Delivering the Lee Silverman Voice Treatment (LSVT) by web camera: A feasibility study

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Abstract

Background: Speech disorders are a feature of Parkinson's disease, typically worsening as the disease progresses. The Lee Silverman Voice Treatment (LSVT) was developed to address these difficulties. It targets vocal loudness as a means of increasing vocal effort and improving co-ordination across the subsystems of speech.

Aims: Currently LSVT is not widely available, and there are practical difficulties associated with the delivery of an intensive treatment in an environment of resource constraints in the NHS. Delivery of LSVT over the Web may address some of these difficulties.

Method: We report a feasibility study in which three individuals with speech disorders resulting from Parkinson's disease received LSVT over the Internet, using broadband connection and a web camera. Participants were seen face to face for every fourth session in order to build a personal relationship, measure vocal sound pressure level (SPL) during treatment and to review and prepare homework tasks. All other sessions were delivered over the Internet.

Results: Broadly similar treatment gains were found between individuals treated over the Internet and those treated face to face (Ramig et al, 2001a). Gains were maintained or improved at an assessment 2 months after the treatment.

Conclusion: This feasibility study demonstrates that delivery of LSVT over the Internet may be both cost and treatment effective, and that a larger trial would be appropriate.

What this Paper adds. The Lee Silverman Voice Therapy (LSVT) was developed to improve the communication of people with dysarthric speech as a result of Parkinson's disease. Although there is evidence for its effectiveness, the intensive nature of the treatment presents difficulties for clinicians and clients. This paper presents a feasibility study of the delivery of LSVT over the Internet. The results for three participants are comparable with those obtained with face-to-face delivery. We conclude that a larger study of the delivery of LSVT over the Internet would be appropriate.

Key Words: Parkinson's disease, Dysarthria, Lee Silverman Voice Treatment, Internet therapy delivery.

Hypokinetic dysarthria is a common feature of Parkinson's disease. Logemann et al (1978) report that the majority of patients with Parkinson's disease will present with speech problems at some stage of the disease. Duffy (2005) describes the features of hypokinetic dysarthria. At the perceptual level these include a weak, breathy, hoarse or harsh vocal quality, reduced loudness, a variable rate of speech including inappropriate silences and a reduction or absence of facial expression. Ho et al (1998) found that voice was the most frequently affected speech characteristic in a large sample of patients. Reduced volume is a common characteristic of parkinsonian voice (Fox and Ramig, 1997; Ho et al 1999). Physiological changes include irregular vocal fold activity, vocal fold bowing and increased rigidity and reduced speed and range of the laryngeal musculature (Smith et al., 1995).

These features may vary because of the progressive nature of the disease. Schulz and Grant (2000) state that depression, cognitive decline and medication may also contribute to this variability but they observe no clear relationship between duration and the severity of the dysarthria. Goberman and Coelho (2002) in their review of the speech changes associated with medication, and Pinto et al (2004), observe that pharmacological and neurosurgical treatments improve tremor, dyskinesia and muscle rigidity but have uncertain effects on speech.

Commonly patients with Parkinson's disease underestimate their problems (Ho et al, 2000; Yorkston et al, 2004) and are often reluctant to raise their voices to improve intelligibility, believing that they are speaking too loudly (Fox et al, 2002; Liotti et al, 2003). This suggests that the voice disorder may be compounded by an impaired perception of its true severity. In a study of how voice and speech changes affect communication, Miller et al (2006) found difficulties initiating and maintaining a conversation, including formulating thoughts and maintaining attention. They also state that feelings of exclusion from the reactions and behaviours of others can reduce confidence and self esteem.

Until recently there was little evidence that speech and language intervention was effective for individuals with Parkinson's disease. This, the progressive nature of the disease and a failure to generalize gains made in treatment were reflected in low referral rates. Mutch et al (1986) found that 65% of patients reported speech problems but only 4.4% had been referred for speech therapy. In a survey in Sweden, Hartelius and Svensson (1994) found that 70% reported impairment to their speech but only 3% had received speech therapy.

When offered, therapy typically targeted respiratory function to improve support for speech, treatment for phonation to improve vocal intensity, articulatory drills to improve precision and reduce rate, and prosodic therapies to improve the use of stress and intonation (see Yorkston et al 1988). Therapeutic devices used to improve intelligibility included amplification devices, delayed auditory feedback, biofeedback and masking devices (Greene and Watson 1968; Downie et al, 1988). Treatment intensity appears to be important. Robertson and Thompson (1984) noted improvements after two weeks of intensive group therapy, which were maintained twelve weeks later. Johnson and Pring (1990) reported gains following ten hours of therapy delivered over four weeks but longer-term benefits were not assessed.

Recently stronger evidence has been reported by researchers using the Lee Silverman Voice Treatment (LSVT) (Fox et al, 2006). Drawing on techniques from motor speech and voice disorders, LSVT addresses the needs of individuals with Parkinson's disease by focusing on vocal loudness as a means to increase vocal effort and improve co-ordination across the subsystems of speech. Treatment uses speech tasks to target phonation and to improve the quiet, monotonous speech resulting from decreased drive to the respiratory and laryngeal musculature (Fox et al, 2002). Improved efficiency of the phonatory source improves vocal fold adduction and laryngeal muscle function and so increases respiratory support for speech (Dromey et al, 1995; Smith et al 1995).

LSVT simultaneously addresses the sensory characteristics of Parkinson's disease evident in difficulties transferring gains from the clinic environment into everyday life. This is achieved through a combination of intensity of treatment and feedback to develop the association between increased vocal effort and improved speech intelligibility (Kleinow et al 2001). Studies show LSVT to be more effective than respiratory-only therapies in improving loudness and pitch variation and at maintaining these changes two years later (Ramig et al 1995, 2001b). In a study comparing sound pressure levels in treated and untreated groups (Ramig et al, 2001a), the latter improved by 5.5 dB after treatment and by 3.7 dB 6 months later on a task where they spoke freely on a chosen topic ('monologue' task). The clinical significance of this result may be gauged by the finding of a difference of 2.9 dB between the treated group and age matched healthy controls before treatment.

Improvements have also been found in articulation, prosody, vocal quality and intelligibility (Dromey et al, 1995; Ramig et al, 1995, 1996, 2001a, 2001b; Countryman et al, 1997; Baumgartner et al, 2001; Sapir et al 2007). This evidence is based on a treatment delivery for four days a week across four weeks, supplemented by additional home practice. The rationale is that individuals can compensate for deficits through a programme of high effort and intense training to enable a re-scaling of the effort required to produce an adequate level of loudness (Ramig et al 1995). Further, evidence suggests that LSVT does not adversely affect voice quality or induce vocal strain (Smith et al. 1995; Ramig et al, 1996; Baumgartner et al, 2001).

In the UK, the National Institute for Health and Clinical Excellence (NICE) and the National Collaborating Centre for Chronic Conditions (2006) comment that evidence for LSVT is good but based on small samples. Studies with well defined inclusion criteria, uniform assessment tasks and outcome measures are required. The NICE guidelines also express concerns about the delivery of an intensive therapy requiring sixteen hours of treatment across four weeks in the current climate of resource constraints within the NHS. Issues include clinician time (with regard to those working across multiple geographical sites or on part-time contracts), transportation availability and cost, and client convenience and motivation.

This problem of resource constraints has suggested alternative models of delivery. A study of an extended programme of delivery (2 days per week for 8 weeks) yielded mixed results (Spielman et al, 2007). Increases in vocal sound pressure levels were comparable to previous studies but barriers to implementation were noted. The present paper takes an alternative approach. An intensive regime (4 sessions a week) is used by returning to the more intensive approach but offering sessions of treatment delivered across the Internet using a web cam. Initial data on three patients are presented.

Therapy across the Internet is in its infancy and research on its effectiveness is limited. The term 'telepractice' was adopted by the American Speech-Language-Hearing Association to describe the delivery of therapy across distances (ASHA 2001). In its broadest definition 'telepractice' includes all interactions conducted via a telecommunications medium rather than face-to-face. However, the advent of Internet based technologies with their improved quality of signal and speed and potential cost savings greatly surpasses previous means of providing remote therapy. A key benefit is improved patient access to specialist services without regard for geographical boundaries, thereby both increasing patient choice and optimising the use of professional expertise (Brinegar and McGinley 1998). For those with mobility problems, electronic access may address service delivery limitations. It offers travel cost savings (for patients and professionals) and may reduce the number of cancelled appointments (ASHA 2005). In terms of the quality of the service for users, home based therapy sessions offer a familiar comfortable environment and enable professionals to treat in functional settings. For some individuals the technology can enhance their treatment, increasing interest levels and motivation (Brennan et al, 2002).

Critics have argued that effective intervention in speech and language therapy requires accurate auditory and visual information acquired through face to face interaction (Hill and Theodoros, 2002) and concerns have been raised that remote delivery may be used to reduce costs and thereby diminish standards of care (Brinegar and McGinley 1998). ASHA (2005) cites criticisms of the lack of face-to-face contact precluding the use of tools such as tactile manipulation to facilitate cueing. Maintaining eye contact may pose difficulties and treatment activities may be restricted due to the fixed positioning of the equipment (ASHA 2005).

Recent studies have examined the technological feasibility of remote therapy with a variety of clients or have compared outcomes of small samples receiving it with outcomes after face-to-face interventions (Mashima et al, 1999; Georgeadis et al, 2004; McCullough, 2001; Theodoros et al, 2003). More recently Theodoros et al (2006) investigated the feasibility and efficacy of delivering LSVT using Internet based video conferencing technology to individuals with speech problems as a result of Parkinson's disease who were situated in a different room.

ASHA (2005) summarises candidacy issues to include difficulties for patients with bilateral motor impairments, visual and hearing difficulties, sitting tolerance, linguistic/cultural issues, severe cognitive impairments and/or attention deficits influencing the ability to engage with the therapist or manage the equipment in distance interactions. ASHA also notes that the availability of third party, on-site support for the patient may also influence candidacy (ASHA 2005). Brennan et al (2002) highlight technophobia and the degree of the user's previous experience and confidence with the technology as issues and Mashima et al (2003) say that remote delivery may be more appropriate as a means of facilitating generalisation and maintenance rather than assessment and treatment.

Patient and clinician satisfaction with remote delivery is an important issue. Whilst responses in the literature have been largely positive (Georgeadis et al 2004, Mashima et al 2003, Theodoros et al 2006), ASHA (2005) say that user satisfaction must be measured separately from therapy outcomes. A possible indication of clinician satisfaction is the finding in a survey by ASHA (2002) that 9% of its members were already offering services remotely and that 47% were interested in doing so.

Despite the studies above, the efficacy of remote delivery has not been fully demonstrated. Hill and Theodoros (2002) point out that studies are of a limited number of communication disorders and that a more structured and scientific approach to study design and implementation is required to facilitate replications. Theodoros et al (2006) found Internet based delivery of LSVT to be both feasible and effective with ten individuals with Parkinson's disease, and identify the need for a larger study to validate their findings. Consistent transmission quality (audio and visual) is required to evaluate clinical outcomes and user satisfaction (Georgeadis et al 2004). Cost-benefit analyses of remote treatment are required so that efficacy is not sacrificed in the pursuit of cost cutting or faster treatment procedures.

Delivery of LSVT over the Internet may overcome difficulties posed by the need for intensive treatment in an environment of resource constraints. Using a web cam via broadband connectivity, individuals with speech problems as a result of Parkinson's disease may be treated remotely in a location of their choice

This study examines the feasibility of using a web camera to deliver LSVT and compares the outcomes with clients treated face to face by Ramig et al (2001a)

Method

Three participants with speech disorders resulting from idiopathic Parkinson's disease were recruited via referrals to the Motor Speech Disorders Clinic at City

University. Participants had to be familiar with IT applications within a Microsoft Windows desktop environment and to possess the necessary equipment within their home. The first three referrals to meet these criteria were recruited. Participation was voluntary with no payment of expenses. Participants were male, aged between 63 and 72 years and had been diagnosed between three and six years previously. The Frenchay Dysarthria Assessment (Enderby, 1983) was used to confirm a profile of voice and speech impairment consistent with mild to moderate hypokinetic dysarthria. Each had a stable medication regime.

Technology

Participants needed a computer with a 1GHz processor, 256 MB RAM and at least 50 MB of free disk space on the hard drive, with a Windows XP operating system, a broadband connection to the Internet and a web cam with headset and microphone. They required Windows Media Player on the computer, an account with Skype (a peer to peer Internet telephony network), and email contact with the clinician.

It was anticipated that differences in skill level, equipment configuration and transmission quality might influence treatment delivery. Prior to the start of treatment each participant had one or more remote practice sessions with the therapist to check that Skype had been correctly downloaded and that account details were accurate and to identify possible environmental or technical difficulties and/or skill deficits.

Treatment

Each participant completed sixteen hours of intensive therapy (as described by Ramig et al, 2001a) delivered 4 times per week for 4 weeks. One session each week was delivered face to face, in participants' homes. This was done in order to build a personal relationship, to objectively measure sound pressure levels during treatment, to review weekly homework sheets and to deliver tailored materials to support the transition of high effort in speech tasks from short phrases to longer reading and conversation tasks. Other sessions were delivered over the Internet. Clearly, the need for face to face sessions means that delivery of therapy was not fully remote; however, for convenience we will refer to our therapy as remote and contrast it with the face to face therapy assessed in Ramig et al (2001a).

Treatment was delivered to established LSVT principles by a clinician certified in LSVT (Ramig et al 1995, 1996, 2001a, 2001b). Speech drills comprising maximum duration ‘ah’ phonation, maximum fundamental frequency range and personal phrases occupy the first half of each session. Stimulated behaviours from these drills are then directly applied in speech tasks for the remainder of the session. Over the course of treatment these comprise a hierarchy of spoken, reading and conversation tasks. Daily homework tasks encourage continued intensity of effort and facilitate carryover into everyday communication.

Instrumentation

During face-to-face sessions sound pressure levels were measured using a Radio Shack digital output sound level meter placed 30cms from the participant’s mouth. It was not possible to accurately measure db SPL during web cam sessions. Approximate measures were obtained by placing the meter at a constant distance to the sound speaker, with the volume of the PC set at a constant level across each session.

Pitch was measured to monitor treatment and provide feedback using a Seiko Chromatic Tuner in both face to face and web cam sessions. Duration was measured using a stopwatch in face-to-face sessions. A digital stopwatch was downloaded for web cam sessions and operated by mouse control.

Voice recordings were made for feedback purposes. In face-to-face sessions these were made using an Olympus Digital Voice Recorder. Recordings were discussed during the session and transferred and saved to the clinician’s PC. Examples were sent to participants as email attachments to illustrate target behaviour and support home practice. During web cam sessions voice recordings were made using HotRecorder™ which allows users to record conversations during Skype calls and play and/or save recorded files.

Safeguarding privacy and confidentiality during the electronic transfer and storage of information was addressed at a number of levels. Firstly assessment took place in face to face settings prior to the treatment programme and medical information was not exchanged during therapy sessions over the Internet. Secondly information exchanged over the Skype network is encrypted, enabling a higher level of security than ISDN or conventional analogue systems (including the telephone network). Thirdly recordings made during the therapy sessions became the property of the participating individuals. Further, the management of secure network requires a computer fitted with state of the art anti spyware and anti virus software that is regularly updated.

Design

Data were collected two weeks prior to therapy, at the start and end of therapy and two months after its completion by the treating speech clinician. The assessment protocol followed that in Ramig et al (2001a) and consisted of three trials of sustained phonation “ah”, reading the ‘Rainbow Passage’ (Fairbanks 1960) and speaking freely on a self-chosen topic for one minute (monologue). Data were compared with that in Ramig et al (2001a).

Assessment: data collection and analysis

Pre and post treatment recordings were made using a PDR1000TC Portable Timecode DAT recorder with a Sony ECM-MS957 Electret Condenser Microphone placed 30cm from the mouth.   Recordings were re-digitised at a sampling rate of 48 KH using the Computerised Speech Lab (Kay Elemetrics, Kay Pentax, Model 4150) in order to be analysed.

SPL dB measurements were calculated by an examiner blind to the pre and post therapy conditions. The peak data points from each sample were used. For the sustained phonation task, the second of the three samples of the vowel “ah” was analysed. Peak decibels were also measured for reading the ‘Rainbow Passage’ and for sixty seconds of connected speech from the monologue task.

It was not possible to collect data under the same recording conditions as the comparison data (Ramig et al, 2001a). In the absence of a sound treated booth data were collected face to face in a quiet room in the participants’ homes.

Results

Table 1 gives the mean results of the 3 participants and of the 14 participants treated face to face in Ramig et al (2001a). Note that in that study there are no data for two weeks prior to therapy as reported here (Ramig et al. report only the mean value for three measures taken in the two weeks prior to therapy) and that the follow up data are from an assessment 6 months not 2 months after therapy.

Insert Table 1 about here.

The scores for the participants in this study change very little across the 2 pre-therapy assessments and are remarkably similar to the mean pre- therapy performance of the participants in Ramig et al (2001a). The improved scores post therapy are also very similar. Table 2 illustrates this by giving the difference between the scores here and in Ramig et al (2001a) in standard deviations (i.e. it treats the latter as a normative sample). This shows the pre and post therapy mean scores in the present study are within half a standard deviation of the scores Ramig at al (2001a). However, the follow up scores of remotely treated participants are considerably higher than those of patients treated face to face.

Insert Table 2 about here.

An analysis of variance on the scores of the remotely treated patients confirmed that they had made significant progress with time ($F(3, 6) = 8.50$, $p = .01$) and planned comparisons confirmed that the effect was due to the improvement in loudness between the pre and the post therapy assessments. A significant interaction between time and type of task was also found ($F(6, 12) = 4.69$, $p = .01$) indicating that the improvement with LSVT was strongest in the prolonged phonation ('ah') task.

Discussion

This feasibility study showed that individuals treated remotely with LSVT can achieve comparable gains to those treated face to face (Ramig et al, 2001a). Prior to therapy they recorded similar vocal sound pressure levels to those treated face to face. The outcomes for the three participants both as a group and as individuals were comfortably within the distribution of scores of patients treated face to face. These findings are consistent with previous clinical research for the efficacy of LSVT in treating speech and voice disorders in individuals with PD (Fox et al 2002). In particular, they may endorse the benefits of the intensive style of the treatment comprising high effort multiple task repetitions and quantification of treatment related changes to promote over learning and internalisation as prerequisites for independent generation and self monitoring of normal loudness levels (Trail et al 2005). Improvements were seen in each of the assessment tasks but were most pronounced in the sustained phonation ('ah') task. This is unsurprising in view of the fact that this task is repeatedly practiced during therapy. A similar trend is seen, but not analysed, in the data obtained by Ramig et al (2001a, see table 1), by Spielman et al (2007) and by Theodoros et al (2006).

A weakness in our design is that post therapy assessments were carried out by the treating clinician. There is evidence that Parkinson patients can increase their volume in response to implicit cues (Ho et al 1999). Although this situation is likely to occur in clinical work, it is desirable that a 'blind' assessor is used in research studies. Ramig et al (2001a) do not state whether they used a blind assessor; Spielman et al (2007) and Theodoros et al (2006) did do so. Use of blind assessors is more inconvenient when assessments are carried out in participants' homes. Although future studies should use blind assessment, it is unclear whether this will remove bias. It may be that the task itself cues the participant. The assessment is objective and gives relatively little scope for bias by the assessor. Treated participants, on the other hand will know that they are being assessed and respond accordingly. That they improve their sound pressure levels under such circumstances may be a poor indication of the volume they achieve in communication. Assessment of the latter is more difficult but more revealing as to the success of treatment.

A further weakness was that it was not possible to conduct assessments in a sound treated booth as in other experimental studies. Transporting patients to such a facility would have largely negated the attraction of receiving therapy in their own homes. This difference in procedure should be borne in mind when comparing across the studies. In defence of our procedure, we note that our loudness levels were very similar to those in Ramig et al (2002a), that the assessment conditions in our study though different from other studies were consistent across the study. The lack of a sound treated booth had no effect on the quality of the analysis and moreover, is likely to be a necessary consequence of remotely conducted LSVT.

Remote delivery may not be suitable for all candidates. Generic candidacy criteria for distance interactions has been summarised by ASHA (2005). These include literacy, hearing and visual abilities and physical endurance determining sitting tolerance. Studies of LSVT delivered face to face have indicated variables that impede successful outcomes. In addition to underlying voice or speech disorders unrelated to Parkinson's disease, these include moderate or severe dementia, depression, atypical Parkinsonism and neurosurgery for Parkinson's disease (Trail et al 2005).

Candidacy criteria for remote therapy may need further consideration. LSVT is appropriate for individuals with mild cognitive impairments in face-to-face settings. Its single treatment goal and emphasis on modelling and repetition are helpful here (Fox et al 2002). This benefit may not extend to individuals with attention and concentration deficits who may have difficulties engaging with a clinician via a monitor and small screen image. Processing speed, memory and executive function deficits may impede the ability to follow directions and to manage desktop operations. Indeed ASHA (2005) calls for candidacy to be assessed on a case-by-case basis.

Lack of the required technology excluded some candidates from participating in this study. Lack of familiarity with or experience of using it excluded others. Costs have been cited as a barrier to providing remote services. These problems are also likely to diminish with time and will be less of an obstacle to accessing treatment. Two of the three participants purchased new hardware and arranged broadband connections. The third purchased a web cam. This indicates a high level of motivation and financial commitment to the treatment that may distinguish the participants from others who could not take part. It may be noted, however, that LSVT in its face-to-face form requires commitment and that expense of travel to receive it may be a financial disincentive.

Reduced face-to-face contact is often seen as a cause of reduced standards of care in remote treatment. In this study, developing a personal relationship with the participants and their spouses/partners was essential. Participants were informally assessed in their homes at the outset of the study. This, coupled with informal calls via Skype prior to therapy, enabled the clinician to assess desktop management skills, gauge family members' responses to the arrival of video conferencing in their homes and build rapport. During the study family members would frequently come to the computer before or during a session to seek information or advice. Face to face meetings also took place at the start of each week of treatment to allow participants to become familiar with the next level of the speech exercise hierarchy prior to the remote sessions. These meetings also allowed objective measurement of loudness levels (measured in dB SPL). This was not possible during remote sessions and so reduced the feedback normally available to participants. Weekly face-to-face sessions provided a guide to change across each stage of treatment.

There are clear advantages to delivering LSVT to clients in their own homes. It is beneficial in terms of fatigue management and for those with reduced mobility. Participants are more relaxed, leading to a better rapport between clinician, client and family members. Speech exercises are practised in the target environment. Uncontrolled environmental events and interruptions occurring during sessions, at first appeared a disadvantage. In fact these gave the clinician an opportunity to see how the individual used their voice in context, and gave the individual an opportunity to reflect on the impact of loudness levels on those around them.

Fear of technology is often cited as a barrier to improving treatment accessibility. Whilst this may inhibit some individuals, observation of the participants in this study left little doubt that they saw remote treatment as convenient and a novel and motivating delivery method. Brennan et al (2002), in their study on remote treatment after stroke, also observed increased motivation and responsiveness as a result of the technology. All the participants in this study commented that daily visits to a hospital would have precluded participation in a treatment programme.

Participants received sound files containing recorded speech exercises via email. These recordings allowed them to review their performance in the sessions if desired. After treatment, participants had recordings that could serve as a model for practice. A notable feature of the results is that sound pressure levels further increased at the two-month follow up assessment. This compares with a slight decline in the follow up data in Ramig et al (2001a). Caution is needed in interpreting these data as the follow up here was conducted only two months after treatment compared with six months in Ramig et al (2001a). It is possible that the individuals treated face to face also made gains to this point before falling away by six months. A possible explanation, however, is that remote treatment has contributed to continued improvement by promoting self reliance and providing a means of reviewing current performance against the sound recordings of their performance during therapy.

During the study the quality of the audio and visual link was variable: at times the quality was excellent, at others the quality of the link was susceptible to deterioration. Upgrading the broadband connection to a uniform 8 Mb per second for all users would be one way to improve line quality. End to end audio delay was addressed by using a headset to override the audio link via the computer's loudspeakers. Optimum sound quality requires a high specification sound card and microphone, but averagely priced soundcards (such as SoundBlaster) achieved adequate sound definition during the study. The quality of the HotRecorder sound files (recorded at 32 Kb per second) was adequate. Improvements may be achieved using alternative products recording at higher bit rates and/or using enhancement tools to amplify, normalise or remove hiss.

The small number of participants in this pilot study prevents us drawing any general conclusion as to the efficacy of LSVT delivered remotely. Such a conclusion must await a larger study. Evaluation of such a study is required at both the outcome and the process levels. It must determine whether outcomes for a large sample of individuals treated over the Internet matches those of individuals treated face to face. This comparison will not be straightforward. There are patients who will benefit from LSVT but who are not suitable for remote treatment. Comparisons of face to face and remote treatment should only be carried out for patients who meet the entry criteria for treatment across the Internet. Currently these criteria are not fully defined. There were too few participants in our study to define these criteria beyond the obvious: that they had to possess the necessary equipment and to be comfortable using it. At the process level, the technological specification described requires further large scale testing to evaluate the efficiency and cost effectiveness of this method of treatment. Patient and clinician satisfaction should also be assessed to evaluate its impact on the quality of service delivery. The present study shows that some patients can benefit from treatment across the Internet and that technical problems associated with it (for both client and clinician) can be overcome. Its role has been to demonstrate that further research is appropriate.

Data from Ramig et al (2001a) 30cm dB SPL				
TASK		Pre therapy (mean of 3 pre-assessments)	Post therapy	6 month f up
Ah		69.1 (5.1)	82.4 (3.9)	79.8 (3.7)
Rainbow		71.3 (3.2)	77.9 (4.2)	76.1 (3.2)
Monologue		69.0 (3.6)	74.5 (4.3)	72.7 (3.6)
Data for remote therapy 30cm dB SPL				
TASK	Pre therapy 1	Pre therapy 2	Post therapy	2 month f up
Ah	67.3 (3.1)	67.7 (3.5)	82.0 (5.2)	85.3 (1.5)
Rainbow	70.3 (1.1)	70.0 (1.1)	77.7 (5.5)	82.3 (5.5)
Monologue	69.0 (3.6)	68.7 (3.4)	75.3 (10.2)	77.7 (8.9)

Table 1. Mean (and standard deviations) dB SPL for participants in Ramig et al (2001a) and for participants in the present study.

TASK	Pre therapy 1	Pre therapy 2	Post therapy	2 month f up
Ah	-0.35	-0.27	-0.10	1.48
Rainbow	-0.31	-0.40	-0.04	1.93
Monologue	0.0	-0.08	0.18	1.39

Table 2. Comparison of remote and face-to-face scores in standard deviations. Pre therapy 1 and 2 are compared with the pre therapy scores and the 2 month follow up with the 6 month follow up in Ramig et al (2001a).

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