

## The Investigation of Treatment Outcomes for Adults with Chronic Brain Injury following Intensive Multidisciplinary Treatment

**Objective:** While medical advancements have led to increased mortality in adults with cerebral vascular accidents<sup>1</sup> and traumatic brain injury<sup>2</sup>, the study of neural plasticity and recovery of function suggests that patients may benefit from intensive communication and physical treatment well into the chronic stages of recovery.<sup>3</sup> Additionally, these patients may experience psychosocial effects of the injury,<sup>2,4,5</sup> as well as, changes over time as they attempt to adjust in various stages of recovery.<sup>4,6-9</sup> Relative to chronic aphasia, it has been found that intensive SLP treatment (over 15 hours a week for 2-6 weeks) has been found to have significant advantage over the traditional model of a few hours a week for a longer duration.<sup>10,11</sup> Similarly, patients with TBI have shown benefit from intensive SLP<sup>13</sup> and multidisciplinary treatment.<sup>14</sup> However, as healthcare costs have escalated, research has also investigated alternative SLP training strategies for patients with chronic brain injury including group treatment,<sup>13,14</sup> utilizing supervised volunteers<sup>16</sup> and computer-assisted instruction.<sup>16-19</sup> In order to explore another cost-effective rehabilitative strategy for individuals in the chronic stage of brain injury recovery, this investigation examined the efficacy of providing a university based, intensive treatment program utilizing resources from communication sciences and disorders (COMD), psychology and kinesiology to treat individuals with chronic aphasia or diffuse brain injury.

**Participants:** Twenty four subjects were targeted. Recruitment focused on 12 individuals with CVA and 12 individuals with TBI, with single onset, at least 1 year post onset, with equal Mild-Moderate/Moderate-Severe distribution and matched across groups in age, gender, education, employment status and previous SLP treatment. Twenty subjects enrolled and as illustrated in Tables 1 and 2, 18 subjects completed the study with 6 each in the Intensive, Weekly and Control Groups. As noted in the table, subject endurance, availability and interest precluded random assignment resulting in the Intensive group being more communicatively impaired, the Weekly group average was the oldest and the Control group was the best educated and had the greatest average years post onset.

**Treatment Conditions:** The Intensive Group participated in a 35 hour a week, 6 week, university based program as illustrated in Figure 1. Subjects received 12 hours a week of COMD (communication sciences and disorders) treatment, including individual (5 hours), small group (5 hours), and large group (2 hours), which was delivered by 2<sup>nd</sup> year master's degree students under the supervision of the university supervisor, a certified SLP. The COMD sessions addressed 6 mutual goals, individualized in cueing and criterion, to promote functional, contextually based multi-modality communication and compensatory techniques for memory/auditory comprehension, word retrieval/ verbal expression and reading/writing. Ancillary communication activities which were presented each week by the investigator, a certified SLP, included: pantomime/improvisation (2 hrs), computer lab (2 3/4 hrs), music appreciation (2 hrs), wellness lecture (1 hr), community integration (5 hrs), social lunch (5 hrs), and watching funny videos (3hrs). Psychological support was provided for 2 1/4 hours per week by a supervising, licensed psychologist with two master's degree students. Modified Tai Chi alternated for 3 weeks

with Watching Funny Videos (3hrs) and was administered by a certified Tai Chi instructor who participates in ongoing Tai Chi research with aging adults. The second treatment condition, the Weekly Group received 3 hours, one day a week, for 6 weeks of COMD treatment. This treatment was delivered by the same supervised students using the same individualized treatment goals to administer 1 ½ hours each of small group and mid size group treatment. The Control Group received no treatment.

**Assessment:** To assess communication and quality of life across treatment, the investigator administered the following battery to each subject: interview of current status/changes in life circumstances, ASHA Quality of Communication Life Scale (QCLS), the Cognitive Linguistic Quick Test (CLQT), Communication Activities of Daily Living-2 (CADL-2), the Aphasia Diagnostic Profiles (ADP), and the Environmental Symbol Recognition Test (ESRT- under development; Davis & Rubin, 2000). The Intensive and Weekly Groups were administered the battery within the week prior to treatment (Pre), within 1 week post treatment (Post-7weeks later) and 7 weeks later (Post-Post). However, due to subject availability, Pre Testing for the Control Group lasted 3 weeks. Subsequent Post and Post-Post Testing were conducted approximately 6 weeks from previous testing. Additionally, to assess physical function, the Intensive and Weekly groups were given Pre, Mid, Post and Post-Post administrations of the Berg Functional Balance Scale (BFBS), The Timed Up and Go Test (TUG), and The Six-Minute Walk Test (6MWT). During treatment, the Experience Sampling Method (ESM) was used to survey the Intensive and Weekly Group subjects' perceptions of their feelings at the end of each treatment activity. Each subject used a Palm Zire 31 Personal Data Assistant (PDA) to record their responses to a probe of five simple questions using a 5 point visual analog scale.

**Results:** During initial testing, the Intensive Group appeared more severely impaired while the Control Group appeared to be the least impaired. Findings on the four cognitive-linguistic measures confirmed that average group severity was different with mean scores remaining the most severe for the Intensive Group and least severe for the Control Group across all administrations (See Table 3). One-way repeated measures analysis of variance with partial eta squared effect size was used to analyze cognitive linguistic, quality of life and physical measures across testing periods. Of the cognitive-linguistic assessments, treatment groups were found to significantly differ across assessment periods in their response to the CADL-2, an assessment of functional communication using simulated everyday situations and allowing multi-modality response (See Table 4). However, similar to findings of other intensive treatment studies, the greatest mean gains were achieved by the Intensive group post treatment.<sup>20,21</sup> While response to the ASHAQCLS was not found to differ significantly by group across testings, the response to ESM questions taken during COMD treatment suggested that the Intensive Group was significantly happier and more satisfied with their communication during treatment than the Weekly Group (see Figure 2 and Table 5). While comparison of physical function with the Weekly Group did not appear significantly different overall, additional analysis compared the Intensive Group following periods when Modified Tai Chi was administered with periods in which it was withheld. A one sample t test suggested that subjects in the Intensive group demonstrated a significantly wider

variation in performance on the TUG following treatment suggesting a significant difference in rate of ambulation after Modified Tai Chi training. (Table 6).

**Conclusions:** Despite the methodological limitations of this small study, empirical gains of the Intensive Group in communication, physical function and during-treatment quality of life suggest that an intensive multidisciplinary program may have greater value to adults with chronic neurological impairment than the traditional treatment model. While there remains tremendous opportunity to further analyze specific aspects contributing to the value of such a program, it appears that as university training programs endeavor to provide clinical practicums in areas such as SLP, psychology, social work, physical therapy, etc. that there is tremendous civic opportunity to contribute to the function and quality of life of individuals with chronic brain injury in their community.

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Table 1  
Subject Assignment to Treatment Condition

Sub	Etio	Ref Sev	Sub Ch	Sub Issue	Tx Grp	Primary Diagnosis according to ADP/CLQT	Secondary Diagnosis
1	DBI	MS	I	None	I	Mod Cogn-Ling Imp	Mod Wd Retr Imp
2	CVA	MM	I	None	I	Borderline Fluent Aph	AOS; Mild CLI
3	DBI	MS	I	None	I	Mild Cogn-Ling Imp	Sev Wd Retr Imp
4	DBI	MM	I	None	I	Mod Cogn-Ling Imp	NA
5	CVA	MS	I	None	I	Broca's Aph	Dys; AOS; Mild CLI
6	CVA	MS	I	None	I	Broca's Aph	AOS; Mod CLI
7	CVA	MM	W	Endur	W	Anomic Aph	Mod Memory Imp
8	CVA	MM	W	Endur	W	TCS Aph	Mild CLI
9	CVA	MS	W	Avail	W	Borderline Fluent Aph	AOS; Mod CLI
10	DBI	MM	W	Avail	W	(Scored WNL)	NA
11	CVA	MS	I	Tran	W	Broca's Aph	AOS; Mod CLI
12	DBI	MM	W	Tran	W	Mild Cogn-Ling Imp	NA
13	DBI	MS	C	Break	C	Mild Cogn-Ling Imp	Mod Wd Retr Imp
14	DBI	MM	C	Break	C	(Scored WNL)	NA
15	DBI	MM	C	Break	C	(Scored WNL)	NA
16	CVA	MS	W	Avail	C	Borderline Fluent Aph	AOS
17	CVA	MM	C	No I	C	Borderline Fluent Aph	Mild CLI
18	CVA	MM	C	No I	C	(Scored WNL)	AOS

KEY: Sub= Subject

Etio= Etiology: DBI= Diffuse Brain Injury; CVA= Cerebral Vascular Accident.

Ref Sev= Inclusive Referral Severity: MM= Mild-Moderate; MS = Moderate- Severe.

Sub Ch= Subject's Choice of Treatment Group.

I= Intensive Treatment Group- 35 hour a week/ 5 day per week program.

W= Weekly Treatment Group- 3 hour a week/1 time per week program.

C= Control Treatment Group- assessment only, no treatment.

Sub Issue= Issues affecting a subject's participation in desired treatment level.

Endur= Subject concerned about their ability to endure a higher program intensity.

Avail= Subject not available during scheduled assessment/treatment for higher intensity program.

Tran= Subject transportation issues precluded participation in higher intensity program.

Break= Subject completed last semester of treatment, but, wanted a break from treatment.

No I= Not recent clinic patient; interested in participating in study, but, not treatment.

Tx Grp= Assigned Treatment Group/Experimental Condition (Groups same as Sub Ch).

Primary Diagnosis According to ADP (Aphasia Diagnostic Profile)/ CLQT (Cognitive Linguistic Quick Test): Severity= Mild, Mod (Moderate) or Sev (Severe).

Impairments= Cog Ling Imp (Cognitive Linguistic Impairment) OR Aph (Aphasia); TCS (Transcortical Sensory Aphasia).

Secondary Diagnosis= Any related communication disorders (Severity same as Primary).

Wd Retr Imp= Word Retrieval Impairment; AOS= Apraxia of Speech;

CLI= Cognitive-Linguistic Impairment; Dys= Dysarthria of Speech.

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Table 2  
Demographic Characteristics of Treatment Groups

Treatment Group		Age	Education	Employment Status	Gender	Years Post Onset
Intensive (N=6)	Mean	44.56	2.33	2.67	1.33	4.37
	SD	23.78	1.75	1.21	.52	4.28
	MIN	21.17	High School	Employed	Male	1.00
	MAX	75.60	GraduateDegree	Unemployed	Female	12.92
Weekly (N=6)	Mean	58.65	2.67	2.67	1.33	2.56
	SD	7.462	1.37	.82	.52	2.12
	MIN	49.83	High School	Employed	Male	1.00
	MAX	72.00	GraduateDegree	Disabled	Female	6.25
Control (N=6)	Mean	49.85	4.00	2.50	1.33	6.79
	SD	9.16	.63	1.22	.52	5.06
	Minimum	36.58	Jr	Employed	Male	2.58
	Maximum	59.92	Coll/TradeSchl GraduateDegree	Unemployed	Female	15.00
Total (N=18)	Mean	51.02	3.00	2.61	1.33	4.57
	Std. Dev	15.59	1.46	1.04	.49	4.17
	Minimum	21.17	High School	Employed	Male	1.00
	Maximum	75.60	GraduateDegree	Unemployed	Female	15.00

Key: Jr Coll/Trade Schl- Completed Junior College or Trade School.



Table 3  
 Descriptive Statistics for Overall Cognitive Linguistic Performance on Test Battery for each Treatment Group

	Descriptive Statistics					
	PRE-Testing		POST		PST-POST	
	Mean	SD	Mean	SD	Mean	SD
<b>CADL-2</b>						
I (N=6)	76.67	21.44	77.33	20.58	84.83	14.69
W (N=6)	91	7.07	92.83	5.74	91	6.57
C (N=6)	94.5	2.5	96.17	2.64	96.33	2.25
<b>Mod ADP</b>						
I (N=6)	140.23	28.3	142.67	27.82	142.83	29.42
W (N=6)	179.12	25.12	180.28	27.71	181.17	32.44
C (N=6)	193.83	18.87	191.17	15.26	195.67	17.67
<b>CLQT</b>						
I (N=6)	58.17	8.7	60.17	12.69	60.75	12
W (N=6)	70.33	13.78	71.67	9.54	70.75	10.88
C (N=6)	79.17	11.14	81.83	7.68	82.83	5.91
<b>ESRT-SC</b>						
I (N=6)	25.17	4.31	26.33	3.2	25.83	4.92
W (N=6)	29.17	3.71	29	5.14	28.67	4.5
C (N=6)	31	0.89	30.83	1.17	31.330	0.82

Key:

CADL-2= Communication Abilities of Daily Living-2

Mod ADP= Modified Aphasia Diagnostic Profiles- All subtests included except Information Units and Phrase Length; see Appendices K and L for subtest performance.

CLQT= Cognitive Linguistic Quick Test; see Appendices M and N for domain scores.

ESRT= Environmental Symbol Recognition Test (under development).

Table 4  
 Repeated Measures Analysis of Overall Cognitive Linguistic Performance (Time \*  
 Treatment Group)

	Mauchly's Test of Sphericity			F Test			partial $\eta^2$
	W	df	p	df	F	p	
CADL-2 I (N=6) W (N=6) C (N=6)	0.573	2	.02*	2.803	5.693	0.006*	0.432
Mod ADP I (N=6) W (N=6) C (N=6)	0.778	2	0.172	4	0.355	0.802	0.045
CLQT I (N=6) W (N=6) C (N=6)	0.932	2	0.611	4	0.215	0.928	0.028
ESRT-SC I (N=6) W (N=6) C (N=6)	0.849	2	0.317	4	0.827	0.506	0.099

Key: F Test= When Mauchly's Test is significant for possible violation of sphericity,  
 the Greenhouse-Geisser Conservative F Test is used; \*p< 05

CADL-2= Communication Abilities of Daily Living-2

Mod ADP= Modified Aphasia Diagnostic Profiles

CLQT= Cognitive Linguistic Quick Test

ESRT= Environmental Symbol Recognition Test (under development)

Table 5  
 Response to ESM questions regarding COMD Activities by Treatment Groups

Questions	Treatment	Descriptive statistics			t-test for Equality of Means- Equal variances not assumed		
		N	Mean	SD	t	df	p
Happy	Intensive	67	4.4776	.78544	-3.552	116.89	.001*
	Weekly	62	3.9194	.98010			
Tired	Intensive	67	1.8651	1.0995	-1.713	124.40	.089
	Weekly	62	2.2097	1.1754			
Stressed	Intensive	67	2.0299	1.1006	-.188	126.90	.851
	Weekly	62	2.0645	.98963			
Communication Satisfaction	Intensive	67	4.1204	.87943	-2.304	108.54	.023*
	Weekly	62	3.6774	1.2516			

Key= Scale 1 to 5

P < .025; Mean scores for Happy and Communication satisfaction inverted to facilitate interpretation.

Table 6

Comparison of Performance of Subjects within the Intensive Group who received Tai Chi on Physical Performance Measures during periods after Tai Chi was administered and after Tai Chi was withheld

	Descriptive Statistics			t Test		
	N	Mean Difference	SD	t	df	p*
BFBT Diff Tx	6	1.5	3.89	0.946	5	0.194
BFBT Diff No Tx	6	0.17	1.47	0.277	5	0.397
BFBT Compare Means				.786	6.4	.23
TUG Diff Tx	6	-2.27	1.43	-3.896	5	0.006*
TUG Diff No Tx	6	.02	3.22	.015	5	0.494
TUG Compare Means				-1.590	6.9	.0785
6MWT Diff Tx	6	98.33	124.97	1.927	5	0.056
6MWT Diff No Tx	6	22.55	80.88	0.683	5	0.265
6MWT Compare Means				1.247	8.6	.124

Key:  $p^* < .05$

BFBT= Berg Functional Balance Scale (Hypothesize > in balance score following Tai Chi).

Diff Tx= For 3 week period each 6 Intensive subjects were enrolled in Tai Chi, value reflects difference from Beginning to End of 3 weeks.

Diff No Tx= For 3 week period each 6 Intensive subjects were NOT enrolled in Tai Chi, value reflects difference from Beginning to End of 3 weeks.

TUG= Timed Up and Go Test (Hypothesize < in seconds following Tai Chi).

6MWT= Six Minute Walk Test (Hypothesize > in meters walked following Tai Chi.)

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9:00	COMD Supervised MA Students: Ind & Medium	Computer lab (MA/CCC-SLP Investigator & student asst) w/ 15 min. Ind psych visits (Lic Psych w/ 2 MA psych students)	COMD Supervised MA Students: Ind & Medium	Wellness Group (Investigator)  Psychology Support Group (Lic Psych w/ 2 MA psych students)	Community Integration- Field trip (MA/CCC-SLP Investigator & COMD MA Students)
9:30	Group Tx		Group Tx		
10:00	COMD Supervised MA Students: Ind & Medium		COMD Supervised MA Students: Ind & Medium		
10:30	Group Tx		Group Tx		
11:00					
11:30					
12:00	Brown Bag- Social Lunch ( MA/CCC-SLP Investigator)				
12:30					
1:00	3 wks Modified Tai Chi (w/ Cert Instructor) or Funny Video (Investigator)	COMD Supervised MA Students: Ind & Medium Group Tx	3 wks Modified Tai Chi (w/ Cert Instructor) or Funny Video (Investigator)	COMD Supervised MA Students: Ind & Medium Group Tx	3 wks Modified Tai Chi (w/ Cert Instructor) or Funny Video (Investigator)
1:30					
2:00	Music Appreciation (MA/CCC-SLP Investigator & student asst)	COMD Supervised MA Students: Ind & Medium Group Tx	Pantomime or Improvisation Activity (MA/CCC-SLP Investigator & student asst)	COMD Supervised MA Students: Ind & Medium Group Tx	Community Integration- Social ( MA/CCC-SLP Investigator)
2:30		COMD Supervised MA Students: Social Games: Large Group		COMD Supervised MA Students: Social Games: Large Group	
3:00					
3:30					
5:30-7:30		Psychology Support Group- Family (Lic Psych w/ 2 MA psych students)			

Figure 1. Multidisciplinary Intensive Treatment Program (for Intensive Group).

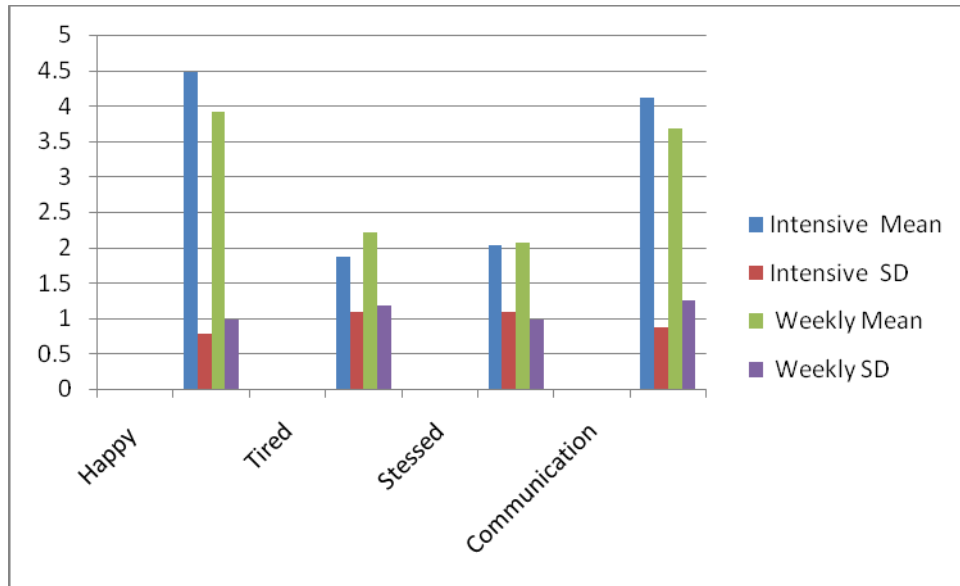


Figure 2  
 Response to PDA questions for COMD activities for Weeks 3-6 treatment by randomly choosing Intensive subjects for Tuesday or Thursday COMD data comparison with Tuesday or Thursday Weekly Group members