2012

**Constraint induced aphasia therapy in the very early phase of recovery following stroke**

Sarah D'Souza  
*Edith Cowan University*

Follow this and additional works at: [https://ro.ecu.edu.au/theses_hons](https://ro.ecu.edu.au/theses_hons)

Part of the Rehabilitation and Therapy Commons

**Recommended Citation**  

This Thesis is posted at Research Online.  
You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorize you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.
- A reproduction of material that is protected by copyright may be a copyright infringement.
- A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
Use of Thesis

This copy is the property of Edith Cowan University. However the literary rights of the author must also be respected. If any passage from this thesis is quoted or closely paraphrased in a paper or written work prepared by the user, the source of the passage must be acknowledged in the work. If the user desires to publish a paper or written work containing passages copied or closely paraphrased from this thesis, which passages would in total constitute and infringing copy for the purpose of the Copyright Act, he or she must first obtain the written permission of the author to do so.

Signed ________________________________

Dated ________________________________
Constraint Induced Aphasia Therapy in the Very Early Phase of Recovery Following Stroke

Sarah D’Souza

A report submitted in Partial Fulfilment of the Requirements for the Award of Bachelor of Speech Pathology Honours, Faculty of Computing, Health and Science, Edith Cowan University

Submitted November, 2012

I declare that this written assignment is my own work and does not include:

(i) material from published sources used without proper acknowledgement, or
(ii) material copied from the work of other students.
Constraint Induced Aphasia Therapy in the Very Early Phase of Recovery Following Stroke

Abstract

Background and purpose: Research suggests communication outcomes following stroke may be greater when treatment is administered in the acute phase of recovery. In addition, treatment outcomes are improved when therapy is provided at a greater intensity. Constraint Induced Aphasia Therapy (CIAT) has addressed the issue of treatment intensity by delivering therapy for three hours per weekday for two weeks, but its effectiveness has largely been investigated in the chronic phase of recovery. Treatment outcomes have typically been assessed on standardised tests and few studies have used connected speech and discourse measures to assess change. This research investigated daily intervention in the very early phase of recovery post stroke comparing CIAT and individual, impairment based intervention for individuals with a range of aphasia severities on a range of discourse measures.

Methods and Procedures: This study used a deidentified subset from a single blinded, randomised controlled trial Study of Aphasia: Early Intensive Treatment [SAEIT]. Patients with acute stroke were recruited within ten days post-stroke from acute and sub-acute Perth metropolitan hospitals to receive CIAT in a modified dose (45-60 minutes, five days a week) or individual, impairment based intervention (1:1 therapy). Both treatments were delivered in the same intensity for four to five weeks. The current study examined discourse samples which were segmented and formatted following SALT transcription conventions. Therapy outcome measures included the aphasia quotient from the Western Aphasia Battery and discourse measures examining microlinguistic elements of discourse immediately post-treatment and at three months follow-up. Treatment outcomes were analysed using mixed design ANOVAs to assess the within groups effect of treatment and the between groups effect of treatment type.

Outcomes and Results: Within groups analyses revealed a statistically significant treatment effect for three discourse measures: mean length of utterances; a measure of grammatical complexity; and the number of utterances containing non-relevant information. Additionally, changes in the AQ severity measure and majority of the remaining discourse measures were not significant but demonstrated a trend towards a positive treatment effect. There was no significant difference between the CIAT and 1:1 therapy groups in any of the outcome measures.

Conclusions: This study found daily CIAT to be comparable to 1:1 therapy on all outcome measures in the very early phase of recovery. Participants tolerated very early daily aphasia therapy and positive treatment gains were evident in the microlinguistic elements of discourse for both treatments. The standardised aphasia severity measure did not reflect changes that occurred in connected speech following intervention which suggests discourse measures are an important component of aphasia therapy outcome measurement. CIAT delivered in a group setting may address resource limitations in the acute setting to assist in increasing therapy intensity in very early aphasia recovery.

Sarah D’Souza, Dr. Natalie Ciccone and Dr. Erin Godecke
COPYRIGHT AND ACCESS DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;
(ii) contain any material previously published or written by another person except where due reference is made in the text; or
(iii) contain any defamatory material

Signed ________________________________

Dated ________________________________
Acknowledgements

I would like to thank my honours supervisors Dr. Natalie Ciccone and Dr. Erin Godecke. I appreciate all the time and effort you have put into this study as well as your much needed encouragement and wisdom throughout the honours process. I have learnt so much this year, thank you. I would also like to thank my friends and family for your support and encouragement this year, it has been greatly appreciated. I would also like to thank my fellow speech pathology honours students Katie Ilich, Vanessa Panak and Dominique Ferreira. Thank you for making the honours process an enjoyable experience.
# Table of Contents

**Introduction** .................................................................................................................. 1
  Aphasia and the Timing of Therapy ................................................................................. 1
  Aphasia and the Intensity of Therapy .............................................................................. 2
  Aphasia and Outcome Measures ..................................................................................... 3
  Constraint Induced Aphasia Therapy (CIAT) ................................................................ 4
  CIAT and the Intensity of Therapy .................................................................................. 5
  CIAT and the Timing of Therapy .................................................................................... 5
  CIAT and Outcome Measures ......................................................................................... 6

**Aims of this Study** ......................................................................................................... 8

**Method** .......................................................................................................................... 9
  Research Design ............................................................................................................ 9
  Participants ...................................................................................................................... 9
  Materials ....................................................................................................................... 12
  Procedure ....................................................................................................................... 13
    Intervention ................................................................................................................ 13
    Assessment Tasks ....................................................................................................... 14
    Discourse measures ................................................................................................... 15

**Results** ........................................................................................................................... 18
  Therapy Compliance ....................................................................................................... 18
  Evaluation of Treatment Effects ..................................................................................... 18

**Discussion** ...................................................................................................................... 23
  Aphasia and the Timing and Intensity of Treatment ...................................................... 24
  Aphasia and Outcome Measures ................................................................................... 27
  Theoretical and Clinical Implications of Findings .......................................................... 31
  Limitations and Future Directions .................................................................................. 32

**Conclusion** ..................................................................................................................... 33

**References** ..................................................................................................................... 35

**Appendix** ....................................................................................................................... 41
### Table of Contents

Appendix ................................................................................................................................. 41

- Aphasia Quotient Scores ........................................................................................................ 41
- Number of C-units .................................................................................................................. 41
- MLU (words) ............................................................................................................................ 42
- Number of Words .................................................................................................................... 42
- Percentage of Words in Mazes ............................................................................................... 43
- Number of Abandoned C-units .............................................................................................. 43
- Number of C-unit Level Errors ............................................................................................... 44
- Number of Word Level Errors ............................................................................................... 44
- Number of Omitted Words ...................................................................................................... 45
- Number of Omitted Bound Morphemes ................................................................................... 45
- % SI-X ...................................................................................................................................... 46
- % SI-0 .................................................................................................................................... 46
- % SI-1 .................................................................................................................................... 47
- % SI-2 .................................................................................................................................... 47
- % SI-3 .................................................................................................................................... 48
- % SI-4 .................................................................................................................................... 48
- Number of Metalinguistic Comments .................................................................................... 49
- Number of Utterances Containing Non-Relevant Information ............................................ 49
Constraint Induced Aphasia Therapy in the Very Early Phase of Recovery Following Stroke

Research suggests communication outcomes following stroke may be greater when treatment is administered within the first four months post-stroke (Robey, 1994; 1998). In addition, treatment outcomes are improved when therapy is provided at a greater intensity, for more than two hours per week (Basso, 2005; Cherney, Patterson, Raymer, Fryman & Schooling, 2008; Pulvermuller & Berthier, 2008; Raymer et al., 2008). Constraint Induced Aphasia Therapy (CIAT) is one treatment approach that has addressed the issue of treatment intensity by providing therapy for three hours per day for five days a week over a three week period (Pulvermuller, 2001; Pulvermuller & Berthier, 2008) but its effectiveness has largely been investigated in the chronic phase of recovery. Within these studies, treatment outcomes have typically been assessed on standardised tests and few studies have used connected speech and discourse measures to assess change. This research investigated the use of CIAT in the very early phase of recovery post-stroke evaluating treatment outcomes on a range of discourse measures.

Aphasia and the Timing of Therapy

Research exploring the effectiveness of aphasia therapy indicates treatment following stroke is most effective when commenced within the first three months post-stroke (Robey, 1994, 1998). When therapy is administered within the first three months post-stroke, communication gains achieved by people with aphasia are nearly twice as large as spontaneous recovery (Robey, 1994, 1998). In addition, people who receive treatment within the first four months post-stroke make significant improvements in comparison to people who receive therapy after the first four months (Robey, 1994, 1998).
Research into the effects of very early aphasia intervention, when therapy is started within the first two weeks post-stroke, has demonstrated mixed findings. Godecke, Hird, Lalor, Rai and Phillips (2011) provided aphasia therapy for five days per week for a minimum of 2-3 hours a week, commencing as early as three days post-stroke. Within this study, treatment resulted in significantly improved communication outcomes at three weeks post-stroke, as measured by a standardised aphasia assessment, quality of life assessment and discourse measures. In contrast, Laska, Kahan, Hellblom, Murray and Von Arbin (2011) administered aphasia intervention two days post-stroke for a minimum of 3.3 hours per week. Laska et al. (2011) found that following intervention, outcomes were not significant in comparison to the control group who did not receive treatment, as measured by standardised aphasia assessments. However post hoc analyses revealed some individual participants demonstrated a significant reduction in aphasia severity at therapy completion which was maintained at six months follow-up, indicating that some individuals may be receptive to very early aphasia intervention.

Further exploration of aphasia treatment in the very early phase of recovery post-stroke is warranted given the current understanding of neuroplasticity, the benefits of intensive aphasia treatment and the positive outcomes associated with very early aphasia treatment (Robey, 1994, 1998; Kleim & Jones, 2008; Raymer et al., 2008; Godecke et al., 2011; Laska et al, 2011).

**Aphasia and the Intensity of Therapy**

There is debate in the literature regarding the definition of treatment intensity in aphasia research (Basso, 2012; Cherney, 2012). Within this study treatment intensity is used to describe the number and duration of treatment sessions. The optimal amount of aphasia therapy has not yet been established (Baker, 2012;
Bhogal et al., 2003; Godecke et al., 2011; Robey, 1998). Aphasia treatment that is provided at a greater intensity has been found to result in greater communication gains compared to treatment provided less intensely (Basso, 2005; Bhogal, Teasell, Foley & Speechley, 2003; Cherney et al., 2008, Cherney, 2012; Robey, 1998). More specifically, therapy outcomes are enhanced when treatment is administered in excess of two hours per week, as communication gains following low intensity treatments (less than two hours per week) are only slightly greater than spontaneous recovery (Robey, 1998). Additionally, research suggests there is no significant difference between moderate and high intensity aphasia intervention therefore therapy administered more than five hours per week may be unnecessary (Bakheit et al., 2007; Robey, 1998). Initial findings exploring highly intensive acute aphasia intervention resulted in no significant difference between highly intensive and moderately intensive treatment in the acute phase as measured by a standardised aphasia assessment (Bakheit et al., 2007). However, the researchers reported that none of the participants within the highly intensive group received the prescribed dose of treatment (five hours per week) and many refused treatment or were unable to tolerate treatment (Bakheit et al., 2007).

**Aphasia and Outcome Measures**

Aphasia is known to negatively affect the microlinguistic aspects of discourse including semantics, lexical diversity, grammatical complexity, communicative efficiency and amount of information conveyed (Armstrong et al., 2011). However comprehensive standardised aphasia assessments which focus primarily on word level production may provide little insight into the everyday communication ability of the individual with aphasia (Patterson & Chapey, 2008). Connected speech is more likely to reflect aphasia severity that cannot be captured
by current standardised aphasia assessments (Patterson & Chapey, 2008). The results of a Cochrane review found no significant advantage of aphasia therapy when outcomes were assessed by aphasia severity measures (Brady, Kelly, Godwin & Enderby, 2012). Protocols that integrate a range of discourse measures, including microlinguistic aspects of discourse, are essential in assessing communication outcomes of aphasia treatments, particularly as people improve their verbal communication as they recover (Armstrong et al., 2011).

**Constraint Induced Aphasia Therapy (CIAT)**

Previous research on CIAT has demonstrated significant improvements in language function and increased communication performance for people with chronic aphasia, 1-11.5 years after stroke (Barthel, 2008; Berthier, 2009; Breier, 2009; Faroqi-Shah, 2009; Kirmess, 2010; Kurland, 2010; Maher, 2006; Meinzer, 2005; Pulvermuller, 2001; Pulvermuller & Berthier, 2008). CIAT is an impairment based group therapy approach, rather than a social compensatory approach to therapy, as per many group interventions. The treatment programme uses communication constraints within a language task to encourage expressive language production. CIAT is thought to take advantage of neuroplastic changes that occur in the brain following stroke (Pulvermuller, 2001). This is achieved by inhibiting avoidance strategies and learned non-use and promoting the redirection of neural pathways involved in verbal output (Pulvermuller, 2001). CIAT tasks require people with aphasia to use verbal expression rather than compensatory strategies by constraining elements of the therapy tasks including the selection of specific material designed to shape the production of treatment targets, the use of ‘rules’ to constrain and extend expressive output and the adjustment of reinforcement contingencies to match the individual’s needs (Pulvermuller, 2001).
**CIAT and the Intensity of Therapy**

Within the initial research protocols CIAT was administered in the chronic phase of recovery for three hours per weekday for two weeks, for a total of 30 hours. This was thought to provide the required massed practice and intensity levels to achieve positive results and was shown to result in greater communication gains when compared to individual therapy provided for 30 hours, provided for one hour per week (Pulvermuller, 2001; Pulvermuller & Berthier, 2008). However, the efficacy of CIAT over other equally intensive treatments is yet to be established as CIAT has not consistently resulted in greater communication gains when therapy is controlled for intensity (Maher et al., 2006; Barthel et al., 2008; Cherney, 2008). Further exploration comparing CIAT another treatment of the same intensity is therefore warranted to explore whether the gains achieved following CIAT can be attributed to the treatment type or the intensity of treatment.

**CIAT and the Timing of Therapy**

CIAT has mainly been explored in the chronic phase of aphasia recovery for individuals ranging from 1-11.5 years post stroke (Barthel, et al., 2008; Berthier et al., 2009; Breier et al., 2009; Faroqi-Shah & Virion, 2009; Kirmess & Maher, 2010; Kurland, Baldwin, & Tauer, 2010; Maher, et al., 2006; Meinzer, Djundja, Barthel, Elbert, & Rochstroh, 2005; Pulvermuller, et al., 2001). Few studies have investigated the impact of CIAT at early phase recovery (Kirmess & Lind, 2011; Kirmess & Maher, 2010) and none have explored CIAT starting within the first month post-stroke. Further exploration of aphasia treatment in the very early phase of recovery post-stroke is warranted given the current understanding of neuroplasticity, the benefits of intensive aphasia treatment and the positive outcomes.
associated with very early aphasia treatment (Robey, 1994, 1998; Kleim & Jones, 2008; Raymer et al., 2008; Godecke et al., 2011; Laska et al, 2011).

Kirmess and Maher (2010) used a case series study to investigate the outcomes of CIAT for three individuals between one and two months post-stroke. This study found gains evident on the standardised aphasia assessment and discourse outcome measures after treatment and at six months follow-up. Kirmess and Lind (2011) used a case controlled study to investigate the impact of CIAT on three participants with mild to moderate aphasia four, six and 14 weeks post-stroke. Following treatment, an overall improvement in the number of words produced and a reduction in aphasia severity were evident. These initial studies of CIAT in the acute phase of recovery demonstrate positive treatment effects on standardised aphasia assessments and discourse measures. However these studies are limited as a result of small sample sizes and lack of control group (Kirmess & Lind, 2011; Kirmess & Maher, 2010). These studies also demonstrate that CIAT administered one month following stroke does not adversely impact language recovery. There is a need to compare CIAT and alternative aphasia treatments to allow direct comparison of treatment type and the impact of intensity in the very early recovery phase.

**CIAT and Outcome Measures**

Research into the effectiveness of CIAT has measured treatment outcomes across a range of areas including functional communication outcomes, general standardised aphasia batteries, tests of specific areas of language and discourse measures.

Improved functional communication outcomes of CIAT have been widely explored within the literature as measured by the Communicative Effectiveness Index (CETI; Lomas et al., 1989) and the Communicative Activity Log (CAL)
There is a wide range of literature demonstrating the impact of CIAT in the reduction of the severity of aphasia as measured on standardised aphasia assessments including the Boston Diagnostic Aphasia Examination (Goodglass, 2001), the Aachen Aphasia Test (Huber, Poek & Willmes, 1984) and the Norwegian Aphasia Test (Reinvang, 1985) (Barthel, Meinzer, Djundja & Rockstroh, 2008; Berthier et al., 2009; Kurland, Baldwin & Tauer, 2010; Meinzer, Djundja, Barther, Elbert & Rochstroh, 2005; Pulvermuller et al., 2001). In addition, improvements in specific language modalities following CIAT have been measured by The Object and Action Naming Battery (Druks & Masterson, 2000), The Boston Naming Test (Kaplan, Goodglass & Weintraub, 2000), The Action Naming Test (Nicholas, Obler, Albert & Goodglass, 1985), The Verb and Sentence Test (Bastiaanse, Lind, Moen & Simonsen, 2006) and The Object Naming Test and The Naming Frequency Test from the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA; Kay, Lesser & Coltheart, 1992) (Kirmess & Lind, 2011; Maher et al., 2006; Meinzer et al., 2005; Pulvermuller et al., 2001).

Several studies have utilised discourse elicitation tasks in assessing outcomes of CIAT, including narrative discourse retells, informal conversation, semi-structured interviews and picture descriptions (Faroqi-Shah & Virion, 2009; Kirmess & Lind, 2011; Maher et al., 2006). These studies have explored the impact of CIAT on the number of narrative words, the number of utterances, the number of sentences, mean length of utterances (MLU) (Maher et al., 2006), proportion of well formed sentences, accuracy of tense, diversity of tense marking (Faroqi-Shah &
Virion, 2009), number of nouns and verbs, lexical diversity, lexical richness, token frequency and semantic specificity, proportion of nouns and verbs, types and tokens of nouns and verbs (Kirmess & Lind, 2011) and Correct Information Units (CIU; Breier et al., 2009).

Number of words, utterances and sentences (Maher et al., 2006) and percent CIU (Breier et al., 2009) improved immediately following therapy however these findings were limited as a result of a small sample size or lack of control group. Additionally, significant improvements were evident in tense accuracy, proportion of well formed sentences and tense diversity immediately following therapy and at three months follow-up (Faroqi-Shah & Virion, 2009).

Treatment outcomes following CIAT have focused primarily on standardised tests with fewer studies focused on the use of discourse measures. The initial results of studies evaluating CIAT using discourse measures are generally positive however their broader application is limited as a result of small sample size or lack of control group.

Aims of this Study

A need exists to compare CIAT and more typical approaches to aphasia therapy in the very early recovery phase when intensity is controlled. Additionally, there is a need to assess treatment outcomes on a range of communication measures that may demonstrate changes in connected speech in aphasia recovery that may not be reflected in the standardised tests commonly used in the literature.

The present study was a non-inferiority trial, to investigate if the proposed treatment (CIAT) was not inferior to more typical aphasia therapy approaches and explore whether outcomes following CIAT were comparable to 1:1 therapy provided at the same intensity in very early aphasia recovery. CIAT is an impairment based
group therapy approach, rather than a social compensatory approach to therapy, as per many group interventions. This study investigated CIAT in the very early phase of recovery in a group therapy approach as this may enable the intensive treatment of more people with aphasia at the one time and provide a more economical impairment based treatment alternative.

Additionally, this study aimed to explore microlinguistic elements of discourse following daily aphasia therapy in the very early phase of recovery in order to explore changes occurring during this time at the microstructural level of discourse for all participants across both therapy types.

Method

Research Design

The study used a subset of participants from a single blinded, randomised controlled trial Study of Aphasia: Early Intensive Treatment [SAEIT] (Godecke, Ciccone, Granger, Hankey & Phillips, 2009). The SAEIT trial had a primary endpoint at four weeks post-stroke. Follow-up measures were taken at three and six months post-stroke. Participants received either CIAT in a group setting (CIAT group) or individual impairment based aphasia therapy (1:1 group). Both SAEIT and the present study investigated the within-subjects effects of intensive therapy over time and the between-subjects effects of treatment type.

Participants

The SAEIT trial included 20 participants who were a median of three days (range: 0-10 days) post-stroke. These participants were recruited from Royal Perth Hospital (RPH) or Sir Charles Gairdner Hospital (SCGH). Additionally, RPH Shenton Park Campus and Osborne Park Stroke Rehabilitation Unit provided stroke
rehabilitation for patients who required ongoing inpatient rehabilitation. Participants were identified as appropriate for SAEIT based on the following criteria:

_Inclusion criteria:_

- Admission to hospital with an acute stroke, less than seven days post onset;
- First ever acute ischemic or haemorrhagic stroke confirmed by computer tomography and/or magnetic resonance imaging within 48 hours of hospital submission;
- Diagnosed with aphasia of any type or severity through the Frenchay Aphasia Screening Test (Enderby, Wood & Wade, 1987) and informal speech pathology assessments;
- Glasgow coma scale greater than 10, which indicates moderate alertness;
- Able to maintain an alert and wakeful state for 30 minutes as assessed by the speech pathologist on the ward;
- Aphasia Quotient (AQ) score of less than 93.8 of the WAB (Kertesz, 1982), as a score of 93.8 indicates ceiling level has been reached;
- Medically stable and able to interact for one hour within seven days of stroke onset;
- Correct hearing and vision;

_Exclusion criteria:_

- Subdural haemorrhage, sub-arachnoid haemorrhage or neuro-surgical intervention;
- A previous diagnosis of aphasia, mental illness, head injury or neurodegenerative condition. Information from the patient’s medical notes was used to determine if any of these conditions were present. Additionally, the speech pathologist on the ward collected a communication history from
the patient with their carers/family members to determine any previous
history of aphasia;

- Not fluent in the English language;
- Uncorrected vision or hearing.

In the SAEIT study at three months post-treatment there was one death (5%),
one person was medically unstable (5%), two participants were lost at follow-up
(10%) and two participants did not complete the minimum (900 minutes) amount of
therapy (10%). In the present study de-identified data was accessed from the SAEIT
study. Of the original 20 participants, 12 people met the criteria for inclusion in the
current study. Three participants (15%) were excluded from this data set because
they did not complete the assessments at the three data points (pre-treatment,
post-treatment, three months post-treatment). This was due to a range of factors including
the inability to complete the assessment at time point one (pre-treatment; 5%),
refusing assessment at time point three (three months post-treatment; 5%) or missing
data at time point three (5%). Time point four (six months post-treatment) was
excluded from the data set as a result of incomplete data due three participants
refusing assessment (self reported their language to be within normal limits) and the
inability to successfully contact two participants.

The group means for age, stroke type and AQ are detailed in Table 1. The
individual demographic data for the participants are detailed in Table 2.

Table 1.

<table>
<thead>
<tr>
<th>Group means for age, stroke type and hemisphere and AQ Score</th>
<th>CIAT group</th>
<th>1:1 group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>63.14 (16.58)</td>
<td>79 (6.04)</td>
<td>* .049</td>
</tr>
</tbody>
</table>
Stroke type
- Ischemic (%): 6 (86) vs. 4 (80)
- Haemorrhagic (%): 1 (14) vs. 1 (20)

Hemisphere
- Left (%): 6 (86) vs. 4 (80)
- Right (%): 1 (14) vs. 1 (20)

AQ score
- Mean (SD): 43.91 (24.31) vs. 50.92 (22.00)

Note: Independent samples t-test was conducted for baseline severity and age.

*Significant difference between groups, p ≤ .05

### Table 2.
**Individual Participant Demographics the CIAT Group and the 1:1 Group**

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Group</th>
<th>Gender</th>
<th>Age</th>
<th>AQ Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CIAT</td>
<td>M</td>
<td>46</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>CIAT</td>
<td>M</td>
<td>52</td>
<td>49</td>
</tr>
<tr>
<td>3</td>
<td>CIAT</td>
<td>M</td>
<td>83</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>CIAT</td>
<td>M</td>
<td>49</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>CIAT</td>
<td>F</td>
<td>84</td>
<td>75</td>
</tr>
<tr>
<td>6</td>
<td>CIAT</td>
<td>F</td>
<td>54</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>CIAT</td>
<td>M</td>
<td>74</td>
<td>46</td>
</tr>
<tr>
<td>8</td>
<td>1:1</td>
<td>M</td>
<td>78</td>
<td>60</td>
</tr>
<tr>
<td>9</td>
<td>1:1</td>
<td>M</td>
<td>72</td>
<td>77</td>
</tr>
<tr>
<td>10</td>
<td>1:1</td>
<td>F</td>
<td>83</td>
<td>16</td>
</tr>
<tr>
<td>11</td>
<td>1:1</td>
<td>F</td>
<td>87</td>
<td>49</td>
</tr>
<tr>
<td>12</td>
<td>1:1</td>
<td>F</td>
<td>75</td>
<td>53</td>
</tr>
</tbody>
</table>

### Materials

The treatment and assessment materials used in the SAEIT study were controlled across treatment sites. The discourse samples for the present study were
analysed using SALT software (Miller and Iglesias, 2008) and SPSS version 19.0 software.

**Procedure**

Participants were assessed at acute hospital submission for inclusion in the SAEIT study between December 2008 and July 2009. Recruitment to SAEIT was completed by the primary investigator and a research assistant. Study participants were randomly assigned to the treatment groups by a random number generator and sealed envelopes. Administration staff not involved in the study randomly allocated the therapy type. Pre-treatment assessments were completed by blinded assessors prior to participants commencing the treatment programme. Therapy was administered following the completion of the baseline assessment.

The therapy intervention programmes began before participants reached day ten post-stroke. Therapy for both treatment groups consisted of daily therapy for five days per week consisting of 45-60 minute sessions, 20 sessions over four to five weeks. Post-treatment assessments were completed immediately following the completion of the therapy programme as well as at three months and six months post-treatment by blinded assessors (qualified speech pathologists) who were not involved in the study.

**Intervention.** Two types of therapy intervention were administered. The CIAT group received CIAT in a modified dose, one hour per day. The individual group received an individual impairment based aphasia treatment delivered in the same intensity. Six trained speech pathologists with greater than three years experience provided therapy to the participants. The speech pathologists who administered therapy were not involved in the assessment sessions.
The procedures developed by Pulvermuller (2001) were used as a guideline for intervention for the CIAT group. The 1:1 group received individual aphasia therapy involving Semantic Feature Therapy (Boyle & Coelho, 1995), Lexical Semantic Therapy (Visch-Brink, Bajema & Vande Sandt-Koenderman, 1997), Mapping Therapy (Schwartz, Saffran, Fink, Myers & Martin, 1994) and Phonological Feature Therapy (Leonard, Rochon & Laird, 2008). Each participant in the 1:1 group had an intervention programme involving one therapy type or a combination of therapy types designed to suit each individual’s needs based on their speech pathology assessment results. The therapy targeted semantic, phonological and orthographic input and output through the comprehension and production of spoken and written single words (verbs and nouns) and sentences. Each type of therapy was administered according to a published protocol.

Following the conclusion of therapy, all participants received standard speech pathology intervention. The amount of therapy received post-intervention was recorded until the patient was discharged from speech pathology therapy or the time since intervention had reached six months.

**Assessment Tasks.** The SAEIT assessment protocol included two standardised tests (The Western Aphasia Battery, WAB; Kertesz, 1982) and the Revised Token Test (McNeil & Prescott, 1978), a measure of Quality of Life (SAQOL; Hilari et al., 2009) and the collection of discourse samples. The assessment tasks were completed an average of six days prior to the commencement of treatment (time point one), immediately post-treatment (time point two), three months post-treatment (time point three) and six months post-treatment (time point four). The assessment tasks were performed in a quiet room with the blinded
assessors. The discourse samples were collected in hospitals in either inpatient settings or outpatient clinics.

The current study examined the collected discourse samples. These were audio-recorded using a lapel microphone and an Olympus DM-550 digital voice recorder. The discourse elicitation tasks followed standardised instructions outlined by Nicholas and Brookshire (1993). This involved a picture description, a procedural narrative and a personal narrative. Participants completed two discourse samples for each discourse elicitation task at time point one, two, three and four. A minimum of 200 words was targeted at each assessment time point. As a result, some participants completed more than two samples for each discourse elicitation task. Additionally, the assessors used prompting questions to facilitate further discourse such as “Can you tell me anything else?”. Interaction between the assessor and the participants was kept to a minimum.

**Discourse measures.** Samples were transcribed orthographically as part of the SAEIT study. For the current study all speech samples were segmented into Communication Units (C-units), main clauses and any attached subordinate clauses and formatted following SALT transcription conventions (Miller & Iglesias, 2008). The microlinguistic aspects of the discourse samples were analysed using the following measures:

- **Number of C-units**: Total number of C-units produced during the assessment.
- **Mean Length of Utterances (MLUs (words))**: The average length of C-units, in words, which provides an indication of the syntactic complexity of utterances (Miller & Iglesias, 2008).
- **Number of words**: Total number of words within the samples.
- Percentage words in mazes: The total number of words in mazes, including filled pauses, false starts, repetitions and revisions, as a percentage of the total number of words which provides a measure of dysfluency (Miller & Iglesias, 2008).

- Number of abandoned C-units: Number of C-units that were abandoned by the speaker before the completion of the C-unit (Miller & Iglesias, 2008).

- Number of C-unit-level errors: Number of C-units containing two or more word-level errors and/or omitted words (Miller & Iglesias, 2008).

- Number of word-level errors: Number of incorrect words produced (Miller & Iglesias, 2008).

- Number of omitted words: Number of grammatical errors involving an omitted word (Miller & Iglesias, 2008).

- Number of omitted bound morphemes: Number of grammatical errors involving an omitted bound morpheme (e.g. plural or past tense markers) (Miller & Iglesias, 2008).

- Mean number of clauses per C-unit (S-I codes): A measure of the number of main and subordinate clauses contained within a C-unit, providing an indication of the grammatical complexity of the C-unit (Miller & Iglesias, 2008). For this study the mean number of clauses per C-unit was examined as a proportion (%) of the number of C-units within each specific category of S-I code compared to the total number of C-units. The following categories, as defined by Miller and Iglesias (2008) were included in this study:
  - %SI-X: Percentage of total C-units that were unintelligible, incomplete or non-verbal.
Very Early Daily Aphasia Therapy 17

- **%SI-0**: Percentage of total C-units that contained omitted subjects or omitted copulas.

- **%SI-1**: Percentage of the total C-units that contained one main clause.

- **%SI-2**: Percentage of the total C-units that contained one main clause and one subordinate clause.

- **%SI-3**: Percentage of the total C-units that contained one main clause and two subordinate clauses.

- **%SI-4**: Percentage of the total C-units that contained one main clause and three subordinate clauses.

In addition to the measures outlined by Miller and Iglesias (2008), the following codes were created for this study:

- **Number of metalinguistic comments**: Number of comments containing evaluations and/or reflections on personal language performance (for example, “I can’t tell you what this is”).

- **Number of utterances containing non-relevant information**: The number of C-units which are not relevant to the task or contain information related to a different topic or task. This category excludes metalinguistic comments as outlined above (for example in the picture description task, “We all laugh at me”).

In the SAEIT study, the discourse transcripts were checked for inter-rater reliability. Additionally, discrepancies within the SALT transcriptions were checked and resolved by a supervising researcher who is a qualified speech pathologist.
Results

Therapy Compliance

The CIAT group received a mean of 1176.43 minutes (19.61 hours) of therapy and 1:1 group received a mean of 1168 minutes (19.47 hours) of therapy. An independent samples t-test indicated no significant difference in the amount of treatment received ($t(10) = 0.34, p > .05$). Additionally an independent samples t-test demonstrated baseline AQ severity between groups was not statistically significant ($t(10) = -0.51, p > .05$). However an independent samples t-test revealed a statistically significant difference in the age of participants in the treatment groups. The 1:1 group participants were significantly older than the CIAT group participants ($t(10) = -2.32, p \leq .05, r = 0.41$) with a moderate effect size.

Evaluation of Treatment Effects

The descriptive statistics of the raw scores from the three assessments are detailed in Table 3.

Differential scores represent gains achieved from baseline to each assessment point to account for baseline severity scores. Prior to further data analysis, differential scores were calculated by subtracting the baseline scores from scores at assessment two (immediately post-treatment) and repeating this calculation for scores at assessment three (three months post-treatment).

A mixed design ANOVA was used to calculate the within subjects variable of treatment effect over the two time points (immediately post-treatment and three months follow-up) and the between subjects variable of treatment type. Figures representing the full data set for all participants over time are presented in the Appendix.
Table 3.
CIAT group and the 1:1 group means and standard deviations (SD).

<table>
<thead>
<tr>
<th></th>
<th>Baseline Mean (SD)</th>
<th>Post-treatment Mean (SD)</th>
<th>3 months post-treatment Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIAT Individual</td>
<td>CIAT Individual</td>
<td>CIAT Individual</td>
</tr>
<tr>
<td>AQ</td>
<td>48.86 (29.17)</td>
<td>77.50 (19.18)</td>
<td>82.83 (16.11)</td>
</tr>
<tr>
<td></td>
<td>50.92 (22.00)</td>
<td>81.05 (25.02)</td>
<td>89.42 (9.91)</td>
</tr>
<tr>
<td>Total no. of C-units</td>
<td>48.71 (39.68)</td>
<td>60.29 (19.58)</td>
<td>64.29 (24.56)</td>
</tr>
<tr>
<td></td>
<td>63.40 (42.90)</td>
<td>85.80 (21.08)</td>
<td>76.20 (23.51)</td>
</tr>
<tr>
<td>MLU (words)</td>
<td>4.93 (1.99)</td>
<td>7.49 (1.52)</td>
<td>7.65 (1.49)</td>
</tr>
<tr>
<td></td>
<td>4.90 (1.07)</td>
<td>8.11 (1.21)</td>
<td>7.72 (1.09)</td>
</tr>
<tr>
<td>No. of words</td>
<td>300.43 (282.51)</td>
<td>486.29 (187.93)</td>
<td>526.00 (186.59)</td>
</tr>
<tr>
<td></td>
<td>426.60 (355.21)</td>
<td>695.00 (204.39)</td>
<td>638.00 (236.28)</td>
</tr>
<tr>
<td>% words in mazes</td>
<td>23.57 (21.07)</td>
<td>8.00 (5.57)</td>
<td>9.86 (12.12)</td>
</tr>
<tr>
<td></td>
<td>11.20 (13.95)</td>
<td>6.80 (1.30)</td>
<td>6.80 (9.51)</td>
</tr>
<tr>
<td>No. of abandoned C-units</td>
<td>6.00 (8.81)</td>
<td>3.29 (3.64)</td>
<td>2.86 (3.63)</td>
</tr>
<tr>
<td></td>
<td>1.60 (1.14)</td>
<td>3.40 (2.51)</td>
<td>2.20 (2.17)</td>
</tr>
<tr>
<td>No. C-unit level errors</td>
<td>4.71 (4.75)</td>
<td>7.14 (10.70)</td>
<td>0.57 (1.13)</td>
</tr>
<tr>
<td></td>
<td>3.20 (3.11)</td>
<td>0.40 (0.89)</td>
<td>0.60 (0.89)</td>
</tr>
<tr>
<td>No. Word level errors</td>
<td>7.57 (5.41)</td>
<td>11.14 (10.42)</td>
<td>8.71 (9.95)</td>
</tr>
<tr>
<td></td>
<td>12.40 (16.01)</td>
<td>7.60 (6.88)</td>
<td>4.00 (1.87)</td>
</tr>
<tr>
<td>No. Omitted words</td>
<td>1.00 (2.24)</td>
<td>5.57 (4.47)</td>
<td>3.43 (3.51)</td>
</tr>
<tr>
<td></td>
<td>0.80 (0.84)</td>
<td>5.40 (1.82)</td>
<td>2.80 (2.05)</td>
</tr>
<tr>
<td>No. Omitted bound morphemes</td>
<td>0.00 (0.00)</td>
<td>0.29 (0.76)</td>
<td>0.14 (0.38)</td>
</tr>
<tr>
<td></td>
<td>0.00 (0.00)</td>
<td>0.40 (0.55)</td>
<td>0.40 (0.55)</td>
</tr>
<tr>
<td>% SI-X</td>
<td>54.92 (33.90)</td>
<td>16.57 (14.97)</td>
<td>9.14 (5.33)</td>
</tr>
<tr>
<td></td>
<td>44.90 (31.70)</td>
<td>9.90 (5.40)</td>
<td>6.64 (4.91)</td>
</tr>
</tbody>
</table>
### Very Early Daily Aphasia Therapy

**Note.** n=12. Means and standard deviations for participants’ complete scores from baseline, immediately post-treatment and three months post-treatment.

<table>
<thead>
<tr>
<th></th>
<th>% SI-0</th>
<th>% SI-1</th>
<th>% SI-2</th>
<th>% SI-3</th>
<th>% SI-4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.55</td>
<td>34.16</td>
<td>3.45</td>
<td>0.70</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>(8.83)</td>
<td>(26.99)</td>
<td>(5.56)</td>
<td>(1.20)</td>
<td>(0.60)</td>
</tr>
<tr>
<td></td>
<td>2.23</td>
<td>41.62</td>
<td>3.45</td>
<td>0.80</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td>(28.27)</td>
<td>(4.41)</td>
<td>(1.11)</td>
<td>(0.00)</td>
</tr>
<tr>
<td></td>
<td>2.53</td>
<td>65.16</td>
<td>14.35</td>
<td>1.33</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(2.19)</td>
<td>(13.65)</td>
<td>(12.49)</td>
<td>(1.95)</td>
<td>(0.00)</td>
</tr>
<tr>
<td></td>
<td>1.42</td>
<td>65.33</td>
<td>18.84</td>
<td>4.02</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>(1.44)</td>
<td>(3.72)</td>
<td>(5.05)</td>
<td>(2.93)</td>
<td>(0.81)</td>
</tr>
<tr>
<td></td>
<td>1.73</td>
<td>67.56</td>
<td>17.75</td>
<td>3.05</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>(1.81)</td>
<td>(6.29)</td>
<td>(5.62)</td>
<td>(1.92)</td>
<td>(0.89)</td>
</tr>
<tr>
<td></td>
<td>1.27</td>
<td>71.05</td>
<td>20.00</td>
<td>4.00</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>(1.59)</td>
<td>(9.43)</td>
<td>(5.54)</td>
<td>(3.25)</td>
<td>(0.39)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No. Metalinguistic comments</th>
<th>No. of utterances containing non-relevant information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.71</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>(12.50)</td>
<td>(7.50)</td>
</tr>
<tr>
<td></td>
<td>1.60</td>
<td>6.20</td>
</tr>
<tr>
<td></td>
<td>(2.07)</td>
<td>(7.63)</td>
</tr>
<tr>
<td></td>
<td>0.57</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>(1.51)</td>
<td>(1.50)</td>
</tr>
<tr>
<td></td>
<td>0.40</td>
<td>2.60</td>
</tr>
<tr>
<td></td>
<td>(0.55)</td>
<td>(2.61)</td>
</tr>
<tr>
<td></td>
<td>1.86</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>(4.91)</td>
<td>(2.23)</td>
</tr>
<tr>
<td></td>
<td>0.40</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>(0.89)</td>
<td>(1.73)</td>
</tr>
</tbody>
</table>

The between groups measure of treatment type was not significant for the standard aphasia severity measure or the discourse outcome measures (p>0.05).

The results indicate a statistically significant treatment effect with a large effect size in the increase of MLU (words) 
\[(F(2, 20) = 41.76, p \leq 0.05, r = 0.63)\] and %SI-2 
\[(F(1, 10) = 6.04, p \leq 0.05, r = 0.13)\] and a reduction in the number of utterances containing non-relevant information 
\[(F(1,10) = 4.95, p \leq 0.05, r =0.12)\].

These results indicate a positive treatment effect for both groups reflecting an increase in the accuracy, efficiency and complexity of connected speech.

Additionally, a reduction in the number of word level errors was significant 
\[(F(1, \ldots))\].
10) = 5.93, \( p < .05, r = 0.01 \) however post-hoc analysis revealed an outlying score in the 1:1 group. Subsequent analysis following the removal of this score showed number of word level errors was not significant \((F(1, 9) = 3.93, p < .05)\). The AQ score for both groups was not significant \((F(1, 10) = 4.77, p > .05)\) however graphed data demonstrated a positive trend towards significance indicating a reduction in the severity of aphasia. There was no significance for number of C-units \((F(1, 10) = 0.16, p > .05)\), number of words \((F(1, 10) = 0.03, p > .05)\), %WM \((F(1, 10) = 0.15, p > .05)\), %SI-X \((F(1, 10) = 2.61, p > .05)\), %SI-0 \((F(1, 10) = 0.70, p > .05)\), %SI-1 \((F(1, 10) = 0.88, p > .05)\), %SI-3 \((F(1, 10) = 0.10, p > .05)\) and %SI-4 \((F(1, 10) = 0.05, p > .05)\). Graphed data, however, demonstrated a trend towards a positive trend for individuals in both groups (see the Appendix) reflecting improvements in regards to grammatical complexity and efficiency of verbal output. There was no significance for number of omitted bound morphemes \((F(1, 10) = 0.07, p > .05)\) however this measure increased for both groups at immediately post-treatment and at three months post-treatment indicating an increase in the number of words with omitted bound morphemes, such as tense markers. There was no significance for number of omitted words \((F(1, 10) = 3.28, p > .05)\). This measure increased for both groups at immediately post-treatment and reduced to below baseline at three months follow-up reflecting an overall reduction in the number of missing words in connected speech.

Additionally, there was no significance of number of abandoned utterances \((F(1, 10) = 1.74, p > .05)\), number of C-unit level errors \((F(1, 10) = 2.13, p > .05)\), number of word level errors \((F(1, 9) = 3.93, p > .05)\) and number of metalinguistic comments \((F(1, 10) = 0.68, p > .05)\) however graphed data revealed different trends for the treatment groups (see the Appendix).
In regards to the CIAT group graphed data demonstrates a positive trend for number of abandoned utterances, indicating an improvement in the accuracy and efficiency of participants’ verbal output. Additionally, number of C-unit level errors and number of word level errors for the CIAT group increased immediately post-treatment. This reduced and was less than baseline measure three months post-treatment reflecting a reduction in errors at the word and utterance level. Additionally, the number of metalinguistic comments reduced immediately following treatment. This increased at three months follow up, however it remained below baseline performance. This indicates a reduction in the number of comments regarding the difficulty of the language task.

For the 1:1 group, the number of C-unit level errors and the number of word level errors demonstrated a positive trend. Number of abandoned utterances for the 1:1 group increased immediately post-treatment. This reduced three months post-treatment to below baseline measures.

There was a significant interaction of treatment type and time for %SI-4 ($F(1, 10) = 6.54, p < .05$). This indicates a different trend between the treatment groups in regards to the number of main clauses containing three subordinate clauses. The CIAT group’s mean for this score decreased immediately post-treatment however increased at three months follow-up. The 1:1 group increased immediately post-treatment however this reduced slightly three months post-treatment. Additionally, the variances between groups for MLU (words) at time point three (three months follow-up) were statistically significant as measured by Levene’s test of equality of variances ($F(1, 10) = 8.23, p < .05$) indicating a significant difference between groups at three months follow-up in regards to the length and complexity of utterances.
Discussion

This study compared the outcomes of CIAT with a 1:1 impairment based aphasia therapy approach provided at the same intensity to determine if there is a difference between these treatment types in the very early aphasia recovery. A positive treatment effect of daily aphasia therapy in the very early phase of recovery was observed in some discourse outcome measures, MLU (words), %SI-2 and the number of utterances containing non-relevant information. However, there was no significant difference observed between very early CIAT intervention and more typical 1:1 aphasia therapy delivered in the same intensity. Baseline severity scores were homogeneous however a statistically significant difference between groups in regards to age was evident which may have impacted therapy outcomes.

Additionally, this study aimed to explore the lexical and syntactic microlinguistic aspects of discourse following daily aphasia therapy in the very early phase of recovery. Some discourse measures revealed a significant treatment effect that was not reflected on the standardised aphasia severity measure. Furthermore, a number of discourse measures were not statistically significant, however reflected a trend towards a positive treatment effect.

There is much debate regarding whether the gains achieved following CIAT are the result of the nature or the intensity of the treatment. In this study, CIAT delivered in a modified dose, one hour per day, was compared to an individual impairment based aphasia treatment approach delivered in the same intensity. Treatment intensity was controlled to enable a direct comparison of treatment type in the very early phase of aphasia recovery. The CIAT group and the 1:1 group achieved positive gains following very early aphasia intervention however neither therapy type demonstrated superiority. The results indicate there is no significant
difference between very early CIAT and an individual impairment based approach when aphasia severity and treatment intensity are controlled.

It is important to highlight the significant difference between groups in regards to age may have impacted the assessment results as the 1:1 group was significantly older than the CIAT group. Research has found age differences in discourse in regards to the efficiency and accuracy of connected speech between young elderly people (between 60-74 years of age) and older elderly people (greater than 75 years of age) (Mackenzie, 2000). This was unavoidable as the result of a randomised controlled trial involving a small sample of participants. Further statistical analysis that accounts for this extraneous variable is required to confirm these results. These preliminary findings suggest the intensive nature of therapy is likely to be a major contributing factor to success of CIAT. This is consistent with current research that has found no clear advantage of CIAT in comparison to individual therapy, when treatment is controlled for intensity (Maher, et al., 2006; Barthel et al., 2008; Cherney, 2008) however these findings should be interpreted with caution.

**Aphasia and the Timing and Intensity of Therapy**

The results indicate that daily CIAT, administered in a modified dose and 1:1 therapy, delivered in the same intensity, had a positive impact on language during very early aphasia recovery. Participants from this convenience sample demonstrated significant positive gains in connected speech reflected in three discourse measures following very early aphasia intervention, within 10 days post-stroke. Additionally, a trend towards a positive treatment effect was evident in the standardised aphasia severity measure and majority of the remaining discourse measures. Daily interaction of 45-60 minutes was not too onerous for participants in
the very early stages of recovery following stroke as a positive effect on aphasia language recovery was evident for both therapy groups. There are mixed findings in the literature regarding the benefits of very early aphasia intervention (when therapy is commenced within the first four weeks post-stroke) as measured by standardised aphasia assessments. However, this study found that very early aphasia intervention did not adversely impact aphasia language recovery and no explicit harmful implications were evident.

These findings are consistent with research conducted by Robey (1994, 1998) and Godecke et al., (2011) which support the clinical application of very early aphasia intervention following stroke. This contrasts with Laska et al.’s (2011) findings where some participants demonstrated statistically significant improvements however as a group, no significant treatment effect was evident. It is interesting to note that participants in the Godecke et al. (2011) study demonstrated positive gains following approximately two hours of therapy per week. Previous research has found that aphasia therapy outcomes are enhanced when therapy is administered for two hours per week which is considered slightly below moderate intensity as outlined by Robey (1998). However in the Laska et al (2011) study, not all participants received the targeted moderately intensive amount of treatment (minimum of 3.3 hours) per week. The optimal amount of treatment in the aphasia recovery is not well understood and is likely to vary between people with aphasia (Robey, 1998). However it has been concluded that higher intensity treatments result in better therapy outcomes (Robey, 1998). A possible explanation for the differences in these research outcomes may be that moderately intensive treatment is required in this phase of recovery in order to achieve significant positive treatment effects for people with aphasia. Additionally, Godecke et al. (2011) assessed treatment
outcomes using a standardised aphasia assessment, a quality of life assessment and discourse measures. However, the Laska et al. (2011) study assessed therapy outcomes using standardised aphasia assessments only. The present study found no significant treatment effect based on the standard aphasia severity measure, therefore mixed findings in the literature regarding the very early aphasia treatment may be the result of insufficient outcome measurement.

In this study, CIAT and individual impairment based treatment was administered slightly below a highly intensive amount of therapy (minimum of five hours per week), as outlined by Robey (1998). The participants within this convenience sample tolerated intensive daily therapy in the very early stages of aphasia recovery. Daily aphasia therapy of approximately one hour per day for five days per week was sufficient to achieve significant positive gains in the very early phase of recovery.

Aphasia therapy is typically conducted after the very early acute phase of recovery as a result of limited resources and the demands of dysphagia assessment and management for patients following stroke (Code & Heron, 2003; Lalor & Cranfield, 2004; Vogel, Maruff & Morgan, 2010). Daily aphasia therapy in the acute phase of recovery resulted in significant communication gains however the clinical applicability of very early daily aphasia therapy may be limited as a result of clinical caseload demands (Code & Heron, 2003; Lalor & Cranfield, 2004; Vogel, Maruff & Morgan, 2010). The gains for each treatment type are comparable, however CIAT conducted in a group setting may address time and resource limitations better in a clinical setting as treatment involves one speech pathologist per three or four people with aphasia.
Aphasia and Outcome Measures

Three discourse measures revealed a significant treatment effect that was not evident in the standardised aphasia severity measure. MLU (words), %SI-2 and number of utterances containing non-relevant information were statistically significant. This indicates that participants’ connected speech became more accurate, efficient and complex as a result of very early aphasia intervention.

Interestingly, the AQ score standardised severity measure was not statistically significant. This indicates that the standardised aphasia severity measure was insufficient in reflecting the positive changes that occurred in connected speech in very early aphasia recovery. This raises questions regarding researchers and clinicians judging the efficacy of aphasia therapy outcomes based on standardised severity measures alone. The use of standardised aphasia severity assessments as the sole measurement of aphasia outcomes may increase the risk of committing type II errors. This is consistent with the finding of the Cochrane review (2012) that concluded that the lack of sufficient evidence supporting aphasia treatment is in part the result of insufficient outcome measurement in aphasia research. Discourse measures have revealed positive changes occurring at the microlinguistic level of discourse that were not reflected in the standard severity measure. Researchers and clinicians need to consider discourse measures when assessing aphasia treatment efficacy as they reflect changes in communication not shown on standard tests.

These findings highlight the need for discourse measures to be included as an essential component of the assessment battery for aphasia therapy outcomes.

A number of discourse measures were not statistically significant, however the graphed data revealed positive improvement (see the Appendix). A significant treatment effect for these measures could be expected with a larger sample size.
Percentage of words in mazes, %SI-X and %SI-0 were observed to decrease immediately post-treatment and at three months post-treatment. Following very early daily aphasia therapy, participants produced fewer filled pauses, revisions or restarts and their ability to remain on topic improved. Additionally, their utterances were more intelligible and the number of utterances with omitted subjects or copulas decreased. These measures, though not statistically significant, indicate that the verbal output of people with aphasia improves in regards to accuracy and efficiency of connected speech following very early daily aphasia therapy.

Additionally, number of C-units, number of words, %SI-1, %SI-3 and %SI-4 increased immediately post-treatment and at three months follow-up demonstrating a trend towards a positive treatment effect. Following treatment, participants increased their verbal output, evident in the production of longer utterances containing more words. Additionally, these utterances were more complex evident in an increase in the use of subordinate clauses. These discourse measures demonstrated a positive shift in the grammatical complexity and accuracy of connected speech during aphasia recovery. This is consistent with the findings of Maher et al., (2006) and Breier et al., (2009) who found that discourse measures revealed gains in verbal output in regards to the number of words and sentences produced as well as the efficiency and accuracy of verbal output.

Several discourse measures appeared to demonstrate a negative shift immediately post-treatment. However performance at three months follow-up was positive in comparison to baseline measures. This was evident for C-unit level errors and metalinguistic comments for the CIAT group and abandoned utterances for the 1:1 group. Immediately following treatment, a number of participants increased their verbal output through the production of a larger number of words and utterances.
This increase in the volume of discourse resulted in the production of more errors immediately following therapy in comparison to baseline performance. Participants later refined and improved the efficiency and accuracy of their verbal output, evident at three months follow-up. This suggests that the process of aphasia language recovery may initially involve the production of a larger number of words and utterances followed by the refinement of these utterances, resulting in more accurate and efficient connected speech.

Furthermore, it is interesting to note that the number of omitted bound morphemes increased for both groups immediately post-treatment and at three months post-treatment. At baseline, several participants produced a limited number of utterances and some baseline discourse samples consisted solely of utterance level errors. The increased amount of verbal output following aphasia intervention resulted in the appearance of errors, such as omitted bound morphemes, that were not present at baseline. It is possible that the language system may require greater amounts of language recovery to enable the refinement and reduction of the occurrence of this error. Based on this outcome measure alone it would appear that participants’ language deteriorated and on face value, this discourse measure failed to reflect the gains achieved in connected speech during aphasia language recovery. This highlights the need to analyse discourse holistically to obtain an overall picture connected speech and identify changes occurring in the language system as a whole.

Although there was no significant group difference, graphed data revealed subtle between group differences on a number of outcome measures. MLU (words) demonstrated a significant difference in the variance of differential scores between the groups at three months follow up evident in the Levene's test of equality of variances. Immediately post-treatment, the 1:1 group achieved greater gains in
regards to MLU (words) in comparison to the CIAT group. At three months follow-up, the 1:1 group’s mean MLU (words) decreased (although remaining higher than performance at baseline). However, the CIAT group’s MLU (words) improved consistently at follow-up. This resulted in a minimal difference between the CIAT and 1:1 group means at three months follow-up. There are a number of possible explanations for the variance. This may be indicative of subtle differences in language recovery as a result of the nature of the two therapy approaches administered. Additionally, it is possible that this difference observed may reflect the variable nature of aphasia presentation (Thompson, 2006). It is important to note that the nature and amount of aphasia treatment received by participants following the completion of therapy was not controlled. Additionally, different levels of engagement in communicative interactions between participants following intervention may have impacted performance at follow-up. It is not possible to determine if these factors contributed to participants’ performance and conclusions cannot be drawn from these results as this study involved a small sample size.

Furthermore, the results of the present study revealed a significant interaction for %SI-4 measure. Post-hoc analyses revealed a potential outlier that may have impacted the results. This participant demonstrated a reduction in the %SI-4 immediately post-treatment and at three months post-treatment. However, this was reflective of more accurate and efficient connected speech. This was also reflected in the participant’s reduction in their number of metalinguistic comments and number of words from the baseline assessment measures. It is not possible to rule out the impact of the variable presentation of aphasia in group studies (Thompson, 2006). Conclusions cannot be drawn from these results as this study
involved a small sample size and most participants did not produce any SI-4 utterances at any of the three assessment time-points.

**Theoretical and Clinical Implications of Findings**

There are a number of theoretical and clinical implications of this study. In regards to CIAT, this study provides preliminary evidence that the gains achieved following CIAT and 1:1 impairment based approach in the very early phase of recovery are comparable. However replication of this study and further statistical analysis are required in order to draw conclusions. CIAT delivered in a group setting may address resource limitations in a clinical setting as it enables a speech pathologist to deliver intensive impairment based aphasia therapy to three or four patients at the same time.

In regards to the timing and intensity of aphasia intervention, impairment based aphasia intervention administered within ten days post-stroke, for approximately one hour per day for five days per week, resulted in significant language gains. These preliminary findings support the application of daily aphasia therapy in the very early phase of recovery and demonstrate that intensive very early aphasia intervention does not adversely impact aphasia language recovery.

In regards to outcome measurement, discourse measures demonstrated significant positive gains in aphasia recovery that were not reflected in the standardised aphasia severity measure. Discourse measures provided insight into the changes occurring at the microlinguistic level of discourse during aphasia language recovery. The findings of the present study question the use of standardised aphasia severity measures in isolation to assess the efficacy of aphasia therapy in clinical practice and aphasia research. The use of standardised aphasia severity assessments as the sole measurement of aphasia outcomes may increase the risk of committing
type II errors. This study highlights the need to include discourse measures as an essential component of the assessment battery for aphasia therapy outcomes.

**Limitations and Future Directions**

There were several limitations within this study that may have impacted the research outcomes. A statistically significant difference between groups in regards to age was evident with a moderate effect size which may have influenced the efficiency and accuracy of participants’ connected speech (Mackenzie, 2000). Further statistical analysis is required in order to confirm the results reported in this study. The between groups difference in age was unavoidable as the result of the randomised controlled trial involving a small sample of participants. The baseline severity scores were not significantly different between the treatment groups. Differential scores were used to account for baseline severity therefore measures were taken to account for differences in the presentation of participants. Additionally, this study did not control for treatment received following the experiment therefore this may have influenced the follow-up results.

The population for the present study was small but representative of a broad range of severity of aphasia. The results of this study are likely to be conservative as a result of the small sample size therefore larger effect sizes are expected with more advanced statistical methods or a larger population sample. These findings are considered preliminary and should be interpreted with caution. There is a need to replicate these findings with a larger sample size. Additionally, a full cost efficiency and economical analysis of CIAT in very early acute stage of recovery is required in order to draw conclusions in regards to the economic benefits of CIAT versus individual therapy in the very early stages of recovery. Furthermore, there is a need
to investigate the long term outcomes of CIAT as well as patients’ experiences of CIAT in the very early stage of recovery following stroke.

**Conclusion**

In this study, the gains of CIAT in a modified dose were comparable to 1:1 therapy in the very early phase of recovery. This study provides preliminary evidence suggesting that therapy intensity is a major contributing factor to the success as CIAT as this study found no advantage of CIAT administered in a modified dose when treatment was controlled for intensity. Daily therapy of 45-60 minutes, five days per week was not too onerous for participants and was sufficient in order to achieve significant treatment gains reflected in three discourse measures. CIAT conducted in a group setting may address time and resource limitations in a clinical setting. The group therapy approach of CIAT may enable the intensive treatment of more people with aphasia at the one time and provide a more economical impairment based treatment alternative.

Discourse measures provided insight into changes that occur at the microlinguistic level of discourse during aphasia language recovery. It appears that aphasia language recovery initially involves the production of an increased volume of connected speech. This is later refined in order to improve the accuracy, efficiency and complexity of verbal output. The present findings highlight the importance of maintaining a holistic approach when employing discourse measures to assess aphasia outcomes. The evaluation of discourse measures in isolation may not provide an accurate representation of changes occurring in the language system as a whole. Although there was no significant group difference, some discourse measures revealed subtle differences between the two treatment groups. This may indicate that different types of aphasia intervention may influence language recovery.
differently. However, this may also be the reflection of the natural variation of aphasia presentation. It is not possible to rule out the impact of possible extraneous factors such as therapy received following this study’s intervention phase or the amount or nature of communication exchanges that participants were involved in.

Discourse measures have revealed improvements at a discourse level that were not reflected in the standard severity measure. This raises concerns regarding researchers and clinicians judging the efficacy of aphasia therapy outcomes based on standardised severity measures alone, as they may be at risk of committing type II errors. Researchers and clinicians need to consider discourse measures when assessing aphasia treatment efficacy as they reflect changes in communication not reflected on standard tests. These findings highlight the need for discourse measures to be included as an essential component of the assessment battery for aphasia therapy outcomes.
References


dependent learning in the context of Constraint Induced Language Therapy.

*Journal of the International Neuropsychological Society, 12*(6), 843-852.


Appendix.

Figure 1. Aphasia Quotient Scores for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 2. Number of C-units for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 3. MLU (words) for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 4. Number of Words for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 5. Percentage of Words in Mazes for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 6. Number of Abandoned C-units in Mazes for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 7. Number of C-unit Level Errors for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 8. Number of Word Level Errors for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 9. Number of Omitted Words for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 10. Number of Omitted Bound Morphemes for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 11. % SI-X for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 12. % SI-0 for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 13. % SI-1 for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 14. % SI-2 for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 15. % SI-3 for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 16. % SI-4 for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.
Figure 17. Number of Utterances Containing Metalinguistic Comments for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.

Figure 18. Number of Utterances Containing Non-Relevant Information for the CIAT Group and the 1:1 Group at Baseline, Immediately Post-treatment and 3 Months Post-treatment.