Introduction

Constraint Induced Language Therapy (CILT) is an aphasia treatment modeled after Constraint Induced Movement Therapy (CIMT) used in physical therapy for limb weakness after stroke. CIMT is based on the notion of "learned non-use", the tendency to rely on the stronger limb thereby hindering rehabilitation of the affected limb (Taub, Uswatte, & Pidikiti, 1999). Studies have shown increased limb use and evidence of motor cortex reorganization (Taub et al., 1999) following CIMT which employs three key principles: 1) massed practice 2) constraint of the unaffected limb 3) forced use of the affected limb (Taub et al., 1999).

In 2001, Pulvermüller and colleagues applied these principles to language treatment for individuals with chronic aphasia. In CILT, compensatory non-verbal communication modalities are constrained and participants are required to make verbal requests and responses. The preliminary study (Pulvermüller et al., 2001) and subsequent follow up studies (Barthel, Meinzer, Djundja, & Rockstroh, 2008; Maher et al., 2006; Meinzer, Djundja, Barthel, Elbert, & Rockstroh, 2005; Szaflarski, 2008) all showed significant improvement in the amount and quality of communication on language outcome measures including standardized aphasia batteries, communication activity logs, and narrative discourse samples. This evidence dispels the notion that continued recovery is not possible for individuals with chronic aphasia but the variables contributing to remediation remain ambiguous. Constraining compensatory communication is a radical shift for speech-language pathologists who have been trained to assist in the maximization of functional communication. Before adopting such a paradigm shift, it is prudent to determine the contribution each factor makes to the success of treatment.

Evidence from the literature supports the contribution of intensity. A review of aphasia rehabilitation studies found that significant treatment effects resulted whenever intensive (at least 8.8 hours per week) training was provided for a total of approximately 100 hours (Bhogal, Teasell, & Speechley, 2003). A comparison of CILT studies to other intensively administered treatments revealed that performance on language outcome measures was generally better and tended to be preserved longer on follow up testing with CILT (Cherney, Patterson, Raymer, Frymark, & Schooling, 2008). Only two studies have controlled for intensity. One compared CILT with traditional therapy (Maher et al., 2006) and one compared CILT to an individually tailored therapy (Barthel et al., 2008). Neither found a clear advantage for CILT suggesting that intensity is a main contributor to positive outcomes following CILT.

In the present study, treatment type was controlled in order to best analyze the contribution of intensity to CILT with individuals with chronic aphasia. CILT was delivered for 30 hours over two weeks to one group and for 30 hours over ten weeks to the second group. This study is the first to investigate whether CILT delivered less intensively results in improvements in language function comparable to those seen in other studies.

Methods

Participants

The nine individuals who participated in this study were recruited from a university-based aphasia group. They were selected based on interest and access to reliable transportation. All participants were at least one year post left CVA. While taking part in the study, individuals did not participate in any other form of language rehabilitation.

Group assignment was determined by transportation availability. Dyads were then created by matching aphasia severity. There were four participants in the intensive CILT (CILT-I) group and five participants in the distributed CILT (CILT-D) group. Overall the CILT-I group presented with more severe language deficits and were more chronic than those in the CILT-D group (see Table 1).

Intervention

CILT was administered to both groups according to the protocol described by Pulvermüller and colleagues (2001). The CILT-I group participated in three hour sessions, five days a week, for two weeks. The CILT-D group participated in one hour sessions, three days a week, for ten weeks. Both groups received a total of 30 hours of treatment. Card sets were created to include nouns of high and low frequency occurrence, varying number and color, and phonemic similarity. Central to CILT is the employment of *forced use* and *constraint* whereby participants are required to produce and respond to verbal communication and alternative communicative modalities such as gesture are constrained. Shaping is also a component of treatment requiring increasingly more challenging linguistic goals. Participants were instructed on individual linguistic targets prior to each session and the clinician provided cueing as necessary.

Standardized assessments

The Western Aphasia Battery Aphasia Quotient (WAB AQ) (Kertsz, 1982), and Communication Activities of Daily Living-2 (CADL-2) (Holland, Frattali, & Fromm, 1999) were administered pre- and post-treatment. Follow-up testing was completed one and two months post-treatment. Follow-up testing remains in progress for those who received CILT-D.

Discourse elicitation and treatment probes

To assess generalization of treatment to connected speech, several types of discourse were elicited including picture descriptions, story retell and conversation. Treatment probes were also administered throughout in order to compare progression of change between groups. A stable baseline of Correct Information Units (CIUs) per minute was established prior to treatment and probes were administered after every six hours of treatment. Participants were shown three randomly chosen Norman Rockwell prints from a set of ten and asked, “What is happening in this picture?” Treatment probes and the other discourse measures were also administered during post-treatment follow-up sessions.

Discourse elicitation and standardized assessment administration were digitally video- recorded. Discourse measures were then transcribed verbatim and analyzed for word and CIU count according to the procedure developed by Nicholas and Brookshire (1993). Words per minute, percent of words that were CIUs and CIUs per minute were then calculated.

Results

Standardized test measures

Due to the heterogeneity of the participants, results are interpreted individually. Three of the four participants in the CILT-I group demonstrated a greater than five point gain on the WAB AQ. By comparison, a greater than five point gain was seen for only one of the five participants in the CILT-D group. (See Table 2.)

Two participants from each group demonstrated an increase of two standard deviations on the CADL-2. Preliminary follow-up data show that gains were maintained for all individuals from both groups. (See Table 2.)

Discourse measures and treatment probes

This study was just completed so for the purpose of this proposal, only baseline data and treatment probes have been analyzed. Figures 1-9 show CIUs/minute for all participants. Treatment began after a stable baseline was reached. Follow up data was included when available. For the CILT-I group, participant I-4 showed the greatest gain in CIUs/min. I-2 and I-3 made slight gains. For the distributed group, only D-2 showed gains. Consistent with the standardized measures, more individuals from the CILT-I group demonstrated positive changes in narrative discourse.

Discussion

- Our preliminary findings confirm previous studies that have shown improvement in expressive and receptive language when all three of the CILT principals (constraint, forced use and massed practice) are employed. Improvements are maintained in follow-up testing.
- Although the CILT-I group consisted of individuals with more severe aphasia, the intensive treatment appears to yield better results. However, for some individuals, the distributed CILT was also effective and the gains maintained.
- In the present study, participants' ability to self-monitor perseverations and paraphasias appeared to be an important outcome factor.
- Language treatment is beneficial for individuals in the chronic phase of aphasia recovery.

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Table 1. Participant characteristics for the Intensive and Distributed Constraint Induced Language Therapy (CILT) groups

ID	Age	Sex	H	YPO	WAB	CADL
I-1	26	M	R	5.6	67.72	90
I-2	53	F	R	1.5	24.8	90
I-3	67	M	R	11.2	32.3	40
I-4	72	F	R	3.5	27.4	8
mean	54.5			5.5	38.055	57
D-1	63	M	R	8	28.9	26
D-2	47	M	R	1.1	50.1	35
D-3	66	M	R	2.7	89	77
D-4	51	F	R	1.8	84.2	81
D-5	77	M	R	1.1	73.6	77
mean	60.8			1.7	65.2	59.2

ID-I=intensive, D=distributed; H=handedness; YPO=years post onset; WAB=WAB AQ

Table 2. Results of standardized language assessment and change in scores, pre tx, post tx, and one month post tx.

ID	WAB AQ Pre Tx	WAB AQ Post TX	WAB AQ Pre-Post change	WAB AQ 1 month post f/u	WAB AQ pre- 1 month post change	CADL Pre Tx	CADL Post Tx	CADL Pre-Post change	CADL 1 month post f/u	CADL pre-1 month post change
I-1	67.72	76.1	8.38	n/a	n/a	8	8	0	n/a	n/a
I-2	24.8	32.6	7.8	33	8.2	8	8	0	n/a	n/a
I-3	32.3	46	13.7	47.7	15.4	4	6	2	5	1
I-4	27.4	30.7	3.3	32.1	4.7	2	3	1	3	1
D-1	28.9	31	2.1	34.7	5.8	4	4	0	3	-1
D-2	50.1	58.7	8.6	61.6	11.5	2	5	3	7	5
D-3	89	86.4	-2.6			6	8	2		
D-4	84.2	83.9	-0.3	78.1	-6.1	7	6	-1	7	0
D-5	73.6	74.7	1.1	73	-0.6	6	6	0	6	0

Highlighted scores indicate clinically relevant change > 5 points for WAB AQ (Shewan & Donner, 1988) and 2 SD change on CADL. CADL scores are reported as stanines and stanine change of 1 represents a 2 SD change. Participant D3 missed two weeks of sessions after the first 7 weeks. He resumed and completed all 30 hours.

Figure 1. Participant I-1. CIUs/minute

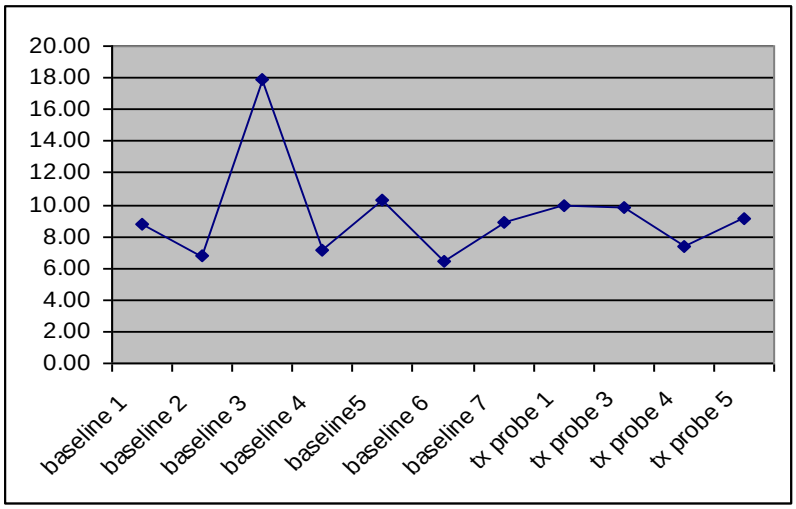

Figure 2. Participant I-2. CIUs/minute

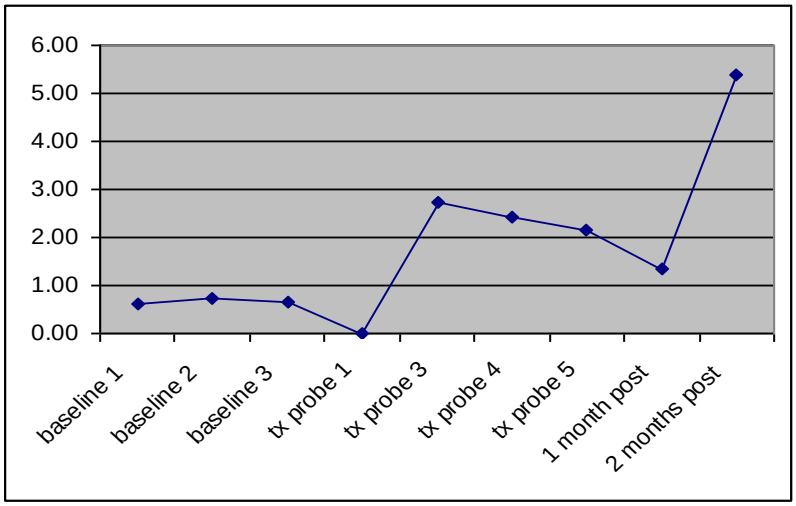

Figure 3. Participant I-3.CIUs/minute

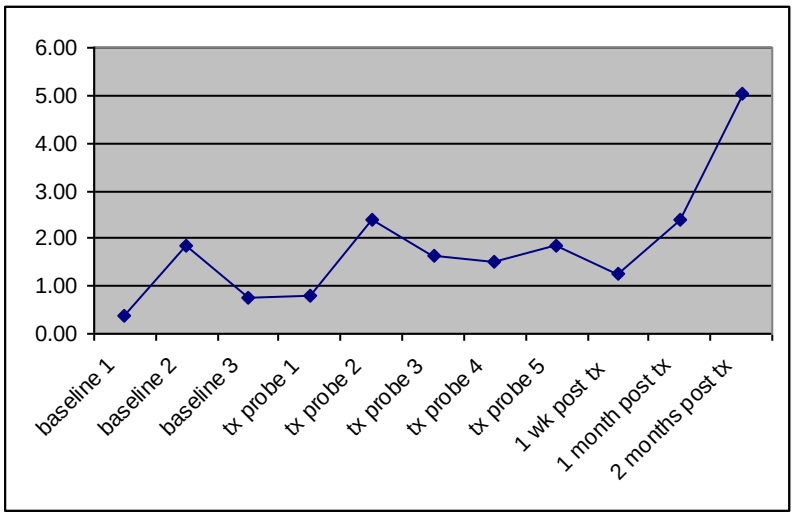

Figure 4. Participant I-4. CIUs/minute

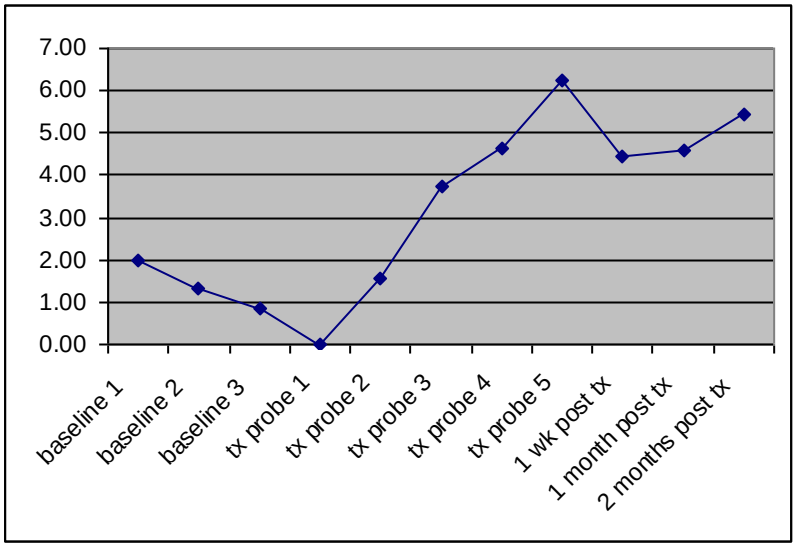

Figure 5. Participant D-1. CIUs/minute

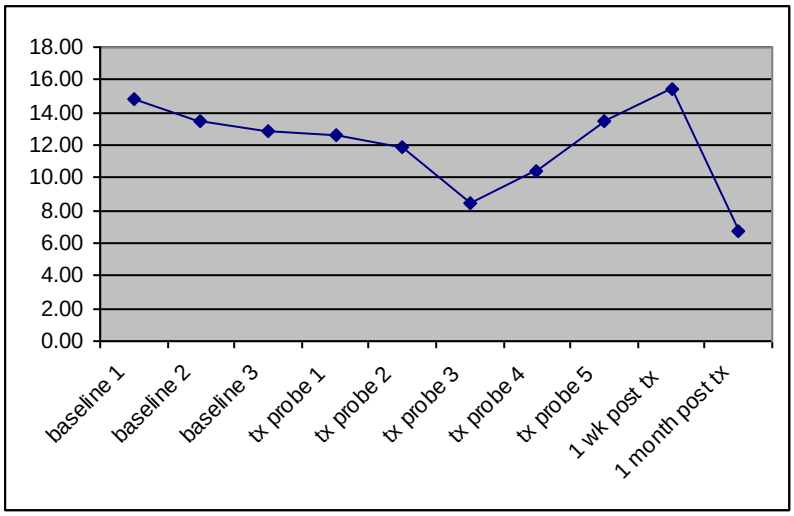

Figure 6. Participant D-2. CIUs/minute

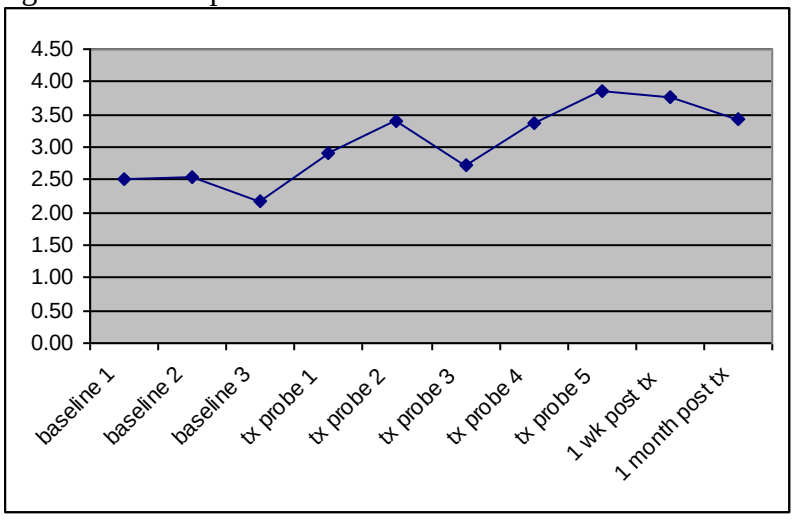

Figure 7. Participant D-3. CIUs/minute

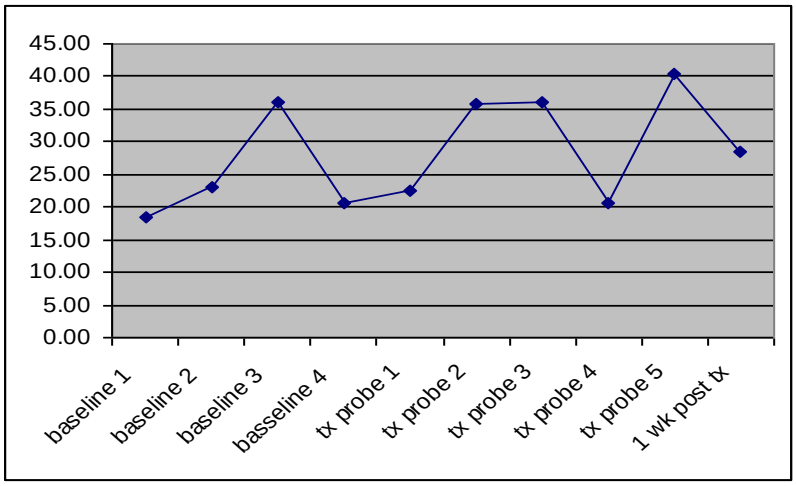

Figure 8. Participant D-4. CIUs/minute

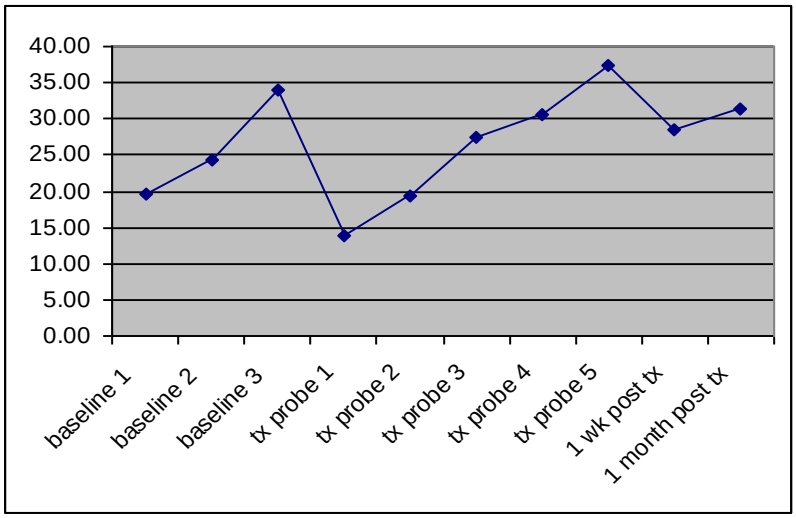

Figure 9. Participant D-5. CIUs/minute