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The Effect of Age on Second Language Acquisition in Older Adults

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ABSTRACT

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A primary purpose of second language (L2) research is to determine what factors hinder or help L2 acquisition. One aspect that has a strong effect on L2 proficiency is learners' age of onset of acquisition (AOA) (Johnson & Newport, 1989). These studies and others suggest that younger learners are more adept than older learners at learning an L2, especially to a near-native level. However, some older learners can become quite proficient in an L2 (Ioup, et al. 1994; Bialystok, 1997; Bongaerts, 1999), although learners who have acquired the L2 over the age of 30 are rarely studied.

Why is it that some older learners are more adept at learning a second language than others? Some argue cognitive abilities (Hyltenstam & Abrahamsson, 2002; DeKeyser, 2006) while others argue social and affective factors (Moyer, 1999) differ across the lifespan, causing younger learners to achieve a higher proficiency than older learners. Little research, however, has examined both these factors, especially in learners who acquired a language beyond early adulthood. Therefore, the purpose of this study was to determine 1) if there are age effects between groups of older adults learning an L2 and 2) what causes any differences found.

This study examines a variety of both cognitive, affective and demographic factors that have been previously shown to affect language learning. The participants included 38 native Spanish speakers placed into four AOA groups: 10-19, 20-29, 30-39, and over 40. In order to test cognitive factors a working memory task as well as a switch task were included (Abrahamsson, 2012; Paradis, 2009). Other factors were assessed using a survey that inquired about motivation, amount of time using the L1 versus the L2, and musical ability (Slevc & Miyake, 2006). Subjects also participated in an elicited imitation task to assess global proficiency in the L2 (Erlam, 2009).

Results suggest that age effects are found even in older learners. Participants with a younger AOA who spend more time speaking the L2 (English) tended to have greater proficiency in the L2. Attentional control was also a predictor.

Keywords: age of acquisition, second language acquisition, cognitive, affective, demographic, ultimate L2 proficiency

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1. Introduction

Despite over 50 years of investigation, researchers have continually failed to come to a decided conclusion on how age at the time of second language (L2) learning (age of onset of acquisition, or AOA) affects the eventual proficiency level of the learner. AOA refers to the point in time when an individual begins to learn a second language. This can often be the same time that a learner moves to a new country that speaks the L2, but not always. It might refer to immersion classes taken in the home country, and it is also possible that even after immigrating to a new country, an individual continues speaking the first language (L1) for some time. Although most research suggests that "earlier is better," meaning that younger L2 learners are better at learning language than are older learners, the causes of this particular phenomenon continue to be controversial (DeKeyser, 2013). Some researchers believe there is in fact a fundamental difference in the way early learners acquire an L2 versus late learners (Bley-Vroman, 1989), others believe there is a gradual decline in language learning abilities across the lifespan (Bialystok & Hakuta, 1999; Hakuta, Bialystok, & Wiley, 2003), and still others consider the variation to be a difference in motivation and other affective factors (Masgoret & Gardner, 2003). In a statement made almost 20 years ago, Patkowski remarked, "the time has come for the field to accept the notion of an age-related constraint on language acquisition, and for the controversy to circumscribe itself to the discussion of its causes" (Patkowski, 1994, p. 206).

A number of related issues have also been under investigation and this study seeks to explore some of these issues. First, very little research has been done on the L2 learning process of older adults, and, associated with that, few studies have been done on the effects of aging on L2 acquisition across the lifespan. Second, is it still unknown whether demographic, affective, or cognitive factors can best predict learner proficiency and ultimate attainment.

Older adults have myriad reasons that they might want to or need to learn a second language. Some of those reasons include immigration, working as volunteers for the Peace Corps or as missionaries, and working for the military or as public servants (Scott, 1989; Seright, 1985). There is also the possibility, as research has suggested, that learning a second language might "help elderly adults recover language abilities which have been lost or weakened" (Scott, 1989, p. 3; see also Clyne, 1981; and Albert & Obler, 1978). Older immigrants might find themselves in a new country with no knowledge of the host language and therefore must be dependent upon others to communicate for them. They might also have children, grandchildren, or in-laws who, having grown up in the new country, are unable to communicate with them unless they learn the new language (Scott, 1989). This study will seek to better understand L2 learning across the lifespan.

Examining many different factors is essential in understanding AOA effects, and especially in painting a clear picture of the L2 learner. Segalowitz and Freed (2004) explain that there are "dynamic interactions that exist among oral, cognitive, and contextual variables. Such interactions may help explain the enormous individual variation one sees in learning outcomes and they underscore the importance of studying such variables together rather than in isolation" (p. 174). Additionally, Gardner, Tremblay, and Masgoret (1997) discuss how many different studies have talked about the influence of various individual differences (for example, language attitudes, motivation, anxiety, self-confidence, language aptitude, etc.), but "there is a lack of research examining the relationships among all these variables simultaneously" (Gardner et al., 1997, p. 344). This study will seek to examine many different factors that might have an impact on ultimate L2 proficiency. These factors will be grouped into demographic/experiential, affective, and cognitive categories, and are all listed below. Each of these factors will be

explained in depth in Chapters 2 and 3.

- Demographic/Experiential Factors:
  - AOA (age of onset of acquisition)
  - LOR (length of residence)
  - Amount of L2 use
  - Education
  - Employment
- Affective Factors:
  - Motivation
  - Reasons for motivation
  - Social integration
- Cognitive Factors:
  - Musical experience
  - Musical ability
  - Working memory capacity
  - Attentional control

The aim of this study is to compare demographic, affective, and cognitive factors, and to determine which variables are the most influential when learning a second language. Both of the terms “demographic” and “experiential” will be used to talk about the first group of factors. These terms refer to factors that are inherent in a learner's background that they do not necessarily have control over. Affective factors in this study are related to an individual's feelings or emotions regarding the L2 learning experience. Cognitive factors pertain to the mental processes involved in learning a second language.

The participants will be divided into four different AOA groups: 10-19, 20-29, 30-39, and over 40. A control group of native English speakers will also be included where applicable. Only adults over the age of 18 will be tested. The specific research questions this study will seek to address are the following:

1. Do the age groups differ in terms of English proficiency?
2. Do the age groups differ in terms of experiential, affective, and cognitive factors?
3. Which of the cognitive, affective, or demographic/experiential factors best predict the

proficiency scores of the participants?

Chapter 2 will include a review of the literature that has been done in this area up to this point. The methodology for this study will be presented in Chapter 3. Chapter 4 will outline the results obtained, and Chapter 5 will include a discussion of the results, conclusions about the results, and ideas for further research

2. Review of Literature

While most researchers now agree that a learner's AOA plays an important role in L2 learning (Abrahamsson, 2012; Abrahamsson & Hyltenstam, 2009; Bialystok & Hakuta, 1999; Chiswick & Miller, 2008; DeKeyser, 2000, 2013; Flege, Yeni-Komshian, & Liu, 1999; Stevens, 1999), it is still unknown what causes these age effects. At least two specific questions remain. First, it is still unknown whether AOA affects learning throughout the lifespan. Unfortunately few studies compare L2 acquisition of learners throughout the lifespan (especially after the age of 30), and so the answer to this question remains tenuous. Therefore, this study seeks to examine AOA across several age ranges: 10-19, 20-29, 30-39, and over 40.

Second, it is still unclear whether cognitive (e.g., working memory, musical ability, and aptitude), affective (e.g., motivation, social interaction), or experiential (e.g., length of time learning the L2, amount of time speaking the L2) factors are most related to AOA effects. Indeed, though many researchers have looked at cognitive, affective, and experiential factors individually, few if any studies have directly compared all three in the same study to determine the relative importance of these three on age effects and L2 learning. The current study will consider all three factors, and attempt to determine which plays the greatest role in L2 acquisition success among older adults.

Included in this review of literature will be a brief history of AOA and L2 acquisition – including a background on how age affects L2 learning, how age affects various aspects of L2 learning differently, and theories of why age affects L2 learning. There will also be a section on cognitive, affective, and experiential factors in L2 learning, and finally, a brief look at some of the studies that have been done to this point on aging across the lifespan.

2.1 Age and Second Language Acquisition

2.1.1 Age affects L2 learning.

This section will give a general background and look at original or landmark studies of how AOA affects one's ability to learn a language. Countless studies have assessed the relationship between age of L2 acquisition and the ability to learn a second language (Abrahamsson, 2012; Abrahamsson & Hyltenstam, 2009; Bialystok & Hakuta, 1999; Bongaerts, 1999; Chiswick & Miller, 2008; DeKeyser, Alfi-Shabtay, & Ravid, 2010; Flege et al., 1999, 2006; Johnson and Newport, 1989, Stevens, 1999; see Long, 1990 for an early review of studies dealing with L2 learning and maturational constraints, and Hyltenstam & Abrahamsson, 2003 for a more recent review). Some of the earliest researchers to discuss maturational constraints of learning a language in general were Penfield and Roberts in 1959 and Lenneberg in 1967. Lenneberg was specifically looking at studies that dealt with recovering from aphasia, and he was especially interested in the biological factor of language learning. He hypothesized that language learning abilities declined with the hemispheric lateralization of the brain, which was believed to begin around puberty. Lenneberg does touch on foreign language acquisition when he states:

> ...automatic acquisition from mere exposure to a given language seems to disappear [after puberty], and foreign languages have to be taught and learned through a conscious and labored effort... However, a person *can* learn to communicate at the age of forty. This does not trouble our basic hypothesis on age limitation because we may assume that the cerebral organization for language learning as such has taken place during childhood, and since natural languages tend to resemble one another in many fundamental aspects the matrix for language skills is present. (p. 176)

This theory has subsequently come to be known as the Critical Period Hypothesis (CPH) and will be discussed in greater detail in section 2.1.3.1.

Among the literature available on age and L2 acquisition, Johnson and Newport's 1989 report has been, and continues to be, considered a landmark study. Whether or not one agrees with their hypotheses, methodology, or conclusions, their research continues to make an impact on the linguistic world. Johnson and Newport (1989) presented two separate, but not necessarily mutually exclusive, versions of the CPH: the exercise hypothesis and the maturational state hypothesis. In their own words, the exercise hypothesis states: "Early in life, humans have a superior capacity for acquiring languages. If the capacity is not exercised during this time, it will disappear or decline with maturation. If the capacity is exercised, however, further language learning abilities will remain intact throughout life" (Johnson & Newport, 1989, p. 64). The maturational state hypothesis is similar and is the stance that was supported by their results. It says, "Early in life, humans have a superior capacity for acquiring language. This capacity disappears or declines with maturation" (p. 64). Johnson and Newport tested 46 native Korean and Chinese speakers who began learning English between the ages of 3 and 39. Their study focused specifically on grammar and they issued a grammaticality judgment test (GJT) to their subjects. They found that only those subjects who had arrived in the United States at a very young age (3-7) were able to perform in the near-native range, and a correlation between age of arrival and accuracy was found only for pre-puberty (early) participants, not for late. Although their study suggests that puberty is a cut-off point for seeing age effects, recent research suggests otherwise (Flege & MacKay, 2011; Flege, Munro, & MacKay, 1995; Bialystok & Hakuta, 1999). Therefore, one of the goals of this study is to examine age effects past puberty.

A succinct yet thorough list of characteristics of adult foreign language learning can be found in Bley-Vroman (1988, 1989). These characteristics, along with a brief explanation of each, are listed below. (For the complete descriptions, see Bley-Vroman, 1989, pp. 6-13)

1. *Lack of success*. Younger learners can acquire a new language without much effort, whereas older learners require a lot of time, effort, and problem-solving capabilities. This links L2 acquisition for an adult closer to learning any other skill, whereas for a child it is a more innate process.
2. *General failure*. Complete success for an adult in learning a second language is extremely rare and possibly non-existent.
3. *Variation in success, course, and strategy*. Adults fail to different degrees and there is a lot of inter-learner variation. Individual differences play a much greater role in adult L2 acquisition than in child acquisition.
4. *Variation in goals*. Adult learners have various reasons for learning the language and tend to only really learn the aspects that they care about most.
5. *Correlation of age and proficiency.* Young immigrants learn the language well, older ones do not.
6. *Fossilization*. Adults often stop short of success while children rarely do.
7. *Indeterminate intuitions.* Non-native speakers do not have the same intuitions as native speakers.
8. *Importance of instruction*. Children do not need formal instruction to learn a second language; they seem to be able to acquire it simply through sufficient input. Adults, however, do need to be formally taught to some extent.
9. *Negative evidence*. Correction is helpful for adults, but not as helpful for children.
10. *Role of affective factors.* Motivation, personality, attitude, etc. play a large role in adult language learning, but seem to have little effect with children.

For the most part, each of these aspects has been tested in empirical research and has been found

to be true.

Finally, something that is often confounded in the literature on how age affects L2 learning is the relationship between rate of attainment, or how quickly a learner acquires a second language, versus ultimate attainment, or the eventual end-state of an individual's language acquisition. An early explanation for the differences between rate of attainment and ultimate attainment was given in Krashen et al. (1979), stating that there are "three generalizations concerning the relationship between age, rate, and eventual attainment" in a second language:

1. "Adults proceed through early stages of morphological and syntactic development faster than children (where time and exposure are held constant).
2. Older children acquire faster than younger children (again in early stages of morphological and syntactic development where time and exposure are held constant).
3. Acquirers who begin natural exposure to second languages during childhood generally achieve higher second language proficiency than those beginning as adults" (Krashen, Long, & Scarcella, 1979, p. 573; see also Long, 1990)

Johnson and Newport also mention that adults are usually initially better at learning a language, but children surpass them in the long run (Johnson & Newport, 1989). Many studies that have not looked at longitudinal effects have found that their older subjects performed better than the younger ones simply because the length of exposure for both groups was not long enough, and, had it been longer, the younger learners would have surpassed the older (Bialystok, 1997, criticized in DeKeyser, 2000; Hyltenstam & Abrahamsson, 2003). On the other hand, some studies have found children to have even an initial advantage over adults in phonological areas (Baker, Trofimovich, Flege, Mack, & Halter, 2008; Flege et al. 1999; Jia & Aaronson, 2003).

Additionally, Flege and his colleagues have found that, at least with phonology and morphosyntax, younger learners acquire features faster than older learners (Flege et al., 2006; MacKay, Flege, & Imai, 2006). These findings seem to be more consistent with what actually happens. Obviously these generalizations in Krashen et al. (1979) are not conclusive, and there are conflicting results among rate studies (Hyltenstam & Abrahamsson, 2003). Some studies have shown an advantage for older learners (Asher & Price, 1967; Snow & Hoefnagel-Höhle, 1977, 1978), some have shown greater success in younger learners (Cochrane, 1980; Yamada, Takatsuka, Kotake, & Kurusu, 1980), and, more recently, Slavoff and Johnson (1995) indicated that there were no significant rate differences between their younger and older participants. In addition, and due to the "doubts concerning their applicability to the question of a critical period or maturational constraints in L2 acquisition, rate studies more or less fell out of fashion in the 1980s, and the focus moved instead to long-term [age of onset] effects" (Hyltenstam & Abrahamsson, 2003, p. 547)

2.1.2 Age affects aspects of L2 learning differently.

Having established that age does indeed affect the learning of a second language, we now look at the research on how specific aspects of acquisition are affected by age. The main linguistic areas of concentration for how age affects L2 acquisition have been phonology, morphology, and syntax. These areas are suspected to be most susceptible to age-related constraints (Harley & Wang, 1997). There has also been some research done on the influence of AOA on lexical development (Spadaro, 1996; Lee, 1998; both summarized in Long, 2006), categorial perception (Long, 2006), aural abilities and the ability to detect accents (Oyama, 1978; Scovel, 1981), and discourse and pragmatics (Scarcella, 1983). Here I will focus specifically on phonology, syntax/morphosyntax, and touch briefly on lexical development.

2.1.2.1 Phonology.

Because foreign accent is one of the most readily obvious deviations from the native speaker norm in an L2 speaker, the area of phonetics and phonology in a second language has been a continual source of interest for researchers. Indeed, many believe and have demonstrated that it is more difficult to be native-like in pronunciation than in any other linguistic category (Birdsong, 2004; Flege, 1999). Says Long in his 1990 review:

SL [second language] phonological attainment is strongly conditioned by learner age. Specifically, a native-like accent is impossible unless first exposure is quite early, probably before 6 in many individuals and by about age 12 in the remainder. Very high standards can be attained starting later, of course, but not, it seems, native-like standards. Some ability appears to have been irreversibly lost (p. 266).

> Some have hypothesized that pronunciation is the most susceptible to age-related changes because it is "the only aspect of language that has a neuromuscular basis," requires "neuromotor involvement," and has a "physical reality" (Bongaerts, 1999, p. 101; see also Scovel, 1988). The reality of this phenomenon has been borne out in various experiments over many years (Flege, Bohn, & Jang, 1997; Flege et al., 2006; Bongaerts, 1999; Birdsong, 2007).

Researchers have found that AOA affects both production and perception of L2 sounds. For production, Oyama (1976) and Thompson (1991) found that age of arrival was the best predictor of overall accurate pronunciation. For specific aspects of production in pronunciation, Baker et al. (2008) found that Korean children produced two of the four vowels examined in the study more accurately than the Korean adults. Moyer (1999) looked at the pronunciation of 24 late, very advanced and very motivated learners of German. Native German judges were still

able to distinguish native subjects from L2 subjects, and the study showed that the L2 participants, though advanced, still performed distinctly below the native pronunciation. However, nonnative speakers did receive higher ratings on more segmental aspects of production (i.e. word lists), rather than global aspects (sentence production, reading a paragraph aloud, free production). Similarly, Birdsong (2007) found that 3 of their 22 late learners were native-like in vowel duration (a specific, segmental aspect of production), even after acoustic analysis, and 9 of the 21 late learners produced 3 consonants with native-like voice onset time (once again, a specific aspect of pronunciation).

For perception, Baker et al. (2008) found that "children are less likely than adults to perceive L2 sounds as instances of a single L1 sound category" (p. 329), meaning that children do not as readily confine a specific L2 sound into a specific L1 sound category. Because children are better able to "perceptually disassociate L2 sounds from L1 sound categories" (Baker et al. 2008, p. 338), they are consequently better able to produce L2 sounds. Flege (1999) found that although production and perception are related, "the ability to perceptually gauge degree of accent in L2 sentences may develop more rapidly, or to a greater extent, than the ability to pronounce [or produce] L2 sentences" (p. 119). Finally, it seems to be the case that intensive training in both production and perception, along with a high motivation to sound native-like, are necessary, but not sufficient, conditions to achieve native-like results in phonology as an older L2 learner (Birdsong, 2007; Bongaerts, 1999; Moyer, 1999).

2.1.2.2 Syntax and morphology.

Not only does AOA affect pronunciation, it also affects the acquisition of L2 syntax and morphology. Similar to the successful acquisition of L2 pronunciation, acquisition of grammar in a second language seems to require that a late learner be unusually interested in and devoted to

language structure, and must be consciously aware of grammatical form (Abrahamsson & Hyltenstam, 2008; Ioup et al, 1994; Schmidt, 1990). These conditions, once again, are necessary, but not sufficient prerequisites for successfully acquiring native-like syntax. In his 1990 review, Long concludes that a language must be acquired before the age of 15 in order to achieve native-like results in morphosyntax.

The Johnson and Newport study (1989) discussed above in section 2.1.1 focused specifically on grammar. They found that participants with an early AOA (i.e. before the age of 7) were able to perform in the native speaker range on a grammaticality judgment task (GJT). Scores declined gradually for participants with AOAs between 7 and 16, and after age 16, scores were uniformly low. However, Bialystok and Hakuta (1999), using the Johnson and Newport data, moved the age back from 16 to 20 and found a moderately strong correlation ($r = -.49$) between age of acquisition and morphosyntax scores for adult learners. DeKeyser (2000) replicated the Johnson and Newport study and found similar results. He hypothesized that some of the adult learners' GJT scores would overlap with the childrens' scores, but only those adults with high verbal aptitude would be able to perform in the younger learner range. The results of his study supported this hypothesis. He found that “learners with high verbal ability can use explicit learning mechanisms to bypass the increasingly inefficient implicit mechanisms, and certain structures, by virtue of their saliency, can be learned explicitly by virtually all learners, regardless of verbal ability” (p. 518). In addition, he found that none of the adult learners were able to successfully acquire the L2 morphosyntax without relying on “explicit, analytic, problem-solving capacities” (p. 518). Abrahamsson and Hyltenstam (2008) found some aptitude effects even among younger learners, but aptitude had no effect on native speakers' grammatical intuitions.

Along those same lines, in another classic study, Coppieters (1987) did an extensive grammaticality judgment test of 21 very advanced L2 French speakers (with a variety of L1s) and found that there were syntactic differences between the native and non-native French speakers. Six of the subjects did not even have a detectable foreign accent, yet there was no overlap between the native and non-native speakers in the distribution of GJT scores. Sorace (1993) conducted a similar study to Coppieters involving L1 English and L1 French speakers who were near-native speakers of L2 Italian. She found similar results: "even for these near-native L2 speakers whose length of residence in Italy ranged from 5 to 15 years, intuitions about grammaticality were substantially different from those of a control group of 36 native speakers" (as quoted in DeKeyser, 2000, p. 504).

2.1.2.3 Lexical development.

Though some researchers claim that lexical development is not subject to age constraints (Klein, 1995), there is emerging evidence that AOA does in fact have an impact on the lexicon of older L2 learners. In his 2006 review, Long states that a critical period for lexical development was found around age 6 (Spadaro, 1996; Lee, 1998). Hyltenstam (1988, 1992) examined grammatical and lexical performance among 17- and 18-year-old Spanish and Finnish L1 speakers learning L2 Swedish. In order to elicit free speech, participants were required to retell four different texts, and to compose an untimed written essay. Each of the age groups (native, AOA <6, and AOA >7) produced around 12,000 words. The native controls made between 1 and 10 errors, the AOA <6 group (early learners) made 1-23 errors, and the AOA >7 (late learners) made 13-26 errors. Hyltenstam (1992) concluded that the "age of 6 or 7 does seem to be an important period in distinguishing between near-native and nativelike ultimate attainment" (Hyltenstam & Abrahamsson, 2003, p. 554) in grammatical and lexical performance.

A recent study by Spadaro (2013) looked specifically at maturational constraints on lexical development in an L2. Using the Kent-Rosanoff word association test, seven written tasks specifically developed for her study, and an oral production task, she focused on specific areas of lexical performance where native and non-native speakers were most likely to deviate. She found that "the level of ultimate attainment of non-native speakers with regard to the lexicon is different from that of native speakers" (p. 62). In addition, the results suggested that "the levels of ultimate attainment are constrained by maturational factors, with younger learners (AO < 6) invariably performing better than older learners" (p. 62). Though little research to this point has been done on age effects and lexical acquisition, this is a promising area for future experimentation.

2.1.3 Theories of why age affects L2 learning.

Researchers and laymen alike recognize that there are clear age constraints to learning a second language. However, "the exact extent, cause, and nature of this phenomenon have been controversial for decades" (DeKeyser, 2013, p. 52). The claim that an age-related decline does indeed exist in the ability of individuals to master a second language is not controversial (Hakuta et al., 2003); what *is* controversial is what causes this age-related decline. In this section we will discuss some of the various theories of the causes of this age-related constraint (Patkowski, 1994). These theories are not necessarily mutually exclusive, and it is the author's belief that there is some overlap between some, if not all, of the theories.

2.1.3.1 The Critical Period Hypothesis.

Perhaps the most contested theory of maturational constraints on L2 acquisition is the Critical Period Hypothesis (CPH). As mentioned in section 2.1.1, Penfield and Roberts (1959) were among the first to claim that critical period effects exist in language acquisition (White &

Genesee, 1996), and Lenneberg (1967) expanded upon that idea. Lenneberg is frequently cited as being the original author of the CPH; however, his hypothesis extended only to first language acquisition (Long, 1990) and he "gave no indication as to what the evolutionary function or benefits of a critical period for (second) language acquisition might be" (Harley & Wang, 1997, p. 25).

Because critical period effects exist in other areas of development, it is not a great stretch to imagine that they might exist in language development as well. Various definitions of a critical period have been given throughout the literature. For a general application, the definition of Gazzaniga (1992) suffices: "Certain environmental events must happen at certain times in the development of an organism in order for normal development to occur" (Gazzaniga, 1992, p. 56; also quoted in Bialystok & Hakuta, 1999, p. 163). Critical periods have been found for visual development in kittens (Hubel & Wiesel, 1965; Kalil, 1989), for imprinting in various bird species (Bornstein, 1989; Bateson, 1979; Hess, 1959; Landsberg, 1975) and for haptic perception in mice (Glazewski et al., 1996), among many other phenomena (Eubank & Gregg, 1999; see Bornstein, 1989 for a review). Long (1990) gives a more specific definition in regards to second language acquisition:

> There are sensitive periods governing the ultimate level of first or second language attainment possible in different linguistic domains, not just phonology, with cumulative declines in learning capacity, not a catastrophic one-time loss, and beginning as early as age 6 in many individuals, not at puberty, as is often claimed. (Long, 1990, p. 255)

This is also viewed as a version of Johnson and Newport's maturational state hypothesis mentioned above in section 2.1.1. Often the terms "critical" and "sensitive" period are used interchangeably in the literature; however, Long subtly points out in this quotation that "critical"

refers to a “catastrophic one-time loss” whereas “sensitive” is more of a “cumulative decline.” Regardless of whether “critical” or “sensitive” is the preferred terminology, they both refer to the same observed phenomenon: after an individual passes a certain stage of development, they are no longer capable of learning a (second) language to a native level.

In order to test the CPH, three different types of studies have been done: individual case studies (Ioup, Boustagui, El Tigi, & Moselle, 1994; Curtiss, 1989; Winitz, Gillespie, & Starcev, 1995), experimental lab studies (Bongaerts, Mennen, & van der Slik, 2000; Abrahamsson, 2012; DeKeyser, 2000; etc.), and wide-scope census studies (Chiswick & Miller, 2008; Stevens, 1999, 2006; Hakuta et al., 2003). All of these have their various strengths and weaknesses, and it can be instructive to look at each different type. Individual case studies can be useful in looking at long-term effects for specific individuals, whereas with larger groups of people, it can be more difficult to observe long-term effects. However, in the cases of individuals, the results cannot always be applied to the general population. Experimental lab studies are important because they can provide very specific data for a number of individuals, and the data collection can be more or less controlled by the researcher. A disadvantage of experimental lab studies is that the language samples collected might not always be a good example of normal production and free speech. Finally, census studies are able to collect a wide range of data covering thousands of people from a number of populations. Usually, however, language skills are self-rated in census studies and do not always reflect the true abilities of each individual.

Emphasis has been placed on the idea that although critical period effects can be somewhat overcome by other factors – high motivation, greater cognitive ability, better problem-solving skills, etc. – implicit language learning mechanisms are unavailable after the critical period has passed. Some have gone so far as to say that “if the scope of the CPH is limited to

implicit acquisition, then there may be no exceptions to it" (Abrahamsson & Hyltenstam, 2008, p. 503, emphasis added; see also DeKeyser, 2000, p. 499). Supporters of the CPH have also made it clear that while an early AOA is necessary to achieve a full native-like competence, it does not automatically mean that younger learners will achieve native-likeness (Abrahamsson & Hytenstam, 2009; Flege, 1999; Flege et al., 2006).

Interestingly, there has been one case where a very successful subject who began learning a second language later (age 21) and did not have formal training in the L2, appeared to acquire it naturalistically. Ioup et al. (1994) looked at two different successful late learners of Egyptian Arabic (EA), Laura and Julie. Laura had formal university training in the L2 and reached very high native-like norms. Julie, on the other hand, relocated to Egypt when she was 21 and married an Egyptian. She had no formal training in EA and according to the study "Julie [had] no noticeable foreign accent, [made] few mistakes in morphology and syntax, [had] good control of the lexicon, including conventionalized forms, and [appeared] to have sophisticated discourse competence" (Ioup et al., 1994, p. 79). Both women were tested on the quality of their speech production, their ability to recognize accents, and their knowledge of syntactic rules. They both scored very high, although with some slight deviance from the native speaker controls, and Julie appeared to be more native-like than Laura. This study also reinforced the idea that a conscious attention to form is necessary for a talented learner to acquire a second language (see section 2.1.2.2).

The Ioup et al. (1994) study has frequently been cited as counter-evidence to the CPH, but it is decidedly not the only one. Many have found a gradual decrease in success rates as age increases (Harley & Wang, 1997; Bialystok & Hakuta, 1999; Hakuta et al., 2003), rather than a sharp decline, as the CPH suggests would be the case. Some have also suggested that the decline

starts before puberty, beginning as early as birth, and have used that as a counter to the CPH (Bialystok & Hakuta, 1999; Flege, 1999). Bialystok and Hakuta (1999) stated, "there appears to be nothing special about the age range before puberty. The decline in proficiency remains constant across the ages" (p. 172). Even with the many studies that have been done to this point, the possible existence of a CPH is still a controversial topic.

2.1.3.2 Biological factors.

Closely related to the Critical Period Hypothesis, and indeed, a possible cause of it, are biological factors. Though not necessarily a hypothesis in and of itself, many have spoken of the role of biological features in second language acquisition. These biological factors are part of what drives the CPH. Lenneberg (1967), the early progenitor of the CPH, proposed that "if we look at behavior from a biological point of view, we should be surprised if we did not find critical periods" (p. 168-69). A possible reason for the deterioration of these biological factors could be that the brain loses plasticity as individuals age. Myelination has frequently been offered as an explanation for the brain losing its plasticity (Pulvermüller & Schumann, 1994; Chiswick & Miller, 2008; Eubank & Gregg, 1999). A good explanation of myelination is provided in Hyltenstam and Abrahamsson (2003): "The myelination of cortical neurons is a physical-chemical process in the brain in which glial cells wrap the axons of the neurons with myelin … (a substance contained in the glial cells that consists of lipids and proteins.)" (p. 561). Wrapping the axons with myelin gives the neurons nutrition and increases their ability to conduct signals, thus making it so that information can be transferred quickly across large distances. In addition, this makes connections with nearby neurons more difficult. Myelination begins at the fetal stage and continues well into adulthood, for at least several decades (Hyltenstam & Abrahamsson, 2003; Maxwell, 1984), causing the brain to be increasingly less plastic, which in

turn causes language development to decline (Long, 1990). According to Pulvermüller and Schuman (1994), the process of myelination causes a decay in the ability to acquire grammatical knowledge.

2.1.3.3 The Fundamental Difference Hypothesis.

The Fundamental Difference Hypothesis (FDH) was first proposed by Bley-Vroman (1989) and it essentially states that the way adults learn a language and the way children learn a language is, in fact, fundamentally different. Children are able to learn a language implicitly whereas adults must learn explicitly. As mentioned above, there are many factors involved in language learning, but it seems that most of these factors only matter in adult acquisition (Long, 2006). Bley-Vroman (1989) suggests that first language knowledge replaces Universal Grammar when adults are learning a second language, and older learners tend to use problem-solving skills rather than language-specific learning devices like children are able to do. However, first-language knowledge and problem-solving skills are not as adept at helping learners acquire a second language. This makes learning a second language for an adult much like learning any other skill, whereas children are specially equipped to learn a language. Bialystok (1997) essentially agrees with this idea and says that adults tend to extend the existing categories for language that they have already created from their first language (assimilation), whereas children seem to create new categories for new aspects of language (accommodation). She claims that the main differences between adult and child acquisition are not because of maturation, but because of different stylistic learning choices (Bialystok, 1997).

2.1.3.4 The Interaction Hypothesis.

Another hypothesis for why older learners are not as successful as younger learners is in the idea that an individual's L1 affects, and most likely hinders, their ability to learn an L2. One particular

proponent of this idea is Flege, and he has developed this theory only on the phonetic/phonological level (Flege, 1999; Flege et al., 1999, 2006). He has coined this the "interaction hypothesis" (Flege, 1999), suggesting that it is impossible for a bilingual to control both of their languages as well as a monolingual of either language because their L1 and L2 phonetic systems interact with each other and sometimes disrupt each other. As an individual begins to learn an L2, the sounds of the new language are perceived in the phonetic categories of the L1 that have already been formed. It is therefore easier to learn to pronounce an L2 phoneme that is very different from anything found in the L1 than it is to learn very similar sounds (Birdsong, 2007; Bongaerts et al., 1997; Flege, 1992a, 1992b, 1995). As Bongaerts et al. (1997) have summarized, "the greater the similarity between an L2 sound and the closest L1 sound, the more likely it will be that the learner will not notice the subtle differences that exist between the two sounds" (Bongaerts, van Summeren, Planken, & Schils, 1997, p. 449)

Empirical evidence of the interaction hypothesis has consisted of demonstrating that participants with different native languages perceive L2 sounds differently, and of showing that children (who have had less experience with their own L1) perceive L2 sounds differently than adults (who have extensive experience with their L1). Rochet (1995) found that native English speakers perceive French /y/ as /u/, whereas native Portuguese speakers perceive the same phoneme as /i/ (see also Flege, 1995). Similarly, native Japanese speakers mispronounce English /θ/ as /s/, whereas Russian L1 speakers mispronounce it as /t/ (Weinberger, 1990; Flege, 1995). Baker et al. (2008) found that native Korean children were less likely than adults to place English vowels into a specific Korean vowel category (see also discussion in section 2.1.2.1).

Others have looked into the idea of language transfer as well. Baker and Trofimovich (2005) looked at both the direction and degree of influence of an L1 and L2. They tried to

determine if the L1 affected the L2 (or vice versa) and how strong that influence was. They found that early bilinguals were better able to separate their two sound systems and that both languages affected each other in early bilinguals, but that only the L1 affected the L2 in late bilinguals. DeKeyser (2013) in giving a list of common methodological flaws and ways to overcome them, mentioned that it is best when looking at L2 proficiency to test subjects who rarely have an opportunity to use their L1 because of the possibility of cross-language transfer. Thompson (1991) similarly supports this view stating that "the acquisition of fully accentless speech in L2 may not be possible if L1 is maintained at a high level of proficiency, no matter how young the age at which the individual started to acquire the second language" (p. 178).

2.1.3.5 Socio-motivational factors.

Various researchers have suggested that there are social and/or motivational reasons for proficiency differences. It appears that adults need a specific purpose or great motivation in learning a second language or they cannot succeed. This has been seen in the Ioup et al. (1994) as well as others (Bongaerts, 1999; Schneiderman & Desmarais, 1988; Novoa, Fein, & Obler, 1988). These social and motivational factors, while present in child language acquisition, appear to have no effect there. As Long (2006) states, many people "point out that variation in social/psychological factors (attitude, motivation, etc.), in the characteristics of the learner's immediate linguistic environment (input, interaction, etc.) and amount of exposure, is often as real in child first language acquisition as in adult language acquisition, yet appear to have no effect there" (Long, 2006, p. 59). Similarly, Hyltenstam and Abrahamsson (2003) state that "social/psychological factors may explain why one 25-year old starter reaches higher levels of proficiency than another 25-year-old starter, but cannot explain why 4-year-old starters generally perform better than 25-year-old starters" (pp. 574-75). Masgoret and Gardner (2003) argue that

only learners who desire to be integrated with the new community and have a positive attitude toward the learning environment are likely to succeed.

Regarding socio-motivation factors, a distinguishing difference between younger and older learners is the probability that the older learner will fossilize in various aspects of his or her acquisition, one of these aspects being pronunciation. A few reasons that this fossilization might occur have been set forth by Klein (1995). One of these reasons could be that the learner simply does not notice that there are differences between his own production and how the rest of society produces the sounds, and the learner therefore cannot imitate the correct pronunciation. There is also the possibility that the learner is able to understand and be understood in the new language and sees no reason to continue to improve his pronunciation. This can happen frequently when communication rather than accuracy is the learner's main focus (Krashen, 1981; Thompson, 1991; Masgoret & Gardner, 2003). A final reason for pronunciation fossilization mentioned by Klein (1995) is that the learner wants to keep their social identity with their L1 community and uses this non-conformity as a way to maintain that social identity.

2.2 Experiential, Affective, and Cognitive Factors

The present study specifically examines a number of cognitive, affective, and demographic/experiential factors to attempt to determine which are most responsible for success in second language learning. This section of the review will focus on what has been said in the literature about some of these cognitive, affective, and demographic factors. According to Krashen (1981), “both language aptitude [i.e. cognitive factors] and attitude (affective variables) appear to be related to second language achievement, but are not related to each other” (Krashen, 1981, p. 218). This thesis will look at all of these variables and see which is best equipped to help language learners succeed.

2.2.1 Demographic/Experiential factors

2.2.1.1 Amount of time learning and using the L2.

Research has shown that the amount of time participants have been learning and using the L2 is positively correlated with their test scores on L2 proficiency (Birdsong, 1992). However, even after 10 years of experience there is no guarantee that the individual will have reached native-like levels (Baker, 2010). In fact, it would be surprising if they did reach native-like levels at all, no matter the amount of experience. In addition, DeKeyser (2013) brings up the point that participants ought to be fairly isolated from other speakers of their L1, in order to have had a sufficient amount of time to practice and use the L2. There is a much greater chance for language transfer and interference if the participants are continuing to frequently use the L1 after attempting to be proficient in the L2.

2.2.2 Affective factors

2.2.2.1 Motivation.

Another theoretical predictor of second language learner success comes in the degree of motivation that the individual possesses, which includes their attitude toward the language and the learning environment. Although strong motivation does not necessarily guarantee success, it does appear that individuals who are more highly motivated succeed to a greater degree than those who are not motivated (Abrahamsson & Hyltenstam, 2008; Ioup et al., 1994). Motivation, along with language learning aptitude, specific phonetic training, etc., are necessary but not sufficient elements required to attain native-like proficiency (Birdsong, 2007). Abrahamsson and Hyltenstam (2008) found that the two participants who were most successful in learning L2 Swedish were both unusually interested in (i.e. motivated) and devoted to language structure and learning. Once again, motivation does not seem to factor into child language development, and

even if it does to an extent, it makes no difference on the outcome (Bley-Vroman, 1989). It is encouraging, however, that with a combination of factors such as high motivation, access to L2 input, and specific phonetic training, adults can, to a great extent, overcome many of the critical period effects (Bongaerts, 1999; Abrahamsson & Hyltenstam, 2008).

It seems that the degree and type of motivation also make an impact in the success of the L2 learner. Those who desire only to be able to function and communicate in a second language often fall far short of the native-like range, whereas those who desire to be native-like succeed to a greater degree (Seright, 1985). Some have referred to the difference between integrative motivation and instrumental motivation. Integrative motivation is the desire to be more like the members of the L2 community and to feel a sense of belonging among them. Instrumental motivation refers to the desire to become proficient in the language in order to advance their career or for other practical reasons (Krashen, 1981; Thompson, 1991).

2.2.2.2 Social Integration.

Social integration refers to an "individual's willingness and interest in having social interaction with members of the L2 group," and could also be labeled "language attitudes" (Gardner et al., 1997, p. 345). Some believe that attitudes toward an L2 community "exert a strong influence on one's L2 learning" (Dörnyei & Skehan, 2003, p. 613). Gatbonton, Trofimovich, and Magid (2005) found that some non-native English speakers in Canada will actually retain a slight foreign accent when speaking English "in order to maintain group affiliation with their native language and culture" (Baker, 2008, p. 187). In addition, Gatbonton et al. (2005) found that "learners treat their peers' L2 accent as an indicator of these peers' degree of ethnic affiliation" (p. 489), meaning specifically that listeners believed those speaking English with a heavier French accent were more pro-Francophone and not pro-Anglophone. Similar results were found

in the same study with native Chinese speakers in Canada. Surprisingly, Baker (2008) found that participants who had more negative attitudes toward an L2 dialect tended to exhibit more features of the dialect. This could indicate that experiential factors, for example the amount of experience using an L2, rather than social factors are more likely to affect which dialectal features are acquired (Baker, 2008). Clearly more research is required in this area.

2.2.3 Cognitive factors

2.2.3.1 Language aptitude.

Cognitive factors are often referred to as "language learning aptitude" and therefore these two terms will be used interchangeably in this section; however, subsequent sections will talk about specific cognitive abilities such as working memory and attentional control. According to Segalowitz and Freed (2004), "aptitude refers to a learner's basic cognitive disposition or readiness for language learning" (p. 175). As mentioned multiple times above in this review, many components must be present in adult language learning in order for a measure of success to be achieved, while these components are not necessary for child language acquisition. One of these factors is a high degree of verbal or language aptitude (DeKeyser, 2000; Abrahamsson & Hyltenstam, 2008). Aptitude does not factor into child language acquisition because they have no need to access their problem-solving abilities and can rely completely on implicit learning (DeKeyser, 2000). It is assumed that because language proficiency declines with age, cognitive functions that are initially in place in humans must also necessarily decline (Bialystok & Hakuta, 1999). A relationship between aptitude and ultimate attainment is present in both younger and older learners, but it is only important for the older learners (DeKeyser et al., 2010).

It is interesting to note that although adults do have higher cognitive development and have already mastered a first language, they still fail consistently to reach native-like levels in a

second language (Long, 2006). As already mentioned, older learners require language learning aptitude, as well as a conscious attention to grammatical form to succeed to any sort of near-native degree (Ioup et al., 1994).

2.2.3.2 Working memory and SLA.

Working memory is a cognitive function that has been shown to have some effect on language acquisition (Abrahamsson, 2012). It is also a factor that will be specifically tested in this study. Younger learners are able to use procedural memory, which is available up until about 5 years of age, whereas older learners must rely on declarative memory any time after 5 (Paradis, 2009; Abrahamsson, 2012). The use of procedural memory can lead to incidental acquisition as well as implicit competence. Declarative memory, on the other hand, enables an individual to learn an L2 intentionally and leads to explicit competence (Abrahamsson, 2012). These two types of memory could both be considered under the category of long-term memory. Once procedural memory in language acquisition is no longer available, an individual must use their declarative memory in order to gain competence in the language. This requires a strong working memory that can transfer information from the individual's short-term memory into their long-term memory to be available for future use.

Working memory is a vital aspect of human cognition and a “distinct structural component of the cognitive system” (Richardson, 1996, p. 121). It has been described as being “fundamental in understanding intellectual performance” and as being “of crucial importance in explaining variations among individuals and among groups of individuals” especially in how they respond to cognitive demands and issues (Richardson, 1996, pp. 147-148). Working memory is separate from both short-term memory and long-term memory, although it is related to both (Lehman & Tompkins, 1998). According to Baddeley (1992), it is defined as “the system

for the temporary maintenance and manipulation of information, necessary for the performance of such complex cognitive activities as comprehension, learning, and reasoning" (p. 281). In addition, it is possible that working memory could be a link between musical training and language abilities (Posedel et al., 2012).

2.2.3.3 Musical ability.

The connection between musical prowess and the ability to learn a language is one that has received much attention in the past few years. It does appear that neither language nor musical aptitude are related to overall IQ, but they are related to each other (Gilleece, 2006; Abrahamsson & Hyltenstam, 2008). However, the exact nature and extent of this interaction is still in question. Both music and language have an obvious aural component and as stated in Francois and Schön (2011): "the fact that musicians perceive some sound features more accurately than nonmusicians do is not so surprising... they spend hours … focusing on sounds and the way the are generated, paying particular attention to pitch, timber, duration, and timing" (Francois & Schön, 2011, p. 2357). Research suggests that music and language might involve similar brain processing (Gilleece, 2006; Slevc & Miyake, 2006; Koelsch & Siebel, 2005; Levitin & Menon, 2003). In addition, similarities have been found in the structure of music and language (Patel, 2003) and in language development and musical perception ability (Anvari et al., 2002; Lamb & Gregory, 1993; Posedel et al., 2012). A connection has even been found between musical training and the ability to recognize emotions based on speech prosody (Thompson et al., 2004).

Two studies specifically examined the connection between late learner success in acquiring an L2 and musical ability. Posedel et al. (2012) found that musical training was linked to both working memory and pitch perception, but only pitch perception ability was a significant

contributor to Spanish pronunciation. They hypothesize that “it may be that the benefits of musical instruction are unique to [late learners], who tend to be past the 'window' of a language learning sensitive period” (Posedel et al., 2012, p. 515). Slevc and Miyake (2006) found that musical ability was related to greater success in receptive and productive phonology. They did not specifically test trained musicians, but gave their participants various musical and linguistic tasks. In fact, if the results had been based on self-ratings of their musical abilities, the correlation would have been much lower. They mention in their study that “several studies failed to find a clear link between self-ratings of musical ability and L2 ability” (p. 675), and this is possibly a reason why even more researchers have not looked into the connection between musical ability and learning a second language.

2.2.3.4 Attentional control.

A final cognitive measure that will be tested in this study is attentional control. Segalowitz and Frenkiel-Fishman (2005) define attentional control as “a person's ability to shift focus of attention from one language-based attention-directing function to another” (p. 646). Segalowitz and Frenkiel-Fishman (2005) also pointed out that “what primarily distinguishes experts from novices [regarding skilled performance] is the expert's superior ability *to manage attentional resources* and *to exercise cognitive control*” (p. 644, italics in original). Control of attention is a factor that has been studied extensively outside of the linguistic domain, and it has been suggested that “mechanisms of the attentional system... should be an explicit component of models of second language acquisition” (Guion & Pederson, 2007, p. 76). Many studies have shown that older participants have a more difficult time performing two tasks simultaneously than do younger participants (McDowd & Shaw, 2000; Kramer & Madden, 2008). In the domain of second language acquisition, the study of attentional control has generally been limited to its

application in phonology and phonetics (Guion & Pederson, 2007; Darcy, Mora & Daidone, 2013). The current study is primarily testing syntax and grammatical sensitivity through the use of an elicited imitation test, and hence I will be looking for a connection between attentional control and grammatical ability/overall proficiency.

One way to measure attentional control is through task switching. When participants must switch task goals from one trial to the next, their performance is generally slower than when there is no task switching involved (Segalowitz, 2003; Allport & Wylie, 1999). The switch task used for this study will be a lexical decision task and will be discussed more in depth in Chapter 3. This task was chosen partially because speed and efficiency of lexical access and speed and efficiency of attentional control are both "cognitive abilities that potentially interact with learning experiences in a dynamic way, both affecting the course of oral performance gains and being affected by learning experiences themselves" (Segalowitz & Freed, 2004, p. 176).

2.3 Aging Across the Life Span

Aging affects not only language acquisition, but many other aspects of life as well. It affects overall cognitive processes (Hakuta et al., 2003), autobiographical memory (Rubin, 2002), stress hormones (Lupien et al., 2005), and even self-esteem (Robins & Trzesniewski, 2005) to name just a few. However we still do not know very much about older learners, especially when it comes to factors that influence their second language learning. In most linguistic studies, a "late learner" refers to anyone who is older than 20 at the latest; usually the late learner cut-off is as early as 12 (Abrahamsson & Hyltenstam, 2009; Abrahamsson, 2012; Bialystok, 1997; Birdsong & Molis, 2001; DeKeyser et al., 2010). There are good reasons for this, after all, as DeKeyser (2013) points out: "age at testing should not go beyond middle age, to avoid effects of cognitive aging on testing results, which constitute a serious risk, and which are

a different research issue altogether" (p. 57). Although he is specifically talking about testing the Critical Period Hypothesis, it is undeniable that cognitive aging would play a large role in older language acquisition, one reason that cognitive factors have been included in this study.

Of the studies that have looked at life span language acquisition, two very opposing views have been established. Some believe that language abilities decline gradually across the life span and generally use this as an argument against the Critical Period Hypothesis (Bialystok & Hakuta, 1999; Hakuta et al., 2003). Others have seen a clear cut-off point where language abilities suddenly and abruptly decline and then flatten out (DeKeyser et al., 2010). Bialystok and Hakuta (1999) have found that older learners are more sensitive to timing factors, requiring longer intervals to answer than younger learners, and that older learners are inherently more cautious and self-conscious, causing them to not answer as readily if they feel like they do not know the correct answer. They claim that these examples show declining cognitive functions across the life span, and because these cognitive functions are specifically related to language learning, it is not surprising that that their decline adversely affects the ability to learn a language. They state that "if age-related changes in ultimate language proficiency are to be attributable to these cognitive changes... then the decline in ultimate proficiency in a second language should also be gradual and constant" (Bialystok & Hakuta, 1999, p. 172). Similarly, Hakuta et al. (2003) said that their "most compelling finding was that the degree of success in second-language acquisition steadily declines throughout the life span" (p. 37).

On the other hand, DeKeyser et al. (2010) found "a steep decline in the learning of grammar before age 18... followed by an essentially horizontal slope until age 40" (p. 413). Their results also indicated that AOA was the most important factor in predicting L2 grammatical success for subjects who began learning before the age of 18, whereas for subjects between the

ages of 18 and 40, aptitude was the strongest predictor. For those who had an AOA of over 40, age at time of testing proved to be the most important predictor of ultimate attainment. Some have also found that even with a sudden decrease in ultimate proficiency related to AOA, age effects have been found after the "presumed end of maturation" (Birdsong, 2004, p. 92), contrary to what Johnson and Newport found in their 1989 study.

Very few, if any, studies have directly compared cognitive, affective, and demographic factors, and examined their relationship to language learning across the life span. The aim of the present study is to compare all three of these factors to determine which variables are the most influential when learning a second language. Four specific AOA groups will be examined: 10-19, 20-29, 30-39, and 40+, and, where applicable, will be compared to a control group of native English speakers. The questions this study will seek to address are:

1. Do the age groups differ in terms of English proficiency?
2. Do age groups differ in terms of cognitive, affective, and experiential factors?
3. Which of the cognitive, affective, or demographic/experiential factors best predict the proficiency scores of the participants?

I hypothesize that the effect of cognitive, affective, and demographic factors will be different across the differing age groups, and that demographic factors will have the greatest influence on proficiency, followed by cognitive factors, with affective factors having little to no influence on the proficiency scores of the participants

3. Methodology

The methodology for the research of the present study will be discussed in this section. This section will explain how it will be determined whether different age groups learning a second language vary in terms of cognitive, affective, and demographic factors. A description of the participants involved in the study along with the questionnaire used will be included. The next section will discuss the stimuli used, as well as explain why it was chosen. The final section will describe the data analysis and how it was completed.

3.1 Participants

The participants for this study were native Spanish speakers (n=38, 35 female, 3 male) who were placed in four different groups based on age of acquisition: 10-19 (n=8), 20-29 (n=9), 30-39 (n=13), and over 40 (n=8). The average age of all Spanish-speaking participants at the time of testing was 39.7 years (standard deviation: 11.5). The majority of the individuals were from Mexico; however, there were also a number from other Central/South American countries (see Table 3.1). The strong bias towards Mexican Spanish participants was due to the fact that many of the immigrants in the Utah Valley region tend to be from Mexico.

Table 3.1
Participants' countries of origin

Country	**# of Participants**
Mexico	22
Peru	6
Chile	4
Panama	2
Argentina	2
El Salvador	1
Honduras	1

All of the participants resided in Utah at the time of the study. The average length of

residence (LOR) in the United States for participants was 12.2 years (range: 3 months-37 years). Only 6 participants had been in the US for less than 5 years at the time of testing, and three of those 6 participants had an LOR of less than 1 year. The age at time of testing for those three participants were 37, 68, and 45. Because of the difficulty in finding participants with a high AOA and a long LOR (see Flege & MacKay, 2011), these three were allowed to participate. A length of residence (LOR) of at least 5 years is generally accepted as the end state of ultimate attainment (Birdsong 2004, Johnson & Newport 1989), and after 5-10 years LOR seems to play little role on ultimate attainment (Long 2005, Krashen et al. 1979, Birdsong & Molis 2001), unless the L2 is used often (Flege & Liu, 2001). A control group consisting of 7 native English speakers (5 female, 2 male) was also tested. The average age of the control group was 38.9 years (range 24-57 years). Table 3.2 shows various demographic characteristics of the 5 different AOA groups (Native English (NE), 10-19, 20-29, 30-39, 40+). To verify that the AOA differences between native Spanish-speaking groups are statistically significant, AOA was set as the dependent variable in a one-way ANOVA test with the resulting $F(3) = 71.810$, $p < 0.001$ and $R^2\text{adj} = 85.5\%$.

Table 3.2
Characteristics (mean, (SD), range) of the five groups of participants

Group	*N*	Age	LOR	AOA
NE	2m, 5f	38.9, (12.4), 24-57	--	--
10-19	0m, 8f	36, (12.8), 18-52	21.8, (11.7), 5-35	14.4, (3.4), 11-19
20-29	1m, 8f	32.4, (6.8), 26-47	10.7, (6.9), 2-23	23.9, (2.3), 20-28
30-39	1m, 12f	36.9, (4.6), 31-46	10.2, (4.2), 0.6-15	33, (2.7), 30-39
40+	1m, 7f	55.1, (8.9), 45-68	7.7, (5.95), 0.2-17	52.5, (10.2) 41-68

Note: NE = Native English, Age = chronological age at time of testing, LOR = length of residence, AOA = age of onset of acquisition. Though some have a rather long LOR, they did not begin actually learning English until well after they had arrived in the U.S. This is possible because Spanish is a common language in the area and participants would have been able to get around without learning the L2. Groups are segmented by AOA.

There was a strong bias towards female participants in this study: 92% of the Spanish speakers were female; we therefore tried to match the English control group, getting 71% of the English participants to be female. Although we tested more women than men, this should not affect the results of this study, since several studies have found that gender plays little role on ultimate attainment in L2 learning. Conklin et al. (2000) found no significant gender differences in schizophrenic patients on a working memory task (specifically a backward and forward digit span test, similar to what was done in the present study). There are a few speculative reasons as to why women would be more apt to want to learn English in an immigration setting than men. Generally men work outside the home and are frequently able to find jobs that do not require them to learn the L2, especially considering that there are a great number of native Spanish speakers throughout Utah and the United States. Women, on the other hand, need to be able to interact in a number of different situations – at the grocery store, the doctor's office, social functions, etc. – and might feel a greater desire to learn the new language. Related to this idea, Peirce (1995) says that a wife in her study "did most of the organization in the family, like finding accommodations, organizing telephones, buying appliances, finding schools for the children" (p. 20).

All participants understood English well enough to be able to complete the required activities. All participants agreed to the Informed Consent form approved by the Internal Review Board for the Use of Human Subjects. The consent form was originally written in English, but

also translated into Spanish to ensure that each participant fully understood the risks and benefits of the study (see Appendix A).

Participants were recruited through community English as a Second Language (ESL) courses and by word of mouth. Permission was first obtained from program coordinators for ESL classes before classroom announcements were made. In most classes, the researcher orally gave a brief description of the tasks for the study. A sign-up sheet was passed around that also briefly explained the requirements and provided a space for potential participants to put their name, phone number, email address, and availability. The interested persons were then contacted individually by telephone and the researcher set up a time to meet with them. Most of the interviews and other data collection took place at the participants' homes. The environment was generally calm and quiet, but there were times when children or pets caused a slight diversion. At the end of data collection, each participant's name was entered to win one of three gift cards to the location of their choice. One of the gift cards was for $50, the other two were for $25. In order to maintain anonymity, participants were assigned an identification number that was used on all of the various tasks.

3.2 Questionnaire

After agreeing to participate in the study and signing the consent form, each of the participants answered a series of questions assessing various experiential, affective, and cognitive features. The questionnaire was administered to each participant orally and individually by the researcher to ensure full comprehension. The complete questionnaire is given in Appendix B.

3.2.1 Experiential questions.

After asking a few general questions, such as where they were born and their age, the

participants were asked about their experience learning English. First, they were asked how long they had been actively trying to learn English, since some spoke only Spanish for a long time after their immigration. This was and is a possibility because of the large Spanish population in the U.S. and in Utah Valley, where participants were tested. In order to roughly assess socio-economic status, participants were asked about their educational and vocational experience, including whether or not their employment had changed since coming to the United States. To determine their amount of L2 usage, the participants were asked to give a percentage (to the nearest 10^{th} percent) of the time they spend speaking English and Spanish in four different situations: with their children, spouse, friends, and at church/social functions (adapted from Baker, 2008).

3.2.2 Affective questions.

Participants were asked to rate on a scale from 1 to 10 their ability to speak both English and Spanish (1 - "I can't speak the language at all," to 10 - "I speak the language like a native speaker"). This was to determine their perceived competence in each language, which Onwuegbuzie, Bailey, & Daley (2000) predict has an effect on their level of foreign language anxiety – an affective variable. They were also asked to rate how motivated they are/were to learn English on a scale of 1 to 10 (1 – not motivated at all; 10 – very motivated to learn). For the self-rated motivation score, the majority of participants answered either 9 or 10; however, 4, 5, 6, and 8 were each reported once as well. Participants were also asked why they were motivated to learn English and their responses were coded as 0 for responses deemed to stem from instrumental motivation and 1 for integrative motivation responses (Krashen, 1981; Thompson, 1991). Examples of instrumental motivation responses include statements like: "Most people here speak English and I get frustrated when I can't understand people," and "I want to

communicate better and get a better job." Integrative motivation examples include "I love the United States and I love English," and "I love English. My children speak it and I want to be able to have that in common with them." To determine the "social integration" (SI) score, the participants were requested to rate their agreement (once again on a scale of 1 to 10) with the following statements:

1. I like living in the United States.
2. I feel part of the American culture.
3. I prefer to speak English more than Spanish.
4. I miss my home country.
5. I am American.

These questions were designed to determine their attitude towards the L2 community and country, and how well they felt like they identified with their new surroundings. The answer for number 4 was key-reversed to match the other answers (instead they would be answering "I do not miss my home country;" if they originally said "8," their answer was changed to "2"). The answers for each individual were averaged to give each participant an SI score (adapted from Baker, 2008).

3.2.3 Cognitive questions.

Some of the cognitive data (working memory capacity and attentional control) was retrieved from the stimuli in section 3.3, which will be discussed below. The cognitive questions that were asked on the questionnaire all dealt with the participants' musical abilities. Recent studies have shown a link between musical abilities and L2 learning (see Chapter 2, section 2.2.3.3). Participants were asked if they played a musical instrument or had experience singing, and what instrument they played. If they played an instrument or had formal training in singing, they were asked how long they had been playing. All participants were then asked to self-rate their musical abilities on a scale from 1 ("I don't have any musical abilities") to 10 ("I am very good at

music”).

3.3 Stimuli

After filling out the questionnaire, each participant in this study completed three different tasks in the following order: a working memory task, a switch task, and an elicited imitation task. The first two tasks were meant to determine working memory capacity and attentional control, while the last task was meant to determine general L2 proficiency. This section will discuss each of these in turn. The working memory task and the switch task were administered using UAB presentation software from the research laboratory of Dr. James Flege (Smith, 1997). In the sections below, I will briefly provide background research for the stimuli used, as well as explain what the stimuli was and how it was presented to the participants in this study.

3.3.1 Working memory task.

There are a number of tests that have been devised to measure working memory, one of which is the backward digit span test (Wechsler, 1981, 1997; Woodcock & Johnson, 1977). In the backward digit span test, the participant is required to listen to a string of numbers and repeat them back in the reverse order from memory. Digit span tests have been used to examine verbal working memory in schizophrenia patients (Conklin, Curtis, Katsanis, & Iacono, 2000), to look at working memory in elderly and right-hemisphere damaged adults (Lehman & Tompkins, 1998), to test working memory in ASL participants (Mayberry, 1993), and to compare working memory differences between older and younger language learners (Scott, 1989). Some researchers have found that age is not correlated with performance on digit span tasks (Conklin et al., 2000; Dobbs & Rule, 1989); however others have found that age – specifically age of acquisition – can affect digit span results (Mayberry, 1993). The backward digit span test is often used because it can be quickly and easily administered (Conklin et al., 2000) and because it is a

standardized task (Lehman & Tompkins, 1998). In addition, “performance on the backward digit span task measures verbal working memory by requiring internal manipulation of mnemonic representations of verbal information in the absence of external cues” (Conklin et al., 2000, p. 277). Similarly, it is purported to be a valid measure because it requires participants to store a string of numbers as well as simultaneously mentally rearranging them (Lehman & Tompkins, 1998).

For the backward digit span task in this study, participants listened to a native English speaker say a series of numbers. The participant then attempted to say the same series of numbers out loud in the reverse order. For example, if the recording said “7 1” then the participant would need to say “1 7.” The task began with the native speaker saying two numbers, then adding one number every other item (2 sets of 2, 2 sets of 3, 2 sets of 4, etc. up to 2 sets of 10). The researcher wrote down each participants' response verbatim as they were completing the activity and then scored the item at a “1” if the participant correctly stated the numbers in order and a “0” if they were unable to do so. After scores of 0 for two items in a row, the task was discontinued. Subsequently, the number of items they got exactly correct was totaled, providing the final score for the working memory task. Almost all of the native Spanish-speaking participants were unable to repeat past the sets of 6 spoken numbers. Each participant was given the following instructions before beginning the task: “You will hear a series of numbers. Please repeat the numbers out loud in the reverse order (backwards). Push “next” to go on to the next series of numbers. The researcher will tell you when to stop.” They were then allowed to ask questions if further clarification was needed and the researcher asked follow-up questions to ensure that every participant understood the task. For a complete list of stimuli used, see Appendix C.

3.3.2 Switch task (lexical decision task).

Included in the stimuli of this study was a lexical decision task (LDT). Generally speaking, a lexical decision task requires a subject to determine whether or not a given stimulus is a word (Fischler, 1997). The term "lexical decision task" was first coined by Meyer and Schvaneveldt in their 1971 study. The literature includes studies on both visual (Meyer & Schvanevelt, 1971; Von Studnitz & Green, 1997) and aural (Holcomb & Neville, 1990; Pallier, Colomé, & Sebastián-Gallés, 2001; Goldinger, 1996) LDTs. Participants are often required to do a number of different things when performing a lexical decision task. Sometimes they must determine if two words are somehow related (e.g. NURSE-DOCTOR). These types of tasks often look at priming effects, attempting to ascertain if a word is accepted more quickly if it is preceded by a semantically related word (Meyer & Schvaneveldt, 1971; Pallier et al. 2001). Often participants must determine if the presented items are words or nonwords (Meyer & Schvaneveldt, 1971).

LDTs are used to test many different populations (Goldinger, 1996). They can be used to examine the lexical knowledge of aphasics (Gordon & Caramazza, 1982; Matthei & Kean, 1989; Blumstein, Milberg, Dworetzky, Rosen, & Gershberg, 1991), bilinguals (Woutersen, de Bot, & Weltens, 1995; Pallier et al., 2001; Von Studnitz & Green, 1997), and children versus adults (Radeau, 1983; Edwards & Lahey, 1993). Particularly pertinent to this study are the age differences found in lexical decision task performance. Edwards and Lahey (1993), found that age adversely affected response times on all tasks tested. Flege et al. (1999) states that "Previous work has shown that as AOA increases, native speakers of Korean … respond more slowly and less accurately to a lexical decision task" (Flege et al., 1999, p. 79; see also Kim, 1996).

Age differences have also been observed when task-switching is required, a concept that is inherent in the design of the LDT presented in this study. Task-switching involves the ability to

"perform two or more tasks at the same time or to rapidly shift emphasis among tasks" (Kramer, Hahn, & Gopher, 1999, p. 343). Kramer et al. (1999) found "large age-related deficits" (p. 343), with the most important factor of the age-related differences being working memory load. They mention that "Older adults were unable to capitalize on practice under high memory loads" (p. 339), but they did find that older adults were capable of improving their performance with practice, at least on a subset of processes.

The LDT presented in this study required participants to discriminate between words and non-words, while at the same time determining if the auditory stimuli was presented by a man or a woman (hence introducing the idea of task-switching). This switch task is based on research by Darcy and García-Amaya (see García-Amaya & Darcy, 2013). For this activity, the participants heard a number of words and non-words (for a complete list of stimuli used, see Appendix D) and were required to push "yes" if the word they heard was a real English word and "no" if the word was a non-word. Approximately one-third of the words they heard were spoken by a native English-speaking male. If they heard a male voice, they were to push "mv" (male voice) instead of responding "yes" or "no" to the lexical decision task. All tokens recorded in the male voice were actual English words. Their response time was recorded, as well as which button they pushed. Following are the instructions the participants received before completing this task: "You will hear a word. If the word you hear is a real English word, click 'yes.' If it is not a real English word, click 'no.' If you hear a man's voice, click 'mv.' Try to do it as quickly and as accurately as possible." They were then given a chance to practice the task with a few items. Follow-up conversation took place to ensure their understanding, after which the actual task was administered. The task consisted of 82 words total (26 real words, 28 non-words, and 28 male voice words).

3.3.3 Elicited imitation.

Elicited imitation (EI) is a testing procedure that has received much attention in the literature over the past 20 years. It involves the subjects hearing a sentence and attempting to repeat what they have heard. It has been used extensively in three different areas: child language research, neuropsychological research, and L2 research (Vinther, 2002; Erlam, 2009). There is still some debate as to whether or not EI is an adequate representation of an individual's global proficiency, but there have been many studies suggesting that it is indeed a valid test (Ellis, 2005; Erlam, 2006, 2009; Graham, Lonsdale, Kennington, Johnson, & McGhee, 2008). Some of the advantages to EI include that a wide range of structures can easily be elicited, the researchers have control over the administration of the test as well as analysis, and it can easily be used with different age groups, languages, and populations (Jessop, Suzuki, & Tomita, 2007). It is also a useful tool when testing low-frequency items that the participants might otherwise try to avoid (Hyltenstam & Abrahamsson, 2003; Long, 1993). However, there are also some challenges and disadvantages associated with EI. Some of these challenges include 1) it is possible that the participants are simply "parroting" what the prompt says, 2) it can be difficult to avoid floor or ceiling effects, 3) it is unsure whether EI tests comprehension or production, and 4) the degree of the subjects' success might depend on the grammatical knowledge they already have of the structures being tested (Jessop et al., 2007). An additional challenge is that there is no way to test spontaneous speech production using elicited imitation (Vinther, 2002).

While taking these challenges into account, however, there is strong evidence that EI is a powerful and valid tool in testing language performance – especially L2 performance (Jessop et al., 2007). Henning (1983) found that EI was a greater assessment of L2 proficiency than oral interviews and sentence completion. Because working memory capacity is limited, when a

participant hears the sentence to be imitated he must chunk the phrases of the sentence together in order to remember them, and those who are more proficient at the L2 are better able to do this (Graham et al., 2008). There is also an idea that "in order for the learner to be able to correctly imitate the target language structure, it must be part of the learner's interlanguage system" (Erlam, 2006). In addition, an early study of EI (Gallimore & Tharp, 1981) found "that EI yields stable test-retest correlations over a period of years, that it is related to language behavior in natural settings, and that it reflects stages of language development as well as the influence of cultural and class phenomena on language performance" (quoted from Vinther, 2002, p. 55). According to Bley-Vroman and Chaudron (1994), "the more you know of a foreign language, the better you can imitate the sentences of the language. Thus, EI is a reasonable measure of global proficiency" (p. 274, see also Ellis, 2005).

3.3.3.1 EI and L2 acquisition.

EI has been used specifically for testing second language proficiency since 1974 (Vinther, 2002; Jessop et al., 2007). Naiman (1974) was one of the first to use EI as a measure of L2 acquisition among first- and second-grade children. He found that an average length of 15 syllables was an adequate length for the test sentences because they were long enough that working memory space was exhausted, but not so long that the children couldn't process them (Naiman, 1974; Vinther, 2002). A relationship has been shown between working memory and elicited imitation tests. Some research suggests that "the capacity of working memory is determined by the stored knowledge that already exists about the language" (Erlam 2006, p. 468; see also Baddeley, Gathercole, & Papagno, 1998). There is also a possibility that working memory could be a link between language abilities and musical training, which was discussed in detail in Chapter 2 (Posedel et al., 2012).

There is also evidence that elicited imitation accesses implicit knowledge of a language, especially if they are required to perform under time pressure (Ellis, 2005). In addition, EI has been shown to be reconstructive in nature, meaning that the participant must first process the stimuli in order to accurately repeat them.

The EI test for this study was administered in order to determine participants' overall English proficiency. The elicited imitation task was presented using an in-house software development project and included a subset of 20 sentences from the original 60 sentences developed. The original 60 sentences are a subset of 180 items written by Graham et al. (2008). The instructions for the task were as follows: “Before you begin the task, the program will take you through a sound check to make sure everything is working correctly. Follow the instructions shown you. For the task, you will hear a native English speaker say a sentence. You will then hear a beep. After the beep, repeat the sentence out loud exactly as you heard it.” Within the program, they were allowed to practice once to make sure they understood the objective. There were 20 sentences total that they were required to repeat as precisely as they could. The average number of syllables in each sentence was 12 (range: 7-18). Both male and female voices were used to record the stimuli sentences. They included difficult grammatical structures and vocabulary in order to avoid ceiling effects. The sentences used differed in both their lexical and syntactic complexity. Below are listed a few example sentences demonstrating varying levels of difficulty.

Easy: “That woman should help her students.”

Moderately difficult: “It makes me happy that you like to snorkel.”

Difficult: “If her heart were to stop beating, we might not be able to help her.”

After each sentence, there was a brief pause and then a beep, indicating that the recording had

started. Participants were then allowed 5-8 seconds to repeat the sentence. Because this thesis will be made available to the public, and because this elicitation test is still used to test ESL students' English proficiency, the complete list of sentences cannot be provided here.

Scoring for the elicited imitation task was done by hand by the researcher. Each sentence was recorded as the participant was saying it. Afterward, the researcher listened to the recordings and marked on a scoring sheet which words were missed in each sentence. Each sentence was worth a total of four points. For every error in a sentence, one point was subtracted from the total. If there were four or more errors, the participant received a score of zero for that particular sentence. If there were incomplete sentences (if the subject began speaking before the beep, or if they had not finished saying the sentence before the allotted time ran out) only the portions of the sentence that were recorded were analyzed and the rest was considered to be an error. A total of 80 points were possible. The average score of the experimental group(s) was about 26 points (range: 0-80). Excluding the participants in the AOA 10-19 group, the average was approximately 14 points (range: 0-50). The average score for the native English speakers was approximately 78 points (range 70-80).

3.4 Data Analysis

The data analysis was broken down by the three research questions: 1) Do age groups differ in terms of their English proficiency? 2) Do age groups differ in their scores on experiential, cognitive, and affective factors? and 3) Which of the factors (experiential, affective, or cognitive) best predicts learners' elicited imitation (English proficiency) scores? To answer the first question, I ran a one-way ANOVA with EI scores as the dependent variable, and the 5 AOA groups (NE, 10-19, 20-29, 30-39, and 40+) as the independent variables. A similar process was used to answer question 2. I continued to run a series of one-way ANOVAs with the dependent

variables being the various measures recorded (LOR, AOA, EI scores, amount of language use, etc.) and the independent variable once again as the 5 different groups (10-19, 20-29, 30-39, 40+, and, where applicable, native English speakers). Finally, to examine the third research question, and in order to determine which of the factors (cognitive, affective, or experiential) best predicts learners' elicited imitation, or L2 proficiency scores, I ran a stepwise linear multiple regression analysis with EI scores as the dependent variable and all of the other recorded measures as predictor variables.

4. Results

This chapter will report the results of the present study. The three research questions to be addressed are: 1) Do the five age groups (NE, 10-19, 20-29, 30-39, 40+) differ in terms of their English proficiency? 2) Do the four nonnative English (NNE) age groups differ in their scores on demographic/experiential, cognitive, and affective factors? 3) Which of the factors (demographic/experiential, social/affective, cognitive) best predicts learners' elicited imitation (L2 proficiency) scores? An alpha level of 0.05 was used to determine significance for all statistical tests.

4.1 Research Question 1

The first research question was "Do groups differ in terms of their English proficiency?" Table 4.1 lists the average scores and standard deviations for each of the groups on the elicited imitation (EI) test, the measure used in this study to determine overall L2 proficiency.

Table 4.1
EI scores across AOA groups (mean, SD, range)

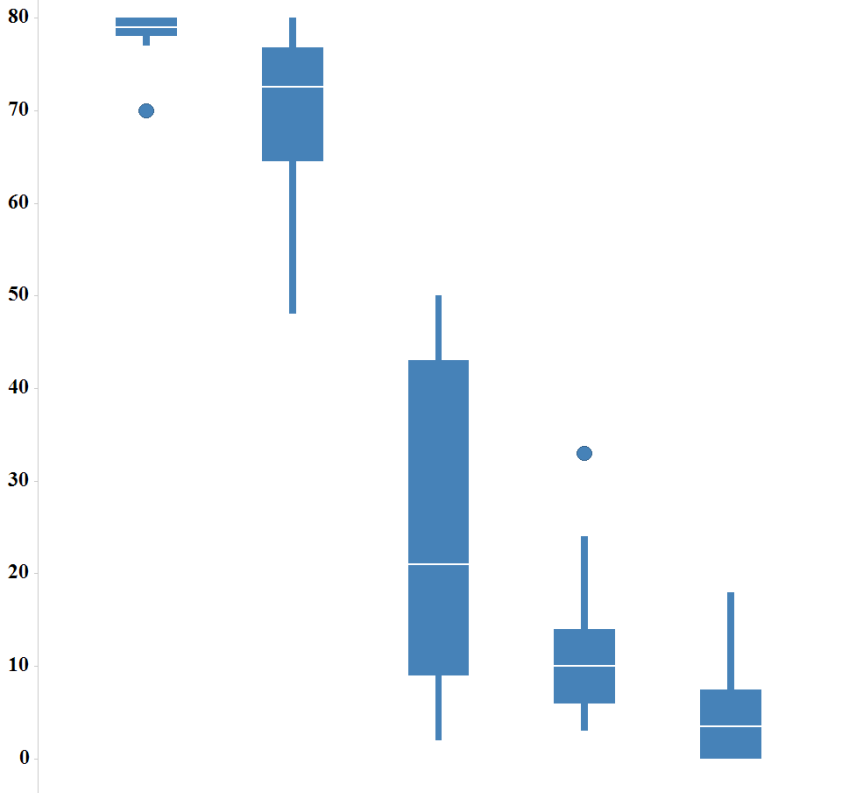
	NE	10-19	20-29	30-39	40+
EI score (out of 80)	77.9, (3.6), 70-80	69.3, (10.9) 48-80	23.9, (17.6) 2-50	12.2, (8.5), 3-33	5.4, (6.6), 0-18

Note: EI scoring is explained in Chapter 3, section 3.3.3.1.

As Table 4.1 demonstrates, the native speakers scored the highest on the test, followed closely by the 10-19 AOA group, with 2 of the 10-19 group performing in the same range as the majority of the native English control group for this study (77-80). The average EI scores are progressively lower for each group as AOA increases. The standard deviation for the 20-29 group is relatively high (17.6), indicating a wide range of scores (from 2-50) for the group overall. In order to determine whether the scores of the five groups differed significantly, I ran an ANOVA with the elicited imitation scores as the dependent variable and AOA as the independent variable, divided

into five groups (NE, 10-19, 20-29, 30-39, 40+). The results of this analysis demonstrated that the groups do indeed differ in terms of English proficiency ($F(4) = 34.394$, $p < 0.001$, R^2adj. = 75.2%). Overall, the NE participants had the highest average EI score, followed closely by the 10-19 AOA group. The other group averages were significantly lower and descended in order of AOA group (20-29>30-39>40+) and did not differ significantly from each other. Figure 4.1 illustrates this in the form of a box plot.

Figure 4.1
Box plot of EI scores across AOA groups



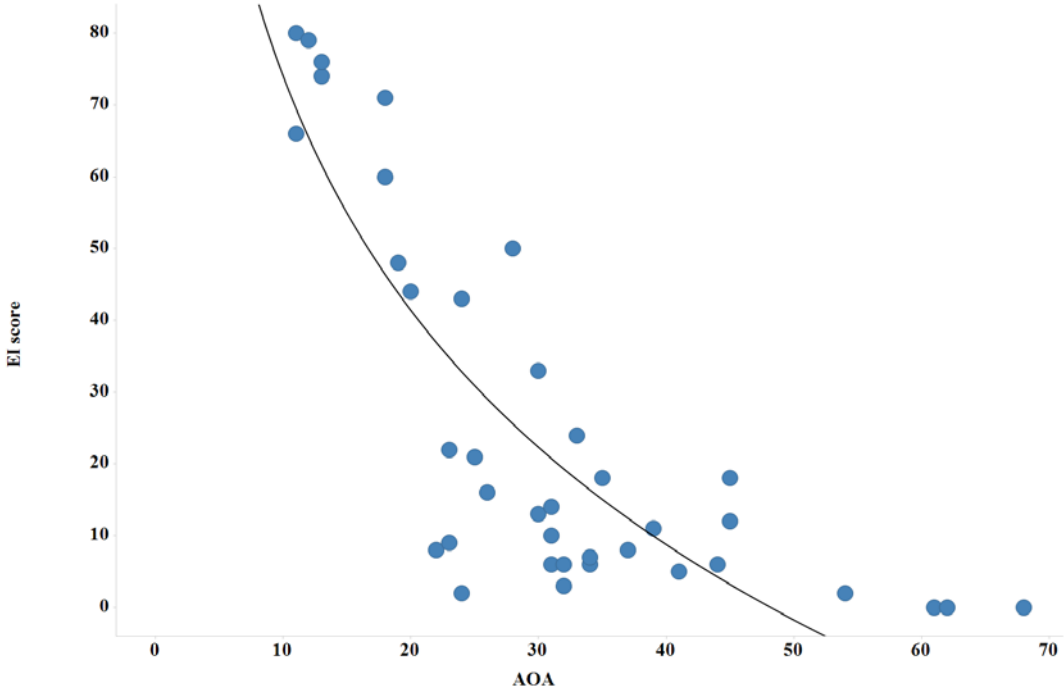
	NE	10-19	20-29	30-39	40 and up
Median	79	72.5	21	10	3.5
Avg	77.8571	69.25	23.8889	12.2308	5.375
StdDev	3.62531	10.8858	17.6029	8.46713	6.56696

Note: The white center line represents the median value, the lower box is the 25th percentile and the upper box is the 75th percentile. The two dots indicate outliers of their groups.

Interestingly, there appears to be a sharp decrease between the proficiency scores of the

10-19 AOA group and the 20-29 group, suggestive of studies supporting a CPH, or clear drop-off in the ability to learn a second language after a certain age. However, while there is a sharp drop around the AOA of 20, there are still age effects that can be seen between the later groups as well, in that the averages slowly decline and do not necessarily level off. There is also a wide amount of variation in the 20-29 age group. These aspects will be discussed in more detail in Chapter 5. These effects are still visible, albeit not quite as distinct, in the scatter plot in Figure 4.2. A logarithmic trend line is included to indicate that the data points decrease fairly rapidly and then begin to level out.

Figure 4.2
Scatter plot of EI scores across AOA groups (Does not include NE scores)



4.2. Research Question 2

The second question addressed in this study is: do the four NNE AOA groups (and the NE control group where applicable) differ in their scores on demographic, cognitive, and

affective factors? The results for this question were obtained once again through a series of one-way ANOVA tests. This question will be divided into the three different categories: demographic, affective and cognitive.

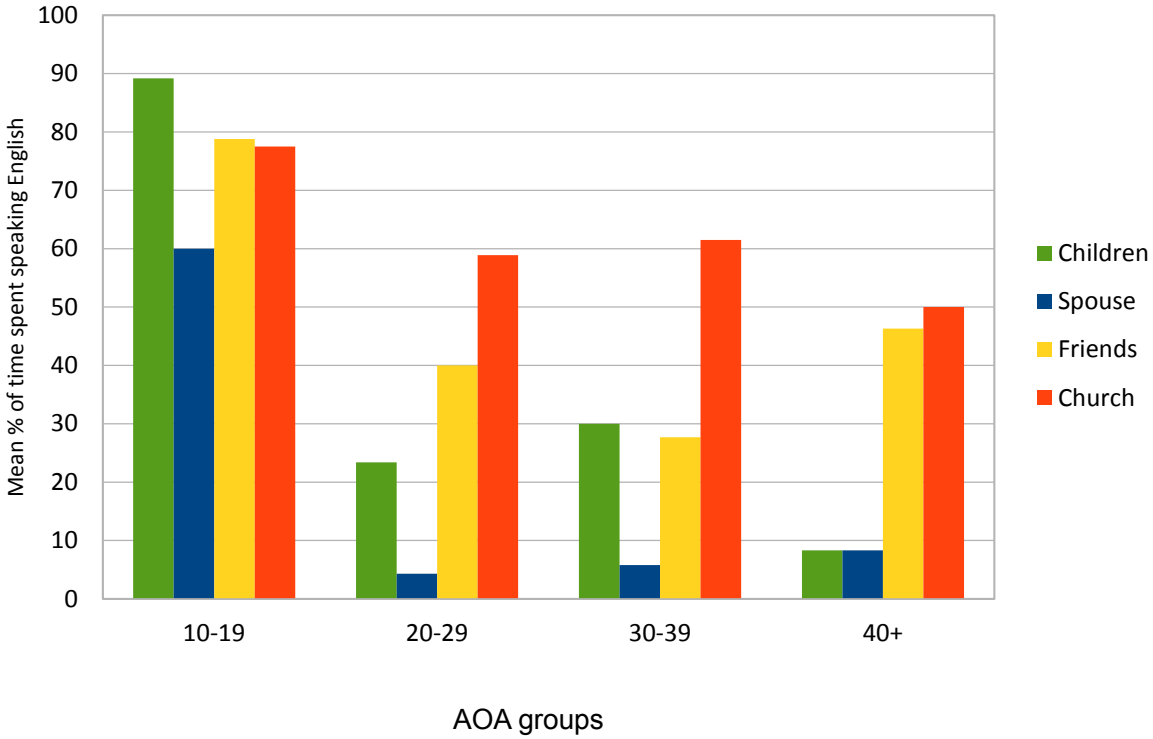
4.2.1 Demographic factors.

A number of demographic factors were recorded, including age of onset of acquisition (AOA), length of residence in US (LOR), amount of L2 use, level of education (Education), type of job held in the home country (Job in HC), and the type of job held in the United States (Job in US). Table 4.2 shows the mean and standard deviation for each category of each group. AOA and LOR will not be discussed extensively here since they were thoroughly examined in Chapter 3.

Amount of L2 use was measured using four different categories: average time spent speaking the L2 (English) with children, spouse, friends, and at church or work (see Figure 4.3). These were then averaged for each participant and the group averages are listed in Table 4.2. The 10-19 age group spends the most amount of time on average speaking the L2 (76%), while every other group spends between 30 and 40% of their time speaking the L2. Those who did not have children or were not married were not included in the averages for those specific variables (speaking with children and speaking with spouse). As can be seen by the graph, the lowest percentage for each group is the amount of time speaking the L2 with a spouse. It is possible that those who immigrated to the United States after the age of 19 or 20 were already married to a native Spanish speaker and therefore would feel more comfortable speaking with them in their shared native language. Those who came before that age, however, as teenagers or younger would not have been married when they immigrated and would possibly have married a native English speaker, forcing the L2 learner to speak English, and in turn improving their English. This goes along with the idea that amount and type of input is critical for an L2 learner

(Thompson, 1991; Flege, 1999; DeKeyser, 2013).

Figure 4.3
Amount of time using the L2 by AOA group



Education was coded on a scale of 0-4: 0 – didn't finish high school, 1 – finished high school, 2 – some college, 3 – college degree, 4 – master's degree/post graduate work. The 10-19 AOA group were the most educated – all of them graduated from high school and all but one participant had at least some college. Somewhat surprisingly, the group with the second highest education was Group 4 (40+). Two of them did not finish high school, but four graduated college with a degree and one did post-graduate work as well (the data for this question was missing for one participant). Participants were asked about their employment status both in their home country and after their immigration. Employment responses were coded as 0 – no job, 1 – "blue collar" job, and 2 - "white collar" job. Examples of "blue collar" jobs included cashier, maid, factory worker, etc. "White collar" jobs included secretary, database management, teacher coordinator, etc. The 10-19 AOA group all reported having no job in their home country. This is

reasonable, considering that they were all school-age when they came to the United States. Interestingly, the only participants to report having "white collar" jobs in the United States were the 10-19 AOA groups. All others had either "blue collar" jobs or no job, even though almost all of the participants in the three older groups had had a job in their home country. This could be due to the language barrier that comes from immigrating to a new country. The younger AOA group tended to be more proficient in English and therefore had higher paying jobs. Table 4.2 shows the group averages for each of these demographic categories.

Table 4.2
Demographic factors: Averages for each AOA group (mean, (SD))

	Group 1 (10-19)	Group 2 (20-29)	Group 3 (30-39)	Group 4 (40+)
AOA (in years)	14.4, (3.38)	23.9, (2.32)	33, (2.74)	52.5, (10.16)
LOR (in years)	21.8, (11.7)	10.7, (6.93)	10.2, (4.16)	7.7, (5.95)
Amount of L2 use (in percentage of time)	76%, (18.7)	34.7%, (24.38)	31.8%, (15.99)	38.4%, (37.68)
Education	2.625 (1.06)	1.11 (1.05)	1.58 (1.31)	2.29 (1.6)
Job in HC	– –	1 (0.5)	1.15 (0.8)	1.63 (0.52)
Job in US	1.375 (0.74)	0.44 (0.53)	0.54 (0.52)	0.5 (0.53)

Note: AOA and LOR averages are in years, Amount of L2 use is by percentage. HC = "home country"

The one-way ANOVA results for the demographic factors can be seen in Table 4.3. Variables that are significant are shaded. The 10-19 AOA group differed significantly from the other groups ($F(3)= 4.398$, $p < 0.01$); however, there was not a significant difference between the older AOA groups. Post-hoc analyses also revealed that the three older groups did not differ from each other in terms of their types of jobs, but they did differ from the 10-19 group.

Table 4.3
Demographic factors: One-way ANOVA results

Dependent Var.	df	*F*	*p*	Partial Eta^2 (η_p^2)
AOA	3, 36	71.810	<0.001	0.867
LOR	3, 37	2.309	0.094	0.169
Amount of L2 use	3, 37	4.398	0.010	0.280
Job in HC	3, 37	11.17	<0.0001	0.496

4.2.2 Affective factors.

Three affective factors were examined in this study: a self-rated motivation score (as rated on a scale from 1-10), a description of what motivated speakers (labeled as "motivated by" below) and social integration (see section 3.2.2 of Chapter 3 for a more detailed description of each category). The participant groups' average scores on each of these factors is provided in Table 4.4.

Table 4.4
Affective factors: Averages for each AOA group (mean, SD)

	Group 1 (10-19)	Group 2 (20-29)	Group 3 (30-39)	Group 4 (40+)
Motivation	9.75 (0.46)	9.9 (0.33)	8.9 (2.02)	9 (1.53)
Motivated by	0 (0)	0.22 (0.44)	0 (0)	.13 (0.35)
SI score	7.6 (2.24)	6.6 (1.33)	6.4 (0.795)	6.6 (1.23)

Note: "Motivation" was measured on a scale of 1-10. "Motivated by" was coded as 1 for answers judged to be representative of internal motivation, and 0 for answers that represented external motivation. SI score = Social Integration score (also on a scale of 1-10).

The 10-19 AOA group had a slightly higher average social integration score (7.6) than the other three groups, but the differences were not significant (see Tables 4.4 and 4.5). Motivation and reasons for motivation did not differ significantly across groups. For motivation, all groups were within the average range of 8.9-9.9 (on a scale of 1-10), and for "motivated by," all groups

were under 0.25 (between 0 and 1), indicating that most participants were externally motivated (coded as 0), rather than internally motivated (coded as 1). None of the differences between the groups regarding affective variables were significant.

Table 4.5
Affective factors: One-way ANOVA results

Dependent Var.	df	*F*	*p*	Partial Eta^2 (η_p^2)
Motivation	3	1.312	0.284	0.107
Motivated by	3	1.478	0.238	0.115
SI score	3	0.859	0.472	0.070

4.2.3 Cognitive Factors.

Finally, I examined participants' responses to the three cognitive factors: musical ability, working memory, and the ability to switch between tasks. Participants were asked if they had experience singing or playing a musical instrument ("Music") and also to rate their overall musical ability on a scale of 1-10 ("Musical ability"). This gave a fairly limited view of their musical experience, considering that their musical ability was self-rated, and their answers to the question about singing or playing an instrument were coded as 0: no musical experience, 1: some experience singing, and 2: some experience playing an instrument, with no indication of how well they actually play or sing. Finally, the memory test and lexical decision task were administered as described in Chapter 3. The switch cost for each participant on the lexical decision task was found by averaging the response time (RT) for "yes" and "no" answers and then subtracting "mv" RT from that average. The average switch costs for each group were fairly comparable, with the exception of Group 4 (40+ AOA), whose average switch cost was 0.847 seconds; much higher than the four other groups.

Table 4.6
Cognitive factors: Descriptive statistics (mean, SD) by group

	NE group	Group 1	Group 2	Group 3	Group 4
Music	--	1.38 (0.92)	0.56 (0.88)	1.08 (0.86)	0.63 (0.74)
Musical ability	--	5.38 (1.85)	3.11 (2.62)	5.38 (2.44)	5.38 (2.62)
Memory test	7.4 (1.9)	5.5 (1.7)	5 (2.2)	4.4 (1.7)	3.6 (1.6)
LDT switch cost (in sec.)	0.328 (0.413)	0.285 (0.196)	0.348 (0.282)*	0.415 (0.847)	0.847 (0.714)

Note: "Music" was coded as follows: 0-no musical experience, 1-experience singing, 2-experience playing a musical instrument. "Musical ability" was self-rated on a scale of 1-10. NE = native English, Memory test score is out of 18 possible points. *The data for one participant in this category was not included because they did not appear to understand the task (answered "yes" or "no" for each token, never "mv"). With their switch cost included, the average for the 20-29 group would be 0.56 (SD: 0.69).

The one-way ANOVA results for cognitive factors are listed in Table 4.7. Though none of the variables (musical experience, musical ability, working memory capacity, and switch costs) are statistically significant, musical ability ($F(3) = 2.248$, $p = 0.1$) and working memory capacity ($F(4) = 1.992$, $p = 0.117$) are approaching significance.

Table 4.7
Cognitive factors: One-way ANOVA results

Dependent Var.	df	*F*	*p*	Partial Eta^2
Music	3	1.142	0.346	0.092
Musical ability	3	2.248	0.100	0.166
Memory test	4	1.992	0.117	0.181
LDT switch cost (in sec.)	4	1.01	0.399	0.082

4.2.4 Summary.

The results of the analyses performed in conjunction with Research Question 2 demonstrate that

differences do exist between the four AOA groups in some aspects. First, in terms of the experiential factors, there was no difference across the groups in terms of LOR, but there was a difference in amount of L2 use. There were also minor differences in socio-economic factors such as education and employment. Second, there did not seem to be any difference between the groups on affective factors: there were no differences in their level of motivation, on what they were motivated by, or on their social integration score. Finally, there were slight differences across age on some of the cognitive tasks. The difference between groups on working memory capacity was approaching significance, although the LDT switch costs between groups were not significant. The differences in musical experience between groups was not significant although musical ability differences were approaching significance.

4.3 Research Question 3

The final research question of this study was: which of the factors (demographic, social/affective, or cognitive) best predicts learners' L2 proficiency scores (as measured by EI)? To answer this I ran a stepwise linear multiple regression analysis (MRA) with EI scores as the dependent variable and all of the variables listed in the left-hand columns of Tables 4.3, 4.5, and 4.7 as predictor variables. I did not include “Job in HC” or “Job in United States” because they were not scalable numerically, meaning that a “white-collar” job cannot necessarily be considered “higher” than a “blue-collar” job. In addition, for “Job in HC” every member of the youngest group (10-19) scored “0” (no job). Thus, these two variables were confounded and were not included in my analysis.

Before running the MRA, correlations were determined between the language proficiency (EI) score and the predictor variables of the MRA. The correlations that were significant included AOA (negatively correlated), average L1 use (negatively correlated), average L2 use

(positively correlated), and working memory capacity (positively correlated). Table 4.8 shows each of the variables with the correlation to EI (*r*) and the significance level (*p*). Variables that are shaded were significantly correlated.

Table 4.8
Pearson correlations between EI and other factors tested

AOA	*r*	-0.736
	p	0.000
Avg. L1 Use (Spanish)	*r*	-0.667
	p	0.000
Avg. L2 Use (English)	*r*	0.667
	p	0.000
How motivated?	*r*	0.245
	p	0.143
Motivated by?	*r*	0.005
	p	0.976
Musical Experience	*r*	0.216
	p	0.192
Musical Ability	*r*	-0.075
	p	0.660
Memory Test	*r*	0.416
	p	0.016
Switch Cost	*r*	-0.241
	p	0.146

Subsequently, I ran the MRA. The variables that best predicted the scores (when AOA was not included) are average L1 use (negatively related), switch costs (negatively related), and LOR (Table 4.9). When AOA was included, the predictor variables were AOA (negatively related), average L1 use (negatively related), and switch costs (negatively related) (see Table 4.10). In other words, the less the participants used their L1 (Spanish) and the faster they were able to switch tasks (a lower number), the better they scored on the EI, or the higher their L2

proficiency. Similarly, the younger the AOA, the higher the EI scores or proficiency scores.

Table 4.9
MRA results without AOA included

Predictor variable	Adjusted R^2	ΔR	B	Standard Error
Average L1 use	.538		-.676	.113
Switch Costs	.610	.072	-13.45	5.35
LOR	.652	.042	.756	.360

Table 4.10
MRA results with AOA included

Predictor variable	Adjusted R^2	ΔR	B	Standard Error
AOA	.602		-1.59	.233
Average L1 use	.725	.123	-.398	.106
Switch costs	.775	.05	-10.99	4.101

4.4 Conclusion

In conclusion, the groups do differ in terms of their English proficiency as measured by the elicited imitation scores. The groups also differ in some individual aspects of demographic and cognitive factors, but not affective factors. The most variation between groups was found among demographic factors, specifically AOA and amount of L2 use. The variables that predicted participants' EI scores when AOA was not included were average L1 use (negatively related), switch costs (negatively related), and LOR. When AOA was included in the multiple regression analysis, AOA (negatively related), average L1 use (negatively related), and switch costs (negatively related) were predictor variables. The implications of these results will be discussed in Chapter 5.

5. Conclusions and Discussion

The aim of the present study was to examine age of acquisition effects across different AOAs, as well as to determine what factors may differentiate between L2 learning at different ages, be they cognitive, affective, or demographic/experiential. Though many researchers have looked at these factors individually within limited age ranges, few have examined all of these in the same study. Doing so allows researchers to know the relative importance of each in language learning. This chapter will further discuss the results presented in the previous chapter, with the following questions as a basis:

1. Do the five age groups tested (NE, 10-19, 20-29, 30-39, and 40+) differ in terms of their English proficiency?
2. Do the four age groups differ in their scores on demographic, cognitive, and affective factors?
3. Which of the factors (demographic/experiential, social/affective, or cognitive) best predicts learners' elicited imitation scores?

Along with these questions, this chapter will also discuss limitations of the present study, as well as implications and future research.

5.1 Research Question 1

As expected, the five age groups do differ in terms of their English proficiency, as mentioned above in Chapter 4. In fact, the large gap between the mean proficiency scores for the 10-19 AOA group (mean: 68.3) and the 20-29 AOA group (mean: 23.9) may be indicative of the passing of a critical period (see section 2.1.3.1 of Chapter 2). However, unlike previous studies which support the Critical Period Hypothesis (Johnson & Newport, 1989; DeKeyser, 2000), the mean scores of the older AOA groups (20-29, 30-39, and 40+) continually decline, suggesting

age effects occur even after puberty (see Chapter 4, Table 4.1 and Figure 4.1). Many second language acquisition studies that have looked at aging across the lifespan have found that proficiency results decline gradually as AOA increases (Bialystok & Hakuta, 1999; Hakuta et al., 2003), without the sharp drop in proficiency seen here between the 10-19 and 20-29 AOA groups. Others have shown a sharp drop-off in proficiency scores around a certain AOA, and then a flattening out for any AOA above that cut-off point (Dekeyser et al., 2010; Johnson & Newport, 1989). The results of the current study are interesting and significant because they seem to combine these two opposing viewpoints. There does seem to be a sharp drop in proficiency scores around the AOA of 19 or 20; however, the older AOA groups (20-29, 30-39, and 40+) do not immediately flatten out as has been seen in other studies, but gradually decline as the AOA increases (refer to Figure 4.1 in Chapter 4).

Another point of interest in the results for this question is the wide spread of proficiency results for the 20-29 AOA group. Their scores on the elicited imitation test range from 2-50. Surprisingly, the participant who scored the highest on the EI test in this group was the one who had the highest AOA (28) and the shortest LOR (2 years) of the group (Table 5.1). The participant with the lowest proficiency score in this AOA group had the second highest LOR. Table 5.1 compares the data of the highest, second highest and lowest scoring participants in the 20-29 AOA group. Based on the data listed below, there does not seem to be an obvious reason for why the highest scoring participant of this group was so successful. She has a fairly high AOA and a relatively low LOR. She reported speaking English roughly 38% of the time, just slightly above the group average, and her social integration score was only 4.6, the lowest score of her group (see Chapter 3 for an in-depth explanation of the social integration score). She did, however, have a relatively high memory test score – the second highest of the group.

Additionally, her average switch cost time on the lexical decision task (0.204 seconds) was a little below the group average (0.285 seconds). The only apparent advantage that she has is her college degree. This data suggests that some other factors that were not tested in this study could be contributing to success in acquiring a second language.

On the other hand, the second highest scoring participant on the EI test didn't finish high school, but had the youngest AOA of the group and a relatively long LOR (14 years). She had a higher social integration score and reported speaking the L2 40% of the time. Her switch cost time was just slightly lower (0.19 seconds) than the highest scorer's time (0.204 seconds). In terms of affective and cognitive factors, all three of these participants (highest, second-highest, and lowest) were relatively comparable and their main differences came in experiential factors. One would expect, however, that the proficiency scores of the highest and lowest scoring participants to be switched based on their respective lengths of residence and ages of acquisition.

Table 5.1
Individual data for highest-, second highest-, and lowest-scoring participants in the 20-29 group

	Lowest Scoring (m)	Second highest scoring (f)	Highest Scoring (f)
EI score (out of 80)	2	44	50
LOR (in years)	18	14	2
AOA (in years)	24	20	28
Education	Finished High School	Didn't finish HS	College degree
Job	Driver	Cashier	Baker
Job in US	Baker	none	none
Avg. L2 Use	22.5% of the time	40% of the time	37.5% of the time
SI score (on a scale of 1-10)	8	6.8	4.6
Memory test	5	5	7
LDT switch cost (in seconds)	2.26435 (wasn't included in final results because didn't follow instructions)	0.19	0.20424

Note: LOR = length of residence, AOA = age of onset of acquisition, SI = social integration

This study differs from other similar studies that have been done. For example, Baker (2010), who is one of the only other researchers who has examined the effect of age on adult L2 learners, looked at phonology and focused on the specific age range of 20-29, whereas the current study focuses on overall proficiency across multiple age ranges. In addition, the subjects in this study were not connected with the university and were not necessarily well-educated, unlike the participants in many studies, including Johnson and Newport (1989). This could indicate that a decline in proficiency across ages occurs despite the level of education. The well-educated are subject to it as well as those with less education.

5.2 Research Question 2

The second research question was to determine if the four non-native English groups differ in their scores on demographic, affective, and cognitive factors. The results of each group of factors will be discussed individually.

5.2.1 Demographic factors.

The first factors studied in this thesis were demographic and experiential factors, including AOA, LOR, amount of L2 use, level of education, and employment. Significant differences between groups were seen for only two of the factors: age of onset of acquisition and amount of L2 use. This section will therefore focus on those two measures. As mentioned in Chapter 2, Long concludes in his 1990 review that a language must be acquired before the age of 15 in order to achieve native-like results in morphosyntax. The results of this study appear to support his assumption. Only scores of participants in the 10-19 AOA group were comparable to the scores of the native English speakers in this study, and only those with an AOA of less than 15 actually achieved native-like scores, meaning that they were within the range of the majority of the native speakers in this study (native speaker range: 77-80) (see Table 5.1). In Table 5.2, the

boxes that are shaded indicate native-like scores. Note that only those with an AOA of 15 or less were able to achieve native-like scores, but not all of the participants under 15 did. This is consistent with findings of others, that native-likeness is possible, but not guaranteed, with an earlier AOA. Supporters of the Critical Period Hypothesis (CPH) have made it clear that while an early AOA is necessary to achieve native-like competence, it does not automatically mean younger learners will succeed in reaching native-likeness, meaning that they would score in the same range as native speakers on linguistic tests (Abrahamsson & Hyltenstam, 2009; Flege, 1999; Flege et al., 2006). No other participants in any other group in this study achieved native-likeness.

Table 5.2
EI scores of 10-19 AOA group

AOA	11	11	12	13	13	18	18	19
EI score	80	66	79	76	74	71	60	48

The groups also differed in amount of L2 use, with the 10-19 group differing significantly from the other groups (see Table 5.3). The 10-19 AOA group spends by far the most percentage of time speaking the L2 (76%) while every other AOA group spends only 30-40% of the time speaking English. Additionally, there is a wide amount of variation for each group, but especially for the 40+ group. Research has shown that the amount of time participants have been learning and using the L2 is positively correlated with their test scores on L2 proficiency (Birdsong, 1992). Once again, however, even though greater use of the L2 can contribute to a person becoming more native-like in the L2, length of experience and amount of use is still not a guarantee that the individual will be more native-like. Some have found that even after 10 years of experience with the L2 that participants can be far from native-like (Baker, 2010). DeKeyser mentions that it is important to test subjects who rarely have an opportunity to use their L1

because it could lead to cross-language transfer. Cross-language transfer is easily a possibility in the current study, because Spanish is a common language in the area where the participants were tested and they could theoretically manage day to day life by not learning English.

Table 5.3
Amount of L2 use by AOA group (mean, (SD))

	10-19	20-29	30-39	40+
Amount of L2 use (in percentage of time)	76% (18.7)	34.7% (24.38)	31.8% (15.99)	38.4% (37.68)

As discussed in Chapter 2, Flege has referred to this cross-language transfer as the Interaction Hypothesis. He concludes that it is impossible for a bilingual to control both of their languages as well as a monolingual of either language because the language systems interact with each other and may disrupt each other (Flege, 1999). This phenomenon was seen in the current study, in that those who spent more time using the L2 (the 10-19 AOA group) were more likely than the others to succeed on the EI proficiency test.

5.2.2 Affective factors.

There were no significant differences between groups in terms of affective factors in this study; however, there are still interesting conclusions that can be made from the results. The affective factors that were examined were motivation (rated on a scale of 1-10), what participants were motivated by, and degree of social integration. (For a more in-depth explanation of each of these factors, see Chapter 3, section 3.2.2.)

Strong motivation does not necessarily guarantee success, but it does appear that individuals who are more highly motivated to learn a second language succeed to a greater degree than those who are not motivated (Birdsong, 2007). All participants in this study reported

a similar degree of motivation (generally a 9 or 10 on a scale of 1-10), and there were not differences between groups on degree of motivation. Those who rated their motivation lower did tend to have lower proficiency scores (see Table 5.4); however, there were those who rated their motivation as high who also received lower proficiency scores. It is a possibility that motivation did not differ significantly across groups because of the methods used to measure motivation in this study. Participants were simply asked to rate their level of motivation on a scale of 1-10, and they would perhaps be hesitant to report lower levels of motivation to the native English-speaking researcher.

Table 5.4
Motivation rating and EI scores for less-motivated participants

Participant ID number	10026	10018	10027
Motivation (on a scale of 1-10)	4	5	6
EI score (80 possible points)	6	3	0

Some research has shown that the type of motivation can impact an individual's success in learning a second language. For this study, the reasons that participants gave for learning English were categorized as either external motivation (coded as 0) or internal motivation (coded as 1). Some researchers have also referred to these as instrumental motivation (or the desire to become proficient in the language in order to advance their career or for other practical reasons) and integrative motivation (or the desire to be more like the members of the L2 community and to feel a sense of belonging among them) (Krashen, 1981; Thompson, 1991). Only three participants in this study gave reasons for learning English that were deemed to stem from internal motivation (or in other words, integrative motivation). Because so few gave “internal

motivation" responses, there were no differences between groups for this factor, but those who did respond with internal motivation tended to score higher on the proficiency test. Two participants in the 20-29 AOA group gave internal motivation responses; one of them received a score of 44 on the EI (the second highest score of the group). The other received a much lower score of 16. One participant in the 40+ group gave an internal motivation response, and they received 18 points on the EI proficiency test – the highest score in that group.

The final affective factor tested in this study was social integration. Masgoret and Gardner (2003) argue that only learners who desire to be integrated with the new community and have a positive attitude toward the learning environment are likely to succeed. Likewise, Dörnyei and Skehan (2003) mention the belief some researchers have that attitudes toward an L2 community can "exert a strong influence on one's L2 learning" (p. 613). Additionally, Klein (1995) suggests that one reason for fossilization (specifically in pronunciation) could be that the learner wants to keep their social identity with their L1 community and culture and uses this non-conformity to maintain that social identity. For this study, participants were asked to rate their agreement on a scale of 1-10 with the following statements (see Chapter 3, section 3.2.2 for a more in-depth explanation):

1. I like living in the United States.
2. I feel part of the American culture.
3. I prefer to speak English more than Spanish.
4. I miss my home country.
5. I am American.

There was not a significant difference between groups on their social integration score. The 10-19 group had a slightly higher score than the other three groups which is not surprising, considering they came to the United States at an earlier age and therefore have more experience with the language and culture.

5.2.3 Cognitive factors.

The cognitive factors tested in this study were musical experience, musical ability, working memory capacity, and attentional control (task-switching). Research suggests that music and language might have similar brain processing (Gilleece, 2006; Slevc & Miyake, 2006; Koelsch & Siebel, 2005; Levitin & Menon, 2003); hence musical ability was considered to be a cognitive factor. Posedel et al. (2012) hypothesize that musical training might be most beneficial for later learners who have already passed the critical period. The four groups did not differ in their musical experience (i.e. no music (coded as 0), experience singing (coded as 1), experience playing an instrument (coded as 2)). Table 5.5 shows the percentages of each group that reported having experience in each musical category.

Table 5.5
Group percentages for musical experience

	10-19 group (n=8)	20-29 group (n=9)	30-39 group (n=13)	40+ group (n=8)
No music	25%	67%	31%	50%
Singing	12%	11%	31%	38%
Playing an instrument	63%	22%	38%	12%

In their reported self-assessed musical ability (on a scale of 1-10), the differences between groups was approaching significance ($F(3) = 2.248$, $p = 0.1$). The differences would have possibly been greater if actual musical ability had been tested, rather than self-assessed musical ability; however, that measure was outside the scope of this study. This will also be discussed more in the following section under the third research question.

Working memory capacity was another of the cognitive factors tested in this study. Previous research says that working memory is a vital aspect of human cognition and a "distinct structural component of the cognitive system" (Richardson, 1996, p. 121). It has been described

as being “fundamental in understanding intellectual performance” and as being “of crucial importance in explaining variations among individuals and among groups of individuals” especially in how they respond to cognitive demands and issues (Richardson, 1996, pp. 147-148). In this study, the differences between groups weren't significant for working memory, but the 10-19 group scored highest (7.4) on average, followed by the 20-29 group (5.5), then the 30-39 group (4.4), and finally the 40+ group (3.6). Their scores did steadily decline as AOA increased, and the differences between groups approached significance (F =1.992, p = 0.117). This may suggest that working memory declines over the life span and might therefore be one of the reasons language learning declines over time, even though the working memory differences between AOA groups in this study were not significant. Greater differences might have been observed had the sample size in this study been larger.

The final cognitive factor tested in this study was attentional control. This was done using a switch task in the form of a lexical decision task. According to Segalowitz and Freed (2004), speed and efficiency of lexical access along with speed and efficiency of attentional control are both “cognitive abilities that potentially interact with learning experiences in a dynamic way” (p. 176). In addition, age-related differences have been found when participants perform switch tasks (Kramer et al., 1999). In this study, no significant differences were found between AOA groups on the switch costs (F= 1.01, p = 0.399). As stated already in Chapter 4, the switch cost was found for each individual by averaging the “yes” and “no” response times and then subtracting the “mv” response time from that. The 10-19 group had the lowest average switch costs (0.285 seconds), even lower than the native English group (0.328 seconds). The oldest group (40+) unsurprisingly had the highest average switch cost (0.847 seconds) although there was a good deal of variation in their switch cost times (standard deviation: 0.714 seconds).

Bialystok (2010) found that bilingual individuals had better attentional control and were more adept at switching between cognitive tasks. In the present study, only some participants would most likely be considered bilingual (having good control of both of their languages) and none of the 40+ AOA group could be put into that category.

5.2.4 Summary.

The greatest differences between groups were found in demographic factors. While there were some minor differences between groups on both affective and cognitive factors, they were not statistically significant. The specific demographic factors that held significant differences between groups were age of onset of acquisition and amount of L2 use. The fact that significant differences were not found between groups on affective and cognitive factors does not necessarily indicate that, for example, all 20-year-olds and all 40-year-olds are equally motivated or have equal cognitive capacities. There are definite possibilities that there are differences in the way each individual learned the language that might have differentiated the groups that were not examined in this study. For example, some individuals might have learned the language implicitly, without any formal training, while others might have attended courses and had explicit instruction.

5.3 Research Question 3

As evidenced by the results of the previous question, there are significant differences between the groups in demographic factors, and minor differences between groups in affective and cognitive factors. The goal now of question 3 is to determine which of those factors best predict the learners' L2 proficiency (EI) scores. Because of the small sample size in this study, the results to this question are somewhat tenuous and can only be suggestive of what might happen with a larger group. When AOA was not included in the multiple regression, the

significant variables were average L1 use, switch costs, and LOR explaining 65.2% of the variance (R^2adj=.652). As stated in Chapter 4, the less the participants used their L1 (Spanish), the faster they were able to switch tasks, and the longer they had been living in the United States, the better their proficiency score. When age of onset was included, the predictor variables were AOA, average L1 use, and switch costs, explaining 77.5% of the variance (R^2adj=.775). Hence, demographic factors (AOA, LOR, and amount of L1 use), along with one of the cognitive factors (switch cost) were best able to predict the proficiency scores of the participants. Affective factors did not play an apparent role in this study; however, other studies of adults suggest that they can play a role (Bongaerts, 1999; Dörnyei & Skehan, 2003).

Previous research corroborates this viewpoint. Hyltenstam and Abrahamsson (2003) state that "the consistent pattern observed in a number of ultimate attainment studies – for example, Asher and Garcia (1969), Oyama (1976, 1978), and Patkowski (1980) – is a significant correlation between AOA and ultimate L2 outcomes, while other factors, such as length of residence (LOR) and degree of motivation, cannot account for the variation in ultimate attainment" (p. 547). Unlike these previous studies, I found that LOR was a predicting factor (a longer LOR could indicate a greater amount of input). However, similar to these studies, I found that degree of motivation, reasons for motivation, and attitudes toward the L2 community could not explain the variance.

It is possible that greater correlation would have been found between proficiency and some of the factors examined in this study if rigorous tests had been used. For example, both motivation and musical ability were self-rated. Studies often do self-assessments and they have been found to be valid to some extent (Hakuta et al., 2003; Hakuta & D'Andrea, 1992; Birdsong, 1992). For musical ability, some might not be aware that they have certain abilities, and assume

that because they have had no formal training, they are not musically talented. Slevc and Miyake (2006) pointed out that "several studies failed to find a clear link between self-ratings of musical ability and L2 ability (Flege, Munro, & MacKay, 1995; Flege, Yeni-Komshian, & Liu, 1999; Tahta, Wood, & Loewenthal, 1981; Thompson, 1991)" (p. 675). Although rigorous musical tests were outside the scope of this study, there is a possibility that had they been conducted, a greater connection would have been found between L2 proficiency and musical ability (Slevc & Miyake, 2006).

5.4 Limitations

As with all empirical research, this study has a number of limitations. First, the sample size was smaller than would be ideal with this type of study, with only 38 total non-native English speakers, and 8-13 in each subset group. In conjunction with this, the subject-to-variable ratio was lower than the minimum recommended 5:1 ratio for multivariate analyses by Thompson (1990). Approximately 11 variables were tested in this study, making the subject-to-variable ratio about 3:1. In addition, there was a strong gender bias towards women, as discussed in Chapter 3, section 3.1. This might have affected some of the answers that participants gave to some of the questionnaire items, especially for the male participants since the researcher was female. Another limitation came from the fact that it was possible not all of the non-native English speakers understood all of the instructions for each task; however, all possible measures were taken to ensure that participants understood the instructions for each task and, with very few exceptions, all were able to adequately perform the tasks. According to Erlam (2006) and Baddeley et al. (1998), "results … suggest that the capacity of working memory is determined by the stored knowledge that already exists about the language" (Erlam, p. 468). For the backward digit span test, all participants demonstrated that English numbers were a part of their already-

existing English knowledge, especially since the numbers used were only from 1-9. Another possible limitation could have been that percentage of time speaking the L2 and amount of L2 use might not necessarily be completely equivalent. For example, it is probable that some of the categories asked about (i.e. speaking with friends and family) might be weighted more than other categories (i.e. speaking at church/in the community). Additionally, just because a participant reports spending X percent of time speaking with a certain group does not mean they were always the one using the language. Finally, three of the participants had an LOR of less than one year, which could have possibly had an effect on the results. However, as seen by figure 4.2 in Chapter 4, there are not really any "outliers" or people who, despite their age, scored exceptionally well or exceptionally poorly. This suggests that the differences in LOR for the older AOA groups might not be significant.

5.5 Further Research

Many of the limitations listed in the previous section could be addressed in further research to improve the findings found here. Additionally, it would be interesting to focus specifically on older learners. This study shows that there are indeed age effects among the older learners, and though I have found that demographic variables seem to be the most prominent factors in predicting L2 success, there is still much research that could be done in this area. Though this study focused specifically on syntax and overall proficiency, it would be interesting to evaluate the participants' pronunciation and add a pronunciation score to the data in order to observe the connections between pronunciation ability and overall proficiency. Future studies could also focus on various L1-L2 combinations to determine if the results found here hold across multiple languages, rather than simply L1 Spanish speakers learning L2 English. Finally, it would be instructive to add more rigorous musical tests to the factors tested in this study.

5.6 Conclusion

In conclusion, though there are limitations present in this study as there necessarily must be in all empirical research, the results of this study add valuable material to the body of knowledge already existing in this field. First, it is possible that the shape of the age of acquisition-ultimate attainment function could be a combination of shapes previously set forth. Specifically, it might contain both a sharp drop in proficiency around the age of 20 in addition to a gradual decline for AOAs later than 19, as explained in the discussion for the first research question (see Chapter 5, section 5.1). Secondly, the most significant differences between AOA groups tended to be in demographic factors, rather than affective or cognitive factors. Finally, demographic and experiential factors – specifically AOA, average L1 use (both negatively related), and LOR – played the most important role in predicting ultimate proficiency scores, with a cognitive factor (LDT switch costs) playing a secondary role.

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APPENDICES

Appendix A: Consent form in English and Spanish

Consent to be a Research Subject

Introduction
You are invited to participate in a research project focusing on adults learning a second language. This research is being conducted by Charisse Major, a graduate student, and Professor Wendy Baker Smemoe, PhD, at Brigham Young University. The purpose of this research is to determine what factors affect adults learning a second language. You were invited to participate because you are a native Spanish speaker learning English and because you began learning English after the age of 30.

Procedures
This activity will take approximately 20 minutes to complete. There are three activities you will participate in:

- You will fill out a short survey about your language background
- You will participate in a short five (5) minute memory task
- You will listen to and repeat English phrases for about five (5) minutes. During this section you will be recorded.

The researcher will come to your location to do these three tasks.

Risks/Discomforts
There are minimal risks for participation in this study. You may, however, feel some discomfort when answering questions or when being audio recorded. If you feel embarrassed or uncomfortable at any time during the study, you may choose to excuse yourself from the study.

Benefits/Compensation
There will be no direct benefits to you for your participation. It is hoped, however, that through your participation researchers may learn about practices and strategies that might be able to assist other adults learning a second language. As a participant your name will be entered into a drawing for one of three prizes: either a $50 gift card to the location of your choice or one of two $25 gift cards to the location of your choice. If you win a prize, you will be informed after all the data has been collected.

Confidentiality
Your performance on this activity will be kept strictly confidential and any publication or presentation on the results of this study will only refer to participants by number or as an entire group. The research data will be kept on a password protected computer and only the researchers will have access to the data. At the conclusion of the study, all identifying information will be removed and the data will be kept in the researcher's locked cabinet.

Participation
Your participation in this activity is voluntary. You have the right to stop at any time or refuse to participate.

Questions about the Research
If you have questions about this study, you may contact Charisse Major at 1564 Moon River Dr. #9; Provo, UT 84604 (801) 850-2528; scottishlassy@gmail.com or Wendy Smemoe at (801) 422-4714;

wendy.smemoe@byu.edu for further information.

Questions about Your Rights as a Research Participant
If you have questions regarding your rights as a research participant, please contact IRB Administrator at (801) 422-1461; A-285 ASB, Brigham Young University, Provo, UT 84602; irb@byu.edu.

Statement of Consent
I have read, understood, and received a copy of the above consent and desire of my own free will to participate in this study.

Name
(Printed):_____Signature:_____Date:_____

Aprobación Para Ser Sujeto del Estudio

Introducción
Se le invita a participar en un proyecto de investigación enfocado en los adultos que están aprendiendo un segundo idioma. El estudio se dirige por Charisse Major, una estudiante graduada, y la Profesora Wendy Baker Smemoe, PhD, de Brigham Young University. El propósito de este estudio es determinar qué factores afectan a los adultos que están aprendiendo un segundo idioma. Se le invitó a participar por ser un nativo hablante del español quien está aprendiendo el inglés, y porque empezó a aprender el inglés después de tener treinta años de edad.

Procedimiento
Esta actividad tomará apróximadamente 20 minutos para completar. Habrá tres actividades de que participará:
- Llenará una encuesta breve acerca de su experiencia con su idioma.
- Participará en una actividad de memoria que tomará cinco minutos.
- Tendrá que escuchar y repetir las frases de inglés por cinco minutos. Esta sección será grabada.

El investigador irá a su localidad preferida para hacer estas tres actividades.

Los Riesgos/Incomodidades
Si participa en este estudio, los riesgos serán mínimos. Sin embargo, es posible que se incomoda o se inquieta al contestar las preguntas mientras están grabando su voz. Si se avergüenza o se incomoda, en cualquier momento, se puede escoger retirarse del estudio.

Los Beneficios/Compensación
No se le beneficiará directamente a Ud. al participar en este estudio. Sin embargo, esperamos que por medio de su participación los investigadores aprenderán prácticas y estrategias que quizás podrán ayudar a otros adultos quienes están aprendiendo un segundo idioma. Como participante, su nombre se ingresará en un sorteo para ganar uno de tres premios: Una tarjeta de regalo de $50 del lugar de su preferencia, o una de dos tarjetas de regalo de $25 al lugar de su preferencia. Si Ud. gana un premio, se le informará después de recibir todos los datos del estudio.

Confidencialidad
Los resultados y respuestas de las actividades serán guardados estrictamente confidenciales y cualquier publicación o presentación sobre los resultados de este estudio se referirá a los participantes solamente por el número o el grupo entero. Los datos de este estudio serán guardados en una computadora protegida con una contraseña y los investigadores son los únicos que tendrán acceso a la información. Al concluir el estudio, toda la información que se identifica a los participantes será quitada de los datos, y los datos serán guardados en un gabinete cerrado con llave.

Participación
Su participación en estas actividades es voluntaria. Tiene el derecho de retirarse del estudio en cualquier momento, o rehusar participar.

Preguntas Sobre El Estudio
Si tiene preguntas sobre este estudio, pueda contactar a Charisse Major, 1564 Moon River Dr. #9; Provo, UT 84604. (801) 850-2528; scottishlassy@gmail.com o Wendy Smemoe, (801) 422-4714; wendy.smemoe@byu.edu para obtener mayor información.

Preguntas de Sus Derechos Como Participante de Este Estudio
Si tiene preguntas concernientes a sus derechos como participante de este estudio, favor de ponerse en contacto con el administrante del IRB (801) 422-1461; A-285 ASB, Brigham Young University, Provo, UT 84602; IRB@byu.edu.

Declaración de Consentimiento
Yo he leído, comprendido, y recibido una copia del consentimiento describido arriba, y deseo participar en este estudio de mi propia voluntad.

Nombre (Imprimido)_____Firma:_____Fecha:_____

Appendix B: Questionnaire

Questionnaire

1. Where were you born? _____
2. How long have you lived in the United States?_____
3. When did you begin learning English? _____
4. When is your birthday (dd/mm/yyyy)? _____
5. What is your educational background? (Ex: Didn't complete high school, High school, Some college, Bachelor's degree, Post-graduate work, etc.)
6. What was/is your job? _____
7. Has your employment changed since coming to the United States? If so, what was it before? _____
8. Please decide how much English and Spanish you use in the following situations (% scales from 10% to 100%):

Talking to my children

English:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Spanish:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Talking to my spouse

English:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Spanish:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Talking to friends

English:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Spanish:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Talking at church

English:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Spanish:	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

9. Rate your ability to speak Spanish on a scale from “1” (I can’t speak Spanish at all) to “10” I

speak Spanish like a native speaker.

1 2 3 4 5 6 7 8 9 10

10. Rate your ability to speak English on a scale from "1" (I can't speak English at all) to "10" I
speak English like a native speaker.

1 2 3 4 5 6 7 8 9 10

11. On a scale of 1 to 10, how motivated are you to learn English? (1 = not motivated at all, 10 = very motivated to learn)

1 2 3 4 5 6 7 8 9 10

12. What motivates you to learn English?

_____

13. On a scale from 1 to 10, please rate your agreement with the following statements (1 = I don't agree at all; 10 = I agree completely)

1. I like living in the United States. 1 2 3 4 5 6 7 8 9 10
2. I feel part of the American culture. 1 2 3 4 5 6 7 8 9 10
3. I prefer to speak English more than Spanish. 1 2 3 4 5 6 7 8 9 10
4. I miss my home country. 1 2 3 4 5 6 7 8 9 10
5. I am American. 1 2 3 4 5 6 7 8 9 10

14. Do you play a musical instrument or sing —if so, what do you play?

_____

15. How long have you played it (or how long have you been singing)?

_____

16. Rate your musical abilities on a scale from 1 (I don't have any musical abilities) to 10 (I am very good at music)

1 2 3 4 5 6 7 8 9 10

Appendix C: Working memory task stimuli

Participant: _____ Date: _____ Test #:_____

ENGLISH DIGIT-SPAN BACKWARDS (WORKING MEMORY TASK)

DISCONTINUE RULE	RECORDING	SCORING RULE
After scores of 0 for 2 trials of an item	All responses verbatim	1-correct 0-incorrect

Span	Trial	Stimulus	Correct response	Actual response	0 or 1
2	a	6-1	1-6		
	b	8-9	9-8		
3	a	7-2-6	6-2-7		
	b	3-0-6	6-0-3		
4	a	7-8-4-3	3-4-8-7		
	b	3-9-2-7	7-2-9-3		
5	a	6-0-7-4-8	8-4-7-0-6		
	b	4-5-7-6-8	8-6-7-5-4		
6	a	4-5-1-6-0-3	3-0-6-1-5-4		
	b	4-8-9-7-3-0	0-3-7-9-8-4		
7	a	6-4-9-7-1-3-5	5-3-1-7-9-4-6		
	b	4-9-7-6-3-8-5	5-8-3-6-7-9-4		
8	a	8-4-5-0-3-6-2-1	1-2-6-3-0-5-4-8		
	b	9-1-7-5-3-2-4-8	8-4-2-3-5-7-1-9-		
9	a	9-5-6-3-8-0-1-9-2	2-9-1-0-8-3-6-5-4		
	b	8-7-3-5-0-6-4-9-2	2-9-4-6-0-5-3-7-8		
10	a	6-8-9-1-3-7-2-4-0-5	5-0-4-2-7-3-1-9-8-6		
	b	7-1-6-5-0-2-9-3-8-4	4-8-3-9-2-0-5-6-1-7		

Total Score: _____ (0-18)

Absolute Score: _____

Appendix D: Lexical Decision Task stimuli

Trial	Stimuli	Word	Correct Response
1	48	Noil	2
2	70	Sing	1
3	36	Lazz	2
4	33	Hit	3
5	64	Pull	3
6	17	Dat	2
7	22	Fed	1
8	29	Gree	2
9	61	Pool	3
10	74	Thaug	2
11	56	Pill	3
12	45	Miss	1
13	1	Ball	3
14	79	Weem	2
15	72	Spa	1
16	51	Pad	1
17	46	Mock	1
18	43	Maid	3
19	30	Had	1
20	11	Boot	3
21	49	Nowk	2
22	67	Red	1
23	32	Hill	1
24	12	Bowce	2
25	14	Cheeth	2
26	47	Mun	2
27	78	Vru	2
28	6	Bed	3
29	28	Gice	2
30	15	Cop	1
31	21	Dull	3

32	62	Pot	3
33	60	Pool	3
34	8	Biss	2
35	66	Rat	1
36	5	Bead	3
37	23	Feeg	2
38	52	Pail	3
39	35	Kowf	2
40	7	Bell	3
41	44	Milk	1
42	13	Bug	3
43	16	Crow	1
44	4	Bame	2
45	54	Peel	3
46	27	Gang	1
47	19	Downg	2
48	58	Pole	3
49	65	Pull	3
50	2	Bang	1
51	59	Pole	3
52	41	Mab	2
53	34	Jek	2
54	57	Pim	2
55	25	Frog	1
56	31	Hill	3
57	37	Lend	1
58	38	Lipe	2
59	76	Voof	2
60	68	Sand	1
61	3	Bat	3
62	50	Pab	2
63	53	Pail	3
64	75	Thoss	2

65	42	Maid	3
66	81	Zoo	1
67	55	Peel	3
68	69	Self	1
69	26	Gal	3
70	40	Limp	1
71	77	Vop	2
72	39	Lid	1
73	63	Pot	3
74	10	Book	3
75	73	Sun	1
76	80	Wind	1
77	82	Zut	2
78	20	Drop	1
79	24	Fox	1
80	71	Slee	2
81	18	Dayce	2
82	9	Boat	3

Note: The “trial” column lists the order in which each word was presented during the actual task. The “stimuli” column is where each of the words would appear in alphabetical order. The shaded words were spoken by a male. Correct response coding: 1 – yes (item is a real English word), 2 – no (item is a non-word), 3 – MV (male voice). Some of the male voice words appear twice in the list.