Summary
Aphasia Treatment over the Internet: A Randomized Placebo-Controlled Clinical Trial

Research indicates that intensive aphasia treatment is more efficacious than treatment applied sporadically over long periods of time (Cherney et al., 2008, 2010). However, in reality, services to persons with aphasia (PWA) are being drastically shortened because of legislation and reduced resources (e.g. transportation difficulties, therapist shortages in rural areas). Telerehabilitation may be a cost-effective way to extend therapy beyond the hospital and clinic, allowing PWAs to receive much needed intensive therapy in their homes.

We present results of a randomized placebo-controlled trial that evaluated the efficacy of an aphasia treatment (Oral Reading for Language in Aphasia – ORLA) administered over the internet. ORLA^{TM} involves repeated reading aloud of sentences, first in unison with the clinician and then independently (Cherney, 1995, 2004; Cherney, Merbitz & Grip, 1986). It focuses on connected discourse, allowing practice on a variety of grammatical structures, rather than just one specific grammatical form. The graded nature of ORLA makes it appropriate for individuals with a broad range of aphasia severities. When delivered by a speech language pathologist (SLP), ORLA has been shown to be efficacious (Cherney et al, 1986, 2010).

A computerized version of ORLA has been developed in which PWAs work with an avatar or virtual therapist who reads aloud, speaks with accurate visual speech, highlights and repeats words and sentences and provides guidance much like a real therapist. With web-ORLA, patients work on their home computers with treatment delivered by the virtual therapist and remote online monitoring and communication by the real SLP. Figure 1 illustrates web-ORLA.

The randomized placebo-controlled trial addressed the following specific questions:

- Does ORLA delivered by a virtual therapist remotely via the internet result in improved language skills (as measured by the Western Aphasia Battery Revised - WAB-R (Kertesz, 2006))?
- Does ORLA delivered by a virtual therapist remotely via the internet result in greater improvements in language skills (as measured by the WAB-R) when compared to placebo computer therapy?
- Are observed improvements in language performance following web-based ORLA, as measured by the WAB-R, maintained over time (6 weeks post-treatment)?

METHODS

Subjects
Participants included 32 individuals with chronic aphasia following a single left-hemisphere stroke occurring more than 6 months previously. Subjects were randomly assigned to one of two conditions: web-based ORLA (3 in 5 chance) and placebo-computer treatment (2 in 5 chance). Randomization was stratified by pre-treatment aphasia severity (WAB-R aphasia quotient (AQ) score <60 vs ≥60) to ensure balance of severity in each treatment arm. A statistician generated the randomization code via computer.

Table 1 shows demographic data for the subjects, including sex, age, handedness, education, time post onset of stroke, and severity and type of aphasia. There was no significant difference between the groups (p>.05) on any of these variables.

Intervention
Both groups (ORLA and placebo) received 9 hours of treatment a week for 6 weeks (i.e. 3x30 minutes/day or 2x45 minutes/day, 6 days a week). The placebo group used a commercial off-the-shelf computer program, Bejewelled, that did not require verbal production or auditory or reading comprehension.

Outcome Measures
Participants were evaluated prior to the start of treatment, immediately following the end of treatment and at a 6 week follow-up to assess maintenance; however, three participants in the ORLA group and two participants in the control group were lost to follow-up. The primary outcome measure was the WAB-R AQ. Secondary outcome measures included the WAB-R reading and writing subtests. Assessments were administered by an independent speech-language pathologist who was blind to the group to which the PWA had been randomized.

RESULTS

Analysis of Group Data
To assess whether web-based ORLA resulted in improvement in language performance, the mean change in WAB-R scores from pre-treatment to post-treatment was compared to zero for those randomized to web-based ORLA, using a two-sided paired t-test. The t-statistic was significant at the 0.05 level for the WAB-R AQ and WAB-R writing, indicating that following 6 weeks of treatment, there was a statistically significant improvement in language performance in these modalities.

To assess whether web-based ORLA resulted in greater improvement in language performance than placebo computer treatment, the mean change in WAB-R scores from pre-treatment to post-treatment for those randomized to web-based ORLA was compared to the mean change in WAB-R scores for those randomized to placebo computer using a two-sided two sample t-test. The t-statistic was not significant at the 0.05 level for the WAB-R AQ, WAB-R reading or WAB-R writing, indicating that following a 6-week treatment program there was insufficient evidence of a difference in language performance improvement between web-based ORLA and placebo computer groups.

To assess whether improvements in language performance for web-based ORLA were maintained over time, the mean change in WAB-R scores from post-treatment to the 6-week follow-up were calculated and compared to zero using a two-sided paired t-test. The t-statistic was not significant at the 0.05 level, indicating that there was no statistically significant change from post-treatment to follow-up. Therefore we conclude that language skills in these modalities were maintained from post-treatment to follow-up.

Analysis of Individual Subject Data
For subjects receiving ORLA, almost 80% made a clinically significant change in at least one language modality; 42% of subjects improved in auditory comprehension and oral expression, as measured by a greater than 5 point change on the WAB-R AQ; 58% improved on the WAB-R reading test and 32% improved on the WAB-R writing test. These results contrast with the individual results obtained with the placebo group who demonstrated clinically significant change in at least one language modality for only 60% of subjects. Furthermore, only 30% of subjects improved in auditory comprehension and oral expression, as measured by a greater than 5 point change on the WAB-R AQ; 38% improved on the WAB-R reading test and 15% improved on the WAB-R writing test.

DISCUSSION

Results suggest that providing web-ORLA is feasible as well as efficacious for some individuals with aphasia. The American Speech-Language-Hearing Association has developed a formal position statement that affirms telespeech as an *appropriate* model of service delivery (ASHA, 2010). Yet most third-party payors are not currently reimbursing telerehab interventions for speech and language disorders. Preliminary outcomes for Web-ORLA support a telerehabilitation model for treating aphasia. Future research should be directed towards differentiating good versus poor responders.

The finding of significant changes in participants receiving the placebo treatment is worthy of further discussion. There is growing interest in the applications of commercially available videogames in health care and rehabilitation. Some research suggests that computer games may be an efficient cognitive rehabilitation tool used to improve skills such as perception, conceptual thinking, attention, and memory (e.g., Larose et al., 1989; Funk et al., 1997).

With the placebo treatment, Bejeweled, intensive practice may have provided training in visual attention, and recent evidence suggests that direct attention training may improve language impairments in aphasia (Coelho 2005; Murray et al., 2006). Additionally, Bejeweled involves identification of colors, shapes, and directions for movement of the gems thereby involving covert practice of language skills. Furthermore, participation in the study may have led to increased interaction and opportunities for communication with family members. Research on the cognitive skills employed and the subsequent impact on language performance in individuals with aphasia from practice on Bejeweled or other commercially available computer games is warranted.

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Table 1. Demographic data for 32 subjects randomized to either web ORLA or placebo computer treatment (includes mean, standard deviation and range)

	ORLA	**Control**
# Subjects	19	13
Male:Female	10:9	9:4
Age (years)	58.27 (13.55) 23.96 – 76.83	55.19 (11.46) 25.49 – 70.47 yrs
Handedness R:L	18:1	12:1
Months post onset	39.75 (40.76) 6.4 – 141.3	60.97(30.19) 18.1 – 127.3
Education (years)	15.53 (3.06) 12-20	15.54 (3.07) 12-21
Baseline WAB AQ	48.76 (22.18) 13.7 – 77.1	49.59 (19.37) 28.0 – 78.9
Fluent: Nonfluent aphasia	9:10	5:8

Figure 1. Web-ORLA
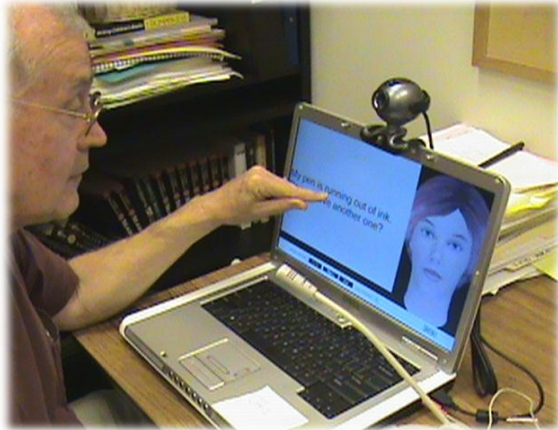
Web-ORLA combines guidance given by a virtual therapist with support from a live therapist. Web-ORLA can be downloaded onto subject's home PC or laptop computers.
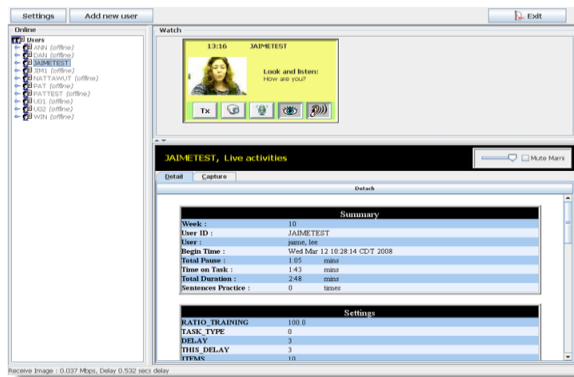
In Web-ORLA, the clinician can log in and see or monitor up to 5 different subjects online, click "watch user" and watch or listen to them practice; provide feedback when necessary; and answer questions.