Chronic Aphasia Recovery in Bilingual Spanish-English and Monolingual Adults

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

CHRONIC APHASIA RECOVERY IN BILINGUAL SPANISH-ENGLISH AND MONOLINGUAL ADULTS

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE in

SPEECH LANGUAGE PATHOLOGY

by

Kristina Ruch

2020
To: Dean Ora Strickland  
College of Nursing & Health Sciences

This thesis, written by Kristina Ruch, and entitled Chronic Aphasia Recovery in Bilingual Spanish-English and Monolingual Adults, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this thesis and recommend that it be approved.

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Date of Defense: July 21, 2020

This thesis of Kristina Ruch is approved.

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Vice President for Research and Economic Development and Dean of the University Graduate School

Florida International University, 2020
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ABSTRACT OF THE THESIS

CHRONIC APHASIA RECOVERY IN BILINGUAL SPANISH-ENGLISH AND MONOLINGUAL ADULTS

by

Kristina Ruch

Florida International University, 2020

Miami, Florida

Professor Monica Hough, Major Professor

The purpose of the current investigation was to investigate and compare aphasia recovery patterns in bilingual and monolingual adults with chronic aphasia. Ten participants with aphasia who were at least one year post-injury were assessed and compared using the Bilingual Aphasia Test (BAT) (Paradis & Libben, 1987) in order to examine their aphasia recovery and language abilities. Bilingual participants performed significantly better in English than in Spanish in naming. Furthermore, results revealed an overall trend towards significance across all of the verbal subtests, with better performance in English than Spanish. Significant differences were noted between groups in English, with the monolingual group performing better than the bilingual group on lexical decision task but the bilingual group performing better than the monolingual group on verbal series. Overall, the bilingual participants performed significantly better than the monolingual group on verbal production in English. The study findings suggest that bilingual versus monolingual aphasia recovery may be different for certain skills at certain times in recovery, but further investigation is needed.
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CHAPTER I

Review of Literature

Introduction

The increase in bilingual speakers in the United States is leading to a growing body of research conducted on bilingualism. Kohnert (2010) has indicated that the human brain is able to develop two languages at the same speed that it can develop one, but there are existing questions, primarily addressing whether knowing more than one language has any advantages over being monolingual. Very little research has been conducted regarding the bilingual brain after a tragedy, such as a stroke or head injury, and if the recovery process differs between monolinguals and bilinguals.

The answers to these questions are critical for professionals working with the stroke population because they can help determine prognosis for patients and help determine the best plans of treatment relative to predicted outcomes. This literature review will outline the characteristics of aphasia, define bilingualism relative to cerebral differences and language acquisition patterns, address the implications bilingualism may have on aphasia recovery patterns, and provide description of chronic aphasia recovery in monolinguals. The review of the literature will conclude with the summary and rationale, plan of study, and experimental questions of the current study.

Characteristics of Aphasia

According to Ryglewicz et al. (2000), aphasia affects up to 42% of stroke survivors. Hallowell (2017) describes aphasia as an acquired language disorder that has a neurological cause. Typically, it affects reception and production of language across modalities along with cognitive impairments in some instances (Lee & Pyun, 2014).
Aphasia is acquired, meaning it is disruption to a degree of language ability. It occurs in people who have already learned language. Aphasia tends to occur most commonly in adults, but it can also occur in children. Aphasia is most commonly caused by stroke, but it can also be caused by other injuries to the neural fibers such as a traumatic brain injury, neoplasm in the brain, infections, or metabolic problems (Hallowell, 2017).

Damage to specific areas of the brain may account for specific patterns of impairments, such as selective naming deficits (Tippett, Niparko, & Hillis, 2014). Reception is affected relative to auditory comprehension, reading comprehension, and understanding sign language. Expressive language is affected relative to the ability to formulate spoken, written, or gestural language (Hallowell, 2017). General discourse is affected by the average amount of words per minute and fewer utterances in general (Fromm et al., 2017). However, difficulties between expressive and receptive language vary from patient to patient. Some symptoms of aphasia may become chronic in stroke patients; however, speech and language therapy is recommended to help patients achieve pre-morbid abilities (Stroke Foundation, 2019).

There are two overall types of aphasia including fluent aphasia and non-fluent aphasia which basically address differences relative to verbal output (Papathanaaiou, et al., 2013). Fluent aphasia presents with difficulties in the receptive aspects of language. Often, the patient is able to speak fluently, but they make little sense. Non-fluent aphasia yields impaired expressive language. Patients may understand what others are saying, but they will have difficulty expressing themselves. Strengths and weaknesses between aphasia types will vary (Papathanaaiou, et al. 2013).
In regard to nonfluent aphasia, global aphasia is a severe form of aphasia, with deficits in all aspects of language. Speech is nonfluent and it is usually limited to one syllable utterances. However, automatic language such as reciting the alphabet may sometimes be preserved. Comprehension, naming, repetition, reading and writing are severely impaired. Broca’s aphasia is also a nonfluent aphasia where speech is effortful, consisting of short phrases or single words. These patterns may also extend to written language. Comprehension is typically intact. However, as language becomes more complex, comprehension difficulties may be apparent specifically in regard to syntax. Repetition, reading aloud, and naming abilities are also affected (Papathanaaiou, et al., 2013). Transcortical motor is another type of nonfluent aphasia where comprehension is preserved to some extent and naming abilities are relatively intact. Phonemic paraphasias and agrammatic output are observed in some cases. However, precise repetition abilities seem to be intact. In some instances, patients may appear echolalic (Crosson, Bohsali & Raymer, 2018). The final nonfluent aphasia is Transcortical mixed aphasia. This is a rare aphasia where patients present with severely impaired comprehension, naming, reading and writing. However, the ability to repeat words and phrases is intact (Papathanaaiou, et al., 2013).

One fluent aphasia type is Wernicke’s aphasia. Patients with Wernicke’s aphasia will have unaffected verbal expression; however, their comprehension is typically severely impacted. Verbal output is characterized by semantic paraphasias, neologisms, and empty speech. Repetition, naming, reading, and writing abilities are all impaired to some degree. The second fluent aphasia type is Transcortical Sensory aphasia in which speech is fluent, but in many cases it is meaningless and unintelligible. Naming, reading
and writing abilities are severely impaired, but the patient will have intact repetition abilities. Patients with conduction aphasia show repetition that is compromised, but speech remains fluent. Phonemic paraphasias and word-finding difficulties are common. Comprehension is typically intact so patients are aware of their difficulties and generally produce several variations of a word in attempts to produce it correctly. Deficits in naming and reading are also common (Papathanaaiou, et al., 2013).

The final fluent aphasia is anomia. Patients with anomia present with difficulties predominantly relative to word retrieval, specifically sparing performance in other language domains. Verbal output is fluent, characterized by word finding difficulties, pauses, and circumlocutions. Repetition, comprehension, and reading abilities are typically not affected (Harnish, 2018). These various forms of aphasia occur due to damage to specific areas of the brain. Symptoms will depend on the lesion site and the size of the lesion. Patients may present with severe deficits and improve over time due to spontaneous recovery, intervention, or both (Hillis et al., 2018).

Bilingualism

According to Bialystok (2009), research has revealed both benefits and weaknesses for bilingual individuals relative to language abilities. A noted adverse effect of development observed in bilingual children is that these individuals typically present with a smaller vocabulary in their first language than their monolingual peers. Relative to bilingual adults, it has been observed that they perform more poorly on rapid naming retrieval tasks in English. However, bilinguals have been observed to show an advantage in memory tasks and executive control.
Biological differences between monolinguals and bilinguals have been noted which may influence linguistic and cognitive flexibility. Bilinguals have shown to have increased density of grey matter in the left inferior parietal cortex, a difference that is more evident in bilinguals who acquired both languages early on and those with greater proficiency in their second language. When bilinguals use two languages throughout the lifespan it results in greater brain stimulation which results in greater cognitive reserve. When fluent bilinguals use both languages frequently, the languages are active and available to the individual when one of the languages is in use. This creates a need to correctly select a word in the correct form that meets the needs of the conversation and is part of the target language and not from the competing language system. The need to maintain attention on the target system is what makes bilingual verbal production different from monolingual verbal production (Bialystok, 2009).

Bilingual language production requires the constant involvement of the executive control system to manage attention; it is possible that this enhances the executive function system making it fit for other functions. The primary processes of executive function are inhibition, cognitive flexibility, and updating information in short term memory. In order to have a better understanding of the research consensus relative to bilingual individuals to having enhanced executive functioning abilities; Bialystok (2009) looked at several studies. One study demonstrated advantages in the theory of mind and reversing ambiguous figures (Bialystok & Shapero, 2005). Another study revealed a significant difference in the response time between congruent and non-incongruent trials and ability to resolve conflicts (Costa, Hernandez, & Sebastion- Galles, 2008). However, the most significant difference appeared during the Stroop task which includes rapidly
naming of color words printed in black. Bilinguals were asked to recall 20 words under various conditions, bilinguals generally recalled fewer words. This task was a verbal working memory task, a domain that is generally more difficult for bilinguals. In further study working memory in bilinguals, it also has been assessed in a non-verbal domain. This domain was tested by having participants arrange square tiles according to various rules. In the simplest condition, designated squares are indicated and participants are asked to recall them in some order; in the most difficult condition, the squares need to be recalled according to an ordering rule such as left to right or top to bottom. For both children and adults, monolinguals and bilinguals attained similar recall scores for the simple tasks. However, as the executive control demands increased, bilinguals demonstrated their performance level better than monolinguals and outperformed them overall (Fernandes et al., 2007). The difference between the abilities was not on working memory, but on conditions that included increased demands for control and inhibition (Bialystok, 2009).

Bialystok (2009) suggested the idea that cognitive reserve build up from extended experience with stimulating activities; this cognitive reserve protects against the onset of dementia. To measure this, Bialystok, Craik and Freedman (2007) compared the age of onset of symptoms in 184 individuals who had been diagnosed with dementia. Half of the individuals were bilinguals who spent the majority of their life using two languages on a regular basis. The bilinguals showed signs of dementia an average of four years later than monolinguals with an average age of 71.4 years in monolinguals and an average of 75.5 years in bilinguals (Bialystok, et al. 2007). The significant difference provides evidence
of the generalized power of bilingualism to sustain cognitive functioning even with the challenges of impending disease (Bialystok, 2009).

Overall, evidence of increased joint activation and conflict for selection by bilinguals is in code switching. This occurs when bilinguals insert a word or phrase from their other language, which may occur intentionally or unintentionally. The pressure to select the correct word form indicates competing activated alternatives and cognitive performance. The findings of these various studies suggest that bilingualism is an experience that can influence cognitive function and cognitive structure. However, all of these studies included participants who were fully bilingual and used both languages daily. It is unclear what level of proficiency and what type of bilingualism will yield similar results (Bialystok, 2009).

Evidence suggests that bilingual children develop vocabulary more slowly in each language than monolingual speakers of that language and perform more poorly on measures of language proficiency (Bialystok, & Feng, 2009). However, as previously stated there is extensive evidence suggesting that bilinguals perform better in executive functioning tasks based on response conflict, inhibitory control, and cognitive flexibility. The advantages have been seen across the lifespan in children, adults, and older adults. These executive function tasks were all nonverbal measures of attention and control, but do not show connection with language processing. There is some evidence to suggest that the bilingual advantage in executive function can be used to improve performance in verbal tasks, where bilinguals typically have a disadvantage. In order to test the bilingual advantage theory, Bialystok and Feng (2009) created a proactive interference task that involves both verbal processing and executive control. Proactive interference occurs
when retrieval of recent material is disrupted by the prior exposure to similar items. This proactive interference effect in which memory declines with subsequent presentation of similar material and is restored when the stimulus category changes has been found in both children and adults. Proactive interference can occur when patients are asked to recall words from the same semantic category and then they are asked to recall words from a different list that are not of the same semantic category. The release of proactive interference is used to indicate levels of controlled processing as it is assumed that the ability to control attention to previously presented information is part of the executive function, but this task also involves verbal processing (Bialystok & Feng, 2009).

In Bialystok and Feng (2009), a proactive interference task was administered to both children and adults in order to determine the relationship between executive control and language proficiency. Bilingual and monolingual children were assessed for language knowledge and short term memory using the Peabody Picture Vocabulary Test, a sequencing span, a digit span, and a proactive interference task. The results of this study conveyed that bilingual children who had a smaller than monolinguals but similar levels of short term and working memory performed the same as monolinguals on a proactive interference task. There were subtle differences between the two groups such as bilinguals committing fewer intrusions than the monolinguals and the bilinguals did not show a significant decline in recall between list one, two and three; this suggests that there is less buildup of interference from the previous word lists. These results indicate that there are no bilingual disadvantages in the ability to attend to lists of words and there may be some advantages relative to executive function and proactive interference (Bialystok & Feng, 2009).
A second study (Bialystok & Feng, 2009) was conducted aiming to find a relationship between bilingualism and language proficiency in proactive interference in young adults. The adults were evaluated in English on the following tasks: a language background questionnaire, a proactive interference task, and the Peabody Picture Vocabulary Test. The proactive interference task was presented on a computer where the participants were given four test lists of ten words. The first three lists contained words from the same semantic category and the fourth list contained words from different categories. The performance of the monolinguals and bilinguals in the proactive interference task was the same, but there were differences in language proficiency based on the vocabulary score. Using analysis of covariance, the authors corrected for differences in vocabulary score and this revealed a significant advantage for bilinguals during the proactive interference task. The results of these studies suggest the lexical retrieval disadvantage and cognitive control advantages in bilinguals interact when performing a complex task. The most noteworthy finding was the importance of the vocabulary score on the word recall from the second study. When vocabulary was used as a covariate, differences between monolinguals and bilinguals are eliminated. These results may indicate that bilinguals have better control of attention to the words held in short term memory. As this study was the first to examine this relationship, further research is necessary to clarify the correlation between language proficiency and executive control (Bialystok, & Feng, 2009).

**Bilingual Aphasia**

Weekes (2010) addressed some important questions researchers have studied surrounding bilingual aphasia. These questions included: how brain damage impacts on
patterns of aphasia observed in the languages of a bilingual speaker and how language type constraints affect patterns of aphasia. Specific language constraints being evaluated have included language status, order in which the languages are acquired, language dominance, and cognate status (two words with the same meaning having the same original root in various languages such as “music” in English and “musica” in Spanish). At this point, several studies have aimed to answer these questions, but the results remain inconclusive (Weekes, 2010).

Paradis (2004) addressed the four potential recovery patterns for bilingual patients with aphasia. The first pattern is parallel recovery in which the aphasic patient’s recovery parallels previous language abilities in both languages, meaning the patient’s premorbid language ability would be reflected in their recovery poststroke. The second recovery pattern is differential recovery which occurs when one language is recovered much better than the other language relative to premorbid fluency. The third pattern is antagonistic recovery, which occurs when the patient is only able to use one language initially; then, the second language gradually becomes available, but the first language regresses and eventually disappears. The final recovery pattern is blending recovery which is when the patient unwillingly mixes their two languages and is not able to speak one language at a time.

Paradis (2004) has also described differential versus selective recovery. Selective recovery is when one language is not affected, but the other language is adversely impacted. Differential recovery is when both of the languages are affected, though one more than the other. Other less common recovery patterns have been reported, but they
have not been labeled and trends have not been seen across groups of patients (Paradis, 2004).

Relative to assessment of bilingual aphasia, Paradis (2004) has indicated that most of the reported bilingual aphasic patients have not been assessed with a comparable instrument in each of their languages. Paradis emphasized that no factor has been identified to predict the status of one language relative to another so it is imperative that aphasic patients are assessed in all the languages they spoke pre-morbidly. Because of this observation, the Bilingual Aphasia Test (BAT), was developed in order to assess aphasia in bilingual, monolingual, and multilingual speakers (Paradis & Libben, 1987). The assessment is available in 65 languages that are culturally and linguistically equivalent tests. In addition to assessing both languages, Paradis has reported that it is important to gather a detailed language acquisition history of the patient and their pattern of use because different patterns may involve different cerebral substrates; furthermore, each language may be differentially vulnerable to a focal lesion within the left perisylvian classical language area (Paradis, 2004).

Although there are growing statistics about the increase of bilingualism in the United States, evidence suggests that many speech-language pathologists currently cannot count on their academic training to serve these individuals realistically, which may translate into service disparities and, in turn, reduced health and communication outcomes (Rosenfeld, 2002). Patients with limited English proficiency, and a lack of SLPs fluent in non-English languages may result in a lack of language assessments, leading to limited to no speech and language treatment which may result in a limited recovery (Wiener, Obler, & Taylor-Sarno, 1995). In addition, when bilingual individuals
are assessed, there may be biased scores relative to cultural and linguistic diversity. Some professional biases may include general assumptions that premorbid abilities in each language are equivalent and that all language modalities are used, being bilingual implies a certain level of proficiency for all bilingual speakers, or that post-morbid differences between the languages are solely due to brain damage. In order to combat these biases, it is vital for SLPs to get a thorough language history of their patients relative to language acquisition, and pre-morbid language abilities (Lorenzen & Murray, 2008). SLPs aim to reduce these biases by evaluating all languages an individual is competent in, adapting assessment measures for different cultural and linguistic populations, measuring processing skills, and using dynamic assessment (Kapantzoglou, Restrepo, & Thompson, 2012).

In addressing rehabilitation for bilingual aphasic individuals, Paradis (2004) focused discussion relative to in which language therapy should be provided. Older research from Chlenov (1948), Wald (1961), Hemphill (1976), and Lebrum (1988) concluded that concurrent therapy in both languages exerted an inhibitory influence upon speech restitution in general and hindered recovery of all languages used pre-morbidly. There is less consensus among authors regarding which language to target during therapy. Hilton (1980) recommended treating in the patient’s strongest language, Krapf (1961) recommended treating in the patient’s native language, and Lebrum (1988) recommended targeting the patient’s best recovered language (Paradis, 2004).

In considering compensatory strategies that could be used during rehabilitation, Paradis (2004) indicated three techniques that are beneficial for patients with bilingual aphasia. These include the following: the use of metalinguistic knowledge, to the extent
that declarative memory is not affected; substitution of pragmatics where syntax or lexical access are unavailable; and the use of translation possibly via metalinguistic knowledge at any level of linguistic structure. In order to target metalinguistic knowledge, patients are instructed to draw attention to surface features of language. The structural approach to this therapy resembles grammatical exercises used for second-language learning such as conjugating verbs. These activities rarely help patients reacquire lost components of their language; instead, they help patients improve the effectiveness of their communication (Cubelli, Foresti, & Consolini, 1988). Another strategy used is overcoming syntactic impairments by substituting pragmatic means for communication, as it has been shown that pragmatic skills generally are well preserved for aphasic patients. Specific intervention plans have been created to facilitate this strategy including the Visual Action Therapy (Helm-Estabrooks, Fitzpatrick, & Barresi, 1982), Promoting Aphasic’s Communicative Effectiveness (Davis & Wilcox, 1985), Functional Communication Treatment (Aten, 1986), and Communicative Strategies (Holland, 1991). The final strategy mentioned is the use of translation when a word is not readily available to a patient (Bond, 1984). For instance, if a patient presents with anomia and they are unable to think of an object name in their first language they can name the object in their second language. If the word is not available to the patient in either language the patient can use gestures to describe the word in hopes that the message will translate to their communication partner. These methods have been effective in the language rehabilitation of monolinguals and can also be effective for bilinguals when the patient is provided with compensatory strategies. It is recommended that when implicit linguistic competence is unavailable to complete the task, metalinguistic knowledge and
pragmatic communication may be used to assist the patients. Also, patients should be encouraged to utilize the translation of words when word retrieval in the desired language is not functioning. Patients may benefit when the tasks are presented in both of their languages as they may rely on bilaterally represented information (Paradis, 2004).

More recently, Centeno and Ansaldo (2017) suggested that intervention contexts should provide optimal stimulation to enhance linguistic recovery, minimize the extent of the disability and promote social functioning. In order to do so, therapists should provide evidence based practice. One recommendation Centeno and Ansaldo provided was to target cognitive skills (i.e. attention, categorization, or problem solving tasks such as card sorting and single digit computations) and use target words that provide cross-linguistic similarities (cognates: rose/rosa) relative to non-cross-linguistic similarities (non-cognates: apple/manzana). This method is likely to provide better cross language generalization from treated language to non-treated language (Kohnert, 2008). The second intervention method that was recommended targets cognitive operations involved in typical expressive features in bilingual communications similarly; this has been useful to treat naming skills in the context of pathological language switching (Ansaldo, Saidi, & Ruiz, 2010). The approach is achieved through translation of various words, which is a skill that is often less impaired than other linguistic skills in bilingual individuals with aphasia. Bilingual therapy would provide a dual-language strategy to maximally stimulate the cognitive-linguistic mechanisms participating in the bilingual language system of the speaker and enhance the dual language use that is typically used by bilingual speakers in daily discourse (Centeno & Ansaldo 2017).
Ansaldo and Saidi (2014) have emphasized that bilingualism is becoming more prominent throughout the world because of globalization. The bilingual population is large and growing worldwide so bilingual aphasia is a more frequent encounter. Furthermore, because of the increased incidence of bilingual aphasia, researchers have focused on cross-linguistic effects that language therapy may provide in one of two languages relative to the untreated language. The evidence regarding language transfer in healthy bilinguals indicates that their speech reflects the influence of one language on the other. The influence results from similarities and differences between the target language and any other previously acquired language; this is referred to as cross-linguistic transfer. If cross-linguistic transfer occurs in healthy bilinguals, researchers assume there will be similar effects among the language abilities in patients with bilingual aphasia. The evidence suggests that cross-linguistic effects are possible, but they depend on several factors including pre- and postmorbid language proficiency.

To date, multiple investigators suggest that semantic approaches result in better cross-linguistic transfer than phonological approaches (Abutalebi, et al. 2009; Croft, Marshall, Pring & Hardwick, 2011; Edmonds & Kiran, 2006, Kiran & Iakupova, 2011; Kohnert, 2004; Kurland & Falcon, 2011; Roberts & Deslauriers, 1999). Furthermore, cognates have better cross-linguistic transfer potential than non-cognates. Additional research needs to be conducted in order to find other ways cross-linguistic transfer can be facilitated during therapy. Many researchers are focusing on anomia as it is the most widespread aphasia sign (Ansaldo & Saidi, 2014).
Patterns of Aphasia Recovery/ Chronic Aphasia

Work by Lendrem and Lincoln (1985) was one of the first to evaluate spontaneous recovery post stroke. The results indicated that spontaneous recovery was very apparent during the first 34 weeks post stroke and the patient’s language abilities improved most markedly between four and ten weeks post stroke (Lendrem & Lincoln, 1985). Holland and Fridriksson (2001) described the clinical aspect of early stroke recovery including spontaneous recovery, early evaluation and intervention. Spontaneous recovery is a well-known phenomenon that occurs within the first three to four months post stroke. During this period, the patient experiences a partial reconstitution of his or her prior language knowledge and skills. Pedersen et al. (1995) who reported that 95% of patients with mild aphasia on admission had reached stable language function within the first two weeks, and the greatest gains for patients with moderate to severe aphasia were also observed within the first two weeks of recovery. This indicates that some patients will improve relatively quickly, but others will have long lasting effects of the aphasia. Davis (2014) agrees that recovery is the greatest between the first two to three months post onset, but progress can be demonstrated well after a year post stroke. A study conducted by Meinzer et al. (2004), assessed the language functions of 28 participants who were at least one year post stroke. After receiving intensive language training, 16 patients had an increase in language functions. These results emphasize the significance of rehabilitation of aphasia even years after the stroke.

Theories have been established relative to how the damaged regions of the brain function during the recovery process. One theory is that the damaged regions are repaired via neurogenesis, or the creation of new neurons. A second theory indicates that the brain
compensates for the damaged regions by using the intact, undamaged regions of the brain (Davis, 2014). Studies on chronic aphasia patients help to promote these theories. The study by Meinzer et al. (2004) indicated that reorganization may occur in the language networks that provide the basis for improved language functions after intensive therapy. Ansaldo, Arguin, and Lecours (2002) also provided evidence that other neural structures may be compensating for the damaged region. One patient demonstrated an increased ability of reading words in different visual fields. At two and six months post onset, the patient was able to read the words quicker from the left visual field. By 10 months post onset, the patient was able to read words from both visual fields equally, indicating a compensation technique from the right hemisphere (Ansaldo, Arguin, & Lecours, 2002).

Brain imaging studies have reported compensatory changes in the hemisphere with the lesion and the hemisphere without the lesion. The brain in patients with aphasia relies on neuroplasticity to change in order to regain their language abilities. Fredriksson, et al. (2010) compared 15 people with aphasia to healthy individuals using MRI imaging to detect any differences during a naming task. The amount of cortical activation in the undamaged regions of the left hemisphere was relatively equal to the amount of items the individual was able to name during the naming task (Fredriksson, et al. 2010). An additional study documented that changes in the left hemisphere near the lesion site may be less probable than changes in the right hemisphere. However, the recovery process may vary between patients and the changes due to neuroplasticity take time and rehabilitation measures (Thiel, Habedank, Herholz, et al. 2006).

The neural changes mentioned begin to occur relatively quickly after a stroke during the spontaneous recovery stage and they can continue for a number of months or
years after the insult. Johnson et al. (2019) has outlined factors that significantly influence language recovery in chronic aphasia patients, indicating that they can continue to make gains in their language abilities well after a year post stroke. The study examined Western Aphasia Battery (WAB) (Kertesz, 1982) scores in 39 aphasic patients that took place at least 6 months post injury and then a second measure occurred between one to three years post stroke. The results indicated that half of the participants improved after their initial WAB assessment. 26% of the participants decreased and 23% remained stable (Johnson et al., 2019).

The investigators evaluated which factors were associated with continued improvements during the chronic aphasia stage. The following factors were considered: handedness, gender, age at stroke, time since stroke occurred, comorbid diseases such as diabetes, hypertension, etc., exercise, education, and the amount of therapy the participants had received. There appeared to be no significant difference between several of these factors regarding which participants made improvements during the chronic phase and which did not. However, there were four factors that suggested an influence on rehabilitation long term. These factors included age at stroke onset, amount of exercise, comorbid diseases, and number of hours spent in therapy (Johnson et al., 2019).

Age at onset may be a factor limiting individuals to make continued improvements during the chronic aphasia stage. Older adults have been reported to have worse accuracy on a comprehension task compared to younger adults (Tun, 1998). Additionally, age has also been reported as a limiting factor in aphasia recovery across a range of studies (Ellis & Urban, 2016; Hillis et al. 2018; Holland, Greenhouse, Fromm, & Swindell, 1989). Johnson et al. (2019) indicated that older age at stroke onset has
negative effects on language recovery. A second limiting factor may be co-occurring diseases. Brands et al. (2005) showed that overall cognition, fluid intelligence, and speed of processing were reduced in patients with diabetes compared to controls. Aside from diabetes, patients may present with several other comorbid diseases such as obesity, hypertension, chronic kidney disease, cardiovascular disease, sleep disorders, and cancer. One explanation as to why those with comorbid diseases are predicted not to recover as well as those without is due to a general cognitive decline that leads to reduced cognitive reserve (Johnson et al. 2019).

An aiding factor in recovery among chronic aphasic patients may be exercise. Previous studies have indicated that aerobic exercise can positively affect recovery post stroke motorically and cognitively (Cumming, Tyedin, Churilov, Morris, & Bernhardt, 2012). Johnson et al. (2019) found that among the patients with comorbid diseases, the individuals that exercised had increased WAB scores over time. The second aiding factor that may influence rehabilitation over time is the role of Speech-Language therapy. Several researchers indicated a possibility for increased language abilities for chronic aphasic patients with the use of speech-language intervention (Breitenstein et al., 2017; Fridriksson, Richardson, et al., 2012; Moss & Nicholas, 2006; Pulvermuller et al, 2001; Smania et al. 2010, Johnson et al., 2019). One limiting factor is that it is unclear how much therapy is needed; furthermore, insurance policy limits often prevent patients from seeking therapy once they reach the chronic stage of recovery.

In conjunction with theories relative to how the brain recovers from stroke, there is some evidence demonstrating how lesion location influences recovery. Researchers have investigated which lesion types result in the best recovery outcomes. Bomi Sul et al.
(2016) investigated the effects of specific brain lesions on prognosis, assessing the characteristic pattern of recovery. The study included 15 participants who suffered their first left hemisphere stroke. Brain lesion size was evaluated using MRI imaging and language abilities were assessed using the Korean version of the Western Aphasia Battery (K-WAB). The language assessment was composed of four sections including fluency, comprehension, repetition, and naming. The patients received their initial assessment using K-WAB within the first three months of stroke onset and the follow-up test was completed at least three months after the initial assessment. Changes in the aphasia quotient (AQ) were compared following the second assessment to determine if a significant change occurred. When brain lesion size reports were evaluated, there was no significant difference in age of patient and brain lesion volume relative to aphasia severity post stroke. After comparing brain lesion data and the K-WAB scores, the results indicated that involvement of Broca’s area, the motor programming center for speech, and the superior temporal gyrus, the comprehension center, were related to poor long-term outcome of aphasia in left hemisphere stroke. Additionally, when the inferior prefrontal gyrus or the premotor cortex are damaged, there is a higher chance for recovery of aphasia. Bomi Sul et al. (2016) emphasized that aphasia is a multidimensional disorder in which patient profiles reflect variation along multiple behaviors; thus, it is important to approach aphasia under multiple core factors such as phonology, semantics, and cognition.

Previous research indicated that not only the location, but also the size of the brain lesion plays a role in determining the prognosis of aphasia in stroke patients (Kertesz, Harlock, & Coates, 1979; Mazzocchi, Vignolo, 1979). However, Bomi Sul et
al. (2016) indicated no significant difference in the volume of brain lesions between the group that had significantly higher aphasia quotients and the group that did not have as significant improvements. Kertesz, Harlock, and Coates, (1979) and Mazzocchi and Vignolo, (1979) noted that not only the location, but also the size of the brain lesion plays a role in determining the prognosis of aphasia in stroke patients. However, Watila and Balarabe (2015) reported that the location of the brain lesion is more crucial than the extent or size of the lesion. Additionally, Heiss, Theil, Kessler, and Herholz (2003) reported that the preservation of the left superior temporal gyrus and the basal ganglia is important for the recovery of aphasia, emphasizing the fact that the location of the lesion is vital to aphasia prognosis. According to the findings, involvement of Broca’s area, inferior prefrontal gyrus, and premotor cortex might be related to the slow recovery rate of aphasia in left hemisphere stroke. In addition, the involvement of the superior temporal gyrus might be related to poor long-term outcome of aphasia in strokes of the left hemisphere. Although this study revealed significant results, the small sample size should be taken into consideration (Bomi Sul et al., 2016).

**Influence of Bilingualism on Recovery of Aphasia**

As indicated previously, Paradis (2004) presented four typical recovery patterns bilingual aphasic patients may encounter including parallel recovery, differential recovery, antagonistic recovery, and blending recovery. Green et al. (2010) studied the phenomenon of parallel recovery in hopes of determining what causes bilinguals to have differing recovery patterns. Previous studies reported that differential recovery occurs when damage to frontal-parietal-subcortical networks occurs which mediates language selection and control (Abutalebi & Green, 2007). In order to test this theory, Green et al.
(2010) assessed two bilingual aphasic patients with a parallel recovery pattern to
determine if lesions were still apparent in the frontal-parietal-subcortical networks even
though they presented with no problem in language selection and no evidence of
involuntary language switching. During further language assessment, the Stroop task and
the flanker task, language control abilities were not as strong as researchers anticipated.
When data were evaluated, one patient presented with difficulties in verbal control and
the second patient presented with difficulties in verbal and non-verbal control. The
findings suggested that it is important to probe the precise nature of the control problems
in bilingual speakers by using a range of tasks and isolating the nature of word
production and the competitive effects in lexical decision making (deciding which
language to produce the target word in). These results indicate that there are non-
linguistic executive processes that are relevant to aphasia recovery patterns in bilingual
individuals (Green et al., 2010).

Davis and Harrington (2012) hypothesized that the type of languages bilinguals
speak may play a role in their recovery patterns. In order to understand this further, Davis
and Harrington (2012) provided a case study with one patient who was a English and
Mandarin bilingual speaker who recovered from severe aphasia. Mandarin is considered a
tonal language and English is considered a non-tonal language, which was hypothesized
to aid her recovery. Tonal languages require tonal changes to indicate meaningful
difference in words. There is some evidence that Mandarin and other tonal languages
require support of the right hemisphere. The patient’s language recovery was remarkable
given her extensive left inferior frontal cortex damage. This patient received intensive
intervention for six months post injury. Throughout recovery the aphasia quotient
improved from 48.3 to 79.8, from Broca’s to Anomic aphasia. Conditions tested included a match object to object description task, match voice to voice after a delay, and verb generation task. All activities were conducted in both Mandarin and English. fMRI images revealed extensive right hemisphere activation associated with both English and Mandarin processing. It is likely that the patient utilized right hemisphere substrates for linguistic means prior to her injury (Davis & Harrington, 2012).

Penn, Frankel, Watermeyer, and Russell (2010) indicated that deficits of executive function have been proposed as all or part of the underlying mechanisms of language impairment in patients with some types of aphasia. Executive functions also play a part in the recovery process. Evidence suggests that people who are bilingual have some executive function advantages compared to monolinguals. Because of these findings, the authors investigated the relationship between executive functioning and conversational strategies in patients with bilingual aphasia. The study included two bilinguals with aphasia and eight monolinguals, seven of which had aphasia and one had right hemisphere damage. The test battery measured behavioral inhibition, working memory, problem solving, and reconstitution. The results yielded a significant difference between the scores of bilinguals and monolinguals in all areas tested. The bilinguals' scores were primarily within normal limits which suggested well-retained executive functions regardless of severity or type of aphasia (Penn et al., 2010).

Relative to treatment, Penn et al. (2010) suggested that a patient’s home language should be the language used for treatment, but others believe that the most frequently used language, the dominant language (Marrero, Golden and Espe-Pfeifer, 2002) or the language that appears spontaneously should be treated (Fabbro et al., 2000). The choice
of monolingual or bilingual therapy is a complex matter and should be individualized based on the patient, the environment and the context of the situation. The results of the study indicated the scores of the bilingual participants were within normal limits and suggested well preserved executive functioning. Regardless of the severity or type of aphasia, the bilingual participants showed evidence of good topic management, conversational repair, and mental flexibility compared to the monolingual participants. Given the results of this study, executive function should be considered when determining if therapy should be provided in the patient's first language, second language, or both. If executive function is well preserved, the compensatory and shifting strategies that the individual utilized premorbidly may be applied after the stroke to facilitate interaction. If the control functions are a strength for the patient, a bilingual approach during treatment may enhance pragmatics and offer a variety of choices. This is especially important if the patient lives in an environment where bilingualism is the norm.

The executive functioning findings in Penn et al. (2010) also addressed another ongoing debate, specifically the role of executive functioning in conversation. Executive functioning may have an impact on the relative transfer of therapy effects from the treated to the untreated language. Therapy approaches are stimulating inhibition mechanisms of the recovering brain and they use control functions rather than solely language functions. This emphasizes the fact that assessment of executive functioning should become a regular component of the clinical battery, particularly in determining the therapeutic approach to be used. Penn et al. (2010) concluded that some bilinguals may have enhanced executive functions such as enhanced mental flexibility, which potentially
provides some additional protection from brain damage. The executive capacity may enable the development of compensatory strategies that may have manifestations in bilingual participants. Although the results are significant, this area requires further exploration as it was a preliminary study. Additionally, the study identifies methodological and analytic challenges such as only including 10 participants and only two of those were bilingual (Penn et al. 2010).

Penn, Barber, and Fridjon (2017) conducted a similar study to assess an assessment battery that would be beneficial to evaluate the language and executive function skills of bilingual individuals with aphasia. The results indicated that the use of the Comprehensive Aphasia Test (CAT) (Swinburn, Porter & Howard, 2005) and a non-verbal executive function test battery revealed that the first twelve weeks post onset is an appropriate time to assess individuals using this assessment battery. Additionally, the results confirmed the findings of Penn et al. (2010), suggesting that executive functioning may offer some explanations for differential recovery profiles. For example, deficits in executive functioning in a bilingual person suggest differing results when compared to a bilingual with intact executive functioning relative to the bilingual advantage in the acute recovery stage. In order to manage this in the clinical setting, speech language pathologists are encouraged to utilize a diagnostic battery that assesses executive functioning and language abilities.

Alladi et al. (2016) also have evaluated the relationship between executive function, bilingualism, and the implications after a stroke. A study including 608 patients who suffered an ischemic stroke, measured association between bilingualism and cognitive outcome of stroke. The results indicated a significant difference in the
percentage of patients with intact cognitive functions post stroke which was more than twice as high in bilinguals than in monolinguals. Additionally, it was reported that no difference was found between bilinguals and monolinguals in vascular risk factors or in the age of stroke, suggesting that the results are not due to an overall healthier lifestyle among bilinguals. As previous research has suggested (Penn et al., 2010; Penn, Barber & Fridjon, 2017), the bilingual individuals achieved higher scores on attention and fluency domains which suggest that these results indicate a protective role of bilingualism in the development of post stroke cognitive impairment (Alladi et al., 2016).

In conjunction with executive functioning and other cognitive impairments, aphasia severity between monolinguals and bilinguals was also measured. Alladi et al. (2016) described an apparent protective effect that is thought to be conferred by the lifelong practice of using two languages and switching between them, while inhibiting the potential competitors during production (i.e. choosing the word the individual wants to say in the language they are speaking in rather than the other language they have access to). Based on the noted cognitive advantages related to bilingualism, Paplikar et al. (2019) measured the impact on language function recovery in aphasia from stroke, accounting for possible confounding variables such as age, education, and immigration. Out of the 608 patients evaluated, it was found that the frequency of aphasia following a stroke was not different between monolingual and bilingual individuals. However, bilingualism was found to be associated with a lesser severity of aphasia. One of the strengths noted that created the difference in post stroke abilities was the preservation of repetition in bilinguals with aphasia. Repetition is considered to be a multifaceted function that relies on attention, working memory, and semantic, syntactic and
phonological processes. The preservation of this ability resulted in an overall less severe aphasia (Paplikar et al. 2019)

Lahiri, Dubey, Ardila, and Roy (2019) replicated Paplikar et al. (2019) and Alladi et al. (2016) studies to determine if the results were consistent. During their current investigation, the data indicated that bilingualism was significantly associated with a less severe grade aphasia. However, hemorrhagic stroke, larger lesion volume, and nonfluent aphasia were observed to be independent predictors of initial aphasia severity. According to Lahiri et al. (2019), bilingualism plays a role in the recovery process and it assists the patient over time; however, in the acute stage of post stroke language recovery, it may not have as big of an impact. Instead, the results of this study indicated that the most important determinants of the initial severity of post-stroke aphasia were lesion-related factors (such as size and location) and the type of aphasia (Lahiri, Dubey, Ardila, & Roy, 2019).

Summary and Rationale

Aphasia is a language disorder that results from stroke and other brain injuries, but it can have different implications across patients especially if they have differing premorbid language abilities. Recovery from aphasia is most prominent during the first two to three months post stroke, but research indicates that individuals may continue to make improvements well after a year post injury. The brain is able to recover from the lesions and regain disrupted language abilities by neurogenesis or by compensating for the damaged regions by using the intact, undamaged regions of the brain. Some factors may indicate a better prognosis of aphasia recovery from stroke such as the age stroke
occurred, medical history, location and size of lesion, and the amount of speech therapy the individual receives.

An additional factor that may influence aphasia recovery is bilingualism. Bilingual individuals may have stronger executive functioning and attention skills than monolinguals. Evidence suggests that regardless of the severity or type of aphasia, bilingual individuals show increased evidence of topic management, conversational repair, and mental flexibility compared to the monolingual participants. These strengths may assist bilingual individuals throughout their lifespan relative to aging and recovering from brain injuries. Specifically, these observations may yield a better recovery of language skills after a stroke. The current investigation allows for an exploration of the factors that may influence recovery patterns of bilingual and monolingual individuals with aphasia.

As indicated, there are various factors that contribute to aphasia language recovery post stroke. Understanding aphasia recovery patterns will aid clinicians when determining prognosis for their patients. The current investigation will determine if bilingualism is an additional factor that may influence aphasia recovery.

**Plan of Study and Experimental Questions**

The purpose of the current investigation is to investigate and compare aphasia recovery patterns in bilingual and monolingual adults with chronic aphasia. Ten participants with aphasia who are at least one year post-stroke will be assessed and compared using the Bilingual Aphasia Test (BAT) (Paradis & Libben, 1987), in order to examine their aphasia recovery and language abilities. The bilingual group’s performance in English will be compared to English performance of the monolingual group.
Additionally, the bilingual group’s English scores will be compared to their Spanish scores.

The following experimental questions will be answered:

1. Is there a significant difference between Spanish and English abilities of bilingual speakers in auditory processing as measured by the following subtests: pointing, simple commands, verbal auditory discrimination, syntactic comprehension?

2. Is there a significant difference between the English abilities of bilingual speakers and monolingual English speakers in auditory processing as measured by the following subtests: pointing, simple commands, verbal auditory discrimination, syntactic comprehension?

3. Is there a significant difference between Spanish and English abilities of bilingual speakers in verbal production measured by the following subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming?

4. Is there a significant difference between the English abilities of bilingual speakers and monolingual English speakers in verbal production measured by the following subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming?
CHAPTER II

Method

Participants

Ten participants with aphasia from a cerebrovascular accident (CVA), intracerebral hemorrhage, or Traumatic Brain Injury (TBI) resulting in aphasia, were included in the study. All participants were at least one year post injury. Five participants are Spanish-English bilinguals and five participants are English speaking monolinguals (Table 1).

Table 1. Participants’ Demographics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Diagnosis</th>
<th>Months Post Onset</th>
<th>Education</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>20CAMME</td>
<td>62</td>
<td>Male</td>
<td>L-Ischemic Stroke</td>
<td>19</td>
<td>14</td>
<td>English</td>
</tr>
<tr>
<td>12SLME</td>
<td>49</td>
<td>Female</td>
<td>L-Ischemic Stroke</td>
<td>17</td>
<td>14</td>
<td>English</td>
</tr>
<tr>
<td>6BSME</td>
<td>42</td>
<td>Male</td>
<td>L-Ischemic Stroke</td>
<td>97</td>
<td>14</td>
<td>English</td>
</tr>
<tr>
<td>11JNME</td>
<td>73</td>
<td>Male</td>
<td>L-Ischemic Stroke</td>
<td>224</td>
<td>14</td>
<td>English</td>
</tr>
<tr>
<td>3WSME</td>
<td>71</td>
<td>Male</td>
<td>L-Hem Stroke</td>
<td>41</td>
<td>14</td>
<td>English</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean: 59.4 SD: 13.58</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Range: 42-73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BILINGUALS</td>
<td></td>
<td></td>
<td>Mean: 14 SD: 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range: 14-14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13AKBSE</td>
<td>49</td>
<td>Female</td>
<td>L-Ischemic Stroke</td>
<td>23</td>
<td>16</td>
<td>Spanish, English</td>
</tr>
<tr>
<td>15JSBSE</td>
<td>38</td>
<td>Male</td>
<td>L-Ischemic Stroke</td>
<td>30</td>
<td>16</td>
<td>Spanish, English</td>
</tr>
<tr>
<td>18KBM</td>
<td>44</td>
<td>Male</td>
<td>TBI</td>
<td>62</td>
<td>18</td>
<td>English, Spanish, Thai, French</td>
</tr>
<tr>
<td>16MVSE</td>
<td>48</td>
<td>Male</td>
<td>L-Hem Stroke</td>
<td>34</td>
<td>14</td>
<td>Spanish, English</td>
</tr>
<tr>
<td>19MIBSE</td>
<td>39</td>
<td>Male</td>
<td>TBI, AVM</td>
<td>124</td>
<td>14</td>
<td>Spanish, English</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean: 43.6 SD: 5.03</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Range: 38-49 p&lt;.05</td>
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</tr>
</tbody>
</table>

The inclusion criteria for the study are as follows: CVA, intracerebral hemorrhage, or TBI resulting in aphasia confirmed by MRI or CT, aged 18+ years, fluent in English.
premorbidly for the monolingual patients, and fluent in both English and Spanish for the bilingual patients. The exclusion criteria were a prior history of stroke, dementia or other neurological disorders that affect cognitive functioning. Demographic, medical history, and language acquisition history were obtained from interviews with patients and caregivers, from the medical history questionnaire (Appendix C) and from the Bilingual Aphasia Test (BAT) (Paradis & Libben, 1987), language history questionnaire (Appendix F).

**Pre-Experimental Testing**

Once the patient or caregiver agreed to participate and returned the informed consent form (Appendix B) and the medical history questionnaire (Appendix C); each patient was administered a language history questionnaire using the BAT portion A (Appendix F). Hearing and vision history were obtained from the patient or caregiver to determine if hearing aids or glasses were needed for the assessment. Hearing and vision were informally assessed in the following manner. In order to assess hearing, the participants were administered an informal hearing screening using the Mimi Test hearing screening app (Appendix E). All participants were able to respond to heard stimuli within the 30 dB or less range indicating no difficulty hearing conversational speech. In order to assess vision, the participant was asked to label ten common pictured images or pair the pictured stimuli with the written option (Appendix D). All participants scored with 80% accuracy or greater. Hemianopsia was informally assessed via the participants medical history questionnaire (Appendix C). If cognitive or language deficits
 prevented the individual from participating in the visual and hearing screening, the participant was assessed via caregiver report and medical history only.

**General Information**

This study was reviewed and approved by the Institutional Review Board at Florida International University on 4/17/20 (Appendix A). Participants were recruited from Aphasia support groups and University speech and hearing clinics through the United States. The pre-experimental testing, medical history, and the assessment with the BAT were administered via ZOOM due to COVID-19 restrictions. The assessment process was approximately 90 minutes for monolingual participants and two 60-minute sessions for bilingual participants.

**Experimental Procedure**

**Materials**

The Bilingual Aphasia Test (BAT) (Paradis & Libben, 1987) is an assessment tool used to assess and diagnose aphasia among the bilingual population. The tool is culturally and linguistically altered in order to be inclusive among the bilingual population and to reduce score biases. For this study, the following portions of the BAT were utilized: Part A: History of bilingualism (Appendix F), Part B: English/Spanish Background, and the following portions of language assessment: spontaneous speech, pointing, simple commands, verbal auditory discrimination, syntactic comprehension, semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming (Appendix 7).
**Procedure**

For the experimental task, all participants were administered a language history questionnaire using the Bilingual Aphasia Test (BAT) section A. All participants were then administered a language assessment using the BAT section B, addressing the specific subtests indicated in the previous section. The bilingual participants completed the different language assessments in two different sessions and the monolingual participants completed the testing in one session. Breaks in testing were provided as needed.

**Data Analysis**

Language evaluations were scored by the examining speech-language pathology student. Auditory processing scores, based on the following subtests: pointing, simple commands, verbal auditory discrimination, syntactic comprehension, were compared between the Spanish and English abilities within the bilingual group, and the English abilities between the bilingual and monolingual group. Verbal production scores were based on the following subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision, series, verbal fluency, and naming. These scores were compared between the Spanish and English abilities within the bilingual group, and the English abilities between the bilingual and monolingual group.
Chapter III

Results

The purpose of the current investigation was to investigate and compare aphasia recovery patterns in bilingual Spanish-English and monolingual adults with chronic aphasia. This study used the BAT (Paradis & Libben, 1987) to explore differences in bilingual versus monolingual participants with aphasia and to compare the English versus Spanish ability in the bilingual participants. The BAT was administered in English to the monolingual participants and in English and Spanish to the bilingual participants. Data was compared between the monolingual and bilingual group in English and between the English and Spanish scores of the bilingual group.

Spanish versus English Abilities in Bilingual Speakers: Auditory Processing

In order to examine the auditory processing abilities of Spanish and English in bilingual speakers with aphasia, the following subtests of the BAT were administered: pointing, simple commands, verbal auditory discrimination, syntactic comprehension. These data are presented in Table 2.

Table 2. Spanish and English scores on auditory processing tasks for bilingual participants

<table>
<thead>
<tr>
<th>Subtest (Total Possible Points)</th>
<th>Eng. Mean</th>
<th>English Standard Deviation</th>
<th>English Range</th>
<th>Spn. Mean</th>
<th>Spanish Standard Deviation</th>
<th>Spn. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointing (9)</td>
<td>8.6</td>
<td>0.89</td>
<td>7-9</td>
<td>8.4</td>
<td>1.34</td>
<td>6-9</td>
</tr>
<tr>
<td>Simple Commands (6)</td>
<td>5.4</td>
<td>1.34</td>
<td>3-6</td>
<td>5.2</td>
<td>1.3</td>
<td>3-6</td>
</tr>
<tr>
<td>Verbal Auditory Discrimination (18)</td>
<td>14.2</td>
<td>3.56</td>
<td>9-17</td>
<td>13.8</td>
<td>3.7</td>
<td>8-17</td>
</tr>
</tbody>
</table>
Paired t-tests were used to compare differences between languages for each subtest.

Results revealed no significant differences between English and Spanish performance for the bilingual participants for any of the auditory processing subtests (p>.05).

**English Abilities in Monolingual versus Bilingual participants: Auditory Processing**

English abilities of bilingual participants were compared to the English abilities of the monolingual participants for the following auditory processing subtests: pointing, simple commands, verbal auditory discrimination, syntactic comprehension. These data are presented in Table 3.

**Table 3. English scores on auditory processing tasks for both bilingual and monolingual participants.**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointing (9)</td>
<td>9</td>
<td>0</td>
<td>9-9</td>
<td>8.6</td>
<td>0.89</td>
<td>7-9</td>
</tr>
<tr>
<td>Simple Commands (6)</td>
<td>5.6</td>
<td>0.55</td>
<td>5-6</td>
<td>5.4</td>
<td>1.34</td>
<td>3-6</td>
</tr>
<tr>
<td>Verbal Auditory Discrimination (18)</td>
<td>15.6</td>
<td>2.3</td>
<td>13-18</td>
<td>14.2</td>
<td>3.56</td>
<td>9-17</td>
</tr>
<tr>
<td>Syntactic Comprehension (87)</td>
<td>66.2</td>
<td>22.21</td>
<td>41-85</td>
<td>72</td>
<td>15.95</td>
<td>49-87</td>
</tr>
<tr>
<td>Total Score (120)</td>
<td>96.4</td>
<td>22.07</td>
<td>70-116</td>
<td>100.4</td>
<td>21.48</td>
<td>68-119</td>
</tr>
</tbody>
</table>
Independent t-tests were used to compare differences in English performance between the monolingual and bilingual participants for each subtest. The results revealed no significant differences between the monolinguals and the bilingual participants in English for any of the auditory processing subtests (p>.05).

**Spanish versus English Abilities in Bilingual Speakers: Verbal Production**

Verbal production abilities in Spanish and English of bilingual speakers were examined via administration of the following subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming. These data are presented in Table 4.

**Table 4. Spanish and English scores on verbal production tasks for bilingual participants**

<table>
<thead>
<tr>
<th>Subtest (Total Possible Points)</th>
<th>Eng. Mean</th>
<th>English Standard Deviation</th>
<th>English Range</th>
<th>Spn. Mean</th>
<th>Spanish Standard Deviation</th>
<th>Spanish Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantic Categories (5)</td>
<td>4.6</td>
<td>0.55</td>
<td>4-5</td>
<td>3.8</td>
<td>1.3</td>
<td>2-5</td>
</tr>
<tr>
<td>Synonyms and Antonyms (10)</td>
<td>8.4</td>
<td>2.61</td>
<td>4-10</td>
<td>7.6</td>
<td>3.29</td>
<td>2-10</td>
</tr>
<tr>
<td>Repetition of Words (30)</td>
<td>28.2</td>
<td>2.95</td>
<td>23-30</td>
<td>29.8</td>
<td>0.45</td>
<td>29-30</td>
</tr>
<tr>
<td>Lexical Decision (30)</td>
<td>26.6</td>
<td>2.61</td>
<td>23-29</td>
<td>26.8</td>
<td>3.11</td>
<td>22-30</td>
</tr>
<tr>
<td>Series (44)</td>
<td>43.6</td>
<td>0.89</td>
<td>42-44</td>
<td>42.8</td>
<td>2.68</td>
<td>38-44</td>
</tr>
<tr>
<td>Verbal Fluency (unlimited)</td>
<td>21</td>
<td>6.28</td>
<td>13-30</td>
<td>17</td>
<td>3.39</td>
<td>12-20</td>
</tr>
<tr>
<td>Naming (19)</td>
<td>16.8</td>
<td>3.83</td>
<td>10-19</td>
<td>10.6</td>
<td>7.27</td>
<td>1-17</td>
</tr>
<tr>
<td>Total Score (138+VF)</td>
<td>149.2</td>
<td>15.61</td>
<td>124-164</td>
<td>138.2</td>
<td>18.7</td>
<td>107-155</td>
</tr>
</tbody>
</table>

Paired t-tests were conducted on the verbal production subtest data to compare differences between Spanish and English for each subtest. There were no significant
differences between languages for synonyms and antonyms, word repetition, lexical
decision, series and verbal fluency (p>.05) However, a significant difference was found
between the two languages relative to naming ability, with the bilingual participants
performing better in English than in Spanish (t = 3.21; p <.05). Furthermore, the results
revealed an overall trend towards significance across all of the verbal subtests, with better
performance in English than Spanish (p =.08).

**English Abilities in Monolingual versus Bilingual participants: Verbal Production**

English abilities of bilingual participants were compared to the English abilities of
the monolingual participants on the following verbal production subtests: semantic
categories, synonyms, and antonyms, repetition of words, lexical decision making, series,
verbal fluency, and naming. These data are presented in Table 5.

**Table 5. English scores on verbal production tasks for both bilingual and
monolingual participants.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantic Categories (5)</td>
<td>5</td>
<td>0</td>
<td>5-5</td>
<td>3.8</td>
<td>1.3</td>
<td>2-5</td>
</tr>
<tr>
<td>Synonyms and Antonyms (10)</td>
<td>8.8</td>
<td>1.64</td>
<td>6-10</td>
<td>7.6</td>
<td>3.29</td>
<td>2-10</td>
</tr>
<tr>
<td>Repetition of Words (30)</td>
<td>21.6</td>
<td>6.07</td>
<td>14-30</td>
<td>29.8</td>
<td>0.45</td>
<td>29-30</td>
</tr>
<tr>
<td>Lexical Decision (30)</td>
<td>29.8</td>
<td>0.45</td>
<td>29-30</td>
<td>26.8</td>
<td>3.11</td>
<td>22-30</td>
</tr>
</tbody>
</table>
Independent t-tests were used to compared differences in English verbal production performance between the monolingual and bilingual participants for each subtest. Results revealed no significant differences between the two groups for the following subtests: semantic categories, synonyms and antonyms, verbal fluency and naming (p>.05). A trend towards significance was observed for word repetition (t = 1.56; p =.06) with bilingual participants repeating more words than monolinguals. There were significant differences between the two groups for the lexical decision (t = 2.77; p<.02) and verbal series (t = 2.45; p<.02) subtests; however, these findings yielded opposing results, with the monolingual English group performing significantly better than the bilingual group on the lexical decision task and the bilingual group performing significantly better than the monolingual group on verbal series. Furthermore, in English, the bilingual participants performed significantly better than the monolingual group overall on verbal production (t = 2.19; p<.05).

**Correlations Between Demographic and Experimental Variables**

Pearson Product Moment correlations were conducted between the following variables across both groups: months post onset insult/injury, age, auditory processing
total scores, and verbal production total score. The correlations were conducted across the English data for the bilingual participants. The results are presented in Table 6.

Correlations involving months post onset were weak and nonsignificant. However, there was a strong significant negative correlation between age and verbal production (p<.01) and a moderate negative correlation between age and auditory processing (p<.05).

Table 6. Pearson Product Moment correlations between demographic variables and BAT scores in English

<table>
<thead>
<tr>
<th></th>
<th>Months Post Onset</th>
<th>Age</th>
<th>English Auditory Processing</th>
<th>English Verbal Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months Post Onset</td>
<td></td>
<td>r=.30</td>
<td>r=-.14</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>r=-.33*</td>
<td>r=-.58**</td>
</tr>
<tr>
<td>Auditory Processing</td>
<td></td>
<td></td>
<td></td>
<td>r=.27</td>
</tr>
<tr>
<td>Verbal Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p<.01; *p<.05
CHAPTER IV

Discussion

In this study, five monolingual English speakers with aphasia and five bilingual Spanish-English speakers with aphasia were assessed via ZOOM using the BAT (Paradis & Libben, 1987). The monolingual speakers were assessed in English and the bilingual speakers were assessed in both Spanish and English. Findings revealed that the recovery of bilinguals with aphasia may be different than the recovery process of monolinguals with aphasia. According to Lahiri et al. (2019), bilingualism clearly plays a role in the recovery process. The current results were supportive of Lahiri et al. (2019) particularly relative to verbal production. Specifically, bilingual participants showed greater improvement for verbal production skills in English than monolingual participants.

Spanish versus English Abilities in Bilingual Speakers: Auditory Processing

In order to examine the auditory processing abilities of Spanish and English in the bilingual speakers with aphasia, the following subtests of the BAT were administered: pointing, simple commands, verbal auditory discrimination, syntactic comprehension. Results revealed no significant differences between English and Spanish performance for the bilingual participants for any of the auditory processing subtests. One indication in support of the results may be that none of the participants reported that they received speech therapy in both Spanish and English. Four participants reported that they received therapy in English only and one participant reported that they received therapy in Spanish only. This observation may correlate with Paradis (2004) in reporting that most of the reported bilingual aphasic patients are assessed with a comparable instrument in each of
their languages. Paradis emphasized that no factor has been identified to predict the status of one language relative to another language so it is imperative that aphasic patients are assessed and treated in all the languages they spoke premorbidly. Centeno and Ansaldo (2017) have suggested that bilingual therapy would provide a dual-language strategy to maximally stimulate the cognitive-linguistic mechanisms participating in the bilingual language system of the speaker and enhance the dual language use that is typically used by bilingual speakers in daily discourse. It is unclear whether the auditory processing results are present because of the generalization of skills learned in therapy that transferred to the untreated language, or whether the participants presented with patterns of a parallel recovery pattern and their abilities in both languages improved simultaneously or to a similar level.

**English Abilities in Monolingual versus Bilingual participants: Auditory Processing**

English abilities of bilateral participants were compared to the English abilities of the monolingual participants for the following auditory processing subtests: pointing, simple commands, verbal auditory discrimination, syntactic comprehension. The results revealed no significant differences between the monolinguals and the bilingual participants in English for any of the auditory processing subtests. These results are congruent with findings of previous studies. It has been suggested that bilingual speakers may have advantages in verbal production (Alladi et al., 2016), but there have not been previous reports of advantages in auditory processing. Other research has indicated that the most important determinants of the severity of post-stroke aphasia were lesion-related factors (such as size and location) and the type of aphasia rather than bilingualism
(Lahiri, Dubey, Ardila, & Roy, 2019). This may be supportive as to why there were no significant differences; however, it is difficult to compare because medical reports indicating lesion-related factors were not obtained for this study.

**Spanish versus English Abilities in Bilingual Speakers: Verbal Production**

Verbal production abilities in Spanish and English of bilingual speakers were examined via administration of the following subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming. A significant difference was found between the two languages relative to naming ability, with the bilingual participants performing better in English than in Spanish. Furthermore, the results revealed an overall trend towards significance across all of the verbal subtests, with better performance in English than Spanish. As indicated previously, four out of five participants received speech-language therapy in English which may support the current findings. Additionally, all five of the bilingual participants received some formal education in English whereas only three of the five participants received formal education in Spanish.

Another important aspect to take into consideration is the type of languages spoken by these individuals. Davis and Harrington (2012) hypothesized that the type of languages bilinguals speak may play a role in their recovery patterns. While English is a Germanic language and Spanish is a Romance language, both languages belong to the Indo-European language family (Hammarstrom, 2016). If the participants in this study were speakers of two languages that varied by language family, it may have yielded
different results. For example, Davis and Harrington (2012) provided a case study with one patient who was an English and Mandarin bilingual speaker who recovered from severe aphasia. Mandarin is considered a tonal language and English is considered a non-tonal language. These different language families were hypothesized to aid her recovery.

**English Abilities in Monolingual versus Bilingual participants: Verbal Production**

English abilities of bilingual participants were compared to the English abilities of the monolingual participants on the following verbal production subtests: semantic categories, synonyms, and antonyms, repetition of words, lexical decision making, series, verbal fluency, and naming. Results revealed no significant differences between the two groups for the following subtests: semantic categories, synonyms and antonyms, verbal fluency and naming. A trend towards significance was observed for word repetition with bilingual participants repeating more words than monolinguals. This correlates with the findings from Paplikar et al. (2010), where one of the strengths noted that created the difference in post stroke abilities was the preservation of repetition in bilinguals with aphasia. Repetition is considered to be a multifaceted function that relies on attention, working memory, and semantic, syntactic and phonological processes. The preservation of this ability resulted in an overall less severe aphasia (Paplikar et al. 2019).

In the current findings, significant differences between the two groups were observed for the lexical decision and verbal series subtests; however, these findings yielded opposing results, with the monolingual English group performing significantly better than the bilingual group on the lexical decision task whereas the bilingual group performed significantly better than the monolingual group on verbal series. Most
importantly, overall in English, the bilingual participants performed significantly better than the monolingual group on verbal production. These findings are congruent with previous research, specifically the conclusions of Alladi et al. (2016). These researchers suggested that bilingual speakers may have advantages in verbal production, describing an apparent protective effect that is thought to be conferred by the lifelong practice of using two languages and switching between them. Furthermore, this protective effect may inhibit potential competitors during production, specifically choosing the word the individual wants to say in the language they are speaking in rather than the other language they have access to. According to Bialystok (2009), when fluent bilinguals use both languages frequently, the languages are active and available to the individual when one of the languages is in use. This creates a need to correctly select a word in the correct form that meets the needs of the conversation and is part of the target language and not from the competing language system. The need to maintain attention on the target system is what makes bilingual verbal production different from monolingual verbal production (Bialystok, 2009) and may apply to the current findings relative to differences between the two groups for English.

**Correlations Between Demographic and Experimental Variables**

Pearson Product Moment correlations were conducted between the following variables across both groups: months post onset insult/injury, age, auditory processing total scores, and verbal production total score. The correlations were conducted across the English data for the bilingual participants. Correlations involving months post onset were weak and nonsignificant. However, there was a strong significant negative correlation
between age and verbal production. As age increased verbal production performance decreased. There was also a moderate negative correlation between age and auditory processing. As age increased, auditory performance subtly decreases. These results indicate similar findings as previous research. Older adults have been reported to have worse accuracy on a comprehension task compared to younger adults (Tun, 1998). Additionally, age has also been reported as a limiting factor in aphasia recovery across a range of studies (Ellis & Urban, 2016; Hillis et al. 2018; Holland, Greenhouse, Fromm, & Swindell, 1989), including bilingual Spanish-English adults.

**Limitations of Study**

This study aimed to investigate and compare aphasia recovery patterns in bilingual and monolingual adults with chronic aphasia and to compare the differences in recovery between both languages spoken by the bilinguals with aphasia. Although this study included a larger sample size (10) than was originally planned for (8), it was still a relatively small number of participants. A second limitation was that all medical history was reported from the patients or caregivers. Because of this, detailed medical reports indicating size, location and severity of lesion were not available. Participant diagnosis varied in that all monolingual participants had aphasia as the result of stroke; however, two out of five of the bilingual participants had a traumatic brain injury resulting in aphasia. Participant demographics, particularly related to age, was a limitation as the monolingual participants as a group were significantly older than the bilingual participants.
This study was conducted on ZOOM due to the COVID19 pandemic which created some limitations. For example, the complex command subtest was not included in the assessments because various items were needed to conduct this subtest and they could not be provided to the participants in a virtual nature. Also, the electronic assessment created some difficulties for the participants and the examiner. Specifically, the examiner was unable to see which item the participant was pointing at for the auditory processing subtests, so the participants had to answer all questions by saying 1-4. This was difficult for some participants so to decrease difficulty, the participants answered by holding up the number of fingers that pertained to their answer. Additionally, in the Verbal Auditory Discrimination subtest, the participants are asked to listen to words that sound alike and select the correct image of the target word. For example, the options may be lice, rice, mice, and dice and the examiner said “lice”. Deciphering between such similar words on an electronic platform may have been more difficult than it would have been if the assessment was administered in person. Another limitation was that the electronic nature of it made it difficult for some participants to participate without the help of their caregivers. Furthermore, some individuals that met the recruitment criteria were not able to participate because they did not have access to the internet, a webcam, or if they had access, they did not know how to log onto ZOOM.

Implications for Future Research

One avenue of research should include analysis of spontaneous speech samples particularly for comparing languages in the bilingual speakers. Another direction for research should involve comparisons with bilingual speakers of different languages in
order to see if findings yield similar results. A third direction for research would be to conduct a similar investigation using a different assessment tool such as the Western Aphasia Battery to compare different language abilities of the participants. Another direction would be to assess executive functioning rather than expressive/receptive language and measure the differences between the monolingual and bilingual groups. A final avenue for continued research would be to measure specific differences between the characteristics of aphasia as the result of stroke and the characteristics of aphasia as a result of a traumatic brain injury.

Summary and Conclusions

The main strengths of the current study are that it is one of the first studies of its kind to assess and compare Spanish and English speakers with chronic aphasia. The results revealed no significant differences between English and Spanish performance for the bilingual participants or between the monolinguals and the bilingual participants in English for any of the auditory processing subtests. Furthermore, there were no significant differences between languages for synonyms and antonyms, word repetition, lexical decision, series, semantic categories, synonyms and antonyms,. However, a significant difference was found between the two languages relative to naming ability, with the bilingual participants performing better in English than in Spanish. Furthermore, the results revealed an overall trend towards significance across all of the verbal subtests, with better performance in English than Spanish. Relative to verbal production findings for the monolingual and bilingual participants in English, a trend towards significance was observed for word repetition with bilingual participants repeating more words than
monolinguals. There were significant differences between the two groups for the lexical decision and verbal series subtests with the monolingual English group performing significantly better than the bilingual group on the lexical decision task and the bilingual group performing significantly better than the monolingual group on verbal series. Overall, the bilingual participants performed significantly better than the monolingual group on verbal production.

As the findings indicate, bilingualism may lead to stronger verbal production scores than observed in monolinguals for individuals with aphasia. Additional studies investigating the abilities of bilingual Spanish-English adults with aphasia are warranted. Further investigation is needed to determine how languages from various language families influence chronic bilingual aphasia recovery. Bilingual versus monolingual aphasia recovery may be different for certain skills at certain times in recovery, but further investigation is needed.
References


Bomi Sul, Joon Sung Kim, Bo Young Hong, Kyoung Bo Lee, Woo Seop Hwang, Young Kook Kim, & Seong Hoon Lim. (2016). The Prognosis and Recovery of Aphasia Related to Stroke Lesion. *Annals of Rehabilitation Medicine, 40*(5), 786.


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MEMORANDUM

To: Dr. Monica Hough

CC: Kristina Ruch

From: Elizabeth Juhasz, Ph.D., IRB Coordinator

Date: April 17, 2020

Protocol Title: "Chronic Aphasia Recovery in bilingual Spanish-English and monolingual aphasia"

The Health Sciences Institutional Review Board of Florida International University has approved your study for the use of human subjects via the Expedited Review process. Your study was found to be in compliance with this institution’s Federal Wide Assurance (00000060).

IRB Protocol Approval #: IRB-20-0153       IRB Approval Date: 04/17/20
TOPAZ Reference #: 109022       IRB Expiration Date: 04/17/23

As a requirement of IRB Approval you are required to:

1) Submit an IRB Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved by the IRB prior to implementation.
2) Promptly submit an IRB Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Utilize copies of the date stamped consent document(s) for obtaining consent from subjects (unless waived by the IRB). Signed consent documents must be retained for at least three years after the completion of the study.
4) Receive annual review and re-approval of your study prior to your IRB expiration date. Submit the IRB Renewal Form at least 30 days in advance of the study’s expiration date.
5) Submit an IRB Project Completion Report Form when the study is finished or discontinued.

HIPAA Privacy Rule: Satisfied

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.
SUMMARY INFORMATION

Things you should know about this study:

- **Purpose:** The purpose of the study is to compare the chronic recovery patterns between monolingual and bilingual adults with aphasia.
- **Procedures:** If you choose to participate, you will be asked to participate in language testing by answering questions from the Bilingual Aphasia Test and by completing a language history questionnaire.
- **Duration:** This will take about 90 minutes.
- **Risks:** You may feel a little fatigued after administration of the language test. The participant may also be at risk for loss of confidentiality because they are providing personal health information.
- **Benefits:** The main benefit to you from this research is the opportunity to participate in speech and language stimulation and assessment.
- **Alternatives:** There are no known alternatives available to you other than not taking part in this study.
- **Participation:** Taking part in this research project is voluntary.

Please carefully read the entire document before agreeing to participate.

PURPOSE OF THE STUDY

The purpose of this study is to compare the chronic recovery patterns of post stroke aphasia in Spanish-English bilingual and monolingual patients.

NUMBER OF STUDY PARTICIPANTS

If you decide to be in this study, you will be one of 8-10 people in this research study.

DURATION OF THE STUDY

Your participation will involve 1-2 session, a total of 90 minutes to 2 hours.
PROCEDURES

If you agree to be in the study, we will ask you to do the following tasks while being audio recorded:

- Answer a questionnaire related to your language history (i.e. how you learned one or both of your languages, how often you use your languages, etc.).
- Answer a questionnaire related to your medical history (i.e. when you had your stroke, etc.)
- Participate in the Bilingual Aphasia Test by answering questions involving naming pictures, following directions, repeating words and sentences, and reading words and sentences. This will take approximately 60-90 minutes.
- Your responses during this assessment will be audio-recorded.
- Participate in an informal evaluation of you hearing and vision abilities by answering questions and responding to heard stimuli.

RISKS AND/OR DISCOMFORTS

The participant may experience mild fatigue upon completion of administration of the language test. The participant may also be at risk for loss of confidentiality because they are providing personal health information.

BENEFITS

The study has the following possible benefits to you: You will have the opportunity to participate in speech and language assessment that will assist in predicting your communication potential and prognosis relative to recovery from aphasia. You will also benefit society by participating in this research, as this investigation will help speech language pathologists determine communication outcomes and prognoses for other bilingual and monolingual patients with aphasia as well as enhance understanding of the possible bilingual advantage.

ALTERNATIVES

There are no known alternatives available to you other than not taking part in this study. Any significant new findings developed during the course of the research which may relate to your willingness to continue participation will be provided to you.

CONFIDENTIALITY

The records of this study will be kept private and will be protected to the fullest extent provided by law. In any sort of report we might publish, we will not include any information that will make it possible to identify you. Research records will be stored securely, and only the researcher team will have access to the records. However, your records may be inspected by authorized University or other agents who will also keep the information confidential.
USE OF YOUR INFORMATION

Your information collected as part of the research will not be used or distributed for future research studies even if identifiers are removed.

COMPENSATION & COSTS

There are no costs to you for participating in this study.

RIGHT TO DECLINE OR WITHDRAW

Your participation in this study is voluntary. You are free to participate in the study or withdraw your consent at any time during the study. You will not lose any benefits if you decide not to participate or if you quit the study early. The investigator reserves the right to remove you without your consent at such time that he/she feels it is in the best interest.

RESEARCHER CONTACT INFORMATION

If you have any questions about the purpose, procedures, or any other issues relating to this research study you may contact Kristina Ruch at 815-558-0221, kruch001@fiu.edu or Dr. Monica Hough, 305-348-2873, mshough@fiu.edu.

IRB CONTACT INFORMATION

If you would like to talk with someone about your rights of being a subject in this research study or about ethical issues with this research study, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.
PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to participate in this study. I have had a chance to ask any questions I have about this study, and they have been answered for me. I understand that I will be given a copy of this form for my records.

_________________________  _______________________
Signature of Participant or participant's personal representative  Date

_________________________
Printed Name of Participant

_________________________  _______________________
Printed name of participant's personal representative  If applicable, a description of the personal representative's authority to sign for the participant

_________________________  _______________________
Signature of Person Obtaining Consent  Date

Page 4 of 4
Appendix C

Please answer the following questions to the best of your ability. If you are unsure of any answers you may leave the spaces blank. Thank you.

Name:_________________________________
Date of Birth:_________________________ Age:____________________
Sex: M___ F____ Time Zone:________________________
Date stroke occurred:________________________
Type of stroke & location:________________________
Monolingual/ Bilingual & Languages Spoken:________________________
Any exposure to other languages? (i.e. class in high school, living abroad, etc.)____
________________________________________________________________________
Other Medical History:____________________________________________________
________________________________________________________________________
Speech/Language Diagnosis:_______________________________________________
Have you received Speech/Language Therapy? Yes ______ No________
Please describe your therapy experiences and length of services: ________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Do you wear hearing aids? Yes_____ No_______
Please describe hearing history______________________________________________
Do you wear glasses? Yes______ No________
Please describe vision history________________________________________________

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1. Apple
2. Flamingo
3. Orange
4. Picture
1. Dog
2. Cat
3. Cow
4. Rat
1. Child  
2. Flower  
3. Glass  
4. Table
1. Flower  
2. Firetruck  
3. Sofa  
4. Popcorn
1. Foot  
2. Phone  
3. Bottle  
4. Paint
1. Cot
2. Dog
3. Car
4. Grass
1. Chair
2. Sheep
3. Cup
4. Tree
1. Pen
2. Folder
3. Fruit
4. Tower
1. Popcorn 2. Banana
3. Window 4. Truck
1. Fish
2. Three
3. Chair
4. Lake
Appendix E

Test Results

Apr 29, 2020 at 1:12 PM

Left 81 %    Right 87 %

YOUR AUDIOGRAM

hearing loss level

<table>
<thead>
<tr>
<th>dB</th>
<th>250 Hz</th>
<th>500 Hz</th>
<th>1 kHz</th>
<th>2 kHz</th>
<th>4 kHz</th>
<th>8 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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- reliable data
- unreliable data
- missing data
Appendix F

BILINGUAL APHASIA TEST
English Version

PART A: Part common to all languages

HISTORY OF BILINGUALISM

The following questions are to be read, as given below, to the patient. If the patient is unable to supply the necessary information, someone else (e.g. a family member) may be asked the questions. For all questions which have yes/no answers, circle "+" for an answer of "yes" and circle "-" for an answer of "no".

If the answer to a question cannot be obtained DO NOT leave it blank. Instead, circle or write "0" in the answer space. This indicates that no answer was available. In the body of the test all instructions to the test administrator are preceded by "***". These instructions are not to be read to the patient.

*** Begin reading aloud here.

1. What was your date of birth? 
2. Where were you born? 
3. As a child, what language did you speak most at home? 
4. As a child, did you speak any other languages at home? 

*** If the answer to (4) is "no" then go to question (6)

5. What other languages did you speak at home as a child? 
6. What was your father's native language? 
7. Did he speak any other languages?

*** If the answer to (7) is "no" then go to question (12)

8. What were your father's other languages at home? 
9. What language did your father speak most to you at home? 
10. Did your father speak any other languages at home?

*** If the answer to (10) is "no" then go to question (12)

11. What other languages did your father speak at home? 
12. What was your mother's native language? 
13. Did she speak any other languages?

*** If the answer to (13) is "not" then go to question (18)

14. What were your mother's other languages? 
15. What language did your mother speak most to you at home? 
16. Did your mother speak any other languages at home?

*** If the answer to (16) is "no" then go to question (18)

17. What other languages did your mother speak at home? 
18. Did anyone else take care of you as a child?

*** If the answer to (18) is "no" then go to question (25)

19. What was his/her native language? 
20. Did he/she speak any other languages?

*** If the answer to (20) is "no" then go to question (25)
21. What were his/her other languages?  
22. What language did he/she speak most to you at home?  
23. Did he/she speak any other languages at home?  

*** If the answer to (23) is "no" then go to question (25)  
24. What other languages did he/she speak at home?  
25. What language did you speak most with friends as a child?  
26. How many years of education have you had?  
27. When you started school what was the language of instruction?  
28. Were there any other languages of instruction at that time?  

*** If the answer to (28) is "no" then go to question (30)  
29. What were the other languages of instruction?  
30. What language did most of the other students speak at this school?  
31. Did you change to a school with another language of instruction after that?  

*** If the answer to (31) is "no" then go to question (49)  
32. What was this language?  
33. After how many years did you switch to this new language of instruction?  
34. Were there any other languages of instruction at that time?  

*** If the answer to (34) is "no" then go to question (36)  
35. What were the other languages of instruction?  
36. What language did most of the other students speak at this school?  
37. Did you change to a school with another language of instruction after that?  

*** If the answer to (37) is "no" then go to question (49)  
38. What was this language?  
39. After how many years did you switch to this new language of instruction?  
40. Were there any other languages of instruction at that time?  

*** If the answer to (40) is "no" then go to question (49)  
41. What were the other languages of instruction?  
42. What language did most of the other students speak at this school?  
43. Did you change to a school with a different language of instruction after that?  

*** If the answer to (43) is "no" then go to question (49)  
44. What was this language?  
45. After how many years did you switch to this new language of instruction?  
46. Were there any other languages of instruction at that time?  

*** If the answer to (46) is "no" then go to question (49)  
47. What were the other languages of instruction?  
48. What language did most of the other students speak at this school?  
49. And after your education was completed, what was your occupation?  
50. Before your accident/illness, what languages were you able to speak?
PART B

ENGLISH BACKGROUND

The following questions are to be read, exactly as given below, to the patient. For multiple choice items, circle the appropriate alternative. For the other items, put the appropriate information in the space provided.

In the body of the test, all instructions to the test administrator are preceded by "***". These instructions are not to be read aloud to the patient.

*** Give the patient the following introduction and then proceed with the questions.

Now, I will ask you some questions about your English. Ready?

1. Have you ever lived in another country where English was spoken? + - (1)

*** If the answer is "no" then go to question (4)

2. What was the name of the country? (2)
3. How long did you live there? (3)
4. Before your illness, was your English speaking:
   1) Not good, 2) Good, 3) Very fluent
   0 1 2 3 (4)
5. How old were you when you learned to speak English? (5)
6. Before your illness, did you speak English at home? + - (6)
7. Did you speak English at work? + - (7)
8. Did you speak English with friends? + - (8)
9. In your daily life before your illness, did you speak English:
   1) Every day, 2) Every week, 3) Every month, 4) Every year, 5) Less than once a year
   0 1 2 3 4 5 (9)
10. Did you ever learn to read English? + - (10)

*** If the answer is "no" then go to (18) (SPONTANEOUS SPEECH)

11. How old were you when you learned to read English? (11)
12. Before your illness, was your English reading:
   1) Not good, 2) Good, 3) Very good
   0 1 2 3 (12)
13. In your daily life before your illness, did you read English:
   1) Every day, 2) Every week, 3) Every month, 4) Every year, 5) Less than once a year
   0 1 2 3 4 5 (13)
14. Did you ever learn to write English? + - (14)

*** If the answer is "no" then go to (18) (SPONTANEOUS SPEECH)

15. How old were you when you learned to write English? (15)
16. Before your illness, was your English writing:
   1) Not good, 2) Good, 3) Very good
   0 1 2 3 (16)
17. In your daily life before your illness, did you write English:
   1) Every day, 2) Every week, 3) Every month, 4) Every year, 5) Less than once a year
   0 1 2 3 4 5 (17)

SPONTANEOUS SPEECH

*** Record FIVE MINUTES of the patient's spontaneous speech. The function of this section of the test is to obtain a sample of the patient's spontaneous speech, and to allow the test administrator to establish a comfortable testing atmosphere. To keep the conversation going, it is suggested that you prompt the patient with questions about:

a) his/her illness
b) his/her work
c) experience in other countries
d) his/her family, etc.
*** After the patient has finished speaking, the test administrator should turn the tape recorder off, and circle the appropriate alternative for each of the following five items. This is intended only to give a general, subjective, preliminary indication of the characteristics of the patient's speech on the tape, which will be analyzed later in detail.

18. Amount of speech
   1) Nothing  2) Very little  3) Less than normal  4) Normal
   ________ (18)

19. Fluency
   1) Bad  2) Fair  3) Good  4) Normal
   ________ (19)

20. Pronunciation
   1) Bad  2) Fair  3) Good  4) Normal
   ________ (20)

21. Grammar:
   1) Bad  2) Fair  3) Good  4) Normal
   ________ (21)

22. Vocabulary
   1) Bad  2) Fair  3) Good  4) Normal
   ________ (22)

VERBAL COMPREHENSION

*** In this section, the patient is required to act out some command that he/she hears. The commands should be read slowly and clearly with normal intonation. If the patient gives no response after five seconds, score '0' and move on to the next question. SCORE ONLY THE FIRST ITEM THAT THE PATIENT TOUCHES.

The patient's responses are scored by either circling '+', '-', or '0' in the area provided. Circle '+' if the patient's response is correct. If the patient's response is incorrect, then circle '-'. Finally, if the patient produces no response (or a response that indicates that he/she did not understand what was required of him/her) then circle '0'. For example, if a patient is asked to touch a book that is on a table and he touches some other object on the table, then the examiner should circle '-'. If, however, he doesn't touch anything (or claps his hands), then the examiner should circle '0'.

POINTING

*** To administer this section, the following items must be placed on a table in front of the patient so that he/she is able to touch each individual item. Materials should be arranged in the following order from left to right: a button, glove, scissors, envelope, ring, brush, glass, matches, key, watch.

*** Begin reading aloud here.

23. Please touch the ring.
24. Please touch the button.
25. Please touch the matches.
26. Please touch the glove.
27. Please touch the key.
28. Please touch the scissors.
29. Please touch the watch.
30. Please touch the envelope.
31. Please touch the glass.
32. Please touch the brush.
   ________ (23)
   ________ (24)
   ________ (25)
   ________ (26)
   ________ (27)
   ________ (28)
   ________ (29)
   ________ (30)
   ________ (31)
   ________ (32)

SIMPLE AND SEMI-COMPLEX COMMANDS

*** Read the following commands to the patient and record his/her response. Scoring criteria for '+', '-' and '0' are the same as for "POINTING". Materials on the table: ring, matches, glass, pencil, fork.

*** Begin reading aloud here.

I am going to ask you to do a few things for me. Are you ready?

33. Please close your eyes.
34. Open your mouth.
35. Raise your hand.
   ________ (33)
   ________ (34)
   ________ (35)
36. Stick out your tongue. + - 0 (36)
37. Clap your hands. + - 0 (37)
38. Put the ring on the matches. + - 0 (38)
39. Put the glass next to the pencil. + - 0 (39)
40. Put the matches under the fork. + - 0 (40)
41. Put the pencil in front of the fork. + - 0 (41)
42. Put the fork in the glass. + - 0 (42)

COMPLEX COMMANDS

*** Numbers 43 to 47 represent complex commands. The entire command (i.e., all of the subcommands) should be read as a single sentence to the patient. For each item the patient will be asked to do something with a set of three objects. The three objects should be on the table within easy reach of the patient.

If the patient’s answer is perfect (all correct in the right order) score “+”. If it is not perfect, score the number of commands that were performed correctly, irrespective of the order. Hence a score of “3” indicates that all three subcommands were performed, but in the wrong order. A score of “2” indicates that two subcommands were performed, irrespective of the order in which they were performed.

Materials: three pieces of paper (small, medium, large); three pencils (blue, yellow, red); three coins (small, medium, large. (value must correspond to size); three sticks (small, medium, large) and a glass; three books.

*** Begin reading aloud here.

43. Here are three pieces of paper. + 3 2 1 0 (43)
   Give me the small one, put the middle sized one on your lap, and throw away the large one.

44. Here are three pencils. + 3 2 1 0 (44)
   Drop the yellow one on the floor, give me the blue one, and pick up the red one.

45. Here are three coins. + 3 2 1 0 (45)
   Push the large coin toward me, turn over the middle-sized one, and cover the small one with your hand.

46. Here are three sticks. + 3 2 1 0 (46)
   Put the short one in the glass, give me the medium one, and tap on the table with the large one.

47. Here are three books. + 3 2 1 0 (47)
   Open the first one, turn over the second, and pick up the third one.

VERBAL AUDITORY DISCRIMINATION

*** In this section the patient must touch the picture which best represents the word which he/she hears. The pictures are identified by the number on the top right-hand corner of each frame. For each item, circle the number of the picture (1-4 or X) that the patient touches. If the patient does not touch any picture nor the "X", then circle '0' in the area provided.

*** Begin reading aloud here.

You are going to hear a word. Please touch the picture that shows the meaning of the word. If none of the pictures show the meaning of the word then touch the large "X". So, for example, if I say "rain" you would touch this picture because it represents the rain. If I say "bird" you touch this X because there is no picture of a bird on that page. Are you ready?

48. MAT
    49. BALL
    50. DUCK
    51. BREW
    52. THICK
    53. KNEES
    54. VAN
    55. JAR  X 1 2 3 4 0 (48)  X 1 2 3 4 0 (49)  X 1 2 3 4 0 (50)  X 1 2 3 4 0 (51)  X 1 2 3 4 0 (52)  X 1 2 3 4 0 (53)  X 1 2 3 4 0 (54)  X 1 2 3 4 0 (55)
| 56. SHIN | X | 1 | 2 | 3 | 4 | 0 | (56) |
| 57. PLATE | X | 1 | 2 | 3 | 4 | 0 | (57) |
| 58. CRAMP | X | 1 | 2 | 3 | 4 | 0 | (58) |
| 59. PEAR | X | 1 | 2 | 3 | 4 | 0 | (59) |
| 60. CHIP | X | 1 | 2 | 3 | 4 | 0 | (60) |
| 61. ROSE | X | 1 | 2 | 3 | 4 | 0 | (61) |
| 62. CRANE | X | 1 | 2 | 3 | 4 | 0 | (62) |
| 63. DEAD | X | 1 | 2 | 3 | 4 | 0 | (63) |
| 64. LICE | X | 1 | 2 | 3 | 4 | 0 | (64) |
| 65. DRIP | X | 1 | 2 | 3 | 4 | 0 | (65) |

SYNTACTIC COMPREHENSION

*** In the following section the patient must touch the picture which best represents the idea expressed in the sentence read to him/her. The sentences should be read with normal intonation. The patient’s response is recorded by circling, in the area provided, the number of the picture that he/she points to. If the patient gives no response after five seconds, score '0' and move on to the next sentence. The patient should have the section of the picture booklet titled "Syntactic Comprehension" in front of him/her so that it is possible to point easily to any one of the pictures on the page by touching it.

*** Begin reading aloud here.

You are going to hear a sentence. Please touch the picture that shows the meaning of the sentence. So if I say "the boy sits" you should touch this picture that shows the sitting boy.

*** Page 1

66. The boy holds the girl. 
67. The girl holds the boy. 
68. She holds him. 
69. She holds her. 
70. She holds them. 

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*** Page 2

71. The father washes his son. 
72. The mother washes her daughter. 
73. He washes him. 
74. He washes himself. 
75. She washes herself. 
76. She washes her. 

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*** Page 3

77. The boy holds the girls. 
78. He holds him. 
79. He holds her. 
80. He holds them. 

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*** Page 4

81. The girl pushes the boy. 
82. The boy pushes the girl. 
83. The boy is pushed by the girl. 
84. The girl is pushed by the boy. 
85. It's the boy who pushes the girl. 
86. It's the girl who pushes the boy. 
87. It's the boy that the girl pushes. 
88. It's the girl that the boy pushes. 

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<td>89. The dog bites the cat.</td>
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<td>90. The cat bites the dog.</td>
<td>1 2 3 4 0</td>
<td>(90)</td>
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<td>91. The dog is bitten by the cat.</td>
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<td>(91)</td>
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<td>92. The cat is bitten by the dog.</td>
<td>1 2 3 4 0</td>
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<td>93. It's the dog that bites the cat.</td>
<td>1 2 3 4 0</td>
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<td>94. It's the cat that bites the dog.</td>
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<td>95. It's the cat that the dog bites.</td>
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<td>96. It's the dog that the cat bites.</td>
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<td>(97)</td>
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<td>98. The car is pulled by the truck.</td>
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<tr>
<td>104. It's the truck that the car pulls.</td>
<td>1 2 3 4 0</td>
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<tr>
<td>106. The father dresses his son.</td>
<td>1 2 3 4 0</td>
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<td>107. She dresses herself.</td>
<td>1 2 3 4 0</td>
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<td>108. He dresses him.</td>
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<td>109. She dresses her.</td>
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<td>110. He dresses himself.</td>
<td>1 2 3 4 0</td>
<td>(110)</td>
<td></td>
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<tbody>
<tr>
<td>111. The girl does not push the boy.</td>
<td>1 2 0</td>
<td>(111)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112. The boy does not push the girl.</td>
<td>1 2 0</td>
<td>(112)</td>
<td></td>
<td></td>
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<tr>
<td>113. The girl is not pushed by the boy.</td>
<td>1 2 0</td>
<td>(113)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>114. The boy is not pushed by the girl.</td>
<td>1 2 0</td>
<td>(114)</td>
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<tbody>
<tr>
<td>115. The girl does not spray the boy.</td>
<td>1 2 0</td>
<td>(115)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>116. The boy does not spray the girl.</td>
<td>1 2 0</td>
<td>(116)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>117. The girl is sprayed by the boy.</td>
<td>1 2 0</td>
<td>(117)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>118. The boy is not sprayed by the girl.</td>
<td>1 2 0</td>
<td>(118)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>119. The girl is not sprayed by the boy.</td>
<td>1 2 0</td>
<td>(119)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120. The girl is sprayed by the boy.</td>
<td>1 2 0</td>
<td>(120)</td>
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<tbody>
<tr>
<td>121. The truck does not pull the car.</td>
<td>1 2 0</td>
<td>(121)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>122. The truck is not pulled by the car.</td>
<td>1 2 0</td>
<td>(122)</td>
<td></td>
<td></td>
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<tr>
<td>123. The car does not pull the truck.</td>
<td>1 2 0</td>
<td>(123)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>124. The car is not pulled by the truck.</td>
<td>1 2 0</td>
<td>(124)</td>
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<tbody>
<tr>
<td>125. The young boy does not wake up his mother.</td>
<td>1 2 0</td>
<td>(125)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126. The mother does not wake up the young boy.</td>
<td>1 2 0</td>
<td>(126)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>127. The young boy is not woken up by his mother.</td>
<td>1 2 0</td>
<td>(127)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128. The mother is not woken up by the young boy.</td>
<td>1 2 0</td>
<td>(128)</td>
<td></td>
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</tbody>
</table>
129. The dog is not bitten by the cat.  
130. The cat is not bitten by the dog.  
131. The dog does not bite the cat.  
132. The cat does not bite the dog.  

133. The man does not kiss the woman.  
134. The woman is not kissed by the man.  
135. The woman does not kiss the man.  
136. The man is not kissed by the woman.  

137. Show me the mother’s baby.  

138. Show me that niece’s uncle.  

139. Show me the vase of this flower.  

140. Show me the manager of this restaurant.  

141. Show me the book of this author.  

142. Show me the dog’s master.  

143. Show me the doctor’s patient.  

144. Show me the director of the film.  

145. Show me the baby’s mother.  

146. Show me that uncle’s niece.  

147. Show me the flower of this vase.
148. Show me the restaurant of this manager. 
1 2 0 (148)

149. Show me the author of this book. 
1 2 0 (149)

150. Show me the master's dog. 
1 2 0 (150)

151. Show me the patient's doctor. 
1 2 0 (151)

152. Show me the film of the director. 
1 2 0 (152)

**SEMANTIC CATEGORIES**

*** In all sections with multiple choices, do not read the number in front of each choice but rather each word, one after the other, with a very short pause between.

***Begin reading aloud here.***

You will hear four words. Please tell me which ONE word does not belong in the group. For example, you might hear:
hat, glove, elephant, shirt. You would choose elephant. Ready?

153. 1) tulip 2) rose 3) frog 4) daisy 
1 2 3 4 0 (153)
154. 1) cabbage 2) apple 3) banana 4) cherry 
1 2 3 4 0 (154)
155. 1) hand 2) foot 3) sock 4) ear 
1 2 3 4 0 (155)
156. 1) chair 2) table 3) bed 4) car 
1 2 3 4 0 (156)
157. 1) blackbird 2) sardine 3) pigeon 4) eagle 
1 2 3 4 0 (157)

**SYNONYMS**

*** Pause here and read the following instructions to the patient:

Now you will hear a single word. I will ask you to give me another word which has a similar meaning. I will give you four choices. So for example I would say "jacket" and then give you four choices: "table", "house", "coat", "car". You would choose "coat" because its meaning is the most similar to "jacket". Ready?

158. SEAT 1) vase 2) pencil 3) armchair 4) watch 
1 2 3 4 0 (158)
159. CLOCK 1) shoe 2) drawer 3) banana 4) watch 
1 2 3 4 0 (159)
160. PENCIL 1) pen 2) hat 3) ashtray 4) apple 
1 2 3 4 0 (160)
161. SANDAL 1) wheel 2) shoe 3) letter 4) garden 
1 2 3 4 0 (161)
162. CANOE 1) match 2) boat 3) newspaper 4) tree 
1 2 3 4 0 (162)

**ANTONYMS**

*** Pause here and read the following instructions to the patient.

Now, you will hear a word and then four choices. But this time I want you to choose the one that has the OPPOSITE meaning. So, for example, if you hear "down" and then the choices: "house", "up", "under", "big", you would choose "up" because its meaning is most opposite to the meaning of "down". Ready?
| 163. HAPPY | 1) glad 2) sad 3) rich 4) baby | 1 2 3 4 0 (163) |
| 164. DARK | 1) shy 2) black 3) light 4) silent | 1 2 3 4 0 (164) |
| 165. YOUNG | 1) big 2) old 3) green 4) small | 1 2 3 4 0 (165) |
| 166. SICK | 1) sad 2) quiet 3) alive 4) healthy | 1 2 3 4 0 (166) |
| 167. WRONG | 1) right 2) way 3) funny 4) mistake | 1 2 3 4 0 (167) |

*** Pause here and read the following instructions to the patient.

Now for these, the choices look very similar BUT ONLY ONE is the opposite of the word you will hear. Ready?

| 168. UGLY | 1) beautiful 2) beauty 3) beautifully | 1 2 3 0 (168) |
| 169. SILENT | 1) noise 2) noisily 3) noisy | 1 2 3 0 (169) |
| 170. SAD | 1) happily 2) happiness 3) happy | 1 2 3 0 (170) |
| 171. FAST | 1) slow 2) slowness 3) slowly | 1 2 3 0 (171) |
| 172. BOLD | 1) careful 2) carefully 3) care | 1 2 3 0 (172) |

GRAMMATICALITY JUDGEMENT

*** For these judgement items, score "+" if the patient says "yes". Score "-" if the patient says "no".

*** Pause here and read the following instructions to the patient.

Now, you will hear some sentences. Please tell me if the sentence is a correct English sentence. For example, if I say "The boy sits on a chair", it is a correct English sentence and you say "yes". But if I say "The boys on a chair sit", it is not correct and you say "no". Ready?

173. She pushes him. judgement + - 0 (173)
174. He dresses herself. judgement + - 0 (174)
175. The cat is biting by the dog. judgement + - 0 (175)
176. It's the boy kiss the girl. judgement + - 0 (176)
177. The truck is pulled by the car. judgement + - 0 (177)
178. It's truck that pulls car. judgement + - 0 (178)
179. The girl is sprayed the boy. judgement + - 0 (179)
180. The boy not wake up his mother. judgement + - 0 (180)
181. It's the boy that pushes the girl. judgement + - 0 (181)
182. The dog not is bitten by the cat. judgement + - 0 (182)

SEMANTIC ACCEPTABILITY

*** Pause here and read the following instructions to the patient.

The next sentences are all correct English sentences. BUT some of them do not make sense. I will read the sentence to you. You tell me if it makes sense. For example, if I say "she cuts her hair with pencil" your say "no" because it does not make sense. "She cuts her hair with scissors" makes sense and you say "yes". Ready?

183. The sun shines by night. judgement + - 0 (183)
184. The cat sits on the roof. judgement + - 0 (184)
185. The flowers grow in the gravy. judgement + - 0 (185)
186. The season comes out of the chimney. judgement + - 0 (186)
187. He is wearing a new suit today. judgement + - 0 (187)
188. They dribble their cars to work. judgement + - 0 (188)
189. The sausage ate the dog. judgement + - 0 (189)
190. They had radios for breakfast. judgement + - 0 (190)
191. She combs her hair in front of the mirror. judgement + - 0 (191)
192. He drinks sand when it is hot. judgement + - 0 (192)
**REPETITION OF WORDS AND NONSENSE WORDS, AND LEXICAL DECISION**

*** In this section the patient is being tested on two abilities: 1) the ability to repeat words, and 2) the ability to tell whether what he/she hears is a word. For each item, first read the word, then wait for the patient to repeat it. The patient must repeat exactly what he/she hears. Circle "+" if the patient’s repetition is correct (allowing for differences of accent or dialect). Circle "-" if the patient’s response is incorrect. If he/she produces no response within five seconds, circle "0".

*** After the patient has repeated (or not repeated) the stimulus, ask him/her whether it is a real English word. Score "+" for a judgement of "yes" (it is a word), and score "-" for a judgement of "no" (it is not a word). If the patient gives no response within five seconds, circle "0" and move on to the next item. Accept nods as answers to judgement questions.

*** Turn the tape recorder on and begin reading aloud here.

I am going to ask you to repeat some words. Some of these are real English words. Some are not really English words. They don’t make sense. Please repeat after me, and then tell me if the word is a real English word. Ready?

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<th>repetition</th>
<th>judgement</th>
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<tbody>
<tr>
<td>193. Mat</td>
<td></td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>195. Ball</td>
<td></td>
<td>+</td>
<td>-</td>
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<tr>
<td>197. Brew</td>
<td></td>
<td>+</td>
<td>-</td>
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<td>199. Chay</td>
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<td>+</td>
<td>-</td>
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<tr>
<td>201. Thick</td>
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<td>+</td>
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<td>203. Goom</td>
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<td>+</td>
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<td>205. Flup</td>
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<td>+</td>
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<td>207. Van</td>
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<td>209. Rop</td>
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<td>211. Pear</td>
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<td>213. Chip</td>
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<td>215. Crane</td>
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<td>217. Lice</td>
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<td>219. Bin</td>
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<td>221. Jar</td>
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<td>223. Signal</td>
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<td>225. Paper</td>
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<td>227. Chetty</td>
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<td>229. Liquid</td>
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<td>231. Barsen</td>
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<td>+</td>
<td>-</td>
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<tr>
<td>233. Sumnip</td>
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<td>+</td>
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83
235. Dolphin
repetition + - 0 (235)
judgement + - 0 (236)
237. Promise
repetition + - 0 (237)
judgement + - 0 (238)
239. Kimmid
repetition + - 0 (239)
judgement + - 0 (240)
241. Melody
repetition + - 0 (241)
judgement + - 0 (242)
243. Elephant
repetition + - 0 (243)
judgement + - 0 (244)
245. Potato
repetition + - 0 (245)
judgement + - 0 (246)
247. Sollick
repetition + - 0 (247)
judgement + - 0 (248)
249. Disaster
repetition + - 0 (249)
judgement + - 0 (250)
251. Seminar
repetition + - 0 (251)
judgement + - 0 (252)

*** Pause here for a few seconds and read the following instructions to the patient.

Now you are going to hear some English sentences. All you have to do is repeat them after me. Ready?

253. The boy pushes the girl.
+ - 0 (253)
254. He is held by her.
+ - 0 (254)
255. It is the dog that bites the cat.
+ - 0 (255)
256. It is the boy that the girl holds.
+ - 0 (256)
257. The car is not pulled by the truck.
+ - 0 (257)
258. He dresses him.
+ - 0 (258)
259. The man does not kiss the woman.
+ - 0 (259)

SERIES

*** In this section the patient is simply asked to recite a series. Circle "+" if the patient does the task perfectly. Circle "." if the patient makes any errors, omits any items out, adds incorrect items, or changes the order of items in the list. If the patient does not respond at all, then circle "0".

*** Begin reading aloud here.

260. Please name all the days of the week.
+ - 0 (260)
261. Could you count from one to twenty-five?
+ - 0 (261)
262. Could you name all the months of the year?
+ - 0 (262)

VERBAL FLUENCY

*** This section tests the patient's ability to recite words beginning with a particular sound. Most important here is the number of words that the patient can produce within ONE MINUTE.

*** Begin reading aloud here.

In this section I will ask you to say as many words as you can that start with a certain sound. For example if I say "I would like you to give me words starting with the sound "s", you would give me words like sit, cement, soap, sailor, salad, special, etc. Ready?
I would like you to give me words that begin with the sound "P". Try to say as many words as you can, as fast as you can.

263. All words begin with right sound?
+ - 0 (263)
264. Number of acceptable words?
(264)

84
O.K., now words that begin with "F"

265. All words begin with right sound? + - 0 (265)
266. Number of acceptable words? __________ (266)

O.K., now words that begin with "K"

267. All words begin with the right sound? + - 0 (267)
268. Number of acceptable words? __________ (268)

NAMING

*** In the following section the patient is required to name the objects shown to him/her. Hold each object up so the patient can easily see it. The objects should be out of the patient's sight before they are presented.

*** Begin reading aloud here.

I will show you some things. Tell me what the thing is called. Ready?

269. Book + - 0 (269)
270. Glasses + - 0 (270)
271. Key + - 0 (271)
272. Cup + - 0 (272)
273. Tie + - 0 (273)
274. Scissors + - 0 (274)
275. Spoon + - 0 (275)
276. Glove + - 0 (276)
277. Pencil + - 0 (277)
278. (Playing) card + - 0 (278)
279. Thermometer + - 0 (279)
280. Button + - 0 (280)
281. Cigarette + - 0 (281)
282. Fork + - 0 (282)
283. Feather + - 0 (283)
284. Ring + - 0 (284)
285. Candle + - 0 (285)
286. Envelope + - 0 (286)
287. Toothbrush + - 0 (287)
288. Watch + - 0 (288)

SENTENCE CONSTRUCTION

*** In this section the patient must create a sentence using the words that you will read to him. For each sentence to be created you should note: 1) whether the patient responds at all; 2) whether the sentence is a correct English sentence; 3) whether the sentence makes sense; 4) whether he/she has used all the words that were read to him/her. Finally, 5) the number of words in the sentence should also be recorded.

*** Begin reading aloud here.

I will give you some words. With these words make the simplest and shortest sentence possible. So, for example, if I give you the words: "door", "open", "nurse", you try to make a simple sentence that uses all the words, like "The nurse opens the door." Ready?

289. House/cat

| Response obtained? | + 0 (289) |
| Correct English sentence? | + - (290) |
| Does it make sense? | + - (291) |
| Number of stimulus words used? | __________ (292) |
| Total number of words? | __________ (293) |