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From the Coordinator

Julie L. Wambaugh

Welcome to our pre-Convention issue of *Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders*. We extend our thanks to McKay Moore Sohlberg for serving as Guest Editor for this excellent issue focused on telerehabilitation.

Announcements

The ASHA ACE award recognizes ASHA members and/or certificate holders who show their commitment to professional continuing education by earning 7.0 ASHA CEUs in 36 months. The Coordinating Committee congratulates our SIG 2 affiliates who recently received the ACE (www.asha.org/sig/02/SIG-2-Affiliates-Who-Earned-an-ACE-in-2011/).

If you will be attending the annual ASHA Convention in San Diego, please consider attending the following sessions sponsored by Special Interest Group (SIG) 2:

- **Short Course (SC05):** “Practice-Based Evidence: Strategies for Generating Your Own Evidence” (Presenters: Rik Lemoncello and Jessica Fanning). This Short Course will be available to SIG affiliates at a discounted rate.
- **Seminar developed by our research committee:** “Collaborative Methods for Training Research and Evidence-Based Practice: The Triad Model” (Presenters: Margaret Greenwald, Connie Keintz, Patrick Coppens, and Grama Rangamani).

Note: ASHA’s Personal Scheduler for Convention allows you to browse, search, and sort Convention sessions to create your personalized daily schedule. Access the tool from the website at www.asha.org/Events/convention/Personal-Scheduler.

We will also have an affiliates’ meeting at Convention and hope that you can participate. All affiliates, guests, and interested ASHA members are welcome to come and learn about our group’s activities and to socialize. The meeting will be held on Friday, November 18, from 12:30-1:30 p.m. in the San Diego Convention Center, Room 26B. Meeting times and locations may change; for the most up-to-date information, please check the schedule at the SIG information kiosk in the ASHA Member Services Center.

This year marks the 20th anniversary of the start of the SIGs. There will be an anniversary celebration on Thursday, November 17, 5:30-7:00 p.m. at the SIG Lounge. The Lounge is located in the Sails Pavilion area of the San Diego Convention Center. You may bring a guest. You may also visit the SIG Lounge to talk with other affiliates at any time during the Convention hours.

SIG 2 began its activities in 1991 under the leadership of Leslie Gonzalez-Rothi. In keeping with the 20th Anniversary Celebration, I would like to extend my sincere thanks to all of our past Coordinators for their leadership.

- Leslie Gonzalez-Rothi 1991-1993
- Pelagie Beeson 1997-1999
- Lynn Maher 2000-2002
Anastasia Raymer 2003-2005
Janet Patterson 2006-2009

Thanks to all of you, too, for your continued affiliation with SIG 2. We look forward to seeing many of you in San Diego.
CE Introduction

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The benefits of telerehabilitation methods are clear and exciting. As discussed in this issue of Perspectives, the ability to remotely deliver therapy increases access to intervention and supplemental practice, which can be instrumental in improving speech, language, and cognition. Although the capacity to provide intervention to clients at distant sites represents an invaluable advance in our field, we must remember that technology is the vehicle for delivering the therapy, not the actual therapy itself. We cannot evaluate the benefits of telerehabilitation divorced from its associated therapies.

The American Speech-Language-Hearing Association (ASHA) formally supports the use of telecommunications to deliver professional services at a distance (ASHA, 2010). Professional services require skills possessed by licensed, trained speech-language pathologists (SLPs). Conducting assessments that lead to the selection of an appropriate intervention, monitoring treatment effects, and modifying intervention-based client performance data are all fundamental components of an effective therapy regimen, whether it is delivered face-to-face by an SLP or remotely by a computer. Scientific clinical decision-making is key to the provision of professional services. It is, thus, not possible to discuss the efficacy of telerehabilitation divorced from the process of rational clinical decision-making. The four articles included in this issue describe a range of applications for using telecommunications to deliver a primary intervention or provide supplementary practice, and all depend upon skilled SLPs engaged in a process of scientific clinical reasoning.

We have just begun to develop the evidence base supporting the efficacy of telerehabilitation. Evaluation of the efficacy of all intervention domains requires following a systematic line of inquiry with research endeavors that expand and build upon the previous work. A recommended research sequence in our field is to conduct Phase 1 and 2 research to determine if a treatment is active in improving function and then progress to Phase 3 studies evaluating efficacy that use rigorous Class 1 experimental designs. Phases 4 and 5 are dedicated to evaluating effectiveness of the target treatment in real-world contexts and measuring efficiency (Robey, 2004). I might suggest that the domain of telerehabilitation requires a modification of this sequence in order to integrate questions related to efficacy and effectiveness early in the research process. From the outset, when examining a telerehabilitation method, the clinician should look at issues related to usability because the human-technology interface is fundamental to the intervention. Three of the articles included in this issue review therapy interventions that have been previously evaluated experimentally in face-to-face contexts and, subsequently, were delivered using telecommunication tools, including Lee Silverman Voice Treatment (LSVT; Ramig, Sapir, Fox, & Countryman, 2001), Oral Reading for Language in Aphasia (ORLA; Cherney, 2010a) and direct attention training (Sohlberg et al., 2003). Client usability is evaluated in conjunction with responsivity to therapy. In addition, Cherney and colleagues (2010b) and Ramig and colleagues (2001) have built an
evidence base that includes experimental evaluation of their telepractice techniques. Their work provides a model for the systematic evaluation of future telerehabilitation methods.

Different categories of research questions are critical for evaluating and promoting the ongoing development of effective telerehabilitation methods and relevant health-care reimbursement policies. One critical area of research is measuring required resources for different telerehabilitation methods, including time and expense. Rende and colleagues describe a series of case studies where clients received three different therapeutic applications, each of which used a readily available and affordable mainstream telecommunication method to provide rehabilitation to clients in their homes. Another important research area that remains unexplored is the affective variables that influence client engagement in telepractice. In the second article, we describe our pilot work evaluating the motivational factors that facilitate home practice.

The field of telecommunications has revolutionized the possibilities for providing effective therapies. The potential benefits extend beyond increased access and supplemental practice. Telecommunications has the potential to capture and analyze particular types of performance data; deliver therapy at optimal times and doses; offer objective, immediate feedback; and promote generalization in natural contexts. We have begun to partner with professionals in other disciplines, such as software and rehabilitation engineers, to facilitate these therapy benefits. Rende and colleagues remind us of the importance of including training in the provision of telerehabilitation in our graduate programs as the evidence base for different methods grows. As we creatively explore the exciting possibilities of telerehabilitation, we must remain mindful of the need for systematic, careful inquiry and adherence to processes of scientific clinical decision-making so fundamental to our practice. In the end, it is the therapy outcomes that matter; technology has clear potential to improve the delivery of therapy and increase its accessibility.

References


The Best of Both Worlds: Combining Synchronous and Asynchronous Telepractice in the Treatment of Aphasia

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Abstract

Telepractice is an appropriate model of service delivery for a person with aphasia (PWA). We define telepractice and its two modes of delivery (i.e., synchronous and asynchronous). We detail a technology, web-Oral Reading for Language in Aphasia (web-ORLA™), developed to provide aphasia treatment intensively from a distance and subsequently evaluated during a clinical trial. In this article, we describe our experiences using web-ORLA™, highlighting the role of the speech-language pathologist (SLP) and discussing the advantages and disadvantages of this unique combination of synchronous and asynchronous telepractice. Web-ORLA™ was delivered to PWAs in their homes by a digital agent, or “virtual therapist,” who served as a model and provided instructions similarly to a real therapist. An SLP at a distant geographical location monitored the sessions remotely, either synchronously or asynchronously, provided feedback, made appropriate adjustments to the difficulty level of the stimuli, and conducted weekly probe assessments of the participants’ performance. Advantages of web-ORLA™ include increased practice, SLP oversight, guidance by the agent, program simplicity, and a level of autonomy and flexibility afforded to the PWA. Given the rapid advances in technology, current technological problems that were encountered are likely to be mitigated.

Advances in telecommunication technology hold great promise as a means of delivering speech and language services to an increasing number of people, regardless of location, with greater intensity, and over longer periods of time, thereby overcoming barriers to treatment accessibility, therapist time, and cost. Furthermore, technology that provides an opportunity for more intensive treatment can be a crucial aspect of rehabilitation for a person with aphasia (PWA), given that research indicates intensive treatment is more efficacious than treatment applied less frequently (Cherney, Patterson, Raymer, Frymark, & Schooling, 2008, 2010). In
this paper, we define telepractice and its modes of delivery. We detail a technology, web-Oral Reading for Language in Aphasia (web-ORLA™), developed to provide aphasia treatment intensively from a distance and subsequently evaluated during a clinical trial. We describe our experiences using web-ORLA™, highlighting the role of the speech-language pathologist (SLP) and discussing the advantages and disadvantages of this unique combination of synchronous and asynchronous telepractice.

**Synchronous and Asynchronous Service Delivery**

The formal position statement from the American Speech-Language-Hearing Association (ASHA) defines telepractice as “the application of telecommunications technology to deliver professional services at a distance by linking clinician to client, or clinician to clinician for assessment, intervention, and/or consultation” (ASHA, 2010, p. 1). The primary benefit of telepractice is expanded access to care. There are many geographic areas, particularly rural locations, where people are unable to receive services due to the distance either they or their therapists would have to travel (Brennan, Georgeadis, & Baron, 2002; Mashima & Doarn, 2008). Even in accessible areas, clients with aphasia are often unable to travel to appointments due to physical limitations or lack of transportation. Telepractice not only increases the number of clients who can be served, but also reduces the potential delay of service (Mashima & Doarn, 2008).

ASHA (2010) affirms telepractice as an appropriate model of service delivery and distinguishes two different modes of telepractice delivery: synchronous and asynchronous. *Synchronous delivery* refers to real-time audio or visual connections between participants, usually a therapist and a client. Connections may be as simple as a phone call or involve complex teleconferencing in which materials are shared and viewed on the participants’ computer screens. Telepractice sessions are typically delivered synchronously (ASHA, 2010), because they provide many of the advantages of one-to-one, in-person therapy, including customized treatment for the individual participant and immediate reinforcement and feedback. Synchronous telepractice is cost-effective; although therapist treatment hours are the same, travel time and expenses are eliminated (Brennan et al., 2002).

The definition of telepractice includes a statement that “the quality of services delivered via telepractice must be consistent with the quality of services delivered face-to-face” (ASHA, 2010). In this regard, several studies have found that synchronous assessment of aphasia via telepractice is comparable to face-to-face assessment and performance (Brennan et al., 2002; Brennan, Georgeadis, Baron, & Barker, 2004; Duffy, Werven, & Aronson, 1997; Georgeadis, Brennan, Barker, & Baron, 2004; Hill et al., 2006; Hill, Theodoros, Russell, Ward, & Wootton, 2009; Palsbo, 2007; Theodoros, Hill, Russell, Ward, & Wootton, 2008; Wertz et al., 1992). The few studies examining synchronous telepractice as a means of delivering treatment to PWAs have confirmed its feasibility and user satisfaction and improvement, although there has been no direct comparison of telepractice with in-person therapy (Baron, Hatfield, & Georgeadis, 2005; Carpenedo, 2006).

In contrast to synchronous delivery, *asynchronous delivery* occurs when patient performance data are collected, stored, and, then, at a separate time, retrieved by the SLP. Asynchronous applications have generally been used “as an adjunctive mode to supplement services delivered in person or to review and validate information observed and recorded during synchronous telepractice encounters” (ASHA, 2010, p. 3).

While synchronous telepractice is primarily used to increase accessibility to the direct services of the SLP, asynchronous telepractice has additional potential by allowing for the greatest amount of client work time for the least amount of therapist time. This greatly affects cost-effectiveness, expands the number of people receiving speech-language services who otherwise could not access a SLP, and increases both the length of time that clients can receive treatment and the intensity of their practice. This is critical because of the growing shortage of
SLPs across the country (Brady, 2007; Mashima & Doarn, 2008), which has resulted in poor availability of services. In addition, there is dwindling financial support for services, as insurance companies increasingly restrict the number of sessions they reimburse (Baron et al., 2005).

Evidence that PWAs benefit from computer-based treatments indicates the potential for successful use of computers in asynchronous telepractice. A number of studies have found little or no difference in outcomes between computer treatment and similar in-person treatment (Cherney, 2010b; Fink, Brecher, Schwartz, & Robey, 2002; Katz & Wertz, 1997; Thompson, Choy, Holland, & Cole, 2010). Additional studies have directly examined asynchronous telepractice as a viable means of treatment for word retrieval difficulties in aphasia (Manasco, Barone, & Brown, 2010; Mortley, Wade, Davies, & Enderby, 2003; Mortley, Wade, & Enderby, 2004; Pedersen, Vinter, & Olsen, 2001; Ramsberger & Marie, 2007; Wade, Mortley, & Enderby, 2003) or difficulties in the production of grammatical structures (Linebarger, McCall, & Berndt, 2004; Linebarger, Schwartz, & Kohn, 2001). In all cases, improvement was noted even when the therapist’s participation was minimal. Only one study compared asynchronous telepractice for word retrieval with in-person treatment (Choe, Azuma, Mathy, Liss, & Edgar, 2007). Although one should be careful in drawing conclusions due to the small sample size, results suggest both conditions are better than no treatment. Furthermore, naming improved more for words learned through asynchronous telepractice than words learned through in-person treatment. This finding may have occurred because the former was daily, whereas the in-person treatment was only weekly.

Both synchronous and asynchronous telepractice have the potential to significantly affect service delivery to PWAs, particularly as new technologies are developed and tested. This article briefly summarizes the procedures of a study that combined synchronous telepractice, asynchronous telepractice, and in-person services to achieve an advantageous balance of cost-effectiveness and treatment efficacy. The randomized placebo-controlled clinical trial evaluated the feasibility and efficacy of such a combined approach. The purpose of this article is to illustrate its feasibility; efficacy results are presented elsewhere (in preparation).

**Study and Treatment Procedures**

Web-ORLA™, the aphasia treatment that was delivered both synchronously and asynchronously, is based on the original ORLA approach that was designed to be delivered in a clinical face-to-face format. ORLA requires the client to systematically and repeatedly read sentences and paragraphs aloud, first in unison with the clinician (or, in this study, with a digital agent that served as a virtual therapist) and then independently (Cherney, 1995, 2010a, 2010b; Cherney, Merbitz, & Grip, 1986). ORLA targets connected discourse, allowing practice on a variety of grammatical structures, rather than just one specific grammatical form. It has four levels of difficulty based on length and reading level. These levels range from simple 3- to 5-word sentences at a first-grade reading level (Level 1) to 50-100 words, presented as a simple paragraph of 4-6 sentences, at a sixth-grade reading level (Level 4). The graded nature of ORLA makes it appropriate for individuals with a broad range of aphasia severities. Data have shown that low-intensity ORLA delivered by computer to individuals with chronic nonfluent aphasia is efficacious and there is no significant difference between outcomes for computer ORLA compared with ORLA delivered by an SLP (Cherney, 2010b).

Web-ORLA™ uses a virtual therapist represented by a face on the screen that correctly moves the lips and tongue as it speaks. The virtual therapist, “PAT” (Personal Animated Therapist), was developed by researchers at the University of Colorado. “PAT” conducted the web-ORLA™ sessions, reading the sentences aloud and instructing the PWA about the steps to follow for each sentence.

Table 1 details the sequence of treatment procedures for PWAs receiving web-ORLA™ during the clinical trial and indicates the mode of delivery and corresponding time on each
task. All PWAs used web-ORLA™ on computers in their homes. An SLP at a distant geographical location monitored the sessions remotely, either synchronously or asynchronously. The PWA’s computer and the SLP’s computer were each connected to the same server in the SLP’s office, and therefore to each other, via the Internet.

**Table 1. Web-ORLA™ Procedures**

<table>
<thead>
<tr>
<th>Timeline (approx.)</th>
<th>Procedure</th>
<th>Mode of delivery</th>
<th>Description</th>
<th>Participant time on task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Screening</td>
<td>In-person or synchronous</td>
<td>Informal screening for -minimal language and attention skills -home Internet connection</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Week 2</td>
<td>Evaluation</td>
<td>In-person</td>
<td>Formal evaluation at Rehabilitation Institute of Chicago or an aphasia center near home</td>
<td>4-5 hours</td>
</tr>
<tr>
<td></td>
<td>Program download (web-ORLA™ or computer game depending on randomization)</td>
<td>Option 1: In-person, using PWA’s own laptop</td>
<td>SLP downloads program(s) onto PWA’s laptop</td>
<td>30 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option 2: Synchronous/asynchronous, using PWA’s own home desktop computer</td>
<td>SLP gives PWAs and caregivers written instructions and telephone support for downloading program(s)</td>
<td>30-60 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option 3: Asynchronous, using loaned laptop computer with program already installed</td>
<td>SLP downloads program(s) onto laptop loaned to PWA</td>
<td>0 minutes</td>
</tr>
<tr>
<td></td>
<td>Establishment of Internet connection</td>
<td>In-person or synchronous</td>
<td>SLP checks and troubleshoots Internet connection</td>
<td>30-60 minutes</td>
</tr>
<tr>
<td></td>
<td>Training</td>
<td>In-person or synchronous</td>
<td>SLP trains PWA and caregiver on use of computer program(s)</td>
<td>1-2 hours</td>
</tr>
<tr>
<td>Weeks 3-8</td>
<td>Treatment</td>
<td>Asynchronous</td>
<td>PWA practices on web-ORLA™ or computer game for 6 weeks</td>
<td>90 minutes/day, 6 days/week, for 6 weeks (54 hours total)</td>
</tr>
<tr>
<td></td>
<td>Sentence Probes</td>
<td>Synchronous</td>
<td>SLP evaluates oral sentence reading once per week for 6 weeks using web-ORLA™</td>
<td>15-30 minutes each week for 6 weeks</td>
</tr>
<tr>
<td>Week 9 &amp; 15</td>
<td>Evaluations</td>
<td>In-person</td>
<td>-Post-treatment evaluation -6-week follow-up evaluation</td>
<td>4-5 hours per evaluation</td>
</tr>
</tbody>
</table>

PWAs usually practiced web-ORLA™ asynchronously, that is, when the therapist was not observing them. Practice became synchronous, however, when the SLP “tuned in.” Icons on the PWAs’ computer screens alerted them when they were being observed by the remote SLP. The eye and ear icons were highlighted when the SLP was watching or listening. The PWA could initiate a real-time conversation with the SLP over the Internet whenever these icons were highlighted.

In her office, the SLP viewed a list of participants who had access to the program. The names of all participants currently logged into the system were highlighted. The SLP could select and synchronously observe up to four PWAs simultaneously working in their homes in
differing geographic locations. She could interrupt the ORLA practice to speak directly to the PWA or send an instant text message. The text message would appear in the middle of the computer screen, pausing the web-ORLATOM program long enough for the PWA to read the message and, if desired, to respond verbally. Alternatively, the SLP could pause the web-ORLATOM program to have a two-way conversation with the PWA and then resume the program, when appropriate. Figures 1 and 2 show screenshots of the training interface for the PWA and the clinician interface used by the monitoring speech-language pathologist respectively during a synchronous web-ORLATOM session.

*Figure 1. Web-ORLATOM Screen Seen by the PWA*

![Screenshot](image1)

The agent (a) gives step-by-step instructions that guide the PWA through the program and (b) reads the sentence stimuli aloud in the same way that a real SLP provides ORLA. Note that the eye and ear in the bottom corner of the screen are highlighted, indicating that the SLP is observing the practice remotely.

*Figure 2. Web-ORLATOM Screen Seen by the SLP*

![Screenshot](image2)

Names of participants who are online are highlighted in the column on the left of the screen. Summary data provides the start time of each session and the length of time the PWA has been practicing.
Like the ORLA program delivered in-person by an SLP, web-ORLA™ can be programmed to meet each PWA’s specific treatment needs. For example, the SLP can change the ORLA difficulty level, increasing or decreasing the length of the sentences. She can also adjust the rate at which oral reading proceeded for Levels 1 and 2. “PAT,” the virtual therapist, can appear on the left or right side of the screen, depending on the PWA’s skills and/or preferences. The clinician can modify the time allowed for particular steps of ORLA to provide the optimal time for the PWA to independently read the sentence aloud, identify a word in the sentence, or read a word aloud. The program can also be set to automatically advance from one sentence to the next or allow the PWA to manually advance it by pushing the space bar. The SLP can include or omit the option allowing the PWA to listen to sentences he/she has just spoken. These options allowed the SLP to tailor the program to the particular PWA’s initial needs and modify it as the participant progressed.

Asynchronously, the SLP can review data that were collected from each web-ORLA™ practice session and stored on the server. These data include audio recordings from each practice session, the number of sentences or paragraphs practiced, and the practice time. Practice summaries for specific periods of time can be generated (e.g., for a single practice session, for a specific week of practice, or from the start of using web-ORLA™ to a specified date). The SLP can review the session data at any time; it was not necessary to observe a web-ORLA™ practice session in real time.

**Clinical Trial Participants**

Participants included a heterogeneous group of 32 individuals with chronic aphasia following a single left-hemisphere stroke occurring more than 6 months previously. They ranged in age from 23 to 76 years, in baseline Western Aphasia Battery Aphasia Quotient (Kertesz, 1982) from 13.7 to 78.9, in education from 12 to 21 years, and in months post-onset from 6.4 to 141.3. Fourteen were fluent, and 18 were nonfluent. The study was based in Illinois, but participants were distributed over 11 states including the East Coast, West Coast, and Midwest.

Participants were randomly assigned (ratio of 3:2) to one of two conditions: computer-based aphasia therapy with web-ORLA™ (Cherney, 1995, 2010a, 2010b; Cherney et al., 1986) or placebo-computer treatment with a nonverbal, commercially available computer game. Nineteen subjects completed the web-ORLA™ treatment group; 13 subjects completed the control treatment. Both groups were scheduled to receive 9 hours of treatment a week for 6 weeks. For the web-ORLA™ group, the actual mean number of hours practiced per week was 8.8 (SD = 1.6), supporting the feasibility of web-ORLA™. While only those in the experimental group received telerehabilitation with web-ORLA™, all participants were evaluated weekly in a telepractice session using oral reading probes of trained and untrained sentences.

**The Role of the SLP**

Although the web-ORLA™ practice can be completed independently and asynchronously by the PWA, the SLP played an important role throughout the study. First, the SLP determined whether potential participants met the candidacy requirements of the study. Potential participants were screened for language skills and questioned about their computer skills and computer access. Participants had to meet the criterion for having Internet access. If a PWA did not have a desktop or laptop at home available for the requisite hours of practice, we loaned him/her a laptop with web-ORLA™ installed. Support at home was important; each participant needed to have a family member or caregiver available to troubleshoot or make contact with the SLP if problems arose with the program during web-ORLA™ practice.

Second, the SLP trained the participants and support persons in the use of the equipment (e.g., set-up, log-on, troubleshooting technical difficulties) as well as in the web-ORLA™ procedures. Most participants traveled to the SLP’s office (at the Rehabilitation Institute of Chicago or at a local aphasia center) for the 2- to 3-hour face-to-face training session. Training was conducted using aphasia-friendly written materials that were brief and
grammatically simple, with pictures and screenshots that augmented the text. During the training session, the SLP set the web-ORLA™ program parameters to match the particular PWA's level and maximize ORLA performance.

Third, the SLP interacted with the PWA synchronously during some web-ORLA™ practice sessions, either via text messaging or by speaking with the PWA. At times, observations confirmed the PWA’s success in mastery of the web-ORLA™ steps and appropriateness of the program parameters. Other times, the SLP used her clinical judgment and provided specific directions to improve the PWA’s ability to follow the steps of web-ORLA™ (e.g., “Listen, don’t talk, during step one”) or provided general reinforcement to the PWA (e.g., “Just wanted to say Hi! I am listening to you”).

Fourth, the SLP reviewed stored data from the web-ORLA™ sessions to ensure each PWA's successful practice and compliance with the study. Based on both the synchronous and asynchronous observations, she modified the program parameters to tailor them to the individual's needs and skill level.

In addition, the SLP can review the stored data for the time each participant practiced during a particular practice session, day, or week. For this study, participants were expected to practice 90 minutes per day, 6 days per week. The SLP periodically checked the data to ensure the PWAs were meeting the goals for the intended practice time. If an individual fell behind in practice for the week, the SLP provided a reminder to keep up with the intended practice time and assisted the PWA in scheduling the missed practice time to reach the weekly target. Guidance was also needed for individuals who were practicing more than was called for by the research protocol. Overall, 16 participants had a mean weekly practice time that was at least 90% of the target time of 540 minutes (9 hours), with 4 of these participants exceeding the goal by at least 10%.

The SLP can also review how many sentences or paragraphs were completed by the PWA in a particular practice session and the time spent on each step of web-ORLA™. For example, data for one participant showed that he was spending a large portion of his web-ORLA™ practice time listening to himself. For this participant, listening to himself was not deemed as important as the quantity of practice on the other steps. To increase the amount of practice of oral expression (i.e., number of sentences per session), the SLP removed the “listen to yourself” step from the PWA’s web-ORLA™ program.

Finally, the SLP was responsible for conducting weekly probes in a synchronous session to evaluate participants’ progress by testing their ability to read aloud independently. A specific appointment time was established at the beginning of each of the 6 weeks of treatment. The probes included trained sentences that had been practiced throughout the week, untrained sentences at the same difficulty level, and untrained sentences at the next highest difficulty level. The SLP set the number and level of sentences for each set of probes. The sentences were then selected randomly by the program. For PWAs, a written sentence appeared on the computer screen, which they attempted to read aloud. The SLP saw the same sentence that the PWA saw and was able to hear the PWA read the sentence aloud. The PWA pressed the space bar to make the next sentence appear, thereby controlling the timing of the probes. PWAs understood that they were being scored for accuracy and time. All probes were recorded, allowing the SLP to score each word at the same time the PWA produced it and then return to the recording at a later time to check the accuracy of the score.

**Advantages and Disadvantages**

The primary benefit of telepractice of any kind is expanded access to care, particularly when it is difficult or expensive for clients to reach clinicians because of geographical remoteness, lack of transportation, physical disability, or even inclement weather. Other advantages may be specific to the telepractice delivery system and/or the particular intervention that is provided. Here we discuss the advantages of web-ORLA™ treatment, which
is unique in its combination of both synchronous and asynchronous delivery of treatment. The program facilitates intensive practice and enables SLP oversight. Furthermore, agent guidance and simplicity allow PWAs who have significant impairment to participate and benefit. The program flexibility and customizability also accommodate a range of participant levels.

In web-ORLA™, the asynchronous mode allows PWAs to practice many hours beyond the usual time allotted to a treating therapist. The importance of intensive practice in aphasia therapy is supported by studies showing the benefit of increased amount and intensity of treatment (Cherney et al., 2008; 2010).

The asynchronous feature of web-ORLA™ also addresses scheduling limitations that arise when practice is synchronous. For example, we were able to accommodate a late riser by offering a late night practice session. This option would not have been possible with synchronous therapy.

The synchronous component of web-ORLA™ allows the SLP to monitor participants’ performance. Because the SLP can hear and see the PWA while he/she was practicing, the SLP can offer encouragement and guidance either by voice or text message through web-ORLA™. If the participant encounters difficulties operating the program, the SLP can troubleshoot more easily by actually seeing and hearing the participant actions.

Weekly sentence probes gave the SLP an objective measure to track the PWA’s progress, without requiring an in-person visit. Based on probe performance as well as practice observation, the SLP adjusted the level of the practice sentences that the participant was receiving; participants gave feedback to the SLP about the effectiveness of the adjustment. The probes can be used independently or in combination with the web-ORLA™ treatment component. In the present study, for example, we used probes to track the progress of not only participants treated by web-ORLA™, but also those treated by the control computer game.

Another component of web-ORLA™ that allows for SLP oversight is the computer-based practice log. The SLP can monitor practice sessions at will. If the PWA practiced too little, the SLP offered encouragement and brainstormed with the PWA and/or caregiver to determine what might be interfering (e.g., scheduling, no quiet place to practice, boredom, practice sessions too long).

The design of web-ORLA™ makes it usable for people with significant levels of aphasia. Web-ORLA™ was simple to use. After participants logged in, they simply pressed the space bar to advance to the next sentence. The program was readily accessible to participants with little experience with computers, those with severe aphasia, and/or individuals able to use only one hand. The graded nature of the ORLA materials is appropriate for PWAs with impairment across a broad range of severity. Because the program uses a virtual SLP, there was support beyond what occurs in most computer programs. Verbal instructions were given by the agent for every step, providing a level of guidance particularly helpful for PWAs with significant impairment.

Web-ORLA™, like some but not all asynchronous programs, gives participants a measure of control and autonomy beyond what they can experience with a real therapist physically present or when timing of the practice sentences is predetermined. Participants decided when they wanted to move on to the next sentence, pause, or stop the session entirely. PWAs practiced for any length of time and for as many trials as they wished. Therefore, web-ORLA™ affords PWAs greater autonomy and self-efficacy in being in charge of their treatment—a job that they alone had to do every day. It also serves as an introduction or reintroduction to computers and can give users the confidence to try computers in other aspects of their lives.

There are also potential disadvantages to telepractice in general and to web-ORLA™ in particular. It is possible that the agent’s presence was not as salient as the presence of a real person. However, though a positive in-person link to an SLP can motivate and encourage the client to do his/her best, a negative connection (e.g., when the SLP is judgmental or
controlling) can produce the opposite effect. Thus, using a virtual therapist potentially mitigates both the positive and negative aspects of working in-person.

A significant limitation is that the virtual therapist in web-ORLA™ cannot give performance-based feedback. She can model the correct way to say a sentence, but she cannot correct error productions, give targeted feedback, or even draw a participant’s wandering attention back to the task in the same way that an SLP can. Thus, unless the SLP happens to be monitoring synchronously at the time, the PWA would not realize he/she is practicing sentences incorrectly.

Perhaps the greatest disadvantages of telepractice relate to technology: the amount of time required to set up the program and troubleshoot technological issues, the cost of the equipment, and the cost of therapist time. Technical difficulty with data transfer may increase therapist time to such a degree that it diminishes telepractice’s advantages (Mortley et al., 2003). Thus, an important factor to examine in any telepractice treatment is how much additional therapist time the technology actually incurs. In the case of web-ORLA, the technical problems involved poor Internet connections, occasions when the server went down so PWAs could not practice, difficulty downloading the program onto the PWA’s personal computer, and glitches that caused interruption or failure of the audio recording feature.

However, technology is rapidly changing and improving; it will, in time, catch up with the requirements of both asynchronous and synchronous telepractice. More of interest is whether telepractice, and in particular a complex blend of asynchronous and synchronous modes such as web-ORLA™, is a feasible and successful means of treatment for PWAs. In this study, we found that it was and that the most difficult problems were due to technology, not people.

In conclusion, the asynchronous aspects of web-ORLA™ (independent practice, participant control of starting and stopping therapy by pressing the space bar) allowed PWAs to practice autonomously and flexibly with as much intensity as they wished, at times that were most convenient to them, and at a potentially large savings in therapist time. Furthermore, the virtual therapist in web-ORLA™ delivered “virtually” synchronous treatment: The PWA was guided by explicit instructions about what to do next and was able to watch the oral-motor movements of the agent as the words were pronounced. In addition, the synchronous component of web-ORLA™ (the SLP’s ability to observe practice sessions, talk or text with PWAs while they were practicing, and conduct formal weekly evaluations) provided much of the personalization of in-person treatment. The SLP could adjust sentences to suit each participant’s level, give encouragement and guidance, and troubleshoot when appropriate. Telepractice has tremendous potential to increase the accessibility of therapy. Web-ORLA™, with its combination of synchronous and asynchronous telepractice, demonstrates one way of achieving the best of both worlds of telepractice.

Acknowledgments

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Rachel Hitch has been an SLP for over 20 years. She has worked with both adult and pediatric patients with stroke, brain injury, brain tumors, and other neurological problems. Her practice has focused on re-entry into the community including return to school, return to employment, and, presently, community groups for persons with aphasia. In addition to clinical work, she has taught at the undergraduate level. Most recently, Rachel has been a research SLP at the Rehabilitation Institute of Chicago’s Center for Aphasia Research and Treatment.

References


The Effect of Choice on Compliance Using Telerehabilitation for Direct Attention Training: A Comparison of “Push” Versus “Pull” Scheduling

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Abstract

Home practice, a type of asynchronous telerehabilitation, is an integral component of most rehabilitation regimens. Exercise drills conducive to home practice have been shown to be beneficial in remediating acquired impairments in attention, speech, language, and voice. A variety of interacting psychological, cognitive, and socioenvironmental factors contribute to short- and long-term exercise adherence. There has been little research evaluating the personal characteristics most likely to motivate clients to engage in their rehabilitation and follow through with prescribed activities. In this project, we were interested in using telerehabilitation to learn more about factors that might increase clients’ adherence to home exercise; we used direct attention training as our experimental domain. The study used a single-subject, alternating treatment experimental design with 2 participants to compare compliance on home attention exercises under two conditions. The Attention Process Training-3 (APT-3, 2010) direct attention training program, delivered via the Televised Assistance Program (TAP) system, allowed us to compare compliance under (a) conditions when the client had no control over the start-up of the program (push) versus (b) conditions when the client had to initiate turning on the program to do the home program (pull). Results showed that home exercise adherence was higher for both participants under the nonautonomous push condition. This ran counter to our hypothesis, based on the therapy literature, that suggested patients are more likely to follow through with home assignments when practice is under their control. We discuss our findings with respect to the interaction between self-efficacy, therapy beliefs, and autonomy for patients with acquired brain injury.

Home practice, a type of asynchronous telerehabilitation, is an integral component of most rehabilitation regimens. Several factors have led to an increase in the role of home programming in all rehabilitation domains. Notably, reimbursement restrictions limiting the number of therapy visits have encouraged patients and clinicians to investigate alternative
methods for addressing therapy goals. A more positive influence is the increasing evidence across a number of rehabilitation interventions showing that “more is better” (e.g., Cherney, Patterson, Raymer, Frymark, & Schooling, 2008). Increased practice, for many interventions, leads to stronger outcomes. In spite of the centrality of home programming for effective rehabilitation, the literature delineating factors that facilitate home practice is sparse.

Exercise drills conducive to home practice have been shown to be beneficial in remediating acquired impairments in attention (Sohlberg et al., 2003), language (Cherney et al., 2008; Robey, 1998), swallowing (Shaker et al., 2002), and voice (Sapir et al., 2002). In this project, we were interested in using telerehabilitation to learn more about factors that might increase clients’ adherence to a home exercise regimen; we used direct attention training delivered over the television as our experimental domain.

**Direct Attention Training**

Sohlberg et al. (2003) reviewed nine experimental studies evaluating the efficacy of attention training and compared participant parameters, attention training components, methodology, and outcomes. They reported that the evidence was generally supportive of direct attention training, when performed in conjunction with metacognitive activities (e.g., feedback, self-monitoring, strategy training) and when training was matched to the individual’s attention profile. Of relevance to the current research, sufficient dosage or intensity of treatment (more than one time per week) was also a practice recommendation.

The newer literature continues to support the Sohlberg et al. practice recommendations, as well as expand the clinical populations with whom direct attention training has been evaluated. Galbiati et al. (2009) evaluated the potential effects of attention training in 65 children and adolescents with cognitive impairments following traumatic brain injury (TBI). Participants in the experimental attention training group received drill-oriented attention exercises that targeted different aspects of attention, such as sustained, selective, and divided attention, as well as strategy and self-awareness training four times per week for 6 months. The results were compared to a control group and showed that participants who received the attention training demonstrated significant gains on tests of attention and a test of adaptive functioning. The intervention program described in this study contained the essential components of sufficient intensity and pairing of attention exercises with strategy instruction as recommended in the previous practice guidelines. A study with similar conclusions (Serino et al., 2006) compared attention training to nonspecific stimulation in nine adult patients with TBI. They found that attention training had a beneficial effect on improving a number of attention and executive function subsystems and improvements generalized to patients’ everyday lives. The study used a repetitively administered working memory task that required the participants to hold on to number sequences and add pairs of digits. The training was administered four times per week, supporting the notion of intensity.

The most rigorous experimental evaluation of direct attention training used the Attention Process Training (APT, 2010) program implemented in the current study (Butler et al., 2008). This group conducted a randomized controlled trial of a cognitive remediation program for 161 children and adolescents who were at least 1 year post-treatment for cancer and who manifested acquired attention deficits as a result of brain radiation and/or chemotherapy. Participants were enrolled at seven sites nationwide. The cognitive remediation program consisted of APT exercises and explicit strategy training. Participants received 40 hours of attention training. The results showed significant improvements on parent report of attention and in academic achievement. The authors suggested that APT in conjunction with strategy instruction is a potentially beneficial treatment for survivors of pediatric cancer with acquired attention deficits. In short, the efficacy studies reporting positive outcomes all implemented the therapy with intensity beyond what would be available in a clinical setting. Hence, the necessity of home practice options is underscored in this rehabilitation domain.
Factors Affecting Home Practice

There is a large body of literature on factors that influence participation in exercise programs. Researchers have attempted to predict or explain exercise program participation in healthy adults (e.g., Dzewaltowski, 1994; Robison & Rogers, 1994) and elderly adults (e.g., Dishman, 1994; Henry, Rosemond, & Eckert, 1998), as well as patient populations receiving physical therapy (e.g., Campbell et al., 2001; Friedrich, Gittler, Halberstadt, Cermak, & Heiller, 1998), occupational therapy (e.g., Chen, Neufeld, Feely, & Skinner, 1999), and speech therapy (e.g., Easterling, Grande, Kern, Sears, & Shaker, 2005). It is clear from that literature that a variety of interacting psychological, cognitive, and socioenvironmental factors contribute to short- and long-term exercise adherence, and no single factor predicts program compliance. Identifying the personal characteristics most likely to motivate clients to engage in their rehabilitation and follow through with prescribed activities may be key to enhancing rehabilitation outcomes (Sohlberg & Turkstra, 2011).

The construct of motivation is particularly complex for clients with neurocognitive impairments who may have difficulty with self-awareness, which compounds other barriers to following rehabilitation programs (Ownsworth et al., 2007). The recognition that increasing client engagement and independent follow-through is critical for achieving positive outcomes has led to the development of interventions that specifically address motivation and engagement (Marin & Wilkosz, 2005). One intervention that is gaining prominence as an approach to address engagement difficulties in rehabilitation is motivational interviewing (MI; Medley & Powell, 2010). This work has influenced the design of our cognitive rehabilitation programs and encouraged us to incorporate and evaluate methods to increase client initiation of therapeutic exercises. Most influential from the MI work has been the identification of personal characteristics with clear effects on client motivation to follow therapy recommendations. These include self-efficacy, belief about the therapeutic benefits of a program, and locus of control or autonomy.

Self-efficacy refers to the belief that one can perform a particular task and is related to self-confidence (Chen et al., 1999; Driver, 2006; Dzewaltowski, 1994; Robison & Rogers, 1994). It is fostered when clinicians seek to enhance clients’ self-confidence and self-determination (Rollnick, Miller, & Butler, 2008). Beliefs and expectations about the therapy program are critical factors for compliance. Positive attitudes toward exercise predict greater willingness to accommodate exercise in daily routines (Campbell et al., 2001). Locus of control or autonomy has also been identified as key to motivation (Rollnick et al., 2008). Research has shown that an internal versus external locus of control, particularly in relation to health responsibility and control over change, predicts completion of exercise programs (Robison & Rogers, 1994; Dzewaltowski, 1994). With an internal locus of control, individuals believe that they have control over change and take responsibility for making active behavioral changes.

In the current project, we attempted to isolate one these elements, locus of control or autonomy, and study its potential influence on exercise compliance for a cognitive rehabilitation regimen: attention training. We used this rehabilitation domain for several reasons. First, we had developed a systematic program for direct attention training, Attention Process Training-3 (APT-3), that included a metacognitive component designed to facilitate self-efficacy and encourage positive beliefs and expectations about therapy outcomes. Because these two motivational factors were built into the program, we could manipulate the autonomy aspect and evaluate the impact of client locus of control on follow-through with neurorehabilitation exercises. Second, the APT-3 program is electronically delivered, and the home exercises can be pushed through our Television Assistive Prompting (TAP) system (Lemoncello, Sohlberg, Fickas, Albin, & Harn, 2011). Using the TAP system, we could automatically schedule and turn on the program remotely (“push” content). Alternatively, we could adjust the settings to a state that required the client to turn on the system and start the attention training program (“pull” content). Hence, the APT-3 program delivered via the TAP
system allowed us to evaluate compliance with the home exercises that were part of a previously validated cognitive rehabilitation program under conditions when the client had no control over the start-up of the program (push) versus conditions when the client had to initiate turning on the program to do the home program (pull). Our specific research questions were:

1. Do individuals with acquired brain injury receiving attention training complete more home practice sessions when the attention exercises are automatically “pushed” to their television or when they can self-initiate and “pull” them to their television on their own schedule?
   Hypothesis: Individuals will complete more sessions under the “pull” condition when they have control of timing of their home practice (internal locus of control).

2. Will individuals indicate a preference for the “push” versus “pull” conditions following the experiment?
   Hypothesis: Individuals will prefer the “pull” condition due to greater autonomy.

3. If individuals receiving attention training complete home practice training at least twice weekly, will there be an improvement in attention as measured by neuropsychological attention tests and a goal attainment scale?
   Hypothesis: If individuals receive once weekly individual treatment supplemented by twice weekly home practice, there will be improvements in attention as measured by attention tests and functional goal attainment.

**Methods**

**Participants**

Two participants were recruited from local speech-language pathologists and consented according to institutional review board policies at the two first authors’ respective universities. Selection criteria included

- Documented acquired brain injury (ABI) in medical records at least 1 year prior
- Primary complaint of attention or working memory impairments by the participant and at least one corroborative source, as measured by the Attention Rating Monitoring Scale (Cicerone & Azulay, 2002)
- No interfering sensory or auditory comprehension impairments precluding completion of the APT exercises, as demonstrated by passing hearing and vision screenings and at least 90% on the Commands and Complex Ideational Material subtests on the Boston Diagnostic Aphasia Exam-3 (Goodglass, Kaplan, & Barresi, 2000)
- Candidate for APT based on performance on the Test of Everyday Attention (Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994), suggesting impairment in at least one area of attention
- No previous direct attention training

There were 2 female participants. Following consent, the participants were administered a cognitive battery, including standardized tests and a questionnaire assessing attention. JG was a 61-year-old female, 15 months post-aneurysm rupture. She lived in a supported residential facility. Both she and her primary caretaker reported difficulty with memory and attention. Performance on the attention battery suggested moderate impairment in working memory, selective attention, and suppression ability. The second participant, KC, was a 40-year-old female, 2 years post-toxic medication reaction. She lived in her own home and, although no longer able to work, she independently managed her household and parenting chores with minor assistance from her mother, who lived in town. Results of initial testing
suggested moderate impairments in attention, particularly executive attention and working memory tasks.

**Design**

The study used a single-subject, alternating treatment experimental design. Single-subject experimental designs have been shown to be powerful research tools for evaluating clinical practice and hold some advantages over group designs (Horner et al., 2005). Instead of inferring a functional relationship between treatment and behavior change by analyzing group performance, single-subject experiments use repeated measures within participants. A review of neurorehabilitation efficacy studies revealed the value of single-subject designs in providing empirical experimental evidence of treatment efficacy in the individual patient (Perdices & Tate, 2009). In particular, the alternating treatment design in which two or more treatments are alternated in quick succession allows evaluation of differential treatment effects (Richards, Taylor, Ramasamy, & Richards, 1999).

**Independent Variable and Fidelity of Implementation**

The independent variable was the APT-3 training program delivered in two different home practice conditions. Two practice modes were alternated and compared: the push condition occurred when the attention training exercises were displayed on the television at a pre-determined time selected by the participant and the pull condition occurred when the participant needed to use the television remote to start the exercises independently. The starting condition was randomly assigned, and the order of the practice conditions was alternated each week. Participants were expected to complete two home exercise sessions per day in both conditions. The content (i.e., the specific attention exercises) was determined by the researcher clinician during the weekly in-clinic therapy session. Fidelity measures were automatically tallied through the TAP system online server, which indicated the date, time, accuracy, and duration of home program completion each time the program was initiated. The server also tracked if participants did not respond to push notifications (e.g., not at home) or if they pressed a button to snooze or refuse participation at the assigned time.

**Clinical Procedures**

The treating clinicians were advanced graduate students in communication disorders who had taken a course on cognitive rehabilitation and been trained to implement direct attention training with one of the respective first two authors. The student clinicians were supervised by one of the researchers. Researchers worked with JG weekly at her home residence; KC attended a university clinic weekly. Following the consenting process, initial assessment, and the home installation of the TAP system, participants were oriented to the attention training program. The attention drills and metacognitive strategies were selected and a goal attainment process was completed, all in accordance with the APT-3 manual. The preferred schedule for the push condition was established for participants beginning with this condition.

For the subsequent 6 weeks, participants participated in weekly attention training sessions for 50-60 minutes each. The weekly sessions comprised the following:

1. **Review of home practice data.** Participants were asked if they had experienced any difficulties and were encouraged to continue to try and complete their assigned exercises twice daily. Any technological or clinical concerns were addressed.

2. **Attention exercises.** Based on home exercise data and APT-3 decision rules specifying when to modify program exercises, current tasks were continued and/or new attention tasks introduced. Every session included at least 30 minutes of attention training with the attention drills.

3. **Strategy implementation.** Practice of selected strategies (e.g., self-talk, visualization) was incorporated into the attention exercises. If participants were not fluent with the strategy, direct instruction and modeling were provided. Prompting to use the strategies was withdrawn when participants used the strategies independently.
4. **Review of home practice plan.** The specific exercises and the ensuing week’s home practice condition were reviewed to make sure participants understood the plan and rationale for home practice. The schedule for the push condition was altered if requested.

These four session components were integrated into a treatment fidelity checklist. The researchers observed a minimum of four sessions conducted by the graduate student clinician and noted 100% fidelity. Because the APT-3 program is manualized, consistency in program implementation was facilitated. One final session was conducted to complete post-testing and schedule the removal of the TAP equipment from the home.

**Materials**

The APT-3 is a software-based cognitive rehabilitation program that runs from a USB drive or a TAP box and has exercises designed to target specific components of attention, including sustained, alternating, and selective attention, as well as working memory and suppression. The theoretical rationale is that repetitive stimulation of discrete attention networks will lead to improved attentional processing. The attention drills are interspersed with effort and reflection ratings. Performance data are captured and stored on the drive with graphic displays that are shown to the participants. APT-3 is an electronic version of the predecessor attention process training program evaluated in previous research (e.g., Sohlberg, McLaughlin, Pavese, Heidrich, & Posner, 2000). The respondent can use either the TV remote or a computer keyboard to respond to the exercises, with the exception of some of the working memory exercises that require a verbal response that is not captured or scored by a computer.

The TAP system was the device used to deliver the APT-3 home exercises. The motivation for using a TV rather than a home computer was because the TAP device allows the TV to be turned on remotely (push), unlike a computer. Both participants received a TAP system that included (a) a Dell Vostro 200 computer (2GHz Intel Core processors and 1GB of RAM), running Windows XP and configured only to run the TAP software; (b) a custom-built TAP set-top box to allow the computer to control and display attention exercise content on the TV (includes an external power supply, connects to a computer via serial port, has a power sensor for detecting if a TV is turned on or off, has infrared remote control and sound sensors, converts video output from a computer to composite video format so that it can be displayed on a TV, and has a built-in speaker to deliver audio cues); and (c) a custom-built TAP remote control with four large response buttons that allows participants to interact with the TAP system. If the TV is off, TAP delivers a warning, then turns it on at a scheduled time; if the TV is already on, TAP will give a warning and then switch the channel to display the attention therapy content. All TAP data, actions, and responses are stored on the TAP system hard drive and also uploaded via secure wireless connections to a central server. A webpage interface allows clinicians to monitor home programs by accessing this logged data. The TAP system was built and evaluated in previous studies evaluating prompting methods for people with cognitive impairments (Lemoncello et al., 2011).

**Dependent Variables and Reliability**

**Exercise compliance.** Completion of home attention exercises was determined by the computer-summarized TAP log data. The TAP system recorded and stored time stamps for program use and performance data for each of the exercises during all push and pull home practice sessions. Reliability was not calculated, given that the computer tracked all compliance data.

**Condition preference.** Each of the participants was queried by the researcher at the final session as to whether she preferred having the home attention exercises delivered by the push versus pull condition. Researchers asked the question in a variety of ways to verify responses.

**Attention function.** Potential changes in attention abilities following in-clinic attention training supplemented with home practice were measured by pre- and post-administration of a standardized measure of attention sensitive to the types of attention breakdowns that occur.
with ABI. The Paced Auditory Serial Addition Test (Gronwall, 1977) requires holding on to and adding auditorally presented number sequences. Potential functional changes were measured using an individualized goal attainment scale (GAS; Schlosser, 2004) and the Attention Rating and Monitoring Scale (Cicerone & Azulay, 2002). The Picture Peabody Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007) was administered pre- and post-attention training as a control measure. The researchers observed all assessment sessions and calculated inter-rater agreement with student clinicians at 92% across all measures (range: 85-100%); all discrepancies were easily resolved through discussion before analysis.

**Data Analysis**

Quantitative data were entered in a Microsoft Excel spreadsheet. Compliance data were graphed for visual analysis. Fine-grained visual analysis allowed for investigation of functional significance and exploration of differences across time in level, trend, variability, and overlap of the data across conditions (Parsonson & Baer, 1986). Performance on the PASAT and PPVT-4 was compared pre- and post-intervention. Outcomes from goal attainment and preference data were evaluated descriptively.

**Results**

We hypothesized that participants would complete more sessions in the pull condition, when they had internal control of their home practice schedule. However, as shown in Figures 1 and 2, both participants completed more sessions in the push versus the pull condition. Overall, participants completed between 30.0 and 87.5% of their scheduled sessions in the push condition. With the exception of KC’s 2nd week of practice, neither of the participants completed any of her scheduled sessions under the pull condition. Consistent with our hypothesis was participants’ stated preference for the pull condition.

*Figure 1. Percentage of Completed Practice Sessions for Push and Pull Conditions for JG*
The 2 participants received weekly direct attention training in the clinic, supplemented by home practice that was more frequent during the push weeks. As shown in Table 1, both participants improved on the PASAT, as hypothesized. JG improved one standard deviation in her total score from pre- to post-treatment and KC improved two standard deviations in her total score. The PPVT-4 was used as a control measure, and no substantial improvements were observed, as hypothesized.

**Table 1. Pre- and Post-Treatment Assessment Scores**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Measure</th>
<th>Pre-Treatment</th>
<th>Post-Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>JG</td>
<td>PASAT*</td>
<td>49.07</td>
<td>52.19</td>
</tr>
<tr>
<td></td>
<td>Set A</td>
<td>38.43</td>
<td>62.08</td>
</tr>
<tr>
<td></td>
<td>Set B</td>
<td>59.43</td>
<td>47.16</td>
</tr>
<tr>
<td></td>
<td>Set C</td>
<td>38.43</td>
<td>53.23</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>32.26</td>
<td>42.35</td>
</tr>
<tr>
<td></td>
<td>PPVT-4** (control measure)</td>
<td>99</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Goal Attainment Scale</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>KC</td>
<td>PASAT*</td>
<td>34.43</td>
<td>55.56</td>
</tr>
<tr>
<td></td>
<td>Set A</td>
<td>30.51</td>
<td>60.46</td>
</tr>
<tr>
<td></td>
<td>Set B</td>
<td>49.48</td>
<td>58.66</td>
</tr>
<tr>
<td></td>
<td>Set C</td>
<td>56.30</td>
<td>69.12</td>
</tr>
<tr>
<td></td>
<td>Set D</td>
<td>56.30</td>
<td>69.12</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>38.10</td>
<td>60.75</td>
</tr>
<tr>
<td></td>
<td>PPVT-4** (control measure)</td>
<td>92</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Goal Attainment Scale</td>
<td>-1</td>
<td>+2</td>
</tr>
</tbody>
</table>

*Reported as standardized T-scores for age-matched peers (normal $M = 50$, $SD = 10$).

**Reported as standardized scores for age and education-matched peers (normal $M = 100$, $SD = 15$).

Impact of potential changes in attention was measured using the GAS. As shown in Tables 2 and 3, both participants showed positive changes on their GAS, with JG reaching her “expected” improvement in attention and KC achieving “best expected” outcome.
Table 2. Complete Goal Attainment Scale for JG

<table>
<thead>
<tr>
<th>GAS Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>+2 Best expected outcome</td>
<td>JG will maintain topics in conversation by demonstrating the ability to self-correct 100% of the time.</td>
</tr>
<tr>
<td>+1 More than expected</td>
<td>JG will maintain topics in conversation by demonstrating the ability to self-correct 75% of the time. She will get off-topic no more than once during a conversation.</td>
</tr>
<tr>
<td>outcome</td>
<td>LEVEL ACHIEVED</td>
</tr>
<tr>
<td>0 Expected outcome</td>
<td>JG will maintain topics in conversation by demonstrating the ability to self-correct 50% of the time. She will get off-topic no more than twice during a conversation.</td>
</tr>
<tr>
<td>-1 Less than expected</td>
<td>JG will maintain topics in conversation by demonstrating the ability to self-correct 25% of the time. She will get off-topic easily and forget where she began.</td>
</tr>
<tr>
<td>outcome</td>
<td>Worst expected outcome</td>
</tr>
<tr>
<td>-2</td>
<td>JG will be unaware of when she is off-topic. She will get off-topic easily and forget where she began.</td>
</tr>
</tbody>
</table>

Table 3. Complete Goal Attainment Scale for KC

<table>
<thead>
<tr>
<th>GAS Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>+2 Best expected outcome</td>
<td>-KC will experience “occasional” difficulty with all of the following: (a) maintaining a “train of thought,” (b) forgetting things immediately after being told, and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. &lt;br&gt; -She will experience 1-2 memory lapses per week where she cannot recall the content from a significant interaction.</td>
</tr>
<tr>
<td>LEVEL ACHIEVED</td>
<td>+1 More than expected outcome</td>
</tr>
<tr>
<td></td>
<td>-KC will experience “occasional” difficulty with two of the following: (a) maintaining a “train of thought,” (b) forgetting things immediately after being told, and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. &lt;br&gt; -She will experience 3-4 memory lapses per week where she cannot recall the content from a significant interaction.</td>
</tr>
<tr>
<td>0 Expected outcome</td>
<td>-KC will experience “occasional” difficulty with one of the following: (a) maintaining a “train of thought,” (b) forgetting things immediately after being told, and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. &lt;br&gt; -She will experience 5-6 memory lapses per week where she cannot recall the content from a significant interaction.</td>
</tr>
<tr>
<td>-1 Less than expected</td>
<td>-KC will continue to experience “frequent” difficulty with (a) maintaining a “train of thought,” (b) forgetting things immediately after being told, and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. &lt;br&gt; -She will experience an average of one memory lapse a day where she cannot recall the content from a significant interaction.</td>
</tr>
<tr>
<td>outcome</td>
<td>Worst expected outcome</td>
</tr>
<tr>
<td>-2</td>
<td>-KC will experience “frequent” difficulty with (a) maintaining a “train of thought,” (b) forgetting things immediately after being told, and (c) becoming fatigued during or after activities that require sustained mental effort. These issues will happen most days. &lt;br&gt; -She will experience average of more than one memory lapse a day where she cannot recall the content from a significant interaction.</td>
</tr>
</tbody>
</table>

Discussion

Our first two research questions compared compliance and preference during the push versus pull home practice conditions. Results showed that home exercise adherence was higher for both participants under the nonautonomous push condition. This ran counter to our hypothesis, based on the therapy literature, that suggested patients are more likely to follow through with home assignments when practice is under their own control. Our findings likely
suggest an interaction between self-efficacy, therapy beliefs, and autonomy. Perhaps, because the APT-3 program promotes self-efficacy and positive therapy beliefs (with the embedded motivation and effort ratings and display of performance data), autonomy was less important. Our results suggest that these personal characteristics may not be equally important. Therapy that bolsters just one or two parameters, such as self-efficacy, may produce positive effects on its own. Although not directly measured in this study, participants did report interest and motivation to complete the attention training program and improve their skills during weekly sessions.

The differential responsiveness between home practice conditions may also suggest that facilitating structure with this population of adults with ABI is more important than facilitating choice when it comes to direct training for individuals with cognitive impairments. Perhaps reducing initiation and planning demands in the push condition promoted increased practice. Participants were queried at weekly visits about any challenges to completing the home program; both participants reported they were motivated to complete exercises during the pull condition, but became distracted or forgot. The consistent findings for both of these participants suggest it may be useful to examine individual affective variables in the design of telerehabilitation and home practice therapies for adults with cognitive impairments following ABI.

Weekly in-clinic APT-3 sessions supplemented by home practice resulted in improved functional gains and standardized attention test performance for both participants. These results supported our hypothesis for the third research question: structured home practice could result in improved attention if it facilitated more practice. Both participants completed once weekly therapy sessions and at least 4 weeks of intensive home practice. These findings suggest that building in methods of home practice to extend in-clinic rehabilitation efforts can be fruitful and support findings in other attention efficacy studies where positive results were seen when patients received attention therapy two or more times per week (Sohlberg et al., 2003).

A major limitation of this study that threatens the external validity is the use of only 2 participants. Replication of effects in more participants with different types of therapy domains would be important to further evaluate the role of choice in motivating clients to comply with home practice. We also made some assumptions about the motivational characteristics of the APT-3 therapy that were not empirically validated. We assumed, based on our own experience and the therapy compliance literature, that the program features requiring self-ratings of effort and motivation and the display of performance feedback would facilitate self-efficacy and encourage positive beliefs and expectations about therapy outcomes. The supposition that these two motivational factors were inherently built into the program and thereby allowed us to evaluate autonomy has face validity, but future research should verify that these features do indeed increase motivation.

The primary contribution of this study is the examination of affective variables that influence the initiation of home practice. Methods to increase the intensity of therapy are needed, and asynchronous telerehabilitation provides an ideal vehicle for supplementing limited in-clinic therapy visits. Expanding our understanding of factors that increase adherence and motivate clients to complete therapy regimens in their home environment should be a part of the telerehabilitation research agenda.

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References


Lorraine Ramig receives lecture honoraria and has ownership interest in LSVT® Global, Inc.

Telepractice Supported Delivery of LSVT®LOUD

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Abstract

This article outlines the essential features and underlying principles of Lee Silverman Voice Treatment (LSVT®LOUD) and explores the delivery of this treatment via telepractice. A detailed summary of the core features of LSVT®LOUD and the principles underpinning this treatment are presented. Current evidence to support the feasibility and validity of synchronous and asynchronous delivery of LSVT®LOUD to people with Parkinson disease (PD) is reviewed. Technology specifications, cost-benefit analyses, and patient satisfaction are discussed. The challenges involved in delivery of LSVT®LOUD via telepractice, such as inconsistent audio and video quality during videoconferencing, accurate measurement of vocal parameters, technical skill level of the clinician, and patient candidacy, are highlighted. LSVT®LOUD can be effectively and reliably delivered via telepractice. Improvements in telecommunications are required to overcome some of the technology challenges encountered in this mode of delivery. Positive benefits of online treatment in relation to savings in time and money and reduced carer burden are emerging. Patient satisfaction with telepractice in the management of the speech disorder associated with PD is high. The uptake of LSVT®LOUD into telepractice is likely to steadily increase with advances in mobile technologies and web-based applications designed to deliver this treatment.

Parkinson Disease

Nearly 90% of individuals with Parkinson disease (PD) develop speech and voice disorders, such as dysarthria (Ho, Iansek, Marigliani, Bradshaw, & Gates, 1998). These can be among the earliest symptoms of PD (Aronson, 1990; Ho et al., 1998; Logemann, Fisher, Boshes, & Blonsky, 1978; Sapir et al., 2001; Sapir, Spielman, Ramig, Story, & Fox, 2007; Stewart et al., 1995) and progress throughout the course of the disease (Sapir et al., 2001). Speech and voice disorders have deleterious effects on communication, health, psychological well-being, and quality of life (Dowding, Shenton, & Salek, 2006; Findley, 2007; Miller, Noble, Jones, & Burn, 2006a, 2006b; Miller et al., 2007; Pell, Cheang, & Leonard, 2006; Pitcairn, Clemie, Gray, & Pentland, 1990) and are considered to be a significant source of disability by
many patients and their families (Fox & Ramig, 1997; Miller et al., 2006a; Miller et al., 2007; Miller, Noble, Jones, Alcock, & Burn, 2008). Unfortunately, current pharmacological and surgical interventions have limited effects on speech and voice disorders (Ramig, Fox, & Sapir, 2008; Sapir, Ramig, & Fox, 2006, 2008). Without access to effective speech treatment, affected individuals often retire early, are forced to give up activities they enjoy, incur substantial medical costs, and have increased mortality (D’Amelio et al., 2006; Schenkman, Zhu, Cutson, & Whetten-Goldstein, 2001; Wermuth, Stemger, Stenager, & Boldsen, 1995).

Reduced vocal loudness (hypophonia), reduced pitch inflection (monotone), and breathy or hoarse voice are the main characteristics of disordered voice in PD (Atarashi & Uchida, 1959; Canter, 1965a, 1965b; Darley, Aronson, & Brown, 1969a, 1969b, 1975; Hartelius & Svensson, 1994; Hoberman, 1958; Logemann, Boshes, & Fisher, 1973; Ludlow & Bassich, 1984; Mutch, Strucwick, Roy, & Downie, 1986; Oxtoby, 1982; Scott, Caird, & Williams, 1985; Selby, 1968; Streifler & Hofman, 1984; Uziel, Bohe, Cadilhac, & Passouant, 1975). Imprecise articulation may appear after the emergence of voice abnormalities and in advanced disease (Ho et al., 1998; Logemann et al., 1973, 1978; Sapir et al., 2001); however, there is preliminary evidence for abnormal vowel articulation even at early stages of the disease (Sapir et al., 2007; Skodda, Visser, & Schlegel, in press). Some patients present a tendency for speech articulation to festinate (rush) and become hesitant and/or dysfluent (Moreau et al., 2007; Skodda & Schlegel, 2008). These speech and voice disorders are collectively termed hypokinetic dysarthria.

Origins of Speech and Voice Disorders

The origins of the speech and voice disorders in individuals with PD are complex and only partially understood. They are likely related to motor problems (hypokinesia/bradykinesia reflecting reduced muscle activation and abnormal scaling or maintenance of the gain of movement amplitude), sensory processing problems (abnormal gating of the somatosensory cortex, abnormal gating of the auditory cortex via feed forward mechanisms, abnormal perception of one’s own voice), cueing problems (reflecting deficits in internal/implicit cueing), neuropsychological problems (impaired attention to action, vocal vigilance, and self-regulation of vocal output), or some combination (Ramig et al., 2008). Additional research is needed to explore these etiologic factors and their interaction and contribution to the speech impairment in PD. Given the complexity of the origins of the speech and voice disorders in PD, it is not surprising that traditional medical and behavioral treatments have had limited success in managing these problems.

In spite of high incidence of voice and speech disorders in individuals with PD, historically only a few of these individuals (3-4%) receive speech therapy (Hartelius & Svensson, 1994; Mutch et al., 1986). This discrepancy might be because in the past, treatment outcomes have been disappointing both in terms of magnitude and long-term maintenance of any therapeutic gains (Allan, 1970; Greene, 1980; Sarno, 1968; Weiner & Lang, 1989).

Intensive Voice Treatment

In 1988, Ramig and colleagues introduced the Lee Silverman Voice Treatment (LSVT® LOUD), a Parkinson-specific approach that trains amplitude (increased vocal loudness) as a single motor control parameter. LSVT®LOUD also trains individuals with PD to “recalibrate” their motor and perceptual systems so they are less inclined to under-scale (reduce amplitude) speech movement parameters. In addition, individuals with PD are trained to compensate for deficits in internal cueing and self-regulation of vocal effort during speech production. LSVT®LOUD trains individuals with PD to actively attend to the amount, effort, and loudness required for normal voice. Finally, the LSVT®LOUD takes advantage of the multisystemic effects of loud phonation on the entire vocal mechanism, namely, simultaneous amplification of respiratory, laryngeal, and orofacial motor output. This multisystemic upscaling of motor
output manifests itself as larger amplitude of speech that more closely resembles normal speech (Sapir et al., 2007; Sapir, Ramig, Spielman, & Fox, 2010).

Over the past 20 years, a series of studies have documented that LSVT®LOUD increased movement amplitude of the respiratory-laryngeal system in individuals with PD and generated a lasting positive impact on vocal sound pressure level (SPL; Huber, Stathopoulos, Ramig, & Lancaster, 2003; Ramig & Dromey, 1996; Smith, Ramig, Dromey, Perez, & Samadari, 1995). These findings were consistent with perceptual data demonstrating improved loudness and voice quality (Baumgartner, Sapir, & Ramig, 2001; Sapir et al., 2002). There was no evidence of vocal hyperfunction (i.e., vocal abuse) post-treatment; to the contrary, LSVT®LOUD has been shown to reduce laryngeal hyperfunction (Countryman, Hicks, & Ramig, 1997) and improve voice quality (Baumgartner et al., 2001). The target in LSVT®LOUD is healthy, normal vocal loudness. Patients are not trained to yell, scream, or use pressed voice. There is also videostroboscopic evidence that the phonatory system becomes more efficient in the production of voice following LSVT®LOUD, as reflected in the more adequate closure and larger and more symmetrical movements of the vocal folds (Smith et al., 1995).

In addition to the direct impact on the respiratory-laryngeal systems following LSVT®LOUD, studies have documented distributed effects across the speech production system, including articulation (Dromey, Ramig, & Johnson, 1995; Sapir et al., 2007), facial expression (Spielman, Borod, & Ramig, 2003), swallowing (El Sharkawi et al., 2002), and neural imaging through use of PET (Liotti et al., 2000; Narayana et al., 2010). To date, guidelines for evidence-based practice (EBP) for behavioral speech therapy (Trail et al., 2005) and publications from the Academy of Neurologic Communication Disorders and Sciences (Yorkston, Hakel, Beukelman, & Fager, 2007; Yorkston, Spencer, & Duffy, 2003) indicate that LSVT®LOUD has the greatest number of positive outcome measures associated with any speech treatment examined in people with PD (Pinto et al., 2004; Yorkston et al., 2003).

The mode of delivery of LSVT®LOUD is different from traditional forms of speech treatment. LSVT®LOUD is delivered in a manner consistent with theories of motor learning (Ofer-Noy, Dudai, & Karni, 2003) and skill acquisition, as well as principles that drive activity-dependent neural plasticity (e.g., intensity, complexity, saliency; Tillerson & Miller, 2002). Therapy is administered four times per week over 4 weeks; each session lasts 50-60 minutes. In addition, there are daily homework and carryover assignments for the entire month of therapy. This protocol embodies many of the fundamental principles of exercise and motor training that have been shown to promote neural plasticity and brain reorganization in animal models of PD (Fisher et al., 2004) and human stroke-related hemiparesis (Liepert et al., 1998). Intensive training, especially when practiced continuously and at the onset of the disease or following brain injury, has been shown to affect molecular changes associated with cell survival, cell growth, and functional recovery, which reflect neural plasticity and brain reorganization (Fisher et al., 2004; Fox et al., 2006; Kleim, Jones, & Schallert, 2003; Liotti et al., 2003; Taub, 2004) and challenge the assumption that there is no potential for recovery of function in PD.

**Technology-Enhanced Accessibility**

There are practical challenges to intensive speech therapy (four individual sessions per week for 4 weeks) necessary for promoting the principles of neural plasticity. The movement disorder associated with PD alone presents an inherent barrier to access to treatment, with many patients requiring assistance with everyday mobility. Regardless of location, many individuals with PD are not able to travel to a clinic, and some may suffer from fatigue as a result of travel, rendering treatment less effective. There are not enough therapists to deliver this treatment regimen to all individuals with PD, a need that will likely increase with the aging of the baby boomer population. Furthermore, continued exercise following the conclusion of speech treatment may be needed to maintain vocal loudness as the disease progresses.
Moreover, intensive treatment can be costly for both the patient and service provider. Thus, there is a need for expanding service delivery while containing costs and human resources.

Telepractice, which involves the use of telecommunications technology to deliver professional services at a distance, has the potential to address many of the issues highlighted above. Current technology has the capacity to address geographic barriers by enabling patients to be treated in their own homes or local communities, thus increasing access to services and specialist practitioners and potentially reducing costs. The ability to treat a person in the home or local context is not only possible, but eminently desirable. There is substantial evidence to support the benefits of rehabilitation within a natural environment where generalization, functional outcomes, and patient satisfaction and self-management are likely to increase (Legg & Langhorne, 2004; Von Koch, Wotruch, & Holmqvist, 1998; Willer & Corrigan, 1994; Ylvisaker, 2003). This approach is endorsed by the World Health Organization (WHO) framework, which promotes a person’s functioning within the context of their environment (WHO, 2001). For people with PD, home-based treatment delivered via various forms of technology has the potential to enhance the calibration, generalization, and maintenance of the improved speech pattern achieved with LSVT®LOUD.

**Technology Requirements**

LSVT®LOUD, when delivered face-to-face, involves the typical patient-clinician interaction and a behavioral treatment paradigm. A critical component of LSVT®LOUD is the measurement of sound pressure level (SPL) and frequency of the voice and the duration of phonation. The treatment features written stimuli and the ability to record and playback the patient’s speech. Therefore, in delivering LSVT®LOUD via telepractice, the SLP needs to use technology that replicates this feature set as closely as possible in order to maintain the integrity of the treatment. Following treatment, the patient will be required to continue practicing the speech and voice exercises on a daily basis in order to maintain treatment benefits. Replication of the treatment and maintenance phases of the LSVT®LOUD program can be achieved with technologies that enable both synchronous (in real-time) and asynchronous (data is collected, stored, and potentially forwarded to a clinician) treatment delivery.

Current technology enables the synchronous delivery of LSVT®LOUD across the Internet via videoconferencing, which readily facilitates the patient-clinician interaction. However, additional tools and features are required beyond basic videoconferencing. Ideally, the technology should be designed to ensure minimal effort or skill on the part of the patient to participate in the online interaction. Theodoros and colleagues (Constantinescu et al., 2010a, 2010b, 2010c; Theodoros et al., 2006) have developed technology that incorporates a core set of features for the online delivery of LSVT®LOUD. These features include (a) a videoconferencing facility that can be provided in the patient’s home or local community, (b) capacity to transmit and display written stimuli on the patient’s screen, (c) ability to measure SPL and frequency of the voice and duration of phonation in real time, and (d) capacity to record and playback high-quality audio recordings of patient’s speech online. This feature may need to be supported by “store-and-forward” technology, where the patient’s speech is recorded in real time at the patient’s end, stored, and then immediately forwarded to the clinician’s computer. This asynchronous technology ensures a high-quality recording that may not be achieved via the videoconference.

Technology for asynchronous delivery of LSVT®LOUD and independent patient practice similarly need to include specialized software to measure vocal SPL and frequency and duration of phonation. The capacity for the clinician to alter treatment parameters (e.g., SPL levels on tasks) for each patient and provide interactive verbal feedback on performance, similar to that provided in a face-to-face setting, are additional key features required in this
technology. These features have been captured in software developed by Ramig and colleagues (Halpern, Matos, Ramig, Petska, & Spielman, 2005).

**Evidence**

Research to date has involved the use of various forms of synchronous and asynchronous technologies, including videophones, videoconferencing via web camera and Skype (an integrated multimedia videoconferencing system), and specialized software to deliver LSVT®LOUD. These technologies have been used either as alternatives to, or in combination with, face-to-face delivery.

Tindall, Huebner, Stemple, and Kleinert (2008) reported on the use of the videophone for delivering LSVT®LOUD to 24 patients with PD. The videophone uses analogue modem technology and connects via the plain old telephone service (POTS). As such, the technology is relatively unsophisticated by current standards and has obvious limitations, one being the difficulty in accurately recording SPL and vocal frequency. Vocal loudness was measured using a sound level meter positioned at the patient’s end in such a way that it could be read by the clinician over the video phone. Such measurement is likely to be affected by visual and auditory signal delay. Measurement of vocal frequency was not mentioned in this study. Tindall et al. (2008) were able to demonstrate significant improvements in SPL for sustained phonation and reading and conversational monologue pre- to post-treatment. When compared to previous face-to-face data (Ramig, Sapir, Fox, & Countryman, 2001), these results were found to be comparable on all measures except for SPL for conversational monologue. While videophones may be useful for the treatment of some patients using LSVT®LOUD, there are obvious limitations to this technology.

A web camera and videoconferencing via Skype has been used by Howell, Tripoliti, and Pring (2009) to deliver LSVT®LOUD to three people with PD, in combination with face-to-face treatment. Participants received one treatment session per week face-to-face and the remaining three sessions via Skype. The investigators acknowledged the inability to accurately record SPL during the online sessions and subsequently used the weekly face-to-face session to record accurate vocal SPL values using a hand-held sound level meter. Auditory feedback of the person’s speech was achieved via e-mailed recordings made during the face-to-face sessions or via a free downloadable audio recorder on the participant’s computer. The results of this study revealed that individuals treated remotely could achieve gains in vocal SPL values for sustained phonation, reading, and conversational speech comparable to those obtained in previous face-to-face studies. Obvious limitations of this technology were the computer specifications and participant training required prior to treatment, the inability to accurately record SPL during the videoconference, and the need for at least one face-to-face session per week.

By developing a specifically designed integrated multimedia videoconferencing system (eHAB) incorporating the core set of features mentioned earlier, Theodoros and colleagues (2006) have attempted to overcome some of the limitations of off-the-shelf technology. Using this system, they have demonstrated the validity and reliability of assessing and treating people with PD online. An early pilot study conducted by Theodoros et al. (2006) examined the feasibility of treating people with PD across the Internet using LSVT®LOUD. In this study, 10 people with PD were treated across a 128kbit/s Internet connection in a laboratory-based setting. Post-treatment, they demonstrated significant improvements across the group for SPL for sustained vowel phonation; reading and conversational monologue; pitch range; and perceptual features of loudness level, pitch and loudness variability, and breathiness. The assessment and treatment of larger cohorts of people with PD were subsequently investigated. Constantinescu et al. (2010a) simultaneously assessed the speech and voice of 61 people with PD online and face-to-face using an Internet connection speed of 128kbps/s consistent with minimum connection speeds available at the time of the study. Perceptual measures of voice, oromotor function, articulatory precision, and speech intelligibility, and acoustic measures of
SPL, phonation time, and pitch range were used to establish validity and reliability. Comparable levels of agreement were achieved between the two assessment environments for the majority of parameters measured. Furthermore, the intra- and inter-rater reliability of the assessors was found to be comparable in the online and face-to-face environments on all assessment tasks. A randomized controlled treatment trial conducted by Constantinescu et al. (2010b) involving 34 people with PD revealed significant improvements across various acoustic and perceptual measures for participants in both the online and face-to-face treatment groups. No significant differences in treatment outcomes were identified for participants in the online and face-to-face treatment environments. These results supported the clinical validity and reliability of delivering LSVT®LOUD across the Internet.

While laboratory-based studies allowed these researchers to develop and refine the technology required to deliver LSVT®LOUD online, the need to provide this treatment in the home was clear. A single-case study piloted the treatment with a person with PD living approximately 90 kilometers away from the clinic (Constantinescu et al., 2010c). Connection to the Internet was achieved via a public telecommunications network. The person with PD achieved substantial improvements in SPL in sustained phonation, reading and conversation, and overall speech intelligibility following the treatment. Research is now being conducted to establish the feasibility of delivering LSVT®LOUD to people with PD in their homes in rural and urban areas using a mobile version of the system and wireless connectivity. Although feasibility and positive outcomes are the primary goals of this research, the economic attributes of the service will also be investigated.

Ramig and colleagues (Halpern et al., 2005) have developed technology (LSVT®LOUD Companion) to enable people with PD to practice the LSVT®LOUD techniques independently. This software can be used in conjunction with face-to-face treatment or in a self-directed manner following a course of 16 sessions of treatment. This software includes calibrated measurement of SPL and frequency of voice, interactive verbal feedback on patient performance, a facility for the clinician to adjust treatment goals, and data analysis. Halpern et al. (2005) reported on the treatment of 16 people with PD who received 50% of their sessions at home using the software and the remaining sessions face-to-face. Results revealed positive outcomes similar to previously published data both immediately post-treatment and at a 6-month follow-up. This technology could also be used in conjunction with real-time online treatment, providing a total telepractice alternative.

Cost-Benefits

Essential to any study involving alternate modes of service delivery is the need to determine the cost-benefits of such an arrangement. The economic attributes of telepractice are critical to its sustainability in today’s health-care systems. Economic analysis of any telehealth service involves examination of the benefits and/or costs to the recipient and the health-care provider. It requires detailed information concerning the costs of technology, facilities, personnel, time expended by patient and service provider, and patient and provider travel expenses, as well as the effects on quality of life (Krupinski et al., 2006).

To date, there is limited information available on the costs and benefits associated with the delivery of LSVT®LOUD via telepractice. Tindall et al. (2008) examined the costs (time and money) incurred by participants receiving LSVT®LOUD via videophones compared to the costs that would have been incurred for traditional delivery of the treatment. The analysis indicated that treatment via videophone resulted in a total time saving of 35 hours and $1,220 in associated costs, which would not have been reimbursable (Tindall et al., 2008).

In a further study, Tindall and Huebner (2009) examined the impact of videophone delivery of LSVT®LOUD on carer burden. A structured caregiver burden interview was conducted with 11 carers of participants who had received the treatment via videophones. Caregivers were asked a series of questions relating to the time and money that would be
required for them to attend a face-to-face therapy session with the person in their care. Each caregiver was then asked to assign a monetary value to the total time spent on attending a therapy session. In addition, the caregivers were asked to provide their overall perception of the impact of videophone-delivered treatment on burden of care. Using this process, it was determined that the total average number of hours saved for the carer was 48 hours valued at $1,024. All carers agreed that videophone delivery of treatment eased the burden of care.

Challenges

The studies conducted to date have highlighted a number of challenges in delivering LSVT®LOUD via telepractice. These challenges center on the inconsistency of audio and visual quality of videoconferencing, accurate measurement of SPL and frequency of the voice online, technical proficiency of the clinician, and patient candidacy. In each of the studies involving real-time delivery of LSVT®LOUD, clinicians were challenged by delays in the audio and/or visual signal and increased pixilation of the visual image (Constantinescu et al., 2010a, 2010b, 2010c; Howell et al., 2009; Theodoros et al., 2006; Tindall et al., 2008). However, as described by Constantinescu et al. (2010b), simple yet effective communication strategies can be implemented to overcome these shortcomings (see hints below). Accurate measurement of vocal SPL and frequency remains a challenge using videophones and Skype. However, these measurement tools have now been successfully developed for other synchronous (Constantinescu et al., 2010a, 2010b, 2010c) and asynchronous technologies (Halpern et al., 2005) and will be used in further iterations. There are inherent technical challenges in the delivery of LSVT®LOUD via telepractice; however, many are surmountable and will inevitably resolve with ongoing developments in technology.

Helpful hints SLPs can use for LSVT®LOUD and telepractice include

Patient Selection

- Assess suitability on an individual basis—do not be misled by appearances.
- Potential exclusion criteria include dementia, severe depression, significant dyskinesia (causes visual image pixilation), significant aided hearing or visual deficits, and marked attention deficits.

Managing Audio Delays

- Practice effective turn-taking and remain silent while the patient is speaking. Do not use interjections (e.g., “I see,” “uh huh”).
- Use short and precise instructions.

Optimizing Video Quality

- Reduce movement to avoid image pixilation.
- Use easy-to-detect hand cues (e.g., thumbs-up for “good,” point upwards for “higher pitch,” “stop” to complete task).
- Rely more on specific verbal directions and patient feedback than on visual information.
- Use store-and-forward technology, where possible, to circumvent degraded visual quality.

Optimizing Treatment Environment

- Use a quiet room with no distractions (e.g., phone, television).
- Ensure appropriate lighting, seating, and desk height.
- Establish a routine for repeated positioning of patient at a set distance from microphone.
- Regularly remind patient to adjust stooped posture, if present.
- Establish mechanism for managing connection failure (e.g., phone call, e-mail, etc.).
The technical skill level of the treating clinician can present a challenge to the delivery of LSVT®LOUD online. Telepractice guidelines (American Speech-Language-Hearing Association, 2005) recommend that clinicians engaging in telepractice should be appropriately trained in the use of specific technology prior to an interaction with a client. Therefore, the onus is on the clinician to ensure that he/she is proficient in the use of the technology, has the capacity to troubleshoot in a timely manner, and/or has rapid access to technology support. It is also advisable for clinicians to have completed several face-to-face LSVT®LOUD treatments prior to engaging in online delivery to ensure that they are confident in administering the treatment.

A further challenge in using LSVT®LOUD via telepractice lies in patient selection. It is inevitable that some people with PD will not be suitable candidates for this mode of service delivery. Patient characteristics associated with PD that may make them unlikely participants include significant dementia; marked impairment of processing speed, memory, and/or executive functioning; severe depression; severe dyskinesias; and significant hearing and/or visual impairment. Dyskinetic movements will result in increased pixilation of the visual image during videoconferencing and may make it difficult for the patient to remain within the camera view. Patients undertaking LSVT®LOUD asynchronously need to be able to organize and maintain a self-directed practice schedule and operate the technology comfortably. Selection criteria that might apply to patients engaging in face-to-face treatment also applies to those involved in telepractice, and suitability of the patient for telepractice remains a clinical decision.

**Patient Satisfaction**

Despite the number of challenges that arise during the delivery of LSVT®LOUD via telepractice, patient satisfaction with online treatment is remarkably high. In all studies conducted to date, the majority of users reported high levels of satisfaction with this mode of delivery. Tindall et al. (2008), using the Telemedicine Satisfaction Survey (Yip, Chang, Chan, & Mackenzie, 2003), found that all of the participants surveyed were highly satisfied with the treatment via videophones, with the highest degree of satisfaction associated with savings in travel time. A similar response was obtained from the 3 participants in the Howell et al. (2009) study, who indicated that they would not have participated in the treatment had they been required to attend a hospital clinic. Eighty percent of participants who were assessed online in the Constantinescu et al. (2010a) study reported that they were more than satisfied or very satisfied with the online experience. A similar percentage of participants (82%) reported high levels of satisfaction with online treatment (Constantinescu et al., 2010b). The person with PD who was treated remotely in the Constantinescu study (Constantinescu et al., 2010c) echoed a high degree of satisfaction with the online experience, indicating a preference for this mode of treatment in the future. The participant recognized and appreciated the time savings and that he did not have to travel.

**Future Directions**

With advances in technology, there is exciting potential for the development of new platforms for the delivery of LSVT®LOUD. For example, web-based applications for this treatment, such as interactive websites, will provide greater flexibility and ubiquity of online service. The escalation of wireless connectivity and the rapid increase in mobile technology will enable the development of additional synchronous and asynchronous applications for delivering LSVT®LOUD. Over time, these applications will increase access and improve treatment outcomes exponentially and in doing so, lessen the burden of the disease to people with PD and their carers.

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References


Telepractice Experiences in a University Training Clinic

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Abstract

Telepractice is a rapidly growing means of providing remote speech-language pathology and audiology services to clients. The primary advantage of telepractice in speech-language therapy is that it improves the accessibility of services. Improved accessibility is important in serving not only clients in rural areas, but also those who are unable to visit the clinic because of physical disability. Telepractice may also make it easier for clients to engage in more intense therapy schedules, because the burdens associated with traveling to and from the clinic are removed. For these reasons, we suggested graduate students in speech-language pathology gain experience in telepractice delivery of services. This article describes our experience training graduate students in the use of telepractice delivery of speech-language therapy. Three different treatment protocols were used with nine different clients. In addition, important issues related to the use of telepractice are identified.

The American Speech-Language-Hearing Association (ASHA; 2010) advocates the use of the term telepractice to describe the remote delivery of speech-language pathology or audiology services rather than the terms telehealth or telemedicine, because these terms suggest a relationship only to health-care settings. Although ASHA promotes the term telepractice, it recognizes telerehabilitation as an acceptable term. In this article, we use the terms telepractice and telerehabilitation interchangeably.

The primary advantage of telepractice, or the delivery of speech-language pathology and audiology services via telecommunication networks and the Internet, is accessibility. Not only can services be provided to patients who are unable to travel to a clinic, but the reduction in travel time and expense allows therapies to be delivered more intensely, if appropriate, and less expensively. Telepractice also provides the opportunity for greater access to clinical experts for consultation and/or service delivery.

One clear value of telepractice is its ability to mitigate barriers to service providers for clients who live in rural areas or have physical disabilities that affect transportation (Houn & Trottier, 2006). Perhaps less evident are the benefits for managing clinicians' high caseloads. Carpenedo (2006) documented the benefits of telepractice offered to the Visiting Nurse Service of New York Home Care when it faced the challenge of increased patient referrals and a shortage of speech-language pathologists in New York City.

Principles of neuroplasticity suggest that intensity of training is necessary to change brain circuitry associated with a targeted behavior or behaviors (Kleim & Jones, 2008). While there is some conflicting evidence (Ramsberger & Marie, 2007; Sage, Snell, & Lambon Ralph,
and at least one reference suggesting that no conclusions can yet be drawn with regard to treatment intensity (Marshall, 2008), a growing body of recent findings from aphasia treatment suggests that intense treatment delivered over a short period of time produces improvements that are greater and last longer than typical protocols (Cherney, Patterson, Raymer, Frymark, & Schooling, 2010; Kelly, Brady, & Enderby, 2010). However, intense treatment presents additional barriers for many patients, because the burdens associated with traveling to and from the clinic are exacerbated.

At the current time, Medicare does not reimburse for speech-language pathology services provided via telepractice. Medicaid reimbursement differs from state to state. Some states have passed legislation that requires services typically covered by private health insurance be covered if provided via telepractice. As evidence grows supporting the effectiveness of telepractice in speech-language pathology, it can be expected that reimbursement policies will change.

Telepractice encompasses a broad range of diverse services. Examples include in-home monitors that alert remote caregivers of a client’s condition, transmission of medical data (e.g., results from a radiology procedure) to a remote physician for interpretation, electronic health records that can be accessed by different facilities and providers, and the remote delivery of clinical service via Internet chat/conferencing software. The Health Insurance Portability and Accountability Act of 1996 (HIPAA) requires health-care providers to establish standards for electronic communications, medical records, and medical transactions. Since its inception, there have been numerous revisions in response to the evolving application and technological advancements; however, development of specific guidelines for HIPAA compliance in telerehabilitation is in the beginning stages. Watzlaf, Moeini, and Firouzan (2010) identify three areas of information security risk specific to the use of voice over Internet protocol (VoIP) systems such as ooVoo or Skype: confidentiality, integrity (preventing information from being altered by unauthorized users), and availability (ensuring that services are available for use when needed). The authors also provide a compliance checklist for clinicians to use in evaluating whether a VoIP system meets basic privacy and security requirements. ASHA (2010, p. 6), in a professional issues statement, advises

Telepractice sessions must be protected from unauthorized access; the method of protection is not specified by HIPAA, and may vary depending on the risks associated with different types of equipment and connections. HIPAA-covered entities must perform a risk assessment and document strategies that they will implement to ensure patient privacy.

Finally, clinicians providing telerehabilitation remote services to clients across state lines are advised to be licensed in the state where the client receiving remote services resides.

Telerehabilitation is a rapidly emerging service delivery model. Readers are, therefore, encouraged to frequently check with ASHA, state associations, and regulatory agencies for new developments related to licensure, reimbursement, and HIPAA compliance. In addition, several journals are dedicated to the subject of telepractice; readers may be interested in reviewing *Telemedicine and e-Health, Journal of Telemedicine & Telecare, International Journal of Telemedicine and Applications, International Journal of Telerehabilitation*, and ASHA Special Interest Group 18’s *Perspectives on Telepractice*.

There is no question that telerehabilitation will play an increasingly important role in the delivery of speech-language pathology services in the future. As faculty in a program preparing future speech-language pathologists and experts in rehabilitation of acquired speech, language, and cognitive disorders in adults, we thought it imperative that students gain experience in this model of service delivery. Thus, 3 years ago we began exploring possible applications of telerehabilitation for clients served in our university Speech, Language, and Hearing Center.
We first acquired three computers (two to be loaned to clients and one for student clinician use) through a university funding opportunity that encouraged the use of technology in teaching and learning. Some of the treatments described below required preparations of materials to be sent home with clients for use during treatment sessions. For example, each client needed sets of stimulus cards when we conducted constraint-induced language treatment, or CILT. A graduate research assistant carefully prepared these materials to ensure that clients could easily identify specific sets of cards and keep materials well organized.

The graduate student clinicians who participated in this experience were in the third, fourth, or fifth semester of their six-semester master's degree program. For some, this was one of their first clinical experiences, and, for others, it was one of their final experiences before beginning full-time, off-campus internships. Prior to beginning this clinical assignment, students successfully completed the graduate seminar corresponding to the particular area of therapeutic service they would be delivering. These students were familiar with video-chatting over the Internet, although they had no experience using this medium for delivery of speech-language pathology services. A doctoral student with technical problem-solving experience was on call for technical assistance. Faculty supervision was provided at the same frequency as would have occurred in a traditional delivery mode. Faculty observed sessions from within the same room as the student clinicians. Finally, because the Speech, Language, and Hearing Center in our department does not bill health insurance, and because Colorado does not have licensure, we did not have to deal with these issues.

In the following pages, we describe three different therapeutic applications delivered to nine clients. Graduate students, supervised by the authors, provided the services.

**Case Study 1: Accent Modification**

The first client in our Speech, Language, and Hearing Center to use telepractice was a native Peruvian Spanish-speaker. She was a speech-language pathologist who contacted the Center about our accent modification program (Sutter & Rende, 2009). Because she could not find a program closer to her home (approximately 85 miles away from the Center), she asked if we could provide the services remotely via video-chat. Because we were unsure about the efficacy of providing accent modification services remotely, we proposed alternating between video-chat format and in-person sessions at our Center. The client came to the Center for the initial and final assessments and every other accent modification session. For the remote sessions, the client and clinician used the free video-chat feature in Google's e-mail (Gmail) on their personal computers to interact via the Internet in real time. The client’s computer had an external webcam and the clinician’s computer had an embedded camera.

At the end of 13 weekly sessions, we asked two questions about the telepractice experience: First, did the technology work and, second, were the results from the intervention comparable to the outcomes we would expect from all in-person sessions? For the technology aspect, we specifically wanted to know

- Was the sound and video quality satisfactory for an intervention that targeted speech pronunciation and prosody?
- Did the clinician think that her intervention cues were as effective via the video-chat format as during the in-person sessions?
- Was the overall satisfaction of the interactions between the clinician and the client similar during the two session formats?

To answer these questions, we asked the clinician and client to each complete a questionnaire designed to solicit feedback on their perceptions of the usability and efficacy of the telepractice sessions. Both the client and the clinician agreed that the sound quality was sufficient during the video-chat sessions, but the time-lag of about 3 seconds between presentation of stimulus and response took some adjustment. From the client’s perspective,
the quality of the video presentation somewhat hindered her ability to discern the visual features of the targets. However, the clinician judged the effectiveness of cuing to be similar during both conditions. Both were satisfied with the level of interaction that the video-chat format provided and felt it was similar to face-to-face interactions.

To determine if the outcomes of the intervention were similar to what we would expect from an in-person intervention, we visually inspected the two data sets. First, we compared performance during the telepractice sessions to the performance during the in-person intervention in order to detect any obvious variations. There were none. Second, we looked at the amount of improvement this client made in producing the target sounds in words and in sentences from the initial assessment. The author of the standard accent reduction program, upon which our intervention was based, estimates that, if a client attends weekly sessions and practices about 5 hours per week for the duration of the program, he or she should expect around a 50% gain in speech sound production (Compton, 2003). Our client reported consistently completing assigned home practice. During the program, she practiced 11 target sounds. By the end, she had reached or surpassed the goals for intervention for 72% of the target sounds in words and 45% of the sounds on the sentence level. From our clinical experience, most clients who attend weekly sessions and practice 4-5 additional hours per week achieve 65-80% improvement of sound production on the word level and 60-65% improvement on the sentence level. However, there is individual variability. Thus, the client’s improvement on the word level was around what we would expect had she come to the Center for every session. Her improvement on the sentence level was lower than we would have predicted, but not outside of the range of what we have observed in our clinic.

Case Study 2: Case Series CILT

Whereas the use of telepractice in the first case study was motivated solely by accessibility to intervention, the use of telerehabilitation with a second group of clients was to accommodate both accessibility and intensity of the treatment in which they participated. CILT (Maher et al., 2006) is a language intervention designed for persons with aphasia. An important aspect of this approach is constraint: Participants are required to use only verbal language (i.e., no gestures or supplemental writing) during all aspects of language treatment sessions. Another important CILT treatment principle is practice intensity. The constraint condition is applied for extensive periods of time, although the ideal dosage of intensity has not been established. At the Center, following current research findings, the 2-week CILT protocol specifies that treatment is conducted 4 days per week for 3 hours per day (Ramsberger, Rende, & Messamer, 2010).

For the past 2 years, we have conducted CILT with seven clients with mild to moderate aphasia via telerehabilitation. We lent them Apple MacBook laptop computers embedded with real-time cameras and microphones for the duration of the sessions. The clinician at the Center also used a MacBook. The Apple MacBook was chosen because Mac supports quick automatic connection to new Internet networks. This was an important feature because the clients needed high-speed Internet access in their homes. All unnecessary applications were removed or hidden from the desktop. The free video-chat program ooVoo was downloaded onto the computer before it was given to the clients. We chose the ooVoo application because it allows free three-way conferencing—an important feature for our CILT program, which involves two participants with aphasia at the same time. In addition, ooVoo proved easy to launch, quit, and restart if technical difficulties occurred.

After starting the ooVoo video-chat, the sessions followed the basic sequence used in face-to-face sessions. The clients did not have to use the computer keyboard or touchpad, except to quit and restart calls, if needed. The card game Go Fish was played during each session to facilitate verbal language production by requesting cards and responding to requests in order to collect as many pairs of matching cards as possible. In order to play this game via
telerehabilitation, the clients were supplied with half-decks of playing cards with black and white line-drawings of people or objects. For most CILT interactions, game participants consisted of two persons with aphasia, with the clinician facilitating the interactions and supporting maximum correct verbal productions with hierarchical cuing. In one instance, the clinician served as both player and facilitator. We based our protocol and stimulus cards on the methods described by Maher and colleagues (2006).

For each CILT session, detailed data collection included time spent in play; number, time, and nature of any technical difficulties; number of correct verbalizations produced by each client, coded by level of required cuing; assessment of most effective cues; and general observations about client participation in the treatment session. Pre-treatment and post-treatment standardized testing included administration of the Western Aphasia Battery (WAB; Kertesz, 1982), the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 2000), the Action Naming Test (Nicholas, Obler, Albert, & Goodglass, 1985), and the retelling of the Cinderella story.

Just as we posed questions during our first case study, we solicited participants’ perspectives regarding use of this technology to conduct the CILT treatment. We were interested in learning whether

- It was feasible for persons with mild to moderate aphasia, and in some cases, with concomitant right hemiparesis, to use the Apple MacBook and ooVoo video-chat application effectively and efficiently to engage in remote treatment sessions
- Persons with mild to moderate aphasia could benefit from cues and support delivered by clinicians through the video-chat format to maximize the number and quality of their performance during sessions
- Persons with mild and moderate aphasia could participate in interactive treatment tasks of a somewhat abstract quality when all stimuli were not visually present
- The results of this intervention were similar to that reported for face-to-face CILT rehabilitation

Our observations, supported by our session notes, answered our first question affirmatively. All of the participants with aphasia easily learned how to launch the ooVoo program and did so independently for the daily treatment sessions. A trend emerged during the first few CILT sessions that affected how we conducted subsequent sessions: Halfway through the 3-hour session, we consistently experienced either significant degradation of the audio and/or video signal or an outright interruption of service. Once we ended the call and re-established the connection through a new call, the service usually resumed without incident for the remainder of the session. As a preemptive act, therefore, we took a scheduled 10-minute break halfway through each 3-hour session. The clients were able to independently end and resume calls within sessions. No motor related problems were noted or reported. Occasionally, spouses intervened with troubleshooting, but these instances were exceptions rather than the rule.

Periodically, we did experience short durations of less than optimal audio or video signals. Our reaction to these disruptions varied. If the signal was distorted, but still useable, we typically continued the treatment tasks; the problem often resolved itself within a matter of minutes. If the technical problems were severe enough to interfere with treatment, ending the call and restarting it usually solved the problem. We did find it useful to arrange ahead of time for the clients to have a phone near the computer with the clinician’s phone number, in case connections were completely lost.

We observed that, in general, the clients easily adapted to the changes in the signal and the resulting changes to the treatment techniques. For example, occasionally, one or both clients lost video reception altogether, but we kept playing without discernible impact on their performance. Rather than view the minor technical distortions as a drawback, one could
consider these glitches a mirror for real-life barriers to communication and an opportunity for clients to practice persevering with their interactions despite less than ideal circumstances.

Although we were interested in the efficiency and effectiveness of using this technology for specific treatment outcomes, we observed an unexpected noteworthy effect. Over the course of the 2-week sessions, we repeatedly noticed increased interpersonal connections between the participants with aphasia. Without prompting, they provided cues to each other when one faltered in a response or request, praised each other when they succeeded in a difficult task, and provided a general supportive atmosphere during sessions. They used a brief time at the end of sessions to share updates on personal and family activities. For example, one client began a treatment session by showing the other client a quilt she had made after a chat about her quilting the day before. Using telepractice by persons with aphasia, not only to practice verbal language production but also to expand social interactions and connectedness, is worth exploring. It was our impression that the social interactions we observed between clients while engaged in telepractice were not unlike those that occur when clients are in the same room. We have recommended, therefore, that CILT dyads continue regular contact via video-chat after completion of the CILT program to give clients additional opportunities to practice verbal interactions in a supportive environment.

Our second question, which addressed the effectiveness of clinical support, was answered by reviewing session notes and observing parts of each session. Although we do not have normative data about the number, quality, and structure of verbalizations that reflect maximum client performance, 30 years of clinical experience provided a benchmark to subjectively judge how well clients responded to clinician support and cuing. Early on in the CILT video-chat delivery, we noted that, when two clients are simultaneously participating in treatment via telepractice, the clinician must first identify the client by name before providing a cue. Although this seems intuitive, beginning clinicians were not always adept at directing cues to individual clients, which caused confusion and limited the effectiveness of the cues. Another difference from face-to-face cuing involved the 3-second time-lag between presentation of a stimulus and a response. Initially, we did not take that time delay into account when providing a response cue, such as an initial phoneme cue, and thus were not providing enough time for the clients to respond. This time-lag sometimes resulted in overlapping talking of client and clinician. With experience, the clinician soon adapted the speaking rate to take this time delay into account.

Once the alerting prompt and time-lag cue time were standardized, cues appeared to be as effective via the computer as in face-to-face treatment sessions. Clients were attentive and responsive to both visual and auditory cues from the clinician. Our documentation of the number of correct verbalizations, both spontaneous and with cuing, support our notion that the clients were taking advantage of the cues in order to fully participate in the telepractice sessions and produced responses that were of the quality and quantity we would expect to see in face-to-face sessions.

The third question explored the clients’ ability to participate in an interactive treatment task via the Internet. Initially, we were concerned that the “mechanics” of playing the game might interfere with the major goal of the intervention, producing verbal responses and requests in a fairly natural routine. The game involved some basic rules, the manipulation of actual cards, and, to some extent, the assumption of an abstract attitude to understand that a game usually played face-to-face was now being done without a partner with actual cards at the same table. We were surprised how easily the clients adapted to this mode of game playing. After one or two hands, most clients needed little prompting to appropriately take their turn, discard and pick up cards, and understand that pairs of cards could be obtained even though each card in the pair was in a different actual place. These observations suggest that persons with mild and moderate aphasia can participate in some cognitively challenging and abstract experiences via video-chat format.
Finally, we wanted to know if providing CILT via video-chat resulted in outcomes similar to those reported for face-to-face intervention. We used three outcome measures to determine if the clients made substantial and clinically significant improvements: (a) changes in performance on the WAB aphasia quotient, (b) number of propositions produced on the Cinderella story retelling, and (c) blinded clinical judgments of the “goodness” of the Cinderella retelling. Substantial changes needed to be demonstrated in at least two of the three measures. We ascertained that four of the seven clients (57%) made substantial and clinically significant improvements in their verbal language production. We used the same criteria to assess the improvement of the participants with aphasia reported by Maher et al. (2006), whose methods we replicated. Their participants took part in face-to-face administration of CILT. Three of their four clients with aphasia made clinically significant changes in their aphasia quotient scores, but when the other two measures are considered, the overall improvement was seen in half of their subjects. So, it appears that the results we obtained via telepractice were similar to what would be expected from face-to-face administration of CILT.

Case Study 3: Severe Aphasia

Our third experience with distance treatment involved working with a 72-year-old man with global aphasia and dense right-sided hemiparesis. He came to the Center about 1 year after suffering a left hemisphere cerebrovascular accident to explore treatment options to improve his communication. At that time, his attempts to communicate largely consisted of unintelligible jargon. Both he and his wife were frustrated by their limited communicative interactions. He lived about 1 hour from the Center and was dependent on others for transportation, so we suggested trying telerehabilitation. We were not sure if a person with such significant linguistic impairment would be a candidate for using technology to interact with a clinician. Therefore, we initiated a trial period of treatment. The trial was successful and he completed the semester of treatment. He subsequently participated in another semester of treatment via telerehabilitation.

The treatment was delivered via the videocalling feature of Skype and laptop computers embedded with real-time cameras and microphones. Treatment sessions were 1 hour per week, and no technical difficulties of note were encountered throughout either semester, perhaps because of the limited length of the sessions. His wife responded to the initial call from the clinician to begin the session. Once the session began, she was available to manipulate stimulus material as needed. Other than that, she did not participate directly in treatment.

The goals for treatment were to decrease his jargon during structured sessions, to increase his interaction with his environment as a precursor to using augmentative and alternative communication, and to establish a reliable yes/no response. The first tasks were developed to facilitate his pointing response to objects placed in front of him. His wife assisted in placing and removing pairs of personal objects for him to attend. Without this assistance, it would have been difficult, if not impossible, to work on this task. The client required cues to suppress his jargon during these pointing tasks, which consisted of the hierarchy: a finger to the lips, verbal cue to “listen,” and a combination of finger gesture and the verbal cue. Delivery of these cues via telerehabilitation was successful. At the beginning of treatment, 40% of his pointing responses were accompanied by jargon. At the end of treatment, he produced jargon only 15% of the time he was engaged in a structured task, without any cuing.

One challenge during treatment was directing the client’s attention to the objects in front of him to which he was required to point. Most likely, it would have been easier to sit across the table from him and gesture to the objects as we say, “Show me your pocket knife.” However, using verbal cues and gestures via telepractice was successful in the long run. Goals may have been achieved earlier in face-to-face interactions for this task, but that is unknown. We do know that without the telepractice, he most likely would not have participated in treatment at all.
After a pointing response was established with minimum concurrent jargon, we expanded the stimulus materials to pictures of objects and eventually developed a simple communication book with pictures of food items, favorite restaurants, and places for outings. The pictures were sent to his wife by e-mail attachment and she put them into a booklet format.

Lastly, we explored the best modality for responding to personally relevant yes/no questions. A thumbs-up/thumbs-down gesture was determined to be the easiest for him to produce and the most reliable. Treatment sessions then focused on increasing that reliability. Telepractice sessions seemed suited for this goal. There were no materials to manipulate or attend to. The client listened to the yes/no questions, responded with the thumbs-up/down gesture, and was given feedback about the correctness of his response. If he did not respond, the clinician modeled the correct response, which the client imitated. Once again, jargon had to be suppressed and was successfully done so with the hierarchy of cues used during the pointing task. This client had no reliable yes/no responses at the beginning of treatment. By the end of treatment, the reliability of his yes/no responses to personally relevant questions was 88% and to simple but more abstract questions was 86%. His baseline performance was at or below chance level.

Based on the treatment outcomes for this client, it seems that telerehabilitation can be successfully used with persons with severe linguistic and communication challenges. With minimal assistance, our client was able to fully participate in these distance treatment sessions with functional communication improvements.

**Lessons Learned**

Overall, our experiences with telepractice have been very positive and have taught us a few lessons. We offer the following summary of our experiences to assist others as they explore the provision of telepractice.

**Technology Lessons**

- There is a variety of free video-chat services that seem to be appropriate for telerehabilitation. We used Gmail video call, Skype, and ooVoo, all with equivalent positive usability.
- The video and audio signals generated respectively with embedded camera and microphone/speakers in both Apple and PCs were adequate for most treatment tasks.
- If we targeted speech production using telepractice again, we would pay more attention to the visual image perceived by the client. We would explore changes in lighting, distances from the camera, and camera position.
- Ending calls that are longer than 90 minutes and then calling back will probably prevent technical degradation of signals.
- When conducting telerehabilitation, be aware of the time-lag between transmission and reception of the signal. Ours was about 3 seconds. Time cues and comments with this lag time in mind.
- Minor technical difficulties often resolved fairly quickly without troubleshooting. We think that these intermittent problems might actually be therapeutically beneficial by providing some real-life challenges to communication.

**Client Lessons**

- Clients were much more adaptable and agreeable to changes during sessions than we anticipated.
• All the clients with mild to moderate aphasia were able to easily and quickly launch the video-chat format. They rarely needed assistance at home with technical problems or treatment tasks.

• Telerehabilitation is a potentially appropriate treatment delivery system for persons with severe aphasia and should be considered when it fills a need for access to services or intensity of treatment.

• Telerehabilitation had the unexpected benefit of fostering interpersonal connections between dyads of participants. Some of these connections continued after the treatment was discontinued.

• Given the recent publication of ASHA’s professional issues statement regarding telepractice, in the future we would pay more attention to client privacy and security issues.

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