Motivating Senior Native Spanish Speakers learning English through an Educational Game

by

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Abstract

Many people believe that the younger you are, the easier it is to learn a second language. This project explores methods for motivating senior native Spanish speakers learning English. Current literature was surveyed with a concentration in language acquisition and literacy, cognition, cultural and motivational factors, and sensory-motor characteristics for older adults. The majority of existing literature focuses on younger populations, so further research into older generations learning English as a foreign language is needed. Moreoever, with regard to basic literacy research, the focus has been on people in their native languages, not English as a second language (Bigelow, & Schwarz, 2010). I sought to test the theory that senior native Spanish speakers would be more motivated to learn English through narrative-based learning as opposed to standard translation learning. I tested both education methods as used in Duolingo, a language-learning app, on my sample of participants and gauged their satisfaction and motivation rates. I learned that subjects were more satisfied with the narrative-based lessons than the standard translation lessons. Higher satisfaction levels are likely to correlate with the participants likelihood to continue using Duolingo. Repeated and regular involvement in language learning activities has been shown by other researchers to increase retention and may ultimately lead to a higher likelihood of learning English as a second language. Roughly 6% of the U.S. population, or 18.5 million people, are Spanish speakers who assess their English proficiency as inadequate. As the baby boomer generation grows exponentially each year, there is a growing market for second language education geared toward older adults, and current free tools can be optimized for this specific audience.

Keywords: senior native Spanish speakers, native language (L1), second, or foreign language (L2), English as a Second Language (ESL and ESOL), Limited English Proficient (LEP), adult cognition, motivation, gamification, human-computer interaction, usability, accessibility

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Motivating Senior Native Spanish Speakers learning English through an Educational Game

It is estimated that 41 million U.S. residents, or 13.4% of the population, speak Spanish. Of this population, roughly 22.5 million, or 55%, reported they also speak English "very well" as classified by the U.S. Census Bureau (CNN, 2019). Therefore, it can be surmised that approximately half the Spanish-speaking population in the U.S., or 18.5 million people, would assess their English proficiency as less than adequate. This population, referred to as the Limited English Proficient (LEP) population, is often characterized as less educated and more likely to live in poverty compared to the English-proficient population. It is estimated that about 25% of the LEP population brought in an annual household income below the poverty line in 2013 (Zong, Zong & Batalova, 2017). Adult members of the Limited English Proficient population earn an average of $3,000 less per year per person as a consequence of poor English skills (Schwartz & Soifer, 2012). Their ethnicity relates directly to the degree to which they are poorer; 61% of immigrant Spanish speakers had incomes below the poverty line while 39% of non-Spanish speakers were below the poverty line (Schwartz & Soifer, 2012). As this growing segment of the U.S. population ages, the U.S.
Census Bureau estimates that nearly one in five U.S. residents will be 65 or older by 2030. Of the 65-and-older population in the U.S., the Hispanic population is growing most rapidly, projected to increase to 17.5 million during the next decade. This

population will make up 20% of all U.S. residents aged 65 and older, becoming the second largest racial/ethnic group (Vincent & Velkoff, 2010).

Mutchler and Brallier (1999) identify immigration history, socioeconomic background, and geographic area of residence as factors in English language proficiency. Unsurprisingly, they predict that older Hispanic people who have immigrated most recently and spent less time in the states than their peers, will be less proficient in English. Recently migrated Hispanics are almost 15 times as likely as their U.S.-born peers to have low levels of English proficiency. According to Chiswick and Miller (2015), determinants of language proficiency among immigrants relies on "exposure to the host country language, efficiency in learning a new language, and economic incentives for learning the new language" (p. 228).

Effects of Limited English Proficiency

Limited English language skills correlate with lower income levels. According to Tse (2001), "today's service-oriented economy requires English ability for all but the lowest paying jobs" (p. 25). Of the LEP population, employed men work in more construction, natural resources, and maintenance careers than English-proficient men and more LEP women work in service and personal-care occupations than English-proficient women. Chiswick and Miller (2007) report that among bilingual people, those who report speaking English "very well" make roughly 10 percent less than people who speak only English. The bilingual people who report speaking English only "well" earn roughly 25 percent less than those who only speak English.

The success of the LEP population in learning English not only has an impact on their individual future financial and educational success, but also on the economic prospects for their communities (Schwartz & Soifer, 2012). Abramitzky & Boustan (2017) attribute low wages not only to limited English proficiency, but also to non-transferable skills and the widening of income distribution, affecting lower skilled workers. Individuals who earn more money can spend more money, and thereby better support their local small businesses. Local businesses may opt for diverse neighborhoods where the likelihood of English-speaking workers and customers is higher than in socially isolated areas. Dayanim (2011) argues that this spatial reflection of the language barrier prohibits businesses in minority neighborhoods from connecting with larger economic activity. However, immigrants tend to move to ethnic enclaves where they have fewer opportunities to hear and speak English, even though there is a correlation between non-English speakers living in these linguistically isolated areas and lower income levels. One reason, among many others, may be that they have less access to information about career opportunities outside of the service industry (Chiswick & P.W. Miller, 2002 as cited in Schwartz & Soifer, 2012). Finally, Florida et al. (2011) also relates social intelligence skills, which are partly language dependent, with higher wages. Not only would learning English provide economic benefits to the LEP population directly, but it would also benefit their surrounding communities indirectly.

In addition to economic implications, limited English skills can affect social welfare. Tse observes the pressure for immigrants to learn English, stating that the U.S. culture is so heavily dependent on English, one feels the need to speak the language in order to feel accepted and empowered to contribute to society. Mutchler and Brallier (1999) note that a lack of English language knowledge relates directly to "poor adjustment, integration, and well-being," and can cause immigrants to feel socially isolated (p. 310).

Additionally, there may also be negative health implications for this population. Limited English proficiency is an obstacle to quality health care and is linked with poorer health outcomes in Latinos (Jacobs et al., 2005, as cited in Sentell & Braun, 2012). Health literacy can be characterized as the ability for an individual to acquire and comprehend basic health information in order to make informed decisions about their health (U.S. Department of Health and Human Services, 2000, as cited in Sentell & Braun, 2012, p. 1). For people who are isolated from health resources and services, such as routine screenings, there is a higher chance they will not receive the level of care obtained by those with access to these resources (Andrulis & Branch, 2007, as cited in Sentell & Braun, 2012). 44.9% of individuals with limited-English proficiency also have low health literacy, compared to 13.8% of English speakers with low health literacy (Sentell & Braun, 2012). Due to the language barrier, this population may have a difficult time communicating with health care providers and insurance agents, and their quality of care can be compromised. This is especially true for

people in nursing homes or hospitals who are completely dependent on the staff. In particular, older Hispanics with lower English proficiency rely on friends, relatives, or bilingual people working in the health care industry to communicate their needs (Mutchler & Brallier, 1999). Bilingual family members or friends may not always be available to help non-English speakers when they need it; this reliance on others to communicate impedes their independence. Thus, there is a need for this population to have access to language education to enable them to communicate, gain autonomy, and ultimately give them better access to quality health care.

Barriers to Learning

Ironically, the lack of English proficiency can be self-reinforcing. The lower-paying service jobs that are open to this population often require long hours, occupying time that could otherwise be spent learning the English skills that could ultimately lead to obtaining higher paying jobs. Moreover, when time is available for education, there are several factors that may impede students from enrolling, such as long waiting lists for English as a Second Language (ESOL) programs (especially the free ones), childcare costs, and travel expenses (Santos, 2009, as cited in Bigelow & Schwarz, 2010). Due to these limiting factors, there is a need to make education financially attainable and conveniently available. Tse supports this notion of the need for broad, free education that considers the restricted resources and employment burdens on second language learners (2001). She notes that current accessible and effective educational programs are often too costly and unable to support the large and ever-growing target population.

Another factor that frequently affects older adults wishing to learn a new language is cognitive decline and neurodegenerative dementias, such as Alzheimer's disease. Such cognitive diseases have been linked to language impairment, including the inability to speak several languages (Nanchen et al., 2017). Observations on language impairment in this population include fluency in written and verbal comprehension, and retrieval. Oftentimes, bilingual people with dementia may involuntarily switch to their dominant language when speaking in another language (Nanchen et al., 2017).

Approach

One approach to learning English is the use of game-based applications that can be accessed on smartphones or computers. This study examines the use of one of these applications, Duolingo, by native Spanish speakers learning English who were over the age of 55. The primary research question explores whether the use of stories in the Duolingo application does or does not increase user satisfaction for participants who used the application for a half hour. In addition to satisfaction rates, supplementary information about English proficiency and short-term memory capacity were also collected. I recruited native Spanish speakers who were learning English and over the age of 55. Each of them assessed their language proficiency and took a short-term memory test. I introduced all participants to Duolingo at the same entry level. All participants started with a placement exam to determine their proficiency level. Participants then performed the translation lessons in the level they placed. In addition to the translation lessons, half of my participants also performed the Duolingo Stories lessons which are narrative based. I recorded accuracy and satisfaction rates in order to determine whether

the narrative-based learning was more enjoyable than the translation lessons that did not involve narratives.

Chapter 2: Literature Review

As previously discussed, learning a second language provides important benefits for immigrants, including improved economic, social, and health outcomes. There are also cognitive benefits to learning a second language. This chapter first outlines the cognitive benefits and requirements for learning a second language, then effective methods of language learning, and finally the effects of age, gamification, and accessibility on second language acquisition.

Cognitive Benefits of Language Learning

Studies suggest that bilingual people perform better than monolingual people in inhibitory control and task-switching. Inhibitory control can be measured using the Stroop test, where color names are presented in text and colored. Monolingual people have less success naming the color of the text when the color and name of color do not match (for example, the word “purple” presented in the color orange) Marian & Shook (2012). Bilingual people can also switch tasks more rapidly than monolingual people. The example Marian and Shook (2012) provide is switching from categorizing objects by color to shape.

Marian & Shook (2012) also found that bilingualism affects sensory processes such as auditory attention. When monolinguals and bilinguals listen to speech sounds such as syllables while background noise is playing, bilingual participants had a larger neural response to the sound than their monolingual counterparts. It was also discovered that the higher the proficiency and earlier acquisition of a second language links to more gray matter in the part of the brain that controls language (Marian & Shook, 2012).

Bilinguals may have an advantage over monolinguals in staving off brain deterioration and cognitive decline. Additionally, Luk, Bialystok, Craik, & Grady's (2011) study found that older bilingual people had more white matter integrity and stronger connectivity compared to their monolingual counterparts. A study of bilingual and monolingual patients with Alzheimer's disease found that, on average, the monolingual patients showed signs of the disease and were diagnosed roughly five years earlier than the monolingual patients (Marian & Shook, 2012). These studies are largely correlational, but still suggestive.

Cognitive Requirements for Language Learning

Researchers believe short-term memory is more indicative than long-term memory with regard to second language development. Thus, researchers interested in second language development have consequently focused on studying short-term memory. Short term memory is crucial to language development due to its role in processing new information, such as words. Juffs theorizes that the larger the capacity to hold novel information in short-term memory, the more likely this information is to pass into long-term memory and thus truly be learnt (2006). Two theories of working memory that Juffs classifies are phonological working memory (PWM) and reading span memory (RSM). Phonological working memory can be measured in two ways. The first PWM test is often referred to as the digit span test and assesses how well participants can memorize lists of unrelated items through repetition (Ellis, 2001:34, as cited in Juffs, 2006). In this test, at every round, participants are presented with a constant five lists of words presented either orally or written that they must memorize and repeat. Participants

are first presented with five lists containing two words each. As the test progresses, the lengths of the five lists increase up to ten words in each. The second PWM test prompts participants to repeat non-words of different syllable length, and sometimes contain phonemes (or units of sound) in a language other than the participants' first language (L1) (Juffs, 2006). This test is meant to gauge participants' ability to encode novel sounds, as they are unable to access stored knowledge to aid them in the repetition aspect of the exam. Dufva & Voeten (1999) consider this second test of PWM to be closely related to acquiring vocabulary and oral skills in a second language (as cited in Bigelow and Schwarz, 2010).

The second theory of working memory, reading span memory (RSM), is meant to gauge participants' active cognitive storage and processing capacities simultaneously. This is measured by prompting participants to read lists of sentences and recall the final word of each sentence. Because both PWN and RSM tests measure different things, their data do not correlate and therefore they should not be compared (Baddeley & Hitch, 1974, as cited in Juffs, 2006). Reading span memory (RSM) is thought to decline with age whereas traditional digit and word span measurements of phonological working memory (PWM) do not.

Where RSM scores correlate with sentence comprehension, PWM scores do not (Juffs, 2006). One may hypothesize that the reason for this is because the information in PWM tests is not presented in a sentence structure as it is in RSM tests. Some studies indicate that the best predictor of success in L2 learning is an assessment of

working memory, measured by a non-word repetition exam (Ellis, 1996, as cited in Juffs, 2006).

Due to these study findings, one might consider tailoring a language acquisition study for older adults by using mostly PWM tasks and avoiding RSM tasks, which may have implications on the test design. However, the author, Juffs, notes that the results of these tests only reflect language experience versus capacity (2006). The differing amounts of capacity observed during the experiments may be attributed to the subjects' amount of exposure to text. It is unclear if PWM and RSM are related when it comes to second language learners. Particular to Spanish-speaking learners, studies showed a weak relationship between RSM and proficiency and a lack of relationship between PWM and overall proficiency (Juffs, 2006).

I used the digit span test, a phonological working memory (PWM) capacity test because it is regarded as a good measure of verbal short-term memory. Although the digit span test includes numbers instead of words, it deals with the order of those numbers instead of spatial short-term memory therefore it is a strong measure of working memory. As stated previously, according to some studies, a good indicator for second language acquisition success is a non-word repetition exam such as the digit span test I administered.

Determinants of Successful Language Learning

Goldstein (2015) asserts that one may just as easily learn two languages as they may learn one, if given similar circumstances. These circumstances include an intact cognitive system and a lush linguistic atmosphere to motivate the

learner. With regard to literacy and formal education, Bigelow and Schwarz (2010) observe that several adults who have had no formal training are able to learn new languages orally; casual settings outside of the classroom sometimes have a greater effect on success. They discovered success with L2 literacy acquisition when programs also focused on developing native languages (Ingersoll, 2001, as cited in Bigelow & Schwarz, 2010). Literacy means that the learner understands that speech can be represented in textual form and that this text communicates meaning (Robson, 1983, as cited in Bigelow and Schwarz, 2010). Literacy aptitude should be considered when accessing one's capacity to learn a second language. According to the original source, Wrigley and Guth (1992), factors such as age, motivation to read, environments, "sociocultural backgrounds, socioeconomic status, and learning abilities or disabilities… influence the literacy development of adults learning English" (p. 7), as cited in Burt, Peyton, and Adams (2003).

Bialystok attributes cognitive and academic progress in the native language as having a positive impact on foreign language acquisition (Bialystok, 1991, as cited in Craats, Kurvers, & Young-Scholten, 2006). Many countries do not frequently support bilingual educational programs, however successful these programs have proven to be in foreign language acquisition (August & Hakuta, 1997, as cited in Craats, Kurvers, & Young-Scholten, 2006). Gillespie (1994) advises teaching in the learners' native language to facilitate the learning experience by giving students the opportunity to

discuss issues comfortably rather than feel powerless in an English-only environment (as cited in Bigelow & Schwarz, 2010).

Blumenfeld, Quinzon, Alsol, and Riera (2017) conducted a longitudinal English education study of 53 older participants who spoke a native language other than English using a curriculum they developed. Their goal was to determine predictors of English proficiency and measure if participants could maintain their native language knowledge while learning a novel language, English. They found that digit span and orientation measures (to time, date, and place, memory, and naming), but not age, were cognitive determinants of English proficiency, while similarity of known languages to English, native language skills, and English language exposure were linguistic indicators of English skills. They discovered that much of new language acquisition in older adults is scaffolded by previous linguistic experiences in their native language. For instance, their curriculum consisted of context clues such as an image describing the English term. This afforded participants greater success in remembering the term because their former language provided an experiential baseline for acquiring the new language. The results of the study show that participants with a native language similar to English, such as Spanish, had greater success learning English as a second language. This is because they were more easily able to transfer knowledge they had built in their native language (Kaushanskaya, 2012).

Effective Methods of Language Learning

There is no one linguistic theory that determines successful language learning because there are so many contributing factors. The progression of research in this field

indicates that what we once thought were the most important features of language (vocabulary, grammar, and pronunciation) have evolved to include "pragmatic and certain sociolinguistic features" (Gass & Mackey, 2012, p.525). While many approaches to language teaching are regarded as effective, immersion learning is most widely considered the ideal effective method of learning a new language and preserving language (Nanchen et al., 2017). Based on researcher Swain's (1985, 1995) work with immersion students, she found that besides comprehensible input (the teachings of instructors), L2 learners need opportunities to practice output, or speaking and writing in the target language in order for successful acquisition (as cited in Gass & Mackey, 2012). There is no better way to practice target language than to be surrounded by those who speak that language. Juffs (2006) advises that success not only be measured by a unit as shallow as vocabulary knowledge, but by one's ability to acclimate to the desired culture. Immersion learning likely makes learners want to assimilate to the target culture due to humans' innate survival skills. Humans protect themselves by fitting in to their surrounding culture. When they appear different from the majority, they become vulnerable. The increased desire to assimilate may aid second language acquisition.

Conversely, classroom second language learning research has a theoretical and practical focus. The most common theoretical framework is the Input, Interaction, Output Approach which focuses on inputs for learners, their outputs, and how interaction results in modifications for both (Gass & Mackey, 2012). When compared to classroom learning, the laboratory setting yielded similar results, suggesting that setting matters

little for language acquisition. What's more telling is the tasks given to students and their resulting interactions that had the most effect on acquisition (Gass & Mackey, 2012). Historically, classroom learning has been criticized for focusing on formal features of language instead of communication and interaction. In recent years, classroom learning has switched its focus to emphasize the social interaction theory.

Interactionists theorize that language learning is attributed to both human faculties and the learner's environment (Nor & Rashid, 2018). It is believed that group interactions including "task-based learning and focus-on-form instruction" (p. 14) are responsible for learners' success (Gass & Mackey, 2012). Task-based language teaching allows learners to collaborate on accepting input, outputting a response in the target language, and receiving feedback (Ellis, 2003, 2009; Long, 2000; Samuda and Bygate, 2008 as cited in Gass & Mackey, 2012). In focus-on-form instruction, learners concentrate on linguistics, such as grammar.

Behaviorist theory attributes language acquisition to observation and conditioning. Learners respond to stimuli (copying their teacher) and are either positively or negatively reinforced. Repetition of this pattern results in learning. This theory is criticized by other linguistic theorists for being too simplistic (Nor & Rashid, 2018). Chomsky's (1976) Universal Grammar concept speculates that everyone has a language faculty and is consequently innately equipped for language learning (Nor & Rashid, 2018). According to Innatists, who believe that many human characteristics are innate, humans have built-in cognitive processes and are unaware they are learning a new

language until they use it to communicate. Innatists believe people acquire language through social interaction. Teachers may use "Foreigner Talk" similar to "Baby Talk" to make learners feel more comfortable by modifying their speech. They slow down their speech, emphasize their enunciation, and speak with a nurturing tone in an effort to make the information more comprehensible (Nor & Rashid, 2018). A study on young Malaysian students learning English found that they were more successful when the instructor presented information in this simplistic, non-threatening way (Nor & Rashid, 2018).

Effects of Age on Second-Language Acquisition

Age-related brain losses are represented in "structural shrinkage, loss of white matter integrity, and reduced functional connectivity", with particular impact on frontal and temporal networks (Kennedy et al., 2009, as cited in Chapman et al., 2013, p. 1). As mentioned previously, in Luk, Bialystok, Craik, & Grady's (2011) study, they discovered that older adults who were lifelong bilinguals had more white matter and stronger connectivity when compared to their monolingual counterparts. Language, executive function, attention, and memory are known to be associated with the frontal lobe of the human brain. Sound is processed in the temporal lobe, which is where auditory language and speech comprehension systems are located. This region also contains conceptual representations for semantic knowledge, essential for the use and understanding of language.

Anand et al. recognize cognitive impairment as an issue that "threatens functionality and quality of life in seniors" (2010, p.1). The authors claim that in order

to maximize mental capacity later in life, protocols that test high-order cognitive skills and complex reasoning must be identified and examined for their effectiveness (Anand et al., 2010). Such high-order cognitive thinking can be classified as gist reasoning, the ability to generate novel ideas and deep interpretations from verbal or auditory information. With the prolonged lifespan of the world's aging population, Chapman et al. (2013), sought to determine if it is possible to take steps toward extending cognitive span to be equivalent to the prolonged life expectancy. Chapman et al., 2013, designed a training program to see if it could increase brain plasticity and measure executive functions such as conceptualization and abstract thinking. Over the 12-week training course, cognitively healthy senior participants had their cerebral blood flow (CBF), functional, and structural connectivity measured via magnetic resonance imaging (MRI) to examine any brain changes. The gist reasoning training program measured cognitive processes including attention, reasoning, and innovation (Chapman et al., 2013). The training prompted participants to perform strategic, top-down processing of complex information into abstracted meanings (Anand et al. 2011, as cited in Chapman et al., 2013). Participants were presented with everyday information such as medical information and newspaper articles, then asked to solve problems and synthesize goals in the context of their personal lives. This study found that strategy-based cognitive training may have a beneficial impact on preventing and potentially reversing age-related brain decline. Specifically, the cognitive training involved had considerable usage of lengthy

language-based materials as well as rich visual stimuli where participants were required to construct novel and abstract interpretations.

While there is much debate over the critical period for learning a new language, Juffs argues that motivation, exposure, and culture have more influence over success than age. Though literate native speakers test better in second language acquisition than their counterparts (Bigelow and Schwarz, 2010), Juffs found that non-literate native speakers have been successful at learning a second language and thereby become literate in their non-native language (2006). The author adds that this would be impossible if a critical period for learning a new language truly existed (Juffs, 2006).

Motivation and Gamification

Unsurprisingly, gamification has been used as an aid to many forms of education. Many successful language learning software presents information in a game-like setting (Duolingo, Babbel, and Memrise to name a few). According to Craats, Kurvers, and Young-Scholten (2006), second language acquisition has primarily been "studied on the basis of oral production, as spoken language is seen as the essential manifestation of language" (p. 11). Gardner and Lambert (1972) identify two forms of language learning motivation: integrative and instrumental, as cited in Alsayed, 2003. Students with integrative motivation are motivated by external factors. They want affirmation from the people in the target culture (of the language they are learning) and seek to assimilate. This type of motivation is effective in classroom settings where there is a culture around learning (Alsayed, 2003). Instrumentality as a motivational factor is where the learner

desires to use language as an instrument, or tool, to progress in their career or everyday life (Lorenset, 2018). Instrumental motivation is a better indicator of success in foreign language learning than integrative motivation (Alsayed, 2003). This relative success may be driven by the fact that instrumental motivation is generally connected to internal desires and goals rather than to strictly external factors. Thus, for instrumentally motivated learners, a social aspect to an educational game would generally be less desirable whereas it would be a stronger motivational factor for integrative learners.

There is much evidence that demonstrates that computer assisted learning is more effective, engaging, and motivational than traditional educational methods. Wang et al. (2008) pinpoint relationships, immersion, and achievements as reasons why people play digital games (as cited in Lorenset, 2018). Lorenset studies how Computer Assisted Language Learning (CALL), digital games and motivation relate to language learning. Some of the appeal that digital games have for learners are narratives, challenges, and goals which make games enjoyable. Part of what makes them effective is their prompt feedback and interactions, contributing to the maturation of players' cognitive processes (Lorenset, 2018). Digital games force the learner to become an active participant and create an opportunity for the gamer to produce an identity separate from that of their physical being. Gee (2005) distinguishes this ability to create and live as a separate identity in a virtual reality as a motivational factor for gamers (as cited in Lorenset, 2018). In this virtual world, learners can play as their 'ideal L2 self' or their ideal self-image as described by Dornÿei (2005) and cited in Lorenset (2018). The self-

determination theory attributes autonomy, competence, and relatedness as major factors of motivation (Deci and Ryan, 1985, as cited in Lorenset, 2018).

Rivera Barreto (2018) also identifies collaboration and relationships among students as motivational factors when learning English as a foreign language so these are key elements that should be considered when designing a language educational program. The author also recognizes the emotional draw that virtual gaming can have on students as a motivational factor. She advises providing context through authentic experiences for students to increase motivation and make learning applicable for students. In her studies, she found that Information and Communication Technologies (ICT) strengthened students' feelings of responsibility toward tasks, boosting their confidence and independence (Rivera Barreto, 2018).

Accessibility and Usability Considerations for Older Adults

Burmeister (2010) sought to discover the value that senior participants placed on their social interactions within an online community. He used a human computer interaction (HCI) methodology called value sensitive design (VSD) that examines the values users' place on socialization in the virtual realm. Contrary to Kurniawan's (2008) study suggesting that older adults are unable to adapt to complexity, Burmeister (2010) proposes a slow introduction to considerable website changes for this population. He found that sudden, substantial change can be cognitively challenging for older adults. His findings contrast the aforementioned sociolinguistic theories that emphasize social context and interaction to facilitate language learning. He recommends more focus on mechanical cognition, involving information processing and

learning, and less on communication and social interaction (Burmeister, 2010). He also found that flat navigation and memory aids proved to be most helpful to his demographic.

Callari, Ciairano, and Re (2012) observe that many available applications are designed to be technology-driven instead of user-driven and are, subsequently, not accessible to older people. They studied the extent to which older people could train their bodies and minds concurrently through various exercises. They found that older participants were more likely to make use of technological devices when they perceive them as user-friendly. Participants' interest and motivation also increased when devices provided them with timely feedback (Callari, Ciairano, and Re, 2012). They advise that designers consider the socio-demographic, economic and cultural changes of older adults, as they are a valuable population to study in the technology space. Designers should focus on the usability for "older people with specific physical characteristics (e.g. physiological limitations in sight, hearing, movement) and cognitive processes" such as selective memory (Callari, Ciairano, and Re, 2012, p. 367). They stress that these systems should be convenient and easy to access and use, in order to lessen the barrier to wider use among older generations.

I employed many of the principles mentioned in this chapter in order to put the supporting research into practice for my study. I tested the effectiveness of a language learning application amongst older adults to see whether age was a determinant for second language acquisition as supporting research denies it as such. I chose to use digit

span as a measure of working memory for my participants since studies have found it to be a strong indicator of successful second language acquisition. Where an immersive setting may not always be practical for the average second language learner, an emphasis on the most effective aspect of immersion learning, socialization, is a more accessible feature to offer in a language learning application. This emphasis would serve integrative learners, who seek to assimilate and are motivated by external factors. I studied narrative as a motivator for learning as some studies in the supporting research suggest it is.

Chapter 3: Methods

Participants

The 12 participants in this study were native Spanish speakers over the age of 55, with some English as a second language. Participants' average age was 66. Remote participants also needed a device from which they could sign into the test environment and an internet connection for the duration of the test. English proficiency ranged from little knowledge to some knowledge as judged by each participant in a self-evaluation. Seven participants reported little use of English; five reported medium usage of English. Participants included seven women and five men, with ages ranging from 55 to 79 with an average age of 66. Ten participants hailed from Maryland while two lived in Nevada. Native dialects included Mexico, El Salvador, Cuba, Colombia, Bolivia, and Peru. Formal education ranged from high school to undergraduate; participants were evenly split between those with a high school education and those with college experience. Participants were asked if they had prior experience with Duolingo or similar language learning software. Written informed consent was provided by each participant, and participants received $10 Amazon gift cards for participating in this study.

Materials

Three pre-tests were administered before participants began the usability test. Participants completed the Language Experience and Proficiency Questionnaire (LEAP-Q), which gathered self-reported proficiency and experience data from bilingual and multilingual speakers (Marian, Blumenfeld, & Kaushanskaya, 2007). Then I administered

the Montreal Cognitive Assessment (MoCA) in Spanish, which is a cognitive assessment to detect cognitive impairment. Lastly, participants took an online digit span test, a phonological working memory test, to measure working memory capacity. These assessments were conducted to gauge cognitive ability and English language proficiency. The MoCA and LEAP-Q were made available in both Spanish and English and participants were allowed to opt out of any question they didn't feel comfortable answering. Participants then used a language learning application, Duolingo, on which users selected answers to questions. Participants shared their screen with me using Zoom meetings and sessions were recorded on-screen to capture clicks and via an optional video recorder when possible to capture body language and spoken words. Scores, attempts for assistance, clicks, and verbal comments were recorded by myself as the moderator.

Design

This study followed a pragmatic approach to methodology with the central assumption being that users of the application learned information and retained it more successfully than if they had not used the application, and that repeated usage of the application would lead to more learning and retention than one-time usage. Both qualitative and quantitative data was collected in a convergent mixed method to provide the most holistic view of the research problem (Creswell & Creswell, 2018). Before the test began, I gathered data on self-reported English proficiency and experience, scores from a cognitive assessment, and scores from a digit span test. I collected quantitative performance data which consisted of language proficiency test

scores from within Duolingo, including failed attempts, requests for assistance either through the app or myself, and number of times pronunciations of words needed to be repeated. After participants used the application, I collected quantitative survey data in the form of Likert scale questions, multiple-choice, and open-ended questions where participants evaluated Duolingo. I performed standard deviation and confidence intervals on the Likert scale questions. The dependent variable in this experiment was satisfaction ratings and the independent variable was Duolingo Stories. Scores from the performance test were analyzed using a paired t-test. Content analysis was performed on the open-ended questions and qualitative data such as comments or questions from participants was collected during testing.

Procedure

Participants took the cognitive and literacy assessments and then began to interact with the Duolingo program. Participants signed consent forms and were given the option to opt out of the video recording. Remote participants were asked to download the Zoom meeting app at the time of recruitment, and I made sure before we began that they could use the app successfully. Participants were asked to share their screens during the test. They had the option of downloading the Duolingo app or going to the web application and signing in with my test account information. Participants were asked to connect to the internet and turn up the volume on their devices before beginning. Each participant started with the placement test within Duolingo to assess their level of comprehension. Participants were then asked to take the lessons in order in the level that

the placement test assigned them. Participants progressed to more difficult levels as they completed lessons.

The control group received six traditional Duolingo lessons and the experimental group received three traditional Duolingo lessons supplemented by three Duolingo Stories lessons. Traditional lessons typically consist of thematic translation questions centered around vocabulary while Duolingo Story lessons are interactive, continuous narrative lessons focused on reading and listening comprehension. Users follow a narrative and answer questions when prompted. The average number of questions in traditional lessons was seven, but additional questions were added when users answered questions incorrectly. Questions were accompanied with visual reinforcements and consisted of multiple-choice questions, sentences to repeat verbally, type the translation, and type what you hear. Some questions were also structured as create-a-sentence by choosing words from a word bank. Duolingo Story lessons are designed to supplement usage of the traditional lessons.

However, since my research indicates this population needs more focus in the area of speaking English versus reading and writing, I asked participants to skip any "type-in" responses to questions in the app. Skipping the questions that would have required participants to type saved time and reduced the degree to which participants' performance and the research results would be affected by dexterity issues. Further study focusing on the impact of dexterity issues on Duolingo language instruction would be valuable, but in this project I wanted to measure participants' language ability

without interference from dexterity issues. For assistance in both the traditional lessons and Duolingo Stories, participants could click or hover over the English words to see their Spanish translations. Additionally, they could repeat the audio if they needed to hear the sentence again. Usage of assistance resources was recorded in addition to final scores.

Six participants were randomly selected to also test three Duolingo Stories in addition to the three traditional lessons. As in the traditional lessons, there are roughly seven questions in Duolingo Stories. The questions consisted of multiple-choice fill-in-the-blanks, multiple-choice comprehension questions asking the user to confirm the context of the story, an opportunity to choose words to create a sentence matching what they hear, multiple-choice translation of single words, and select the pairs to match an English word with its Spanish translation. Unlike the traditional lessons, in Duolingo Stories users are allowed to guess until they get the correct answer and wrong answers are not counted against their score. However, the moderator marked down every wrong answer and recorded the number of attempts it took to get the correct answer.

The goal of this comparison was to determine if the narrative had any effect on the success or attitude towards the application for participants. At the end of testing, participants were asked to give their assessment of the lessons in a Likert scale. Users also had the chance to write in any aspects of the application they enjoyed or found not useful or difficult. Between each participant test, progress was reset so that every participant began their lessons as a beginner with zero points.

Chapter 4: Findings

Results

Because I was only able to work with participants for single sessions, I was unable to measure the impact of Duolingo on language learning or retention. Instead, I focused on qualitative measures such as subjective satisfaction and participants' perceptions of the lessons they executed. I report on the quantitative measures I was able to obtain, for example, performance rates, for context. The effects are not statistically significant due to the diversity of my small sample size (12 participants). Significant data points are reflected in Table 1.

Table 1
Usability Testing Results

Participant #	P1	P2	P3	P5	P5	P6	P7	P8	P9	P10	P11	P12
Age	76	79	56	65	73	77	58	60	55	66	69	61
Gender	F	F	F	M	F	M	M	M	M	F	M	F
Digit Span	4	4	5	5	6	4	5	7	7	6	4	5
Accuracy	36%	31%	84%	97%	86%	80%	84%	83%	89%	90%	76%	95%
Preference	n/a	n/a	Story	Story	Translation	Story	n/a	Story	n/a	Story	n/a	n/a

Performance

The participants who scored highest on the digit span test reported higher exposure to English than most other participants and were on the younger side of the age range of participants. Of the subjects with the highest digit span scores, one subject, (P8, age 60) reported a 10% exposure to English while the other subject, (P9, age 55) reported a 20% exposure to English. The only other participants that were younger, (P3, age 56 and P7, age 58) both scored 5 on the digit span test. The only other participants who

reported relatively high exposure to English scored a 6 (P5, age 73) and a 5 on the digit span test (P3, age 56). The data is contained in Table 2.

Table 2
Participants' Digit Span Scores and Exposure to English

Participant #	P1	P2	P3	P5	P5	P6	P7	P8	P9	P10	P11	P12
Digit Span Scores	4	4	5	5	6	4	5	7	7	6	4	5
Reported Exposure to English	5%	1%	50%	15%	30%	1%	5%	10%	20%	5%	2%	5%

The mean of the y values is 5.17 (digital span scores) and the mean of the x values is 12.42 (reported exposure to English). The correlation value is 0.339. A low positive correlation can be drawn between digit span scores and exposure to English as seen in Figure 1 (Fernando, 2020).

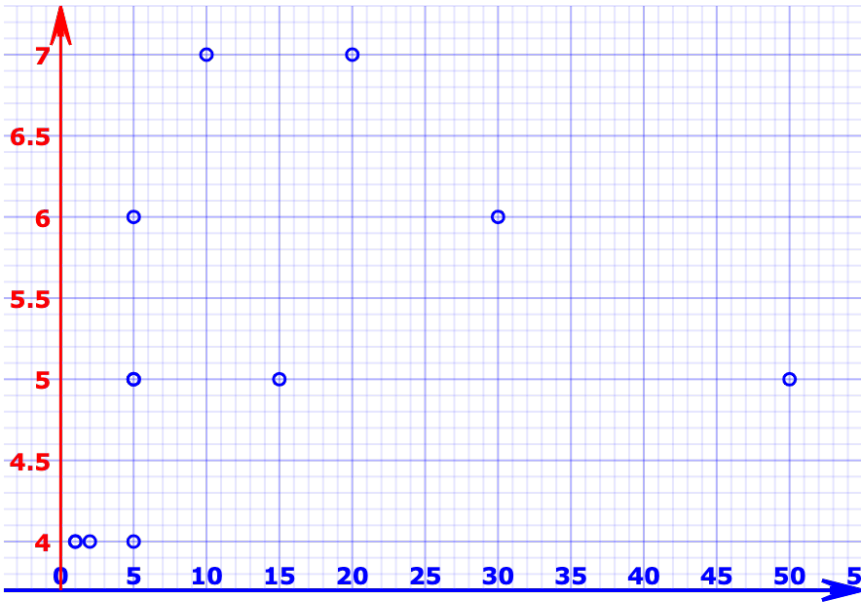

Figure 1. Low positive correlation between age and digit span score.

The digit span test instructions were translated for participants with less fluency in English, thus, it makes sense that participants' English literacy would have no effect on their understanding of the test. Additionally, the written numerals presented in the test (0-9) are the same in Spanish as they are in English.

A relationship between age and digit span score may be drawn. The subjects who scored lowest on the digit span test were in higher age ranges than their counterparts. P1 (age 76), P2 (age 79), P6 (age 77), and P11 (age 69) scored the lowest with 4's. P5 (age 73) is an outlier with a score of 6 as represented in Table 3.

Table 3
Participants' Age and Digit Span Scores

Participant #	P1	P2	P3	P5	P5	P6	P7	P8	P9	P10	P11	P12
Age	76	79	56	65	73	77	58	60	55	66	69	61
Digit Span	4	4	5	5	6	4	5	7	7	6	4	5

The mean of the x values is 66.25 (age) and the mean of the y values is 5.17 (digit span). The correlation value is -0.619. A low negative correlation can be drawn between age and digit span scores as seen in Figure 2.

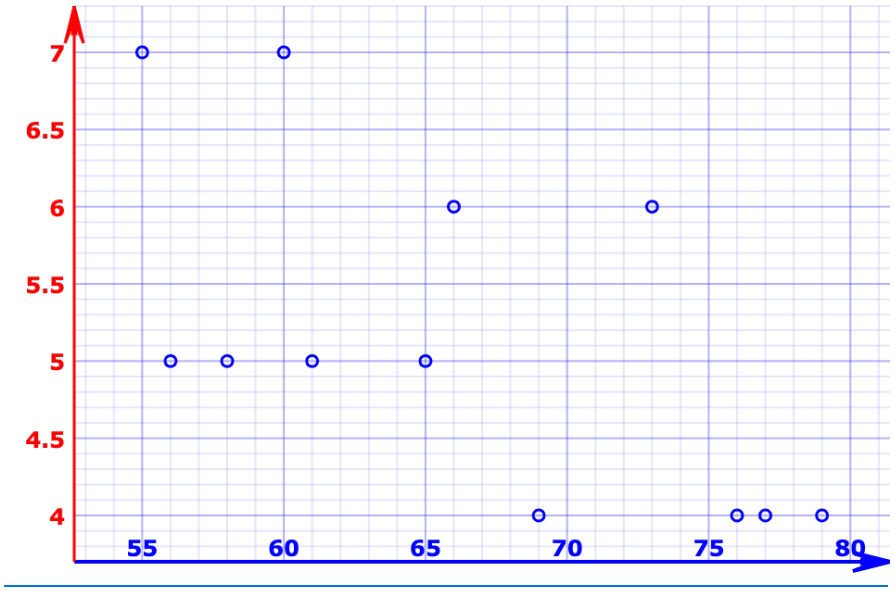

Figure 2. Low negative correlation between age and digit span score.

A correlation can also be calculated between the amount of formal education these subjects had and their digit span test scores. Those with more formal education (e.g., undergraduates) tended to score higher on the digit span test with an average score of 5.75 for P3, P5, P9, and P12 compared to 4.875 of those with less formal education experience (P1, P2, P4, P6, P7, P8, P10, P11) as seen in Table 4.

Table 4
Participants' Digit Span Scores and Formal Education

Participant #	P1	P2	P3	P5	P5	P6	P7	P8	P9	P10	P11	P12
Digit Span	4	4	5	5	6	4	5	7	7	6	4	5
Formal Education	High school	High school	Under-graduate	High school	Under-graduate	High school	High school	Some college	Under-graduate	High school	Some college	Under-graduate

Years of education are quantified as follows: high school equaling 1, some college equaling 2, and undergraduate degree equaling 3. The mean of the x values is 5.17 (digit span) and the mean of the y values is 1.83 (levels of schooling). The correlation value is 0.46. A low positive correlation can be drawn between digit span scores and formal education as reflected in Figure 3.

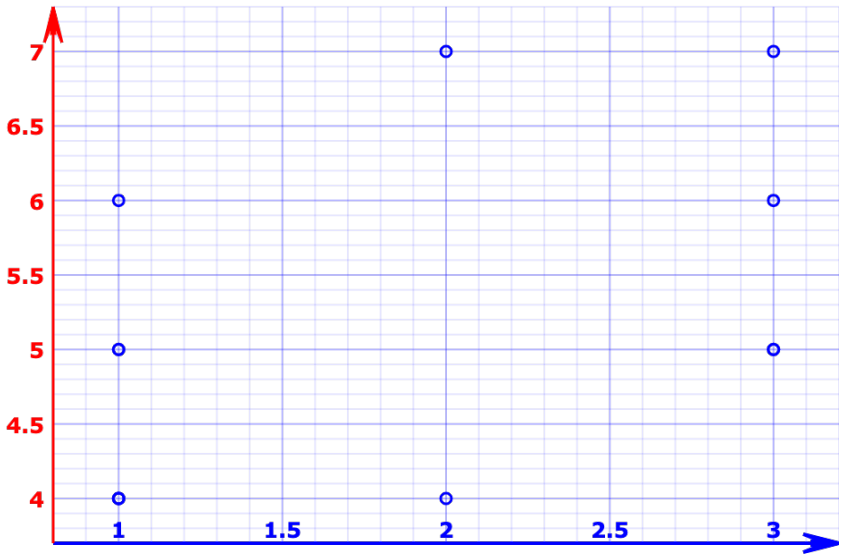

Figure 3. Low positive correlation between digit span scores and formal education.

Subjects with more formal education also scored higher in the Duolingo tests with an average score of 86%. Those with fewer years of formal education scored an average of 70%. Two strong outliers (P1 and P2) scored significantly lower than their counterparts on the Duolingo translation lessons as seen in Table 5. Percentages of questions answered correctly were used for scores (rather than number of answers)

because every participant answered a different number of questions. In the translation lessons, for every wrong answer provided, the lesson increased by one question. Thus, every participant had a different total number of questions asked of them (since no one got 100% on the translation lessons).

Table 5
Participants Education and Test Scores

Participant #	Formal Education	Translation Scores	Story Scores	Combined Scores
P1	High school	36%	n/a	36%
P2	High school	31%	n/a	31%
P7	High school	84%	n/a	84%
P9	Undergraduate	89%	n/a	89%
P11	Some college	76%	n/a	76%
P12	Undergraduate	95%	n/a	95%
P6	High school	90%	75%	80%
P8	Some college	88%	79%	83%
P5	Undergraduate	84%	86%	86%
P10	High school	94%	87%	90%
P3	Undergraduate	71%	100%	84%
P4	High school	94%	100%	97%

Participants who performed the Duolingo translation lessons but did not complete the Story Lessons scored an average of 68.5%. This group again includes the outliers P1 and P2. For the second group, the average score on the Duolingo translation lessons was 87%. Their average score for the story lessons was 88% with two subjects scoring a perfect 100%.

Age was not a correlating factor of Duolingo performance as seen in Table 6. The average age of those who placed in the second level was 67.25 while those who placed in the first level of the placement test had a close average age of 65.75.

Table 6
Participants' Age and Test Scores

Participant #	P2	P1	P11	P6	P8	P3	P7	P5	P9	P10	P12	P4
Age	76	65	56	79	60	61	73	69	66	77	58	55
Test Scores	31%	36%	76%	80%	83%	84%	84%	86%	89%	90%	95%	97%

The mean of the y values is 77.58 (score) and the mean of the x values is 66.25 (age). The correlation value is -0.29333 as displayed in Figure 4.

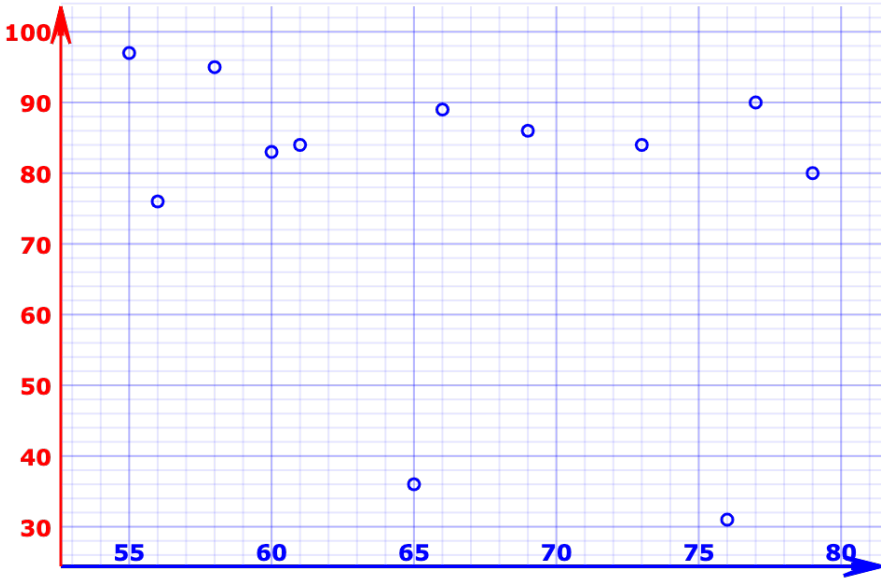

Figure 4. No correlation between age and test scores.

The participants who reported the highest levels of exposure to English also reported less trouble communicating in English in their everyday lives. Only one of these five participants (P3) reported struggling to communicate in English daily. The rest of the

participants in the study with low exposure to English all reported that they have difficulty communicating in English as represented in Table 7.

Table 7
Participants' Digit Span and Exposure to English

Participant #	P2	P6	P11	P1	P7	P10	P12	P8	P5	P9	P5	P3
Exposure to English	1%	1%	2%	5%	5%	5%	5%	10%	15%	20%	30%	50%
Difficulty Communicating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes

There is no correlational relationship between subjects who have played educational language games in the past and any other data gathered. For example, it doesn't correlate with placement test scores or scores on Duolingo lessons. Participants who reported use of educational language games did not perform any better than those participants who did not play such games.

As mentioned previously, as users answer incorrectly in Duolingo, the number of total questions they must answer increases. For every wrong answer, one question is added to the total. The additional question, which appears at a random time, is the same question they previously answered incorrectly, affording participants the opportunity to learn from their mistakes.

Calculations

Percentages on test scores were rounded to single decimal places. Average scores of the Duolingo translation lessons were 68.5%. Half of the participants also conducted Duolingo Story lessons. Their scores averaged 86.7%. Margins of error are high because of the small sample sizes.

Confidence Interval

Of the participants who performed strictly translation lessons, their mean score was 68.5%. With 95% confidence the population mean is between 48.2 and 88.8, based on 6 samples as reflected in Table 8.

Table 8
Confidence Interval Duolingo Translations

95% Confidence Interval 68.5, 95% CI [48.2, 88.8]	68.5 ± 20.3 = (48.2 to 88.8)
Margin of Error	20.3
Sample Size	6
Sample Mean	68.5
Standard Deviation	25.43
Confidence Level	95%

Of the participants who performed Duolingo stories in addition to translation lessons, their average percentage score was 86.66%. With 95% confidence the population mean is between 82.2 and 91.1, based on 6 samples as seen in Table 9.

Table 9
Confidence Interval Duolingo Stories

95% Confidence Interval 86.66, 95% CI [82.2, 91.1]	86.66 ± 4.42 = (82.2 to 91.1)
Margin of Error	4.42
Sample Size	6
Sample Mean	86.66
Standard Deviation	5.53
Confidence Level	95%

The average percentage score for participants who only completed Duolingo translation lessons was 68.5%. The value of z is 0. The value of p is 1. The average percentage score for participants who completed Duolingo translation lessons and story lessons was 86.66%. The value of z is 0.00295. The value of p is .997686. The results

are not significant at $p < .05$. Thus, the difference in test performance is not statistically significant at this sample size.

Subjective Satisfaction and Perceptions

Across the board, participants felt as though the placement test placed them in the appropriate level within the application. Of the six participants who encountered Duolingo Story lessons, 83% preferred the story lessons to the traditional lessons. I observed several participants struggling with one aspect of the story lessons (matching pairs of translated words based on the story); however, only ?? participants mentioned this issue during their post-test discussions.

Only one participant (P5) who performed Duolingo stories reported enjoying the translation lessons more than the story lessons. I also witnessed P5 answering the same question incorrectly four times during one of the traditional lessons. This participant also had difficulty with a question during the stories lesson that instructed them to choose a word from a list that completed the sentence. Instead of choosing one word, the participant chose each answer presented to them in the order they appeared. As a result, this participant's perception of their success was greater than reality. This is a naturally occurring phenomenon called illusory superiority wherein people tend to overestimate their positive qualities and underestimate their negative qualities (Cohen et al. 2014).

The five participants who reported favoring the story lessons over the translation lessons specifically valued the variety that Duolingo stories provided over the repetitive translation tasks found in the traditional Duolingo translation lessons. When asked to

assess their preference on a scale of 1-5, with 1 being least preferable and 5 being most preferable, every participant ranked 5 for stories except P5 as represented in Table 10.

Table 10
Participant Lesson Preference

Participant #	P3	P4	P5	P6	P8	P10
Preferred Translation Lessons	1	1	5	1	1	1
Preferred Story Lessons	5	5	1	5	5	5

Every participant saw the potential usefulness of Duolingo and thought it could be used to successfully learn a new language. Five of six participants, or 83.33% enjoyed and preferred Duolingo stories to the translation lessons. It can be inferred that Duolingo stories increase satisfaction and therefore increases willingness and interest in using the application as a means of education in the future.

Observation Notes

As an observer of the tests, I can say that most mistakes participants made were minor. They seemed to understand the fundamentals of the English language, but often would forget an adjective or conjunction. These are the sorts of errors that are best addressed through frequent practice, such as that offered by Duolingo.

Some participants continued to answer a participle question incorrectly, almost as if they disagreed with the answer, but when asked if they thought the answer Duolingo provided made sense, they confirmed it did.

Discussion

Although the results of my study are not statistically significant due to my small sample size, I was able to receive useful feedback from participants that reflected their satisfaction with certain aspects of Duolingo.

A low positive correlation can be drawn between digit span scores and exposure to English. This slight correlation appeared despite the fact that the instructions for the digit span test were provided in Spanish, thus performance on the digit span test was presumably not affected or confounded by English proficiency. It makes sense that participants with strong working memories would have an advantage in learning English, and thus may have sought out additional opportunities for English exposure. W It is similarly plausible that younger participants would perform better on the digit span test due to less possible cognitive decline. However, in the aforementioned research, scholars found that some bilingual older adults had less cognitive decline and longer attention spans than their monolingual counterparts. This might explain the positive correlation between digit span and exposure to English, but it contradicts the negative correlation between age and digit span seen in this data. [[calculate two-factor correlation—ask Bridget or Deb]]

Participants with higher levels of education tended to score higher on the digit span test than their counterparts. This data implies that people with more education have a higher working memory capacity in regards to language learning, but a further, longitudinal study would need to be conducted to confirm this notion. Age did not

correlate with placement or Duolingo test performance. As might be expected, participants with more exposure to English had less difficulty communicating in English in their everyday lives and vice versa. No correlation could be drawn between participants who reported playing educational language games in their past and any other data points. Exposure to past educational language games did not correlate with short term memory capacity or language proficiency.

A longitudinal study examining this demographic could reveal patterns of retention thereby indicating acquisition of the target language. For example, a multiple-week study where participants play Duolingo with the start of each new week taking the placement test could measure progress in addition to the level progression of each participant. The placement test could be indicative of retention of information. I would also track subjective satisfaction scores with each type of lesson over time.

Design Implications

Some design implications for the creation or improvement of an educational foreign language application for older adult native Spanish speakers were documented in the literature, based on the research of others. For example, much research has emphasized the link between motivation and timely and accurate feedback for users. Part of the emotional draw of games is quick feedback, to maintain attention but also to motivate the user. Accurate feedback is helpful in the educational aspect of games. Similarly, Burmeister (2010) has suggested that memory aids and flat navigational structure are most helpful in a technology system designed for older users.

The involvement of stories in language learning is more significant. Humans have used stories and visuals to communicate since the dawn of time. Implementing a narrative with scenarios and goals into the gaming application will keep users' interest and motivate them to explore the application further. Most of the participants in my study who performed the Duolingo story lessons reported higher preference in those lessons over the translation lessons. They claimed the story lessons were more engaging and that they didn't enjoy the repetitive, simplicity of the translation lessons. One participant noted that they appreciated getting the correct answer immediately from Duolingo when they answered incorrectly during the story lessons. In contrast, during the translation lessons, participants who answered incorrectly were not given the correct answer; instead they were forced to move on to other questions and come back to the same question they answered incorrectly later, as an extra question. Consequently, translation lessons had a higher possibility of taking longer than the story lessons. In addition, I observed more variety in the subject matter in the story lessons versus the traditional translation lessons.

I think the narrative structure of an educational game should be explored further. My participants reported distaste for the monotony and repetition of the translation lessons. Other social and gamification elements in Duolingo were not a focus of this particular study. Duolingo offers a social and gaming aspect to its application, in that users can link to friends in the application and compare scores and progress. There is also a leaderboard that compares users by progress. Duolingo rewards users with badges for milestones achieved and encourages further usage of its application. Rewards allow users

to further progress in the application by granting lives, or another chance, when users answer too many questions incorrectly. However, I think the most important feature of a game-based language learning tool would be narrative.

Chapter 5: Conclusion

I was not able to perform a longitudinal study and therefore could not measure retention over a period of time. My sample size was also too small to provide any statistical significance in my results. In a future study, I would increase my sample size and perform a longitudinal study to measure retention trends. Since my participants found Duolingo story lessons more enjoyable, I would further explore a narrative-based educational structure with variety in scenarios and perhaps incorporating more of the translation type of questions testing vocabulary, grammar, and pronunciation. I would test the new narrative lessons against the traditional lessons to see if satisfaction rate changes. As seen in my study, there was still one participant that enjoyed translating to the stories.

Further Research

While I was able to research satisfaction rates and draw correlations between test scores and personal factors, further longitudinal studies need to be conducted to explore the efficacy of Duolingo as a language learning application for older adults. Retention rates could not be calculated in this study; however, retention is an important measurement of the effectiveness of Duolingo in language learning. Given the increased likelihood of satisfied users to return and repeat usage of the application, it can be hypothesized that satisfaction is a contributing factor to retention. Further studies should be conducted to explore the effectiveness and satisfaction with a variety of narrative-based lessons.

Younger generations tend to dominate the available research on the topics of foreign language acquisition and technological cognitive training. A need for further research into the older adult population of native Spanish speakers learning English exists, especially as this population has grown in more recent years. This population is capable of continued learning and could benefit from a gaming language learning application that considers their particular learning needs. It is evident that the older adult population is embracing technology like never before.

I imagine a future language learning application that would employ the narrative-based structure that allows users to choose their path, similar to the Black Mirror Episode "Bandersnatch" or Bear Grylls "You vs. Wild." In these cinematic experiences, the writers produced seemingly endless storylines and gave viewers decision points, at which viewers are prompted to choose their next path and ultimately their own narrative ending. This element of narrative choice is particularly appealing to audiences because although the storylines are prescribed, giving them the control and choice to engage in the story offers them a sense of independence and makes them feel a part of the story. I believe employing this approach to language learning could be popular among all ages, and designed appropriately, could also be an effective tool for the senior population interested in learning a second language.

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Appendix A: Participant Recruitment

Duolingo Language-Learning Testing

I am currently conducting research on second language learning for Senior native Spanish speakers. Participants will join me, the investigator, either in-person or remotely online in a Zoom meeting room and spend about 20 minutes playing Duolingo, a language-learning application. Additionally, participants will be asked demographic information, questions about their English proficiency, will perform a working memory assessment and be asked questions about Duolingo after they are finished playing. All materials are available in Spanish and English. Participants are allowed to opt out of any question they don't feel comfortable answering and have the option to leave the test at any time. Participants time with me should take less than an hour. Remote participation is possible through the Zoom meeting application, which requires download and sharing of your screen with me. You may choose to download the Duolingo application or use the web application from any device with my login information. I will be recording our session for an accurate account of events but I will not use the recorded files in my research. Recordings will be destroyed upon completion of our session. I will not use any names or quotes to my research.

I am looking for 12 native Spanish speakers with little to some English literacy age 55 and older.

This research will take place between March 1 - March 8 at the convenience of participants.

Participants will receive a $25 gift certificate to Amazon.

This project is being led by Michelle Worrest, a graduate student at the University of Baltimore. If you have any questions, please do not hesitate to contact her at michelle.worrest@ubalt.edu or 240-481-5810.

Figure 5. Recruitment invitation in English.

Prueba de aprendizaje de idiomas de Duolingo

Actualmente estoy realizando una investigación sobre el aprendizaje de un segundo idioma para hablantes nativos de español. Los participantes se unirán a mí, el investigador, ya sea en persona o remotamente en línea en una sala de reuniones de Zoom y pasarán unos 20 minutos jugando a Duolingo, una aplicación de aprendizaje de idiomas. Además, se les pedirá a los participantes información demográfica, preguntas sobre su dominio del inglés, realizarán una evaluación de la memoria de trabajo y se les harán preguntas sobre Duolingo una vez que hayan terminado de jugar. Todos los materiales están disponibles en español e inglés. Los participantes pueden optar por no recibir preguntas que no se sienten cómodos respondiendo y tienen la opción de abandonar el examen en cualquier momento. El tiempo de los participantes conmigo debería tomar menos de una hora. La participación remota es posible a través de la aplicación de reunión Zoom, que requiere descargar y compartir su pantalla conmigo. Puede elegir descargar la aplicación Duolingo o usar la aplicación web desde cualquier dispositivo con mi información de inicio de sesión. Grabaré nuestra sesión para obtener una cuenta precisa de los eventos, pero no utilizaré los archivos grabados en mi investigación. Las grabaciones serán destruidas al finalizar nuestra sesión. No utilizaré nombres ni citas para mi investigación.

Estoy buscando 12 hispanohablantes nativos con poca o algo de alfabetización en inglés de 55 años o más.

Esta investigación se llevará a cabo entre el 1 de marzo y el 8 de marzo entre semana y fines de semana a conveniencia de los participantes.

Los participantes recibirán un certificado de regalo de $25 para Amazon.

Este proyecto está siendo dirigido por Michelle Worrest, una estudiante graduada de la Universidad de Baltimore. Si tiene alguna pregunta, no dude en comunicarse con ella en michelle.worrest@ubalt.edu o 240-481-5810.

Figure 6. Recruitment invitation in Spanish.

CONSENT FORM FOR PARTICIPATION IN RESEARCH ACTIVITIES
Duolingo Language-Learning Testing

Michelle Worrest, michelle.worrest@ubalt.edu, 240-481-5810

I. ABOUT THE STUDY:

I am being asked to be part of a research study. The purpose of this study is to improve the language learning application, Duolingo, for Senior native-Spanish speakers. My part in this study will last about an hour. I will fill out questionnaires and complete 6 Duolingo lessons, and then answer some follow up questions. About 12 participants will be invited to participate. I understand that being part of this study is not harmful. I know that I can stop being a part of this study at any time.

II. PRIVACY:

Information from the study will not be shared with other researchers or used for future studies. I understand that my name will not be shared when the results of this study are published. If there is any information that might identify me, that information will only be used if I give permission. Only transcriptions of voice recordings will be used in reports of the research. Data collected as part of the research, even if identifiers are removed, will not be used or distributed for future research studies. Data will be destroyed upon completion of the project. If needed, I give permission for Michelle Worrest to share the information from this study with the University of Baltimore Institutional Review Board (IRB) and regulatory agencies as required by law.

For sound and voice recordings:

☐ Yes, I give permission to use transcriptions of my voice comments in scientific publications or presentations (I understand my name will not be attached to any quotes).

☐ No, I do not give permission to use transcriptions of my voice comments in scientific publications or presentations.

III. MY CONSENT:

Michelle Worrest has answered all my questions about being in this study. If I have any more questions, I can contact Michelle Worrest at 240-481-5810 or michelle.worrest@ubalt.edu. For questions about my rights as a participant in this research study, I can contact the head of the University of Baltimore Institutional Review Board at 410-837-6199, irb@ubalt.edu.
I agree to be part of this study. And I am 18 years old or older.

Participant's Name: _____

Participant's Signature: _____ Date: _____

Investigator's Signature: _____ Date: _____

Figure 7. Consent form in English.

FORMULARIO DE CONSENTIMIENTO PARA LA PARTICIPACIÓN EN ACTIVIDADES DE INVESTIGACIÓN
Prueba de aprendizaje de idiomas

Michelle Worrest, michelle.worrest@ubalt.edu, 240-481-5810

I. SOBRE EL ESTUDIO:
Se me pide que forme parte de un estudio de investigación. El propósito de este estudio es mejorar la aplicación de aprendizaje de idiomas, Duolingo, para hablantes nativos de español. Mi parte en este estudio durará aproximadamente una hora. Completaré cuestionarios y completaré 6 lecciones de Duolingo, y luego responderé algunas preguntas de seguimiento. Cerca de 12 participantes serán invitados a participar. Entiendo que ser parte de este estudio no es dañino. Sé que puedo dejar de ser parte de este estudio en cualquier momento.

II. PRIVACIDAD:
La información del estudio no se compartirá con otros investigadores ni se utilizará para futuros estudios. Entiendo que mi nombre no se compartirá cuando se publiquen los resultados de este estudio. Si hay alguna información que pueda identificarme, esa información solo se utilizará si doy permiso. Solo se utilizarán transcripciones de grabaciones de voz en los informes de la investigación. Los datos recopilados como parte de la investigación, incluso si se eliminan los identificadores, no se utilizarán ni distribuirán para futuros estudios de investigación. Los datos serán destruidos al finalizar el proyecto. Si es necesario, doy permiso para que Michelle Worrest comparta la información de este estudio con la Junta de Revisión Institucional (IRB) de la Universidad de Baltimore y las agencias reguladoras según lo exija la ley.

Para grabaciones de sonido y voz:
☐ Sí, doy permiso para usar transcripciones de mis comentarios de voz en publicaciones o presentaciones científicas (entiendo que mi nombre no se adjuntará a ninguna cita).

☐ No, no doy permiso para usar transcripciones de mis comentarios de voz en publicaciones o presentaciones científicas.

III. MI CONSENTIMIENTO:
Michelle Worrest ha respondido todas mis preguntas sobre participar en este estudio. Si tengo más preguntas, puedo contactar a Michelle Worrest al 240-481-5810 o michelle.worrest@ubalt.edu.
Para preguntas sobre mis derechos como participante en este estudio de investigación, puedo contactar al jefe de la Junta de Revisión Institucional de la Universidad de Baltimore al 410-837-6199, irb@ubalt.edu.
Acepto ser parte de este estudio. Y tengo 18 años o más.

Nombre del participante: _____

Firma del participante: _____ Fecha: _____

Firma del investigador: _____ Fecha: _____

Figure 8. Consent form in Spanish.

Appendix B: Participant Evaluations

Northwestern Bilingualism & Psycholinguistics Research Laboratory
Marian, Blumenfeld, & Kaushanskaya (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech Language and Hearing Research, 50* (4), 940-967.
Adapted to pencil-and-paper version by Marilyn Logan

Language Experience and Proficiency Questionnaire (LEAP-Q)

Last name		Today's Date	
Age		Male ☐	Female ☐

(1) Please list all the languages you know **in order of dominance**:

1	2	3	4	5

(2) Please list all the languages you know **in order of acquisition** (your native language first):

1	2	3	4	5

(3) Please list what percentage of the time you are *currently* and *on average* exposed to each language. (*Your percentages should add up to 100%*):

List language here:					
List percentage here:					

(4) When choosing to read a text available in all your languages, in what percentage of cases would you choose to read it in each of your languages? Assume that the original was written in another language, which is unknown to you. *(Your percentages should add up to 100%*):

List language here:					
List percentage here:					

(5) When choosing a language to speak with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report percent of total time. (*Your percentages should add up to 100%*):

List language here					
List percentage here:					

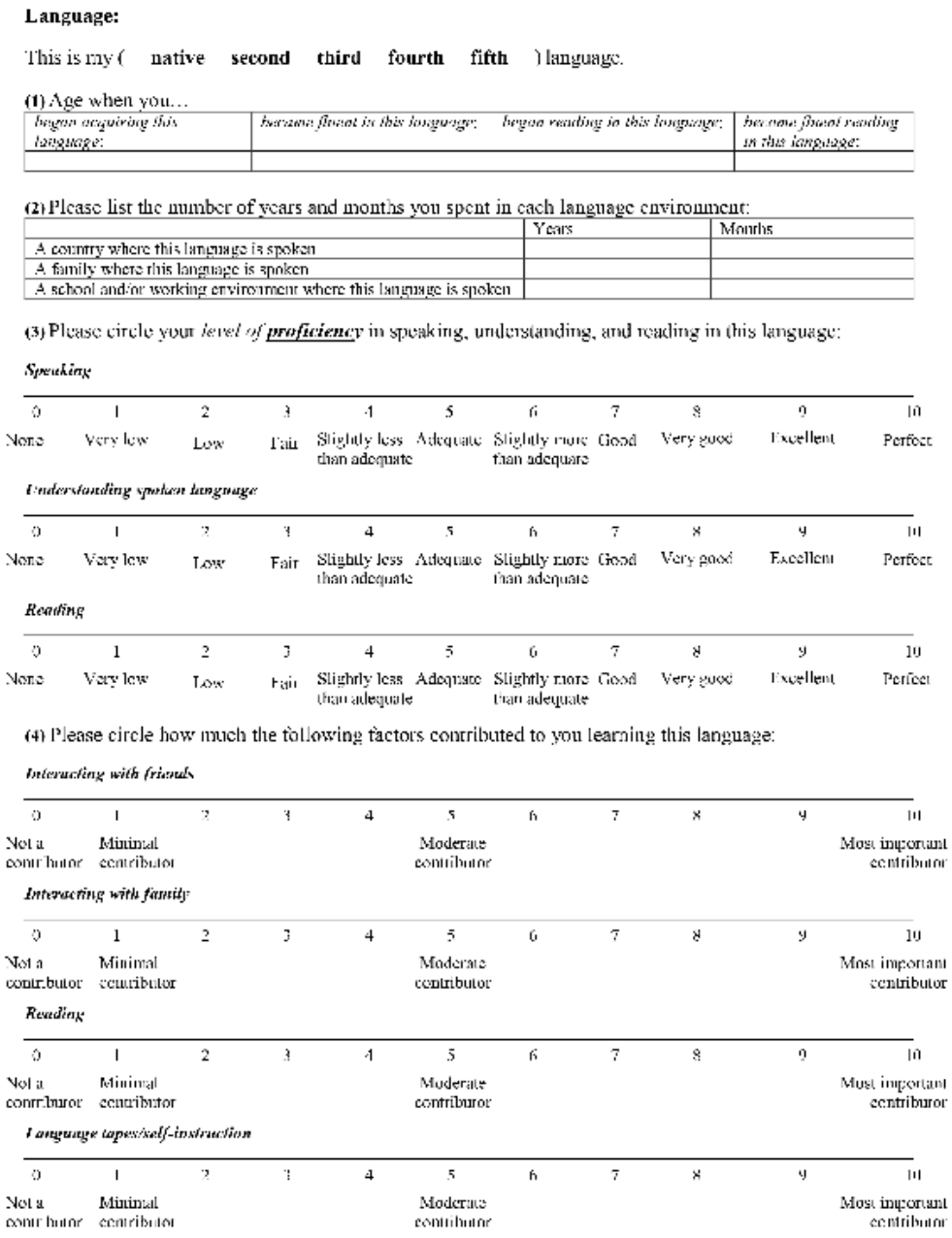
(6) How many years of formal education do you have? _____

Please check your highest education level (or the approximate US equivalent to a degree obtained in another country):

☐ Less than High School
☐ High School
☐ Professional Training
☐ Some College
☐ College
☐ Some Graduate School
☐ Masters
☐ Ph.D./M.D./J.D.
☐ Other:

(7) What country were you born in? _____

Figure 9. Language Experience and Proficiency Questionnaire (LEAP-Q) in English.



Language:

This is my (**native** **second** **third** **fourth** **fifth**) language.

(1) Age when you…

began acquiring this language:	*became fluent in this language:*	*began reading in this language:*	*became fluent reading in this language:*

(2) Please list the number of years and months you spent in each language environment:

	Years	Months
A country where this language is spoken		
A family where this language is spoken		
A school and/or working environment where this language is spoken		

(3) Please circle your *level of* ***proficiency*** in speaking, understanding, and reading in this language:

Speaking

0	1	2	3	4	5	6	7	8	9	10
None	Very low	Low	Fair	Slightly less than adequate	Adequate	Slightly more than adequate	Good	Very good	Excellent	Perfect

Understanding spoken language

0	1	2	3	4	5	6	7	8	9	10
None	Very low	Low	Fair	Slightly less than adequate	Adequate	Slightly more than adequate	Good	Very good	Excellent	Perfect

Reading

0	1	2	3	4	5	6	7	8	9	10
None	Very low	Low	Fair	Slightly less than adequate	Adequate	Slightly more than adequate	Good	Very good	Excellent	Perfect

(4) Please circle how much the following factors contributed to you learning this language:

Interacting with friends

0	1	2	3	4	5	6	7	8	9	10
Not a contributor	Minimal contributor				Moderate contributor					Most important contributor

Interacting with family

0	1	2	3	4	5	6	7	8	9	10
Not a contributor	Minimal contributor				Moderate contributor					Most important contributor

Reading

0	1	2	3	4	5	6	7	8	9	10
Not a contributor	Minimal contributor				Moderate contributor					Most important contributor

Language tapes/self-instruction

0	1	2	3	4	5	6	7	8	9	10
Not a contributor	Minimal contributor				Moderate contributor					Most important contributor

Figure 10. Cont'd Language Experience and Proficiency Questionnaire (LEAP-Q) in English.

Northwestern Bilingualism & Psycholinguistics Research Laboratory
Marian, Blumenfeld, & Kaushanskaya (2007).
Traducción por Rojas & Iglesias (2008) Temple University Bilingual Language Laboratory
Adaptado a la versión del lápiz-y-papel por Marilyn Logan

Cuestionario de Experiencia y Competencia Lingüística

Apellido(s)		Fecha	
Edad		Masculino ☐	Feminino ☐

(1) Por favor indique todos los idiomas que conozca **en orden de dominio**:

1	2	3	4	5

(2) Por favor indique todos los idiomas que conozca **en orden de adquisición** (su idioma materno primero):

1	2	3	4	5

(3) Por favor indique que porcentaje del tiempo Ud. *actualmente* y *en promedio* está expuesto a cada idioma. (*Los porcentajes deben de sumar a 100%*):

Indique idioma:					
Indique porcentaje:					

(4) ¿Al escoger leer un texto disponible en todos sus idiomas, en que porcentaje de los casos escogería leerlo en cada idioma? Asuma que el texto original fue escrito en un idioma que Ud. no conoce. (*Los porcentajes deben de sumar a 100%*):

Indique idioma:					
Indique porcentaje:					

(5) ¿Al escoger que idioma usar para hablar con una persona igualmente fluida a Ud. en todos sus idiomas, que porcentaje del tiempo escogería Ud. hablar en cada idioma? Por favor indique el porcentaje del tiempo total. (*Los porcentajes deben de sumar a 100%*):

Indique idioma:					
Indique porcentaje:					

(6) ¿Cuantos años de educación tiene Ud.? _____

Por favor indique su nivel más alto de educación (o la aproximación Estado Unidense equivalente a un título obtenido en otro país):

☐ Menos que escuela secundaria
☐ Escuela secundaria/preparatoria
☐ Entrenamiento Profesional
☐ Algo de Universidad
☐ Universidad
☐ Algo de Escuela Post-Graduado
☐ Maestría
☐ Ph.D./M.D./J.D.
☐ Otro:

(7) ¿En qué país naciste? _____

Figure 11. Language Experience and Proficiency Questionnaire (LEAP-Q) in Spanish.

Idioma:

Este es mi idioma (**materno** **segundo** **tercero** **cuarto** **quinto**).

(1) Edad cuándo Ud. …

empezó a adquirir:	*llegó a ser fluido en:*	*empezó a leer en:*	*llegó a leer fluidamente en:*

(2) Por favor indique el número de años y meses que Ud. pasó en cada ambiente lingüístico:

	Años	Meses
Un país donde este idioma es hablado		
Una familia donde este idioma es hablado		
Una escuela y/o ambiente de trabajo donde este idioma es hablado		

(3) Por favor seleccione su *nivel de* ***competencia*** al hablar, comprender, y leer este idioma:

Hablar

0	1	2	3	4	5	6	7	8	9	10
Ninguna	Muy baja	Baja	Pasable	Poco menos que adecuada	Adecuada	Poco más que adecuada	Buena	Muy buena	Excelente	Perfecta

Comprender

0	1	2	3	4	5	6	7	8	9	10
Ninguna	Muy baja	Baja	Pasable	Poco menos que adecuada	Adecuada	Poco más que adecuada	Buena	Muy buena	Excelente	Perfecta

Leer

0	1	2	3	4	5	6	7	8	9	10
Ninguna	Muy baja	Baja	Pasable	Poco menos que adecuada	Adecuada	Poco más que adecuada	Buena	Muy buena	Excelente	Perfecta

(1) Por favor seleccione cuanto los siguientes factores contribuyeron a su aprendizaje de este idioma:

Conviviendo con amistades

0	1	2	3	4	5	6	7	8	9	10
Ninguna contribución	Contribución mínima				Contribución moderada					Contribución más importante

Conviviendo con familia

0	1	2	3	4	5	6	7	8	9	10
Ninguna contribución	Contribución mínima				Contribución moderada					Contribución más importante

Leyendo

0	1	2	3	4	5	6	7	8	9	10
Ninguna contribución	Contribución mínima				Contribución moderada					Contribución más importante

Cintas de lenguaje/audio instrucción

0	1	2	3	4	5	6	7	8	9	10
Ninguna contribución	Contribución mínima				Contribución moderada					Contribución más importante

Figure 12. Cont'd Language Experience and Proficiency Questionnaire (LEAP-Q) in Spanish.

Appendix C: Usability Testing

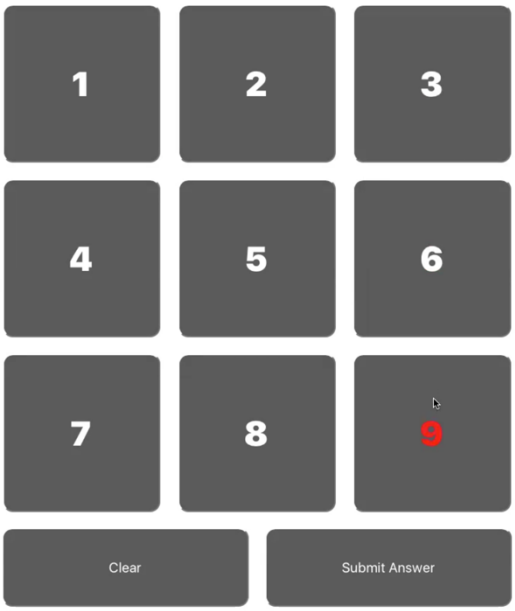


Figure 13. Digit Span test.

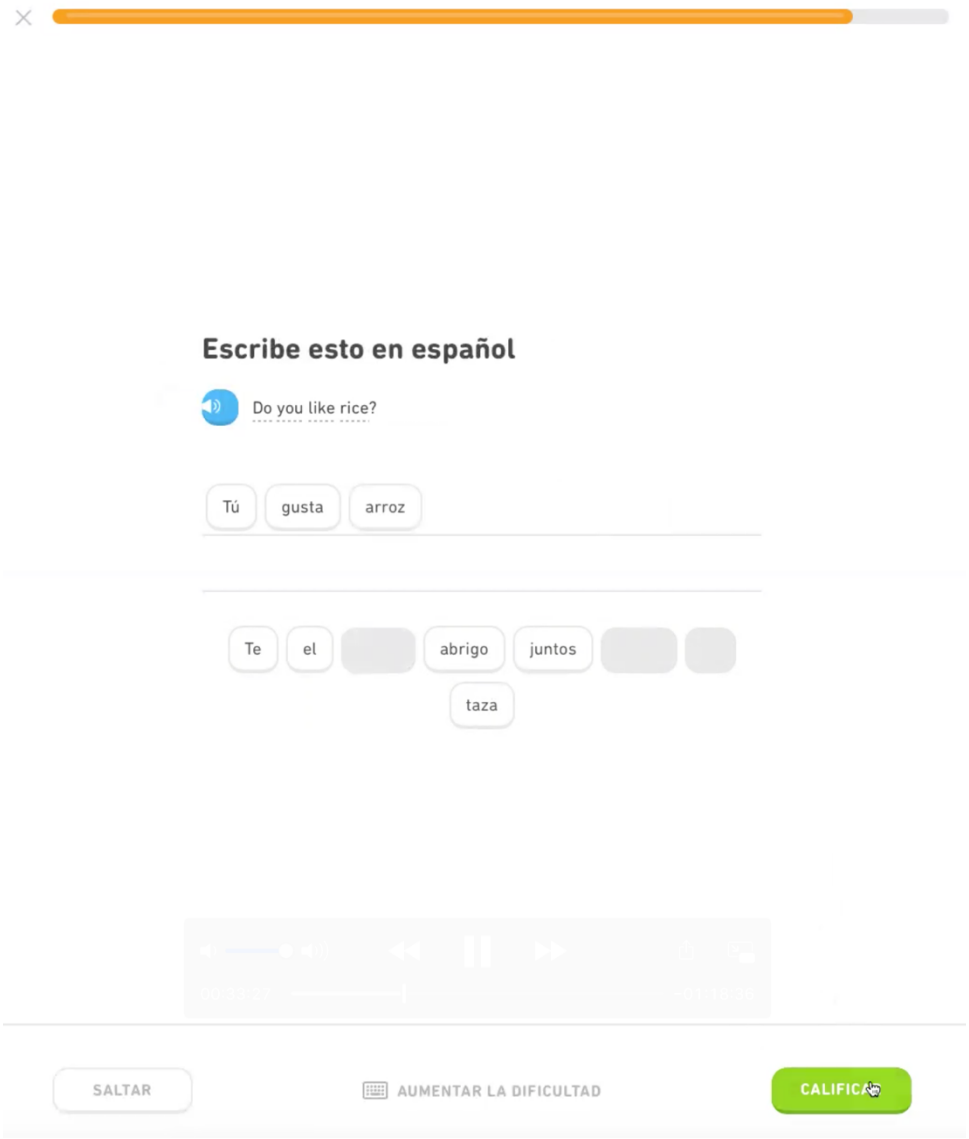


Figure 14. Duolingo translation lesson.

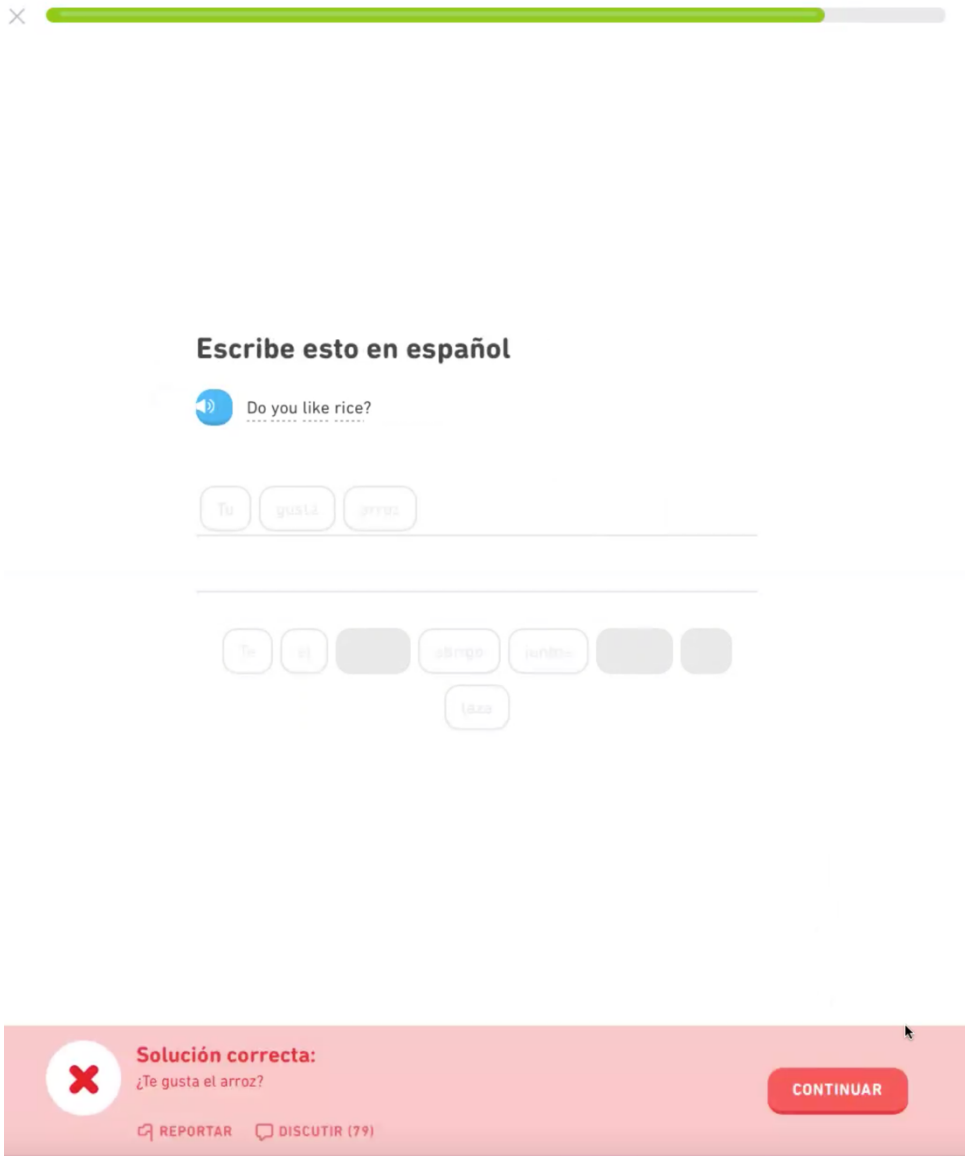


Figure 15. Duolingo translation lesson correction.

Survey Questions

The questions listed below will be asked of participants after the Duolingo usability test. Questions are either multiple choice, open-ended, or require answers based on a Likert scale ranging from 5 responses.

1. Overall, how easy or difficult did you find the questions in the test?
    a. Very difficult
    b. Difficult
    c. Neutral
    d. Easy
    e. Very easy

2. Did you have difficultly recognizing any words?
    a. Yes
    b. No
3. If so, which ones?
    a. Open-ended response

4. Overall, how easy or difficult did you find using the Duolingo app?
    a. Very difficult
    b. Difficult
    c. Neutral
    d. Easy
    e. Very easy

5. Did you feel you needed explanation as to how to use the app?
    a. Yes
    b. No

6. Did you understand how to correct your mistakes or change your answers?
    a. Yes
    b. No

7. Did you understand how to answer pronunciation questions (speak out loud, this may not be applicable)?
    a. Yes
    b. No

8. Did you understand how to choose the translation for the tap the pairs questions?
    a. Yes
    b. No

9. Do you feel as if the placement test placed you in the correct level of the game?
    a. Yes
    b. No

Figure 16. Survey questions in English.

Preguntas de la encuesta

Las preguntas que se enumeran a continuación se harán a los participantes después de la prueba de usabilidad de Duolingo. Las preguntas son de opción múltiple, abiertas o requieren respuestas basadas en una escala Likert que va desde 7 respuestas.

1. En general, ¿qué tan fácil o difícil encontraste las preguntas en el examen?
    a. Muy dificil
    b. Dificil
    c. Neutral
    d. Fácil
    e. Muy fácil

2. ¿Tuviste dificultades para reconocer alguna palabra?
    a. Si
    b. No

3. Si es así, ¿cuáles?
    a. Respuesta abierta

4. En general, ¿qué tan fácil o difícil le resultó usar la aplicación Duolingo?
    a. Muy dificil
    b. Dificil
    c. Neutral
    d. Fácil
    e. Muy fácil

5. ¿Sintió que necesitaba una explicación sobre cómo usar la aplicación?
    a. Si
    b. No

6. ¿Entendió cómo corregir sus errores o cambiar sus respuestas?
    a. Si
    b. No

7. ¿Entendiste cómo responder preguntas de pronunciación (hablar en voz alta, esto puede no ser aplicable)?
    a. Si
    b. No

8. ¿Entendiste cómo elegir la traducción para tocar las preguntas de pares?
    a. Si
    b. No

9. ¿Sientes que la prueba de nivel te situó en el nivel correcto del juego?
    a. Si
    b. No

Figure 17. Survey questions in Spanish.

Appendix D: Results

Pre-screening questions	P1	P2
1. Have you ever played any educational language games before?	No	No
1a. If so which ones? What did you enjoy about them?	n/a	n/a
1b. Was it a helpful learning experience?	n/a	n/a
1c. If not, are there other games that you enjoy playing? On which device?	no	no
2. Do you experience trouble communicating in English in everyday life?	Yes	Yes
2a. In what scenarios do you experience this?	Everyday communication	Talking to doctors
2b. How do you attempt to overcome language barriers?	Ask people to repeat or try to explain to them how to communicate	n/a
3.Do you use any apps or web tools to help you communicate more effectively?	No	No
3a. If so, which ones?	n/a	n/a
4.What motivates you to learn English, if anything? A24	Job	Children
Age	76	79
Gender	F	F
Known languages in order of dominance	Spanish, English	Spanish, English
Known languages in order of acquisition	Spanish, English	Spanish, English
Percentage of exposure	Spanish: 95% English: 5%	Spanish: 99% English: 1%
Preference in reading	Spanish: 100%	Spanish: 100%
Preference in speaking	Spanish: 100%	Spanish: 100%

Figure 18. Results for participants 1 and 2 (part 1).

P3	P4	P5
No	No	No
n/a	n/a	n/a
n/a	n/a	n/a
no	Games on phone	Games on computer or phone and on Facebook
Yes	No	No
Banks, insurance, doctors	n/a	n/a
Taking English classes at community college	n/a	n/a
Yes	Yes	Yes
Google translate	Google translate only when writing, not speaking	Google translate
School: teacher and classmates	n/a	n/a
56	65	73
F	F	M
Spanish, English	Spanish, English	Spanish, English
Spanish, English	Spanish, English	Spanish, English
Spanish: 50% English: 50%	Spanish: 85% English: 15%	Spanish: 70% English: 30%
Spanish: 100%	Spanish: 100%	Spanish: 100%
Spanish: 100%	Spanish: 100%	Spanish: 100%

Figure 19. Results for participants 3, 4 and 5 (part 1).

P6	P7	P8
Yes	Yes	No
Duolingo	Babel	n/a
Yes	Yes	n/a
n/a	n/a	Games on phone
Yes	Yes	No
Everyday	Talking everyday in restaurants, etc.	n/a
Google translate	Google translate	n/a
Yes	Yes	No
Google translate	Google translate	n/a
To communicate	Family	n/a
77	58	60
F	M	M
Spanish, English	Spanish, English	Spanish, English
Spanish, English	Spanish, English	Spanish, English
Spanish: 99% English: 1%	Spanish: 95% English: 5%	Spanish: 90% English: 10%
Spanish: 100%	Spanish: 100%	Spanish: 100%
Spanish: 100%	Spanish: 100%	Spanish: 100%

Figure 20. Results for participants 6, 7 and 8 (part 1).

P9	P10	P11
No	No	No
n/a	n/a	n/a
n/a	n/a	n/a
Games on phone	no	no
No	Yes	Yes
n/a	Everyday	Supermarket, everyday encounters
n/a	Google translate	n/a
No	Yes	No
n/a	Google translate	n/a
n/a	n/a	n/a
55	66	69
M	F	M
Spanish, English	Spanish, English	Spanish, English
Spanish, English	Spanish, English	Spanish, English
Spanish: 80% English: 20%	Spanish: 95% English: 5%	Spanish: 98% English: 2%
Spanish: 100%	Spanish: 100%	Spanish: 100%
Spanish: 100%	Spanish: 100%	Spanish: 100%

Figure 21. Results for participants 9, 10 and 11 (part 1).

P12

Yes

Duolingo

Yes

n/a

Yes

Google translate

Yes

Google translate

Family and job

61

F

Spanish, English

Spanish, English

Spanish: 95% English: 5%

Spanish: 100%

Spanish: 100%

Figure 22. Results for participant 12 (part 1).

Education	Highschool		Highschool	
Country of origin	El Salvador		Colombia	
Digit Span score		4		4
Placement test level	Level 1		Level 1	
Combined percentage of standard lessons and stories				
Standard Lessons Accuracy	23/64		23/75	
Standard Lessons Percentage		36%		31%
Story Accuracy				
Story Percentage				
5. Overall, how easy or difficult did you find the questions in the test?	Neutral		Difficult	
6.Did you have difficultly recognizing any words?	Yes		Yes	
7. If so, which ones?	Don't remember		Many of them	
8.Overall, how easy or difficult did you find using the Duolingo app?	Easy		Difficult	
9. Did you feel you needed explanation as to how to use the app?	No		Yes	
10.Did you understand how to correct your mistakes or change your answers?	No		No	
11.Did you understand how to answer pronunciation questions (speak out loud, when applicable)?	Yes		No	
12. Did you understand how to choose the translation for the tap the pairs questions?	No		No	
13. Do you feel as if the placement test placed you in the correct level of the game?	Yes		Yes	

Figure 23. Results for participants 1 and 2 (part 2).

Undergraduate		Highschool		Undergraduate	
Colombia		El Salvador		Cuba	
	5		5		6
Level 1		Level 2		Level 1	
	84%		97%		86%
30/42		31/33		27/32	
	71%		94%		84%
33/33		31/31		32/37	
	100%		100%		86%
Very easy		Very easy		Very easy	
No		No		No	
n/a		n/a		n/a	
Very easy		Very easy		Very easy	
No		No		No	
Yes		Yes		Yes	
Yes		Yes		Yes	
Yes		Yes		Yes	
Yes		Yes		Yes	

Figure 24. Results for participants 3, 4 and 5 (part 2).

Highschool	Highschool	Some college	
Mexico	Mexico	Bolivia	
	4	5	7
Level 2	Level 1	Level 1	
	80%		83%
19/21	38/45	28/32	
	90%	84%	88%
30/40		31/39	
	75%		79%
Very easy	Easy	Easy	
No	No	No	
n/a	n/a	n/a	
Very easy	Very easy	Very easy	
No	No	No	
Yes	Yes	Yes	
Yes	Yes	Yes	
Yes	Yes	Yes	
Yes	Yes	Yes	

Figure 25. Results for participants 6, 7 and 8 (part 2).

Undergraduate	Highschool		Some college
Peru	Mexico		El Salvador
7	6		4
Level 1	Level 2		Level 1
		90%	
39/44	30/32		41/54
89%	94%		76%
	33/38		
		87%	
Very easy	Very easy		Easy
No	No		Yes
n/a	n/a		Don't remember
Very easy	Easy		Neutral
No	No		No
Yes	Yes		Yes
Yes	Yes		Yes
Yes	Yes		Yes
Yes	Yes		Yes

Figure 26. Results for participants 9, 10 and 11 (part 2).

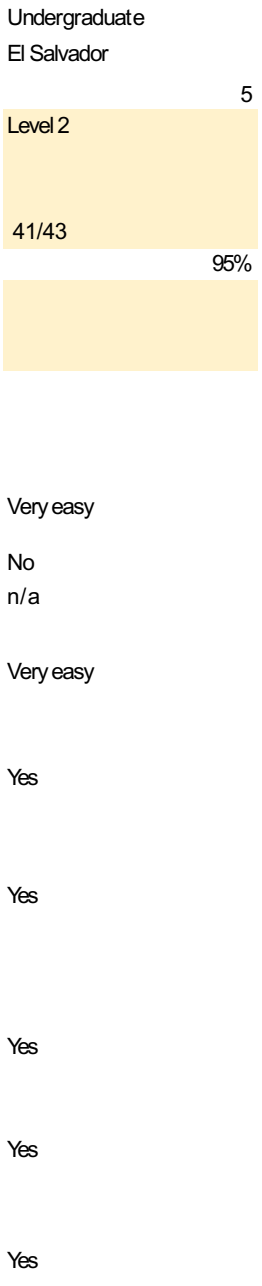


Figure 27. Results for participant 12 (part 2).

14. If no, should it have placed you at a more difficult or easy level?	n/a	n/a
15. Which type of questions did you find easiest?	Single answer multiple-choice	Single answer multiple choice
16. Which type of questions did you find most difficult?	Select the pairs	Select the pairs
17. [For participants who performed Duolingo Stories – specify the story so they remember -- the museum story, for instance] Which lessons did you enjoy more, Duolingo traditional lessons or Duolingo Stories?	n/a	n/a
18. Why did you enjoy one more than the other?	n/a	n/a
19. If there is a feature in Duolingo that you could change what would that be and why?	None	None
20. Do you have any suggestions for improving the app?	No	No
21. Do you see yourself using Duolingo to further your learning in the future?	Yes	No
22. Why or why not?	It's fun once I get the hang of it	Too difficult to use
23. Do you think Duolingo could be an effective tool to learn a second language?	Yes	Yes
24. Why or why not?	It is working if you stick with it	n/a

Figure 28. Results for participants 1 and 2 (part 3).

n/a	n/a	n/a
All were equally easy	Single answer multiple-choice	Multiple-choice translation of one
Choose words to create the sentence	Choose words to create the sentence	Select the pairs
Duolingo Stories	Duolingo Stories	Duolingo traditional lessons
translating can get boring, stories are more engaging	narrative	likes translating
None	None	None
Too much repetition in content. Vary it more and include more realistic scenarios.	No	No
Yes	Yes	No
Enjoyable game	It's fun and educational	n/a
Yes	Yes	Yes
Enough variation in exercises	Very specific with language. Translation was clear. Alot of people can learn.	Effective

Figure 29. Results for participants 3, 4 and 5 (part 3).

n/a	n/a	n/a
Single answer multiple-choice	Single answer multiple-choice	Verbally repeat sentences
Choose words to create the sentence	Choose words to create the sentence	Select the pairs
Duolingo Stories		Duolingo Stories
	n/a	
more interesting	n/a	Correct mistake right away
None	None	None
No	No	No
Yes	Yes	Yes
It works.	n/a	Fun to pass time
Yes	Yes	Yes
It works.	n/a	It seems effective

Figure 30. Results for participants 6, 7 and 8 (part 3).

n/a	n/a	n/a
Multiple-choice translation ofone	Single answer multiple-choice	Single answer multiple-choice
Select the pairs	Select the pairs	Choose words to create the sentence
	Duolingo Stories	
n/a		n/a
n/a	Enjoyable to follow storyline	n/a
None	None	None
No	No	No
Yes	Yes	Yes
It's fun	n/a	It seems to work
Yes	Yes	Yes
It's engaging	It works	It's fun

Figure 31. Results for participants 9, 10 and 11 (part 3).

n/a

All were equallyeasy

Select the pairs

n/a

n/a

None

No

Yes

Use it already

Yes

works

Figure 32. Results for participant 12 (part 3).