Intensive Versus Distributed Aphasia Therapy

A Nonrandomized, Parallel-Group, Dosage-Controlled Study

Jade Dignam, BSpPath; David Copland, PhD; Eril McKinnon, BSpPath; Penni Burfein, BSpPath; Kate O’Brien, BSpPath; Anna Farrell, PhD; Amy D. Rodriguez, PhD

Background and Purpose—Most studies comparing different levels of aphasia treatment intensity have not controlled the dosage of therapy provided. Consequently, the true effect of treatment intensity in aphasia rehabilitation remains unknown. Aphasia Language Impairment and Functioning Therapy is an intensive, comprehensive aphasia program. We investigated the efficacy of a dosage-controlled trial of Aphasia Language Impairment and Functioning Therapy, when delivered in an intensive versus distributed therapy schedule, on communication outcomes in participants with chronic aphasia.

Methods—Thirty-four adults with chronic, poststroke aphasia were recruited to participate in an intensive (n=16; 16 hours per week; 3 weeks) versus distributed (n=18; 6 hours per week; 8 weeks) therapy program. Treatment included 48 hours of impairment, functional, computer, and group-based aphasia therapy.

Results—Distributed therapy resulted in significantly greater improvements on the Boston Naming Test when compared with intensive therapy immediately post therapy (P=0.04) and at 1-month follow-up (P=0.002). We found comparable gains on measures of participants’ communicative effectiveness, communication confidence, and communication-related quality of life for the intensive and distributed treatment conditions at post-therapy and 1-month follow-up.

Conclusions—Aphasia Language Impairment and Functioning Therapy resulted in superior clinical outcomes on measures of language impairment when delivered in a distributed versus intensive schedule. The therapy program had a positive effect on participants’ functional communication and communication-related quality of life, regardless of treatment intensity. These findings contribute to our understanding of the effect of treatment intensity in aphasia rehabilitation and have important clinical implications for service delivery models. (Stroke. 2015;46:2206-2211. DOI: 10.1161/STROKEAHA.115.009522.)

Key Words: aphasia ■ intensity ■ language ■ neuroplasticity ■ rehabilitation ■ speech therapy ■ treatment
in the acute (time post onset, <3 months) or chronic stage (time post onset, ≥3 months) of stroke recovery. There was, however, a strong positive relationship between intensity and activity/participation-based therapy outcomes in the chronic stage. Furthermore, a Cochrane review conducted by Brady et al. found that intensive aphasia therapy significantly reduced aphasia severity when compared with non-intensive aphasia therapy; however, significantly more individuals withdrew from intensive programs. As such, the evidence for intensive aphasia therapy remains mixed, and there is uncertainty as to whether intensive treatment is appropriate for all individuals with aphasia.

A small number of studies have systematically compared different levels of treatment intensity while controlling the dosage of aphasia therapy provided. Consistent with the distributed practice effect, Raymer et al. and Sage et al. provided evidence demonstrating that distributed aphasia therapy may be equally or more effective than intensive aphasia therapy when considering the long-term maintenance of treatment gains. However, the dosage-controlled studies conducted to date have provided a relatively limited dosage of impairment-based therapy, to a small sample of participants, using a repeated-measures, crossover design. In addition, Martins et al. investigated the effect of treatment intensity in the subacute aphasia population, and as such, their findings may have been influenced by spontaneous recovery. Consequently, the comparative effect of intensive versus distributed aphasia therapy, when provided in a controlled dosage, warrants further investigation.

A preliminary study conducted at the University of Queensland evaluated the efficacy of the intensive, comprehensive aphasia program, Aphasia Language Impairment and Functioning Therapy (Aphasia LIFT), and found that the program positively affected participants’ language impairment and functional communication. This study aims to further investigate the effect of treatment intensity by comparing the efficacy of Aphasia LIFT when delivered in a dosage-controlled, intensive versus distributed treatment schedule on communication outcomes in adults with chronic aphasia.

Table 1. Sample Characteristics at Baseline

<table>
<thead>
<tr>
<th>Variable</th>
<th>LIFT</th>
<th>D-LIFT</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>16</td>
<td>18</td>
<td>...</td>
</tr>
<tr>
<td>Sex</td>
<td>2 women, 14 men</td>
<td>4 women, 14 men</td>
<td>0.66</td>
</tr>
<tr>
<td>Mean age, y (SD)</td>
<td>56.9 (10.3)</td>
<td>60.0 (11.5)</td>
<td>0.41</td>
</tr>
<tr>
<td>Handedness (EHI), n</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>15</td>
<td>16</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>Left</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Location of stroke (left hemisphere), n</td>
<td>16</td>
<td>18</td>
<td>...</td>
</tr>
<tr>
<td>Time post onset (SD), mo</td>
<td>47.3 (49.3)</td>
<td>31.1 (51.4)</td>
<td>0.36</td>
</tr>
<tr>
<td>Mean CAT severity score (SD)</td>
<td>51.6 (6.4)</td>
<td>52.3 (5.3)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

CAT indicates comprehensive aphasia test; D-LIFT, distributed therapy condition; EHI, Edinburgh handedness index; and LIFT, intensive therapy condition.

### Methods

#### Design

This phase II study used a nonrandomized, parallel-group, pre–posttest design. Three intensive (LIFT) and 8 distributed (D-LIFT) trials of Aphasia LIFT were conducted at the University of Queensland and in rehabilitation centers in Brisbane and Sydney, Australia between November 2012 and August 2014. Trials consisted of groups of 2 to 6 participants, and the results of these trials were pooled for analysis. Participants were allocated to LIFT (n=16) and D-LIFT (n=18) based on their geographic location, the availability of a position within the research program, and personal factors (eg, participant availability, transport, and accommodation). This study was approved by the relevant institutional ethics committees, and written informed consent was obtained from participants before participation in study procedures.

#### Participants

Thirty-four adults with chronic aphasia resulting from unilateral, left hemisphere stroke(s) were recruited to participate in the study (Table 1; Table I in the online-only Data Supplement). All participants were >4 months time post onset, spoke fluent English before their stroke, and presented with residual word finding difficulties on the Boston Naming Test (BNT). Individuals with comorbid neurological conditions, severe apraxia of speech, or severe dysarthria were excluded from the study.

#### Assessment and Intervention

Participants completed a comprehensive speech and language assessment battery, administered by a qualified speech pathologist, before commencing therapy. Outcome measures were collected immediately post therapy and at 1-month follow-up. Where possible, assessments were administered by nontreating speech pathologists.

Treatment was based on the therapy principles outlined in Rodriguez et al. Participants each received 48 hours of aphasia therapy, comprised of 14 hours of impairment therapy, 14 hours of functional therapy, 14 hours of computer-based therapy, and 6 hours of group therapy. As anomia is a predominant feature of aphasia, impairment therapy primarily aimed to remediate word-retrieval deficits using a combined semantic feature analysis and phonological component analysis approach. Computer therapy also targeted word-retrieval impairments and included training with the software programs StepbyStep and Aphasia Scripts. Functional therapy was tailored to individuals’ communication goals and included a range of treatment approaches, for example, script training and communication partner training. Group therapy was based on the Aphasia Action Success Knowledge program (Grohn, Brown, Finch, Worrall, Simmons-Mackie, Thomas, unpublished data, 2012) and included education on stroke and aphasia, compensatory strategies for effective communication, and avenues to access further support.

A comprehensive Aphasia LIFT manual was developed to promote treatment fidelity. Therapy was provided by qualified speech pathologists who received training on the treatment approaches used in Aphasia LIFT. In some instances, computer therapy was facilitated by speech pathology students or a trained allied health assistant under the supervision of a qualified speech pathologist.

#### Treatment Schedule

To evaluate the effect of treatment intensity, the total dosage of therapy; in number of therapy hours, remained constant and the frequency and duration of intervention varied between groups. Aphasia LIFT was delivered for 3 weeks (16 hours per week; total 48 hours), whereas D-LIFT was delivered for 8 weeks (6 hours per week; total 48 hours; Table 2). The cumulative treatment intensity for impairment therapy was measured according to the framework proposed by Warren et al. (Table II in the online-only Data Supplement).

#### Outcome Measures

Outcome measures were selected based on the recommendations of the exploratory phase I/I study investigating the clinical efficacy of...
Aphasia LIFT.23 The BNT was administered as the primary outcome measure to assess participants’ word-retrieval abilities. Secondary outcome measures included a proxy-rated measure of participants’ functional communication (Communicative Effectiveness Index [CETI])24, and self-report measures of participants’ communication confidence (Communication Confidence Rating Scale for Aphasia)25 and communication-related quality of life (Assessment of Living with Aphasia25).

**Statistical Analyses**

Two-tailed t tests and Fisher exact tests were used to compare the 2 cohorts, LIFT and D-LIFT, at baseline. To evaluate changes on the primary and secondary outcome measures, linear mixed models (LMM) were used. The use of LMM is preferable to general linear models (eg, regression, ANOVA, and ANCOVA) for modeling of longitudinal, repeated-measures data as it enables explicit modeling of correlation patterns and variance–covariance structures.26 To evaluate the effect of treatment by groups (LIFT and D-LIFT), separate models were fit for each outcome measure with time (pretherapy, post-therapy, and follow-up) and aphasia severity score from the Comprehensive Aphasia Test27 as fixed effects and participants as random effects. Furthermore, LMM were used to compare groups (LIFT and D-LIFT), covaried for aphasia severity score and pre-therapy performance, on each outcome measure at post-therapy and follow-up. The BNT and CETI data were transformed before analysis using reflect and square root and square root transformations,26 respectively. Data approximated a normal distribution according to the Shapiro–Wilk test of normality28 (P>0.05).

**Results**

The treatment groups were comparable for age, time post onset, sex, handedness, and measures of language impairment and functional communication at baseline (P>0.05). Thirty-two participants completed the Aphasia LIFT trial. Two D-LIFT participants (P29 and P31) withdrew from therapy because of acute-onset medical reasons and their data have been excluded from analyses. Another D-LIFT participant (P18) was not available for follow-up testing because of a change in personal circumstances. All 16 participants under the LIFT condition completed the therapy program. The mean therapy attendance rate was high (LIFT:47.7 hours; D-LIFT:47.9 hours), and the total dosage of therapy provided, in number of therapy hours, was comparable between groups (P=0.72). Furthermore, the cumulative treatment intensity for impairment-based therapy was comparable between groups (P=0.66; Table II in the online-only Data Supplement).

**Primary Outcome Measures**

Statistical analyses revealed a significant improvement in naming performance on the BNT at post-therapy compared with pretherapy for LIFT (F1,15=12.93; P=0.003) and D-LIFT (F1,15=29.92; P<0.001; Figure; Table III in the online-only Data Supplement). Likewise, there was a significant improvement in naming performance on the BNT at follow-up compared with pretherapy for LIFT (F1,15=6.50; P=0.02) and D-LIFT (F1,14=37.87; P<0.001). LMM, covaried for pretherapy BNT naming performance, revealed a significant difference between groups at post-therapy (F1,12=4.91; P=0.04) and follow-up (F1,12=11.85; P=0.002), with naming performance being significantly higher for D-LIFT compared with LIFT.

**Secondary Outcome Measures**

The CETI data are based on a sample of 28 participants (LIFT, n=15; D-LIFT, n=13), as 4 participants did not have a communication partner participate in the study. Participants’ functional communication, as measured by the CETI, was significantly higher for both groups at post-therapy, (LIFT: F1,14.5=31.57; P<0.001 and D-LIFT: F1,14.5=67.21; P<0.001) and follow-up (LIFT: F1,14=34.35; P<0.001 and D-LIFT: F1,14=71.97; P<0.001) compared with pretherapy. LMM, covaried for pretherapy CETI performance, revealed a trend favoring D-LIFT at post-therapy; however, this did not reach significance (P=0.05). There was no significant difference between groups on the CETI at follow-up (P=0.21).

Participants’ communication confidence, as measured by the Communication Confidence Rating Scale for Aphasia, was significantly higher for both groups at post-therapy (LIFT: F1,15=7.18; P=0.02 and D-LIFT: F1,15=16.56; P=0.001) and follow-up (LIFT: F1,15=6.08; P=0.03 and D-LIFT: F1,14=28.07; P<0.001) compared with pretherapy. There was no significant difference between groups on the Communication Confidence Rating Scale for Aphasia at post-therapy (P=0.79) or follow-up (P=0.48).

Finally, there was a significant improvement in participants’ communication-related quality of life, as measured by the Assessment of Living with Aphasia, for both groups at post-therapy (LIFT: F1,15=6.24; P=0.02 and D-LIFT: F1,15=10.81; P=0.005) and follow-up (LIFT: F1,15=9.64; P=0.007 and D-LIFT: F1,14=8.00; P=0.01). There was no significant difference between groups on the Assessment of Living with Aphasia at post-therapy (P=0.37) or follow-up (P=0.75).

**Discussion**

This is the first dosage-controlled, parallel-group design study to compare the short and long-term therapeutic outcomes of an intensive versus distributed comprehensive aphasia program in participants with chronic aphasia. This study demonstrated that Aphasia LIFT had a positive and enduring effect on participants’ language impairment and functional communication. Interestingly, we found that aphasia therapy provided in a distributed schedule of 6 hours per week (8 weeks; total 48 hours) resulted in superior language gains on the primary outcome measure, the BNT, when compared with an intensive treatment regime of 16 hours per week (3 weeks; total 48 hours). This benefit of distributed training on word retrieval was maintained 1 month post therapy. Principles of experience-dependent neuroplasticity suggest that treatment intensity is a critical element driving neurological and
functional recovery post stroke (ie, intensity matters). Our results indicate that when controlling the dosage of therapy provided, distributed therapy resulted in significantly greater impairment-based therapy gains compared with intensive therapy. The advantage for distributed training, with respect to the maintenance of treatment gains, is consistent with the results of Sage et al" and provides support for the distributed practice effect. Sage et al used theories of learning and cognition to account for the benefit of distributed training on word retrieval in aphasia rehabilitation. As learning underpins the rehabilitation process, future consideration of these theories as they relate to the dosage, intensity, and duration of aphasia rehabilitation services is warranted.

With respect to measures of participants’ functional communication (CETI), communication confidence (Communication Confidence Rating Scale for Aphasia), and communication-related quality of life (Assessment of Living with Aphasia), we found comparable improvements for the intensive and distributed treatment conditions at post-therapy and 1-month follow-up. Although there was a trend favouring D-LIFT on the CETI at post-therapy, this did not reach significance. Importantly, these results indicate that both intensive and distributed treatment models had a positive and enduring effect on the real-life, functional communication of participants. Furthermore, a distributed therapy model did not reduce the efficacy of Aphasia LIFT, with respect to participants’ functional communication outcomes.

The results of previous dosage-controlled studies suggest that distributed therapy may result in equivalent or even superior long-term, clinical gains on impairment-based measures of word retrieval when compared with intensive therapy. However, because of design limitations and the use of small sample sizes, the generalizability of these results is limited. Our study sought to overcome previous methodological limitations by investigating the effect of treatment intensity using a parallel-group design in a larger sample of participants with chronic aphasia. Furthermore, in addition to controlling the total hours of therapy provided, our study measured the cumulative treatment intensity for impairment-based therapy, as per Warren et al, to ensure that the dosage of impairment therapy provided was consistent between groups. The findings of this phase II study build on the results of earlier research and provide increased support for the benefit of distributed training on measures of language impairment and comparable gains on measures of functional communication and communication-related quality of life. In view of an ageing population and increasing demands for healthcare services, a distributed therapy model, such as that used in our study, presents an efficacious and potentially more feasible alternative model of care. Furthermore, for many individuals with aphasia, highly intensive treatment protocols may not be clinically appropriate, because of personal, medical, and logistical factors.

Figure. Nontransformed scores for primary and secondary outcome measures for Aphasia Language Impairment and Functioning Therapy (LIFT) and distributed LIFT (D-LIFT) at pretherapy, post-therapy and follow-up. A, Boston Naming Test (BNT); B, Communicative Effectiveness Index (CETI); C, Communication Confidence Rating Scale for Aphasia (CCRSA); and D, Assessment of Living with Aphasia (ALA).
Consistent with this argument, Brady et al. found that significantly more individuals withdrew from intensive therapy than non-intensive therapy. We did not replicate this finding; however, it is acknowledged that our sample was comprised of individuals with chronic aphasia who volunteered to participate in Aphasia LIFT. As such, our sample may have been subject to selection bias. Further research into the clinical suitability and accessibility of intensive versus distributed service delivery models in aphasia rehabilitation is an important direction for future research.

Because of the complexity of behavioral interventions provided in intensive, comprehensive aphasia programs, it is difficult to determine which elements of therapy may respond to treatment intensity. Previous dosage-controlled research suggests that impairment-based therapy may be optimized with distributed training. However, it is possible that computer-based therapy or functional therapy targeting communication activity/participation may differentially respond to treatment intensity. Unfortunately, this research question cannot be resolved by investigating a comprehensive therapy program. Although this design may be viewed as a limitation of this study, it reflects the combination of therapy approaches that are used in clinical practice.

Outcome measurement for aphasia rehabilitation is complex, and therapy gains may be difficult to quantify with respect to the everyday relevance for individuals with aphasia. In view of the comprehensive nature of Aphasia LIFT, this study endeavored to measure outcomes across impairment and activity/participation domains. Although we found a significant advantage for D-LIFT on an impairment-based measure of word retrieval (BNT), it is important to note that both treatment conditions positively influenced the real-life effectiveness of participants’ communication at the activity/participation level, as measured by a validated assessment tool (CETI).

The definition of intensity in the aphasiology literature is ambiguous, ranging from 5 hours per week to >15 hours per week. This study aimed to compare the effect of 2 different levels of treatment intensity, provided at the same total dosage. Although the distributed schedule used (6 hours per week, including 2 hours of direct impairment therapy) is still less intensive than the 8.8 hours per week deemed necessary by Bhogal et al. to achieve therapeutic gains, future research could evaluate the effect of an even less-intensive treatment model, such as 2 hours per week, which more closely approximates usual care.

Summary/Conclusions
A distributed model of Aphasia LIFT resulted in the superior acquisition and maintenance of language-impairment therapy gains on the primary outcome measure, the BNT, when compared with intensive therapy. Aphasia LIFT had a positive effect on participants’ functional communication, communication confidence, and communication-related quality of life, regardless of treatment intensity. This research contributes to our understanding of the effect of treatment intensity, independent of therapy dosage, on aphasia rehabilitation outcomes. Treatment intensity is integral to the provision of effective and efficient aphasia rehabilitation services. Furthermore, establishing optimal treatment intensity is an important research question, with implications extending beyond aphasia management to the multidisciplinary rehabilitation of stroke. Consequently, the outcomes of this research provide an important contribution to the field and have significant implications for clinicians, consumers, and service providers involved in stroke and aphasia rehabilitation.

Acknowledgments
The Communication Research Registry is acknowledged as a source of participant recruitment. We acknowledge the support provided by the speech pathologists at Prince of Wales Hospital (Randwick, New South Wales), St George Hospital (Kogarah, New South Wales), Royal Rehabilitation (Ryde, New South Wales), and The Royal Brisbane and Women’s Hospital (Herston, Queensland), and the people with aphasia and their family members.

Sources of Funding
This work was supported by the National Health and Medical Research Council Centre of Clinical Research Excellence in Aphasia Rehabilitation under grant number 569935, a Royal Brisbane & Women’s Hospital Foundation grant, and a Speech Pathology Australia postgraduate research grant. D. Copland was supported by an Australian Research Council Future Fellowship.

Disclosures
None.

References


Intensive Versus Distributed Aphasia Therapy: A Nonrandomized, Parallel-Group, Dosage-Controlled Study
Jade Dignam, David Copland, Eril McKinnon, Penni Burfein, Kate O’Brien, Anna Farrell and Amy D. Rodriguez

*Stroke*. 2015;46:2206-2211; originally published online June 23, 2015; doi: 10.1161/STROKEAHA.115.009522

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2015 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/46/8/2206

Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2015/06/25/STROKEAHA.115.009522.DC1

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org//subscriptions/
SUPPLEMENTAL MATERIAL

Intensive Versus Distributed Aphasia Therapy: A Non-Randomized, Parallel-Group, Dosage-Controlled Study.

Jade Dignam,1,2,3,4 BSpPath; David Copland,1,2,3 PhD; Eril McKinnon,2,3 BSpPath; Penni Burfein,4 BSpPath; Kate O’Brien,1,3 BSpPath; Anna Farrell,4 PhD; Amy D. Rodriguez,1,2,3 PhD

1UQ Centre for Clinical Research, The University of Queensland, Australia
2School of Health and Rehabilitation Sciences, The University of Queensland, Australia
3NHMRC Centre of Clinical Research Excellence in Aphasia Rehabilitation
4Speech Pathology Department, Royal Brisbane & Women’s Hospital, Queensland, Australia

SUPPLEMENTAL TABLES

Table I. Sample Characteristics for Individual Participants.

Table II. Cumulative Treatment Intensity for Impairment-based Therapy.

Table III. Mean Scores for Primary and Secondary Outcome Measures for Aphasia LIFT and D-LIFT at Pre-therapy, Post-therapy and Follow-up
Table I. Sample Characteristics for Individual Participants.

<table>
<thead>
<tr>
<th>ID</th>
<th>Group</th>
<th>Age</th>
<th>Sex</th>
<th>Handedness</th>
<th>Stroke</th>
<th>TPO</th>
<th>Stroke Site</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>LIFT1</td>
<td>54</td>
<td>M</td>
<td>Right</td>
<td>Haemorrhagic</td>
<td>20</td>
<td>Left</td>
<td>Sales manager</td>
</tr>
<tr>
<td>P2</td>
<td>LIFT1</td>
<td>70</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>33</td>
<td>Left</td>
<td>Business owner</td>
</tr>
<tr>
<td>P3</td>
<td>LIFT1</td>
<td>51</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>9</td>
<td>Left</td>
<td>Accountant</td>
</tr>
<tr>
<td>P4</td>
<td>LIFT1</td>
<td>57</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>66</td>
<td>Left</td>
<td>Film maker</td>
</tr>
<tr>
<td>P5</td>
<td>LIFT1</td>
<td>50</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>126</td>
<td>Left</td>
<td>Maintenance business</td>
</tr>
<tr>
<td>P6</td>
<td>LIFT1</td>
<td>70</td>
<td>M</td>
<td>Right</td>
<td>Not Available</td>
<td>52</td>
<td>Left</td>
<td>Hospitality</td>
</tr>
<tr>
<td>P7</td>
<td>LIFT2</td>
<td>47</td>
<td>M</td>
<td>Right</td>
<td>Not Available</td>
<td>24</td>
<td>Left</td>
<td>Engineer</td>
</tr>
<tr>
<td>P8</td>
<td>LIFT2</td>
<td>41</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>29</td>
<td>Left</td>
<td>Engineer</td>
</tr>
<tr>
<td>P9</td>
<td>LIFT2</td>
<td>68</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>135</td>
<td>Left</td>
<td>Sales representative</td>
</tr>
<tr>
<td>P10</td>
<td>LIFT2</td>
<td>41</td>
<td>F</td>
<td>Right</td>
<td>Haemorrhagic</td>
<td>16</td>
<td>Left</td>
<td>Nurse</td>
</tr>
<tr>
<td>P11</td>
<td>LIFT2</td>
<td>66</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>161</td>
<td>Left</td>
<td>Bus driver</td>
</tr>
<tr>
<td>P12</td>
<td>LIFT3</td>
<td>52</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>22</td>
<td>Left</td>
<td>Psychologist</td>
</tr>
<tr>
<td>P13</td>
<td>LIFT3</td>
<td>54</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>11</td>
<td>Left</td>
<td>Training officer</td>
</tr>
<tr>
<td>P14</td>
<td>LIFT3</td>
<td>66</td>
<td>M</td>
<td>Left</td>
<td>Thromboembolic</td>
<td>34</td>
<td>Left</td>
<td>Accountant</td>
</tr>
<tr>
<td>P15</td>
<td>LIFT3</td>
<td>52</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>9</td>
<td>Left</td>
<td>Engineer</td>
</tr>
<tr>
<td>P16</td>
<td>LIFT3</td>
<td>71</td>
<td>F</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>9</td>
<td>Left</td>
<td>Nurse</td>
</tr>
<tr>
<td>P17</td>
<td>D-LIFT1</td>
<td>76</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>13</td>
<td>Left</td>
<td>Banker</td>
</tr>
<tr>
<td>P18</td>
<td>D-LIFT1</td>
<td>47</td>
<td>M</td>
<td>Left</td>
<td>Thromboembolic</td>
<td>9</td>
<td>Left</td>
<td>Arborist</td>
</tr>
<tr>
<td>P19</td>
<td>D-LIFT1</td>
<td>62</td>
<td>M</td>
<td>Right</td>
<td>Haemorrhagic</td>
<td>38</td>
<td>Left</td>
<td>Shop keeper</td>
</tr>
<tr>
<td>P20</td>
<td>D-LIFT2</td>
<td>71</td>
<td>M</td>
<td>Left</td>
<td>Thromboembolic</td>
<td>17</td>
<td>Left</td>
<td>Milkman</td>
</tr>
<tr>
<td>P21</td>
<td>D-LIFT2</td>
<td>64</td>
<td>M</td>
<td>Right</td>
<td>Not Available</td>
<td>225</td>
<td>Left</td>
<td>Engineer</td>
</tr>
<tr>
<td>P22</td>
<td>D-LIFT2</td>
<td>55</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>23</td>
<td>Left</td>
<td>Chef</td>
</tr>
<tr>
<td>P23</td>
<td>D-LIFT3</td>
<td>59</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>16</td>
<td>Left</td>
<td>Carpet layer</td>
</tr>
<tr>
<td>P24</td>
<td>D-LIFT3</td>
<td>52</td>
<td>M</td>
<td>Right</td>
<td>Haemorrhagic</td>
<td>19</td>
<td>Left</td>
<td>Handyman</td>
</tr>
<tr>
<td>P25</td>
<td>D-LIFT3</td>
<td>56</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>13</td>
<td>Left</td>
<td>Professor radiology</td>
</tr>
<tr>
<td>P26</td>
<td>D-LIFT4</td>
<td>69</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>82</td>
<td>Left</td>
<td>Financial advisor</td>
</tr>
<tr>
<td>P27</td>
<td>D-LIFT4</td>
<td>35</td>
<td>M</td>
<td>Right</td>
<td>Haemorrhagic</td>
<td>8</td>
<td>Left</td>
<td>IT Consultant</td>
</tr>
<tr>
<td>P28</td>
<td>D-LIFT5</td>
<td>58</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>16</td>
<td>Left</td>
<td>Salesman</td>
</tr>
<tr>
<td>P29*</td>
<td>D-LIFT5</td>
<td>54</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>21</td>
<td>Left</td>
<td>Mining supervisor</td>
</tr>
<tr>
<td>P30*</td>
<td>D-LIFT6</td>
<td>43</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>14</td>
<td>Left</td>
<td>Quarantine inspector</td>
</tr>
<tr>
<td>P31*</td>
<td>D-LIFT6</td>
<td>77</td>
<td>F</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>4</td>
<td>Left</td>
<td>Home duties</td>
</tr>
<tr>
<td>P32</td>
<td>D-LIFT7</td>
<td>72</td>
<td>M</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>22</td>
<td>Left</td>
<td>Professor sociology</td>
</tr>
<tr>
<td>P33</td>
<td>D-LIFT8</td>
<td>59</td>
<td>F</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>12</td>
<td>Left</td>
<td>Administration assistant</td>
</tr>
<tr>
<td>P34</td>
<td>D-LIFT8</td>
<td>71</td>
<td>F</td>
<td>Right</td>
<td>Thromboembolic</td>
<td>7</td>
<td>Left</td>
<td>Hospitality</td>
</tr>
</tbody>
</table>

Note. ID = Participant identification number; TPO = Time post onset; LIFT = Intensive therapy condition; D-LIFT = Distributed therapy condition; *Participant withdrew from study.
Table II. Cumulative Treatment Intensity for Impairment-based Therapy.

<table>
<thead>
<tr>
<th>Dosage Terms*</th>
<th>Term Definitions</th>
<th>Term Values</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose Form</td>
<td>The therapeutic activity or task in which a teaching episode occurs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Picture naming. Active ingredients = SFA and PCA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: Mean (SD)</td>
<td>The number of therapeutic inputs (i.e., number of words treated using SFA/PCA cycle) per session.</td>
<td>8.5 (1.6)</td>
<td>8.2 (2.0) .65</td>
</tr>
<tr>
<td>Session Duration</td>
<td>The duration of each intervention session in minutes.</td>
<td>60 minutes</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Session Frequency</td>
<td>The number of intervention sessions per unit time.</td>
<td>4-5 x per week (total 14)</td>
<td>1-2 x per week (total 14)</td>
</tr>
<tr>
<td>Total Intervention Duration</td>
<td>The total period of time in which a particular intervention is provided.</td>
<td>3 weeks</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Cumulative Intervention Intensity: Mean (SD)</td>
<td>The product of dose x dose frequency x total intervention duration.</td>
<td>118.3 (22.6)</td>
<td>114.3 (28.6) .66</td>
</tr>
</tbody>
</table>

* Dosage terms proposed by Warren et al.¹. SFA = Semantic Feature Analysis; PCA = Phonological Component Analysis.

Note. * Dosage terms proposed by Warren et al.¹. SFA = Semantic Feature Analysis; PCA = Phonological Component Analysis.
Table III. Mean Scores for Primary and Secondary Outcome Measures for Aphasia LIFT at Pre-therapy, Post-therapy and Follow-up

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Pre-therapy Mean (SD)</th>
<th>Post-Therapy Mean (SD)</th>
<th>Follow-up Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BNT</td>
<td>23.4 (18.1)</td>
<td>26.6 (18.0)</td>
<td>26.1 (18.6)</td>
</tr>
<tr>
<td>CETI</td>
<td>41.0 (18.7)</td>
<td>55.5 (17.8)</td>
<td>57.7 (17.3)</td>
</tr>
<tr>
<td>CCRSA</td>
<td>66.4 (15.5)</td>
<td>74.8 (15.0)</td>
<td>76.6 (16.0)</td>
</tr>
<tr>
<td>ALA</td>
<td>100.0 (18.1)</td>
<td>108.9 (19.3)</td>
<td>111.5 (18.4)</td>
</tr>
<tr>
<td>BNT†</td>
<td>5.4 (1.7)</td>
<td>5.1 (1.7)</td>
<td>5.1 (1.8)</td>
</tr>
<tr>
<td>CETI†</td>
<td>6.3 (1.3)</td>
<td>7.4 (1.2)</td>
<td>7.5 (1.2)</td>
</tr>
<tr>
<td>D-LIFT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BNT</td>
<td>25.9 (16.6)</td>
<td>31.4 (17.4)</td>
<td>32.9 (17.6)</td>
</tr>
<tr>
<td>CETI</td>
<td>48.2 (11.7)</td>
<td>70.2 (12.3)</td>
<td>70.3 (13.8)</td>
</tr>
<tr>
<td>CCRSA</td>
<td>64.1 (15.5)</td>
<td>74.2 (14.5)</td>
<td>77.8 (15.7)</td>
</tr>
<tr>
<td>ALA</td>
<td>97.1 (17.2)</td>
<td>112.2 (18.2)</td>
<td>111.2 (20.5)</td>
</tr>
<tr>
<td>BNT†</td>
<td>5.2 (1.6)</td>
<td>4.5 (1.9)</td>
<td>4.3 (2.0)</td>
</tr>
<tr>
<td>CETI†</td>
<td>6.9 (0.9)</td>
<td>8.3 (0.8)</td>
<td>8.3 (0.8)</td>
</tr>
</tbody>
</table>

Note. LIFT = Intensive therapy condition; D-LIFT = Distributed therapy condition; BNT = Boston Naming Test; CCRSA = Communication Confidence Rating Scale for Aphasia; CETI = Communication Effectiveness Index; ALA = Assessment of Living with Aphasia; †Reflect and square root transformation; ‡Square root transformation.
References


