An Enhanced Protocol for Constraint-Induced Aphasia Therapy II: A Case Series

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Purpose: The initial version of Constraint-Induced Aphasia Therapy (CIAT I) consisted of a single exercise. This study sought to evaluate the feasibility for future trials of an expanded and restructured protocol designed to increase the efficacy of CIAT I.

Method: The subjects were 4 native English speakers with chronic stroke who exhibited characteristics of moderate Broca’s aphasia. Treatment was carried out for 3.5 hr/day for 15 consecutive weekdays. It consisted of 3 components: (a) intensive training by a behavioral method termed shaping using a number of expressive language exercises in addition to the single original language card game, (b) strong discouragement of attempts to use gesture or other nonverbal means of communication, and (c) a transfer package of behavioral techniques to promote transfer of treatment gains from the laboratory to real-life situations.

Results: Participation in speech in the life situation improved significantly after treatment. The effect sizes (i.e., $d'$) in this domain were ≥2.2; $d'$ values ≥0.8 are considered large. Improvement in language ability on a laboratory test, the Western Aphasia Battery—Revised (Kertesz, 2006), did not achieve statistical significance, although the effect size was large—that is, 1.3 (13.1 points). Conclusion: These pilot results suggest in preliminary fashion that CIAT II may produce significant improvements in everyday speech.

Key Words: speech rehabilitation, Broca’s aphasia, Constraint-Induced Aphasia Therapy II, stroke transfer package, training by shaping, intensive speech training

After a stroke, a severe impairment of language production and comprehension occurs in 30%–38% of patients (Pedersen, Jorgensen, Nakamaya, Raaschou, & Olsen, 1995). Approximately 40%–60% of these individuals remain aphasic into the chronic phase (Pedersen, Vinter, & Olsen, 2004). The loss of effective verbal communication associated with aphasia is socially isolating and reduces independence. There is disagreement concerning the effectiveness of conventional speech-language therapies (Carter, Connor, & Dromerick, 2010; Greener, Enderby, & Whurr, 2008). Some forms of therapy, though, have been found to be of value even when initiated during the chronic phase of speech-language deficits (Carter et al., 2010). Although there is a relative paucity of research that has examined therapies initiated 6 months or more after the onset of aphasia, several types of interventions appear to have some efficacy (Allen, Mehta, McClure, & Teasell, 2012). Intensity of treatment, in particular, seems crucial to therapeutic success (Brindley, Copeland, Demain, & Martyn, 1989; Carter et al., 2010). Perhaps the most promising interventions for chronic aphasia so far have been language and communication therapies that use trained caregivers and volunteers to facilitate improvements in everyday life situations. Functional communication therapy using scripted interventions administered by trained volunteers has demonstrated efficacy for improving everyday communicative abilities in two randomized controlled trials (Kagan, Black, Duchan, Simmons-Mackie, & Square, 2001; Worrall & Yiu, 2000). Supported Conversation for Adults with Aphasia (SCA) is an approach based on training conversation partners to more effectively communicate with persons with aphasia, improving speech and language skills in social situations (Kagan et al., 2001). SCA has been shown to produce positive changes in the social communication skills of individuals with aphasia (Simmons-Mackie, Raymer, Armstrong, Holland, & Cherney, 2010). Similarly, a recent review of individualized interaction-focused approaches suggested that behavioral training of social conversational strategies in everyday life situations is a viable option for improving communicative abilities in people with chronic aphasia.
may benefit individuals with aphasia (Wilkinson & Wielaeert, 2012). However, these studies were largely qualitative and exploratory in nature.

The therapies that have shown some efficacy in chronic aphasia have two or more of the following three elements in common: (a) intensity, (b) involvement of the caregiver or significant others in the patient’s life, and (c) a focus on problem solving and behavioral training of speech in everyday life situations rather than exclusively in the clinic. The Constraint-Induced Aphasia Therapy II (CIAT II) protocol harnesses and combines all of these components.

**Constraint-Induced Movement Therapy and Learned Nonuse**

The first use of clinical constraint-induced (CI) therapy treatment principles and procedures was for the improvement of upper extremity motor deficit after stroke (Taub et al., 1993). Modifications have been applied to the upper extremities after traumatic brain injury (Shaw et al., 2005); in individuals with multiple sclerosis (Mark et al., 2008); in young children with cerebral palsy (Taub et al., 2011; Taub, Ramey, Echols, & DeLuca, 2004); and to the lower extremities after stroke, spinal cord injury, fractured hip (Taub, Uswatte, & Pidikiti, 1999), and multiple sclerosis (Mark et al., 2013).

Constraint-induced movement therapy (CIMT) is said to be efficacious for improving the motor deficit of the extremities, in part because it overcomes a learned inhibition of limb use, termed learned nonuse, that develops in the acute period after different types of substantial neurological injury. When coordination of the movement of a limb is very poor, as is typical soon after injury, attempts to use that limb fail and are thereby punished, reducing the frequency of future attempts to use that limb. Strategies to accomplish tasks that are successful, such as using the limb on the other side of the body or asking a family member to complete the tasks, are rewarded and become more frequent. This learning process results some time after injury in a greatly reduced real-world use of an extremity compared to the motor ability that the extremity can be shown to have in the laboratory by a test in which patients are requested to make the best effort of which they are capable. There is evidence for the existence of this mechanism (Taub, 1977, 1980; Taub, Uswatte, Mark, & Morris, 2006). It is possible to induce the phenomenon in rodents with cortical infarcts by training (Allred, Cappellini, & Jones, 2010; Allred & Jones, 2008; Allred, Maldonado, Hsu, & Jones, 2005).

Learned nonuse would appear to also occur when there is language impairment after neurological injury. Because of halting and slow verbal production and incomplete understanding, speech becomes effortful and often embarrassing. The person compensates by remaining silent and using nonverbal means of communication. Moreover, the caregiver often “speaks for” the person with aphasia to facilitate communication, thereby further suppressing the person’s tendency to speak for him- or herself (Croteau & Le Dorze, 2006; Croteau, Vychytíl, Larfeuil, & Le Dorze, 2004). Given the likely similarity of the mechanism underlying part of the deficit of both the extremities and language, it seemed reasonable to attempt to improve speech after damage to the central nervous system (CNS) by developing a treatment for language that was parallel in as many respects as possible to the one that had been successful for improving motor deficit of the extremities. This was the conceptual basis that underlay the formulation and application of the CIAT protocol both in its original form (Pulvermüller et al., 2001) and in its present restructuring (i.e., CIAT II).

**CIAT**

At the beginning of the last decade, Pulvermüller, Taub, and colleagues (Pulvermüller et al., 2001) developed the original CIAT treatment for poststroke aphasia that was reported to produce, over the course of 2 weeks, a substantial improvement in linguistic ability both in the laboratory and in participation in speech in life situations. Later studies obtained similar results (Berthier et al., 2009; Carter et al., 2010; Cherney, Patterson, Raymer, Frymark, & Schooling, 2008; Kirmess & Maher, 2010; Maher et al., 2006; Meiner et al., 2004; Meiner, Djundja, Barthel, Elbert, & Rockstroh, 2005); these and other studies are reviewed in Meiner, Rodriguez, and Gonzalez Rothi’s (2012) article.

Although CIAT I was modeled on the procedures of CIMT for improving motor deficits of the extremities after damage to the CNS, the modeling was only partial. In the present study, the original protocol was restructured extensively to make it as similar to CIMT as possible by doing three things: (a) including a larger variety of expressive language exercises than the single-language game of the original protocol, including a role-playing task that made the training activities more similar to those encountered in daily life; (b) making the treatment more intensive (i.e., more verbal responses required and shaped each treatment day) during the same 3-hr training period used in the CIAT I study; and (c) adding a “transfer package” (TP) of techniques designed to facilitate transfer of therapeutic gains from the treatment setting to life situations. In addition, a third week of training was added.

The TP techniques consisted of behavioral contracts with the patient and caregiver to carry out specified activities using only speech and not gesture or other means of communication, monitoring amount of out-of-laboratory speech by daily maintenance of a verbal behavioral diary, daily administration of a structured questionnaire (the Verbal Activity Log [VAL]), problem solving to circumvent apparent barriers to participation in speech in life situations, home practice exercises, periodic phone contacts after the end of treatment, and involvement of a caregiver in all phases of the treatment. These behavioral techniques, singly and in combination, have been used extensively for the treatment of a number of clinical conditions including, for example, the outpatient treatment of cocaine dependence (Higgins, Budney, & Bickel, 1997); autism; adherence to behavior modification training for parents of children with behavior problems (Eyberg & Johnson, 1974); and the control of obesity (Ostfeld et al., 2007), smoking (Bowers, 1987), and alcoholism (O’Farrel, 1998).
We anticipated that use of the TP, the larger number and variety of ecologically veridical training tasks, and the more intensive and extended training would produce a substantial treatment effect, especially for spontaneous use of speech in daily life, as is the case for extremity movement after CI MT. The study we present in this article addressed this hypothesis on a preliminary basis.

Method and Procedure

Participants

Four native English speakers with chronic stroke (>1 year post-event) who exhibited characteristics of moderate Broca’s aphasia were recruited from an outpatient speech and language clinic at an urban medical center in the southeastern United States. Additional speech-language deficits of the participants are indicated by the pretreatment Western Aphasia Battery—Revised (WAB–R; Kertesz, 2006) scores, presented in Table 1.

Participants comprised a convenience sample and were enrolled consecutively upon meeting the inclusion/exclusion criteria listed below without consideration of other factors. They were treated in two cohorts of two participants each in the order in which they were recruited. Their ages ranged from 60 to 83 years ($M = 71$ years). All were right-hand dominant prior to stroke. The hemispheric cerebrovascular accident had been experienced 1.3–8.0 years ($M = 3.9$ years) previously. The extent of the lesion in individual participants is shown in Figure 1.

The five inclusion criteria included (a) diagnosis of Broca’s-like aphasia based on the WAB–R; (b) Aphasia Quotient score between 50 and 80 on the WAB–R; (c) a reduced amount of spontaneous use of language in life situations, as evidenced by a score of less than 2.5 on each of the two scales of the VAL (see below); (d) agreement to have a caregiver present with them at all times during treatment; and (d) no record of severe neurological deficits, such as non-verbal cognitive abnormality, dementia, or other neurodegenerative disorder. No participant had a diagnosis of depression according to the Zung Depression Scale (Zung & Durham, 1965); one person had been prescribed an antidepressant 3 years prior to the study and was taking the medication at the time of the intervention. All participants were screened using the National Institutes of Health Stroke Scale (National Institutes of Health, 2003) to determine severity of the stroke. Participant characteristics are presented in Table 2. The study was conducted at the University of Alabama at Birmingham, whose institutional review board for human research approved this research. All participants provided signed informed consent.

Intervention

As noted, all participants were required to have a caregiver present with them throughout treatment. The caregivers were trained to carry out the exercises under the supervision of a speech-language pathologist at all times soon after the beginning of treatment. This enabled the caregivers to provide the participants with supervised practice of the activities that were assigned as homework during treatment and after the completion of treatment. It had the secondary benefit of adding to the realism of the verbal interaction in the role-playing exercise in the laboratory. Caregiver participation was used in addition to therapist involvement, not instead of it.

Participants received 3 hr of training on each weekday for 3 weeks, plus 30 min daily devoted to TP techniques (45 + 7.5 hr = 52.5 total hr of in-laboratory treatment). At the start of each day, the participants completed the How Well Scale of the VAL (see below) with their caregiver present to verify accuracy of scores. Five exercises were then given in the order in which they were recruited. Their ages ranged from 60 to 83 years ($M = 71$ years). All were right-hand dominant prior to stroke. The hemispheric cerebrovascular accident had been experienced 1.3–8.0 years ($M = 3.9$ years) previously. The extent of the lesion in individual participants is shown in Figure 1.

Table 1. Western Aphasia Battery—Revised (WAB–R) scores pre- and post–Constraint-Induced Aphasia Therapy II (CIAT II).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pre</th>
<th>Post</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information content</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>6</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>S2</td>
<td>9</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>S3</td>
<td>7</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>S4</td>
<td>8</td>
<td>7</td>
<td>–1</td>
</tr>
<tr>
<td>$M (SD)$</td>
<td>7.5 (1.3)</td>
<td>8.8 (1.3)</td>
<td>1.3 (1.7)</td>
</tr>
<tr>
<td>Auditory comprehension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>8.4</td>
<td>9.6</td>
<td>1.2</td>
</tr>
<tr>
<td>S2</td>
<td>7.7</td>
<td>8.9</td>
<td>1.2</td>
</tr>
<tr>
<td>S3</td>
<td>6.4</td>
<td>8.7</td>
<td>2.3</td>
</tr>
<tr>
<td>S4</td>
<td>4.0</td>
<td>5.7</td>
<td>1.7</td>
</tr>
<tr>
<td>$M (SD)$</td>
<td>6.6 (1.9)</td>
<td>8.2 (1.7)</td>
<td>1.6 (0.5)</td>
</tr>
<tr>
<td>Repetition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>6.5</td>
<td>9.7</td>
<td>3.2</td>
</tr>
<tr>
<td>S2</td>
<td>7.6</td>
<td>8.8</td>
<td>1.2</td>
</tr>
<tr>
<td>S3</td>
<td>7.7</td>
<td>8.5</td>
<td>0.8</td>
</tr>
<tr>
<td>S4</td>
<td>7.6</td>
<td>8</td>
<td>0.4</td>
</tr>
<tr>
<td>$M (SD)$</td>
<td>7.4 (0.6)</td>
<td>8.8 (0.7)</td>
<td>1.4 (1.2)</td>
</tr>
<tr>
<td>Naming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>6.3</td>
<td>8.2</td>
<td>1.9</td>
</tr>
<tr>
<td>S2</td>
<td>8.5</td>
<td>9.2</td>
<td>0.7</td>
</tr>
<tr>
<td>S3</td>
<td>7.3</td>
<td>7.6</td>
<td>0.3</td>
</tr>
<tr>
<td>S4</td>
<td>7.3</td>
<td>6.7</td>
<td>–0.6</td>
</tr>
<tr>
<td>$M (SD)$</td>
<td>7.4 (0.9)</td>
<td>7.9 (1.1)</td>
<td>0.6 (1.0)</td>
</tr>
<tr>
<td>Aphasia Quotient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>58.5</td>
<td>82.9</td>
<td>24.4</td>
</tr>
<tr>
<td>S2</td>
<td>75.6</td>
<td>91.8</td>
<td>16.2</td>
</tr>
<tr>
<td>S3</td>
<td>66.8</td>
<td>77.6</td>
<td>10.8</td>
</tr>
<tr>
<td>S4</td>
<td>64.0</td>
<td>64.8</td>
<td>0.9</td>
</tr>
<tr>
<td>$M (SD)$</td>
<td>66.2 (7.1)</td>
<td>79.3 (11.3)</td>
<td>13.1 (9.9)$^*$</td>
</tr>
</tbody>
</table>

$^*$At posttreatment, gains on the Aphasia Quotient were large but did not achieve significance in this small sample, $t(3) = 2.6, p = .077$, $d' = 1.3$. The Aphasia Quotient summarizes performance on all of the WAB–R subtests. Therefore, paired $t$ tests were not conducted for the subscores labeled above it.
discouraged. The therapist did not respond to gestures or nonverbal vocalizations when they were exhibited and cautioned against their use, and they instructed the caregivers to do the same. All task performances were timed. The breakdown of approximate time spent on each task and other activities are as follows:

- Completion of the How Well scale of the VAL, review of daily home diary and home skill assignment check-off list = 30–40 min (including problem solving)
- Speech repetition drills = 20 min
- Activities of daily living (ADL) phrase repetition drills = 25 min
- Language card game = 30 min
- Picture description = 30 min
- Role play = 30 min
- Home skill assignment = 5 min

Participants were treated in cohorts of two. Both members of a cohort were treated at the same time and were seated with their caregiver and therapist at opposite ends of a long table, with the participants’ view of one another during performance of treatment exercises occluded by removable cardboard dividers except in the language card game exercise, in which low barriers prevented view of other players’ card hands but not their faces. This arrangement reduced distraction but allowed social interaction. In all of the exercises except the language card game, treatment was one on one with one of two therapists who alternated participants on successive days. The language card game involved the participation and interaction of the two participants in a cohort. The exercises were effortful for the participants, and rest intervals were introduced as soon as the therapists began to see a decrease in a participant’s overall speech and language ability.

The first two exercises were intended to be warm-ups, “priming” a participant’s language use for carrying out the next three, more challenging exercises. Task 1, speech/repetition drills, used words/phrases that are frequently omitted from the speech of persons with a nonfluent type of aphasia (i.e., functor words and pronouns). The words were arranged in two lists of 20 items each, with groupings of five items, graded according to difficulty. Estimation of difficulty was based on values in language frequency and use data (Cambridge English Corpus, n.d.). Different lists of equivalent subset difficulties were presented in each exercise on alternate days and repeated several times on each day. First, the therapist would say a word (or phrase) and the participant would have to repeat it as rapidly as possible. Participants were given up to 30 s to produce the best articulation of the target word/phrase of which they were capable. If the word/phrase was not repeated with good intelligibility, the participant was provided with phonemic cueing and/or placement cueing up to three times, and then the next word or phrase was introduced. The numbers of words and/or phrases that were repeated correctly were recorded. Current and past

Table 2. Participant characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>M (SD)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>72</td>
<td>60</td>
<td>83</td>
<td>68</td>
<td>70.8 (9.6)</td>
<td></td>
</tr>
<tr>
<td>Years post onset</td>
<td>1.1</td>
<td>8.0</td>
<td>1.3</td>
<td>5.5</td>
<td>4.0 (3.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Stroke characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIH Stroke Scale</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>6.8 (2.9)</td>
<td>0R/4L</td>
</tr>
<tr>
<td>Side of brain affected</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>4R/0L</td>
<td></td>
</tr>
<tr>
<td>Prestroke dominant side</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>4R/0L</td>
<td></td>
</tr>
<tr>
<td>Lesion location</td>
<td>FRST</td>
<td>PFP</td>
<td>IPFP</td>
<td>LPFP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of lesion (cm³)</td>
<td>201.7</td>
<td>155.0</td>
<td>38.7</td>
<td>130.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. NIH Stroke Scale = National Institutes of Health Stroke Scale; L = left; R = right.
scores were shown to the participant after each list of items was completed so that current performance could be compared to past performance. Competition against one’s personal best has been found to be a powerful factor in maintaining motivation to keep improving performance at a high level during this process, termed shaping (Skinner, 1938, 1968), which has been used in previous research with CIMT (Taub et al., 1994). Other standard shaping procedures used here (when they were needed) included mouthing the beginning of a word when a participant was having difficulty initiating articulation (cuing), repeating the whole word if necessary (modeling), and urging the participant to keep speaking as rapidly as possible while maintaining the quality of the utterance (prompting and coaching).

Task 2, ADL phrase repetition drills, was also a repetition task given for priming purposes. The participant was asked to repeat, in a specified time (60–120 s, based on shaping level), scripted ADL phrases or short sentences that are commonly involved in a functional conversation. Examples of the lowest-level ADL phrases/short sentences used include “Is the coffee ready?” and “Are you going with me?” As the participant was “shaped” during the task, the ADL phrases/short sentences could have been increased to, for example, “Is the coffee ready for me right now?” and “Are you going with me to the movie?” Once the participant had finished with the repetition portion of the task, the caregiver would respond as in typical conversation, with “Yes, the coffee is ready,” or “No, I am not going with you.”

Task 3, the language card game, was the same as that used by Pulvermüller et al. (2001), modified for the participation of three (rather than four) players: the two participants and an additional player, who could be a caregiver or another therapist. It involved the use of a simple card game resembling the game “Go Fish.” In brief, a participant asked one of the other players if he or she was holding a card with a specific object(s), animal(s), or person(s) in specific work professions, or actions (depending on the participant’s shaping level) pictured to match one in the requestor’s own hand. For example, one participant might say to the other, “Do you have a card with one red shoe?” and the other participant would be required to answer with the following information, “Yes, I do have (no, I don’t have) a card with one red shoe.” If he or she did, the requestor could meld those cards. A participant won the game if he or she could meld each of the cards dealt to him or her so that none was left. The way that each of the two players with aphasia asked one of the other participants for a card to meld, and responding to a request was shaped. The difficulty of the required request was progressively increased in small steps along several dimensions: number of words, number of social formulas (dialogue acts), number of words, number of social formulas (dialogue acts), grammatical correctness, and precision of card description (animal/pet/dog). The deck of cards was composed of simple picture cards (Super Duper products, www.superduperinc.com). The game was organized so that the objects represented on the cards became progressively more complex as performance improved. In addition, the adjectives and verbs used in card description had to be progressively more precise and specific. The caregivers sat with the participants and prompted them to avoid errors and keep the pace of play brisk under the supervision of the therapist, who was not one of the three players in the game. The amount of time each participant took and the number of words used in a phrase/sentence during each interaction were recorded on a separate form for each participant by the circulating therapist, and this form was periodically shown to the participants individually. Participants were encouraged to use more words during each turn and to use more complex adjectives to describe the items pictured on the cards.

Task 4 was a picture description task that involved showing each participant black-and-white action cards that depicted daily life situations (Life Interests and Values Cards; Haley, Womack, Helm-Estabrooks, Caignon, & McCulloch, 2008). As in all the tasks, an objective of Task 4 was to facilitate increased fluency of speech while under a certain amount of time pressure. The starting point was the number of items that could be named within 15 seconds. There were then four levels of complexity through which the participant progressed as expressive language ability increased. Level 1 required the participant to use a carrier phrase when naming particular items within 30 s (e.g., “This is a car.” “This is the boy”). Level 2 required the therapist to say, “Tell me what you see and what they are doing.” The participant was timed for 45 s, and the numbers of phrases, utterances, and sentences used were recorded. During Level 3, the therapist chose two words (nouns, verbs, or adjectives) that the participant was required to use within a phrase and/or sentence in describing a card; the two words were written on cards shown to the participant. The number of phrases and/or sentences spoken was recorded for the 60 s permitted for each card. For the last level, Level 4, the participant was given 90 s to respond to the instruction, “Tell me a story about what is happening in the picture.” Feedback was given concerning numbers of words used per sentence or phrase at all levels of difficulty; for the last level, feedback on the quality of the overall content of the story was also given.

Task 5 involved role-playing in which both the participant and his or her caregiver were involved. Common everyday interpersonal interactions were simulated. The therapist or the caregiver began the interaction under the therapist’s supervision because, at least at first, initiation was frequently too difficult for the participants; they just “froze” and stopped trying. To prevent the caregiver from engaging in the often very strong tendency to speak for the person with aphasia, the caregiver’s portion of the interaction was scripted, and no other verbal communication by the caregiver was permitted. The participant’s portion of the interaction was not scripted. The simulated activities included talking to a specific friend or relative on the phone, paying for an item being purchased at a cash register, ordering food in a restaurant, and greeting a relative in the morning. The caregiver read prepared questions or comments from the script, and the therapist recorded each of the participant’s responses, examining them for improved numbers of words per utterance, improved grammaticality, and expansion of the number of content information units spoken. An attempt
was made to keep each interaction continuing as long as possible. This task was considered to be the most important one because it related directly to the participant’s ability to use language in everyday activities in life situations, and effort was expended to make it as realistic as possible. This task also served to provide examples to participants and caregivers of what their homework practice should consist of as they interacted with different people in the community.

**Transfer Package**

Research that has used CI therapy principles to improve the motor deficit of the extremities after stroke has found that, by far, the most important factor in effecting transfer of the gains made in the laboratory to the life situation was the administration of the set of behavioral techniques termed the transfer package (TP), which have been described in detail (see Morris, Taub, & Mark, 2006; Taub et al., 2013; Taub, Uswatte, Mark, & Morris, 2006). Consequently, the CIMT TP techniques were modified so that they were language appropriate. Their use was a major emphasis here. The verbal TP consisted of the procedures described in the following sections.

**Behavioral contract.** At the outset of treatment, the therapist negotiated a contract with the participants in which agreement was reached that the participant would speak as much as possible outside the laboratory; a separate contract was negotiated independently with the caregiver that speech would be encouraged but aid would be limited. Specific situations during which the participant would speak were discussed and written down. At the end of this process, the negotiated document was signed by the participant (or caregiver), the therapist, and a witness to emphasize the character of the document as a contract. Behavioral contracting is used routinely in the CIMT studies in our laboratory (e.g., Taub, Uswatte, Mark, & Morris, 2006) and, as noted earlier in this article, is also used extensively in the behavioral treatment of a number of clinical conditions.

**Daily home diary.** During treatment, participants—with the caregiver’s cooperation—cataloged on a Daily Diary Form whether and how much they spoke during the activities specified on the home skill assignments. The diary was reviewed daily in order to problem-solve with participants and their caregivers, to alert them to missed opportunities for verbal interaction, and to determine how much of the time outside the laboratory was spent on homework activities.

**Daily administration of the VAL.** The VAL collects information about use of language in 12 commonly encountered situations. The daily account of participants’ performance of activities on the How Well scale of this instrument was probed and verified in a number of ways and served to keep their attention on the use of language outside the laboratory. As noted above, approximately 30–40 min were spent reviewing the VAL (and daily home diary) with both participants and caregivers. Prior to the study, a VAL manual was written with a scripted method for administering the test so that probing and verifying questions could be asked in a standard manner. If a participant rated a particular behavior a 3, an example of a verifying response would be for the therapist to say, “You rated that activity a 3. That means that you used speech for that activity but it was slow and you used just 3 to 4 words. Do you agree?” The final rating was determined by the participant.

**Problem solving.** During administration of the VAL and review of the home diary, the therapist helped each participant analyze and overcome any barriers to using speech in specific situations. For example, if a participant was concerned about the timeliness of a response while ordering in a restaurant, time was spent discussing ways this problem could be dealt with. The participant could explain that this was a therapy exercise and then ask the server for permission to proceed. If the participant felt that, while speaking in a public place, others were staring or not understanding what had been said, strategies to help the participant reduce embarrassment and increase comprehension by the listener were discussed and practiced.

**Home skill assignments.** During treatment, participants and their caregivers were asked to carry out three easy, three medium, and four difficult language tasks at home, selected daily from a list of approximately 100 items. These were written on the daily Home Skill Assignment Sheet, and the therapist engaged in problem solving with the participant and caregiver about how each exercise could be carried out most effectively. As therapy progressed and participants began to use more language in their daily environment, the homework exercises increased in difficulty. In addition, participants were asked to spend 15–30 min performing specific language tasks repetitively with their caregiver at home on a daily basis. The practice tasks were chosen to improve the most significant language deficits. Participants or caregivers checked off the activities they had carried out on the form provided to them and showed it to their therapist at the beginning of each day.

**Posttreatment practice.** Toward the end of treatment, an individualized program of approximately 50 tasks was developed and given to the participants. They were encouraged to perform a number of the tasks for 30–45 min daily with their caregiver after the completion of treatment in the laboratory. There was general adherence with this instruction for three of the participants but not for the noncompliant participant (S4).

**Posttreatment telephone contacts.** Participants were contacted weekly for the first month after treatment and monthly until 6 months posttreatment. During each telephone contact, both the How Well and Amount of Use scales of the VAL were administered and problem solving was carried out.

**Measures**

Treatment outcomes were assessed for the domains of actual participation in speech in the life situations (VAL) and separately for the maximum language ability of which a person was capable when prompted in the laboratory (WAB-R). The VAL is a scripted, structured interview that measures participant-/caregiver-reported amount (the 11-point Amount of Use scale) and quality (11-point How Well scale).
of participants’ participation in speech in the life situations outside the laboratory during 12 commonly encountered situations. Participants provided answers to questions, and caregivers verified each answer. When there was a disagreement, the therapist facilitated discussion between the two by repeating the anchoring definitions given in the scales (see the Appendix); on the rare occasions when resolution could not be reached, the participant’s decision was final. To standardize administration of the VAL, a test manual was written. The test items and the rating scales are presented in the Appendix. The test manual is available from the first author on request. The VAL is a revision of the Communication Activity Log (CAL) used in the CIAT I study (Pulvermüller et al., 2001). A clinimetric study of the VAL has been completed (Haddad et al., 2013). The correlation of the VAL Amount of Use scale and the amount of speech recorded overnight in life situations by a voice-activated tape recorder and processed by the Sound Forge 9.0 program (Sony) was .79, p < .0001. Correlation with the Communicative Effectiveness Index (Lomas et al., 1989)—a reliable, valid instrument that measures real-world communication (speech plus other means of communication)—was .85, p < .0001. Correlation with the WAB–R was .85, p < .0001. Test–retest reliability of the VAL Amount of Use scale was .95.

Both the CAL and VAL are modeled closely after the Motor Activity Log, which has been used extensively in our (Taub et al., 1993) and other (Wolf et al., 2006) laboratories for assessing use of an impaired extremity in life situations after stroke and other types of damage to the CNS. The Motor Activity Log has been found to be a valid measure with strong clinimetric values (Usuwatte, Taub, Morris, Light, & Thompson, 2006; Usuwatte, Taub, Morris, Vignolo, & McCulloch, 2005; van der Lee, Beckerman, Knol, de Vet, & Bouter, 2004). An instrument derived from the (adult) Motor Activity Log, the Pediatric Motor Activity Log, has also been found to be reliable and valid (Lin et al., 2011; Usuwatte et al., 2012).

Maximum language ability was measured with the WAB–R, which has established reliability and validity (Shewan & Kertesz, 1980). It comprises four subtests (Spontaneous Speech, including Information Content and Fluency Scales; Auditory Comprehension; Repetition; and Naming). Both scales of the VAL and the WAB–R were administered before and after treatment; in addition, the How Well scale of the VAL was given at the beginning of every treatment day before training began and at each follow-up occasion (i.e., weekly for the first month after treatment and at the 3- and 6-month posttreatment time points).

Statistical Analysis

We analyzed changes in the outcome measures from pre- to posttreatment and posttreatment to follow-up using two-tailed paired t tests with an alpha (α) of .05. Effect size for the treatment outcomes was characterized using r, which is the mean change of an outcome divided by its SD. In the meta-analysis literature, r values > 0.8 are considered large (Cohen, 1988).

Results

The data in Table 3 and Figure 2 show that the participants, on average, made large improvements in amount of participant-/caregiver-reported participation in speech in the life situation. At posttreatment, the mean gain on the VAL Amount of Use scale was 2.1 points (SD = 1.1). 95% confidence interval (CI) [1.1, 3.1], p = .022, d* = 2.2. A significant additional improvement in scores was observed at the 6-month follow-up: The mean change from posttreatment was 0.4 points (SD = 0.3). 95% CI [0.2, 0.7], p = .042, d* = 1.7. Three of the participants showed a monotonic increase in amount of speech between the end of therapy and the 6-month posttreatment follow-up. The noncompliant participant (S4) exhibited a fluctuating record after the end of treatment, so her slightly improved level of performance 6 months after treatment may have been the result of spontaneous variation (see Figure 2).

The participants, on average, made large improvements in speech capacity, as represented by WAB–R Aphasia Quotient scores. However, the change did not achieve significance for the small group of four participants in this sample. The gain at posttreatment was 13.1 points (SD = 9.9), 95% CI [3.2, 22.8], p = .077, d* = 1.3. (For the three participants who adhered to the requirements of the therapy, the mean gain was 17.1 points.) The changes on the WAB–R subscales that make up the Aphasia Quotient are presented in Table 1. Additional details concerning the method and results may be found in the case histories in the online supplemental materials.

Discussion

Participation in speech in life situations, as indexed by the VAL, showed large improvements as a result of CIAT II immediately after treatment on the Amount of Use and How Well scales (d = 2.2 and 3.1, respectively). There was further improvement for the 6 months after the end of treatment. This could possibly be due, at least in part, to the use of the TP, especially the two posttreatment components: (a) at-home activity assignments and (b) periodic phone contacts when the VAL and problem solving were carried out. It should also be noted that the mean change of the WAB–R Aphasia Quotient was 13.1 points (17.1 points for the three adherent participants). The change for all four participants is 2.3 times greater than the natural variability in scores on this test, as indicated by the mean change for chronic patients from one testing occasion to another in the absence of an intervention, which is 5.3 (Shewan & Kertesz, 1980). However, we should emphasize that these results are preliminary, having been obtained from only four participants. They can therefore be construed not as a demonstration of efficacy but only as being of interest and warranting further experimental evaluation. Nor can any conclusions be drawn with confidence about which aspects of the treatment resulted in the gains observed until components–analysis studies have been conducted.

Changes From CIAT I Protocol

Sample composition. The participants in this study all had a diagnosis of moderate Broca’s aphasia based on their
score on the WAB–R and clinical evaluation. In the original CIAT I study (Pulvermüller et al., 2001), only three of the 10 experimental participants had this diagnosis. This change must be taken into consideration in evaluating the two studies.

**Duration of training.** The duration of training was increased to 3 weeks in CIAT II from the 2 weeks given in the original CIAT I study (Pulvermüller et al., 2001). However, the amount of training time on a treatment day did not differ between this study and the original CIAT I study. The increased duration of training might be a factor contributing to the difference in outcomes between the two studies.

**Composition of training exercises.** The modifications to the CIAT I procedure included expanding the number of different exercises from just the original language card game to five activities: two warm-up repetition exercises, a somewhat modified language card game, a task requiring a description of depicted situations, and a role-playing task. The purpose of the first two tasks was to facilitate or prime performance on the later tasks, and the intended purpose of the last two tasks was to provide participants with a varied verbal experience that was closer to their everyday life situation experience than the single card game exercise. We thought that this would aid in the centrally important transfer of therapeutic improvements achieved in the laboratory to the life situations.

**Intensity of training exercises.** The two repetition, picture description, and role-playing exercises involved more intensive training than did the language card game. The original language card game required participants to speak (either as a requester or respondent) only on every other play, and they were not timed. The four new exercises required the participants to speak on every trial (in the card game, on two of every three plays), their responses were timed, and the requirement to increase rate of speech was emphasized.

**Shaping of performance.** There was an increased emphasis on shaping that was pervasive throughout all aspects of the training. The increased emphasis on shaping, focusing on achieving small but progressive increments in performance, may have provided a scaffolding that made.

### Table 3. Participation in speech in the life situation (Verbal Activity Log) scores pre– and post–CIAT II.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pre</th>
<th>Post</th>
<th>4-week follow-up</th>
<th>3-month follow-up</th>
<th>6-month follow-up</th>
<th>Change from pre to post</th>
<th>4-week follow-up</th>
<th>3-month follow-up</th>
<th>6-month follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amount of Use scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>0.3</td>
<td>3.6</td>
<td>3.9</td>
<td>4.3</td>
<td>4.3</td>
<td>3.3</td>
<td>0.3</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>S2</td>
<td>1.8</td>
<td>3.8</td>
<td>3.8</td>
<td>4.1</td>
<td>4.3</td>
<td>2.0</td>
<td>0.0</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>S3</td>
<td>1.4</td>
<td>3.6</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>2.2</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>S4</td>
<td>2.9</td>
<td>3.8</td>
<td>3.5</td>
<td>4.1</td>
<td>3.9</td>
<td>0.9</td>
<td>-0.3</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>M (SD)</strong></td>
<td>1.6 (1.1)</td>
<td>3.7 (0.1)</td>
<td>3.8 (0.2)</td>
<td>4.1 (0.1)</td>
<td>4.1 (0.2)</td>
<td>2.1 (1.0)*</td>
<td>0.1 (0.3)</td>
<td>0.4 (0.2)*</td>
<td>0.4 (0.3)*</td>
</tr>
<tr>
<td><strong>How Well scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>0.7</td>
<td>3.6</td>
<td>3.3</td>
<td>4.0</td>
<td>4.0</td>
<td>2.1</td>
<td>0.5</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>S2</td>
<td>1.3</td>
<td>2.9</td>
<td>3.0</td>
<td>3.8</td>
<td>4.1</td>
<td>1.6</td>
<td>0.1</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>S3</td>
<td>0.6</td>
<td>3.6</td>
<td>3.8</td>
<td>3.8</td>
<td>4.0</td>
<td>3.0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>S4</td>
<td>2.2</td>
<td>3.8</td>
<td>3.6</td>
<td>3.8</td>
<td>3.9</td>
<td>1.6</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>M (SD)</strong></td>
<td>1.2 (0.7)</td>
<td>3.3 (0.5)</td>
<td>3.4 (0.4)</td>
<td>3.9 (0.1)</td>
<td>4.0 (0.1)</td>
<td>2.1 (0.7)*</td>
<td>0.2 (0.3)</td>
<td>0.6 (0.6)</td>
<td>0.8 (0.5)</td>
</tr>
</tbody>
</table>

*At posttreatment, gains on the Amount of Use scale were significant, \( t(3) = 4.4, df = 3, p = .022, d^* = 2.2. \) At the 4-week follow-up, the scores were similar to those at posttreatment, \( t(3) = 0.6, df = 3, p = .572, d^* = 0.3. \) At the 3-month follow-up, there was an additional 0.4-point improvement from posttreatment, \( t(3) = 4.4, df = 3, p = .021, d^* = 2.2. \) At the 6-month follow-up, gains from posttreatment were the same as at 3 months, \( t(3) = 3.4, df = 3, p = .042, d^* = 1.7. \) For the How Well scale, gains were significant at posttreatment, \( t(3) = 6.3, df = 3, p = .008, d^* = 3.1. \) At the 4-week follow-up, the scores were similar to those at posttreatment, \( t(3) = 1.0, df = 3, p = .375, d^* = 0.5. \) The gain from posttreatment to the 3-month follow-up was 0.6 points but was not significant because of the variability in the gains, \( t(3) = 2.0, df = 3, p = .136, d^* = 1.0. \) The gain from posttreatment to the 6-month follow-up was 0.8 points. Although this change was large, it did not achieve significance in this small sample, \( t(3) = 2.8, df = 3, p = .071, d^* = 1.4. \)

Figure 2. Changes in amount of participation in speech in life situations after a course of Constraint-Induced Aphasia Therapy II. The mean gain from pretreatment on the Verbal Activity Log (VAL) Amount of Use scale was significant at posttreatment. After treatment, there was an additional significant performance gain. Data in the graph are ipsitized—that is, pretreatment scores are set to 0 for each participant, and subsequent scores are reported as changes from pretreatment. S1, S2, S3, and S4 refer to subject/participant numbers; wk = week; F-up = follow-up.
improvements easier to achieve. This approach, which permitted participants to have many small but discriminable successes, may have also increased participant motivation to improve.

**Feedback of the time of responses.** The timing of activities in the first four exercises of CIAT II, frequent feedback of the recorded times, and encouragement to exceed previous personal-best performance had the effect of generating an increased verbal output and gave the training exercises a motivational aspect similar to that of video games. At the same time, feedback was given to maintain or improve quality of speech. Speech production in many patients with aphasia is halting and slow. This is a problem for them in life situations and is presumably at least part of what leads to the “speaking for” behavior of many caregivers (Croteau & Le Dorze, 2006; Croteau et al., 2004). It is a basic principle of operant conditioning/behavior analysis that training should be carried out directly on the behavior that is the target of change. This was part of the rationale for timing responses in the treatment exercises. The improved score on all subtests of the WAB-R indicates that this emphasis on speed of speech production did not result in an impairment of quality. Timing of responses and immediate feedback of this information has always been an integral part of the protocol for the training of impaired movement in CIMT.

**TP.** This set of behavioral techniques was designed to facilitate translation of improvements in speech achieved in the laboratory to life situations and paralleled the TP for motor function in CIMT (Taub, Uswatte, Mark, & Morris, 2006). The TP is the main way in which CI therapy differs from other rehabilitation procedures. Its critical importance in producing a large treatment effect has been demonstrated for CIMT (Taub et al., 2013). In Taub et al.’s (2013) study, 20 participants with chronic stroke had been given the full CI motor therapy protocol, including the TP. Twenty other participants received the same treatment in the laboratory, but none of the TP techniques was administered. Both sets of participants showed a significant increase in the amount of use of the more-affected arm in the life situation, but the improvement of the CI therapy/TP participants was approximately 2.5 times as great as the improvement recorded for the no-TP participants. The CI therapy/TP participants also exhibited an increase in cortical gray matter in sensory/motor areas of the cortex, whereas the no-TP participants showed none (Gauthier et al., 2008).

The TP in this study may have increased the amount of verbal practice so that it encompassed a larger portion of the day than would be the case for CIAT I. In addition, the TP may have promoted integration of therapeutic gains achieved in the laboratory with everyday life situation activities. Other aphasia therapy research has found that increasing the intensity of treatment increases the magnitude of the treatment effect (Carter et al., 2010; Meinzer et al., 2012). The TP may thus be an inexpensive and practical method of increasing the amount of training in which a participant engages during the course of the treatment day, as well as a method of extending the treatment past the time when formal therapy has ended.

A key to the implementation of the TP was the involvement of the family caregiver in all phases of the in-laboratory treatment. This experience enabled the caregiver to continue practice of the laboratory exercises with participants in the home, prompt real-world social interactions in other settings, and educe caregiver speaking-for behavior (Croteau et al., 2004; Croteau & Le Dorze, 2006), which may unwittingly increase the participant’s verbal learned nonce. The intention was to immerse participants with aphasia in a therapeutic environment throughout the day so that improved speech and attempts to continue improving it became a habitual part of their lives. As noted, participation of the caregivers in the treatment was not meant to supplant the function of therapists, which was essential.

The requirement that caregivers and participants practice verbal exercises after the completion of the laboratory phase of the treatment may have been responsible for the absence of loss in retention of treatment gains attained in the laboratory over the 6 months of follow-up and, indeed, for the continued slow improvement of the participants during this period. The periodic phone contact with the participants after the end of laboratory treatment was also designed to increase retention, as it had for CIMT (Taub et al., 2013).

**Relative importance of the changes in protocol.** The CIAT II protocol thus differed in many respects from that of CIAT I. As noted, it is not possible to determine with confidence which of these components, or combination of components, is responsible for the outcome of CIAT II without further detailed components-analysis research.

**CIAT Plus**

It is important to note that Meinzer et al. (2005) introduced a modified form of CIAT I (which they called CIAT Plus) that had some of the added elements of CIAT II, including having a family member in training sessions, assigning home exercises, and keeping a daily diary. The additions resulted in a continued improvement in participation in speech in life situations over the 6 months of follow-up. A similar result was observed after administration of CIAT II, which supports the value of those treatment components. However, the group that received the CIAT Plus protocol did not have a better treatment effect than the CIAT I comparison group in Meinzer et al.’s study immediately after the end of the therapy period, as assessed by the CAL, Communicative Effectiveness Index, and the Aachen Aphasia Test (Huber, Poeck, & Willmes, 1984). It should be noted that the CIAT II has a number of components that CIAT Plus does not. These include daily administration of the VAL, problem solving, a behavioral contract, four new in-laboratory exercises, more intensive and extended training, and a strong emphasis on frequent feedback and shaping during the laboratory exercises.

**Adherence to the Treatment Protocol**

The importance of adherence to the requirements of the protocol is illustrated by the results for Participant 4 (S4), who
did less well than the other participants by a wide margin. She was also the participant who was only marginally ad-
herent to the homework requirements. Each of the other participants assiduously performed all the at-home exercises given them. Even in the laboratory, S4 exhibited reluctance to maintain the pace of speech urged by the therapist during the first half of treatment; during the second half of treatment, in-laboratory adherence improved slightly. In the follow-up phone calls, S4 stated that she had not practiced her homework assignments after the first week posttreatment.

The therapy was intensive, but it was not reported as being aversive by three of the participants, and even Participant 4 was disconcerted only during the first half of training. The countervailing factor appeared to be the participants’ awareness of the rapid progress they were making. This was explicitly stated repeatedly by each of the participants; even S4, who was noncompliant during the first half of her treatment, noted her improvement (which prevented her from dropping out). The social facilitation provided by therapists and caregivers, and the interaction between participants, also appeared helpful in this regard. Personal stories were shared with the therapists by participants and caregivers who gave accounts of family and friends noting differences in the participants’ speech ability daily.

In summary, the method of CIAT II differs from that of CIAT I in a number of important ways. It was administered for 15 consecutive weekdays rather than 10. Because the four new exercises involved one-on-one participant–therapist interaction, the in-laboratory training was more intense and concentrated than in CIAT I, in which the amount of speech was reduced by multiple players taking turns participating. The increased emphasis on shaping, focusing on achieving small but progressive and discriminable increments in performance, may have increased participant motivation and made improvement more likely. The TP procedures may have helped participants transfer therapeutic gains in the laboratory to life situations. It would be valuable for future components-analysis research to identify the relative contribution of these different elements to the efficacy of CIAT II.

Treatment effect difference between best performance in the laboratory and actual participation in speech in the life situation. Although the effect size of the treatment on the WAB–R was large ($d’ = 1.3$), this effect did not achieve significance ($p = .077$), presumably because of this study’s small sample size ($n = 4$). The effect sizes for improvement in participation in speech in life situations, as recorded by the VAL, were considerably larger: 2.2 and 3.1 for the Amount of Use and How Well scales, respectively. The large disparity between the improvement in participation in speech in life situations versus the improvement in prompted maximal activity on an in-laboratory test is characteristic of CIMT (Taub et al., 1993, 2013; Taub, Uswatte, King, et al., 2006). The apparent basis for this disparity is that CI therapy is particularly effective in overcoming the learned nonuse component of a deficit resulting from damage to the CNS (Taub & Uswatte, 2009; Taub, Uswatte, Mark, & Morris, 2006), which is reflected primarily in amount of participation in speech in life situations as indicated by scores on the VAL.

CI therapy–type interventions also improve the quality of maximal performance of which a person is capable on command in the laboratory/clinic, whether motor or language, but not nearly to the same extent (Uswatte & Taub, 1999, 2005).

It is interesting that the WAB–R subscale that showed the second largest change was the Auditory Comprehension scale, although no explicit attempt had been made to improve understanding. However, the treatment involved not only intensive use of expressive speech but also the understanding of frequently given instructions and questions. The understanding of speech appears to have thereby been enhanced. This adventitious result is consistent with that obtained in the original CIAT I study (Pulvermüller et al., 2001).

Limitations and Conclusions

Interpreting the results of this preliminary study is limited by the small number of participants and the absence of a control group. Therefore, before meaningful conclusions can be reached, a larger scale study would have to be carried out with control groups and with blinded clinicians carrying out the testing. However, the results from this study are consistent with data from CIMT studies, and they appear promising, warranting further research.

Acknowledgments

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Appendix

Verbal Activity Log

Participants and their caregivers were jointly asked to rate the amount and quality of the participant’s speech in 12 different situations compared to before the stroke. The questions are listed below and followed by the two rating scales. The manual for administering this instrument may be obtained by contacting the first author.

1. Did you talk while eating a meal with others you did know?
2. Did you talk to an employee in an office, store, or public place (e.g., post office, market)?
3. Did you answer the phone?
4. Did you introduce yourself to others?
5. Did you take a message from someone on the phone and deliver it to someone verbally?
6. Did you tell a story or relay an event to someone?
7. Did you use sentences when talking?
8. Did you start a conversation with your caregiver or others in your family?
9. Did you talk about any of your needs?
10. Did you make a phone call and talk, or take over a phone call and talk?
11. Did you talk with others while in a group?
12. Did you verbally order for yourself in a restaurant?

Verbal Activity Log Scales

Amount of Use scale

0—My speech was not used at all for that activity. (0%)
0.5—Occasionally used speech but only very rarely. (very rarely used—10%)
1.5—Sometimes used speech, but rarely. (rarely used—25%)
2.5—Used speech about half as much as before the stroke. (half the time—50%)
3.5—Used speech almost as much as before the stroke and did not rely on my caregiver very often. (frequently—75%)
4.5—Used speech as often as before the stroke. (100%)

How Well scale

0—My speech was not used at all for that activity. (0%)
0.5—My speech was used for that activity but was not helpful. (very poor—10%)
1.5—My speech was of some use during that activity but I required help and my speech was slow. (poor—25%)
2.5—My speech was used for that activity but it was slow and I only used 2–4 words. (fair—50%)
3.5—My speech was used for that activity and was almost normal but not quite as fast or as accurate as before the stroke. (almost as good as before stroke—75%)
4.5—My speech for that activity was as good as before the stroke. (100%)

Note. Percent values refer to comparison to time before stroke.