Effectiveness of an impairment-based individualized treatment program using an iPad-based software platform

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Introduction

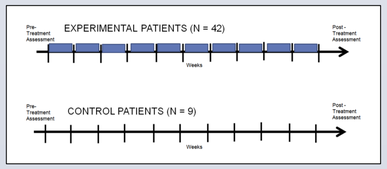
- Individuals with language and cognitive deficits following brain damage likely require long-term rehabilitation. Consequently, it is a huge practical problem to provide the continued communication therapy that these individuals require.
- Several studies have examined computerized rehabilitation with small numbers of aphasiac participants, providing promising preliminary results for the use of technology in the rehabilitation (Doesborgh et al., 2004, Fink et al., 2002, Palmer et al., 2012, Pedersen et al., 2001, Ramsberger and Marie, 2007).
- More recently, the advent of tablet based devices, such as the iPad, has proved to be promising for rehabilitation (Holland, 2014; Hoover and Carney, 2014; Kiran et al., 2014; Kurland, 2014; Kurland et al., 2014; Ramsberger and Messamer, 2014; Szabo and Dittelman, 2014).
- Kurland et al. noted there was often a need for the software to increase in task difficulty when their participants showed improvement, demonstrating the need of tailored therapy for individuals (Kurland et al., 2014).

Objectives

In the present project, a large scale preliminary clinical efficacy study was conducted to examine language and cognitive rehabilitation outcomes in patients who received continuous, personalized, and self-paced rehabilitation language and cognitive program using a structured iPad-based therapy program.

Research Questions

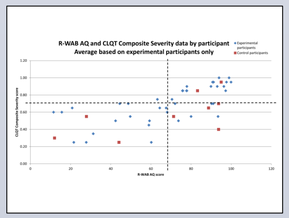
1. Can an iPad-based treatment program be provided in a standardized but individualized manner. If so, what does treatment dosage and treatment compliance look like?
2. What is the effect of the treatment on standardized measures and is it different between the control and experimental groups?
3. Are the individualized therapy tasks for language and cognitive therapy effective for improving overall language and cognitive performance?
4. What are profiles of individual responsiveness to treatment?
5. What is the nature of between-task co-improvement across different therapy tasks across participants?



Participants

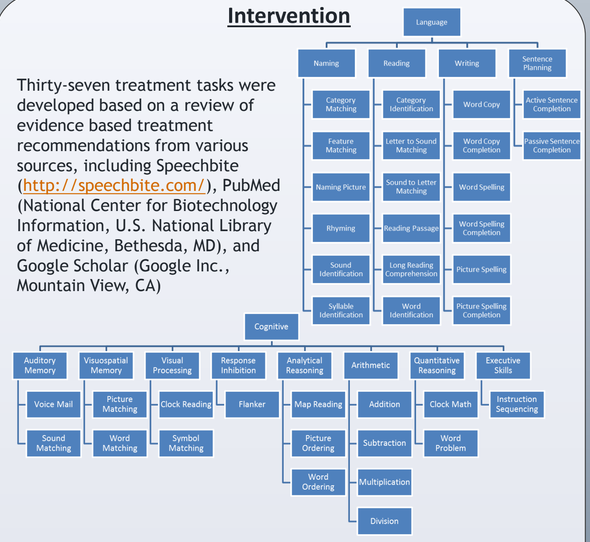
Fifty-one individuals with aphasia due to a stroke or traumatic brain injury were recruited to use an iPad-based software platform, Constant Therapy (www.constanttherapy.com), for a 10 week treatment program.

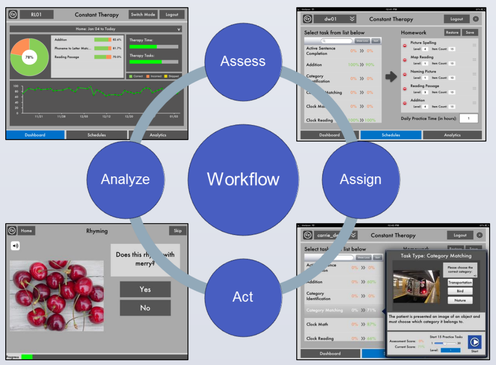
Each participant was tested before and after therapy on: Revised-Western Aphasia Battery, Boston Naming Test, Pyramids and Palm Trees, and Cognitive Linguistic Quick Test.



Intervention

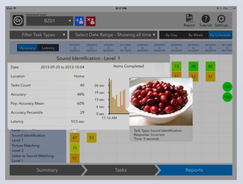
Thirty-seven treatment tasks were developed based on a review of evidence based treatment recommendations from various sources, including Speechbite (http://speechbite.com/), PubMed (National Center for Biotechnology Information, U.S. National Library of Medicine, Bethesda, MD), and Google Scholar (Google Inc., Mountain View, CA)

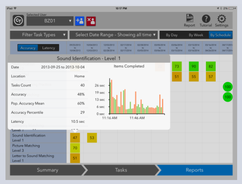




Data Analytics

Reports provided by the software, which include accuracy and latency by item, by task, and by week for each participant.

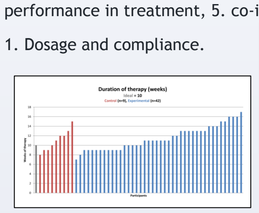


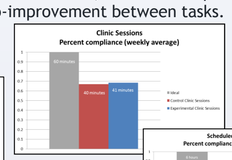


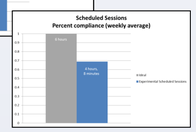
Results

1. Usage data and duration of treatment, 2. participants' changes on standardized measures, 3. task effectiveness, 4. individual participant performance in treatment, 5. co-improvement between tasks.

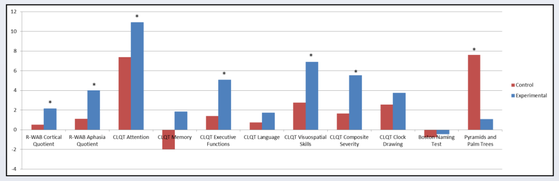
1. Dosage and compliance.







2. Changes on standardized measures.



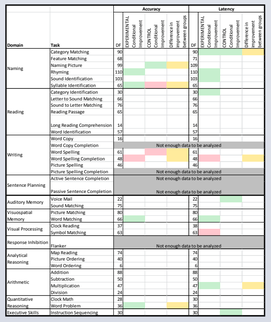
3-4. Mixed model regression for each task (across patients, collapsing levels) using log odd of accuracy or latency as the dependent measure.

Calculated contrast effect: What is the rate of change per session

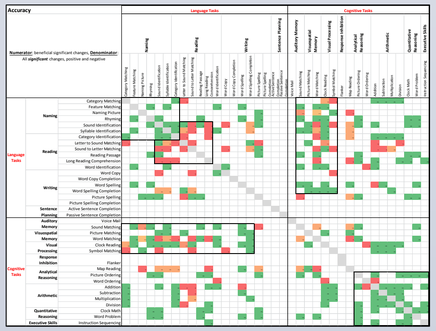
- Green- rate of change per session is significantly positive
- Red- red of change per session is significantly negative

Taking into account the effect of R-WAB AQ or CLQT Composite Severity on treatment outcomes

- Light blue: participants with a low score show more improvement in the task
- Dark blue: participants with a high score show more improvement in the task

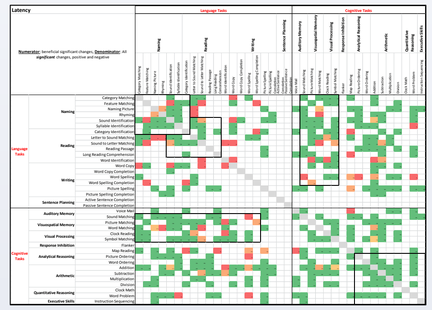


5. Accuracy co-improvement table of beneficial and significant slope values.



Results (continued)

5. Latency co-improvement table of beneficial and significant slope values.



Conclusions

1. The experimental and control groups did not differ in terms of dosage, or in terms of percent of compliance out of the ideal time, but experimental participants completed overall more time than control participants.
2. Experimental participants showed more significant and positive changes in their standardized tests than control participants. This shows that more practice resulted in greater gains in standardized measures.
3. While both groups showed improvement, experimental participants showed more changes than control participants when examining just assisted or both types of sessions.
4. The changes in experimental participants were possibly driven by language and cognitive standardized measures scores, showing effects such as tasks where participants with lower R-WAB AQ scores improve on simpler language tasks. While this may seem obvious, it is important to show that impairment-based therapy can show benefits.
    1. Six tasks show effects where participants with high CLQT Composite Severity scores and participants with low R-WAB AQ scores both showed improvement.
    2. Five tasks show effects where participants with low CLQT Composite Severity Scores and participants with high R-WAB AQ scores both showed improvement.
5. When examining how participants improve on tasks when assigned together throughout the treatment, several groupings of task co-improvement appear: reading and naming tasks, arithmetic and quantitative reasoning tasks, and language and cognitive tasks (including, memory tasks that use linguistic stimuli with reading and naming tasks).

These results provide preliminary but important evidence that systematic, structured, tablet-based and individualized therapy can be provided to patients.

Selected References

Kurland, J., Wilkins, A.R., and Stokes, P. (2014). iPractice: Piloting the Effectiveness of a Tablet-Based Home Practice Program in Aphasia Treatment. *Seminars in Speech and Language* 35, 51-64.

Kiran, S., Des Roches, C., Balachandran, I., and Ascenso, E. (2014). Development of an Impairment-Based Individualized Treatment Workflow Using an iPad-Based Software Platform. *Seminars in Speech and Language* 35, 38-50.

Acknowledgements and Disclosure

Funding for this project from Wallace Coulter Foundation for Translation Research.

Disclosure: SK owns equity in Constant Therapy and serves as the Chair of the Scientific Advisory Board for Constant Therapy. CD, IB, and EA each own a portion of the stock equity that BU owns.