

**INCREASING SPONTANEOUS VERBALIZATION IN CHRONIC APHASIA:  
ENHANCED PROTOCOL OF CONSTRAINT INDUCED APHASIA THERAPY**

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A THESIS

Submitted to the Department of Hearing, Speech and Language Sciences  
and the Graduate School of Gallaudet University  
in partial fulfillment  
of the requirements for the degree of  
Master of Science in Speech-Language Pathology

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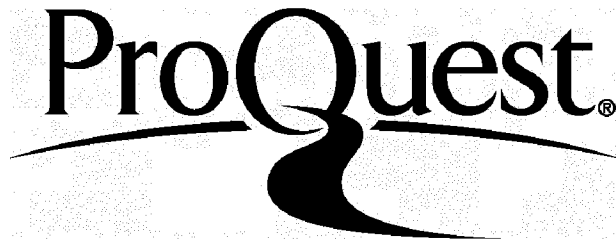
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*Ma. Concepcion P. Segismundo*  
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## **Abstract**

### **Increasing Spontaneous Verbalization in Chronic Aphasia: Enhanced Protocol of Constraint Induced Aphasia Therapy**

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The increasing prevalence of aphasia with the impending projection of a Speech-Language Pathology (SLP) personnel shortage suggests an increased demand for speech and language therapy services in the future. With this, identification of effective and efficient group aphasia therapy is important. Recent modification in the intensive, social-functional restorative communication approach, also called as Constraint Induced Aphasia Therapy II (CIAT II), has shown promising results with increasing spontaneous speech in everyday life situations in individuals with chronic aphasia. However, the extent of applicability of the enhanced CIAT II protocol in terms of outcomes in other areas of language as well as aphasia severity has not been fully explored. This research study aimed to: (1) determine the effect of CIAT II on language measures (aphasia severity, naming and quality of spontaneous speech), and (2) examine the effect of CIAT II on the amount and quality of participation in spontaneous speech in life situations in an adult with severe chronic aphasia (12 years and 9 months-post stroke during first CVA and 1 year post stroke during 2<sup>nd</sup> CVA). Results revealed significant gains on tests of

aphasia severity as well as measures of lexical diversity (type token ration, percentage of nouns and percentage of verbs) both in narrative and discourse tasks. However, no significant change was observed on naming measures as well as perception in the amount and quality of spontaneous speech in everyday activities. This thesis suggests that, for an individual with severe chronic aphasia, the enhanced CIAT protocol (CIAT II) may not produce significant improvements in naming and everyday speech but, may result in significant changes on standardized test of aphasia severity and measures of lexical diversity.

## TABLE OF CONTENTS

Acknowledgements .....	i
Abstract .....	iv
List of Tables .....	viii
List of Figures .....	ix
Chapter 1: Introduction .....	1
Origins of an Intensive Social-Functional Approach to Language Therapy .....	5
Principles of CIAT .....	6
Modifications to the Original CIAT Protocol .....	9
CIAT Treatment Outcomes .....	13
Research Questions .....	19
Chapter 2: Methodology .....	21
Experimental design .....	21
Participant .....	21
Outcome Measures .....	23
Assessment Administration .....	26
Procedures .....	27
Data Analysis .....	38
Chapter 3: Results .....	41
Research Question One .....	41
Western Aphasia Battery –Revised Aphasia Quotient .....	41
Naming Measures .....	41
Discourse Measures .....	41

Research Question Two .....	48
Chapter 4: Discussions and Future Directions .....	53
Treatment Outcomes .....	53
Aphasia severity measure .....	53
Naming measures .....	57
Discourse Measures .....	59
Amount and Quality of Participation in Speech .....	64
Study Limitations .....	67
Implications and future directions .....	68
Implications .....	68
Future directions .....	69
Reference List .....	71
Curriculum Vitae.....	79

## LIST OF TABLES

Table 1: Breakdown of Intervention Activities in the CIAT II and the approximate time spent on each task .....	31
Table 2: Actual scores and change scores in WAB-R.....	43
Table 3: Actual scores and change scores in standardized naming measures.....	45
Table 4: WAB spontaneous speech sample analysis of lexical diversity reported in terms of mean length of utterances (MLU), number of different words (TYPE), total number of words (TOKEN), type-token ratio (TTR), percentage of nouns (% nouns) and percentage of verbs (% verbs) .....	46
Table 5: Discourse sample analysis of lexical diversity reported in terms of mean length of utterances (MLU), number of different words (TYPE), total number of words (TOKEN), type-token ratio (TTR), percentage of nouns (% nouns) and percentage of verbs (% verbs) .....	49
Table 6: Amount and quality of participation in speech in the life situation using the Verbal Activity Log (VAL) scores .....	50
Table 7: Amount and quality of participation in speech in the life situation using the Verbal Activity Log (VAL) average scores and change scores .....	51

## LIST OF FIGURES

Figure 1: Actual scores in the WAB-R during pre- and post-treatment sessions..... 44

Figure 2: Mean scores of the Amount and How Well Scales of the VAL during pre-treatment, treatment and post-treatment sessions ..... 52

## CHAPTER ONE: INTRODUCTION

Every year, a total of 795, 000 Americans suffer from a stroke (Centers for Disease Control and Prevention, 2015). One third of these strokes result in aphasia (Benson & Ardila, 1996; Sinanovic, 2011; Berthier, 2005). Aphasia is a communication disorder resulting from a lesion to the brain usually caused by a cerebro-vascular accident or stroke (National Institute of Neurological Disorders and Stroke, 2015). Individuals with aphasia often present with impairments in receptive language as in reading and listening and expressive language as in speaking and writing (American Speech-Language-Hearing Association, 2015). Prevalence of aphasia is reported to be 80,000 individuals each year. According to the National Institute on Deafness and other Communication Disorder (NIDCD), in 2010, one million individuals in the United States had aphasia. As the baby boom generation ages, it is projected that the prevalence of aphasia will double to 180,000 by the year 2020 (National Aphasia Association, 2015). The increasing number of cases each year raises the need for rehabilitation services to address language difficulties for people with aphasia. Thus, the demand for aphasia therapy will dramatically increase.

Aphasia therapy provided by licensed Speech-Language Pathologists plays an important role in the management of aphasia symptoms. During the acute stage of aphasia, the first three to six (3-6) months post-stroke, most patients present with a number of medical diagnoses requiring more complex intervention (Duffy, Fossett & Thomas, 2010). With this, only a limited amount of time is spent on language assessment and intervention. In a National Outcome Measure Survey published by American Speech-

Language-Hearing Association (ASHA) (2011), more Speech Language Pathology (SLP) service time is spent on addressing swallowing issues than providing aphasia therapy in acute hospitals, inpatient rehabilitation facilities and skilled nursing facilities. The average amount of SLP service delivery ranges from 2.6 to 13.8 hours for an average 10-34.5 days, with only 36-50% spent on aphasia therapy (ASHA, 2011). With the short length of stay patients with acute aphasia spend in these settings, appropriate management of acute aphasia may be limited.

Aside from the limited number of service hours provided during the acute stages of aphasia, healthcare settings are faced with SLP personnel shortage (ASHA, 2005). 70-80% of the persons with aphasia discharged from acute hospitals and acute rehabilitation facilities are recommended to continue speech and language therapy (ASHA, 2011). With the lack of SLP personnel to provide services to the individuals with aphasia, most of those with aphasia are deprived of speech and language services especially during the chronic stage of their language impairment. Thus, an increase in number of underserved patients with chronic aphasia results. Chronic aphasia is characterized by aphasia symptoms persisting for more than 6 to 12 months post-stroke (Meinzer, Streiftau & Rockstroh, 2007; Pedersen, Vinter & Olsen, 2004). With the increasing number of aphasia cases and the limited number of certified SLPs, there is a need for a more effective and efficient aphasia therapy approach.

A number of aphasia therapy approaches have proven to be effective in managing aphasia symptoms (Robey, 1994; Bhogal, Teasell & Speechley, 2003; Robey, 1994; Whurr, Lorch & Nye, 1992). These approaches to aphasia therapy can be categorized as compensatory or restorative. Compensatory approaches to rehabilitation enhance an

individual's functioning by encouraging behavioral adaptation to loss of function (Simmons-Mackie & Damico, 1997). Restorative approaches, on the other hand, focus on retraining or rebuilding neural processes that were damaged to regain functions (Cheeran, 2009).

One of the most popular restorative aphasia therapy approaches was based on a motor therapy approach from the field of Physical Therapy. Recent research on stroke motor therapy looked at the "theory of learned non-use" in which an increased reliance on the unaffected limb results from difficulty and frustration using the affected limb (Grotta, et al., 2014). This approach to therapy is called Constraint Induced Motor Therapy (CIMT) (Taub, et al., 1999). It is a physical therapy program focusing on restorative approach to motor therapy to counter learned non-use of affected muscle groups (Szaflarski et al., 2008). Compared to Traditional Motor Therapy Approaches which focus on compensatory and strengthening activities, CIMT focuses on intensive and graded use of the affected limb with constraint applied during therapy (Kwakkel, Veerbeek, van Wegen, & Wolf, 2015). This therapy approach in the field of physical therapy is considered a highly effective intervention in improving upper limb paralysis (Kwakkel, et al., 2015; Grotta, Noser, Ro, Boake, Levin, Aronowski, & Schallert, 2014; Batool, Soomro, Amjad, & Fauz, 2015).

The CIMT approach to physical therapy was then applied to treatment of language disorders. Pulvermuller, Neinger, Elbert, Mohr, Rockstroh, Koebbel & Taub (2001) introduced Constraint Induced Aphasia Therapy (CIAT). CIAT is a group aphasia therapy that focuses on intensive practice, shaping individuals' linguistic behavior, using constraints to encourage individuals to use spoken language in settings parallel to

naturalistic environment and emphasizing treatment to improve an individual's communication abilities and needs (DiFrancesco, Pulvermuller & Mohr, 2012). Similar to CIMT, the proponents of CIAT suggested that people with aphasia avoid communication situations that are difficult and frustrating (Pulvermuller et al., 2001) and rely on communication channels that are accessible and convenient to them, such as written language or gesture. With this, individuals with aphasia experience learned non-use of spoken means of communication. CIAT focuses on shaping the client's linguistic behavior by encouraging use of spoken language while constraining other means of communication. In addition, this aphasia therapy program was based on pragmatic and communicative aphasia therapy principles that capitalize on application of everyday life situations in therapy the setting (Pulvermuller et al, 2001; Pulvermuller & Berthier, 2008).

CIAT used therapeutic language games (Wittgenstein, 1953), which is a set of verbal and nonverbal actions in a prearranged environment. The language games can accommodate at least 2 participants. Language games were adapted to therapy to provide opportunity to practice different communication forms such as requesting, rejecting, clarifying and acknowledging (Pulvermuller & Roth, 1991). In the CIAT Protocol, participants play a card game, similar to *Go Fish*, in which they attempt to find the cards matching what they have in their hands. Using the principles of CIAT, constraints are applied on the materials of the game such as use of a visual barrier and levels of pictures presented. The rules, on the other hand, serve as shaping techniques to encourage participants to use verbal language. Reinforcement strategies are tailored to individual patients throughout the game (Pulvermuller et al., 2001; Pulvermuller et al., 2008).

## **Origins of an Intensive Social-Functional Approach to Language Therapy**

CIAT was based on a social-functional communication therapy approach that uses speech acts (Pulvermuller & Roth, 1991; Difrancesco, Pulvermuller & Mohr, 2012). A social-functional communication approach primarily focuses on the pragmatic aspects of language (Kempler & Goral, 2011). That is, the target of therapy is production of relevant, unambiguous and informative language necessary for effective communication (Kempler & Goral, 2011; Goff, 2013). Speech acts, on the other hand, are described as the basic unit of communication (Wilcox & Davis, 1977). These include two main elements, words or symbols used in communication and the illocutionary force or the purpose of communication (Searle, 1969; Wilcox & Davis, 1977). Examples of speech acts include making requests, responding to questions, making statements, greeting, thanking, agreeing and complaining. Hence, this type of aphasia therapy focusing on speech acts addresses both spoken language production and pragmatics or language use (Pulvermuller & Roth, 1991; Difrancesco, Pulvermuller & Mohr, 2012), which are necessary for successful everyday communication situations (Searle, 1969; Wilcox & Davis, 1977).

As mentioned above, CIAT builds on three principles (e.g. massed practice, behavioral relevance and focusing). These principles were originally used for rehabilitation of motor deficits resulting from cerebro-vascular accident (CVA) or stroke (Taub, Uswatte & Pidikiti, 1999).

## **Principles of CIAT**

Three major neuroscience principles of CIAT include massed practice, behavioral and communicative relevance and focusing. These principles and their applications to therapy are discussed in the following paragraphs.

**Massed practice.** Massed practice refers to an intensive therapy schedule over a short period of time (Raymer, Beeson, Holland, Kendall, Maher, Martin, Rose, Thompson, Turkstra, Boyle, Conway, Hula, Kearns, Rapp, Simmons-Mackie, Rothi, & Altmann, 2008; Cherney, Patterson, Raymer, Frymark, & Schooling, 2008). In a MEDLINE systematic review investigating the relationship between intensity of therapy and aphasia recovery, it was found that 8.8 hours of therapy per week for 11.2 weeks had a more significant treatment effect than aphasia interventions provided for 2 hours per week for 22.9 weeks (Bhogal, Teasell & Speechley, 2003). In addition, intensive practice was reported to facilitate coincidence learning that promotes rewiring of neuronal connections and language changes in individuals with aphasia (Difrancesco, Pulvermuller & Mohr, 2012). CIAT utilizes this principle by administering a card game in an intensive treatment schedule, 3-4 hours per day for 2 weeks (Cherney, et al., 2008; Pulvermuller, et al., 2001; Faroqi-Shah & Virion, 2008; Difrancesco, Pulvermuller & Mohr, 2012).

**Focusing.** This principle was originally based on an approach to rehabilitation in Physical Therapy called Constraint Induced Movement Therapy (CIMT) (Taub, 2004; Taub, Uswatte & Pidikiti, 1999). Research on CIMT states that focus training of the affected limb promotes re-strengthening and re-wiring of neuronal connections, suggesting brain reorganization resulting from training (Taub, 2004; Taub, et al., 2002; Taub, Uswatte & Pidikiti, 1999).

Efficacy of the CIMT was first examined in animal studies. Monkeys with an affected limb, resulting from surgically-induced somatosensory damage, were observed to spontaneously use the unaffected limb. With restriction in use of the unaffected limb and training of the affected limb, monkeys were able to regain function of the affected limb (Taub, Uswatte & Pidikiti, 1999). The findings observed in animal research led to human rehabilitation research. Ostendorf and Wolf (1981) examined the effect of movement restriction to humans. In this study, 25 individuals, who suffered from cerebro-vascular accident (CVA) and traumatic brain injury (TBI) presenting motor deficits in one arm, were invited to participate. All of the participants were asked to wear a sling on the unaffected arm all day for 2 weeks. During post-testing, improvements in speed of movement were noted. Significant effects on motor function were also observed (Taub, Uswatte, Pidikiti, 1999).

The findings observed in CIMT were considered in relation to the development of CIAT (Pulvermuller & Berthier, 2008; Difrancesco, Pulvermuller & Mohr, 2012). Individuals with aphasia who have difficulties using spoken language often avoid verbal communication and resort to more accessible means such as pointing and gesturing. With this, learned non-use of spoken language results (Pulvermuller, et al., 2001; Pulvermuller & Berthier, 2008; Difrancesco, Pulvermuller & Mohr, 2012). The CIAT principle of focusing states that “it is advantageous to focus patients on their remaining language abilities, especially on those they avoid using” (Pulvermuller & Berthier, 2008, p. 571). In CIAT, linguistic constraints to use verbal utterances during language games are provided to facilitate practice of verbal communication skills that still available to individuals with aphasia (Difrancesco, Pulvermuller & Mohr, 2012).

**Behavioral and communicative relevance.** The principle of behavioral significance states that “it is advantageous to practice language in relevant action contexts” (Pulvermuller & Berthier, 2008, p. 569). Action contexts refer to the speech acts described by Searle (1969). This principle is based on the social-functional basis of CIAT. That is, improving a person’s abilities to be able to communicate in everyday life situations (Pulvermuller & Berthier, 2008; Difrancesco, Pulvermuller & Mohr, 2012). CIAT capitalizes on this principle through the language games (Wittgenstein, 1953). These therapeutic language action games encourage practice of different speech acts such as requesting, clarifying, responding, giving directions and rejecting (Pulvermuller & Berthier, 2008; Difrancesco, Pulvermuller & Mohr, 2012).

From a neuroscience standpoint, Wittgenstein (1953) reported that there is a strong link between language and action systems at the cortical level. That is, facilitating one may result to an improvement in another. Thus, facilitating language practice in a functionally relevant task and utilizing non-linguistic actions may reactivate impaired language comprehension and expression (Pulvermuller & Berthier, 2008; Difrancesco, et al., 2012). Difrancesco and his colleagues (2012) proposed that pragmatic language-action embedding during CIAT causes a spread in neural activity that facilitates processing in areas affected by brain damage. The focus on increasing neural activity in the sensorimotor areas through relevant action contexts makes CIAT different from other therapy approaches.

## **Modifications to the Original CIAT Protocol**

The original CIAT protocol introduced by Pulvermuller and his colleagues (2001) was aimed at facilitating practice of speech acts in a communicative therapeutic environment while encouraging spoken language and constraining the use of gestures and nonverbal means of communication. In the original protocol, participants were engaged in a therapeutic game, three to four hours per day for ten days. These language action games (LAGs) were performed in small groups involving two to three participants and a therapist. Each participant is given a set of cards that they have to match with similar cards from other participants. Picture cards used during LAGs are belong to one of the following categories: (1) common name of object with high frequency, (2) less common name, and (3) names that is phonologically similar to that of another object. Barriers were placed in front and on either side of each participant to prevent each participant from seeing each other's cards or hands. Use of non-verbal means of communication such as pointing or gesturing was not permitted.

Since CIAT was initially introduced by Pulvermuller, et al., (2001), a number of literature reported a variety of modifications to the original CIAT protocol (Meinzer, Djundja, Barthel, Elbert & Rockstroh, 2005; Faroqi-Shah & Virion, 2009; Kirmess & Maher, 2010; DiFrancesco, Pulvemuller & Mohr, 2012; Johnson, Taub, Harper, Wade, Bowman, Bishop-McKay, Haddad, Mark & Uswatter, 2014).

In 2005, Meinzer and his colleagues introduced CIATplus, an extension of the original CIAT protocol. The CIATplus included written materials and photographs of everyday situations and a training module to involve the participant's relative in the implementation of individual communication exercises. Similar to the original CIAT

protocol (Pulvermuller, et al., 2001), participants received training 3 hours per day for 10 days. Picture cards used during the LAGs included cards of object drawing that included written language such as rhyming words and categories as well as photographs of everyday situations. In this protocol, use of gestures and other nonverbal means of communication were discouraged. The CIATplus protocol also added participant exercises to be completed at home, daily communication practice with a family member and a daily record of communication activities engaged outside therapy activities.

Kirmess and Maher (2010) explored that applicability and outcome of constraint induced language therapy (CILT) in individuals in the early phase of recovery from aphasia. Similar to previous CIAT studies (Pulvermuller, et al., 2001; Meinzer, et al., 2005), participants received training for 3 hours a day for 10 days. However, modifications were applied based on the participant's stability and stamina, being in an acute care setting. While some participants received training in 3-hour blocks, others participated in multiple shorter sessions of 45 minutes. In their study, Kirmess and Maher (2010) utilized colored pictures in 10 categories based on assumed communicative relevance for daily living within two frequency rates and at four complexity levels. While the study placed visual barriers between participants, hand movements for individual support were neither prohibited nor encouraged.

In 2012, Difrancesco, Pulvermuller & Mohr provided a comprehensive description of the methods of Intensive Language Action Therapy (ILAT), a new term replacing constraint induced aphasia (or language) therapy (CIAT or CILT). Similar to the original CIAT protocol (Pulvermuller, et al., 2001), participants are engaged in an intensive training through LAGs for 3 hours a day for 10 days. The LAGs include both

verbal communicative actions such as asking for one of the cards, rejecting or denying ownership of similar or matching cards and non-communicative actions such as showing, handing over or taking and putting aside a card. While performing the LAGs, participants sit around a table with barriers between them to ensure that participants do not have visual access to other participant's cards and it would be difficult to use and perceive any nonverbal means of communication such as gestures or pointing. With the current view on neuroscience highlighting the functional connection and synergistic interaction of language and action systems, the protocol published by Difrancesco, Pulvermuller and Mohr (2012) allowed use of gesture and non-verbal activity that complement verbal communication. Participants were only discouraged to substitute spoken language with gesture but they were allowed to use gestures when practicing their verbal abilities. Another modification to the original CIAT protocol was the materials used during LAGs. Difrancesco, Pulvermuller & Mohr (2012) utilized colored photographs of objects or people taking part in a range of activities. These picture cards were grouped using the following categories: word frequency (high to low), minimal pairs, semantic categories, multi-feature object and object arrangements, spatial relationships and actions. During LAGs, the choice of materials was adjusted to the participant's needs, abilities and interest.

In a study by Faroqi-Shah and Virion (2009), the applicability of constraint induced language therapy (CILT) for individuals with agrammatic aphasia was examined. In this research study, participants were assigned to one of two treatment groups, one utilizing the original CIAT/CILT protocol (CILT-O) and another adding a morphosyntactic constraint to the original CIAT/CILT protocol (CILT-G). Both groups

utilized the original CIAT protocol for engaging participants in LAGs, allowing only verbal responses and restricting other modes of communication and shaping the participants' target verbal productions. In the modified protocol (CILT-G), the visual barrier was not used. Instead, the participants were only given verbal instructions. In addition, grammaticality constraint was added during shaping. That is, participants in the CILT-G were required to include an adverb and appropriate verb tense morphology when requesting for a card. Participants in the CILT-G group were also required to judge the verbal requests of their partners based on their use of grammatical markers.

In 2014, Johnson and her colleagues introduced the enhanced protocol for CIAT. According to Johnson, Taub, Harper, Wade, Bowman, Bishop-McKay, Haddad, Mark & Uswatte (2014), the original CIAT protocol was restructured to make it similar to CIMT. The modification of the original CIAT protocol included: (1) the addition of a variety of expressive language exercises such as role-playing tasks, speech repetition drills and picture description tasks, (2) an intensive treatment requiring more verbal responses during the 3-hour treatment period and (3) addition of transfer package to facilitate transfer of skills learned in the treatment setting to life situations. Similar to the original CIAT protocol, participants received 3 hours of training on each weekday for three weeks, plus 30 minutes devoted to the implementation of the transfer package. Seven different therapy activities were presented in the same sequence on each treatment day. These include: (1) completion of the How Well scale of the verbal activity log (VAL), review of daily home diary and home skill assignment checklist, (2) speech repetition drills, (3) activities of daily living (ADL) phrase repetition drills, (4) language card game, (5) picture description, (6) role-play and (7) home skill assignment. Throughout the

training, use of gestures or nonverbal vocalizations for communication were strongly discouraged.

### **CIAT Treatment Outcomes**

Pulvermuller and his colleagues (2001) were the first to examine the effectiveness of CIAT. In the study, CIAT was compared with traditional aphasia therapy. Seventeen participants with aphasia were assigned to two groups: one received CIAT and the other received traditional aphasia therapy. Total amount of therapy was similar for both groups; however, frequency and length of therapy each day differed. Individuals in the CIAT group participated in therapeutic language games for 3 to 4 hours for 10 days. Participants in the traditional therapy group received therapy for 3 to 5 weeks, with a total of 20 to 54 hours of intervention. Aside from differences in intensity, treatment protocols between 2 groups also differed. Individuals in the CIAT group participated in a card game, which they find pictures that match the pictures in their hands, using verbal communication. In the traditional aphasia therapy group, individuals received exercises that involve naming, repetition and sentence completion tasks. In these activities, there were no constraints to use spoken language.

Pulvermuller, et al. (2001) found that individuals in the CIAT group showed substantial post-therapy gains compared to traditional aphasia therapy group, which did not show significant improvements. Improvements in naming and language comprehension tests were noted in the CIAT group, but not in the repetition test. Participant's perception about their performance in everyday life improved for the CIAT group but not for the traditional aphasia therapy group. This result was supported by the

ratings of blinded clinicians who indicated a 10% improvement in communicative activities over the 10-day interval. The results were remarkable, however, factors contributing to the improvement in outcome measures were not indicated. Although the importance of massed practice in improving language performance was mentioned, possible effects of other principles of CIAT on therapy success were not implied. Some subsequent studies attempted to determine other factors that may contribute to the success of CIAT (Maher, Kendall, Swearingin, Rodriguez, Leon, Pingel, Holland & Rothi, 2006; Barthel, Meinzer, Djundja & Rockstroh, 2008).

In a study by Maher, et al. (2006), Constraint Induced Language Therapy (CILT) (n=4), an approach requiring constraints in language modality was compared with Promoting Aphasic Communicative Effectiveness (PACE) (n=5), an approach allowing all modes of communication. Both treatments were presented with similar therapy intensity (3-4 hours per day; 4 days per week for 2 weeks, with a total of 24-36 hours), utilizing the dual card game. Shaping was provided for both treatments. As mentioned, the only difference between the two intervention types was the communication modality. Participants in the CILT group were constrained to use only spoken language when participating in dual card game while multimodality communication was allowed in the PACE Group.

Maher, et al., 2006 found that participants from both groups showed significant improvement in posttest measures. However, only CILT participants maintained these increase in scores 1 month after the intervention. In terms of discourse production, both groups increased in the amount and accuracy of information during communication. However, subjective assessments of trained speech pathologists blind to condition and

time of sample noted that participants in the CILT group improved in their ability to retell stories during posttest and 1-month follow-up. The findings of the study in terms of standard test measures and narrative discourse were found to be consistent with the existing evidence (Pulvermuller, et al., 2001). The results of the study showed that constraint plays an important role in increasing maintenance of skills in CILT. However, the presence of severe apraxia in most of the participants, 3 participants in the PACE group and 1 participant in the CILT group, raises a question about the validity of the results obtained. It was not clear if there is a relationship between presence of apraxia and the performance of participants in the PACE group.

Barthel, et al. (2008) investigated possible factors contributing to the success of CIAT. Model-Orientated Aphasia Therapy (MOAT) was compared to CIAT. MOAT is an individualized language training approach that is administered in the same intensive schedule as CIAT. Therapy setting is based on the individual's specific symptoms and linguistic skills. Twelve participants in the MOAT group received 30 hours of individual therapy for two weeks. In addition, participant's relatives were involved in the treatment to facilitate communication between them and the participants. Baseline measures were obtained before therapy, after therapy and six months post-therapy. Results were compared to the CIAT data from twenty-seven participants in a previously published study utilizing similar time points (Meinzer et al., 2005).

Barthel, et al. (2008) found that MOAT resulted in significant improvements in standard language measures. Similarly, MOAT resulted in significant improvements in ratings on everyday communication using the Communication Activity Log (CAL) (Pulvermuller, et al., 2001) and Communicative Effectiveness Index (CETI) (Lomas,

Pickard, Bester, Elbard, Finlayson & Zoghaib, 1989; Schlenk & Schlenk, 1994). These improvements were maintained during the 6-month follow up period. Both MOAT and CIAT showed no significant difference in treatment gains in terms of aphasia severity measures. However, MOAT participants demonstrated more remarkable improvements in writing and naming skills than CIAT participants. Similarly, MOAT participants obtained higher scores in the CAL when compared to the CIAT group. This indicates that participants showed improvement in everyday communication. These results highlight the contribution of specificity and intensity of training as well as involvement of relatives and caregivers in the success of participants in the MOAT group. Although the importance of relative or caregiver involvement was mentioned, its possible effects on language outcomes other than everyday communication were not implied. Few studies on CIAT or ILAT examined the effect of relative or caregiver involvement in overall language outcomes in individuals with aphasia (Meinzer, et al., 2005; Johnson, et al., 2014).

In a study by Meinzer and his colleagues (2005), the effects of additional training in everyday communication by family members were examined. Twelve participants with chronic aphasia received CIAT while fifteen participants received a modified CIAT, CIATplus, with the addition of home training exercises. Both groups received 30 hours of training over a two-week period (3 hours per day for 10 days). Dual-card game was presented in both groups. The CIAT group used pairs of cards with object drawings while the CIATplus group used additional cards with written language and photographs of everyday life situation. Family members of participants in the CIATplus group were encouraged to engage the patients in verbal communication at home and facilitate daily

communication practice. Home exercises and training provided at the end of each session were facilitated by relatives. Relatives used a diary to keep record of communicative activities performed by the client outside the therapy setting. Standardized language tests and two questionnaires assessing quality and quantity of everyday communications were administered before the training, 2-weeks after the training and during 6-months follow-up.

Meinzer, et al. (2005) found that there were no significant differences in treatment gains between CIAT and CIATplus on aphasia severity measures. However, participants in CIATplus group achieved more pronounced gains in everyday communication than participants in the CIAT group. These treatment gains were maintained during the 6-month follow up period. Although participants and relatives in the CIATplus group reported a perceived increase in comprehension, there were no significant differences between groups.

Recent research on CIAT examined the effectiveness of an enhanced CIAT protocol or CIAT II (Johnson, et al., 2014). Aside from modifying the original ILAT protocol that primarily focuses on language action games through a dual-card task, Johnson, et al. (2014) added other components in the training protocol. The CIAT II protocol include the following tasks: completion of the How Well Scale of the Verbal Activity Log (VAL), speech repetition drills, activities of daily living (ADL) phrase repetition drills, dual-card game, picture description task, role playing and home skill assignment. Johnson, et al, (2014) also introduced the transfer package (TP) for individuals with aphasia. TP is based on recent research on CIMT principles to improve transfer of skills in daily life situations (Morris, Taub & Mark, 2006; Taub, et al, 2013;

Taub, Uswatte & Morris, 2006). In aphasia therapy, the TP includes techniques that would facilitate transfer of language skills learned in therapy to everyday life situations. Specifically, the transfer package consisted of behavior contracts stating that the patient and family member agreed to use predominantly spoken language to communicate, a verbal log diary that would track amount of verbalization at home and in the community, a questionnaire related to the use of spoken language, problem solving to improve communication at home and in the community and home practice exercises.

Four native English speakers with chronic (1.3-8.0 years post-onset) Broca's aphasia received a total of 52.5 hours of CIAT II (3.5 hours/day for 15 consecutive days). Participants and their relatives were provided with the TP to complete each day throughout the training period. Treatment outcomes included ratings of the amount and quality of participation in speech in everyday life situations and language ability measures. These were obtained before the training, after the training, weekly 1-month after, 3-month and 6-month follow-up).

Johnson, et al. (2014) found that there was a statistically significant treatment gains in participation in speech in everyday life situations. This improvement was maintained during the 6-month follow-up period. Similarly, improvement in language measure was noted. However, it was not statistically significant.

While the most current modification of the original CIAT protocol, the CIAT II, did not show statistically significant improvement in language outcomes, its effect on other areas of language has not been explored. In addition, there is no current research studying the efficacy of the enhanced CIAT protocol in adults with severe chronic aphasia (more than 10 years post-stroke). Thus, this study aimed to investigate the

efficacy of CIAT II for individuals with severe chronic aphasia. The following research questions were posed:

**Question #1:** Does the CIAT II produce improvements in language measures for an individual with severe chronic aphasia? To address this question, CIAT II was administered to an individual with chronic aphasia (>1 year post-event), exhibiting severe Broca's aphasia. Western Aphasia Battery - Aphasia Quotient (WAB-AQ), naming measures and discourse measures were obtained before and after treatment to determine changes in aphasia severity. Naming measures were obtained from the following tests: Western Aphasia Battery – Revised: Naming subtest (WAB-R; Kertesz, 2006), Boston Naming Test (Kaplan, 2001) and Verb Naming Test (Cho-Reyes & Thompson, 2012). Discourse measures included the following: lexical diversity using number of different words used, total number of words, type-token ratio and percent noun and verbs used, and mean length of utterances (MLU). These were obtained through the following discourse tasks: Western Aphasia Battery – Revised: Spontaneous speech subtest (WAB-R; Kertesz, 2006), Aphasiabank Stroke Story and Coping and the Cinderella story retell. The outcomes obtained were compared with normative data for adults.

It was hypothesized that if the massed practice, shaping and addition of transfer package to facilitate transfer of treatment gains contribute to improvements in language abilities of individuals with severe chronic aphasia, then aphasia severity scores, naming accuracy scores and discourse measures would be different after treatment. If massed practice, constraint compensatory strategies and addition of transfer package were not sufficient to result in a significant change, then, it was hypothesized that individuals with

chronic aphasia would not demonstrate difference in severity scores, naming accuracy and discourse measures.

**Question #2:** Does CIAT II produce greater changes in the amount and quality of participation in spontaneous speech in life situations of an individual with severe chronic aphasia? To address this question, the VAL was administered daily throughout the implementation of the CIAT II. The outcomes and severity measures obtained were plotted and analyzed.

It was hypothesized that if the use of transfer package contributes to improvements in participation in speech in the life situation of individuals with chronic aphasia, then amount and quality of participation in everyday speech during post-treatment testing would be different from values obtained before treatment. If the implementation of transfer package was not sufficient to result in a significant change, then, it was hypothesized that individuals with chronic aphasia would not demonstrate changes in everyday speech.

## **CHAPTER TWO: METHODOLOGY**

### **Experimental Design**

The design for the study was a single-subject case study design across behaviors and the aim of the study was to investigate the efficacy of CIAT II for individuals with chronic aphasia. The dependent variables were measured at two time points: baseline (within two months prior to treatment) and post-treatment (within a week after the completion of treatment). Test measures used by Johnson, et al. were replicated for the design of the study. Additional tasks were included to directly assess naming accuracy and quality of spontaneous speech through a variety of narrative and conversational samples. Treatment was conducted for a two-week period, and task and materials were modeled after those used by Johnson, et al. (2014).

### **Participant**

The participant, LM, is a 67-year old right-handed English-speaking African American female with a chronic, non-progressive aphasia. At the time of recruitment, LM was 1 year post-stroke from her second cerebrovascular accident (CVA) and 12 years and 9-months post-stroke from her first CVA. She has normal hearing and corrected vision. LM had 12 years of education and had earned a high school diploma. According to medical records, in 2004, she had a left CVA and initially presented with moderate verbal/oral apraxia, moderate expressive and mild to moderate receptive aphasia. She received intensive speech therapy in an acute rehabilitation hospital for six weeks during

her initial stroke. When she was discharged, she received services from a home health speech therapy and outpatient rehabilitation hospital. Therapy goals initially focused on multi-modal communication, auditory comprehension of yes-no questions and comprehension of written materials. Between the initial-onset of CVA until now, LM inconsistently received speech and language therapy services. In an evaluation performed at 6-years and 7-months post-stroke, she was given a diagnosis of Broca's aphasia with a fluency and informational content score of 4/20, repetition score of 19/100 and naming score of 15/100 in Western Aphasia Battery (WAB; Kertesz, 2000). No apparent apraxia was noted in the apraxia subtest of the WAB. In a language screening administered 6-months post-stroke from her second CVA and 12 years and 3-months post-stroke from her first CVA, the bedside WAB-R (Kertesz, 2006) was administered. LM obtained an overall bedside aphasia score of 30.8 and a bedside language score of 31.8, both indicative of Broca's aphasia. She was judged to be non-fluent (fluency and informational content score of 5/20) with concomitant difficulties in following sequential commands (2/10), repetition (2/10) and naming (2.5/10).

The participant was clear of the following: existence of prior neuropsychiatric conditions, presence of visual-perceptual deficits, drug dependence, presence of severe verbal apraxia and presence of cognitive disorders. Participants achieving a score of 100% on the WAB-R spontaneous speech and naming subtests were excluded. The Apraxia Battery for Adults - Second Edition (ABA-2) (Dabul, 2000) was used to rule out existence of severe apraxia. LM was identified with moderate verbal apraxia, as indicated by the standard scoring for the apraxia battery utilized. LM did not have any previous history of depression or other neuropsychiatric disorder.

LM's son, her primary caregiver, was the point of contact for arrangement of travel and scheduling of treatment sessions. He was contacted by email and phone call. LM previously received speech language therapy. However, during the study, she was asked to discontinue any other speech therapy outside the CIAT II therapy provided in the study. This research was conducted with the approval of the Gallaudet University Institutional Review Board (IRB) and the participant provided written informed consent prior to commencing study participation.

## **Outcome Measures**

### *Measures of Aphasia Severity*

The language severity measure reported by Johnson, et al. (2014) was used to assess the change in the severity of aphasia. The Western Aphasia Battery-Revised (WAB-R) (Kertesz, 2007) was used as a pretest baseline and post-test comparison. WAB-R measured aphasia severity by measuring the Aphasia Quotient (AQ). The AQ includes composite scores in the areas of spontaneous speech, auditory comprehension, naming and repetition.

### *Measures of Naming Abilities*

Naming skills were measured using the following:

- 1) Western Aphasia Battery - Revised (WAB-R) Naming Subtest (Score = 100). This score is determined by obtaining scores for 4 naming tasks: object naming, word fluency, sentence completion and responsive speech. Possible scores range from 0-100, with zero representing inability to name an object, complete a

sentence, identify object belonging to category and identify an object described.

This test has test-retest reliability.

- 2) The Boston Naming Test (BNT), maximum score=60, (Kaplan, Goodglas & Weintraub, 2001) Pictures of black and white picture stimuli were presented during pretest and posttest. Stimuli range from easiest to most difficult to name.
- 3) The Verb Naming Test (VNT) of the Northwestern Assessment of Verbs and Sentences- Revised, maximum score = 22 (Cho-Reyes & Thompson, 2012). This verb naming assessment tool is identified as one of the battery of tests in the Aphasia Protocol (MacWhinney, 2001). Line drawings of people performing actions were presented during pretest and posttest. Stimuli range from easiest to most difficult to name. Possible score range from 0-22. This score is obtained by counting the number of correctly identified pictures.

#### Measures of Spontaneous Speech Quality

The following measures were used to assess the effects CIAT II on the quality and quantity of spontaneous speech:

- 1) Western Aphasia Battery-Revised, Spontaneous Speech- Fluency, Grammatical Competence and Paraphasia Score, maximum score =10 (Kertesz, 2007). This score is determined by analyzing the content and form of language when describing the Picnic picture on WAB-R. Possible scores range from zero to ten, with zero representing no word produced and ten representing grammatically correct utterances

2) Narration of the Cinderella story and Stroke Story and Coping Speech Sample.

The Cinderella story retell was used to obtain a narrative speech. Eliciting Cinderella story has been frequently used in aphasia research (Faroqi-Shah & Virion, 2009; Maher, et.al., 2006, Faroqi-Shah& Thompson, 2007). In addition, normative measures associated with aphasic speaker's narration of the Cinderella story have been published (MacWhinney, Fromm, Holland, Forbes, Wright, 2010). In compliance with the typical procedure for eliciting the story from individuals with aphasia, the participant was allowed to review only the picture scenes of Cinderella story to ensure that inability to recall the story details would not affect the quality of the narrative. In addition to the narration of the Cinderella story, discourse samples using the questions regarding stroke story and coping from the Aphasiabank (MacWhinney, Holland, Forbes, Spector & Fromm, 2008) were obtained. These were elicited once during pre- and post-testing. The participant was informed she would engage in an informal conversation with the researcher. The discourse samples for both tasks were recorded, transcribed and used for analysis. The CHAT Transcription and the CLAN program from the CHILDES database (MacWhinney, 2000) were used to transcribe and analyze the language samples. Mean length of utterances (MLU), total number of different words, total number of words, percentage nouns and verbs were used as outcome measures.

### Measures of Participant's Perception

The Verbal Activity Log (VAL) (Johnson, et al., 2014) is a questionnaire developed to determine the participant's use of spoken language in 12 commonly encountered everyday life situation. This include two scales: how well scale and how much. This scale was used by Johnson, et al. (2014) to determine changes in the amount and quality of spoken languages skills used in everyday situations. Aside from administering the "How well scale" of the VAL in 10 consecutive days throughout the intervention, it was also administered during baseline testing and post-testing. The numerical value assigned for each corresponding scale were used to compare changes in perception before and after the intervention.

### **Assessment Administration**

The following language measures were administered during two assessment sessions (baseline and post-treatment): WAB-R AQ (Kertesz, 2007), BNT (Kaplan, et al., 2000), VNT (Cho-Reyes & Thompson, 2012), Stroke Story and Recovery and Cinderella story retelling. The test order varied across assessment sessions. All tests were presented in one day while providing ten to fifteen minute breaks in between assessment to prevent testing fatigue. Baseline assessments were administered by the primary researcher. Post-treatment testing was administered by a research assistant, so that familiarity with the primary researcher would not impact performance.

All test measures (WAB-R, BNT and VNT) used identical assessment forms and stimuli at each administration (baseline and post-treatment). The probes for each discourse tasks were also similar during both assessment sessions. These may have

produced a repeated administration effect, which often results from the lack of alternate forms for commonly used aphasia tests. In addition, assessment measures were administered only one time, and this score may not be a true representation of the participant's abilities. This research study did not obtain multiple baselines due to limited time constraint and scheduling conflicts.

### **Procedures**

The procedures for the study were based on the CIAT II protocol (Johnson, et al., 2014). For this particular study, the participant was required to have her caregiver present with her throughout treatment. During one-on-one training activities, the caregiver was asked to observe through a two-way mirror. In three tasks, the caregiver was required to be present in the room with the participant to facilitate the activity. The caregiver received training on how to carry out the exercises under the supervision of the researcher at all times during the duration of treatment. This training enabled the caregiver to provide the participant with supervised practice of the activities that were assigned as homework throughout the treatment period.

The participant received three hours of training for 10 consecutive weekdays with 30- minutes additional time devoted to the implementation of the transfer package (30 hours + 3 hours = 33 hours of training). All treatment sessions took place in a quiet therapy room. During most of the activities during treatment, the participant was seated across the researcher and caregiver to facilitate social interaction. A removable cardboard divider was placed on the table during the language card game to occlude the participant's view of her partner's cards. As the language card game requires at least two

participants, one of the primary researchers took turns with the participant. Sessions were video recorded using the Panasonic Wireless Internet Video Recorder, an Apple iPad and an iPhone recorder for transcription and coding.

### *Stimuli*

A list of function words (i.e. articles, pronouns, prepositions, conjunctions) with varying length and complexity was created. The Corpus of Contemporary American English (Davies, 2008) was used to estimate the frequency and difficulty of the words selected for training. These words were used as stimuli during speech repetition drills, one of the intervention tasks. Three lists of 20 items each were arranged and graded according to difficulty.

A list of Activities of Daily Living (ADL) phrases was also arranged. High-frequency words based on the Corpus of Contemporary American English (Davies, 2008) were used to create phrases and sentences. ADL phrases and sentences, which were tailored to the participant's daily activities, were presented during phrase repetition tasks. Ten lists of 10 phrases and sentences each were arranged and graded according to length and complexity.

A set of 280 commonly used Bank of Standardized Stimuli (BOSS) pictures in color were printed on standardized wallet size cards (3 x 5 inches) and used as experimental stimuli. Using the database on word frequency in the Corpus of Contemporary American English (Davies, 2018), experimental stimuli were grouped and arranged in different category levels. Each set of cards represented the different category levels of ILAT (Difrancesco, Pulvermuller & Mohr, 2012). The category levels include:

word frequency (Category 1-3), minimal pairs (Category 4), semantic categories (Category 5), multi-feature objects and object arrangements (Category 6), spatial relationships (Category 7) and action words (Category 8). Each set included 12-16 pairs of picture cards.

It should be noted that the pictures were normed and standardized (Brodeur, Dionne-Dostie, Montreuil, & Lepage, 2010). Normative data have been collected on 480 pictures. Seventy-two individuals named the pictures and provided ratings (using 1-5 scales) to determine the object category, familiarity, visual complexity, object agreement, viewpoint agreement and manipulability (Brodeur, et al., 2010).

Black and white picture cards depicting daily life situations (Life Interest and Values Cards; Haley, Womack, Helm-Estbrooks, Caignon & McCulloch, 2008) were used during picture description tasks. Ten sets of 4-5 picture cards each were presented throughout the treatment session. Picture cards were selected based on the complexity of verbal responses required.

Role-playing scripts were also developed for each treatment session. These scripts were tailored to the daily activities engaged by the participant and her caregiver. The scripts were created to prevent the caregiver from engaging in the strong tendency to control the conversation with the participant. The scripts were graded based on the task expectations, activity familiarity and participant's readiness to engage in more complex linguistic tasks.

### *Intervention Tasks*

At the beginning of each treatment session, the participant and caregiver reviewed and verified the scores on the completed Verbal Activity Log (VAL) reflecting the participant's performance during the previous day. Johnson, et al. (2014) looked at the How Well scale of the VAL. However, for this study, both the How Well and Amount scales were reviewed and verified throughout the duration of treatment. The participant was engaged in five exercises following the same sequence on each treatment day. The different intervention tasks and the approximate time spent on each task is listed on Table 1. While Johnson, et al, strongly discouraged the use of gestures or nonverbal verbalizations for communication, gestures and nonverbal means of communication were neither prohibited nor encouraged during each treatment session. This is consistent with the current view on the synergistic interaction and functional connection between language and action systems that strongly links gesture and non-verbal activity to verbal communication (Difrancesco, Pulvermuller & Mohr, 2012). Instead, the participant was strongly encouraged to use spoken language when engaging in different activities during the treatment sessions. Similarly, the caregiver was instructed to encourage use of spoken language and respond only when the participant communicates verbally, without adding constraints to use of gestures and non-verbal means of communication.

Table 1. Breakdown of Intervention Activities in the CIAT II and the approximate time spent on each task.

<b>Intervention Task</b>	<b>Allotted Time</b>
Completion of the How Well and Amount Scale of the Verbal Activity Log, review of the home diary and home skill assignment	30-40 minutes
Speech repetition drills	20 minutes
Activities of Daily Living (ADL) phrase repetition	25 minutes
Language Card Game	30 minutes
Picture Description	30 minutes
Role Playing	30 minutes
Home Skill Assignment	5 minutes

The repetition drills were intended to be warm-ups to prepare the participant for carrying out more challenging, subsequent tasks. During the speech repetition drills, words that are frequently omitted from the speech of individuals with non-fluent aphasia were presented. These involve function words such as articles, prepositions, linking verbs, pronouns and conjunctions. The words were arranged in three lists of 20 items each, graded according to saliency and difficulty. Estimation of frequency and difficulty was based on the Corpus of Contemporary American English (Davies, 2008). Different lists were presented in each exercise on alternate days and repeated several times during each treatment session. The participant was provided up to 30 seconds to produce the best articulation of the target word. If the target word was not repeated with good intelligibility, phonemic cueing, modelling and phonetic placement were provided. The number of words that were repeated with good intelligibility was recorded. Comparison of current and previous scores was shared with the participant. This was to encourage competition against one's personal best, which has been found to be a motivating factor

to keep improving performance at a high level (Skinner, 1968). This is consistent with the shaping procedures used in research studies on CIMT (Taub, et al., 1994).

In the ADL sentence/phrase repetition drill, the participant was asked to repeat scripted ADL phrases and sentences that are commonly used in a functional conversation. These phrases were tailored to the participant's daily activities and linguistic abilities. Examples of the lowest-level ADL phrases/sentences used include "Good morning!", "How are you?" and "I don't understand." Throughout the treatment period, the participant's phrases and sentences were shaped and increased in terms of length and complexity. For example, base phrases and sentences were expanded to "Good morning, (communication partner's name)", "I am doing fine.", "I don't understand, please say it again." As soon as the participant had completed the repetition of a phrase or sentence, the researcher would respond as in typical conversation, with "I am fine, thank you," or "Oh you don't understand. Let me say it again."

The language card game was patterned to the original CIAT protocol (Pulvermuller, et al., 2001). It was modified for the participation of two players (rather than four players). Language action games in ILAT involve verbal communication in the context of other communicative and non-linguistic actions (Difrancesco, Pulvermuller & Mohr, 2012). The games involve some non-communicative actions as characterized by showing, passing or taking cards as well as spoken language such as asking for the card, clarifying questions or responding to requests. In this study, similar principles were applied. The participant joined by another researcher engaged in a language game in which all of the participants involved were provided with a set of pictures laid down in front of them. Prior to the start of the language card game, the deck of cards was

presented to the participant through naming drills. The participant was asked to identify the pictures in the cards to ensure picture familiarity. The language card game resembled the game “Go Fish” in which the participant asked the other play if she is holding a card with a specific picture of object, animal, person or actions to match one in her own set of cards. The participant was encouraged to use spoken means of communication to ask each other for cards in order to make pairs of similar pictures, to respond to questions by affirming or rejecting a request, depending on the presence or absence of a requested picture. For instance, one participant may ask the other, “Do you have a picture of house?” and the other participant is required to respond by providing the following information, “Yes, I have a house” or “No, I don’t have house.” Each round was considered completed when both participants were able to find the match of the cards in their deck. The participant and the other player took turns in requesting and responding to requests. The difficulty of the task was progressively increased in small steps based on the following elements: number of words, use of polite words/social markers (i.e. “please”, “thank you”, “name of the participant”), grammatical correctness and specificity of description (i.e. blue house, three cups, big ball). During the duration of the language game, the primary researcher sat beside the participant and provided support with verbally naming the pictures and shaping her verbal productions. The number of turns the participant took and the number of words used in a phrase or sentence during each exchange were recorded on a separate form. The participant’s performance every session through the log was periodically presented to the participant to encourage her to use more words and more specific utterances when describing items or objects in each picture card. Use of nonverbal means of communication was neither prohibited nor

encouraged. This is consistent with the recommendation of Difrancesco, Pulvermuller & Mohr (2012) that gestures used behind barriers as means of self-cueing are permitted as long as the other participant does not have visual access to the pictures and the gestures. While the main goal of CIAT or ILAT was to promote verbal communication, it does not prohibit self-cueing (e.g. gestures and hand movements) that may be associated with spoken language production (Difrancesco, Pulvermuller & Mohr, 2012; Pulvermuller & Berthier, 2008).

In the picture description task, the participant was presented with black-and-white action cards that reflected daily life situations. The Life Interests and Values Cards (Haley, Womack, Helm-Estabrooks, Caignon & McCulloch, 2010) were used as stimuli during treatment. In the CIAT II protocol proposed by Johnson, et al. 2014, this task was initially aimed at increasing fluency of speech while under a certain amount of time pressure. For this research study, time constraints were removed and the task was focused on facilitating an increase in spontaneous speech during picture description tasks. The task was introduced by asking the participant to name items in each picture. Unlike the protocol used in the Johnson et al. study, the participant progressed through two levels of complexity as their expressive language skills improved. During Level 1, the participant was required to use a carrier phrase when naming a particular item (i.e. “This is a man,” “This is a couch.”). In the 2<sup>nd</sup> level, the researcher encouraged the participant to provide a more spontaneous and specific description of the picture. The researcher used the prompt, “Tell me what you see in the picture and what they are doing?” The participant’s responses were recorded and transcribed on a separate form. At the end of the task, the

participant was provided with information regarding the number of words used and the number of pictures accurately identified and described.

During the role-playing task, both the participant and her caregiver were involved. Common interpersonal communication interactions were simulated. These include situations such as answering a phone call, conversation over breakfast or dinner, creating a grocery list, talking about a TV show, medication management, going to the movies and ordering food at a restaurant. Conversations were initiated by the caregiver under the supervision of the researcher, as individuals with non-fluent aphasia usually present with difficulty initiating conversations and they tend to stop trying after failed attempts at starting a conversation. Scripts for the caregivers were created to prevent the caregiver from taking over the conversation. The participant's responses were not scripted. The caregiver read prepared questions or comments from the script and the researcher recorded each of the participant's responses, determining the number of words per utterance, grammaticality, specificity of words used. For every interaction, an attempt to keep the conversation going as long as possible was made. Johnson, et al. (2014) emphasized the importance of this task as it was directly related to the participant's ability to use language in everyday activities in life situations. This task also provided practice and model to caregivers that participant of how the homework practice should be performed or facilitated at home or in the community.

### *Transfer Package*

Transfer package was initially introduced in constraint induced (CI) therapy principles in relation to motor therapy approaches. It has been found to be an important

element in facilitating transfer of the gains made in therapeutic setting to everyday life situations of individuals who experience muscle weakness and/or paralysis secondary to stroke (Morris, Taub & Mark, 2006; Taub, et al., 2013). For this particular study, the transfer package used consisted of behavioral techniques that aim to facilitate transfer of gains in terms of linguistic functions to everyday life situations. The components of the transfer package used in this study are similar to those utilized by Johnson, et al. in the CIAT II. protocol. These included a behavioral contract stating that participant and caregiver agree to perform the activities, a daily diary reflecting a record of number of instances the participant use spoken languages abilities, daily administration of the verbal activity log (VAL), home skills assignments including three easy, three medium and four difficulty tasks to be performed by the participant and problem-solving to determine difficult communication situations.

At the beginning of treatment, the researcher negotiated a contract with the participant and caregiver in which agreement was reached that the participant would speak as much as possible outside the therapy clinic and that the caregiver would encourage use of spoken language at home and in the community. Specific situations where the participant was required to use verbal language were discussed and listed. At the end of the process, the behavioral contract was signed by the participant, caregiver, researcher and a witness to emphasize the character of the document as a contract.

Throughout the duration of treatment, the caregiver was required to keep a daily log of the situations in which the participant engaged in outside the therapy sessions and how much they used spoken language during the activities indicated. The participant's performance in the home skills assignment was also recorded in this daily log. This log

was reviewed daily in order to problem-solve with the participants and caregivers, to help them identify missed opportunities for facilitating verbal interactions and to determine how much time was needed to perform a specific home skill assignment.

During treatment, the caregiver was required to complete the How Well and Amount scale of the VAL, which collects information about use of language in commonly encountered situations. The caregiver's ratings for each day were probed and verified during the initial 30-40 minutes of the sessions during which a review was provided to both the participant and the caregiver. Standard questions mentioned in the Johnson, et al. protocol were used for probing and verifying responses. For instance, if the caregiver rated a particular behavior a 2, a verifying response of the researcher would be, "Your caregiver rated that activity a 2. That means that you used speech for that activity but it was slow and you required help from your caregiver. Do you agree?" The final rating was determined by the agreement between the participant and the caregiver. While Johnson, et al. required their participants to complete the VAL, in this research study the caregiver was asked to complete the VAL due to the limited written language comprehension of the participant.

The problem-solving component of the transfer package consisted of the analysis of the completed VAL as well as the assessment of the participant's performance in the home skill assignment. The researcher helped the participant and caregiver to identify difficult communication situations and determine strategies to overcome the barriers in using spoken language in such situations. For example, if the participant started to get frustrated for being unable to recall a specific name of grocery item, time was spent on discussing ways that this problem can be managed. The researcher would suggest

strategies to facilitate word retrieval while grocery shopping such as repeating a phrase or word prior to asking for help from a store associate or requesting for a time to organize her thoughts before she make requests. In addition, the participant was also encouraged to advocate for herself whenever she is in public places by explaining to those around her that she had a stroke and she is having difficulty talking but she is trying her best to use spoken language.

The home skill assignment was provided every day throughout the treatment sessions. The participant and her caregiver were asked to perform three easy, three medium and three difficult language tasks at home, selected from a list of approximately 100 items. These language tasks were tailored to the participant's daily activities as reported by her caregiver. The home skill assignments were written on the daily Home Skill Assignment Sheet, and the therapist engaged the participant and the caregiver on how each exercise could be effectively facilitated. As therapy progressed and the participant started to increase her spontaneous verbalizations, homework exercises increased in difficulty. The caregiver was required to keep a log of the participant's performance in every home skill activity. These logs were reviewed at the beginning of each treatment session.

## **DATA ANALYSIS**

### *Scoring and Reliability*

All tests were scored by the primary researcher and by research assistants who are familiar with the scoring procedure. Reliability scoring occurred during testing or reviewing video recording of the session and research assistants were blinded to the

treatment condition to ensure unbiased reliability for computing test scores. For discourse measures, samples were transcribed from audio and video recording using the CHAT Transcription System (MacWhinney, 2000). To ensure reliability of transcriptions, twenty-five percent of all discourse samples were transcribed and coded again by research assistants, who are knowledgeable about the coding strategy. Research assistants were blinded to treatment condition and time of sample.

Reliability differences were addressed during transcription and coding processes. Initially, a discrepancy in the process of identifying fillers and word approximations were noted in the transcriptions of the primary researcher and reliability scorer. Guidelines for transcribing fillers and word approximations were adapted from the CHAT Transcription Manual (MacWhinney, 2000). After discussing the guidelines, transcription differences were resolved. All discourse samples were reviewed and corrected. Revised transcriptions were recoded and reliability scorer coded 50% of the revised discourse samples. Interrater reliability for the recoding was 96.91%. All discourse materials were then analyzed for the linguistic diversity measures and statistical analysis were performed on the primary researcher's revised transcriptions.

### *Statistical Analysis*

Due to the limited number of samples and possible inter-individual variation on the severity of language deficits, nonparametric statistics were used for data analysis. Each of the participant's test scores between two time points (baseline and post-treatment) were analyzed using the Revised Standardized Difference Test (RSDT; Crawford & Garthwaite, 2005; Garthwaite & Crawford, 2004). When analyzing the

results of the standardized tests administered in the study, Shewan and Donner's (1988) criteria were used to determine if the changes were significant. Shewan and Donner (1988) reported that a 5-point difference in WAB AQ (Kertesz, 2007) scores is considered significant. A change of 2 standard deviations on the BNT (Kaplan, et al, 2000) and 2.81 standard deviations on the VNT (Cho-Reyes & Thompson, 2012) determined significant change on this measure.

Discourse measures transcribed through the CHAT Transcription system were analyzed using the CLAN program. CLAN was used to analyze quantity and lexical diversity of discourse samples in terms of number of different words, total number of words, percentage nouns and verbs and mean length of utterances (MLU). CLAN was also used to compare results with the measures of previous AphasiaBank participants (MacWhinney, Fromm, Forbes & Holland, 2011).

## CHAPTER THREE: RESULTS

As stated in Chapter 1, the present study examined the efficacy of CIAT II for individuals with long-term severe chronic aphasia. The chapter is organized in the order of the research questions.

*Research Question #1: Determining the efficacy of CIAT II for individuals with long-term moderate-to-severe chronic aphasia*

### *3.1.1 Western Aphasia Battery – Revised Aphasia Quotient*

The Aphasia Quotient (AQ) composite score of for the Western Aphasia Battery-R (Kertesz, 2007) as well as the breakdown of scores based on four different subtests during baseline and post-treatment sessions are shown along with the change scores in Table 2. The participant improved by 5.3 points during post-treatment testing. Using the Revised Standardized Difference Test (RSDT; Crawford & Garthwaite, 2005), this difference was noted to be significant ( $p \leq 0.05$ ). Summary of the results of the WAB-R and scores obtained in each subtest are found in Figure 1. This significant difference is also consistent with values reported by Shewan and Donner (1988).

### *3.1.2 Naming Measures*

#### *3.1.2.1 WAB-R Naming Subtest*

The scores obtained during the administration of the WAB-R Naming Subtest (Kertesz, 2007) along with the change scores during baseline and post-treatment can be seen on Table 2. A 0.8 improvement in scores was observed during post-treatment. This

change was noted to be significant using the RSDT analysis (Crawford & Garthwaite, 2005).

### *3.1.2.2 Boston Naming Test*

The scores obtained during the administration of the Boston Naming Test (Kaplan, et al. 2000) as well as the change scores during baseline and post-treatment testing are summarized in Table 3. A 2-point decline was observed during post-treatment testing. Potential explanations for this are explored in the Discussion chapter.

### *3.1.2.3 Verb Naming Test*

The Verb Naming Test (Cho-Reyes & Thompson, 2012) results along with the change scores during baseline and post-treatment testing can be seen in Table 3. The participant demonstrated a 1-point improvement in scores between pre-treatment and post-treatment testing. RSDT (Crawford & Garthwaite, 2005) analysis showed a significant change in the participant's verb naming abilities. Factors which may underlie this change are further explored in the Discussion chapter.

### *3.1.3 Discourse Measures*

#### *3.1.3.1 WAB Spontaneous Speech-Fluency, Grammatical Competence, and Paraphasias*

The Spontaneous Speech Subtest score in the WAB-AQ is given along with the change scores during baseline and post-treatment testing in Table 2. A 2-point improvement in the overall spontaneous speech score was observed during post-treatment

Table 2. Actual scores and change scores in WAB-R

<b>WAB Subtests</b>	<b>Pre-TX</b>	<b>Post-TX</b>	<b>Post-pre change</b>
Information Content	4	5	1*
Fluency, Grammatical Competence and Paraphasias	3	4	1*
Comprehension	5.6	5.55	-0.45
Repetition	1.8	1.7	-0.1
Naming	2	2.8	0.8*
WAB-R AQ	32.8	38.1	5.3*

Maximum score (Information Content = 10; Fluency, Grammatical Competence and Paraphasias = 10; Comprehension = 10; Repetition = 10; Naming = 10; WAB-R AQ = 100)

\*significant at  $p \leq 0.05$ (based on RSDT; Crawford and Garthwaite, 2005)

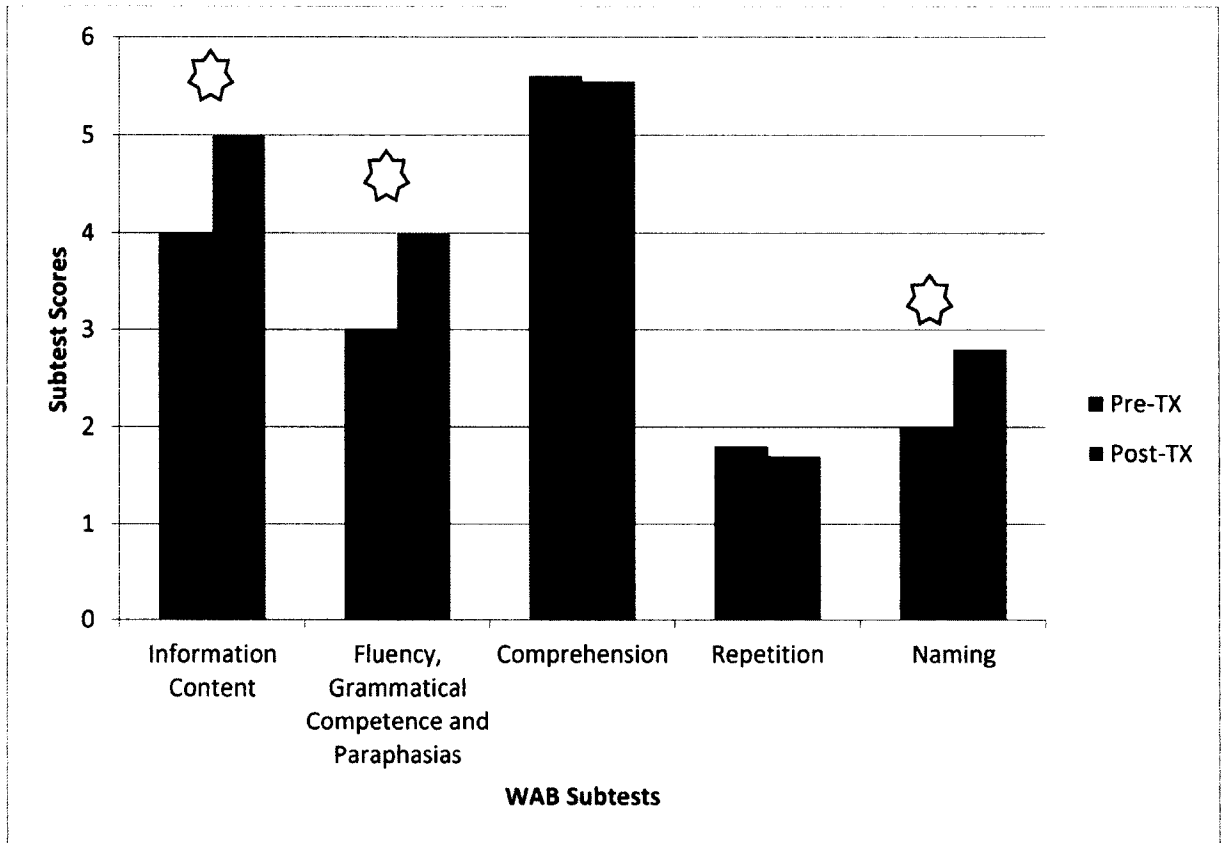


Figure 1. Actual scores in the WAB-R during pre- and post-treatment sessions.

\*significant at  $p \leq 0.05$ (based on RSDT; Crawford and Gathwaite, 2005)

Table 3. Actual scores and change scores in standardized naming measures

<b>Standardized</b>	<b>Naming</b>	<b>Pre-TX</b>	<b>Post-TX</b>	<b>Post-pre change</b>
<b>Measures</b>				
Boston Naming Test		3	1	-2
(maximum score = 60)				
Verb Naming Test		1	2	1*
(maximum score = 22)				

\*significant at  $p \leq 0.05$  (based on RSDT; Crawford and Garthwaite, 2005)

Table 4. WAB spontaneous speech sample analysis of lexical diversity reported in terms of mean length of utterances (MLU), number of different words (TYPE), total number of words (TOKEN), type-token ratio (TTR), percentage of nouns (%Nouns) and percentage of verbs (%Verbs).

<b>Measures of Lexical Diversity</b>	<b>Pre-TX</b>	<b>Post-TX</b>	<b>Post – pre change</b>
MLU	2.077	2.569	0.492
TYPE	14	71	57
TOKEN	50	338	288
TTR	0.28	0.21	-0.07
% Nouns	14.815	21.389	6.574
% Verbs	16.667	12.5	-4.167

testing. Factors which may underlie this change are further explored in the Discussion chapter.

The WAB Spontaneous speech samples were transcribed and coded using the CHAT and CLAN Transcription and Coding System (MacWhinney, 2000). These samples were used to calculate measures of lexical diversity. The results are shown in Table 4.

It can be observed that although there were gains in the number of different words (TYPE) and total number of words (TOKEN), type token ratio (TTR) decreased during post-treatment measures. Similarly, a 4 percent decrease in percentage of verbs was noted during post-treatment testing. On the other hand, a 6 percent increase in percentage of nouns was observed during post-treatment testing. Factors which may underlie these changes are further explored in the Discussion chapter.

### *3.1.3.2 Analysis of Lexical Diversity of Discourse Samples*

As described in the Methodology section, discourse samples were obtained through the narration of the Cinderella story and elicitation of Stroke Story and Coping. These were used to calculate measures of lexical diversity. The results are shown in Table 5. These results were compared with the normative data obtained from the Aphasia Talkbank database (MacWhinney, 2000). Overall, a significant increase in type-token ratio (TTR) and percentage of verbs were noted in both discourse samples.

The participant demonstrated a significant increase in TTR and percentage of verbs used during elicitation of stroke story and coping speech sample. No significant changes in mean length of utterance (MLU), number of different words (TYPE), number

of total words (TOKEN) and percentage of nouns (% Nouns) were noted during production of stroke story and coping speech sample.

During the Cinderella story retelling, a significant increase in TTR, % Nouns and % Verbs were noted. Similar to the results of the stroke story and coping sample analysis, no significant changes were noted in MLU, TYPE and TOKEN measures.

*Research Question #2: Effect of CIAT II on the amount and quality of participation in speech in life situations*

### *3.2 Verbal Activity Log*

The amount and quality of participation in speech in life situations were measured using the Verbal Activity Log *Amount and How Well Scale*. The scores in the VAL during pre-treatment testing, ten days of treatment and post-treatment testing can be found on Table 6. The average scores in the *Amount and How Well Scales* in the VAL during pre-treatment and post-treatment measures along with the change scores are found on Table 7. The mean scores obtained throughout the treatment sessions were used to obtain the mean scores and standard deviation for each scale. Figure 2 shows the summary of the mean scores obtained in the *Amount and How Well Scales* of the VAL.

At post-treatment, no significant changes in the amount and quality of participation in speech in life situations were noted. Factors which may underlie this result are further explored in the Discussion chapter.

Table 5. Discourse sample analysis of lexical diversity reported in terms of mean length of utterances (MLU), number of different words (TYPE), total number of words (TOKEN), type-token ratio (TTR), percentage of nouns (%Nouns) and percentage of verbs (%Verbs).

Key: ***Bold and Italicized*** = Significant by a criterion of at least 1 standard deviation change score (Note: Standard deviation values based on discourse samples obtained from control group in the Aphasiabank; MacWhinney, 2000).

Discourse Samples	Measures of Lexical Diversity	Pre-TX	Post-TX	Post – pre change
Stroke Story and Coping Speech Sample	MLU	1.857	2.37	0.513
	TYPE	12	25	13
	TOKEN	38	59	21
	TTR	0.316	0.424	<b><i>0.108</i></b>
	% Nouns	4.878	6.25	1.372
	% Verbs	12.195	17.188	<b><i>4.993</i></b>
Narration of the Cinderella Story	MLU	2.533	3	0.467
	TYPE	16	30	14
	TOKEN	35	54	19
	TTR	0.457	0.556	<b><i>0.099</i></b>
	% Nouns	2.632	20	<b><i>17.368</i></b>
	% Verbs	13.158	16.364	<b><i>3.206</i></b>

Table 6. Amount and quality of participation in speech in the life situation using the Verbal Activity Log (VAL) scores.

<b>Data Point</b>	<b>Verbal Activity Log Scales</b>	
	<i>Amount Scale</i>	<i>How Well Scale</i>
<b>Baseline</b>	<b>2.5</b>	<b>2.22</b>
Day 1	2.825	3.075
Day 2	2	2.76
Day 3	2.7	3.1
Day 4	2.69	3.19
Day 5	2.55	2.675
Day 6	2.575	2.85
Day 7	2.6	3.07
Day 8	2.6	2.86
Day 9	2.675	2.93
<b>Post-treatment</b>	<b>2.57</b>	<b>2.81</b>

Table 7. Amount and quality of participation in speech in the life situation using the Verbal Activity Log (VAL) average scores and change scores.

<b>Verbal Activity</b>	<b>Pre-TX</b>	<b>Post-TX</b>	<b>Post – pre change</b>
<b>Log Scales</b>			
<i>Amount Scale</i>	2.5	2.57	0.07
<i>How Well Scale</i>	2.22	2.81	0.58

(Amount Scale Mean = 2.57; SD = 0.21; How Well Scale Mean = 2.94; SD = 0.27)

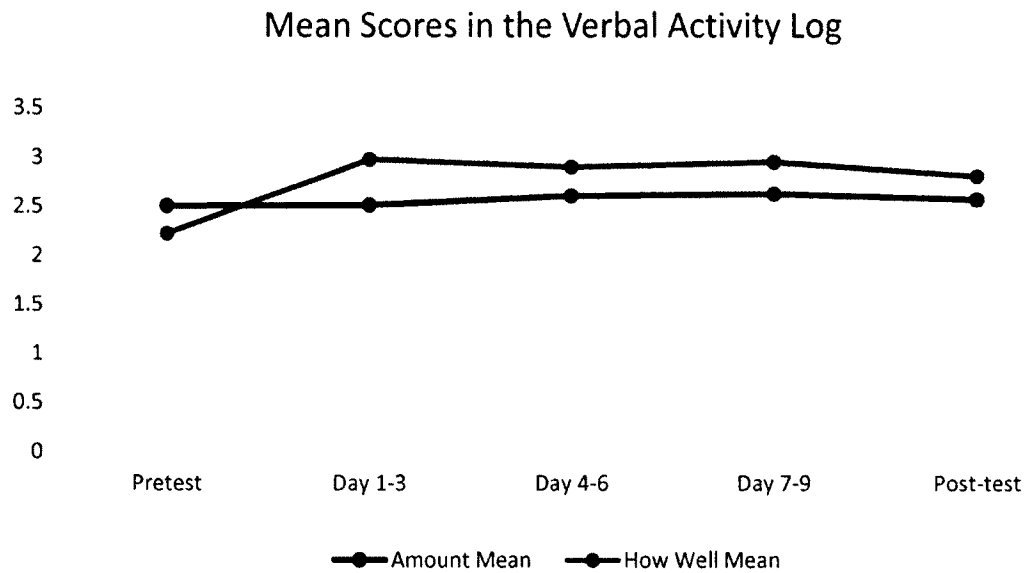


Figure 2. Mean scores of the *Amount* and *How Well Scales* of the VAL during pre-treatment, treatment and post-treatment sessions.

## CHAPTER FOUR: DISCUSSION AND FUTURE IMPLICATIONS

In this thesis, the enhanced protocol for constraint induced aphasia therapy II (CIAT II) was administered to an individual with severe Broca's aphasia and moderate verbal apraxia to determine the efficacy of CIAT II on adults with moderate-to-severe long-term chronic aphasia. The participant was tested on measures of aphasia severity, naming accuracy, spontaneous speech quality before and immediately after treatment. Participant's perception of the amount and quality of speech participation in life situations was measured through the Verbal Activity Log (VAL; Johnson, et al., 2014) before treatment, during the course of therapy and immediately after treatment. The treatment outcomes revealed that an individual with severe chronic non-fluent aphasia with accompanying moderate verbal apraxia, in some ways, responds positively to CIAT II. Positive gains in language measures, naming accuracy and lexical diversity in spontaneous speech were noted. The implications of these findings with reference to the research questions are addressed below.

### *4.1 Treatment Outcomes*

#### *4.1.1 Post-treatment outcomes of aphasia severity measure*

Based on the theoretical viewpoints of the CIAT II (Taub, et al., 2013; Johnson, et al., 2014), it was hypothesized that if the massed practice, shaping and addition of transfer package to facilitate transfer of treatment gains are sufficient to overcome learned non-use, the participant with severe chronic aphasia would show improvement in

aphasia severity scores after receiving the enhanced protocol of constraint-induced aphasia therapy. The findings in this thesis (WAB-R AQ; Kertesz, 2007) showed that the participant produced a positive significant change from baseline to post-testing. The following paragraphs review the difference between the findings of this study and previous CIAT II literature at post-treatment and possible reasons for the differences in performances are discussed.

Comparing the results obtained by Johnson, et al (2014) with scores obtained by the participant receiving CIAT II in this thesis, post-treatment gains in terms of aphasia severity measures are consistent. Participants in the CIAT II study by Johnson et al. (2014) produced positive gains in WAB-R AQ (Kertesz, 2007) after post-treatment. While these gains did not achieve significance for the group of participants in the sample, significant positive changes within individual participants are evident in the Johnson, et al. study (range 10.8 to 24.4 post – pre-treatment change in WAB-R AQ) except for one participant. Using the natural variability in scores of the WAB-R, which was identified to be 5.0 (Shewan & Kertesz, 1980), it can be noted that the change for all participants (Mean change WAB-R AQ = 13) is greater than the change observed with the participant in this thesis (WAB-R AQ change = 5.3). The minimal significant change at post-treatment evidence by the present study is not strong enough to assert that individuals with moderate-to-severe long-term chronic aphasia are able to benefit from CIAT II based on standardized aphasia severity measures. There are several possible explanations for this finding.

First, it is important to consider the differences in aphasia severity, onset of aphasia and presence of apraxia of speech in the participant in this study in relation to

participants in previous CIAT II studies. The participant in this study presents with moderate-to-severe Broca's aphasia, 12 years post-onset and a recent stroke 2 years ago. In addition, the participant has a diagnosis of a moderate verbal apraxia as indicated by the results of ABA-2 (Dabul, 2000). Johnson, et al (2014) classified their participants with moderate Broca's aphasia based on their scores on WAB-R (AQ scores between 50-80) at baseline. It was not indicated if the participants in the Johnson, et al. study have a diagnosis of apraxia of speech. Using the WAB-R AQ scores, it is suggested that the participant in this thesis had a more severe aphasia (WAB-R AQ = 32.8) than the participants in a previous study. This difference in participant profile could provide an explanation as to why the participant in this thesis did not produce as much significant change as the individuals in the Johnson, et al. study. Previous CIAT studies suggested mixed results in participants with chronic moderate-to-severe aphasia with or without concomitant apraxia of speech (AOS) (Szaflarski, et al., 2008; Goral & Kempler, 2009; Kempler & Goral, 2011). Kurland, Pulvermuller, Silva, Bruker & Andrianopoulos (2012) reported that AOS is a factor exacerbating non-fluent aphasia. The severity of aphasia as well as the presence of AOS affects the benefits an individual can achieve from CIAT. This finding suggests that the severity of the participant's aphasia and the diagnosis of moderate AOS contributed to the minimal gains achieved after treatment.

Second, as it was hypothesized in this thesis, it may be that the intensity of the CIAT II implemented in this thesis is not sufficient to produce marked changes in language severity measure. As mentioned earlier, the duration of training was decreased from 3 weeks given in the CIAT II study (Johnson, et al., 2014) to 2 weeks, treatment period similar to the original CIAT I study (Pulvermuller, et al., 2001). While the

amount of training time on a treatment day did not differ between this study and the CIAT II study, the participants in the CIAT II study received a total of 52.5 hours of in-laboratory treatment while the participant in this thesis only received a total of 33 hours of in-laboratory training. In an evidence-based systematic review by Cherney, et al. (2008), treatment intensity was associated with positive changes in outcome measures of language impairment in individuals with chronic and acute. The decrease in duration of training might be a factor contributing to the difference in outcomes between the two studies.

A third noteworthy point is the sensitivity of the measure used to assess aphasia severity for individuals with severe chronic aphasia and moderate verbal apraxia. The Western Aphasia Battery – Revised (WAB-R; Kertesz, 2007) was based on a normative sample of individuals with a diagnosis of aphasia. Co-morbidities such as apraxia of speech and dysarthria were not considered in the normative data. With this, the test may not be sensitive enough to recognize the subtle treatment gains achieved by the participant. In addition, most of the subtests included in the computation for the WAB-R AQ required verbal expression, it would have been difficult for the participant to evidence positive significant changes on these subtests to achieve a higher AQ score. It is widely recognized that there is a lack of sensitive tests that would detect progress for individuals with aphasia and concomitant motor speech disorders and the test used in this thesis may not have adequately assessed the participant's gains (Faroqi-Shah & Virion, 2009).

#### *4.1.2 Post-treatment outcomes of naming measure*

The participant in this study, who received CIAT II protocol, evidenced inconsistent gains on naming measures after treatment. A minimal but significant improvement in naming was observed in the WAB-R Naming subtest (Kertesz, 2007) as well as the Verb Naming Test (Cho-Reyes & Thompson, 2012). A decline in the post-treatment score of the BNT (Kaplan, et al., 2000) was observed. However, it should be noted that the score obtained during post-testing for the BNT remained within one standard deviation of the mean. The significant improvement in naming is consistent with the results of previous CIAT studies (Pulvermuller, et al., 2001; Barthel, et al., 2008; Kurland, et al., 2012; Kavian, Khatoonabadi, Ansari & Saadati, 2014). The score achieved in the BNT, on the other hand, is similar to the results obtained by Szaflarski, et al. (2008). Currently, there are no studies that examine the effect of CIAT II on naming accuracy. There are several possible explanations for the post-treatment results on naming accuracy of the participant receiving CIAT II.

First, this thesis hypothesized that an enhanced protocol of CIAT would produce significant benefits for individuals with severe chronic aphasia in terms of naming accuracy because of the inclusion of a larger variety of expressive language exercises with emphasis on increased verbal productions. Aside from the language-card game, which was adapted from CIAT I (Pulvermuller, et al., 2014), the participant in this study was provided with training on naming through picture description tasks. It is possible that the exposure of the participant to naming tasks contributed to the gains obtained after treatment.

A second explanation of the gains achieved by the participant in this study is the benefit an individual with aphasia can obtain from a deficit-specific focus to the intensive language protocol. Barthel, et al. (2008) initially proposed deficit-specific focus, which characterizes additional components of CIAT II. The modifications in the CIAT I study could have contributed to the treatment gains produced related to naming accuracy.

Third, the increased emphasis on shaping throughout the training may have contributed to the gains in naming accuracy achieved by the participant. Johnson, et al. (2014) mentioned that the emphasis on shaping while focusing on achieving small progressive increases in performance could improve participant motivation and facilitate success in verbal expression. During treatment, the participant was provided with feedback on the accuracy of naming during picture description and language-card games and was encouraged to overcome personal best. These may have contributed to the treatment gains achieved in this study.

One explanation for the decline in naming accuracy in the BNT (Kaplan, et al., 2000) could be due to the limited sensitivity of this assessment tool to recognize subtle changes in expressive language. In addition, compared to the Naming subtest of WAB-R (Kertesz, 2007) and VNT (Cho-Reyes & Thompson, 2012), BNT included more complex stimuli material that could have also contributed to the participant's decreased performance during post-testing.

A final factor that may have contributed to the decrease in score at post-treatment testing was a change in examiner administering the standardized tests. All post-treatment assessments were administered by a research assistant who was unfamiliar with the

participant to ensure absence of administration bias, and this may have influenced the outcomes.

#### *4.1.3 Post-treatment outcomes of discourse measures*

Post-treatment score on the WAB-R Spontaneous Speech Subtest revealed significant improvement in the overall spontaneous speech score. Post-treatment measures of lexical diversity based on discourse samples obtained were noted to be inconsistent. On analysis of lexical diversity using the WAB-R spontaneous speech sample obtained, an increase in number of different words, total words, mean length of utterances and percentage nouns were observed. Using the discourse samples obtained through the narration of the Cinderella story and the elicitation of the Stroke Story and Coping, a significant increase in type-token ratio and percentage of verbs were noted. In the narration of Cinderella story, in particular, a significant gain in percentage of nouns was evident. These findings are interpreted in the succeeding paragraphs with three major considerations. First, no CIAT II studies, to date, have reported examining discourse of individuals with severe chronic aphasia; hence, there is lack of comparative data from similar treatment protocol. Second, there is limited available literature examining the effects of CIAT on linguistic measures in discourse contexts in individuals with moderate-to-severe long-term chronic aphasia and moderate apraxia of speech. Most of the available studies that used linguistic measures in discourse as a treatment outcome have used a variety of subjective and objective communication measure to compare changes in participant's speech before and after treatment (Maher, et al., 2006; Szaflarski, et al., 2008; Faroqi-Shah & Virion, 2009; Goral & Kempler, 2009; Kirmess & Lind,

2011). In particular, Szaflarski et al. (2008) used total number of words, number of different root words and number of utterances as a linguistic measure during a story retell task. Faroqi-Shah and Virion (2009) assessed morphosyntactical structure in discourse based on proportion and well-formedness of verb production, tense accuracy and diversity. Goral and Kempler (2009) examined verb production in narrative contexts by assessing noun and verb productions. In these studies, diverse pattern of individual changes was reported (Maher, et al., 2006; Szaflarski, et al., 2008; Faroqi-Shah & Virion, 2009; Goral & Kempler, 2009; Kirness & Lind, 2011). Information from previous studies should be carefully considered given the variability of performance in different discourse genre. Finally, there is a dearth of resources for normative data on lexical diversity measures that the results of this thesis can be compared with. As this research study utilized three different discourse types including a story retell (narration of the Cinderella story), spontaneous discourse (Stroke Story and Coping) and a combination of picture description and spontaneous discourse (WAB Spontaneous Speech), criterion for clinical significance may vary across tasks. The Aphasia Talkbank (MacWhinney, 2000) currently has a database on lexical diversity measures for normal adults on narration of Cinderella Story and elicitation of spontaneous speech (Important Event versus Stroke Story and Coping). Discourse data on these two tasks were considered significant if they were at least above one standard deviation change from baseline to post-treatment testing, considering the participant's aphasia severity and the presence of apraxia of speech. While a previous study used at least two standard deviations above the mean as a criterion for considering significance (Faroqi-Shah & Virion, 2009), it should be noted that their study involved participants with milder severity of aphasia compared to the

participant in this study. Since there are no current normative data on WAB-R Spontaneous Speech (Kertesz, 2007) that the linguistic measures obtained in this study can be compared with, discourse data on this were described based on observed changes noted during baseline and post-treatment. There are several possible explanations for the post-treatment spontaneous speech score and lexical diversity findings.

First, this thesis hypothesized that the intensity, massed practice and addition of the transfer package would result in significant changes in discourse measures (e.g. WAB-R Spontaneous Speech-Fluency, Grammatical Competence and Paraphasias Subtest Score (Kertesz, 2007) and lexical diversity measures). While the results showed a minimal significant improvement in overall spontaneous speech score, post-treatment measures on lexical diversity were inconsistent across tasks. While there was a general trend of gains in mean length of utterances (MLU), number of different words (TYPE), number of total words (TOKEN) and percentage of nouns, a decrease in number of type-token ratio (TTR) and percentage of verbs were noted in the WAB-R Spontaneous Speech discourse sample. Also, the gains observed across tasks were not all judged to be significant. While this effect was unexpected, it could be explained by the difference in discourse genres. Armstrong (2000) reported that difference in discourse genre could account for variability of performance in tasks involving text-sampling. Higher efficacy scores and cohesive harmony were associated with more spontaneous discourse than picture description tasks (Armstrong, 2000; Kirmess & Lind, 2011). As the WAB-R spontaneous speech involved a combination of spontaneous speech elicitation and picture description, the retell of Cinderella story and elicitation of Stroke Story and Coping were more semi-structured and reflective of natural conversations and discourse contexts. In

relation to the difference in discourse genre, it can be noted that a significant increase in percentage of nouns during narration of Cinderella story can be noted compared to the two other discourse samples. This can be explained by the participant's familiarity with the story and her access to the details of the story through scanning of the wordless picture book prior to the retell. The Cinderella story has been used in aphasia research because of its utility and general familiarity in Western cultures (MacWhinney, et al., 2010; Faroqi-Shah & Thompson, 2007; Faroqi-Shah & Virion, 2009).

Second, as it was hypothesized in this thesis, it may be that massed practice which involved picture description tasks may not be sufficient to improve lexical diversity measures in discourse tasks that involve description of a picture situation. One of the modifications in the CIAT II (Johnson, et al., 2014) involves the addition of a picture description task, which facilitates description of a black and white picture scene using phrases and sentences with increasing length and complexity, a task similar to the picture description section of WAB-R Spontaneous Speech Subtest (Kertesz, 2007). While the skills facilitated in this task such as increasing length and complexity of verbal productions did not transfer to the measures of lexical diversity in the WAB spontaneous speech discourse, it may have contributed to the gains in more spontaneous and contextual discourse genres (narration of Cinderella story and elicitation of Stroke Story and Coping) obtained in this thesis.

A third and more practical possibility that could account for the variability in lexical diversity measures across tasks is experimental error. The participant in this thesis was diagnosed with moderate apraxia of speech, which impacted her speech formulation and production. Despite being internally motivated, her unsuccessful attempts to say the

intended word contributed to her increased frustration, especially during the initial part of post-treatment testing, when WAB-R was administered. It is possible that the participant's increased frustration level and emotional status at the time of testing impacted her performance during spontaneous speech and picture description tasks in the WAB Spontaneous Speech Subtest.

Finally, the difference in examiner eliciting the discourse samples could account for the variability in measures of lexical diversity across tasks. All post-treatment discourse samples were elicited by a research assistant who was unfamiliar with the participant to ensure absence of testing bias. Although similar scripts were used for discourse elicitations, follow-up questions vary on both testing points. For instance, when the participant demonstrated difficulty answering probe questions such as "How's your talking?", troubleshooting probe questions were asked such as "Are you having trouble with your talking?" Follow-up questions varied based on the participant's response and the elicitor's subjective interpretation of the response. These follow-up questions either allowed the participant to continue to try using speech or to restrict their responses. In addition, the amount of support and follow-up questions provided during each discourse elicitation may have contributed to the differences in the findings. The amount and type of support from non-aphasic communication partners have been identified as a relevant factor for the amount of spoken language production in different discourse contexts (Armstrong & Ferguson, 2010; Simmons-Mackie & Kagan, 1999). These could explain why there was variability in the findings with regards to measures of lexical diversity across different discourse samples.

#### *4.1.4 Amount and Quality of Participation in Speech in Life Situation*

The analysis of the Verbal Activity Log (VAL) scores revealed that there were no significant changes in the amount and quality of participation in speech in everyday life situations. These results are similar to the findings of Szaflarski, et al. (2008), who also did not find significant changes in the frequency of communication use based on the shortened version of Communication Activity Log, a measure similar to the VAL. These results, however, do not reflect the changes noted in communication use in participants who received CIAT I (Barthel, et al., 2008; Berthier, et al., 2009; Difrancesco, Pulvermuller & Mohr, 2012; Meinzer, et al., 2005; Pulvermuller et al., 2001) and CIAT II (Johnson, et al., 2014). Previously published studies reported overall gains in communication in everyday activities in participants receiving CIAT and a much greater improvement in participation in speech in the life situation when a home program or transfer package was added to the CIAT protocol (Meinzer, et al., 2005; Johnson, et al., 2014). There are several possible explanations for the outcomes obtained in this thesis.

First, the lack of change in the amount and quality of communication found in this study may be related to the breadth of communication situations addressed in the VAL. The items included in the VAL range from daily activities such as eating with familiar persons and talking on the phone to occasional activities such as talking to employees in a public place and ordering at a restaurant. The participant in this study only engages in few social activities and these include occasional trips to the grocery store, weekly Church visits and occasional telephone contacts with relatives and friends. In addition, she only lives with her son, who is her constant communication partner. Throughout the

treatment session, approximately 5-7 out of 12 communication situations were completed in the VAL. The limited number of communication opportunities where amount and quality of speech can be assessed could have possibly impacted the scores obtained in the VAL. In addition, the VAL may not have captured the gains in amount and use of speech in communication situations not included in the scale.

A second possible reason for the lack of change in the amount and use of communication found in the study is the lack of validity and reliability data supporting the use of VAL in measuring change in amount and quality of speech in daily life situations. In the Johnson, et al. (2014) study, only the correlation of the Amount of Use scale with other daily communication measures was reported. VAL was reported to be correlated with the Communicative Effectiveness Index (CETI) with a score of 0.79 and with the Communication Activity Log with a score of 0.85. In addition, the lack of specificity of the scale description for the amount of use and how well scales have consistently been a source of confusion in the part of the participant and caregiver. The descriptions did not include information about the use of jargons, carrier phrases and perseverative speech during communication activities. For instance, the participant uses the carrier phrase "I know no. I don't know." The frequency of use of this phrase in communication situation could receive a score from 3 – 5; however, the quality of speech could be judged depending on the interpretation of the caregiver. The caregiver, who completed the VAL forms throughout the study, consistently raised questions about how the scales could be confusing due to the differences in interpretation across individuals. Thus, the results obtained in the study could be a reflection of the instrument as well as inconsistent interpretation of the scale descriptions.

Third, the lack of improvement noted in the amount and quality of speech in daily life activities could be attributed to the modifications made in the study. Unlike the Johnson, et al. (2014) study where the participants completed the VAL and the caregivers verified the scores during treatment session, VAL was completed by the caregiver in this study due to the participant's limited comprehension of written language. Compared to the caregivers, participants may be more biased in judging the gains achieved in daily communication. Caregivers, who are used to the participant's communication behaviors, may not consider small gains in amount and quality of speech in life situations as they are used to the speech patterns of the individual with aphasia. Another modification to the CIAT II was the lack of periodic phone contacts to the participant and the caregiver. Johnson, et al. (2014) highlighted the importance of periodic phone contacts to increase retention of therapy gains in the improvement amount of participation in speech. The absence of periodic phone contacts during the duration of treatment could have negatively impacted the scores obtained in the VAL.

Finally, the adherence of the participant and caregiver to the activities recommended in the transfer package could have impacted the scores obtained in the VAL. Adherence to the treatment protocol was emphasized by Johnson, et al. (2014) when one of the participants in their study did not show significant improvements. In this thesis, the caregiver reported several instances of not completing the home skill assignment due to the participant's increased level of frustration when completing the assigned difficult tasks. Also, the participant and the caregiver had inconsistent reports about implementation of the transfer package. This could have negatively impacted the

caregiver's perception in the amount and quality of speech in participation in life situations.

Despite the results, the participant and the caregiver reported positive outcomes. The participant's son reported that the participant had more attempts to use spoken language to communicate. Additionally, the research assistants noted the increase of the participant's verbal productions during conversations. This observation was supported by the participant's speech-language pathologist at GUHSC when she resumed treatment with the clinician.

#### *4.2 Study Limitations*

The findings of this study suggest that, for individuals with severe chronic aphasia with moderate apraxia of speech, CIAT II decreases aphasia severity and increases lexical diversity of narrative and conversational speech. While these results are interesting, it is important to consider the limitations of this study to assist in appropriate interpretation of these results and help in designing future studies.

This study only involved one participant, making it a single-subject case study, and this made it difficult to determine reliable statistical significance of the outcome measures obtained. Also, the presence of moderate apraxia may have impacted her performance in language measures requiring verbal production.

Although this study attempted to create a comprehensive testing protocol to assess changes in a variety of language domains, there were several limitations to the testing battery. The time interval between testing was approximately five weeks (baseline to post-treatment testing), and there was potential for a repeated exposure effect.

This thesis aimed to collect naturalistic speech samples from participants. However, the presence of camera and an audio recorder may have influenced the participant's performance during discourse elicitation tasks. This study was also limited in its ability to establish true baseline in discourse contexts. Individuals with non-fluent aphasia greatly vary in their speech abilities as a function of context, conversational partners and comfort level. Thus, it is necessary to collect baseline measures over several time points to obtain a more realistic representation of the participant's abilities.

### *4.3 Implications and Future Directions*

#### *4.3.1 Implications*

To our knowledge, this is the first study to examine the efficacy of CIAT II for individuals with severe chronic aphasia. It is also the first study to examine the effects of CIAT II on naming accuracy and measures of lexical diversity in narrative and conversational speech. Hence, the findings add crucial information to the existing body of literature on CIAT as well as on the restorative therapy techniques for individuals with chronic aphasia. The findings of this study highlight the important contribution of massed practice, shaping and addition of transfer package within the context of constraint induced aphasia therapy in reducing the severity of aphasia in individuals with severe chronic aphasia. Results suggest that CIAT II may increase quality of speech in narrative and conversational discourse, as demonstrated by gains in measures of lexical diversity. There is, however, a relative limitation of CIAT II for individuals with moderate apraxia of speech, as noted in the outcome measures of the study.

#### *4.3.2 Future Directions*

This research study raised several important questions regarding the benefit for the enhanced protocol for constraint-induced aphasia therapy (CIAT II) for individuals with severe chronic aphasia. Future studies should attempt to replicate the study and results with a larger participant cohort and use other daily communication measure to determine the transfer of therapy gains in everyday life situations by assessing the quality and quantity of speech in everyday activities. Obtaining measurement that would indicate maintenance of treatment gains should be considered in future studies. In addition, future studies should also include a control group to determine which element of the CIAT II plays a significant role in reducing severity of aphasia and increasing lexical diversity in spontaneous speech. As current research builds to support a treatment approach that would positively impact different aspects of language, the effect of CIAT II on different language measures such as grammaticality, word retrieval, semantics and phonological processing should be explored. Finally, in order to fully establish the benefit of CIAT II for individuals with moderate-to-severe chronic aphasia, further research should directly compare CIAT II with other aphasia treatment approaches.

This study was a single-subject design with a weak class of evidence examining pre- and post-treatment behaviors. It is a phase 1 study designed to examine the efficacy of a new protocol for a treatment approach. It is therefore important that future studies focus on producing well-controlled treatment studies to increase the strength of these evidences. This study was a starting point for future examination of applications of CIAT II. As the results of the study provide promising results for individuals with severe

chronic aphasia, it is hoped that this treatment approach could positively impact the delivery of significant treatment effects for individuals with chronic aphasia.

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## EDUCATION

### **Gallaudet University, Washington, D.C.**

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Master of Science in Speech-Language Pathology (Current GPA: 3.959)

Seltzer League Awardee (May 2016)

ASHA Minority Student Leadership Program Class 2016

**University of the Philippines, Manila** – College of Allied Medical Professions April 2011

Bachelor of Science in Speech Pathology (Cum Laude; GPA: 3.72)

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## CLINICAL EXPERIENCE

### **The Lab School of Washington**

Jan 2017 – present

Graduate Intern

- Provides speech and language therapy to school-aged children presenting with language disorders, specific language impairment, articulation disorders, phonological processing disorders, literacy difficulties and learning disabilities.

### **MedStar National Rehabilitation Network (National Rehabilitation Hospital)**

Graduate Intern

Aug – Dec 2016

- Evaluation and treatment of clients presenting with swallowing disorders, cognitive impairments, aphasia, cognitive-linguistic difficulties secondary to stroke, traumatic brain injury, anoxic brain injury and trauma.
- Experience with the following assessment tools: *Western Aphasia Battery- Revised (WAB-R)*; *Boston Diagnostic Aphasia Evaluation – 3<sup>rd</sup> Edition (BDAE-3)*; *Woodcock Johnson Test of Cognitive Abilities – III (WJTC-A-III)*; *NRH Evaluation of Right Hemisphere Function (ERHF)*; *Videofluoroscopic Swallowing Study (VFSS)/Modified Barium Swallow Study (MBSS)*; *Ross Information Processing Assessment – 2<sup>nd</sup> Edition (RIPA-2)*; *Assessment of Language-Related Functional Activities (ALFA)*; *Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES)*; *Cognitive Linguistic Quick Test (CLQT)*; and *informal assessment of receptive and expressive language*.
- Computerized scheduling (AppointmentsEverywhere™) and documentation (Medilinks™) experience including: eval in progress, eval complete, bedside swallowing assessment, modified barium swallow study, daily progress notes, weekly progress notes, group planning notes, group notes, exception notes and discharge summaries.
- Participated in team conferences, continuing education lectures and case presentations.

### **Gallaudet University Hearing and Speech Center**

Graduate Intern

Jun – Aug 2016

Graduate Clinician

Fall 2015-Spring 2016

- Evaluation and treatment of clients presenting with articulation disorders, voice disorders, phonological processing disorders, receptive and expressive language delay and disorders, aphasia and deafness.
- Experience with the following screening measures: *Fruharty Preschool Speech and Language Screening*, otoscopic examination, immittance testing and pure tone testing.
- Experience with the following assessments: *Rossetti Infant-Toddler Language Scale, Pre-school Language Scale – 4<sup>th</sup> edition (PLS-4)*; *Clinical Evaluation of Language Fundamentals – 5<sup>th</sup> edition (CELF-5)*; *Clinical Evaluation of Language Fundamentals Preschool – 2<sup>nd</sup> edition (CELF-P2)*; *Western Aphasia Battery-Revised (WAB-R)* *Goldman-Fristoe Test of Articulation – 2<sup>nd</sup> edition (GFTA-2)*; *Khan-Lewis Phonological Assessment (KLPA-2)*; *The MacKay-Kummer SNAP Test – Revised: Simplified Nasometric Assessment Procedures*; *Test of Language Competence (TLC)*; *Fisher-Logemann Test of Articulation (FLTAC)*; *Receptive One-Word Vocabulary Test (ROWPVT)*; *Ling 6 Sound Test*; *Stuttering Severity Instrument- 4<sup>th</sup> Edition*; *Central Institute for the Deaf Everyday Sentences, speech and language sampling and informal assessment of receptive and expressive language*.
- Documentation experience including: diagnostic reports, therapy plans, progress report, discharge summaries and S.O.A.P. Notes.

## PROFESSIONAL EXPERIENCE

**Renoxx Caregivers, Inc., Therapeutic Integration Center, Lanham, MD** Mar 2014 – Aug 2015  
*Team Lead – Therapeutic Integration Staff/ Case Manager Assistant*

- Monitored direct support staff and their implementation of the Individualized Education Program of each participant.
- Facilitated implementation of daily activities in the Therapeutic Integration (TI) Center.
- Provided direct support services to children enrolled under the Autism Waiver Program.

**Independently: A Family-Centered Occupational and Speech Therapy Services Provider** May 2013 – Jan 2014  
**Private Clinic, Batangas, Philippines** Aug 2011 – Nov 2012  
*Speech and Language Pathologist*

- Evaluated and managed children, adolescents and adults with feeding, speech and language difficulty.
- Participated in parent-teachers-therapists conference with other professionals to provide a more holistic management for clients.
- Conducted school and home visit to improve collaboration of different professionals and improving family involvement.
- Co-managed with occupational therapists to handle a play and share social skills class for toddlers.

**Mary Mediatrix Medical Center, Department of Rehabilitation Medicine** June 2013 – Jan 2014  
**Batangas, Philippines** Sept 2011 – Nov 2012  
*Speech and Language Pathologist*

- Evaluated and managed both children and adult with speech and language problems such as apraxia, aphasia, and articulation difficulties.
- Participated parent-teachers-therapists conference with other professionals to provide a more holistic management for clients.
- Collaborated with doctors and other medical professionals to address client's needs. Improved existing hospital protocols regarding dysphagia management.
- Planned and implemented free clinics, trainings and seminars to increase public awareness on the field of speech therapy.

**Speechworks Developmental Center** June 2013 – Jan 2014  
**Private Clinic, Batangas, Philippines** Sept 2011 – Nov 2012  
*Speech and Language Pathologist*

- Evaluated and managed children with feeding, speech and language difficulty.
- Participated in parent-teachers-therapists conference with other professionals to provide a more holistic management for clients.
- Conducted school and home visit to improve collaboration of different professionals and improving family involvement.

**Operation Smile Philippines, Manila Cleft Care Center**  
Aug 2013 – Jan 2014

*Volunteer Speech Pathologist*

- Evaluated and managed children and adults with cleft lip and palate.
- Participated in free clinic missions by screening patients prior to surgery and increasing public awareness about cleft lip and palate.

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## RESEARCH EXPERIENCE

**Neurolinguistics Lab, Department of Hearing, Speech and Language Sciences** Aug 2015 – present  
**Gallaudet University**  
*Research Assistant*

- Collects and reviews literature related to the lab's research studies.
  - Provides assistance by performing data collection and transcribing speech and language samples using the CHAT and CLAN Transcription Program.
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## CERTIFICATION & SKILLS

- Language Proficiency: English, Filipino (Tagalog), American Sign Language (ASL)
  - Certified Speech-Language Pathologist, Philippine Association of Speech Pathologist
  - Basic Level CUED Speech – Gallaudet University
  - PROMPT Level I: Introduction to Technique Training – Manila, Philippines (May 2013)
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## RESEARCH PRESENTATIONS

- Maul, K.K. & Segismundo, M.C.P. (2016). *Enhancing Spontaneous Verbalizations in Chronic Aphasia: Transfer Package of Intensive Language Action Therapy*. Poster Presentation at Speech-Language-Hearing Association of Virginia Conference, March 18, 2016.
  - Maul, K.K. & Segismundo, M.C.P. (2016). *Enhancing Spontaneous Verbalizations in Chronic Aphasia: Transfer Package of Intensive Language Action Therapy*. Poster Presentation at Gallaudet University Research Expo, March 24, 2016.
  - Segismundo, M.C.P., Maul, K.K., Faroqi-Shah, Y.F. & Goffen, R.G. (2016). *Enhancing Spontaneous Verbalizations in Chronic Aphasia: Transfer Package of Intensive Language Action Therapy*. Poster Presentation at American Speech-Language-Hearing Association Convention, Philadelphia, Pennsylvania, November 18, 2016.
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## SEMINARS ATTENDED

<b>Beyond Workbooks: Cognitive Rehabilitation for TBI</b> Don MacLennan, MA, CCC-SLP MedStar National Rehabilitation Network, Washington, DC	Mar 2017
<b>Chronic Cough and Irritable Larynx Syndrome</b> Brittany Palmer, Kristine Teets, Marissa Simpson, Lee Akst ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Disorders at the Interface of Language and Motor Control: Experiments &amp; Modeling</b> Joseph Duffy, Lisa Goffman, Frank Guenther, Edwin Maas ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Multidisciplinary Approach to Evaluation and Treatment of Airway Patient</b> Brittany Palmer, Kristine Teets, Marissa Simpson, Alexander Hilel ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Phonological Treatment in Aphasia: Getting at the Core Deficit</b> Pelagie Beeson ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Differentiating Mild Cognitive Impairment from Healthy Aging</b> Kimberly McCullough, Kathryn Bayles ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Preserving Functions and Improving Outcomes in Head and Neck Cancer Patients</b> Barbara Messing, Ryan Sobel ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Treatment Mechanisms in the Lidcombe Program: Reflecting on Current Research</b> Michelle Donaghy ASHA 2016 Convention, Philadelphia, Pennsylvania	Nov 2016
<b>Perspectives on Auditory Neuropathy/Dys-synchrony Spectrum Disorders</b> Jennifer Smart, PhD Gallaudet University, Washington DC	Apr 2016
<b>AAC Intervention and Compensatory Strategies for Progressive Communication Disorders</b> Rachel Johnson, PhD, CCC-SLP Speech-Language-Hearing Association of Virginia (SHAV) Conference, Chantilly, VA	Mar 2016
<b>Dysphagia Diagnostic and Treatment Decisions, Common Pulmonary Diseases</b> James Coyle, PhD, CCC-SLP, BCS-S Speech-Language-Hearing Association of Virginia (SHAV) Conference, Chantilly, VA	Mar 2016
<b>Executive Functioning School and Life: What is Its Impact on Special and General Education Populations and How Do We Accommodate for Its Deficits?</b> Diane Talarico-Cavanaugh, MEd Speech-Language-Hearing Association of Virginia (SHAV) Conference, Chantilly, VA	Mar 2016

**Maximizing Cochlear Implant Outcomes with Short-Term AR Intervention**

Claire Bernstein, PhD  
Gallaudet University, Washington DC

Oct 2015

**Social Thinking Seminar**

Michelle Garcia-Winner, MA, CCC-SLP and Pamela Crooke, PhD, CCC-SLP  
International School Manila

Sept 2011