PERFORMANCE ON A PICTURE-WORD VERIFICATION TASK BY BILINGUAL PERSONS WITH APHASIA

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By

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LIST OF ABREVIATIONS

AAC……………………………………………………Alternative/Augmentative Communication
AOS...Apraxia of Speech
ADLs...Activities of Daily Living
ASHA..American Speech-Language-Hearing Association
ASHA FACS...American Speech-Language-Hearing Association
Functional Assessment of Communication Skills for Adults
BAT……………………………………………………………………Bilingual Aphasia Test
CVA………………………………………………………………….Cardiovascular Accident
BPWA... Bilingual Persons with Aphasia
PWA ....Persons with Aphasia
PC .... Proportion Correct
RT ....Response Time
TCM..Transcortical Motor Aphasia
TCS ....Transcortical Sensory Aphasia
WAB ....Western Aphasia Battery

ABSTRACT

PERFORMANCE ON A PICTURE-WORD VERIFICATION TASK BY BILINGUAL PERSONS WITH APHASIA

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Given the estimated annual growth of bilingual aphasia cases (Lorenzen & Murray, 2008), there is an immediate need for research targeting the management of this population. There is reason to believe that the effective management of bilingual aphasia will not mirror approaches used for monolingual cases (Lorenzen & Murray, 2008). This investigation seeks to identify differences in language processing when utilizing first and second languages individually or in combination. A picture-word verification task was used, and it was hypothesized that providing persons with aphasia with additional written information to facilitate semantic processing would be beneficial, resulting in faster and more accurate response selection. Using a single subject design, three participants with aphasia, bilingual prior to onset, were administered the Bilingual Aphasia Test (BAT) and a picture-word verification task. Each of the participants presented with unique language histories and fluency levels of non-English languages. The experiment included two picture-word verification tasks incorporating the use of each language individually and both languages together. The fundamental design of the two paradigms was identical, but the stimuli utilized and the presentation sequence of the four conditions was different. In both paradigms, the four conditions were presented 30 times each, half as a picture-word match and half as a non-

match. This resulted in a total of 240 stimulus presentations, 60 of each condition. Analyses were conducted on proportion correct (PC) and response time from stimulus onset (RT) within each of the four experimental conditions for each participant. Non-responses were removed from PC and RT data, and outliers were retained. Nonparametric statistics were used to identify significant associations in the case of PC and significant differences in the case of RT for each participant. For PC data, chi-square analyses were conducted to identify correlations between the number of accurate responses given in each condition. For RT data, the Kruskal-Wallis tests on rank scores (Kruskal & Wallis, 1952) were conducted for all participants. Mann-Whitney U tests were conducted on all possible contrasts when applicable. Post-hoc pairwise comparisons were made separately when applicable. All statistic tests were based on a significance level of $\alpha = .05$. Only one of the participants (P1) demonstrated a statistically significant difference between conditions. Although the other participants did not reveal statistically significant differences in performance, general trends were still observed suggesting better performance on one condition versus the others. The uniqueness and varied responses of the participants highlight the importance of considering the strengths and needs of each language when working with bilingual persons with aphasia. This would likely result in the greatest therapeutic gains as illustrated by Ansaldo and Saidi (2010), and may also reveal residual language abilities that can aid functional communication. The present investigation provides support for continued efforts on the topic of bilingual aphasia management and specifically speaks to the augmentation of input options aspect of design theory of alternative and augmentative communication (AAC) devices. Functional implications to indirectly target non-English languages and non-therapeutic opportunities to utilize these languages should also be considered to improve quality of life.

CHAPTER ONE: INTRODUCTION

Aphasia is an acquired language disorder that is characterized by difficulty, or an inability, to comprehend or express language due to brain damage. It can affect any or all modalities of communication, including reading, writing, listening, and speaking. Aphasia typically results from injury to the left perisylvian cortex; however, the specific structures damaged vary considerably across persons with aphasia (PWA). This disorder is not considered to be developmental, but rather is acquired after the acquisition of language. Further, aphasia is not the result of sensory, motor, and/or intellectual deficits (Hallowell & Chapey, 1981). Although the etiology of aphasia can vary extensively, the most common cause is a cerebral vascular accident (CVA), or stroke. Aphasia can also result from head injuries, surgical trauma, brain tumors, and/or infections of brain tissue (Hallowell & Chapey, 1981). Approximately 85% of aphasia cases are the result of stroke; the remaining 15% are a combination of surgical trauma, traumatic brain injury, degenerative disease, and tumors (http://aphasia.com/wordpdf/1.BasicStatistics.pdf).

Types of Aphasia

As previously mentioned, aphasia can affect all modalities of communication (i.e., speaking, listening, reading, and writing) to varying degrees depending on the location of the lesion and its size (Hallowell & Chapey, 1981). As a result, aphasia profiles are generally described as fluent or nonfluent given the clinical signs and symptoms presented. The only sign and symptom that will be present across all types of aphasia is anomia, or difficulty retrieving and producing words. Further, there are multiple aphasia types that fall under the classifications of fluent or nonfluent aphasia. A person with fluent aphasia is one who produces relatively normal rate, rhythm, and melody of speech with appropriate prosodic features, regardless of the clarity of the communication attempt. Fluent types include Wernicke's aphasia, transcortical sensory aphasia

(TCS), anomic aphasia, and conduction aphasia. Those PWA who have Wernicke's or TCS can often be described together as they both have impairments in comprehension of language, but speak fluently with an even prosody and without considerable effort or struggle. Syntactic use reflects a variety of functor words and general acknowledgement of syntactic rules; however, the content of language attempts is impaired. Sentences produced by individuals with fluent aphasia are generally long and well-formed, but often exhibit verbal paraphasias (i.e. substitutions of semantically related words), neologisms (i.e. nonsense, made-up words), jargon (i.e. rambling of speech), and/or circumlocution (i.e. description of the intended word). It is the impaired comprehension of language, and the failed association of strings of speech sounds and their meanings that lead to the relatively incoherent ramblings of some persons with fluent aphasia. Adding to the struggles for effective communication, these individuals are often unaware of the language errors produced, and therefore they will seldom make attempts to correct those errors (Hallowell & Chapey, 1981).

Those PWA who have conduction or anomic aphasia are also described as fluent; however, the clinical presentations of these types differ considerably from those just discussed. PWA who experience conduction or anomic aphasia can be described together because there is only one minor distinction between their clinical profiles. Generally, persons presenting with conduction aphasia have impaired repetition as the hallmark of the disorder. They have extraordinary difficulty repeating words/phrases due to the damage of the arcuate fasciculus which is the communication link between posterior and anterior language zones of the left cerebral cortex. They may be able to repeat words with single syllables, but as the length and complexity of words increases, so does the production of phoneme errors. Persons with conduction aphasia often exhibit fluent speech patterns with appropriate rate, intonation, and stress, and demonstrate intact comprehension of spoken and written language; however, they display paraphasias that are both semantic and phonemic in nature. Handwriting is typically legible and neat; however, writing to dictation will demonstrate word and spelling errors (Brookshire, 2003).

Those who have anomic aphasia have only one obvious sign: impaired word-retrieval when speaking or writing. They tend to have fluent speech and use correct grammar; however, their fluency is often riddled with failures in word retrieval. These individuals will often exhibit inappropriate pauses, circumlocution, and substitution of targets with nonspecific words, such as “it” or “thing”. Comprehension of language remains relatively intact. Anomic aphasia can result from lesions throughout the left hemisphere cortex including both anterior and posterior regions (Brookshire, 2003).

The aphasia types just described are those demonstrating relatively intact fluency of speech. However, in some cases, PWA are described as nonfluent. Nonfluent aphasia is characterized by the lack of intonation and rhythm when speaking, or the inability to produce spoken language with the exception of a few words or phrases. The aphasia types described as nonfluent include: Broca’s aphasia, transcortical motor aphasia (TCM), and global aphasia. In comparison to those with fluent aphasia, persons with nonfluent aphasia often have relatively intact comprehension, but they are unable to produce long, well-formed utterances that incorporate syntactic form. For example, individuals who present with Broca’s aphasia exhibit a slow rate of speech that is often hesitant and arduous in nature, and they often pause inappropriately between words or syllables. Their speech often sounds monotonous due to a lack of intonation and stress. Like those with fluent aphasia, they also have difficulty with word retrieval. Persons with Broca’s aphasia often present with misarticulations and distortions of vowel and consonant sounds. Their utterances are generally short and are comprised largely of content words, such as nouns, but lack functor words, such as articles. This creates a telegraphic feel to their communication attempts. Given that auditory comprehension is relatively intact, they are very aware of the mistakes made in speech and writing, and will make repeated attempts to repair these errors. Writing is typically representative of speech, meaning that it too is agrammatic and effortful. Writings of those with Broca's aphasia are rarely in cursive and will often contain misspellings, distortions, and omissions of letters (Brookshire, 2003).

Very similar to Broca's aphasia is TCM, characterized by markedly reduced speech output combined with intact repetition skills and auditory comprehension. A person who exhibits TCM will have difficulty initiating and maintaining communication due to the area of damage in the frontal lobe. As the lesion location generally spares all three major structures that broadly constitute the language processing system (i.e., Broca's area, Wernicke's area, and the arcuate fasciculus), persons with TCM tend to have intact comprehension and repetition skills. Persons with TCM tend to be alert and oriented to conversations, but are often not conversationalists due to an inability to initiate and maintain conversations. Persons with TCM are able to produce fluent, long, and complex phrases or sentences without error once they have been urged into speaking (Brookshire, 2003).

In some cases, the extent of brain damage can be quite extensive, affecting the entire left perisylvian region. When this occurs, global aphasia is often the consequence. In cases of global aphasia, severe impairments in all aspects of language are observed. Few people with global aphasia are capable of reading simple words, and their verbal output is severely limited, generally consisting of a few monosyllabic words, stereotypical utterances (i.e. use of only one word or phrase, which may be real or nonsense), over learned phrases (i.e. "love you"), or expletives. Generally, a person with global aphasia is alert and oriented to a task, and is known to be socially appropriate; they often follow directions for, and perform well on nonverbal tasks (Brookshire, 2003).

Bilingualism

Given that there are so many possible presentations of aphasia, the management of the disorder would logically vary across patients. The World Health Organization recommends in its Classification of Impairment, Disability, and Handicap **(**http://www.who.int/en/, 2012) that impairments, including aphasia, be managed by taking into consideration the impairment itself as well as the personal and environmental factors that facilitate or hinder optimal function. Although many variables exist, bilingual or multilingual status prior to aphasia onset is one variable that should be given full consideration when assessing and treating the impairment and managing personal and environmental needs of the client and family. Although there is still little consensus regarding the definition of bilingualism, a general definition describes a person who uses or is able to use more than one language fluently (Merriam-Webster dictionary, 2011).

Some definitions, like that of American linguist Leonard Bloomfield, are not as open for interpretation. Bloomfield suggests that in order to be fully bilingual, an individual must have native-like control over both languages (Bloomfield, 1933). In other words, it should be as if two monolingual individuals are in the same body. In order to be identified as bilingual under Bloomfield's definition, an individual must be able to speak, write, and read proficiently in each language, as well as use correct syntax, morphology, and semantics for each language. Essentially, an individual would need to express proficiency in each language similar to that of a monolingual in one language.

Decades later, Haugen (1953) lessened the restrictions of Bloomfield's definition by adding that bilingualism should be considered the ability to produce comprehensive and significant sentences in each language. Haugen purported that to be bilingual; a person must be able to use the language with enough control that they are able to communicate adequately with native speakers of that language. In other words, bilingualism begins when a speaker of one language begins to use a second language in a meaningful way to communicate. Similarly, Diebold (1961) proposed that a bilingual individual does not need to have native-like control over all aspects of the second language, but that it is sufficient for a bilingual individual to possess passive knowledge of reading and writing in the second language so long as he or she has the ability to communicate verbally with an individual who is a native speaker of the second language adequately and fully . Ultimately, linguists began to realize that it is impossible and too subjective to list criteria to identify someone as truly bilingual. According to Mackey (1959), it is not the mastery of a language that should be taken into consideration, but the use of a language. How well does the bilingual individual know the languages being used? Furthermore, the functionality of the languages, or the purposes for which the languages are used, should be considered.

Of particular relevance to speech-language pathologists is the definition provided by the American Speech-Language-Hearing Association (ASHA, 2004), which defines bilingualism as:

> The use of two languages by an individual. It is a fluctuating system in children and adults whereby use of and proficiency in two languages may change depending on the opportunities to use the languages and exposure to other users of the languages. It is a dynamic and fluid process across a number of domains, including experience, tasks, topics, and time. (ASHA, 2004)

There is a continuum associated with bilingualism with an extensive amount of variability. Bilingualism is unique to each communicator, and is dependent on the amount of exposure to specific languages, as well as the quality thereof.

Clearly, bilingualism is difficult to define; there is a myriad of definitions for this one term. Some are more strict definitions of bilingualism, while others are based on the use of a language, rather than the competence. Bilingualism is a relative term that can encompass a wide variety of meanings depending on the beliefs of those defining bilingualism. If a person has a more maximalist view of bilingualism, then he or she will more than likely adhere to the definition set by Bloomfield, whereas an individual with a minimalist view will tend to adhere more to the definition broadened from Bloomfield's definition or the definition set by Mackey (Li, 2000). Most authors suggest that bilingual status exists on a continuum of fluency, and that it is not a black-and-white distinction (Hakuta, 1986; Paradis, 1996). Therefore, a speaker may be considered more fluent or less fluent rather than categorized by an all or nothing characterization. It is also important to note that a bilingual speaker may be more proficient in one modality than another, for example, a comprehension versus expression task (Cutler, Mehler, Norris, & Segui, 1992; Hyltenstam, 1992). The implication here is that considerable variability exists in terms of what constitutes bilingual status. For the purpose of this paper, bilingualism will be defined as any person who is able to use a non-native language to communicate with those speaking that language. It is not necessary for the individual to possess native-like control over the second, or subsequent, language; but it should be functional in nature.

Neuroimaging of Bilingualism

With the advent of functional neuroimaging, researchers were given even greater insights into bilingualism. For example, it has been determined that there are significant differences in the organization of languages in the brain by those considered bilingual or multilingual (Kim, Relkin, Min Lee, & Hirsch, 1997). In a study of five right-handed multilingual men, researchers sought to map out patterns of brain activation associated with processing languages in which participants were fluent and those in which they were not (Yetkin, 1996). Participants were asked to perform a generative naming task involving three languages with three levels of fluency. Results suggested that activation in the left frontal lobe of the brain was observed in all of the five subjects who performed the language task. The greatest amount of activation was observed when the participants completed the generative naming task in the language in which they were not fluent. This suggests that processing of languages in multilingual individuals is different depending on the level of fluency in a particular language; the less fluent the speaker is, the greater the cortical recruitment to complete the task. This is likely associated with the cognitive load involved in the attempt to process a language that is theoretically more difficult to use compared to one that is natural and automatic. This supports theorists views on fluency and bilingualism: that fluency should be considered as it influences cortical activation of language processing in more and less fluent languages.

Similarly, Pernai (1998) took into consideration proficiency and age of acquisition in an effort to study cortical organization of multiple languages better. Participants included a group of Italian-English speakers who acquired the second language (L2) after the age of ten and a group of Spanish-Catalan speakers who acquired their second language before the age of four. Both groups demonstrated high proficiency when using the languages. Task requirements involved listening to stories in both languages and answering questions about the stories during which the participants underwent Positron Emission Tomography (PET) scans. A group of control participants with low proficiency in a second language also completed the task and underwent PET scanning.

Participants with high proficiency in both languages demonstrated very similar patterns of activation regardless of age of acquisition. However, those results differed from those of the control group with low second-language proficiency. This suggests that proficiency of language use, or fluency, is more responsible for patterns of cortical activation and perhaps cortical organization, rather than age of acquisition.

Although this is useful to understand bilingual processing, the question remained how two languages are actually organized within the brain: as a single unit or perhaps as multiple regions dedicated uniquely to one language or the other. One study investigating this enigma, utilized a confrontation picture naming task with persons preparing for neurosurgery (Lucas, 2004). While mapping out language processing regions of the cortex, researchers administered the naming task in each language spoken by the patients. Two conditions were used in which the participants' primary language (condition 1) and the second language (condition 2) were utilized. While participants completed the naming task, different areas of the brain were stimulated and the subsequent effect documented. A "language map" was created by organizing essential sites for each language on a uniform cortical grid. These sites were compared to those of monolinguals who were asked to complete the same object-naming task in their native language. Results of the study were somewhat conflicting. Of the 22 participants completing the task, only one demonstrated completely shared cortical sites for both languages. That is, the same regions of the cortex that processed the first language were also responsible for processing the second. Next, nine participants in this sample had relatively isolated cortical sites for both languages in which they were tested.

This means that different regions of the cortex were responsible for processing the first language compared to the second. Finally, 13 participants demonstrated both shared and unique language processing regions; in some bilingual speakers, language is processed in one shared site for all languages in addition to sites unique to each language. It is not certain why this organizational pattern emerged; however, it may be associated with age of acquisition, method of learning, or proficiency of language use. Regardless of the reason, the study provides an interesting perspective into bilingual aphasia following stroke, and the increasingly unique consequences of this injury on language processing in known languages.

Treatment of Bilingual Aphasia

The necessity to classify bilingualism is imperative in order to determine how to interact with and best manage bilingual persons with communication disorders, including aphasia. Over the last thirty years, the population of people speaking multiple languages has increased steadily (U.S Census Bureau, 2007). As the cases of bilingualism continue to increase, the frequency of bilingual aphasia will also increase. In fact, it has been reported that the number of new bilingual aphasia cases will rise to an expected 45,000 per year (Lorenzen & Murray, 2008). Literature is emerging on this topic, and it has been suggested that management of bilingual aphasia will likely deviate from diagnostic and treatment intervention methods found to be effective and efficient for monolingual persons with aphasia (Lorenzen & Murray, 2008). Motivating continued research on this topic is the literature that suggests that recovery patterns of the two languages may not always be parallel, possibly influenced by the relative severity of aphasia in each language independently (Lorenzen & Murray, 2008).

Three different patterns of recovery in cases of bilingual aphasia have been observed: parallel, selective, and differential (Faroqi-Shah, Frymark, Mullen, & Wang, 2010). Parallel recovery refers to relatively equal recovery of both languages simultaneously, whereas selective recovery suggests that only one language improves over time while the other remains unchanged.

Differential recovery is dependent upon the level of fluency or usage prior to the onset of aphasia, meaning that the more fluent or most frequently used language will recover more than the less fluent, less used language. Considering these constructs, Faroqi-Shah and colleagues (2010) reviewed evidence related to the treatment of bilingual persons with aphasia, specifically examining the outcomes associated with what they called cross language transfer (CLT). The study reviewed outcomes of language treatment provided in the secondary (or less dominant) language of the participant, the extent of CLT, variables affecting CLT, and general outcomes of language treatment. Data from 14 different studies involving 45 bilingual persons with aphasia (BPWA) revealed that there was a positive correlation between post-treatment outcomes of the participant's first language, as expected, but also remarkable generalization, or CLT, to the untreated language.

As additional evidence, Marangolo and colleagues (2009) examined treatment-induced changes in expressive language ability of two languages spoken by a BPWA after a left ischemic lesion. One aspect of this larger study involved the participant completing two weeks of expressive language treatment utilizing a second language alone. It was determined that treatment of the second language resulted in a significant increase in language processing of the untreated language. This suggests that traditional monolingual aphasia treatment may result in generalization to the untreated second language. The authors go on to question whether treatment in multiple languages may be more influential to overall recovery in clients who are bilingual, as opposed to monolingual treatment (Marangolo, Rizzi, Peran, Piras, & Sabatini, 2009).

Treatment of Aphasia Using Augmentative and Alternative Communication

The present investigation provides researchers with the necessary motivation to explore further how current treatment methods may be modified (e.g. augmented input) to accommodate bilingual persons with aphasia best. For some PWA, augmentative and alternative communication

(AAC) is an appropriate option to facilitate communication. AAC devices encourage social communication for those who are not necessarily able to communicate without a device and have been developed specifically to adjust for communication after its loss (Beukelman, Fager, Ball, & Dietz, 2007). The use of an AAC device by adults with chronic, severe aphasia has been assessed; in a study of functional communication, investigators sought to determine if participants' linguistic abilities could be augmented so that they may be able to use an AAC device adequately in order to produce functional communication (Johnson, Hough, King, Vos, & Jeffs, 2008).

Participants engaged in AAC treatment for one hour a day, four days a week, for three months. Materials for the treatment were specific to each participant, and included individualized pictures that were personally relevant to that participant. Treatment activities included several stages, but were meant to teach how to use the device as a communication tool. Initially, orientation to the device was provided in a single session, and included learning to turn the device on and off and how to charge the battery. The first stage of actual training was symbol identification in which each participant was asked to identify the symbol displayed. Each participant had to meet the set criterion of four correct symbol identifications out of five trials; successful completion of this stage led to advancing to the next stage of treatment. In the second stage, participants were taught navigation of the device and were expected to navigate to the correct category and choose a specific symbol. The third stage, Scenario Role Play, was designed to determine if use of navigating the system was effective. Participants were asked a specific question about a situation or specific daily activity, and they were expected to respond accordingly within 30 seconds. The final stage required participants to respond to specific questions about their daily activities by combining two or more symbols. Pre-and post-tests were used to determine whether the AAC device was beneficial to these PWA. All three participants demonstrated improved communicative independence; two of the participants also demonstrated significant improvement in daily planning, reading, writing, and number concepts. Based on these findings, it was suggested that AAC devices were a practical option for some persons with severe nonfluent aphasia.

Further supporting this literature, a study by Johnson and Hough (2009) sought to determine the role of an AAC device to enhance language and communication abilities of persons with chronic, severe aphasia using a single case study. A 56-year-old male participant's communication improvements were monitored regularly throughout a treatment period similar to that of Johnson et al. (2008). The three stages implemented in this study included symbol identification, scenario role play, and sentences. It was determined by pre-, inter-, and post-test scores on the *Western Aphasia Battery* (WAB; Kertesz, 2006) and the *ASHA FACS Communication Independence Scales (*Frattali, Thompson, Holland, Wohl, & Ferketic, 1995*)* that the participant's language scores showed continual improvement throughout treatment, with the greatest improvement being in the final month of treatment.

Statement of Purpose

Clearly, the literature supports that AAC devices are an appropriate approach to facilitate functional communication for many PWA. It remains to be seen if this is indeed a viable option in the case of BPWA, and if the bilingual status may be incorporated to make the device more effective as a communication tool. Assuming that AAC devices are still a successful management approach for BPWA, it remains to be seen how symbols should be presented to make the device most functional. Given that the two languages may be differentially impaired by a focal lesion, using one language or the other, simultaneously or singularly, on the AAC device may result in more effective and optimal use. The current investigation is designed to shed light on this very issue. The purpose of the present investigation is to determine the effect of first and second languages on the performance of three BPWA on a picture-word verification task (PWVT). The following questions were addressed and hypotheses tested:

Question 1: Will BPWA perform better on the PWVT when given written stimuli in English (L1), their other language (L2), or both languages together (L1+L2)?

Hypotheses:

H_0: BPWA will not perform differently on a PWVT when given written stimuli in English (L1), their other language (L2), or both languages simultaneously (L1+L2).

H_1: BPWA will perform better on a PWVT when given both languages simultaneously (L1+L2).

Question 2: When given both languages simultaneously, does the orientation of the written stimuli, as in one presented spatially above the other, influence performance (i.e., English above the second language, second language presented above English)?

Hypotheses:

H_0: BPWA will not perform differently on a PWVT when shown either the English written stimuli spatially above that of the second language or when shown the second language written stimuli spatially above the English.

H_1: Persons with bilingual aphasia will perform better on a picture-word verification task when shown the English written stimuli spatially above that of the second language.

CHAPTER TWO: METHODS

Participants

Three BPWA were recruited for study participation. Each participant provided informed consent approved by the Institutional Review Board of Western Carolina University prior to participating in this study. The informed consent form was read aloud to each participant and caregivers, if present, while the participant read along with a printed copy. All questions from the participant or caregivers were answered satisfactorily before signing the consent to participate document. Prior to completing selected assessments, participants were asked to provide personal, medical, and educational information. When necessary, this information was obtained from family members with the consent of the participant.

Assessment

Each participant was administered the Bilingual Aphasia Test (BAT; Paradis, 2011) in English and his second language to determine type and severity of aphasia in each language. Volunteer translators were present during the assessment session to administer and score non-English assessment tasks. Given that all participants lived in a rural region of western North Carolina, recruitment of translators was challenging. The French translator was identified in the foreign language department of Western Carolina University. Although not current, this individual was previously a certifieded French translator. The Dutch translator was identified by the speech-language pathologist employed by the second participant's residence (a long-term care facility); she was a licensed school psychologist and this participant’s daughter. This translator was a native of the Netherlands, and was fluent in both English and Dutch. She was selected because she was familiar with communicating with a person with aphasia and was also very familiar with the rules of standardized assessment. The Vietnamese translator was a graduate student in the Department of

Communication Sciences and Disorders at Western Carolina University. She was born in Vietnam, and continued to speak the language with her family. She had also completed coursework and clinical practica related to aphasia.

The BAT is a language assessment that assesses language skills of a bilingual or multilingual individual with aphasia. It is designed to assess the integrity of the language systems for each language that was previously used as well as in both languages simultaneously. The BAT is a comprehensive language test used to assess the inconsistency between various language functions, either lost or spared, in individuals who were bilingual prior to acquiring aphasia. The BAT consists of three parts, A, B and C, with several subsections of parts B and C. In part A, the test administrator requests information from the client or a family member about his or her language history. Questions are directed at languages other than English spoken in the home or at school, as well as languages spoken by the immediate family, friends, and teachers. The initial subtest of part B gathers information regarding the client’s use of English, in particular. Questions include proficiency in English, age at which the client learned to speak English, where and how often English was used, and proficiency with reading and writing in English.

The subtests of part B assess multiple aspects of language processing in considerably more detail. These aspects include verbal expression, auditory comprehension, repetition, naming, reading and writing, as well as arithmetic. Verbal expression is assessed using the following subtests, although not necessarily in this sequence: Spontaneous Speech, Series, Verbal Fluency, Sentence Construction, and Description. In these subtests, the participant was asked to provide a five minute long spontaneous speech sample, state words that appear in series (e.g. days of the week), and recite words that begin with a particular letter. Furthermore, the participant was asked to create sentences using words provided and to provide commentary about a comic strip.

Auditory comprehension was assessed using the following subtests, although not necessarily in this order: Verbal Comprehension, Pointing, Simple and Semi-complex Commands, Complex Commands, Verbal and Auditory Discrimination, Syntactic Comprehension, Semantic Categories, Synonyms, Antonyms, Grammaticality Judgment, Semantic Acceptability, and Lexical Decision. In the Verbal Comprehension subtest, participant is asked to follow basic and complex commands (e.g. “Close your eyes.”); these involved manipulating objects as well as using features of the body and testing room. Verbal and Auditory Discrimination required the participant to match the word stated aloud by the examiner (e.g. mat, ball, duck) to pictures and objects. In the Syntactic Comprehension subtest, the participant to touch the picture which best represents the sentence given aloud by the examiner (e.g. “The boy pushes the girl.”). The Semantic Categories task requires the participant is asked to identify the target that does not belong in a group of words read aloud by the administrator (e.g. tulip, rose, *frog*, daisy). The Grammaticality Judgment section requires the participant to determine if the sentences that are provided by the administrator are grammatically correct sentences (e.g. “He dresses herself.”). The Semantic Acceptability section requires the participant to determine if the sentence provided by the administrator was logical (e.g. “The sun shines by night.”). Finally, the Lexical Decision task measured the participant’s ability to judge whether a stimulus word was a real English word or a nonsense word (e.g. chay, goom, flup).

Repetition was assessed using the following subtests: Repetition of Words and Nonsense Words. In this subtest, the participant’s ability to repeat real words (e.g. mat, ball, dolphin) and phrases (e.g. “The boy pushes the girl.”) was assessed, as well as a series of nonsense words (e.g. bim, kimid).

Naming was assessed using the Naming subtest, in which the participant is asked to name pictured and real objects presented by the examiner (e.g. book, glass, pencil). Naming was further assessed in a generative naming task in which the participant was asked to generate words that began with a particular phoneme (e.g. /p/, /k/). Further, a description section is implemented in which the participant is asked to describe a series of pictures that are shown (e.g. a comic strip).

Reading and writing were assessed using the following subtests: Reading, Reading Comprehension for Words, Reading Comprehension for Sentences, Writing, Copying, and Dictation. Here, the participant was asked to read words or phrases some aloud or silently, and in some cases, the participant was asked to point to a corresponding picture (e.g. cat, mall, chick) after reading a word or phrase. In the writing subtests, the participant was asked to provide a spontaneous writing sample, to copy words from the stimulus book, and to write words read aloud by the test administrator.

Mental arithmetic was assessed in a single subtest of the same name during which the participant was asked to complete math calculations silently; they do not use pen and paper to help them determine the correct answer (e.g. five minus four).

Part C of the BAT assesses the participant's ability to switch between two languages. These subtests included for both languages tasks of word recognition, word and sentence translations, and grammaticality judgments of sentences. In the word recognition portion of Part C, the participant is provided with a printed list of words in English and a second column of words in their native language. They are presented with the English column of printed words and asked to indicate with pointing which is the translation of the word presented. Additionally, a different column of native language words is presented and the participant must indicate the translations of those words in English. In the word and sentence portion of Part C, the participant is asked to listen to a word or sentence and then provide the translation in the opposite language (e.g. kniv-knife, "om aftenen drikker han en kop the"- "In the evening, he drinks a cup of tea."). During grammaticality judgments of sentences, the participant is asked to listen to a sentence which is read by the test administrator and determine if the sentence is correct or incorrect. If the sentence is deemed to be incorrect, the participant is then asked to provide the corrected sentence (e.g. "His watch showed ten minutes over three.").

Case Studies

Participant 1 (P1):

P1 is a 46-year-old male who experienced a stroke in December of 2008. The stroke resulted from a hemorrhage in the basal ganglia during a thrombectomy to remove a blood clot in the external carotid artery that developed following a car accident seven months prior. Although not fully documented, it was reported that he may have experienced some brain trauma during this car accident, as well. After his car accident, P1 was released to go home; it was not until months later that he experienced his stroke while writing a letter.

P1 was described by his parents as a "loquacious, articulate and highly intelligent speaker." He had graduated cum laude from the University of Pennsylvania, majoring in intellectual history. Prior to his stroke he was fluent in three languages: English, French, and Hebrew. Given the data acquired during the part A interview of the BAT, it was indicated that P1 spoke primarily English with his family and friends for the majority of his life and at the time of his stroke. However, he was raised speaking both French and Hebrew as the primary languages in the home and school. His parents reported that he has always been a talkative individual, and enjoyed writing stories and screenplays. It was reported that within one year of having the stroke, P1 had made significant gains in speech, grammar, and word-finding skills. In the summer of 2011, P1 completed the *Levels of Speech Usage Categorical Rating Scale* (Baylor, Yorkston, Eadie, Miller, & Amtmann, 2008); he reported that in the last year his speech had been used intermittently, primarily at the conversational level and on a daily basis. P1 presented with right-side hemiparesis, but reported that he completed all activities of daily living (ADLs) independently and did not require assistance in completing tasks. P1 was left handed prior to his stroke; he maintains proficient handwriting skills. P1 also reported perfect vision and hearing, and he did not present with signs associated with cognitive impairment. P1 did not work or volunteer at the time of this research as he was focusing all time and energy into regaining speech and language abilities and use of his right hand.

P1 was administered the English-French version of the BAT to determine the extent of the aphasia in English and French.

BAT Results-Part A: Following administration of Part A, it was learned that P1 was born in South Africa and spoke primarily English at home with his family. He reported that his father and mother were both native speakers of English, but also spoke an unspecified African language and Yiddish. In addition, P1 was cared for as a child by a woman from Hong Kong. Although she was a native speaker of Chinese, she primarily communicated with him in English. When conversing with friends, P1 generally spoke in either English or French as he attended school in Montreal. He also attended a day school in which Hebrew was taught, but did not speak Hebrew outside of the classroom. After obtaining a Bachelor’s of Arts in Intellectual History, P1’s occupation was screenwriting. Prior to his accident, P1 was able to speak French, English, Hebrew, and some German; although, he was not proficient in the latter.

French BAT Results- Part B: Quantitative data related to the French portion of part B are presented in Table 2.1. P1 completed the BAT part B in French on two separate days due to the time required to complete all tasks. P1 demonstrated a high level of auditory comprehension of French, but was less fluent speaking in French than in English. P1’s spontaneous language sample in French was laborious and halting. He demonstrated a minimal amount of speech, poor fluency, fair pronunciation, poor grammar, and poor vocabulary. However, when asked to point to objects named by the examiner, he was able to identify 9 out of 10, follow all 5 simple commands and 3 of 5 semi-complex commands. P1 was also able to follow complex directions, demonstrating complete performance, but with incorrect order on four out of five opportunities. When asked to indicate a picture that matched an auditorily-presented word, P1 identified 15 out of 18 pictures. P1 was able to respond correctly to all questions regarding a story that was read aloud to him.

P1 demonstrated difficulty with more complex language in French, such as syntax; semantics; automatic, general, and generative naming abilities; morphology; sentence completion; description; and reading comprehension. When asked to identify one picture out of four that represented a sentence that was read, P1 demonstrated difficulty comprehending some sentences with more complex syntax (e.g. "Elle le tient", "Elle la tient"). P1 exhibited difficulty in determining the semantic accuracy of sentences in French (e.g. "Le soleil brille la nuit"). P1 also struggled when choosing an appropriate synonym for a word when provided with four choices.

P1 was unable to recite a series of automatic responses (e.g. "Name all the months of the year"- participant responded that he was unable to do so in French as he had just re-learned the recitation of a series in English). P1 also had difficulty during the generative naming tasks, such as naming words beginning with the letter "p." He named 5 of 20 objects presented by the examiner, having difficulty on items such as *tasse*, *fourchette*, *plume*, and *bague*. When asked to complete a sentence in French using the provided words, P1 was able to write down a sentence and then read it aloud, for example, "Le doctor s'assorsar le chair." When these sentences were reviewed, it was determined that the word order of the words were correct, but that no verbs had been conjugated.

P1 displayed difficulty with derivational morphology and morphological opposites during the assessment. When asked to change a given word to an adjective, P1 was able to provide three of ten correctly (e.g. visible, visiblement). During the morphological opposites, P1 was asked to provide an opposite to the given word that was morphologically similar (e.g. visible, invisible). P1 was able to provide four morphologically similar, but opposite, words out of ten provided. When asked to complete a description of a cartoon strip, P1 was able to produce minimal amounts of speech, did not reach the end of the cartoon strip, and was unable to tell a connected story or simply describe pictures.

Reading comprehension for French words and sentences in French was challenging. P1 was asked to read a list of words or sentences, and then indicate a picture in a field of four that best illustrated what was read. He responded accurately to three of ten words and five of ten sentences during this task. However, when asked to read the words or sentences to himself, and then choose a picture that represented the word or sentence, he was able to do so with only two errors. P1 copied words and sentences in French without error, and wrote words and sentences dictated by the examiner.

English BAT Results- Part B: Quantitative data related to the English portion of part B are presented in Table 2.2. P1 performed better on the English portion of the BAT part B, possibly due to the language therapy he received in English after his stroke. P1 was much more fluent in English as compared to French given the spontaneous speech sample; he demonstrated a normal amount of speech using a maximum of eleven words per utterance and an average of eight words per utterance, improved fluency despite pauses during word retrieval, fair articulation of speech sounds (he demonstrated difficulty with blends and affricates), more intact grammatical forms, and better availability of vocabulary. During the description subtest, P1 was asked to look at six pictures and tell a story about the pictures. He was able to provide a relatively normal amount of language content and tell a connected story. Unfortunately, he failed to include the last of the six pictures in his story. P1 demonstrated difficulty with derivation morphology tasks when asked to change a word provided into an adjective (e.g. nature, natural).

P1 also demonstrated intact auditory comprehension in English, completing all tasks (i.e., pointing to objects, following commands) without error. P1 performed well on the verbal auditory discrimination portion, as well, identifying 16 out of 18 pictures correctly when provided an auditory target word. P1 displayed good comprehension of syntax when asked to indicate a picture in a field of four that represented the sentence provided (e.g. "It's the boy who pushes the girl."). He completed the Semantic Categories task perfectly when asked to determine which word, read aloud by the examiner, did not belong in a group of four.

During the naming tasks, P1 was able to name in English all 20 items presented to him, and he identified an antonym to a word provided by the examiner. P1 was able to choose each of the words correctly in the Synonyms section when provided with a target word, and when provided with four words from which to choose. P1 was able to complete the Semantic Acceptability section without error when asked to determine if a sentence was correct; each sentence provided was grammatically correct. P1 was able to recite automatic phrases in the Series subtest without difficulty, naming all the days of the week. He had some difficulty with generative naming tasks; he was able to generate 11 words beginning with /p/, eight words beginning with /f/, and four words beginning with /k/. He also demonstrated some difficulty completing sentences when provided with four words to use in the sentence; although, he was able to complete sentences with three words.

P1 read English words and sentences aloud without error, and he was able to choose pictures correctly that represented a word or sentence that he read silently to himself. He was able to perform all copying of words and dictation of words and sentences correctly when asked to do so.

English /French BAT Results- Part C: Quantitative data related to the English-French part C are presented in Table 2.2. During Part C of the BAT, P1 was able to translate words from French-to-English with only two errors, but produced considerably more errors when asked to do the same task English to French. When translating sentences from French to English, P1 required one or two repetitions of the stimulus before responding. Several errors were noted in his translations related to syntax, semantics, and phonology. When asked to translate sentences from English-to-French, P1 was unable to do so.

In the final section of Part C, P1 was asked to determine if sentences were grammatically correct, and if incorrect, he was asked to provide the correct sentence in the target language. When asked to complete this task in French, he stated that all of the statements were correct and did not need to be corrected. When asked to complete the same task in English, P1 he was able to correct four out of five incorrect sentences, and identified all correct sentences.

Based on this assessment, P1 demonstrates more intact language processing in English than in French. P1 has not used his French since before the onset of aphasia; therefore, some of his errors could be related to lack of use in the past several years. P1 experiences residual difficulty in syntactic comprehension, generative naming tasks, sentence construction, minimal morphological errors, and some difficulty with describing and comprehending series of pictures in English. In French, P1 demonstrated difficulty with spontaneous language production, generative naming syntactic comprehension, synonyms, automatic naming, object naming, sentence construction, morphology, picture description, and reading some words and sentences aloud.

Participant 2 (P2):

P2 is a 78-year old right-handed male who experienced a stroke in 2011. A sudden onset of slurring of his speech, difficulty walking, and left side weakness were observed at home. His diagnosis at the time was lacunar cerebrovascular accident with left hemiparesis, coupled with dysarthria. A CT scan of his head was done which indicated low attenuation of white matter changes that was determined to be severe. Multiple lacunar infarcts were shown bilaterally, but there was no evidence of hemorrhage. Carotid ultrasounds were completed and revealed numerous plaques throughout the common internal carotid arteries bilaterally. P2 has bilateral weakness in his arms and legs, and has required assistance for nearly all ADLs since his stroke in 2011.

P2 was administered the English-Vietnamese version of the BAT to determine the extent of the aphasia in English and Vietnamese.

BAT Results-Part A: P2 was born in Vietnam and is a native speaker of the southern dialect of Vietnamese. He lived in Vietnam until he was 60 years old, at which point he moved to the United States. He was raised by his two parents who both spoke Cambodian and Vietnamese, although they primarily spoke Vietnamese in the household. P2 completed high school, and he reported that he worked in a factory. P2 was five years old when he learned to speak, read and write in Vietnamese, and stated that he spoke Vietnamese every day at work and with friends. Currently, he primarily speaks Vietnamese with his family and English with his caregivers.

P2 did not learn to speak English until he had moved to the United States, around the age of 60 years old. He reported speaking English every day, but not on a proficient level. It was reported that he learned to read single words, but did not learn to write. Caregivers report that he has good comprehension of English, but they do not understand his speech the majority of the time. His family reported that since his stroke and tracheotomy, they had difficulty understanding his Vietnamese. He speaks very softly and has a harsh quality to his voice.

Vietnamese BAT Results- Part B: Quantitative data related to the Vietnamese portion of part B are presented in Table 2.3. P2 completed the Vietnamese portion of Part B of the BAT in two sessions. He did not show signs of frustration during testing but did state that he felt there had been too much testing. Although P2 has a soft, harsh voice, he was still able to complete a spontaneous speech sample which revealed a minimal amount of speech with cueing, bad fluency, but normal grammar and vocabulary. There was evidence of dysarthria, as well, characterized by slow rate, breathy-hoarse vocal quality, short phrases, and imprecise articulation; this affected intelligibility of speech, especially in the presence of background noise. Quantitative data related to part B is presented in Tables 2.3.

P2 was asked to complete simple, semi-complex, and complex commands, P2 was able to follow all simple and semi-complex commands, but he was unable to manipulate objects in order to complete the complex commands. He was instead asked in Vietnamese by the translator to complete two and three step commands that did not require the manipulation of objects and was able to do so correctly in the proper order (e.g. nhắm mắt lại, đặt tay trên bàn, và mở miệng của bạn -close your eyes, put your hands on the table, and open your mouth). When asked to point to objects, he was able to identify 9 out of 10 objects correctly.

P2 was unable to repeat words and provide correct lexical decision making regarding nonsense words, but was able to repeat sentences correctly. He was also able to name 15 out of 20 objects in Vietnamese that were presented to him, demonstrating difficulty with pencil, card, thermometer, button, and candle. P2 was able to complete automatic naming tasks (e.g. Hãy dẽm từ 1 tới 25). P2 was also able to complete reading activities when asked to read aloud words and sentences. He also demonstrated the ability to copy written words that were provided correctly, as well as write words and sentences that were dictated. When asked to write sentences in Vietnamese

Table 2.1

Quantitative data (correct responses out of total number of items) for Participant1 on part B of the Bilingual Aphasia Test (BAT).

Subtests	French	English
Pointing	9/10	10/10
Simple Commands	5/5	5/5
Semi-complex Commands	3/5	5/5
Verbal Auditory Discrimination	15/18	16/18
Syntactic Comprehension	67/87	81/87
Semantic Categories	4/5	5/5
Synonyms	1/5	5/5
Antonyms I	5/5	5/5
Antonyms II	2/5	4/5
Grammaticality Judgment	7/10	9/10
Semantic Acceptability	3/10	10/10
Repetition	30/30	30/30
Judgment	27/30	28/30
Sentence Repetition	2/7	7/7
Series	0/3	3/3
Naming	5/20	20/20
Semantic Opposites	5/10	10/10
Derivational Morphology	3/10	10/10
Morphological Opposites	4/10	10/10

Mental Arithmetic	5/15	14/15
Listening Comprehension	5/5	3/5
Reading (words)	3/10	4/10
Reading (sentences)	5/10	10/10
Reading (text)	5/6	5/6
Copying	5/5	5/5
Dictation (words)	4/5	4/5
Dictation (sentences)	5/5	4/5
Reading Comprehension (words)	9/10	10/10
Reading Comprehension (sentences)	9/10	10/10

Table 2.2

Quantitative data (correct responses out of total number of items) for Participant1 on part C of the English-French Bilingual Aphasia Test (BAT).

Subtest Name	Score
Word Recognition (French)	5/5
Word Recognition (English)	5/5
Word Translation (French)	8/10
Word Translation (English)	4/10
Translation of Sentences (French)	4/12
Translation of Sentences (English)	0/12
Grammaticality Judgment (French)	4/16
Grammaticality Judgment (English)	11/16

that were dictated, he was able to produce one perfectly, produce five words in the first sentence, four words in the second, and six words in the fifth and sixth sentences. When asked to provide a writing sample, P2 was able to write well with good handwriting skills, although his use of accents was incorrect.

P2 performed with 60 percent accuracy on both the grammatical judgment portion in which he was asked to determine if a sentence was grammatically correct (e.g. "Chiẽc xe hà kéo xe du lịch."); as well as the semantic acceptability subtest where each sentence provided was grammatically correct but might be semantically incorrect (e.g. "Mặt trới chiẻu ban dêm."). He displayed difficulty in the Semantic Categories section in which he was asked to determine which word, out of a series of four provided, did not fit with the group of words (e.g. vạn thọ, hỏng, ẽch, cúc).

P2 demonstrated difficulty in reading and listening comprehension tasks, and was unable to provide a verbal description of a cartoon strip. He displayed difficulty with generative naming tasks and was unable to name more than one word beginning with /x/, repeating the same word three times. P2 was also unable to complete the sentence completion subtest in which words were provided and a sentence was to be constructed. He was unable to remember the target words to construct the sentences. P2 also demonstrated difficulty in providing synonyms and antonyms when provided with the target word and four choices.

P2 was unable to indicate pictures which represented sentences in the Syntactic Comprehension portion of the assessment. This subtest was terminated after nine errors were noted. P2 was unable to change words to adjectives (e.g. "Rõ, Một cách rõ rang."), provide morphological opposites (e.g. "Dẽ thãy, Kho thãy."), or produce semantic opposites (e.g. thặt, gia') in each subsequent subtest. He also demonstrated difficulty with verbal auditory discrimination in which he was to indicate a picture that represented words that were provided auditorily by the administrator.

English BAT Results- Part B: P2 was able to complete the English portion of Part B of the BAT in one day. His spontaneous speech sample results indicated very little to no amount of speech, poor fluency, pronunciation, grammar, and vocabulary. P2 was able to name some objects (i.e., key, tie, spoon), but reached ceiling after three consecutive incorrect responses. P2 was able to copy all of the single words in the copying section, but was unable to write words that were dictated to him by the administrator (e.g. fat, glue, stick).

P2 was unable to complete the following subsections in which he reached ceiling on the first three consecutive questions: pointing, simple commands, semi-complex commands, complex commands (which had been altered as he could not manipulate several of the objects), Verbal Auditory Discrimination, Syntactic Comprehension, Semantic Categories, Synonyms, Antonyms, Grammaticality Judgment, Semantic Acceptability, Repetition of Words and Nonsense Words, Lexical Decision, Series, Verbal Fluency, Naming, Sentence Construction, Semantic Opposites, Derivational Morphology, Morphological Opposites, Description, Mental Arithmetic, Listening Comprehension, Reading, Dictation, Reading Comprehension for Words, Reading Comprehension for Sentences, and a Spontaneous Writing Sample.

English/Vietnamese BAT Results- Part C: P2 was unable to complete any of Part C of the BAT. Quantitative data related to part C is presented in Table 2.4. Although P2 was unable to complete any of the tasks of Part C of the BAT, his family reported that he was able to communicate functionally with those speaking English.

Overall, P2's native language of Vietnamese is relatively intact in comparison to that of his English language skills. Upon completion of Part B of the BAT it was determined that there was a discrepancy between language scores in which P2 performed more accurately on the several Vietnamese sections. The sections include: pointing, simple commands, semi-complex commands, verbal auditory discrimination, syntactic comprehension, grammaticality judgment, repetition of words and nonwords, repetition of sentences, series, naming, mental arithmetic, listening comprehension, reading words and sentences, dictation, and reading comprehension for words and sentences. Results also indicated that there was little to no discrepancy between other language skills of P2. The sections in which there was little to no discrepancy were: description, semantic opposites, derivational morphology, morphological opposites, judgment of words versus nonwords, and copying words. P2 was unable to complete any of Part C of the BAT which is also indicative of the substantial discrepancy between Vietnamese language abilities and English language abilities.

Based on the BAT results that were gathered, it can be concluded that P2 has severe aphasia in his English and Vietnamese languages, although his Vietnamese is more intact. P2 is highly non fluent in both languages. P2 is unable to produce more than 4 to 5 words at a time. P2 also has difficulty with comprehension, but more so in his English language as compared to his Vietnamese. P2's naming abilities are severely limited in English but more intact in his native Vietnamese. P2 generally uses more nouns and verbs in his speech in both languages. P2 is able to copy words in English, and write in Vietnamese, but he does not use writing skills in order to augment communication in any way. P2 demonstrates difficulty with morphology and semantics in both languages, although the deficit is less pronounced in his Vietnamese language.

Participant 3 (P3):

P3 is a 92-year old male who was hospitalized in 2010 with an acute massive stroke. He had experienced a right internal carotid artery occlusion and a right middle cerebral artery (MCA) stroke. After the stroke occurred he had severe left sided paralysis along with left-side facial droop. Since his stroke in 2010, P3 has needed total care to complete ADLs with the exception of eating, which he can do independently. P3 has experienced severe apraxia of speech (AOS) since his stroke and caregivers report difficulty in understanding his speech, although he enjoys communicating with others. He is able to write down his needs so that caregivers can determine his needs. He also employs the use of hearing aids bilaterally, but still needs people to speak loudly so that he can hear adequately.

BAT Results-Part A: P3 is a native of the Netherlands and lived there until he was 34 years old, at which time he moved to the United States. At that time he also began to learn to read and write in English as well and became proficient at speaking, reading, and writing. Prior to his stroke, P3 spoke, wrote, and read English daily. P3 reported that he spoke English with friends and co-workers premorbidly.

Dutch BAT Results- Part B: Quantitative data related to the Dutch version of part B are presented in Table 2.5. P3 was able to complete the Dutch portion of Part B of the BAT in two sessions, and breaks were needed to avoid frustration. P3 demonstrated a high level of auditory comprehension; he was able to complete the pointing, simple and semi-complex commands without difficulty or error, and only exhibited one error in the complex commands subtest when asked to manipulate three books that were provided. P3 was also able to complete the verbal auditory discrimination subtest with limited difficulty, but did have trouble with the portion of the Syntactic Comprehension subtest in which only two pictures were presented (e.g. De hond wordt niet door de kat gbeten). P3 did not demonstrate any difficulty with semantic categories or synonyms, but did have trouble with some antonyms (e.g. Lelijk, Droevig, Laf). It should be noted that on several of the subtests in which verbal output was necessary, P3 would indicate his answer with gestures, such as pointing, or holding up fingers for numbers.

P1 was administered the English-Dutch version of the BAT to determine the extent of the aphasia in English and Dutch.

P3 also performed well on the grammaticality judgment and semantic acceptability subtests. He demonstrated difficulty with more complex sentences when assessing grammatical judgment, such as “De hond niet wordt gebeten door de kat.” P3 was able to repeat both real words and nonsense words, with some articulatory error due to AOS, and was able to determine if the word was a real word. P3 exhibited difficulty with four of the nonsense words: Kla, Stor, Goop, and Preen. P3 was able to name 16 out of 20 objects in Dutch in the naming section, but was unable to name *das* (*tie)*, *kaart (card)*, *thermometer*, and *veer* (*feather)*. P3 was able to answer 7 out of 10 of the semantic opposite’s stimuli Although P2 was unable to complete any of the tasks of Part C of the BAT, his family reported that he was able to communicate functionally with those speaking English. in Dutch, having trouble with *arm* (*poor)*, *breed* (*wide)*, and *dik* (*thick)*.

P3 demonstrated difficulty with portions of the test in which copious amounts of verbal output was required. He was unable to produce more than a few sentences in the spontaneous speech portion, displaying less than normal amounts of speech, fair fluency, fair pronunciation, good grammar, and fair vocabulary. When completing the description of the cartoon strip, P3 was able to produce very little speech, did not get to the end of the strip, and did not tell a connected story or describe more than one of the pictures. P3 was unable to complete four of the sentence construction portions as he was unable to remember the words he was provided (e.g. bureau, openen, lade). P3 also had difficulty in completing the derivation morphology (e.g. kracht, krachtig) and morphological opposites subtests (e.g. alfabeet, analfabeet). P3 was able to answer the

Table 2.3

Quantitative data (correct responses out of total number of items) for Participant 2 on part B of the Bilingual Aphasia Test (BAT).

Subtest	Vietnamese	English
Pointing	9/10	0/3
Simple Commands	10/10	0/3
Semi-complex Commands	5/5	0/3
Verbal Auditory Discrimination	11/18	0/3
Syntactic Comprehension	14/22	1/4
Semantic Categories	2/5	0/3
Synonyms	2/5	0/3
Antonyms I	2/5	0/3
Antonyms II	5/5	0/3
Grammaticality Judgment	6/10	0/3
Semantic Acceptability	6/10	0/3
Repetition	1/11	0/3
Judgment	0/11	0/3
Sentence Repetition	6/7	0/3
Series	2/3	0/3
Naming	15/20	3/10
Semantic Opposites	0/3	0/3
Derivational Morphology	0/3	0/3
Morphological Opposites	0/3	0/3

Description	0/3	0/3
Mental Arithmetic	6/10	0/3
Listening Comprehension	3/5	0/3
Reading (words)	10/10	0/3
Reading (sentences)	10/10	0/3
Reading (text)	3/6	0/3
Copying	5/5	5/5
Dictation (words)	5/5	0/3
Reading Comprehension (words)	6/10	0/3
Reading Comprehension (sentences)	7/10	0/3

Table 2.4

Quantitative data (correct responses out of total number of items) for Participant 2 on part C of the English-Vietnamese Bilingual Aphasia Test (BAT).

Subtest Name	Score
Word Recognition (Vietnamese)	0/5
Word Recognition (English)	0/5
Word Translation (Vietnamese)	0/10
Word Translation (English)	0/10
Translation of Sentences (Vietnamese)	0/12
Translation of Sentences (English)	0/12
Grammaticality Judgment (Vietnamese)	0/16
Grammaticality Judgment (English)	0/16

question presented in the listening comprehension subtest adequately, and was able to read all words and each of the sentences presented in the reading section. However, when reading sentences he made multiple attempts that were laborious and had several articulation errors. P3 was unable to complete the series task.

P3 was able to copy words in Dutch; however, actually moving the hand to write was difficult. He was also able to write words that were dictated, but needed multiple repetitions from the test administrator. P3 had difficulty in writing sentences, even when multiple repetitions were provided. He was able to write some of the words from each sentence (e.g. Hij duwt, De wordt door hond, Het is zijn de). P3 was able to complete the reading comprehension for words subtest with 3 errors out of 10 (e.g. luis, mus, roer). Reading comprehension for sentences was more difficult with 6 correct out of 10 (e.g. Hij wast zich, Het is de vrachtwagen die de auto aanrijdt, Hij houdt haar vast, Het meisje wordy door de jongen geduwd). P3 was unable to provide a succinct spontaneous writing sample. He was able to write several words, but did not write complete sentence with intact grammar or punctuation.

English BAT Results- Part B: Quantitative data related to the English version of part B are presented in Table 2.5. P3 was able to complete the English portion of Part B of the BAT in one session. Some frustration was noted, a break was given, and P3 was able to continue with less frustration. A spontaneous speech sample was taken, and P3 exhibited very little speech, poor fluency, pronunciation, and grammar, and fair vocabulary. He was able to complete the pointing subtest with only one error and was able to complete all simple commands, but exhibited some difficulty with semi-complex commands with three out of five errors.

P3 exhibited difficulty with the complex commands, completing three commands with a score of one, indicating that one subcommand was followed, and two subcommands yielded no response. P3 performed well on the verbal auditory discrimination portion in which he was asked to indicate a picture which represented a word provided by the examiner. He correctly answered 14 questions, self-correcting on one, and demonstrated four errors in identification.

P3 demonstrated frustration throughout the Syntactic Comprehension subtest, as well as difficulty in comprehending the task; after completion of questions 81 through 88, the next subtest was continued to avoid further frustration. P3 performed well on the Semantic Acceptability subtest, correctly identifying sentences as correct or incorrect with 80% accuracy. Although P3 was unable to repeat the words and nonsense words in the Repetition section, he did demonstrate good lexical decision skills with 23 correct out of 30 opportunities. P3 also performed well when asked to name objects that were presented with 15 correct out of 19 trials.

P3 was able to read aloud words written on paper correctly but was unable to read more than three words when asked to read sentences. During the copy and dictation section, P3 attempted to write words and sentences, which indicates that he understood the task, but was unable to write the correct word. When performing the Reading Comprehension for Words subtest, P3 demonstrated 7 correct out of 10 when asked to identify a picture which represented the word; his performance was 4 correct out of 10 items on the Reading Comprehension for Sentences subtest. P3 attempted to complete the Description subtest when asked to describe a cartoon strip; but only produced less than normal amounts of speech, did not go the end of the cartoon strip, and did not describe the pictures or tell a connected story.

There were several sections in which P3 was unable to complete the task; in the first, three items were given, and after three consecutively incorrect responses were obtained, the next subtest was presented. The sections that P3 was unable to complete were: Synonyms, Antonyms, Repetition of Sentences, Series, Verbal Fluency, Sentence Construction, Semantic Opposites, Derivational Morphology, Morphological Opposites, Mental Arithmetic, Listening Comprehension, Dictation of Sentences, and Spontaneous Writing Sample.

English/Dutch BAT Results- Part C: Quantitative data related to the English-Dutch version of part C are presented in Table 2.6. P3 was able to complete several subtests in Part C of the BAT, although translating sentences from Dutch to English, and vice versa, was not possible. P3 was able to indicate words in Dutch when provided the English word without error, and the same was result was obtained in translating from English to Dutch. When asked to complete the grammaticality judgments section, P3 was able to indicate if a sentence was correct grammatically, but was unable to provide the corrected sentence.

Overall, P3's language scores were similar in several sections of Part B of the BAT, including; pointing, simple commands, semi-complex commands, verbal auditory discrimination, semantic acceptability, judgment of real words versus nonwords, series, naming, reading at word level, dictation of sentences, and reading comprehension for both words and sentences. P3's native language of Dutch is slightly more intact in several areas in which his English was not. The areas in which there was a discrepancy of his language scores wherein his score was higher in Dutch were the following: syntactic comprehension, semantic categories, synonyms, antonyms, grammaticality judgment, repetition of words, sentence repetition, morphological opposites, derivational morphology, listening comprehension, copying, and dictation of words. On Part C of the BAT assessment, P3 demonstrated language scores that were equivalent in both English and Dutch.

Based on the results gathered from the BAT, it can be concluded that P3 has a high level of comprehension in both English and Dutch. As part of his intact comprehension of language, P3 is able to follow directions. He demonstrates some difficulty in the areas of naming objects and does not have fluent speech. His speech output is fairly telegraphic in both Dutch and English and his speech has errors due to his Apraxia of Speech. Although he does not have fluent speech, P3 will use gestures to augment his communication; P3 is able to write words and some sentences also to help augment communication. He demonstrates difficulty with morphology and semantics in both languages, although morphology and semantics are both more intact in his Dutch language.

Experimental Task

The experimental tasks included two picture-word verification tasks incorporating the use of each language individually and both languages together. These tasks were designed and run on E-prime1.1. [computer software] (Psychology Software Tools, Inc.; 2002). The fundamental design of the two paradigms was identical, but the stimuli utilized and the presentation sequence of each of the four conditions was different. In each condition, a black and white line drawing was presented in the center of a 15 inch, computer monitor measured diagonally with a width of 12 inches and height of 9 inches. Directly below the picture, centered, was the written stimulus that either named the picture shown or did not. In the event that two written words were provided, they were presented one directly above the other, but both still below the picture (see Figure 2.1).

The four conditions presented included the following: language 1 only (Condition 1; C1); language 2 only (Condition 2; C2); language 1 presented spatially above language 2 (Condition 3; C3); language 2 presented spatially above language 1 (Condition 4; C4). In both paradigms, the four conditions were presented 30 times each, half as a picture-word match and half as a non-match. Therefore, each paradigm consisted of 120 stimulus presentations. This resulted in a total of 240 stimulus presentations, 60 of each condition. Each picture was shown for up to four seconds for P1 and P3; indication of response led to the removal of that stimulus item and the start of the next stimulus trial. For P2, each stimulus trial was shown for up to 10 seconds due to the bilateral limb weakness. This allowed him additional time to press response buttons. As with paradigms for P1 and P3, after P2 indicated his response, the stimulus was removed from the screen, leading into the next stimulus trial. Each stimulus trial was separated by two seconds of waiting during which no visual stimulus was shown. This allowed participants to return their hands to the neutral position on the table before the next stimulus item was shown.

The picture-word verification task required the participant to indicate if the word(s) shown below the picture accurately named the picture shown. Participants were asked to respond to the task by depressing one of two buttons with the preferred hand. Response buttons were secured to the table in front of the participant towards the hemi-space of the preferred hand. The button on the right indicated a picture-word non-match, whereas the button on the left indicated a match. A resting pad to return the hand to a neutral position between stimulus trials was provided. Trials included the presentation of one of 60 different black-and-white images of high and low frequency of occurence, concrete nouns presented simultaneously with a written stimulus presentation. Thirty unique pictures were presented four times each in both experimental paradigms. Only the first response given by the participant was recorded. Response time (RT) and proportion correct (PC) data were collected for each response.

Stimuli

Picture stimuli were randomly selected using the word frequency list developed by Snodgrass and Vanderwort (Snodgrass & Vanderwart, 1980). To exclude items potentially unfamiliar to the participants due to cultural, geographic, or language variations, translators were asked to review the selected items and confirm that it was indeed a word the participant would likely know in the other language. If a word was determined to be questionable, it was removed and replaced with another word from the Snodgrass and Vanderwort list. After excluding items

Table 2.5

Quantitative data (correct responses out of total number of items) for Participant 3 on part B of the Bilingual Aphasia Test (BAT).

Subtest	Dutch	English
Pointing	10/10	9/10
Simple Commands	5/5	5/5
Semi-complex Commands	2/5	2/5
Verbal Auditory Discrimination	16/18	14/18
Syntactic Comprehension	30/40	9/22
Semantic Categories	5/5	0/3
Synonyms	5/5	0/3
Antonyms I	5/5	0/3
Antonyms II	2/5	0/3
Grammaticality Judgment	7/10	5/8
Semantic Acceptability	8/10	8/10
Repetition	30/30	0/30
Judgment	26/30	23/30
Sentence Repetition	3/7	0/3
Series	0/3	0/3
Naming	16/20	16/20
Semantic Opposites	7/10	0/3
Derivational Morphology	4/10	0/3
Morphological Opposites	5/10	0/3

Mental Arithmetic	5/15	0/3
Listening Comprehension	5/5	0/3
Reading (words)	10/10	8/10
Reading (sentences)	10/10	0/3
Reading (text)	6/6	0/3
Copying	5/5	0/3
Dictation (words)	5/5	0/3
Dictation (sentences)	0/3	0/3
Reading Comprehension (words)	7/10	7/10
Reading Comprehension (sentences)	6/10	4/10

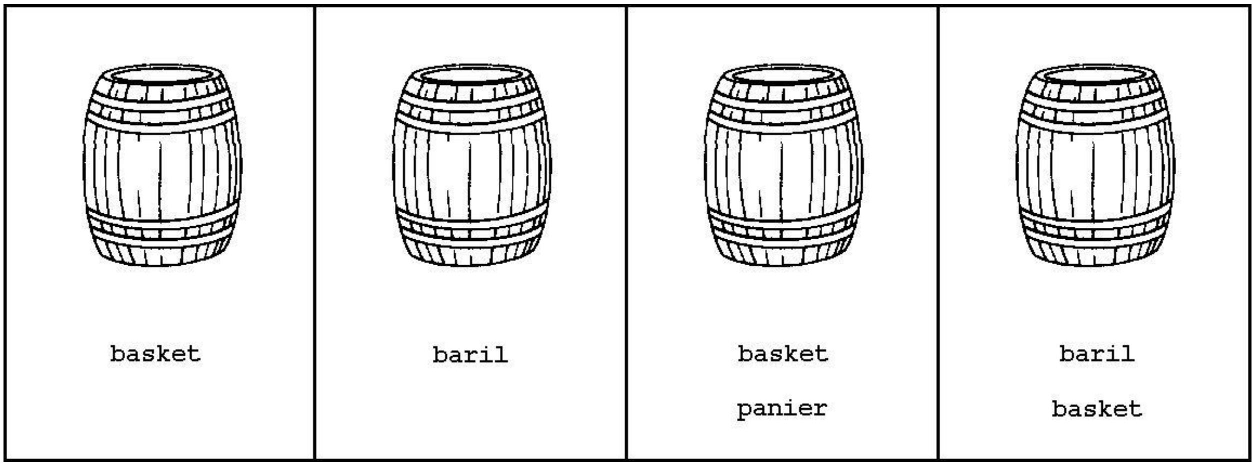
Table 2.6

Quantitative data (correct responses out of total number of items) for Participant 3 on part C of the English-Dutch Bilingual Aphasia Test (BAT).

Subtest Name	Number of Items
Word Recognition (Dutch)	5/5
Word Recognition (English)	5/5
Word Translation (Dutch)	10/10
Word Translation (English)	10/10
Translation of Sentences (Dutch)	0/3
Translation of Sentences (English)	0/3
Grammaticality Judgment (Dutch)	8/16
Grammaticality Judgment (English)	8/16

Figure 2.1

Example of a stimulus item for each condition.



potentially unfamiliar to a speaker of French, Dutch, or Vietnamese, 120 words were randomly assigned to one of the two experimental paradigms. Because some items were appropriate targets for one language but perhaps not the other two, not all stimuli used across paradigms were the same. The stimuli used in paradigms 1 and 2 are listed in Table 2.7.

Pictures were presented as black-and-white line drawings similar to the pictures selected by Snodgrass and Vanderwart (1980) to ensure clarity of the desired picture name. Further, five undergraduate and graduate students in the Department of Communication Sciences and Disorders at Western Carolina University accurately named all 120 items when presented with the picture stimulus. Directly beneath each picture, centered on the screen, was the written stimulus presented in Courier New 18 pt bold. The written stimulus was presented in English or the other language spoken by the participant. These words were verified to be accurate translations of their English counterparts by the translators used in this research. As was previously discussed, the written stimulus named the picture shown 50% of the time. When providing nonmatch names for the picture, efforts were made to present a semantically-related word from the Snodgrass and Vanderwort list (1980).

Data Analyses

Analyses were conducted on behavioral data by calculating the mean proportion correct (PC) and mean response time from stimulus onset (RT) within each of the four experimental conditions for each participant. Data from experimental paradigms were combined, and then analyzed as a single, larger data set for each individual participant. For all statistical analyses, non-responses were removed from PC and RT data, and outliers were retained for purposes of this exploratory study since non-parametric statistics were conducted. Preliminary analysis of the

Table 2.7

Stimuli items of Paradigm 1 & 2, Match and Nonmatch (shown in parenthesis)

Paradigm 1
Airplane (Bicycle), Barrel (Basket), Bottle (Kettle), Button (Spool), Cake (Bread), Cap (Pants), Celery (Asparagus), Chain (Lock), Couch (Rocking chair), Duck (Peacock), Flag (Arrow), Glove (Finger), Helicopter (Motorcycle), Knife (Needle), Moon (Star), Mouse (Ant), Necklace (Ring), Pineapple (Lemon), Rabbit (Fox), Scissors (Axe), Sheep (Goat), Sock (Boot), Tie (Belt), Truck (Bus), Umbrella (Pocket book), Vest (Blouse), Watermelon (Peach), Dog (Raccoon[F], Cow [VD]), Ladder (Wrench[F], Saw[VD]), Recordplayer[F] (Television), Violin[VD] (Television).
Paradigm 2
Balloon (Sun), Book (Desk), Beetle (Butterfly), Bowl (Pitcher), Box (Suitcase), Carrot (Artichoke), Chicken (Eagle), Crown (Hat), Eye (Nose), Fence (Windmill), Fork (Spoon), Frog (Fly), Jacket (Sweater), Monkey (Giraffe), Paintbrush (Pen), Pepper (Corn), Screw (Nail), Seal (Fish), Stove (Frying Pan), Strawberry (Banana), Swing (Ball), Tomato (Lettuce), Trumpet (Flute), Watch (Clock), Wheel (Anchor), Wineglass (Cup), Garbagecan (Ashtray[FD], Vase[V]), Glass (Light bulb[FD], Pot[V]), Mitten (Hand [FV], Shoe[D]), Ostrich (Zebra[FV], Elephant[D]).

Note. Superscripts F-French, V-Vietnamese, D-Dutch indicate word was changed based on language/culture.

distributions PC and RT data per condition indicated non-normality as skewness and kurtosis statistics were beyond plus or minus 2 for P1 and P3 (Tables 2.8 and 2.9). Therefore, nonparametric statistics were used to identify significant associations in PC and significant differences in RT across conditions for each participant individually. Specifically, for PC data, chi-square analyses were conducted to identify correlations between the number of accurate responses given in each condition across the four conditions. For RT data, the Kruskal-Wallis tests on rank scores (Kruskal & Wallis, 1952) were conducted for all three participants. Mann-Whitney U tests were conducted on all possible RT contrasts when applicable. The following post-hoc pairwise comparisons were made separately: C1 vs. C2; C1 vs. C3, C1 vs. C4; C2 vs. C3; C2 vs. C4; and C3 vs. C4. All statistic tests were based on a significance level of $\alpha = .05$. Since this experiment was exploratory adjustments to alpha (e.g. Bonferroni corrections) were not made.

Procedures

Each participant was provided with a consent form approved by the Institutional Review Board of Western Carolina University. The consent form was read aloud to each participant and caregivers, questions were answered, and informed consent was obtained from each participant prior to any involvement in the study. Each participant was asked to attend a single session lasting three hours in which the BAT and the two experimental paradigms were administered. Breaks were given to the participants when needed. Unfortunately, all participants required a second day to finish all tasks due to fatigue. This additional day of testing was completed within one week of the first testing session. The study was conducted at one of three locations; Western Carolina University Speech and Hearing Center, the Center for Healthy Aging of the Mountain Area Health Education Center, or the participant’s place of residence. Assessments and experimental tasks were administered in a private, quiet, comfortable, and well-lit location.

Table 2.8

Descriptive statistics of proportion correct (PC) per condition for each participant.

Participant 1				
	Condition 1 (*n* = 60)	Condition 2 (*n* = 59)	Condition 3 (*n* = 60)	Condition 4 (*n* =59)
Accurate Count	.55	.50	.53	.56
Accuracy % within Conditions	91.7%	84.7%	88.3%	94.9%
Participant 2				
	Condition 1 (*n* = 19)	Condition 2 (*n* = 26)	Condition 3 (*n* = 22)	Condition 4 (*n* = 20)
Accurate Count	.9	.16	.12	.12
Accuracy % within Conditions	47.4%	61.5%	54.5%	60.0%
Participant 3				
	Condition 1 (*n* = 57)	Condition 2 (*n* = 58)	Condition 3 (*n* = 60)	Condition 4 (*n* = 54)

Accurate Count	.21	.26	.33	.23
Accuracy % within Conditions	. 36.8%	.44.8%	55.0%	.42.6%

Table 2.9

Descriptive statistics of response time (RT) in milliseconds per condition for each participant.

Participant 1				
	Condition 1 (*n* = 60)	Condition 2 (*n* = 59)	Condition 3 (*n* = 60)	Condition 4 (*n* = 59)
Mean	1062	1517.32	1309.73	1227.47
Median	961.50	1169	1151.50	1130
Range	1811	2534	2736	2049
SD	312.62	697.43	479.04	326.19
Skewness	2.25	.99	2.03	2.40
Kurtosis	6.87	-.14	5.56	9.09
Participant 2				
	Condition 1 (*n* =19)	Condition 2 (*n* = 26)	Condition 3 (*n* = 22)	Condition 4 (*n* = 20)
Mean	5732.11	4332.12	5194.95	4664.20
Median	6073	3844	4544	3936
Range	8306	7779	6056	6506
SD	2676.78	1901.12	2188.63	2052.48
Skewness	.044	.849	.385	.998
Kurtosis	-1.26	.53	-1.46	-.11
Participant 3				
	Condition 1 (*n* = 57)	Condition 2 (*n* = 57)	Condition 3 (*n* = 60)	Condition 4 (*n* = 54)
Mean	1433.75	1366.25	1569.05	1511.46

Median	1292	1280	1425.5	1353.5
Range	2499	1688	3267	2857
SD	504.79	352.13	580.72	559.01
Skewness	1.57	1.08	1.27	2.04
Kurtosis	2.94	1.02	2.33	4.95

Participants were given spoken and written instructions for the experimental tasks. They were also be allowed to practice the task using a two-minute trial if understanding of task requirements was uncertain. The stimuli presented in this task were not used in the other experimental tasks. The practice trial was two minutes in length, containing 12 stimulus trials; participants practiced viewing the stimuli and responding with the response buttons. All participants demonstrated understanding of the task and were able to proceed to the experimental paradigms of interest.

CHAPTER THREE: RESULTS

Participant Data:

Participant 1:

Descriptive statistics of PC per condition for Participant1 are presented in Table 2.8. During C1, the accuracy percent within conditions for PC was 91.7%. The accuracy percent within condition in C2 and C3 for PC was 84.7% and 88.3%, respectively. PC in C4 had an accuracy percent within conditions of 94.9%. **The chi-square statistical test indicated that there was no significant association between the number of accurate responses given in each of the four conditions for this participant**: ($\chi^2(3) = 3.734$, $p = .292$).

Descriptive statistics of RT per condition for Participant1 are presented in Table 2.9. During C1, the mean rank RT was 81.56, with a minimum RT of 674 msec and a maximum of 2485 msec. The mean rank RT for Condition 2 was 139.58, with a minimum RT of 753 and a maximum of 3287 msec. In Condition 3, 130.51was the mean rank RT, with a minimum RT of 679 and a maximum of 3415 msec. Finally, 126.81 was the mean rank RT for Condition 4, and the minimum RT was 777 and the maximum was 2826 msec. **The Kruskal-Wallis test indicated that there was a significant difference in RT between conditions P1: (**$H(3) = 25.441$, $p < .000$). To follow up on this significant finding, the Mann-Whitney two-tailed post hoc tests were conducted, and these findings can be found in Table 3.3. The Mann-Whitney tests revealed significant differences between the following conditions: Conditions 1 and 2 ($U = 1034.500$, Z= -4.018, $p = 0.000$), Conditions 1 and 3 ($U = 1037.500$, Z= -4.002, $p = 0.000$), and Conditions 1 and 4 ($U = 1007.500$, Z= -4.053, $p = 0.000$). The following tests did not reach significance: Conditions 2 and 3($U = 1617.500$, Z= -.958, $p = 0.338$), Conditions 2 and 4($U = 1514.500$, Z= -1.358, $p = 0.174$), and finally, Conditions 3 and 4 ($U = 1691.500$, Z= -.417, $p = 0.677$).

Given these data, P1 responded most accurately to C1 when English was presented in isolation. However, there was no significant difference in the number of accurate responses in this condition compared to the others; therefore, this is best described as a trend in favor of C1. Regarding RT, P1 responded fastest to stimuli presented in C1, and this was determined to be significantly different from the other conditions. Therefore, these data suggest that P1 performed best under C1. It is also worth highlighting that P1 performed worst on C2, French only. Although his PC rates were still considerably strong at 83% accurate, there are definite trends to suggest that he had more difficulty when the English was not provided at all.

Participant 2:

Mean proportion correct and response time data are presented in Tables 3.3 and 3.4, respectively. During C1, the accuracy percent within conditions for PC was 47.4%. The accuracy percent within conditions for PC in C2 and C3 was 61.5% and 55.4%, respectively. C4 had an accuracy percent within conditions for PC of 60.0%. **The chi-square statistical test indicated that there was no significant association between the number of accurate responses given in each of the four conditions for this participant**: ($\chi^2(3) = 1.045.$, $p = .790$).

Similar analyses were completed for RT. During C1, the mean rank RT was 51.68, with a minimum RT of 1496 and a maximum of 9802 msec. The mean rank RT for C2 was 37.69, with a minimum RT of 1692.00 and a maximum of 9471 msec. In C3, 47.09 was the mean rank RT, with a minimum RT of 2548 and a maximum of 8604 msec. Finally, 41.50 was the mean rank RT for C4, and the minimum RT was 2439 and the maximum was 8945 msec. **The Kruskal-Wallis test indicated no significant difference among conditions**: ($H(3) = 3.905$, $p = .272$). This indicates that P2 responded at a comparable rate across conditions, suggesting that there was no difference in information processing between conditions.

Participant 3:

Mean proportion correct and response time data are presented in Tables 3.5 and 3.6, respectively. During Condition 1, the accuracy percent within conditions for PC was 36.8%. On average, the accuracy percent within conditions for PC in C2 and C3 was 44.8% and 55.0%, respectively. In C4 the accuracy percent withing conditions for PC was 42.6%. **The chi-square statistical test indicated that there was no significant association between the number of accurate responses given in each of the four conditions for this participant**: ($\chi^2(3) = 4.084$, $p = .252$).

During Condition 1, the mean rank RT was 107.51, with a minimum RT of 828 and a maximum of 3327 msec. The mean rank RT for Condition 2 was 103.93, with a minimum RT of 799 a maximum of 2487 msec. In Condition 3, 127.70 was the mean rank RT, with a minimum RT of 434 and a maximum of 3701 msec. Finally, 118.37 was the mean rank RT for Condition 4, and the minimum RT was 865.00 and the maximum was 3722 msec. **The Kruskal-Wallis test**

Figure 3.1

Accurate vs. Not accurate response data across conditions for P1

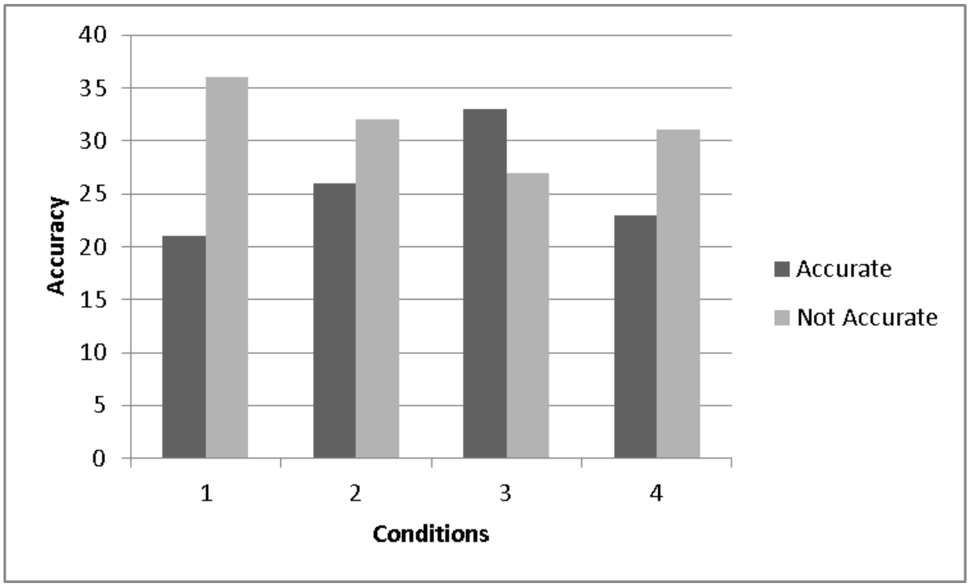


Figure 3.2

Response Time data across conditions for P1

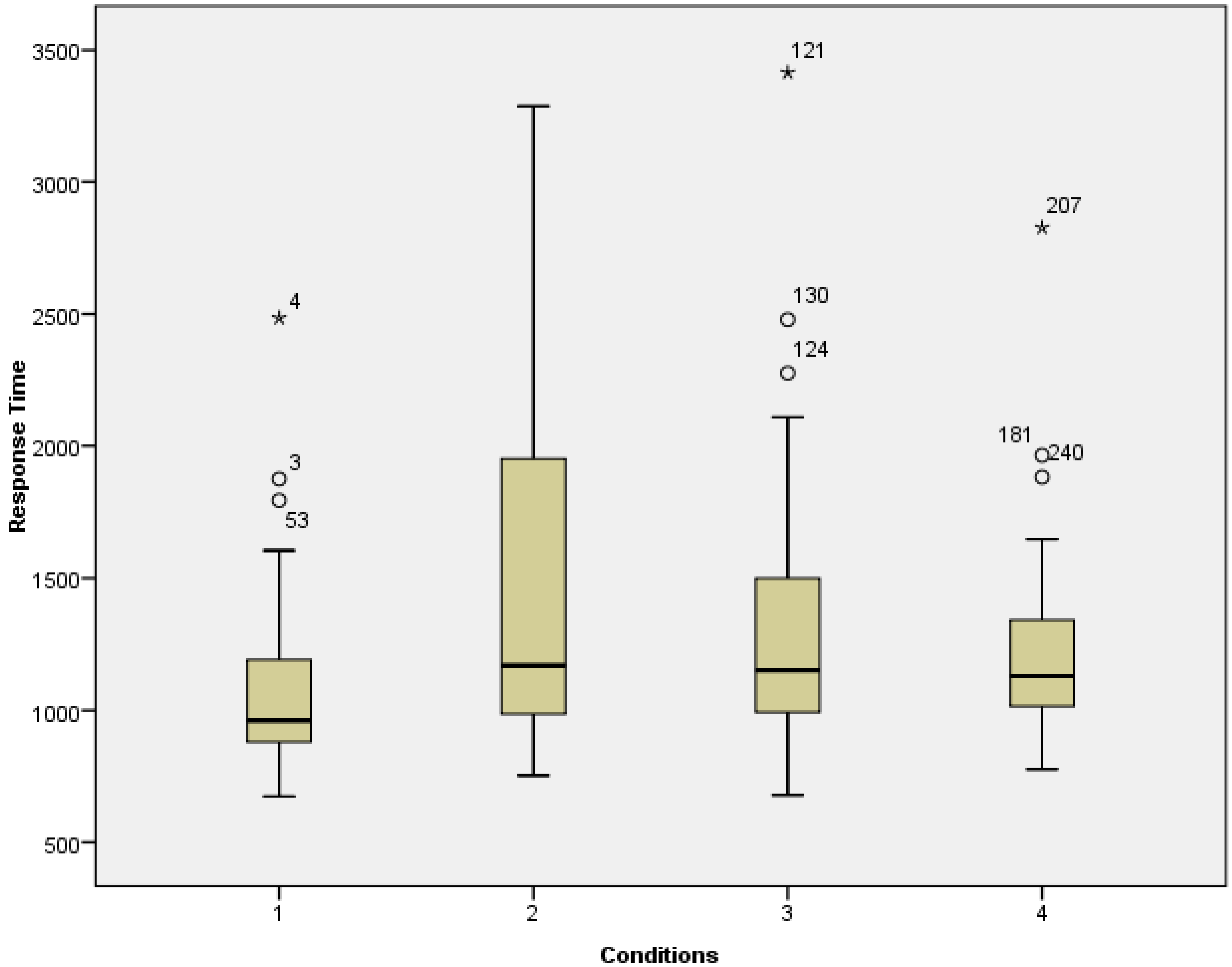


Table 3.1

Mean ranks and Kruskal-Wallis test results for RT of each condition for each participant.

Participant 1		
Ranks	*n*	Mean Rank
Condition 1	60	81.56
Condition 2	59	139.58
Condition 3	60	130.51
Condition 4	59	126.81
Kruskal-Wallis test statistic		
Chi-square	25.441	
df	3	
Significance value	$p < .000$	
Participant2		
Ranks	*n*	Mean Rank
Condition 1	19	51.68
Condition 2	26	37.69
Condition 3	22	47.09
Condition 4	20	41.50
Kruskal-Wallis test statistic		
Chi-square	3.905	
Df	3	
Significance value	$p = .272$	
Participant3		
Ranks	*n*	Mean Rank

Condition 1	57	107.51
Condition 2	57	103.93
Condition 3	60	127.70
Condition 4	55	118.37
Kruskal-Wallis test statistic		
Chi-square	4.693	
Df	3	
Significance value	p = .196	

Table 3.2

Mann-Whitney test results comparing all conditions of RT data for P1.

	Mann-Whitney test (U)	*Z*	*p*-value	Effect size (*r*)
C1 vs C2	1034.500	-4.018	.000	-.367
C1 vs C3	1034.500	-4.018	.000	-.367
C1 vs C4	1037.500	-4.002	.000	-.367
C2 vs C3	1007.50	-4.053	.000	-.370
C2 vs C4	1617.500	-.958	.338	-.088
C3 vs C4	1514.500	-1.358	.174	-.124

Figure 3.3

Accurate vs. Not Accurate response data for P2

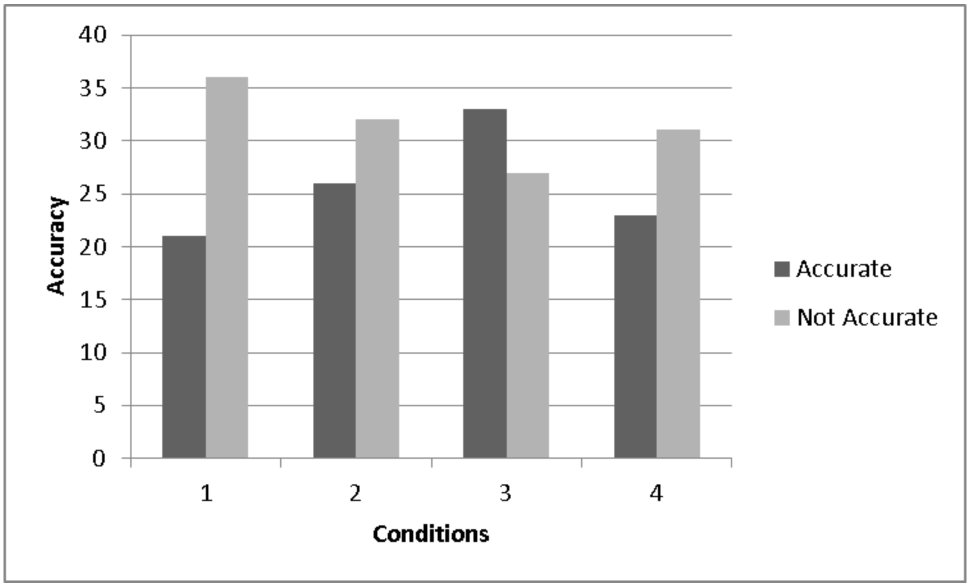
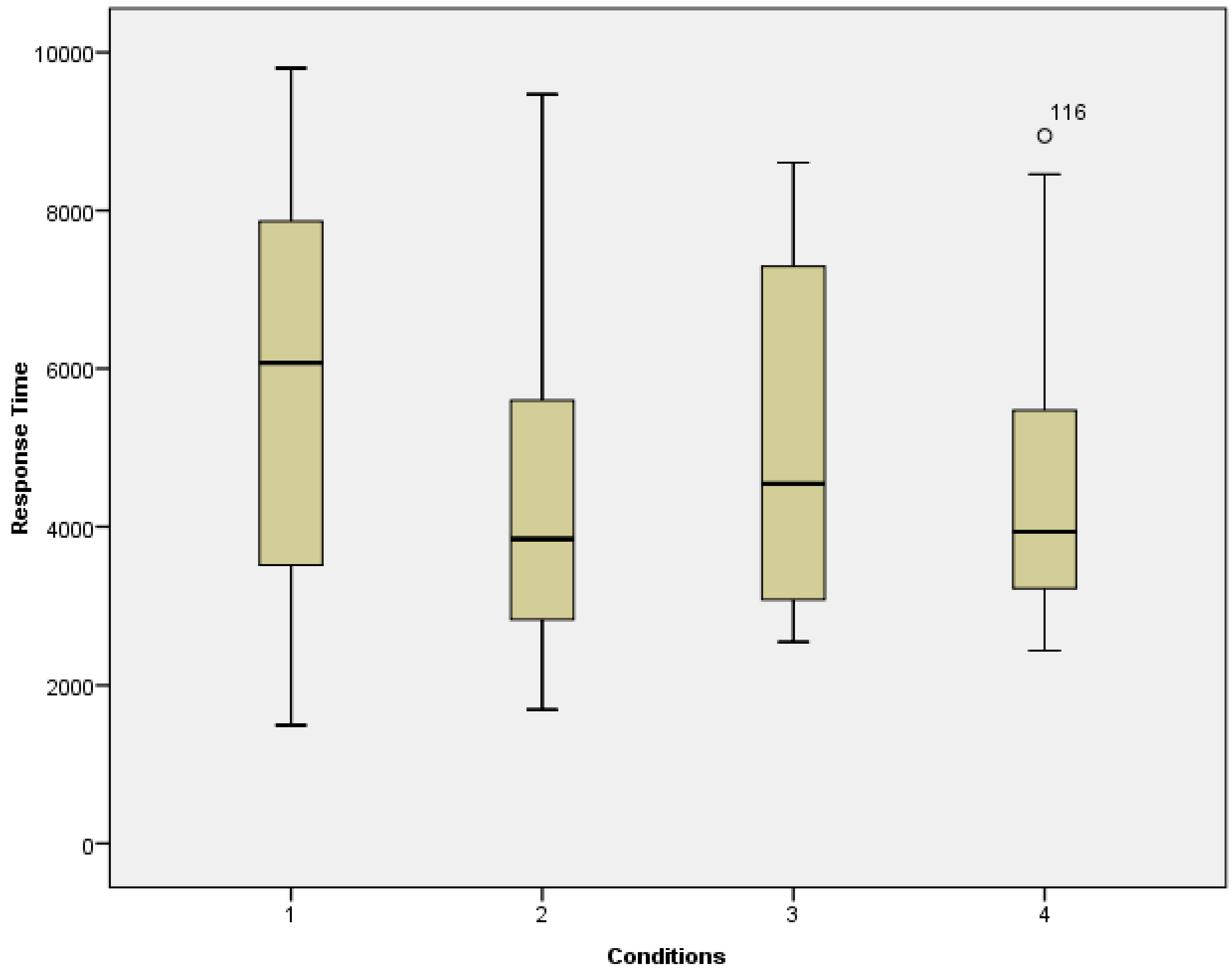


Figure 3.4

Response Time data across conditions for P2



indicated no significant difference between conditions in terms of RT for this participant: ($H(3) = 4.693$, $p = .196$). This indicates that P3 responded at a comparable rate across conditions, suggesting that there was no difference in information processing between conditions.

CHAPTER FOUR: DISCUSSION

Conclusions and Implications

Given the estimated annual growth of bilingual aphasia cases (Lorenzen & Murray, 2008), there is an immediate, increasing need for research targeting the management of this population. This is because there is reason to believe that the effective management of bilingual aphasia will in fact not mirror approaches used for monolingual cases (Lorenzen & Murray, 2008). The purpose of the present investigation was to identify differences in language processing when utilizing first and second languages individually or in combination. The task utilized here was a picture-word verification task, and it was hypothesized that providing persons with aphasia with additional information to facilitate semantic processing would be beneficial, resulting in faster and more accurate response selection. Using a single subject design, three participants with aphasia, bilingual prior to onset were recruited and administered the BAT and a computer-based picture-word verification task.

Description of Findings

Each of the three participants presented with very unique language histories and fluency levels of non-English languages. Descriptively, this appears to have had a significant influence on response accuracy and time across conditions. The differences in participants' clinical profiles appear to be correlated with their equally unique patters of performance on the computer task. Prior to his stroke, P1 had a high proficiency and early acquisition of both English and French languages;

Figure 3.5

Accurate vs. Not Accurate response data across conditions for P3

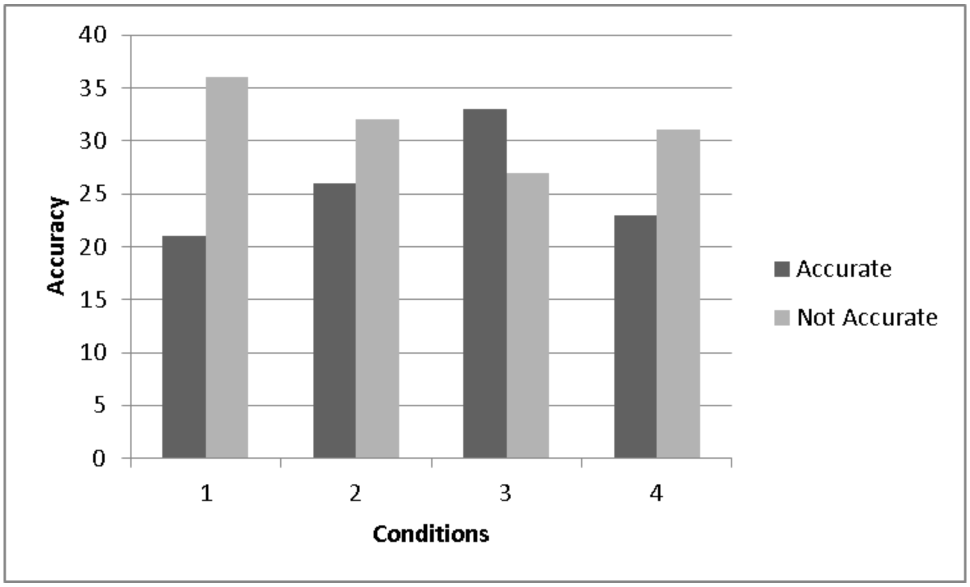
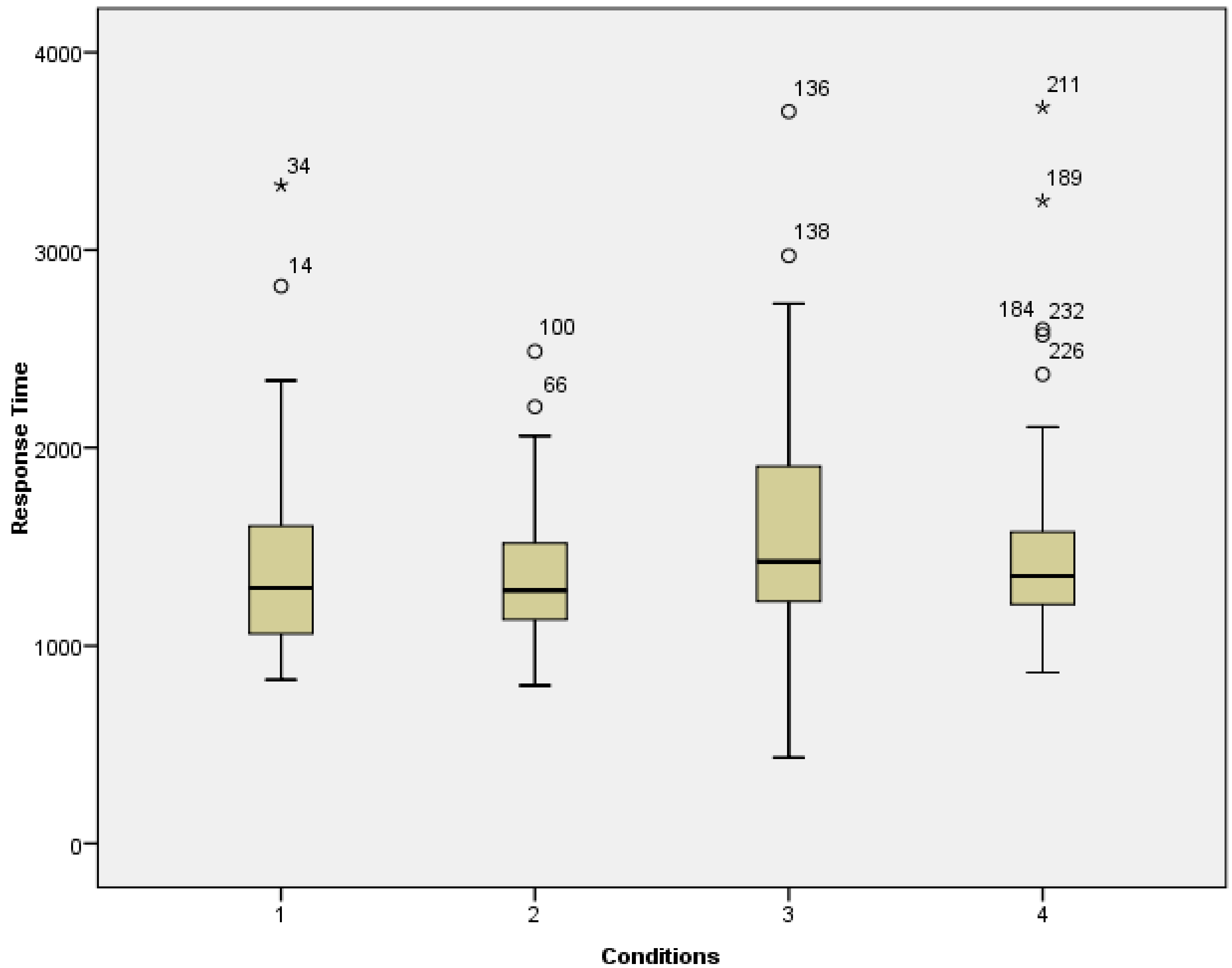


Figure 3.6

Response Time data across conditions for P3



he also used each language on a daily basis with friends and family. Due to his exceptional proficiency prior to his stroke, P1 commanded both languages with native-like control, and was able to read, write, and speak each language adeptly. P1's performance on the computer task was the most succinct; he performed at near 100% accuracy on all conditions. Further, his was the only data analysis that revealed a significant difference between conditions. Data analysis revealed a significant decrease in response time on Condition 3 compared to Condition 2, and agreater decrease on Condition 4 compared to Conditions 2 and 3. This suggests a faster processing rate, and a benefit to this participant when including French language in combination. Data analysis suggests that he processed information faster when provided with both languages, but performed slightly faster when the combination provided was both L1 followed by L2. It was discussed that P1's French may have been more fluent had he been more regularly exposed to French after his stroke and possibly received intervention in French.

P2, who demonstrated the least proficient use of his English language, later acquisition of English, and least amount of English usage on a daily basis, performed poorly on the computer task. P2 needed additional time when responding to stimuli most likely due to the motor impairment of the limbs, and he did not demonstrate any benefit when including English and Vietnamese in any combination. This is most likely because he never learned to read efficiently in English (only single words), and he was unable to write English. P2 primarily used Vietnamese when communicating with family and all caregivers and staff in his long-term care facility. He very rarely spoke English after the onset of stroke. P2 only completed one of the two paradigms, as he was unable to respond accurately to either the English or the Vietnamese conditions, despite his ability to read and write in Vietnamese prior to his stroke. Clearly, the use of written stimuli in either language was without benefit for this participant.

Prior to his stroke, P3 was able to speak, read, and write in Dutch and English with equal proficiency, and used each language on a daily basis in his adult life. P3 did not learn to speak, read, or write English until his thirties, but had been exposed to it in school from the age of five years old. He learned to speak Dutch as his native language, and upon entering school at age five, he acquired reading and writing of the Dutch language. Although his age of acquisition of each language differed, he was able to use all aspects of each language adeptly with native-like control by adulthood; and both Dutch and English were used on a daily basis. Although P3 did not perform as well as P1, his performance on the computer task was good across conditions. Unfortunately, there were no significant differences between conditions in terms of PC or RT, but it certainly did not hinder language processing for this client when both English and Dutch were presented.

Given the obvious variability among these three participants, and their varied responses to the picture-word verification task, it is important that speech-language pathologists working with bilingual persons with aphasia take into consideration the strengths and needs of each language. Although a daunting task, this would likely result in the greatest therapeutic gains as illustrated by Ansaldo and Saidi in 2010, and may also reveal residual language abilities that can be maximized for functional communication. To illustrate, it was reported by family of P1 that his performance on the French version of the BAT revealed language processing patterns consistent with his language processing in English immediately following the stroke. The discrepancies between French and English language assessments are likely due to four-years of aphasia therapy in English. In the event that P1 had also received aphasia treatment in French, he may have regained language skills in French as well as in English. This achieves the goal of improved language processing, but also taps into a secondary yet equally important goal of improved quality of life (assuming that use of the French language was of personal importance). Neither P2 nor P3 have received language treatment for aphasia as the paramount disorder for these participants was dysphagia.

Apart from the trends supporting that language history and use influenced performance on the picture-word verification task, there are other factors to be considered. Specifically, the task demands of conditions 1 and 2 are different from those of conditions 3 and 4. Conditions 1 and 2 displayed a single word, which theoretically should require less processing time compared to two words, as was the case in conditions 3 and 4. Regarding proportion correct, it was determined that both P1 and P3 demonstrated the highest proportion correct when both languages were presented; however, no differences were observed between conditions 3 and 4 for either of these participants. That is, it did not matter for these individuals if English was presented above or below the second language. Accuracy was improved simply by providing the additional language content. Interestingly, the addition of a second word in conditions 3 and 4 decreased the time to respond for P1 and P3. Evidently, the addition of the second word did not slow processing for these participants to a significant extent, making the use of both languages in a therapeutic or functional communication setting increasingly appropriate.

Despite the small sample size and range of bilingualism in these subjects, the findings just described have a significant impact on the management of bilingual aphasia. Specifically, these findings suggest that whenever possible, patients identified as bilingual should be administered an assessment in all languages spoken. Research suggests that there are potentially separate cortical processing regions within the brain for each language that an individual speaks (Kim, Relkin, Min Lee, & Hirsch, 1997; Lucas, 2004). Research also suggests that lesions in bilingual or multilingual individuals can be isolated to one area of the brain and therefore only one language and not the other language (Lorenzen & Murray, 2008). When the occurrence of lesions is isolated to one area of the brain and by extent to one language, the subsequent languages may be strong and can be used to facilitate communication. Comprehensive bilingual assessment would reveal a more accurate aphasia profile of clients, thus leading to the selection of the best management approaches. Unfortunately, this may be a practical challenge, especially in rural communities as it is difficult to find translators/interpreters who can assist in the assessment process, follow guidelines of standardized testing, and communicate with persons with neurogenic communication disorders. Making matters even more complicated will be finding translators/interpreters who are licensed by a certification committee to provide translation/interpretation services and are proficient in a particular language. Consequently, it is recommended that the availability and ease of use of bilingual assessments be improved for more practical application in the clinical setting.

Although the present investigation provides support for continued efforts on the topic of bilingual aphasia management, it most specifically speaks to the design theory of AAC devices. In many cases, AAC devices, from high-tech to no-tech, are designed to meet the needs of the individual client. Therefore the integrity and presence of multiple languages must be considered for these devices to be most appropriate to the individual. As these data suggest, providing written stimuli in multiple languages is beneficial to the client in terms of the processing accuracy of visual stimuli. This may facilitate stimulus selection in general and facilitate accuracy of stimulus selection. If it is determined that a client will perform better with multiple languages, then speech-language pathologists should be making an effort to provide access to multilingual therapy. If functional communication is the ultimate goal, these data suggest the need for incorporating both languages in an AAC device.

Another topic related to revising management of bilingual aphasia relates to incorporating both languages directly during therapy. There is evidence to suggest that treatment of one language in a bilingual person with aphasia may show improvement in an untreated second language (Faroqi-Shah et al., 2010; Marangolo et al., 2009). Present anecdotal evidence would support this. After participating in this research, P1 stated that he was “thinking more in French,” and that he had experienced an “explosion of French.” Because it is not realistic that all speech-language pathologists could become proficient enough in even three or four of the most frequently encountered languages, there is a need for creative planning and continued research to explore viable, reasonable options for providing bilingual aphasia treatment. For example, simply encouraging clients to use the other language may be beneficial to them. Reading and writing in the non-English language could be beneficial in language recovery, even if the speech-language pathologist is not fluent in that language. Completing naming tasks in the second language may also prove beneficial and relatively easy to implement in sessions with the utilization of web searches.

As part of a goal towards improved quality of life, speech-language pathologists or related professions such as social work and recreation therapy could develop a database of volunteers in the community (e.g. religious centers, volunteer groups, universities/colleges) who speak the second language of the client; regular interaction would provide the client with an opportunity not only to practice the other language, but to enjoy also the time spent with other persons. Although research would be needed to draw evidence-based conclusions, these are just a few ideas that may facilitate language recovery in multiple languages and quality of life in bilingual persons with aphasia. It is also imperative to include the stakeholders of each client in treatment. Including stakeholder in treatment can assist in carryover of treatment but also to encourage communication on a regular basis.

Limitations of the Present Study

Although current data are promising for future research, several factors must be considered when these data are being interpreted and generalized to other bilingual persons with aphasia. Despite the small sample size being a general limitation in aphasia research, and regardless of the exploratory goal of this study, the present investigation included only three participants. This means that data are limited to these participants individually, and generalization to the aphasia population at large is limited. Statistical analyses were restricted to nonparametric measures because assumptions of normality were not met, and there was insufficient power to detect significant differences that would allow comparisons to the aphasia population. This small sample size was a most likely a consequence of the rural region in which this research was conducted. Efforts were made to recruit additional participants by contacting practicing clinicians in the surrounding cities; however, no additional subjects were identified. A larger sample size is necessary before these data can be generalized to the bilingual aphasia population at large.

A second limitation that was revealed through this behavioral trial was the low occurrence of translators/interpreters in this area. It was difficult to find translators/interpreters who spoke the same language/dialect as these participants, and who were certified to be translators. Even if certified translators were identified, they would not necessarily be trained to administer standardized testing and document patient response. In addition to the unique nature of aphasia and its assessment, and the issue of recruiting translators/interpreters appropriate for an endeavor such as this, presents even more limitations. Although the translators/interpreters were not certified, the Dutch and Vietnamese translators/interpreters were familiar with standardized testing and with communicating with a person with aphasia. The French translator was given the opportunity to familiarize himself with the assessment tool, and administered the assessment accurately. Further he is considered to be an expert in the field, holding a Ph.D. in French.

Directions for Future Study

The current study was designed to provide scaffolding that would support future research regarding the assessment and management of bilingual persons with aphasia. For example, there are currently few bilingual aphasia tests with which to determine the significance of the language deficit in bilingual PWA. The present study provides justification for expanding the availability and reasonableness of bilingual assessments of aphasia. The assessment that was used for this study, the BAT, was very lengthy, and several of the participants demonstrated frustration with specific sections. Research suggests that the short form of the BAT may be as effective as the full assessment in discriminating between the extent and severity of the aphasia disorder across languages; however, it was noted that there are some modifications that should be implemented. It was discussed that specific tasks that are both long and have a high internal consistency could be shortened in order to reduce assessment time and frustration. It was also discussed that the amount of visual stimuli could be reduced; as some of the pictures were unrecognizable (Ivanova & Hallowell, 2009). In this study, the short form of the BAT was used when possible; however, for the purpose of research, a more comprehensive assessment was desired. Clinically, however, the full version of the BAT is unreasonable.

Regarding management, the anecdotal evidence here and documented evidence in the literature related to generalization of untreated languages (Faroqi-Shah et al., 2010; Marangolo et al., 2009) should motivate future research related to incorporating the second language in treatment directly. Furthermore, and of particular relevance to this study, the use of AAC devices that incorporate multiple languages should be examined with this population. Increasing the sample size in order to include a more random sample would allow for more information to be gathered which may be more indicative of language recovery and communication options in bilingual persons with aphasia. Furthermore, an analysis of communication of a larger group of bilingual persons with aphasia who present with similar types and severities of bilingual aphasia may provide guided recommendations of specific communication treatments, compensatory strategies, or AAC devices that would be most effective and appropriate for a given client. Ideally, by improving the management of this population, there would be evidence of improved functional communication and improved quality of life. When considering AAC use with BPWA it is imperative that the input design be considered to find the best augmented fit to accommodate for individual differences.

CHAPTER FIVE: REFERENCES

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APPENDIX A: CONSENT FORM

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

PERFORMANCE ON A PICTURE-WORD VERIFICATION TASK BY BILINGUAL PERSONS WITH APHASIA

Study to be Conducted at: Western Carolina University
Speech and Hearing Clinic
McKee Building
Cullowhee, NC 28723

Mountain Area Health Education Center (MAHEC)
Biltmore Campus
118 West T Weaver Boulevard
Asheville, NC 28803

Sponsor: Western Carolina University Department of Communication Sciences and Disorders

Principal Investigator: Amanda Graham, B.S.
Graduate Student
argraham1@catamount.wcu.edu
(828) 316-8665

Faculty Supervisor: Leigh Morrow-Odom, Ph.D., CCC-SLP
Assistant Professor, Clinical Supervisor
kmodom@email.wcu.edu
(828) 227-3834

INTRODUCTION

You are being asked to participate in a research study. The Institutional Review Committee of Western Carolina University has reviewed this study for the protection of your rights. However, before you choose to be a research participant, it is important that you read the following information and ask as many questions as necessary to be sure that you understand what your participation will involve. Your signature on this consent form will acknowledge that you received all of the following information and explanations verbally and have been given an opportunity to discuss your questions and concerns with the principal investigator or faculty supervisor.

PURPOSE

Aphasia is a language disorder in which a person may have difficulty understanding and producing language, naming common objects, reading, and writing. You are being asked to participate in this study because you are a bilingual person with speech and language problems due to a stroke. The purpose of this study is to look at the ability of persons with aphasia (PWA) who are bilingual to complete a computer task of matching pictures and written words in both languages you speak.

PROCEDURES

If you agree to be in this study, the following will happen:

1. You will complete some assessments to determine the degree of your speech and language impairment. During these, you will be asked to repeat sounds, words, and phrases, complete some simple movements with your body or mouth, answer questions, name objects, and describe pictures. Completion of this task will take approximately 90 minutes.
2. On the same day as your aphasia testing, you will also complete two computer tasks to test your ability to match pictures and written words. While sitting in front of a computer screen, you will be instructed to press a button if the picture and written word match or do not match. Some of the written words will be in English, and others will be in your other language. Completion of these computer tasks will take about 30 minutes.

POSSIBLE RISKS

Any experiment has possible side effects. The procedures used in this study may cause all, some, or none of the side effects listed.

You will be required to complete some speech and language tests. These tests may be difficult and cause some frustration. However, any frustration related to testing and treatment is expected to be minimal, and similar to what you might experience in traditional speech-language therapy. Also, research will be conducted in a quiet, accessible, and private environment. Breaks will be offered at several points throughout the session.

EXCLUSIONS

For persons receiving treatment, you will not be able to participate in this study if you are less than 18 years of age. Only persons with a history of a single stroke are eligible for this study. Also, persons who have other neurological disorders (such as Parkinson's disease or dementia) are not able to participate. Participants must also be bilingual speakers prior to the onset of aphasia.

POSSIBLE BENEFITS

It is hoped that the information gained from the study will help in the management of future patients with speech and language problems caused by stroke who are also bilingual. In addition, it is hoped that this improved understanding of your language abilities may result in improved management of your language needs and your quality of life.

COST TO YOU FOR PARTICIPATING IN THIS STUDY

There will be no cost to you for participating in this study.

PAYMENT FOR PARTICPATION

To You:

You will not be paid for participating in this study.

To Investigators:
The investigators on this study are not being paid to conduct this research beyond their usual salary. None of the investigators on this project stand to gain financially from the results of this study.

To Institution:
Western Carolina University will not be paid for this study.

COMPENSATION FOR INJURY AS A RESULT OF STUDY PARTICIPATION
Although it is not anticipated, if you get hurt or sick because of participating in this study, emergency medical treatment is available but will be provided at the usual charge. The study sponsor will not pay for this treatment. You will be responsible for any charges accrued. No financial compensation (payment) will be available to you from the study sponsor. You or your insurance company will be charged for continuing medical care and/or hospitalization. You understand that you have not given up any of your legal rights by signing this consent form.

VOLUNTARY PARTICIPATION
Your participation in this study is voluntary (your choice). You may refuse to take part in or stop taking part in this study at any time. You should call the investigator in charge of this study if you decide to do this. Your decision not to take part in the study will not affect your current or future treatment provided by us.

The investigators and/or the sponsor may stop your participation in this study at any time if they decide it is in your best interest. They may also do this if you do not follow the investigator's instructions.

NEW INFORMATION
During this study, you will be told of any important new information that may affect your willingness to participate in this study.

AUTHORIZATION TO USE MEDICAL INFORMATION
As part of this research study, only the principal investigator and her research team will have access to the medical information you provide while you are participating in this study. Medical information will not be requested from your physicians or any hospital from which you have received medical care. These study records may be kept on a computer or in a locked filed cabinet and will include all information collected during the research study, and any health information you provide that is related to the research study. The principal investigator and her research team will use this health information as they conduct this study. To evaluate the results of the study, and with compliance with federal and state law, your information may be examined by the Institutional Review Board of Western Carolina University. This study may result in scientific presentations and publications, but steps will be taken to make sure you are not identified, such as the assignment of an identification number to take the place of your name on all study related materials. All study related information will be kept for five years following the completion of the study. After that time, all information will be destroyed.

If you have any questions about the privacy of your health information, please discuss this with the principal investigator or co-investigators.

CONTACT FOR QUESTIONS OR TO REQUEST SUMMARY OF RESULTS

For more information concerning this study and research-related risks or injuries, or to request a summary of the results for this study, you may contact the primary investigator, Amanda Graham at (828) 227-7251 or the faculty supervisor Dr. Leigh Morrow-Odom at (828) 227-3834. You may also contact a representative of the Institutional Review Board of Western Carolina University for information regarding your rights as a participant involved in a research study at (828) 227-7212.

CONSENT TO PARTICIPATE

My investigator, Amanda Graham, has explained the nature and purpose of this study to me. I have been given the time and place to read and review this consent form, or it has been read to me, and I choose to participate in this study. I have been given the opportunity to ask questions about this study and my questions have been answered to my satisfaction. I agree that my health information may be used and disclosed (released) as described in this consent form. After I sign this consent form, I understand I will receive a copy of it for my own records. I do not give up any of my legal rights by signing this consent form.

____
Printed Name of Participant

______________________________ ____________ ____________
Signature of Participant Date Time

______________________________ ____________ ____________
Signature of Witness Date Time

INVESTIGATOR STATEMENT

I have carefully explained to the participant the nature and purpose of this study. The participant signing this consent form has (1) been given the time and place to read and review this consent form; (2) been given opportunity to ask questions regarding the nature, risks and benefits of participation in this research study; and (3) appears to understand the nature and purpose of the study and the demands required of participation. The participant has signed this consent form prior to having any study-related procedures performed.

______________________________ ____________ ____________
Signature of Primary Investigator Date Time

________________________________ _____________ _____________

Signature of Faculty Supervisor Date Time

Primary Investigator: Amanda Graham (828) 316-8665

Faculty Supervisor: Dr. Leigh Morrow-Odom (828) 227-3834