect marker by L2 learners of Japanese: Transfer, universal, or multiple factors? *Studies in Second Language Acquisition*, 29, 1-38.
- Unsworth, N., Heitz, R.P., Schrock, J.C., & Engle, R.W. (2005). An automated version of the operation span task. *Behavior Research Methods*, 37, 498-505.
- Valdés, G. (2005). Bilingualism, heritage language learners, and SLA research: opportunities lost or seized? *Modern Language Journal*, 89, 410-426.
- Ventureyra, V., Pallier, C. & Yoo, H. (2004). The loss of first language phonetic perception in adopted Koreans. *Journal of Neurolinguistics*, 17, 79–91.
- Waas, M. (1996). *Language Attrition Downunder*. Frankfurt: Peter Lang.
- Walter, C. (2004). Transfer of reading comprehension skills to L2 is linked mental representations of text and to L2 working memory. *Applied Linguistics*, 25, 315-339.
- Weltens, B., & Marjon G. (1993). Attrition of vocabulary knowledge. In R. Schreuder & B. Weltens (Eds.), *The bilingual lexicon*. Amsterdam: Benjamins.
- Williams, J, N, & Lovatt, P. (2003). Phonological memory and rule learning. *Language Learning*, 53, 67-121.
- Willis, C. S., & Gathercole, S. E. (2001). Phonological short-term memory

- contributions to sentence processing in young children. *Memory*, 9, 349-364.
- Wu, H. (2011). Attitudes and actions of Chinese families toward heritage language maintenance. (Doctoral dissertation), Arizona State University, Arizona.
Retrieved from Dissertations & Theses: Full Text. (Publication No. AAT 3288035).
- Yağmur, K. (1997). *First Language Attrition Among Turkish Speakers in Sydney*.
Tilburg University Press.
- Yeni-Komshian, G. H., Flege, J., E., & Liu, S. (2000). Pronunciation proficiency in the first and second languages of Korean-English bilinguals. *Bilingualism: Language and Cognition*, 3, 131-149.