Technology

In this issue:

Speech
Pathology
Australia

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From the editors

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Contents

THIS ISSUE OF THE *JOURNAL OF CLINICAL PRACTICE IN SPEECH-Language Pathology (JCPSLP)* on "Technology" reminds us of the advantages of technology. It has made health care more accessible to many people who cannot access traditional service delivery for one reason or another. Technology also gives us an avenue to objectively document and assess clients' communication and/or swallowing. The world of information technology is rapidly evolving, however, and it is important to keep abreast of these changes, particularly as there is such a reliance on the internet for information and resources nowadays.

Kerry: Although being co-editor of the *JCPSLP* has been a time-consuming task (mostly confined to the hours after tucking my children in to bed at night), I enjoyed the whole experience immensely and gained many skills. I had the pleasure of working with authors, reviewers, our editing team, the *JCPSLP* committee, and Speech Pathology Australia to produce six issues that I am extremely proud of. Being in this position exposed me to a broad range of issues in our profession, whereas in the past I would have confined my reading to a narrower set of topics.

Marleen and I proposed a number of changes to shape the direction of this clinical journal and increase its appeal to potential authors and readers. We would like to thank Speech Pathology Australia Council for being so receptive to our ideas and suggestions. We would also like to thank the reviewers who gave up their time to give detailed constructive feedback to improve each submission; this was pertinent especially for topics which Marleen and I know little about. Reviewers have an invaluable role in shaping the finished product of all submissions, ones that carry the "peer review" label and ones that do not, as all submissions are carefully appraised and edited, by (blind) reviewers and/or the editors. Finally, it has been an absolute pleasure working with my co-editor Marleen Westerveld who taught me so much about the editing process and so much more, and whom I will always look up to as a mentor.

Marleen: It is hard to believe it has been four years since I took on the position of co-editor of this journal (in October 2009 with Nicole Watts-Pappas) and I would like to finish up with a few thank-yous! Thank you to Natalie Ciccone for stepping in as guest co-editor when Kerry was on maternity leave. Thank you to our former committee members, Suze Leitão, Mary Claessen, Andrea Murray, and Julia Day; your input has been invaluable. Welcome to Elizabeth Lea, David Trembath, and Samantha Turner who recently joined the committee (see p. 160). Thank you also to all the Speech Pathology Australia members who provided written or verbal feedback at the recent Speech Pathology Australia National conference. There was overwhelming support for the journal's new name, the topic-based approach, and the publication of relatively short, clinically relevant articles. And last, but not least, thank you to Kerry, for being such a wonderful colleague these last few years. Although it will be difficult to "let go", I am confident that the journal is in good hands with incoming editors Jane McCormack and Anna O'Callaghan. I wish them all the best!

A survey of the clinical use of telehealth in speech-language pathology across Australia

Anne J. Hill and Lauren E. Miller

Anne J. Hill (top) and Lauren E. Miller

Research into the use of telehealth technology for speech-language pathology (SLP) services has been conducted for over 30 years; however, it is unknown whether this research has translated into clinical practice. A web-based survey was deployed to determine key factors around the clinical use of telehealth by Australian SLPs. Quantitative analysis revealed that clinicians are using a wide range of technology to deliver a variety of SLP services to both paediatric and adult populations. A number of benefits to using telehealth in clinical practice were identified, along with significant barriers to the expansion of telehealth in SLP. Suggested facilitators for the further development of telehealth in SLP included more professional development in the area of telehealth, demonstrations by experienced users of telehealth, and access to electronic assessment and treatment resources. Limitations of the study are discussed with directions for future research.

Telehealth is defined as the application of telecommunications technology to the delivery of professional health services at a distance by linking clinician to client, or clinician to clinician, for assessment, intervention, and/or consultation (American Speech-Language-Hearing Association [ASHA], 2005). Telehealth has been endorsed by ASHA as an appropriate and suitable service delivery model for speech-language pathology (SLP) provided that telehealth services are of the same quality as those delivered face to face (ASHA, 2005). As a service delivery model, telehealth has the capacity to overcome issues relating to access to services such as distance and immobility, as well as assisting in caseload prioritisation, allowing for intensive treatment regimes, reduced length of stay in hospital, longer term rehabilitation management, and meeting the increased demand for SLP services (ASHA, 2005).

Research into the use of telehealth delivery of SLP services has been conducted for over 30 years, increasing during the last decade due to the expansion of technology, high-speed data transmission, and rising demand for

SLP services (Hill & Theodoros, 2002; McCue, Fairman, & Pramuka, 2010). This research has explored the use of a variety of technology such as videoconferencing, telephone, videophone, email, and Skype (Mashima & Doarn, 2008; McCue et al., 2010). While the research is dominated by feasibility projects and case studies, a number of high-quality randomised control trials and robust pilot studies have produced an emergent evidence base for the use of telehealth for some services (Reynolds, Vick, & Haak, 2009). It should be acknowledged that a discrepancy is evident in the literature between paediatric and adult studies, with the majority of research being undertaken with adults (Reynolds et al., 2009). A growing body of literature supports *assessment* via telehealth, particularly for the following groups: adult dysarthria (Hill et al., 2006; Hill, Theodoros, Russell, & Ward, 2009a), adult apraxia of speech (Hill, Theodoros, Russell, & Ward, 2009b), adult aphasia (Hill, Theodoros, Russell, Ward, & Wootton, 2008), paediatric speech, language, and literacy disorders (Waite, Theodoros, Russell, & Cahill, 2010a, b), patients post-laryngectomy (Ward et al., 2009), and the assessment and review of clients using alternative and augmentative communication (Styles, 2008).

The literature around the use of telehealth in *treatment* services is less diverse. Two adult telehealth treatment programs found to be equivalent to traditional delivery modes are the Lee Silverman Voice Treatment program (LSVT® LOUD; Constantinescu et al., 2011), and the Camperdown Programs for adults who stutter (Carey et al., 2010). The use of telehealth in the treatment of paediatric fluency disorders with the Lidcombe Program has also been examined through a well-executed phased research program using telephone and postal services (Lewis, Packman, Onslow, Simpson, & Jones, 2008; Wilson, Onslow, & Lincoln, 2004). It is interesting to note a tendency for researchers to investigate the application of treatment programs that already have established efficacy in the face-to-face environment. Nevertheless, there is an urgent need to invest in high-quality telehealth research into other intervention programs if the evidence base for intervention delivered via telehealth is to become fully established.

While current research literature supports telehealth as an effective service delivery model for some SLP services, the question remains as to whether it has translated into clinical practice. A survey of the use of telehealth in SLP and audiology was conducted in the United States of America by ASHA in 2002. Of the 825 SLPs who responded, 9% reported using telehealth to deliver services; however, 47% of SLPs reported an interest in using it in the future.

The SLP respondents to ASHA's survey used telehealth primarily for counselling and follow-up services, and to a lesser degree for treatment and screening (ASHA, 2002). Telehealth was used across a range of disorders (e.g., motor speech and cognitive communication disorders) and settings (e.g., schools, client's home) (ASHA, 2002). Other key findings from the survey were the barriers to the expansion of telehealth services, which included the cost of technology and lack of professional standards (ASHA, 2002). Results of this survey prompted ASHA to provide members with information on types of technology available and endorse telehealth as a suitable service delivery model where the quality of the service is equivalent to face-to-face delivery. To date ASHA has not re-surveyed its members on their use of telehealth.

Although not specifically focusing on the clinical use of telehealth in SLP, a number of recent Australian surveys have investigated service delivery models and attitudes towards the use of technology in SLP (Department of Health and Aging [DHA], 2011; Dunkley, Pattie, Wilson, & McAllister, 2010; Zabiela, Williams, & Leitão, 2007). The earliest of these surveys canvassed SLPs in non-metropolitan areas across Australia and found that although technology was available, only 8 of the 51 respondents were using telehealth to deliver direct SLP services (Zabiela et al., 2007). These findings were attributed to a lack of training in the use of telehealth and a lack of evidence for its effectiveness (Zabiela et al., 2007). Dunkley et al.'s (2010) survey of both rural residents and SLPs in New South Wales found that clients not only had greater access to a range of technology than the SLPs expected, but also had a positive attitude towards the use of telehealth as they believed it would improve access to services that would otherwise be infrequent or unavailable. In contrast, SLPs reported less access to technology in their workplace, with some clinicians believing that current technology was not advanced enough for many client populations such as those with dysphagia and intellectual disability (Dunkley et al., 2010). The Department of Health and Aging's (DHA) eHealth readiness survey also looked at barriers to the adoption of telehealth across 15 allied health professions, including SLP. Reported barriers included a lack of appropriate funding under Medicare for allied health services, poor access to services, and a lack of relevant technology (DHA, 2011). The DHA survey indicated that education is needed if telehealth is to be embraced by practitioners and that some allied health professionals believe the barriers and cost of technology outweigh the benefits of telehealth (DHA, 2011).

Overall, the research literature points to an emergent evidence base for the use of telehealth in the provision of some SLP services, and a growing interest in alternative service delivery models in SLP. This indicates a need for specific research investigating the clinical use of telehealth in SLP practice in Australia. Therefore, the current study aimed to determine the types of technology being used in the provision of direct telehealth services by SLPs in Australia, and the client populations with whom telehealth is being used clinically, and to examine the facilitators, barriers, and benefits to the clinical use of telehealth in SLP.

Method

Ethical clearance

The study was reviewed and granted ethical clearance from the University of Queensland and from the Speech Pathology Australia (SPA) council. Gatekeeper approval was also obtained from leaders of SLP in Queensland Health.

Participants

The survey recruited practising SLPs in Australia who were using telehealth in their clinical practice. Participants were excluded if they were still completing their undergraduate study, did not use telehealth in their clinical practice, or did not fully complete the survey. The participant information sheet and consent form were at the beginning of the web survey and participants could not complete the survey until they had consented to participate by choosing "accept". Consent was provided by 91 SLPs to participate in the study; however, 36.3% of respondents (n = 33) did not fully complete the survey and were therefore excluded from the data analysis. Data analysis was conducted on 57 complete responses. The respondents were predominantly female (98.2%), Australian born (89.5%), under the age of 45 years (77.3%), and worked full-time (70.2%), with the remainder working part-time (28.1%) or in a locum position (1.8%). The number of full-time equivalent years the SLPs had been working ranged from 0.5 to 35 years with an average of 10.9 years. Responses were received from SLPs in Queensland (42.1%), New South Wales (36.8%), Victoria (15.8%), Western Australia (3.5%), and the Northern Territory (1.8%). There were no respondents from the other states or territory.

Survey

The survey was developed and implemented through SurveyMonkey® and consisted of 27 multiple choice questions, in which the respondent could select multiple responses and four open-ended questions, which related to qualifications, number of years of practice, postcode of workplace, and benefits of using telehealth in clinical practice. Participants had the option of completing the survey anonymously or providing their contact details at the end of the survey. The survey was available for 10 weeks and contained questions relating to demographics, technology used in the provision of services via telehealth, client populations with whom telehealth is used, and the facilitators, barriers, and benefits of using telehealth in clinical practice. The survey took approximately 10 minutes to complete and had to be completed in one sitting.

Procedure

Speech Pathology Australia distributed the link to the survey to all members via the association's e-newsletter. An email link was also sent through the heads of department at all universities with SLP courses across Australia and heads of SLP departments in Queensland Health and Education Queensland. Time constraints prevented more widespread distribution through public health and education facilities in other states.

Statistics

The quantitative data were analysed using frequency counts and some cross-tabulations for multiple response sets. The qualitative data were analysed by two researchers using content analysis to determine themes in the responses (Creswell, 2009).

Results

Due to length restrictions, not all of the data gathered from the survey are able to be reported here. This article will focus on the settings and technology used in telehealth, client populations with whom it is used, and users' perceptions of the benefits, barriers, and facilitators of telehealth in SLP.

Telehealth settings

The respondents reported providing telehealth services from a number of settings, including public health facilities (57.9%), private practice (22.8%), public education settings (12.3%), community service (10.5%), and specialist services (8.8%). Fewer respondents reported providing telehealth services from private education settings (5.3%), private health services (1.8%), or nursing homes (1.8%). Inspection of the postcodes supplied by respondents revealed that 14 respondents worked in metropolitan centres, while the majority of respondents (75.43%) worked in regional areas. Regional areas included relatively large centres as well as smaller towns.

Respondents reported that clients typically accessed information and communication technology (ICT) for their telehealth sessions from their home (70.2%), medical centre (21.1%), school (21.1%), or work (10.5%).

Telehealth technology

The respondents reported most commonly using the telephone, email, and videoconferencing in their provision of telehealth services (see Figure 1). Cross-tabulation of responses against postcode revealed that 23% of

metropolitan SLPs used stand-alone videoconferencing to provide telehealth services, in contrast to 60.5% of regional SLPs. Computer-based videoconferencing (excluding Skype) was used by just six respondents, five of which were regional SLPs. However, the use of Skype (video and audio) was evenly distributed across metropolitan and regional SLPs.

The majority of clinicians reported having used telehealth for fewer than six years (80.8%); however 10.5% of clinicians reported using some modes of telehealth (e.g., telephone and email) for more than 10 years. Videoconferencing was the first real-time audio-visual technology to be embraced by clinicians surveyed approximately 8 years ago, followed by customised telehealth systems and Skype at 2 and 4 years ago respectively.

Direct telehealth services

Results revealed that 40.4% of clinicians used telehealth to deliver assessment services including standardised assessment (10.5%) and informal assessment (40.4%). The majority of clinicians (86%) reported using telehealth to deliver treatment services. These services included consultations (70.2%), follow-up sessions (66.7%), family
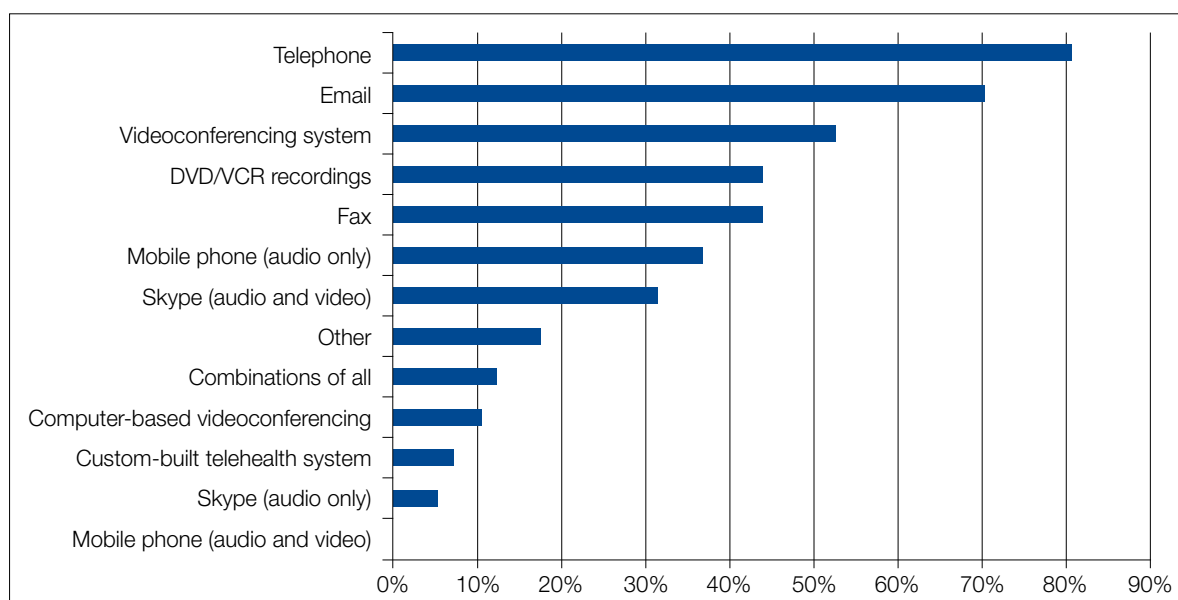
Figure 1. Technology used in the provision of SLP telehealth services
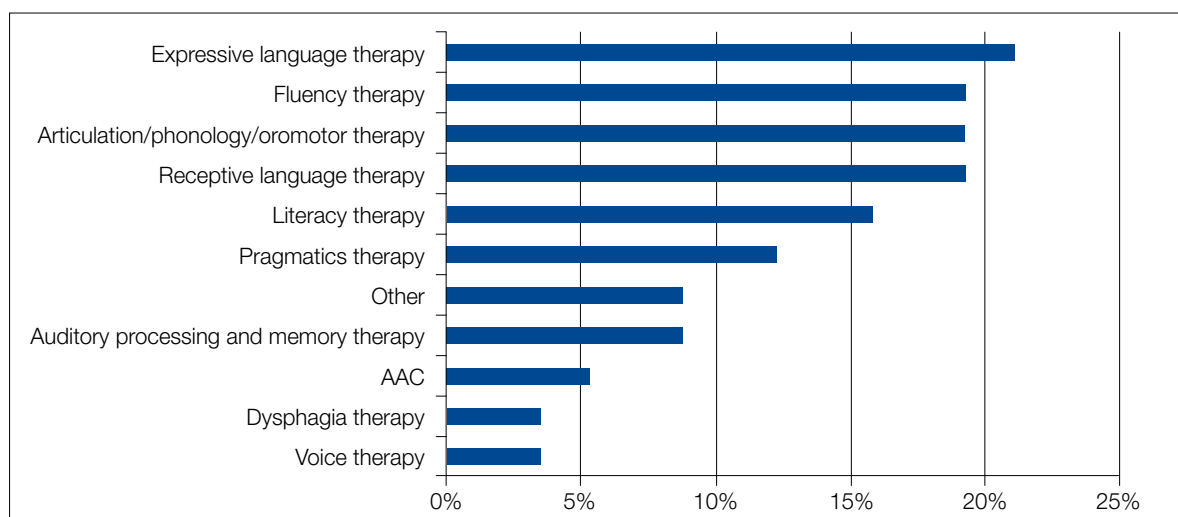
Figure 2. Types of direct therapy delivered to paediatric clients via telehealth
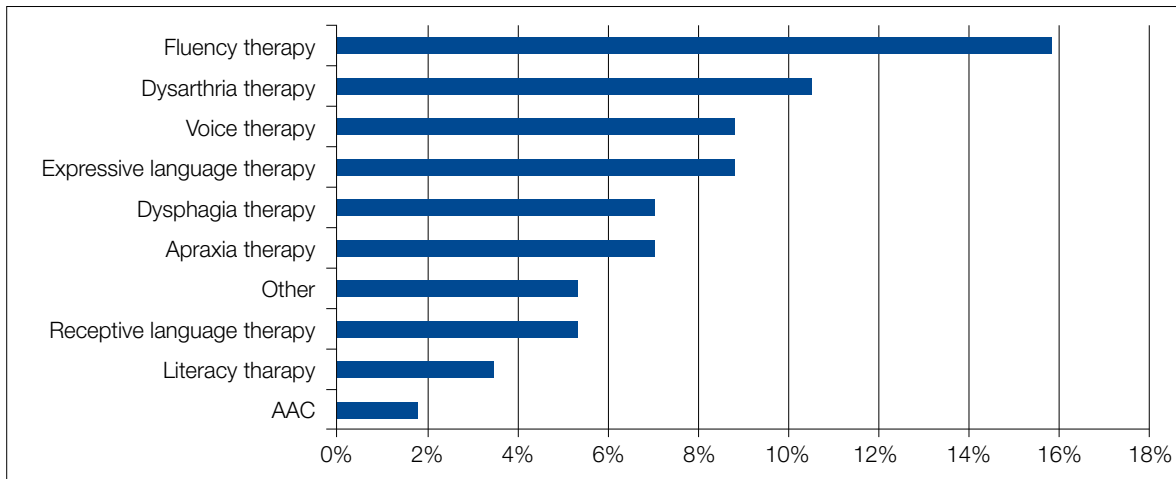
Figure 3. Types of direct therapy delivered to adult clients via telehealth

support (59.6%), direct therapy (45.6%), and teacher support (36.8%).

Client populations

The majority of respondents (73.6%) reported using telehealth with 0–30% of their caseload while a small number of clinicians (7%) reported use with 90–100% of their caseload.

Paediatric populations

The majority of respondents (78.95%) who had a paediatric or mixed caseload reported using telehealth to provide direct therapy to paediatric populations across all age groups. The types of direct therapy provided via telehealth reflected the paediatric populations most often treated (see Figure 2).

Adult populations

A smaller proportion of respondents (52.63%) reported using telehealth with a variety of adult client populations, but most commonly with those people with dysphagia, degenerative neurological disorders, or stroke. Of these respondents, 33.3% provided direct therapy to adult clients via telehealth. Figure 3 displays the types of direct therapy provided. Cross-tabulation of the type of treatment results against postcode revealed that fluency treatment via telehealth is occurring only in NSW and Victoria, while dysphagia management via telehealth is occurring only in Qld.

Benefits, barriers, and facilitators to using telehealth

Most respondents (71.9%) were confident or very confident in their use of telehealth and satisfied or very satisfied (71.9%) with the service they provided via telehealth.

Benefits

Respondents reported a wide range of benefits to using telehealth in their clinical practice. Their responses to this open ended question were analysed using content analysis (Creswell, 2009) with five major themes emerging: access, time efficiency, client focus, caseload management, and cost efficiency. Each theme contained benefits for both the client and the clinician. A sample of open responses is displayed in Table 1.

It was found that 70.2% of respondents considered telehealth to be a cost-effective service delivery option for SLP services. The majority of respondents (70.2%) reported

they would like to expand their telehealth service to provide a more regular outreach service, to include new technology such as Skype, and to broaden the client populations assessed and treated via telehealth.

Barriers

A number of barriers to the current use of telehealth in clinical practice were identified by respondents. The most commonly reported barriers were problems with technology (71.9%) and telecommunication connections (45.6%), closely followed by a lack of assessment and treatment resources suitable for telehealth (40.4% and 36.8% respectively). Difficulty accessing ICT to conduct telehealth (31.6%) and a lack of ICT support (31.6%) were also cited

Table 1. Respondents' comments on the benefits of using telehealth in clinical practice	
Benefits	**Respondent comments**
Access	Equitable access to services Easier to share materials with clients Easily access support from other clinicians The client can stay in their local area and receive appropriate treatment
Time efficiency	Time efficient for both client and clinician Reduce staff travel time Efficient for student supervision Time efficient for the client not having to travel to the clinic
Client focus	Increased intensity of treatment Increased frequency of reviews More realistic idea of client's abilities in natural environment The client takes greater responsibility for the treatment program
Caseload management	Increased client base in private practice Increased awareness of clinical issues Increased flexibility Easier to manage clients one after another, less preparation of materials, easy to organise appointments
Cost efficiency	Reduced cost Reduced travel expenses Reduced time away from work for clients Reduced cost and resources required by the family and clinician or service
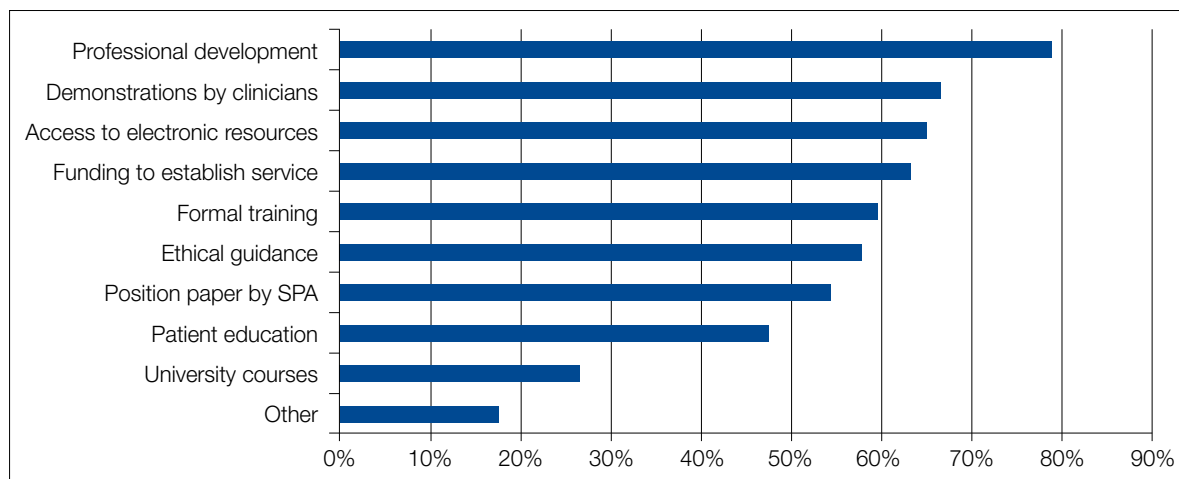
Figure 4. Suggested facilitators to the development of telehealth in SLP

as significant barriers to current use. Respondents identified similar barriers to the expansion of telehealth services in their clinical practice.

Facilitators

Respondents suggested a number of potential facilitators for the further development of telehealth as a service delivery option for SLP services (Figure 4). "Other" suggestions (17.5%) included promotion and support of telehealth and its growing evidence base in SLP, funding for allied health assistants to be based in rural outreach clinics, increased options for clients to access telehealth within the community, clinical capacity to trial new things without impacting on waiting lists, introduction of telehealth into university courses to prepare new clinicians, and education of clients about telehealth.

Discussion

The literature supports an emergent evidence base for the use of telehealth in the provision of some SLP services; however, it is unclear whether this has led to an expansion in the use of telehealth in clinical practice. The responses to the current survey provide information on the types of technology being used in clinical telehealth in SLP, as well as on the populations with whom telehealth is used. The respondents to the survey provide an insight into some of the benefits, barriers and facilitators to the use of telehealth in clinical SLP in Australia. It is important to note that the small sample size and skewed geographic distribution of the respondents place some limitations on the conclusions which can be drawn. However, despite the sample being small (n = 57), the respondents to this survey were demographically similar to the SLP population in Australia (SPA, 2005; Speech Pathologists Board of Queensland, 2010).

Telehealth settings and technology

The respondents to the current survey predominately provided telehealth services from public health services and private practice, contrasting with the findings of the ASHA survey in 2002 in which most respondents provided telehealth services from schools or non-residential health care facilities. However, both surveys reported that the majority of their clients accessed telehealth services from their home. It remains unclear what type of technology clients are using in their home.

A range of telehealth technology has been reported in the research literature with videoconferencing being the most commonly used (McCue et al., 2010). The clinicians who responded to this survey reported using the same types of technology to deliver telehealth services, although videoconferencing was the third most common form of technology used. This is in contrast to the findings of Dunkley et al. (2010) and Zabiela et al. (2007) who reported that although rural SLPs had access to videoconferencing facilities they were rarely used as an approach to service delivery. Both Dunkley et al. (2010) and Zabiela et al. (2007) attributed their findings to a lack of SLP training and confidence using the technology and lack of access to videoconferencing for clients. The increased use of videoconferencing by SLPs may reflect improvements in training in the use of the technology. Indeed, a large percentage of the respondents in this study reported they were confident or very confident using telehealth technology. The current survey reported clients accessing technology from a wider variety of locations including their home, medical centre, school, and work. There seems to be greater access to telehealth for clients than found in the previous surveys.

Client populations

The literature supports a growing evidence base for the telehealth delivery of some SLP services, with stronger evidence for its use in adult populations (Reynolds et al., 2009). Furthermore, reviews of the literature have revealed higher quality research into the use of telehealth for assessment rather than treatment services (Reynolds et al., 2009). Interestingly, the respondents to this survey reported using telehealth for the delivery of treatment services (86%) over twice as often as assessment services (40.4%), and the respondents used telehealth with paediatric clients (78.95%) more often than adult clients (52.63%). While it could be speculated that these findings suggest that some SLPs who responded to this survey have not waited for a firmly established evidence base before applying new service delivery options to their practice, it is important to remember that the types of treatment services provided via telehealth more often included consultation (70.2%), follow-up (66.7%), and support services (59.6%) than direct therapy (45.6%). In the case of paediatric treatment services this may have increased the proportion of respondents reporting use of telehealth with this population. Nevertheless, further exploration of the types of direct treatment services provided to children via telehealth is

warranted. Robust clinical research will be vital to the establishment of a strong evidence base.

With regard to providing services to adults via telehealth, fluency treatment was most often delivered, followed by dysarthria and voice therapy. These findings are in keeping with the evidence base for using telehealth in the delivery of fluency and the LSVT® LOUD treatment programs (Carey et al., 2010; Constantinescu et al., 2011). Closer analysis revealed that fluency treatment via telehealth was occurring only in NSW and Victoria, while dysphagia management via telehealth was occurring only in Qld. This may reflect clinicians' access to appropriate technology and hands-on training by the actual centres or to researchers working on establishing the telehealth evidence base for these programs (Reynolds et al., 2009). These may well be examples of the research translating into clinical practice.

Benefits, barriers, and facilitators

Respondents identified a range of benefits to using telehealth in clinical practice which were classified into five major themes; access, time efficiency, client focus, caseload management, and cost efficiency (see Table 1). These benefits have also been identified and discussed in the research literature; indeed overcoming the issue of access and promoting time efficiency are well-established drivers of telehealth (Bashshur, 1995). Additional benefits telehealth may garner include meeting the needs of house-bound clients and treatment in non-clinic environments promoting generalisation (Mashima & Doarn, 2008; McCue et al., 2010; Tindall, Huebner, Stemple, & Kleinert, 2008). Telehealth has also been promoted as enabling clinicians to cover a larger geographic area while providing more services to patients (Mashima & Doarn, 2008) and this was confirmed by the current survey. This last point is especially important in Australia as a third of the country's population lives in regional or remote areas (ABS, 2008).

Interestingly, 70.2% of survey respondents felt that telehealth is a cost-effective service delivery option despite a paucity of cost-benefit research in SLP (Mashima & Doarn, 2008; Tindall et al., 2008). True cost effectiveness requires a benefit-cost analysis to be examined within the clinical evidence base (Davalos, French, Burdick, & Simmons, 2009) and this remains an area in which more research is required. Although the respondents considered telehealth to be cost effective, they also expressed concern about the cost of technology and availability of resources. Similar barriers were identified in the ASHA survey (2002) and the eHealth readiness survey by the DHA (2011). It will be important for SLPs wanting to implement or expand their telehealth services to use this increasing body of data on barriers to lobby for change.

Respondents were generous in their suggestion of facilitators to further develop telehealth as a service delivery option. Professional development courses, demonstrations, electronic assessment and treatment resources, and funding to establish telehealth services were the most desired, closely followed by formal training and ethical guidance. The responses closely align to those reported in the surveys by Dunkley et al. (2010) and ASHA (2002). The ASHA survey (2002) also revealed that education and training in telehealth through university or professional development had facilitated the use of telehealth clinically in the United States. Furthermore, the continued rollout of the National Broadband Network and the interest government

bodies are displaying in the use of telehealth bodes well for the future of telehealth SLP services in Australia.

Limitations and future directions

This study is the first of its kind examining the clinical use of telehealth in SLP practice across Australia. The responses from the study provide insight into how telehealth is being used in clinical practice and suggests facilitators to enhance this mode of service delivery; however, a number of limitations around the design and distribution of the survey were evident. A major limitation in the survey design was the omission of a definition of telehealth at the beginning of the survey. Inclusion of an unambiguous definition would have provided respondents with a clearer understanding of the nature and purpose of the survey and would have reduced potential confusion between computer-based therapy and telehealth. The other major limitation of the survey was the exclusion of the clinicians not using telehealth. Their inclusion would have substantially enhanced the survey by providing a measure of the extent of telehealth use in SLP, in addition to valuable information on why these clinicians don't use telehealth, the barriers they have encountered, and their views on facilitators to their future use of telehealth. Other limitations of the survey design included a lack of questions regarding the types of technology used by clients to receive telehealth services and a clear delineation between direct therapy services to a client and consultation or support services around a client, particularly with regard to paediatric populations.

The authors made use of the national professional association's (Speech Pathology Australia) network for distribution of the survey which afforded potential participation by SLPs throughout Australia. However, other distribution channels were also utilised (e.g., heads of university SLP courses and leaders in Queensland Health). The bias in using mainly Queensland-based organisations may have produced a degree of bias in the results with Queensland having the highest percentage of respondents (42.1%). Furthermore, the survey was available only for 10 weeks. A longer timeframe and reminder emails may have enabled a higher response rate.

The relatively small response to the survey (n = 57) may have been due to a number of factors. The distribution and design flaws evident in the survey have almost certainly contributed; however, another explanation may be that the uptake of telehealth within SLP is still not widespread. The broader telehealth literature has found that the clinical use of telehealth is not as widespread as had been predicted (Walker & Whetton, 2002). While the barriers to using telehealth clinically as reported by the respondents may provide some insight into reasons for low uptake of telehealth, information from non-users would further clarify the factors around uptake.

In order to track the clinical use of telehealth in SLP practice, this study could be repeated every three to four years to determine if telehealth has expanded or if the aforementioned facilitators have been implemented. Future studies should address the design and distribution limitations of the current study to provide comprehensive data on the clinical use of telehealth in SLP.

Conclusion

This study was conducted to determine the clinical use of telehealth by SLPs in Australia. A wide variety of paediatric

and adult clients were reported to access SLP services via telehealth with clinicians delivering a diverse range of direct therapy. However, the results of the survey appear to show a deviation from the emergent evidence base for telehealth in SLP, with the majority of respondents using telehealth to provide clinical treatment services to paediatric populations despite a paucity of evidence in the literature. Clinicians reported high levels of confidence and satisfaction in the services they delivered via telehealth.

Respondents identified a range of benefits to using telehealth in clinical practice and expressed a strong desire to expand their telehealth services. However, significant barriers to this expansion were identified especially in relation to technology, telecommunication infrastructure, and resources. Clinicians suggested a number of facilitators for the further development of telehealth in SLP and these comments require careful consideration by the institutions responsible for the education of SLPs and the provision of SLP services to all client populations. With the Australian government showing interest in telehealth, now is the time for education and training into the telehealth delivery of SLP services so that our profession is ready to respond to new technologies, new telecommunication infrastructure, and client demands for alternative service delivery options. Telehealth will be part of the future for SLP in Australia and should be embraced to facilitate the increased access to services that clients with communication and swallowing problems require.

Acknowledgments

References

American Speech-Language-Hearing Association. (2002). *Survey report on telepractice use among audiologists and speech-language pathologists*. Retrieved from http://www.asha.org/uploadedFiles/practice/telepractice/SurveyofTelepractice.pdf

American Speech-Language-Hearing Association. (2005). *Speech-language pathologists providing clinical services via telepractice: Position statement*. Retrieved from www.asha.org/policy

Australian Bureau of Statistics (ABS). (2008). *Year book Australia 2008* (No. 90 ABS Catalogue No. 1301.0). Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/mf/1301.0

Bashshur, R. L. (1995). Telemedicine effects: Cost, quality, and access. *Journal of Medical Systems*, *19*(2), 81–91.

Carey, B., O'Brian, S., Onslow, M., Block, S., Jones, M., & Packman, A. (2010). Randomized controlled non-inferiority trial of a telehealth treatment for chronic stuttering: The camperdown program. *International Journal of Language and Communication Disorders*, *45*(1), 108–120.

Constantinescu, G. A., Theodoros, D. G., Russell, T. G., Ward, E. C., Wilson, S. J., & Wootton, R. (2011). Treating disorders speech and voice in Parkinson's disease online: A randomised controlled non-inferiority trial. *International Journal of Language and Communication Disorders*, *46*(1), 1–16.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Davalos, M. E., French, M. T., Burdick, A. E., & Simmons, S. C. (2009). Economic evaluation of telemedicine: Review of the literature and research guidelines for benefit-costs analysis. *Telemedicine and e-Health*, *15*(10), 933–948.

Department of Health and Aging (DHA). (2011). *The ehealth readiness of Australia's allied health sector* (Publications Approval Number: D0512). Retrieved from http://www.health.gov.au/internet/publications/publishing.nsf/Content/ehealth-readiness-allied-toc~app-3~Speech+pathologists

Dunkley, C., Pattie, L., Wilson, L., & McAllister, L. (2010). A comparison of rural speech-language pathologists' and residents' access to and attitudes towards the use of technology for speech-language pathology service delivery. *International Journal of Speech-Language Pathology*, *12*(4), 333–343.

Hill, A., & Theodoros, D. (2002). Research into telehealth applications in speech-language pathology. *Journal of Telemedicine and Telecare*, *8*(4), 187–196.

Hill, A. J., Theodoros, D. G., Russell, T. G., Cahill, L. M., Ward, E. C., & Clark, K. M. (2006). An internet-based telerehabilitation system for the assessment of motor speech disorders: A pilot study. *American Journal of Speech-Language Pathology*, *15*(1), 45–56.

Hill, A. J., Theodoros, D., Russell, T., & Ward, E. (2009a). The redesign and re-evaluation of an internet-based telerehabilitation system for the assessment of dysarthria in adults. *Telemedicine and e-HEALTH*, *15*(9), 840–850.

Hill, A. J., Theodoros, D., Russell, T., & Ward, E. (2009b). Using telerehabilitation to assess apraxia of speech in adults. *International Journal of Language and Communication Disorders*, *44*(5), 731–747.

Hill, A. J., Theodoros, D. G., Russell, T. G., Ward, E. C., & Wootton, R. (2008). The effects of aphasia severity on the ability to assess language disorders via telerehabilitation. *Aphasiology*, *23*(5), 627-642.

Lewis, C., Packman, A., Onslow, M., Simpson, J. M., & Jones, M. (2008). A phase II trial of telehealth delivery of the lidcombe program of early stuttering intervention. *American Journal of Speech-Language Pathology*, *17*(2), 139–149.

Mashima, P. A., & Doarn, C. R. (2008). Overview of telehealth activities in speech-language pathology. *Telemedicine and e-HEALTH*, *14*(10), 1101–1117. doi:10.1089/tmj.2008.0080

McCue, M., Fairman, A., & Pramuka, M. (2010). Enhancing quality of life through telerehabilitation. *Physical Medicine and Rehabilitation Clinics of North America*, *21*(1), 195–205.

Reynolds, A. L., Vick, J. L., & Haak, N. J. (2009). Telehealth applications in speech-language pathology: a modified narrative review. *Journal of Telemedicine and Telecare*, *15*(6), 310–316.

Speech Pathologists Board of Queensland. (2010). *Annual report 2009–10*. Retrieved from http://www.speechpathboard.qld.gov.au/publications.htm

Speech Pathology Australia (SPA). (2005). *Productivity commission health workforce study: Speech Pathology Australia response*. Retrieved from http://www.pc.gov.au/__data/assets/pdf_file/0009/10215/sub053.pdf

Styles, V. (2008). Service users' acceptability of videoconferencing as a form of service delivery. *Journal of Telemedicine and Telecare*, *14*(8), 415–420.

Tindall, L. R., Huebner, R. A., Stemple, J. C., & Kleinert, H. L. (2008). Videophone-delivered voice therapy: A comparative analysis of outcomes to traditional delivery for adults with Parkinson's disease. *Telemedicine and e-HEALTH*, *14*(10), 1070–1077.

Waite, M. C., Theodoros, D. G., Russell, T. G., & Cahill, L. M. (2010a). Assessment of children's literacy via an internet-based telehealth system. *Telemedicine and e-HEALTH*, *16*(5), 564–575.

Waite, M. C., Theodoros, D. G., Russell, T. G., & Cahill, L. M. (2010b). Internet-based telehealth assessment of language using the CELF-4. *Language, Speech and Hearing Services in Schools*, *41*, 445–458.

Walker, J., & Whetton, S. (2002). The diffusion of innovation: Factors influencing the uptake of telehealth. *Journal of Telemedicine and Telecare*, *8*(S3), 73–75.

Ward, E., Crombie, J., Trickey, M., Hill, A., Theodoros, D., & Russell, T. (2009). Assessment of communication and swallowing post-laryngectomy: A telerehabilitation trial. *Journal of Telemedicine and Telecare*, *15*(5), 232–237.

Wilson, L., Onslow, M., & Lincoln, M. (2004). Telehealth adaptation of the lidcombe program of early stuttering intervention: Five case studies. *American Journal of Speech-Language Pathology*, *13*(1), 81–93.

Zabiela, C., Williams, C., & Leitão, S. (2007). Service delivery in rural, remote and regional speech pathology. *Acquiring Knowledge in Speech, Language and Hearing*, *9*(2), 39–47.

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Stand-alone Internet speech restructuring treatment for adults who stutter

A pilot study

Shane Erickson, Susan Block, Ross Menzies, Mark Onslow, Sue O'Brian, and Ann Packman

Shane Erickson (top), Susan Block (centre) and Ross Menzies

This Phase I pilot study assessed the viability of a clinician-free Internet presentation of speech restructuring treatment for chronic stuttering. Two participants reduced their percentage of stuttered syllables by 59% and 61% respectively from pre-treatment to immediately following completion of the program. Additionally, self-reported stuttering severity and situation avoidance were also reduced. These results were attained with optimal clinical efficiency, without any clinician contact, after 6 weeks for one participant and 4 weeks for another. Participants did not incur costs such as clinic fees, travel, or time away from work for clinic attendance. We conclude that further development of this stand-alone Internet treatment and clinical trialling is warranted.

Stuttering is a developmental speech disorder that usually begins when children are 3 or 4 years old. It is common for those affected to not fulfil their educational and occupational potential (Klein & Hood, 2004). Stuttering is associated with considerable personal financial cost (Blumgart, Tran, & Craig, 2010), and poses obvious economic problems for society. Social anxiety is common among those who stutter with social phobia reported for up to 60% of clinical cohorts (Blumgart et al., 2010; Iverach et al., 2009a), with those cohorts also at risk for anxiety related mood and personality disorders (Iverach et al., 2009b).

Considerable progress has been made with treatment methods for chronic stuttering, with reviews of replicated clinical trials favouring speech-restructuring procedures (Bothe, Davidow, Bramlett, Franic, & Ingham, 2006; Onslow, Jones, O'Brian, Menzies, & Packman, 2008). Speech restructuring refers to the use of a new speech pattern to reduce or eliminate stuttering while aiming to sound as natural as possible (Onslow & Menzies, 2010).

Clinical trials have demonstrated the efficacy of the Camperdown Program, a speech restructuring treatment (O'Brian, Cream, Onslow, & Packman, 2001; O'Brian, Onslow, Cream, & Packman, 2003). This program utilises an exemplar to model Prolonged Speech (PS) (and no direct instruction in how to re-produce the speech pattern), as well as the removal of strict programmed schedules (O'Brian et al., 2001). The essential features of the Camperdown Program make it suitable to be adapted to models not requiring direct face-to-face contact between clinician and client. This was demonstrated in recent research investigating a telehealth version in which participants received treatment via the telephone (Carey et al., 2010; O'Brian, Packman, & Onslow, 2008). Telehealth delivery particularly benefits those clients isolated from speech pathology services for geographical reasons – in Australia, this is around one-third of clients (Wilson, Lincoln, & Onslow, 2002). Rural areas in Australia have low population density and large distances between urban settlements making adequate provision of health services difficult.

Even in metropolitan areas difficulties accessing stuttering treatment still exist because of the demands that traditional treatment programs place on clinics and clinicians. Lifestyle factors also present a barrier for metropolitan-based clients seeking treatment. In addition to clinic fees for treatment, direct and indirect costs are significant and often overlooked. These may include direct expenses such as transportation and indirect costs including time off work for clients and family members and childcare costs. Such costs may make treatment prohibitively expensive.

Despite a reduced demand for resources compared with traditional delivery models, there are still some limitations with telehealth delivered stuttering treatments. First, telehealth delivery requires specialist training and second, a considerable amount of clinician time is still required (Carey et al., 2010). Therefore, even though client travel time is reduced, some indirect costs including client time away from work remain.

Internet-based treatment may present a solution to these problems by overcoming clinical infrastructure, travel, and logistical issues for clinic administrators, clinicians, and clients. Several Internet-based treatments are now well established in other areas of health care, for example, the "MoodGYM" site (MoodGYM, n.d.) provides cognitive behaviour therapy (CBT) for depression. A recent randomised controlled trial found that this Internet program was a feasible and powerful intervention (Christensen, Griffiths, & Jorm, 2004). "Fearfighter" is another computer-based CBT program for the treatment of phobias and panic attacks (Marks et al., 2003). It has been shown to be efficacious for more than 700 patients (Hayward, MacGregor Peck, & Wilkes, 2007). While such programs

have mostly shown similar outcomes to comparable in-clinic services (Kenwright, Liness, & Marks, 2001), it should be noted that long-term follow-up of participants in these trials has been absent and drops outs have been a considerable problem. Additionally, Internet-based treatments raise significant ethical issues such as how to assess the appropriateness of clients for this delivery method and whether clients are monitored for their response to treatment.

Because of the prominence of social anxiety among those who stutter, and hence the possibility of social avoidance, the Internet would have the additional advantage of allowing treatment to be accessed with anonymity (Tate & Zabinski, 2004). Clinical trials of the stand-alone "CBTpsych.com" site for social anxiety in adults who stutter have shown encouraging compliance rates and effect sizes (Helgadóttir, Menzies, Onslow, Packman, & O'Brian, 2011).

In consideration of the aforementioned potential benefits Internet-based treatment could offer, including increased access to treatment and a potential reduction in costs and resources, the aim of the current study was to develop and trial an Internet-based, clinician-free modified Camperdown Program. This pilot study was designed to assess the viability and safety of the program. A positive outcome for a preliminary trial would justify continued development of such a delivery model for adult stuttering treatment.

Method

Participants

Participants were two stuttering adults who had sought treatment at the La Trobe University Communication Clinic in Melbourne, Australia. Participant 1 was a male 22-year-old full-time university student who worked part-time as a hospital ward clerk. Participant 2 was a 30-year-old female with secondary school education who worked part-time as a masseuse. Neither participant had received speech restructuring treatment previously. Participant 1 had received stuttering treatment focusing on reading as a child while Participant 2 had completed tongue exercises, singing, reading, and rate control more than 10 years previously.

Procedure

The participants were invited to participate during an initial clinic assessment. After this session no personal contact was made with either participant. The participants received hard copies of the questionnaires outlined below during the initial assessment and returned these via mail prior to commencing treatment. Post-treatment questionnaires were sent to the participants and returned via mail after the completion of their speech measures.

Immediately after pre-treatment measures were taken, the participants were emailed a link to the treatment website and login details. Emergency contact details of a technical person involved in the construction of the website, but not familiar with the aims of the study, were provided at the beginning of the program in case of technical problems.

Primary outcome measure

The primary outcome measure was percentage of syllables stuttered (%SS). At each assessment point, during the week prior to starting the program, and immediately after completion of the final phase of the program, two randomly scheduled 10-minute telephone conversations were recorded for each participant. Research assistants who

were unknown to the participants, made one "routine" call and one "challenging" call. Routine calls allowed the participant to discuss self-initiated topics. Challenging calls involved controversial topics and comprised a predetermined number of interruptions and disagreements. Participants were unaware of when the calls would be made and that challenges would be included. Calls were made to the participants' mobile phones. Participants were permitted to decline a call, for example, if it interrupted work, but the subsequent call was not re-scheduled for a specific time.

All eight audio recordings (two recordings at each assessment for each participant) were de-identified and presented in random order to a speech pathologist specialising in stuttering treatment but independent of the study. As well as being blind to the identity of the participant, the speech pathologist was unaware of the assessment from which the sample was obtained. Measures of %SS were made using an EasyRater button-press counting and timing device. To establish intra-rater reliability, all recordings were re-presented to the observer on a second occasion in random order. To establish inter-rater reliability, all recordings were presented blind to another experienced rater not associated with the study and unaware of its purpose, who measured %SS with the same button-press counting and timing device. The second rater was also unaware of the identity of the participants and the assessments from which their samples came.

Secondary outcome measures

Severity ratings. Participants provided self-ratings of their stuttering severity in eight common speaking situations using a written questionnaire before and after treatment. These were talking with a family member, a familiar person, an authority figure, a group, a stranger, talking by telephone, when ordering food, and providing name and address details. The participants were asked to rate their "typical severity" for each situation using a scale of 1–9 where 1 = *no stuttering*, 2 = *extremely mild stuttering*, and 9 = *extremely severe stuttering*. Typical was defined as the score which would have been given for around 75% of speaking time in each situation.

Avoidance. Participants also reported their avoidance of these speaking situations, before and after treatment on the aforementioned questionnaire. Participants were asked to record their level of avoidance of these situations by circling either *never*, *sometimes*, or *usually* for each situation.

Impact of stuttering. Impact was measured before and after treatment using the Overall Assessment of the Speaker's Experience of Stuttering (OASES). This 100-item scale has previously been established as a valid and reliable method of establishing the overall impact of stuttering (Yaruss & Quesal, 2006). Multiple aspects of the condition are scored on a Likert scale and the total scale takes approximately 20 minutes to complete. The OASES contains four sections: (a) general information, (b) reactions to stuttering, (c) communication in daily situations, and (d) quality of life. An overall impact score is calculated based on scores from all subscales.

Reliability

Given the small number of recordings, analysis of agreement was considered more informative than correlation analysis. For intra-rater agreement, all ratings of the two observations (eight recordings) differed by less than 1.0 %SS. Regarding the inter-rater agreement, 75% of

Mark Onslow (top), Sue O'Brian (centre) and Ann Packman

ratings (6 recordings) differed by less than 1.0 %SS and 100% differed by less than 2.0 %SS.

The Internet program

The program adopts the primary methods of the Camperdown Program (O'Brian et al., 2008). These are (a) an operationalised video model for teaching the speech restructuring pattern, (b) no programmed instruction to instate natural-sounding stutter-free speech, (c) no formal transfer tasks to assist generalisation of stutter-free speech, and (d) a 9-point severity rating scale to replace %SS measures and a 9-point naturalness rating scale to evaluate speech quality. As this trial aimed to test only the feasibility of the program to reduce stuttering, participants did not complete the maintenance stage.

A linked administration website was developed as a database for storage of participant responses. Researchers were able to locate the time and date of a participant's use of the program and determine their current stage of treatment. Additionally, responses to the program's interactive questions were able to be stored and reviewed by the researchers. These questions related mainly to the participants' understanding of treatment concepts.

The program consists of nine phases and begins by presenting background information and the requirements of the program. Participants require a recording device with sufficient memory to record 10 minutes of conversation. The participants are informed that phases of treatment will only become unlocked once they have completed the goals for the previous phase. However, they can always return to past phases if more practice at that level is required. At the start of every phase, participants are informed of the anticipated time required to complete the phase.

Phase 1

Participants identify five speaking situations representative of their daily life and assign and graph a *typical* and *worst* severity score for each. Typical is defined as around 75% of speaking time in the situation and worst as the most severe level that occurred. The participants are required to begin assigning a severity score to at least one of the five situations each day. The site provides audio examples of stuttered speech and corresponding severity scores (as judged by expert consensus) to guide participants with scoring.

Phase 2

Participants are provided with the Camperdown speech-restructuring model along with instructions to imitate the speech pattern without stuttering. They are required to read in unison with the model, record each attempt and then judge, during playback, whether the imitation closely approximated the model.

Phase 3

When participants are satisfied that they can imitate the model in unison with the recorded exemplar, they are required to practise reading it aloud without the recording. These attempts are recorded and reviewed for accuracy and fluency. The target is to achieve three consecutive attempts to criteria of speech naturalness 9 and stuttering severity 1. In other words, the goal is to produce highly unnatural sounding speech with no stuttering. If participants have difficulty imitating the target speech pattern or are unable to use it to stop stuttering, they are required to repeat the above sequence of tasks, recruiting help from a friend or family member, if needed, to explore differences between the model and their attempted imitations.

Phase 4

Participants make a series of 1–2 minute recordings of self-generated monologues at naturalness 9 and severity 1. As in the previous phase, participants are asked to evaluate and compare their recordings with the exemplar. Participants are required to complete three recordings of 1–2 minutes using their new speech pattern to remain stutter free.

Phase 5

Participants are required to complete three consecutive self-generated 3-minute monologues and then three consecutive 10-minute monologues at naturalness 9 and severity 1. Participants are asked to reflect on any changes to the daily severity ratings made for their nominated five representative speaking situations. In this phase, the site suggests that participants regularly practise using their new speech pattern by completing subsequent monologues at naturalness 9 and severity 1. It is suggested that participants enlist a "speech buddy" to help with practice or continue to self-evaluate using recordings.

Phase 6

The site introduces participants to the concept of improving speech naturalness using the speech pattern, and how to measure changes with the naturalness scale. Example recordings of stutter-free speech produced at different naturalness levels from 1 to 9 (as judged by expert consensus) are presented. Participants complete a quiz to identify the naturalness of speech examples at different levels.

Phase 7

The site provides a video tutorial which explains (a) the Camperdown Program procedure for instating natural-sounding stutter-free speech using speech cycles (practice, trial and evaluation), and (b) the performance-contingent protocol for progression through the cycles (see O'Brian, Cream, Onslow, & Packman, 2001). Participants are required to produce at least six consecutive cycles with severity 1–2 and naturalness 1–3 practising alone, as well as at least six cycles talking with a friend or family member. Links are provided to assist participants with a range of clinical problems typically encountered such as sounding less natural than intended or conversely stuttering when trying to improve naturalness. In the event of repeated failure to attain program criteria, the site provides possible reasons for this and strategies for solving the problem during the next cycle attempt.

Phase 8

During this phase participants are required to make speech recordings and self-reports of their severity and naturalness in representative, everyday situations. Participants use the five speaking situations nominated during Phase 1, ranking them in order from easiest to hardest based on their average daily severity scores since starting treatment. Participants are encouraged to make a series of 10-minute conversations with a goal of maintaining a naturalness of 1–3 and a severity of 1–2. Participants start with their easiest situation and progress to more difficult situations as they meet progression criteria.

Phase 9

This maintenance phase has been built into the Internet site using the standard Camperdown Program format. However, participants did not complete this phase because this trial was intended only to establish the viability and possibility of a treatment effect using the program. Nonetheless, the

importance of maintenance cannot be understated and future users will be encouraged to make regular recordings of their speech in everyday speaking situations and evaluate them for naturalness and severity. Users will be able to record results from these attempts on the Internet site and graph their progress. Additionally, the site will provide prompts to encourage problem solving should they not achieve a naturalness of 1–3 and severity of 1–2 in each recording.

Results

Clinical progress

Participant 1 completed the program in just over 6 weeks, logging in 26 times. Participant 2 completed the program in 4 weeks and logged in 35 times. The specific number of

treatment hours could not be accurately determined because it was unclear how much time during each login the participants spent doing the treatment. For example, the participants may have logged in and left the computer unattended. Neither participant contacted the researchers for technical support.

Per cent syllables stuttered

Figure 1 presents %SS scores for each beyond clinic telephone call pre-treatment and post-treatment. Marked improvements were noted for both participants in each of the assessment calls after treatment. Participant 1 recorded a 61% reduction in stuttering frequency for the routine call and a 57% reduction for the challenging call. Participant 2 recorded a 79% reduction in stuttering frequency for the routine call and a 42% reduction for the challenging call.

Severity ratings

The mean self-reported typical stuttering severity in the eight situations for Participant 1 (Figure 2) pre-treatment was 7.0 (range 3–9) and post-treatment was 5.1 (range 1–7). For Participant 2 (Figure 3) the mean severity rating was 6.0 (range 6–6) before treatment and 1.4 (range 1–2) after treatment. Participant 1 reported an improvement in seven of the eight situations. Interestingly, the only speaking situation with no improvement was the telephone (where the speech measure was obtained). Further, Participant 1 reported only small improvements when speaking to a stranger. Participant 2 reported a large improvement for each of the speaking situations, with typically no stuttering (severity 1) in five of the eight situations and very mild stuttering (severity 2) in the other three situations (group, stranger, authority).
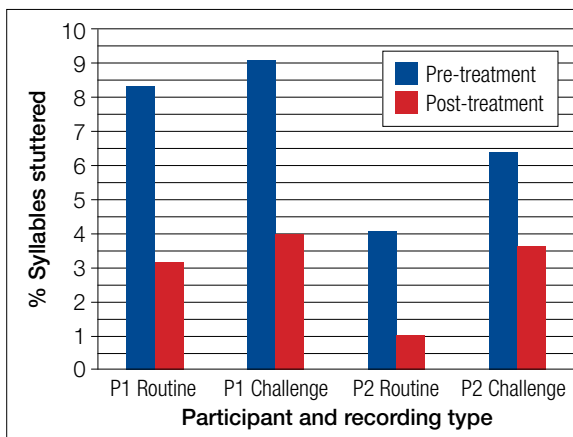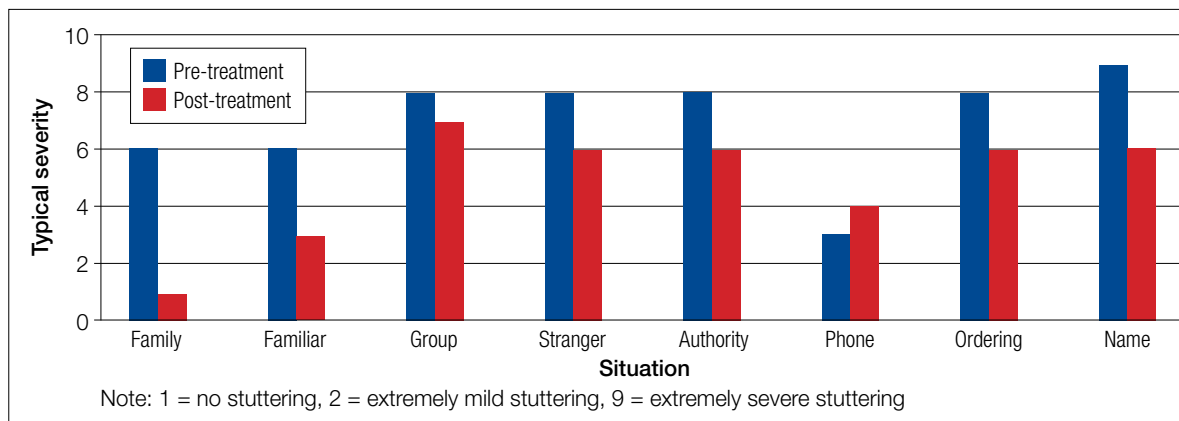

Figure 1. Primary speech outcome – %SS
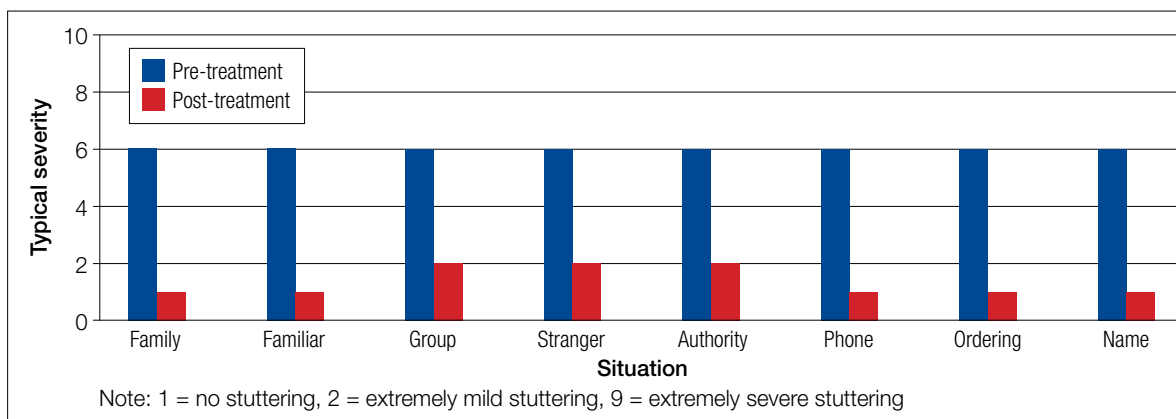

Figure 2. Participant 1 – Self-report

Figure 3. Participant 2 – Self-report

Avoidance

After treatment, Participant 1 reported never avoiding three situations that he previously avoided *sometimes* or *usually* (family, familiar person, group). Two further situations (ordering food and providing name and address) reduced from *usually* avoided to *sometimes* avoided. The remaining three situations were unchanged. Participant 2 reported that after treatment she *never* avoided three situations she previously avoided *sometimes* (phone, ordering food, and providing name and address). Additionally, after treatment the "group" situation was avoided *sometimes* after previously avoiding it *usually*. The remaining four situations were unchanged; however, two (family and familiar people) were previously *never* avoided and two (stranger and authority) were *sometimes* avoided.

Impact of stuttering

After treatment, both participants improved their scores in each of the four sections assessing the impact of stuttering as well as the "overall" OASES scale. Participant 1's "overall" impact was reduced from a *severe* level (77) to a *moderately severe* level (62), and Participant 2 from a *moderate* level (58) to a *mild-moderate* level (34). Participant 1 recorded the largest impact reduction post-treatment in the "communication in daily situations" section (from 74 *severe* to 54 *moderate*) while Participant 2 recorded the largest reductions in "quality of life" (57 *moderate* to 25 *mild*) and "reactions to stuttering" (75 *severe* to 38 *mild-moderate*).

Discussion

This pilot study assessed the viability of a stand-alone Internet speech restructuring program for the reduction of stuttering with two participants. It is the first published investigation of Internet-delivered treatment for adults who stutter. Positive outcomes suggest the program is manageable and has the potential to reduce stuttering without any clinician input.

Stuttering reduction was confirmed with both objective and self-report data. The two participants reduced their stuttering by an average of 59% and 61% respectively from pre-treatment to post-treatment. Despite the obvious advantages this program provides, the stuttering reductions are not as substantial as previously reported Camperdown Program variants in a similar phase of research. For example, the 10 participants who completed O'Brian et al.'s (2008) pilot study using telehealth delivery reduced their stuttering by an average of 82%. However, it should be noted that there was considerable individual variation, with 3 of the 10 participants reducing their stuttering by less than 80%. Additionally, O'Brian et al.'s (2003) clinician-delivered Camperdown Program yielded a mean 95% reduction immediately after treatment.

Participant reports of typical severity during everyday speaking situations in this trial were consistent with the objective data. Similarly, both participants reported considerable reduction in avoidance of specific speaking situations post-treatment. This is an important finding in light of the social anxiety that is typical for many stuttering adults (Iverach et al., 2009a). Furthermore, the treatment improved quality of life measures for both participants, albeit to a small degree. Therefore, while both participants were still stuttering mildly after treatment, it appears the program yielded further positive effects beyond reducing surface stuttering behaviours.

Clinical implications

These results were attained with optimal clinical efficiency, without any clinician contact. Participants had the convenience and flexibility of accessing a treatment without visiting a clinic, thereby eliminating costs associated with clinic fees, travel, and time away from work. The program also allowed the participants to complete the program at their own pace. One participant required 6 weeks to complete the treatment and another required 4 weeks. This suggests that the Internet-based treatment was sufficient to motivate these participants. Further research could establish the number of hours required to complete treatment.

Clearly this clinician-free delivery will not be suitable for all clients and it is not the intention of this development to aim for this. Some clients will prefer and/or need the continued input of a clinician; however, it may also be that clients can use a combination of Internet delivery and clinician input. A more refined version of the program also will be useful for generalist clinicians who may have limited experience or limited skills treating adults who stutter. For these clinicians, the program also may act as a guide for treatment.

Limitations and future research

The limitations of this pilot study are clear but should be acknowledged. The paper presents the results of just two participants and provides only descriptive analysis of their results. Generalisations beyond these two participants cannot be made. Additionally, this study does not report long-term follow-up data. However, given it is essentially a proof of concept study the primary aim was to establish the feasibility of the program. The findings suggest that further development of this Internet-based program may make treatment available to many adult stuttering clients who have access to the Internet but who, for geographic and other reasons, are isolated from treatment services.

Future research could also address issues beyond the scope of this preliminary study. For example, larger scale trials may be able to identify particular client characteristics that predict success. Additionally, ethical issues should be considered such as responsibility for clients who don't respond to treatment, deciding how clients access the treatment (i.e. open access or only via a speech pathologist) and whether safeguards are needed to ensure that only adults access the program.

During the course of this trial we discovered many potential improvements to the program, and plan further development and refinement. Some of these improvements include improved website design for better client interactivity and increased database monitoring of client use of the program. Judging by the process of development and refinement of a stand-alone site for cognitive behaviour therapy for stuttering clients (Helgadóttir et al., 2011), such pursuits may be productive. In principle, there is no reason why continued development and clinical trialling of this treatment method should not produce outcomes comparable to the in-clinic or telehealth delivered Camperdown Program.

References

Blumgart, E., Tran, Y., & Craig, A. (2010). Social anxiety disorder in adults who stutter. *Depression and Anxiety*, *27*, 687-92.

Bothe, A. K., Davidow, J. H., Bramlett, R. E., Franic, D. M., & Ingham R. J. (2006). Stuttering treatment research 1970–2005: II. Systematic review incorporating trial quality

assessment of pharmacological approaches. *American Journal of Speech-Language Pathology*, 15, 342–52.

Carey, B., O'Brian, S., Onslow, M., Block, S., Jones, M., & Packman, A. (2010). Randomised controlled non-inferiority trial of a telehealth treatment for chronic stuttering: The Camperdown Program. *International Journal of Language and Communication Disorders*, 45, 108–120.

Christensen, H., Griffiths, K. M., & Jorm A. F. (2004). Delivering interventions for depression by using the internet: randomised controlled trial. *British Medical Journal*, 328(7434), 265–270.

Hayward, L., MacGregor, A. D., Peck, D. F., & Wilkes, P. (2007). The feasibility and effectiveness of computer-guided CBT (FearFighter) in a rural area. *Behavioural and Cognitive Psychotherapy*, 35, 409–419.

Helgadóttir, F. D., Menzies, R., Onslow, M., Packman, A., & O'Brian, S. (2011). Innovative standalone CBT Internet social anxiety treatment: A Phase II trial with stuttering. *Manuscript submitted for publication*.

Iverach, L., Jones, M., O'Brian, S., Block, S., Lincoln, M., Harrison, E., … Onslow, M. (2009a). Screening for personality disorders among adults seeking speech treatment for stuttering. *Journal of Fluency Disorders*, 34, 173–186.

Iverach, L., O'Brian, S., Jones, M., Block, S., Lincoln, M., Harrison, E., … Onslow, M. (2009b). Prevalence of anxiety disorders among adults seeking speech therapy for stuttering. *Journal of Anxiety Disorders*, 2, 928–934.

Kenwright, M., Liness, S., & Marks, I. (2001). Reducing demands on clinicians by offering computer-aided self-help for phobia/panic: Feasibility study. *British Journal of Psychiatry*, 179(5), 456–459.

Klein, J. F., & Hood S. B. (2004). The impact of stuttering on employment opportunities and job performance. *Journal of Fluency Disorders*, 29, 255–273.

Marks, I. M., Mataix-Cols, D., Kenwright, M., Cameron, R., Hirsch, S., & Gega, L. (2003). Pragmatic evaluation of computer-aided self-help for anxiety and depression. *British Journal of Psychiatry*, 183(1), 57–65.

MoodGYM. (n.d). The MoodGYM training program mark III. Retrieved from http://moodgym.anu.edu.au/welcome

O'Brian, S., Cream, A., Onslow, M., & Packman, A. (2001). A replicable, non-programmed, instrument-free method for the control of stuttering with prolonged speech: Paper presented at the 2nd Asia Pacific Conference on Speech, Language and Hearing, Part IV. *Asia Pacific Journal of Speech, Language and Hearing*, 6, 91–96.

O'Brian, S., Onslow, M., Cream, A., & Packman, A. (2003). The Camperdown Program: Outcomes of a new prolonged-speech treatment model. *Journal of Speech, Language, and Hearing Research*, 46(4), 933–946.

O'Brian, S., Packman, A., & Onslow, M. (2008). Telehealth delivery of the Camperdown Program for adults who stutter: A Phase I Trial. *Journal of Speech, Language and Hearing Research*, 51, 184–95.

Onslow, M., Jones, M., O'Brian, S., Menzies, R., & Packman, A. (2008). Defining, identifying, and evaluating clinical trials of stuttering treatments: A tutorial for clinicians. *American Journal of Speech-Language Pathology*, 17, 401–415.

Onslow, M., & Menzies, R. (2010). *Speech restructuring*. Accepted entry in www.commonlanguagepsychotherapy.org/fileadmin/user_upload/Accepted_procedures/speechrestr.pdf

Tate, D. F., & Zabinski, M. F. (2004). Computer and Internet applications for psychological treatment: Update for clinicians. *Journal of Clinical Psychology*, 60(2), 209–220.

Wilson, L., Lincoln, M., & Onslow, M. (2002). Availability, access, and quality of care: Inequities in rural speech pathology services and a model for redress. *International Journal of Speech-Language Pathology*, 4, 9–22.

Yaruss, J. S., & Quesal, R. W. (2006). Overall Assessment of the Speaker's Experience of Stuttering (OASES): Documenting multiple outcomes in stuttering treatment. *Journal of Fluency Disorders*, 31, 90–115.

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What's the evidence?

Use of telerehabilitation to provide specialist dysphagia services

Elizabeth C. Ward and Clare Burns

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Elizabeth C. Ward (top) and Clare Burns

In this edition of "What's the evidence?" the scenario explores the challenge of providing specialist rehabilitation services for a rural patient on their return home from a metropolitan centre following head and neck (H&N) cancer management. Within Queensland, two hospitals located in the capital city provide the majority of the state-wide specialist care services for patients with H&N cancers. Hence many non-metropolitan patients are required to travel significant distances to access these specialist services during and post treatment. As part of their role, the specialist clinicians at the metropolitan centres provide outreach and clinical support to non-metropolitan clinicians who support the patients on their return home. This scenario explores the potential of using telerehabilitation as a service delivery model for a patient located outside the metropolitan centre. It also highlights the use of telehealth to provide mentoring and support for the local clinician.

Clinical scenario

Mr Jones (58) manages a large cattle property in western Queensland. He presented to his general practitioner with a 4-month history of dysphagia, weight loss, and odynophagia (pain on swallowing). He was subsequently referred to the combined head and neck (H&N) clinic of a large metropolitan hospital (1,400 km away) for specialist services where he was diagnosed with a tumour of the left pyriform fossa with nodal involvement (T2 N1 SCC) and underwent chemoradiotherapy.

On completion of treatment Mr Jones continues to experience moderate dysphagia. A modified barium swallow (MBS) assessment establishes he is safe for small amounts of puree diet and moderately thick fluids; however, he requires nasogastric tube (NGT) feeds to meet his hydration and nutritional requirements. Due to financial difficulties and work commitments he is desperate to go home and the team support this, providing adequate speech pathology follow-up can be arranged. Mr Jones requires intensive swallowing intervention to enable transition to full oral intake and removal of the NGT. You are aware that the speech pathologist working in Mr Jones' local health service is a recent graduate who has no clinical experience in managing patients with H&N cancer. You contact her and she expresses concern with independent management of this case and requests support. In your role as the specialist clinician in the metropolitan cancer service, you provide mentoring and clinical support to colleagues within your cancer service district. Support is typically provided via email and telephone. However, given (a) the severity of Mr Jones' dysphagia, and (b) the novice clinician's request for mentoring, you feel that more direct assistance with his ongoing rehabilitation is needed. To help address these issues, you consider the possibility of a specialist consultation service via telerehabilitation to provide some shared clinical sessions with this patient and his local clinician on his return home.

Response to this scenario

Addressing the difficulties encountered by patients accessing health care demands the adoption of different modes of service delivery (Bashshur, 1997; Yellowlees & Brooks, 1999). Telehealth, the delivery of health care services using technology, is one mode of health care service delivery that allows patients to access specialist services by alleviating the barriers of distance, immobility, travel time, and cost (Kuo, Delvecchio, Babayan, & Preminger, 2001; Mun & Turner, 1999). Furthermore, it has been suggested that this mode has the potential to help clinicians optimise the timing, intensity, and sequencing of therapy services to help facilitate patient outcomes (Winters & Winters, 2004). This case scenario provides an opportunity to explore telehealth/telerehabilitation services and address questions including: "Is telerehabilitation suitable for this patient?", "Do I have access to technology to provide the service?", and then "What's the evidence?"

Recent guidelines note that "the candidacy and appropriateness for telerehabilitation should be determined on a case by case basis with selections firmly based on clinical judgement, client's informed choice and professional standards of care" (Brennan et al., 2011, p. 664). You consider your patient and his situation, his pressing need for ongoing swallowing rehabilitation, his age and motivation, and the concerns of the remote new graduate clinician and determine that there are multiple factors favouring the use of telerehabilitation. You then consider the issue of equipment availability. You are aware there is general videoconferencing as well as specialist technology available in your metropolitan hospital setting. You contact the local coordinating service and establish that there is

videoconferencing equipment (with standard single fixed adjustable zoom camera) available to use and that similar equipment is available at the regional setting.

With the answers to your initial questions largely positive, you now seek the evidence for providing telerehabilitation. You need evidence for two reasons. First, you need evidence to justify this alternate mode of service delivery to your line manager. Second, you are seeking information from the literature to inform how best to deliver the service.

Developing an answerable clinical question

You begin by using the PICO framework to develop your clinical question (Sackett, Richardson, Rosenberg, & Haynes, 1997). This involves considering the Patient or Problem, the Intervention, any Comparison intervention, and specific Outcomes you are seeking (Asking a good Question PICO: http://www.usc.edu/hsc/ebnet/ebframe/PICO.htm). Studies have found a trend for higher percentages of relevant citations found when searching using PICO formatted questions (Schardt, Adams, Owens, Keitz, & Fontelo, 2007).

Patient or problem

Your actual specific "patient/problem" group is H&N patients with dysphagia following chemoradiotherapy. However, you are aware that telerehabilitation is a relatively new area of service delivery for speech pathology and the chances of finding data on this particular subset of patients are remote. Hence you feel it is more beneficial to further widen your "patient/problem" group to patients with dysphagia to ensure you access all relevant literature, then narrow this down further to the H&N clinical subgroup if evidence is available.

Intervention

In this situation, you are not necessarily examining an intervention but rather a model of care, hence your "intervention" in this case is telerehabilitation. In this emerging field of technology, many terms are used to describe the provision of health services through a remote manner. Although telerehabilitation is the specific term used to deliver rehabilitation services via technology, not all studies use this term. For instance in policy documents of the American Speech Hearing Association (ASHA) the term "telepractice" is the adopted terminology (Brown, 2011). As such, it will be important to search all main terms used in this field such as: telehealth, telemedicine, telepractice, telecare, and telerehabilitation.

Comparison intervention

The comparison intervention is traditional face-to-face (FTF) practice.

Outcomes

The standard for evaluating a tele-service is to ensure that the quality of the services delivered via this modality are comparable with those delivered via traditional FTF services (American Speech-Language-Hearing Association, 2005). Hence, the outcome you are seeking in your evidence search is whether or not dysphagia services can be delivered via telerehabilitation, and to standards comparable to traditional clinical practice.

Clinical question

In light of the considerations above, your clinical question for this scenario is "Can telerehabilitation be used to provide management services for an individual with dysphagia following chemoradiotherapy?"

Searching for the evidence

You don't have access to database searches via your office desktop so the hospital librarian assists you to run searches through PubMed, CINAHL, PsychINFO, the Cochrane library, and SpeechBITE™. In your search terms you use * to truncate terms, – e.g., *swallow** (note: some databases use $ instead of * to truncate words eg., *swallow*$) – to indicate to the search engine to find words with those first letter strings (e.g., *swallow*, *swallows*, *swallowing*). When you try using *tele** to cover all possible telehealth terms you find over 600 hits with the majority not relevant due to unrelated words, e.g., *telephone*. Hence you proceed using all telehealth terms you know linked by *or* (NHMRC, 2000). Your final search term looks like this: (*dysphagia OR swallow**) AND (*telecare OR telemedicine OR telehealth OR telerehabilitation OR telepractice*). You limit you search to English papers only.

Your searching provides the following results: PubMed = 17, CINAHL = 9, PsychINFO = 4, Cochrane = 0, and SpeechBITE™ = 0. After removing duplicates, erroneous hits, and excluding papers determined as unsuitable, you find you have a list of 13 possible papers. On return to your office you run a final search in Google Scholar from your work desktop using the advanced search builder. This produces 589 hits. All 13 papers found in the databases were located on the first few pages of Google Scholar search, and a further 7 possible articles were located. A further 10 pages (at 10 hits per page) were scanned. When no further new scientific literature was identified the search was terminated.

After reading the 20 publications you found, 7 were subsequently excluded as they either (a) were general discussion papers, (b) covered aspects of telehealth practice other than speech pathology, (c) discussed the use of technology for remote assessments for other scientific purposes, not telerehabilitation, (d) did not involve adult patients, or (e) neither the publication source nor year of publication could be verified (Internet document). This left 6 general review papers and 7 scientific papers. Cross searching of the reference lists of these papers revealed one further paper for consideration. As the review papers were general discussions of the literature, were not systematic reviews, and contained all articles you had found, these were ultimately excluded, bringing your total set of papers for review to 8. Of these, there were 3 papers specifically related to studies using telehealth to assess and manage H&N cancer populations. A further 5 papers were specific to swallowing management via telehealth for other clinical populations; however, only 3 of these were relevant. The others related to the equipment (Perlman & Witthawaskul, 2002) and then the application of remote MBS assessments of swallowing (Malandraki, McCollough, He, McWeeney, & Perlman, 2011). As performing remote MBS is beyond the nature of the service you are considering right now, these 2 papers were not included in your review . Table 1 lists the 6 papers relevant to this review.

Using the NHMRC matrix for evaluating a body of evidence (NHMRC, 2009) you classify the body of evidence in Table 1 in relation to your clinical question as follows: Evidence base – good; Consistency – good; Clinical impact – satisfactory; Generalisability – satisfactory; and Applicability – good. Furthermore, your overall decision

Table 1. Key research articles identified

Author (date)	Nature of telerehabilitation consultation	Clinical population	Evaluation	Outcome	Level of evidence*
Lalor et al. (2000)	Assessment of language and swallowing via satellite connection	Single case post CVA	Case discussion and review of problems and solutions faced during assessment	Concluded it was possible to determine the nature and extent of the swallowing and language problems despite the challenges	IV
Myers (2005)	Case descriptions (n = 3) of providing (a) speech and psychological support, (b) support and therapy for voice and swallowing issues, and (c) voice prosthesis management via videoconferencing	2 total laryngectomy and 1 chemoradiotherapy patients	Limited case discussion of management provided via telerehabilitation for 3 cases	Concluded utility for telehealth in the management of patient with H&N cancer is promising	IV
Sharma et al. (2011)	Performed CSE using a customised videoconferencing system with additional capabilities (store and forward; free standing zoom capable web camera, lapel microphone) and including modifications incorporated into the CSE protocol to assist online assessment	10 standardised patients portraying 2 each of normal, mild, moderate, and severe dysphagia	Levels of agreement between diagnostic decisions from simultaneous FTF and online assessments	High levels of agreement found between online and FTF decisions across all aspects of the clinical swallow assessment: general orientation, alertness, and posture; oromotor and laryngeal assessment; and decisions and recommendations	III-2
Ward et al. (2007)	Assessment of alaryngeal speech and swallowing via a system providing videoconferencing and additional capabilities (store and forward)	20 laryngectomy patients	Compared diagnostic decisions from simultaneous FTF and online assessments of communication, swallowing, and stoma status	Found acceptable levels of agreement between online and FTF ratings for oromotor, speech, and swallowing clinical decisions, but issues with limited vision from fixed webcameras. Clinicians reported reduced satisfaction. Patient satisfaction was high	III-2
Ward et al. (2009)	Assessment of alaryngeal speech and swallowing using custom built telerehabilitation units providing real-time videoconferencing with additional capabilities (store and forward; additional free standing zoom capable webcameras)	10 laryngectomy patients	Compared diagnostic decisions from simultaneous FTF and online assessments of communication, swallowing, and stoma status	With new system modifications since the Ward et al. (2007) paper this study found acceptable levels of agreement between online and FTF ratings for oromotor, speech, swallowing, and stoma status. Clinicians and patients reported high satisfaction	III-2
Ward et al. (2012)	Performed CSE using the customised videoconferencing system with additional capabilities plus the CSE modifications as detailed in Sharma et al. (2011)	40 patients from inpatient and outpatient caseload	Levels of agreement between diagnostic decisions from simultaneous FTF and online assessments	Clinically acceptable levels of agreement found between online and FTF decisions across: oral, oromotor, and laryngeal function; food and fluid trials; aspiration risk; and clinical management decisions	III-2

Note: * NHMRC (2009); FTF = face-to-face; CSE = clinical swallow examination; CVA = cerebrovascular accident

regarding the Grade of Recommendation (NHMRC, 2009) is a "C" meaning "Body of evidence provides some support for recommendation but care should be taken in its application", largely because there is evidence for assessment but only very weak evidence for rehabilitation. Equally, the evidence base is still small, with limited numbers and patient diversity to date.

One of the primary concerns of your line manager is the relative safety of managing dysphagia via the telehealth modality, so you decide to critique in more detail the paper presenting the strongest evidence. The paper by Ward, Sharma, Burns, Theodoros, and Russell (2012) has the largest cohort studied; it includes patients with actual aspiration risk; and you note that 45% of the cohort came

from cancer care patients. Although it is an assessment paper not research evidence for rehabilitation, the ability to assess and detect aspiration risk when dealing with a patient remotely is a primary safety issue addressed by this paper. Your critique is detailed in Table 2.

Clinical bottom line

There is currently Level III-2 evidence to support the assessment of dysphagia and weak Level IV evidence for the provision of ongoing dysphagia rehabilitation via telerehabilitation. Hence there is some positive evidence to support the use of telerehabilitation for this client, though you acknowledge that this recommendation is only at NHMRC level "C" – meaning that this recommendation

Table 2. Critically appraised article	
Article purpose	Establishing the validity of conducting clinical dysphagia assessments for patients with normal to mild cognitive impairment via telerehabilitation
Citation	Ward, E. C., Sharma, S., Burns, C., Theodoros, D., & Russell, T. (2012). Validity of conducting clinical dysphagia assessments for patients with normal to mild cognitive impairment via telerehabilitation. *Dysphagia*. doi: 10.1007/s00455-011-9390-9
Design	Non-inferiority cohort study
Level of evidence	NHMRC Level III-2 (for diagnostic studies)*
Quality of evidence	Only 14% of the 47 items in the "Recommended reporting elements" of the extended Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist[1] were not reported (40% not applicable). Average non-reporting rates across 60 published cohort studies has been found to be 23.6%[1]
Participants	40 participants with mild (28%), moderate (55%), moderate-severe (7%), and severe (10%) dysphagia from inpatient and outpatient caseload of a large metropolitan hospital. Aetiology: 55% acquired or progressive neurological conditions and 45% cancer care patients. Patients with greater than mild cognitive impairment were excluded.
Experimental group	Telerehabilitation assessment of a clinical swallow assessment. Assessments conducted simultaneously by an online clinician and a FTF clinician (located in the room with the participant). Specific system modifications and modifications to the clinical swallow exam were detailed.
Results	Levels of agreement between the diagnostic decisions made online and FTF reached clinically acceptable levels of agreement (criteria: 80% exact agreement and/or Kappa >0.6): agreement for the oral, oro-motor, and laryngeal function tasks ranged from 75%–100% (Kappa 0.36–1.0); ratings of food and fluid trials ranged from 79%–100% (Kappas 0.61–1.0); and parameters related to aspiration risk and clinical management had exact agreement ratings between 79% and 100% (Kappas 0.49–1.0). High clinician ratings for: overall satisfaction, ease of use, ability to competently assess the patient, ability to generate rapport, and audio and visual quality.
Summary	When using the described purpose-built telerehabilitation system with the described modifications to the CSE and the use of an assistant at the patient end, there is comparable clinical accuracy between diagnostic decisions on the CSE made online and FTF in patients with normal to mild cognitive impairments. Further research is needed to assess accuracy using other types of technology to perform dysphagia assessments and the use of these systems with more clinically diverse patient populations.
Clinical bottom line	Performing a CSE via telerehabilitation can achieve comparable clinical decisions to those made in the FTF clinical environment for individuals with normal to mild cognitive impairment.

Note: FTF = face-to-face; CSE = clinical swallow examination
* Classification for diagnostic studies, NHMRC, 2009
[1] Poorolajal, Cheraghi, Irani, & Rezaeian (2011)

"must be applied carefully to individual and organisational circumstances and should be interpreted with care" (NHMRC, 2009, p. 8).

Technology concerns

From your review you realise that although many elements, such as the appropriate connection bandwidth, and use of modified utensils and throat markers during dysphagia assessments (see Ward et al., 2012) can be easily implemented in your own sessions, most research has used more advanced technology systems than are available to you. In particular, you can see the limitation of not having components such as store-and-forward capabilities (Ward et al., 2007; Ward et al., 2009; Ward et al., 2012), which record the session and allow playback for later clinical decision-making, or free-standing cameras with lighting for better oral cavity visualisation. However, you reflect that you do have a speech pathologist in the room with the patient who is simultaneously assessing the patient and can assist with clarification and verification of any missed information.

Managing remote instrumental swallowing assessment

Your primary concern is the rehabilitation of safe swallowing for this client. While the evidence supports the use of telerehabilitation for conducting clinical swallowing assessments, for ongoing rehabilitation you will want access to instrumental assessment data. Although there is preliminary evidence to support the use of technology to administer and evaluate a MBS assessment (Perlman & Witthawaskul, 2002; Malandraki et al., 2011), unfortunately the rural service to which the patient is returning does not have MBS facilities. Although you can commence treatment based on the instrumental study performed at the metropolitan hospital prior to your client being discharged home, it is acknowledged that it may be necessary in the future for the client to return to the metropolitan setting for further instrumental review.

Patient perceptions of this mode of service

In your readings you noted that studies report positive patient perceptions regarding receiving speech pathology services via telerehabilitation. This gives you further confidence to try this mode of service delivery. In particular, the positive patient satisfaction data reported by Ward et al. (2007) and Ward et al. (2009) for laryngectomy patients following a telerehabilitation assessment of their communication and swallowing has most relevance to your current client. You do acknowledge that this data was based on perceptions of a single assessment session only, so you plan to monitor your client's perceptions and concerns closely over the course of the sessions.

Conclusion

Although there is only weak evidence for the use of telehealth for dysphagia rehabilitation, the overall results of the review, and the evidence supporting telehealth

assessments support a trial of this service delivery model to manage dysphagia in this clinical scenario. You decide to progress with the delivery of dysphagia rehabilitation services via telerehabilitation, maintaining regular monitoring of patient status and patient and clinician satisfaction throughout.

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References

American Speech-Language-Hearing Association (2005). *Speech-language pathologists providing clinical services via telepractice: Position statement*. Available from www.asha.org/telepractice.htm

Bashshur, R. L. (1997). Telemedicine and the health care system. In R. L. Bashshur, J. H. Sanders, & G. W. Shannon (Eds.), *Telemedicine: Theory and practice* (pp. 265–290). Springfield, IL: Charles C Thomas.

Brennan, D. M., Tindall, L., Theodoros, D., Brown, J., Campbell, M., Christiana, D., … Lee A. (2011). A blueprint for telerehabilitation guidelines – October 2010. *Telemedicine and e-Health*, *17*(8), 662–665.

Brown, J. (2011). ASHA and the evolution of telepractice. *Perspectives on Telepractice*, *1*(1), 4–9.

Kuo, R. L., Delvecchio, F. C., Babayan, R. K., & Preminger, G. M. (2001). Telemedicine: Recent developments and future applications. *Journal of Endourology*, *15*(1), 63–66.

Lalor, E., Brown, M., & Cranfield, E. (2000). Telemedicine: Its role in speech and language management for rural and remote patients. *ACQuiring Knowledge in Speech, Language and Hearing*, *2*(2), 54–55.

Malandraki, G. A., McCullough, G., He, X., McWeeny, E., & Perlman, A. L. (2011). Teledynamic evaluation of oropharyngeal swallowing. *Journal of Speech Language and Hearing Research*, *54*(6), 1497–1505. doi: 1092-4388_2011_10-0284.

Mun, S. K., & Turner, J. W. (1999). Telemedicine: Emerging e-medicine. *Annual Review of Biomedical Engineering*, *1*, 589–610.

Myers, C. (2005). Telehealth applications in head and neck oncology. *Journal of Speech-Language Pathology & Audiology*, *29*(3), 125–129.

National Health and Medical Research Council (NHMRC). (2000). *How to review the evidence: Systematic identification and review of the scientific literature*. Canberra: Author.

National Health and Medical Research Council (NHMRC). (2009). *NHMRC levels of evidence and grades for recommendations for developers of guidelines*. Canberra: Author.

Perlman, A. L., & Witthawaskul, W. (2002). Real-time remote telefluoroscopic assessment of patients with dysphagia. *Dysphagia*, *17*(2), 162–167. doi: 10.1007/s00455-001-0116-2

Poorolajal, J., Cheraghi, Z., Irani, A. D., & Rezaeian, S. (2011). Quality of cohort studies reporting post the Strengthening the reporting of observational studies in epidemiology (STROBE) statement. *Epidemiology and Health*, 33, 4 pages. doi: 10.4178/epih/e2011005.

Sackett, D. L., Richardson, W. S., Rosenberg, W., & Haynes, R. B. (1997). *Evidence-based medicine: How to practice and teach EBM*. New York: Churchill Livingstone.

Schardt, C., Adams, M. B., Owens, T., Keitz S., & Fontelo, P. (2007). Utilization of the PICO framework to improve searching PubMed for clinical questions. *BMC Medical Informatics and Decision Making*, *7*, 16. doi: 10.1186/1472-6947-7-16.

Sharma, S., Ward, E. C., Burns, C., Theodoros, D., & Russell, T. (2011). Assessing swallowing disorders online: A pilot telerehabilitation study. *Telemedicine Journal and e-Health*, *17*(9), 688–695. doi: 10.1089/tmj.2011.0034

Ward, E., Crombie, J., Trickey, M., Hill, A., Theodoros, D., & Russell, T. (2009). Assessment of communication and swallowing post-laryngectomy: A telerehabilitation trial. *Journal of Telemedicine and Telecare*, *15*(5), 232–237. doi: 15/5/232 [pii]10.1258/jtt.2009.081204

Ward, E. C., Sharma, S., Burns, C., Theodoros, D., & Russell, T. (2012). Validity of conducting clinical dysphagia assessments for patients with normal to mild cognitive impairment via telerehabilitation. *Dysphagia*. doi: 10.1007/s00455-011-9390-9

Ward, L., White, J., Russell, T., Theodoros, D., Kuhl, M., Nelson, K., & Peters, I. (2007). Assessment of communication and swallowing function post laryngectomy: A telerehabilitation trial. *Journal of Telemedicine and Telecare*, *13* Suppl3, 88–91. doi: 10.1258/135763307783247293

Winters, J. M., & Winters, J. M. (2004). A telehomecare model for optimizing rehabilitation outcomes. *Telemedicine and eHealth*, *10*, 200–212.

Yellowlees, P. M., & Brooks, P. M. (1999). Health online: The future isn't what it used to be. *Medical Journal of Australia*, *171*, 522–525.

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Objective measurement of dysarthric speech following traumatic brain injury

Clinical application of acoustic analysis

Christine Taylor, Vanessa Aird, Emma Power, Emma Davies, Claire Madelaine, Audrey McCarry, and Kirrie J. Ballard

Speech pathologists typically use perceptual features and clusters of features to diagnose dysarthria type. Although ecologically valid, perceptual assessment remains largely subjective. This paper describes a sample of readily available acoustic measures and their perceptual correlates that can be applied in the clinical setting in order to objectively evaluate the degree of impairment and outcomes of intervention. The speech of three individuals with acquired dysarthria secondary to traumatic brain injury was perceptually rated for diagnosis. The samples were then analysed acoustically using measures that potentially quantify these perceptual features. Results indicated that most features were well quantified by an acoustic measure(s), while others were less clear. Some acoustic measures may be less sensitive to mild impairments while more extensive normative data are required for other measures. However, the acoustic measures used here provide a starting point to objectively describe dysarthric features, document treatment outcomes, and support accountability in service provision.

Dysarthria is a disorder of speech motor control that affects one-third of individuals with traumatic brain injury (TBI) (Duffy, 2005). Dysarthria has a significant and sustained effect on quality of life. People with dysarthria have a reduced ability to communicate effectively in everyday activities, which can lead to social, vocational and life participation restrictions (WHO, 2001). The current gold standard for clinical diagnosis of dysarthria is subjective perceptual judgement of speech behaviours across a range of tasks. Perceptual measures are considered of highest value in terms of ecological validity (Duffy 2005). However, characterising dysarthria types can present challenges due to the inherent variability seen both within and across speakers. In addition, inter-rater agreement among non-expert clinicians on presence and severity of perceptual speech dimensions can be as low as 50–60% (Zyski &

Weisiger, 1987). Kent (1996) provided a comprehensive review of factors that undermine reliability of perceptual judgements within and across clinicians. For example, our accuracy of judgements is vulnerable to effects of drift over time, as one becomes more familiar with a client's speech, as well as our level of expertise and familiarity with the possible range of severity.

Several researchers have developed objective measurement protocols to address problems with perceptual judgements but, generally, these have not made their way into routine clinical practice (Kent & Kim, 2003; Ludlow & Bassich, 1984; Murdoch, 2011). Barriers may include perceived or real difficulties with access to technical equipment, reduced expertise, entrenched clinical practices, and lack of time to collect and analyse objective measures. Also, it has been argued that some objective measures (e.g., vocal jitter or shimmer) may not correlate well with perceptual features (e.g., vocal roughness or harshness) (Bhuta, Patrick, & Garnett, 2004). One possible reason for a low relationship for some measures may be the use of nonspeech or quasi-speech tasks or simple word-level tasks to avoid the highly varied nature of connected speech.

In the contemporary delivery of health care, where accountability is paramount, the use of objective measurements can strengthen our assessment methods and tracking of improvement. Understanding which measures have a strong relationship to perceptual features at all levels of speech production is critical to this endeavour. A comprehensive review of such measures is beyond the scope of this paper and several excellent overviews are already available (e.g., Kent, Weismer, Kent, Vorperian, & Duffy, 1999; Thompson-Ward & Theodoros, 1998). Instead, we will provide a brief overview of some acoustic measures developed for measuring vocal quality and prosody, features commonly affected in dysarthria.

When evaluating vocal quality, one usually measures fundamental frequency (*f0*) and intensity, and signal to noise ratios in a stable production task (e.g., sustained *ah*) to capture features such as habitual pitch, hoarseness, and breathiness. Frequency measures quantify the rate, range, and variability of vocal fold vibration. Jitter and shimmer measure cycle-to-cycle change in frequency and amplitude, respectively, with elevated values thought to indicate pathology (Kent et al., 1999). High jitter values may correlate with perceived roughness (Colton, Casper, & Leonard, 2006; but see Bhuta et al., 2004). Harmonics-to-noise ratio (HNR) reflects abnormal vibratory characteristics of the folds and correlates with perceived hoarseness (e.g.,

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Christine Taylor (top), Vanessa Aird (centre) and Emma Power

Yumoto & Gould, 1982). Of note, software programs have different algorithms for calculating these measures which may yield differing results (Maryn, Corthals, De Bodt, Van Cauwenberge, & Deliyski, 2009). It is best to use norms generated by the selected software and standardise data collection methods to achieve highly reliable measurement over time. Further, the software may generate some erroneous f0 measurements (e.g., excessively high values at the edges of vowels) that distort maximum and average measures. Care is taken to omit these from the selection used for calculations (see Figure 1).

Analysis of prosody also involves measuring frequency and intensity, as well as segment or syllable durations, but at word or connected speech level. English is a stress-timed language that generally alternates stressed and unstressed syllables in a word or sentence. One measure proving useful for capturing this pattern is the pairwise variability index (PVI), which is a normalised measure of relative duration, f0, or intensity over a word or speech sample (Ballard, Robin, McCabe, & McDonald, 2010; Courson, Ballard, Canault, & Gentil, 2012; Low, Grabe, & Nolan, 2000; Vergis & Ballard, 2012). Specifically, one calculates the difference in duration (or f0 or intensity) over two consecutive vowels and divides the difference by their average. This calculation is done pairwise for the whole sample and the average PVI value used as an index of stress variability. Low et al. (2000) reported that in British-English average PVI for vowel duration (PVI_Dur) in sentences containing all stressed words (100% stressed) is ~30 and rises to ~78 for sentences with alternating stressed and unstressed words (50% stressed). The Grandfather passage (Darley, Aronson, & Brown, 1975) contains about 60% stressed words so PVI values below 30 indicate equal and excess stress.

Most of the recommended acoustic measures of speech can be made using free downloadable speech acquisition and analysis programs, such as PRAAT (http://www.fon.hum.uva.nl/praat). PRAAT was first released in 1995 and is regularly maintained by its developers (P. Boersma and D. Weeninck, University of Amsterdam). It has been used extensively for analysis of both healthy and impaired speakers. Comprehensive manual and tutorials on the website provide guidelines for checking for errors in measurement that can occur more frequently with the more variable speech of dysarthria.

Aims

The aim of this study was to demonstrate the use of a small number of easy-to-collect acoustic measures using a free software program, PRAAT (Boersma & Weenink, 2010), for three prototypical dysarthria cases: one spastic, one ataxic, and one flaccid dysarthria case. The list of measures presented here is by no means comprehensive, but rather provides an introduction to using the PRAAT software and perhaps an incentive to explore it more fully. We report the results of these acoustic analyses, compare them with available normative data, and how they relate to perceptual judgements.

We predicted that the individuals with spastic or flaccid dysarthria would demonstrate abnormal vocal quality measures (e.g., jitter, shimmer, HNR), associated with perceived abnormal vocal quality. The individual with ataxic dysarthria and notable pitch breaks and vocal tremor was expected to show high variability of f0 during sustained ah production. We expected that all would demonstrate reduced speech rate in diadochokinetic and connected speech tasks. Further, the individuals with spastic and ataxic dysarthria would deviate from normal on objective measures of prosody (i.e., relative duration, f0 and/or intensity across syllables in connected speech as measured by the PVI), reflecting the perception of equal stress or scanning speech, respectively. Perception of monopitch or monoloudness should be reflected as lower PVI values for f0 and dB (PVI_f0, PVI_dB), respectively.

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Participant	Age	Sex	PTA (months)	CT results	TPO	Injury	Dysarthria	ASSIDS
Participant 1	39	M	3.5	Large left SAH and SDH and 10 mm midline shift, craniotomy and evacuation of haemorrhage	3	Fall	Mild-moderate Spastic	84% (single words) 94% (sentences)
Control 1	41	M						
Participant 2	27	F	1	Left occipital penetrating wound with bullet fragmentation and swelling of bilateral cerebellar hemispheres, SAH and SDH surrounding occipital lobes and cerebellar hemispheres, left parietal craniectomy and debridement of foreign body	18	Focal open head injury	Moderate Ataxic	86% (single words) 95% (sentences)
Control 2	30	F						
Participant 3	26	M	6	EDH, left SDH, base of skull, temporal and sphenoid fracture, left cerebellar haematoma, bilateral craniotomy, hydrocephalus and meningitis, CSF drainage and ventriculoperitoneal shunt	15	Motor vehicle accident	Severe Flaccid	26% (single words) Sentences not attempted
Control 3	25	M						

Table 1. Demographic and injury data for the three participants with dysarthria and three age- and gender-matched control participants

Note: PTA: post-traumatic amnesia; TPO: time post-onset; ASSIDS: Assessment of Intelligibility for Dysarthric Speech (Yorkston, Beukelman & Traynor, 1984); SAH: subarachnoid haemorrhage; SDH: subdural haemorrhage; EDH: extradural haemorrhage; CSF: cerebrospinal fluid.

Method

Participants

Three participants with TBI were recruited from a specialist metropolitan brain injury unit. Individuals were selected based on an unequivocal clinical diagnosis of a single dysarthria type based on the Mayo clinic oral motor and speech motor examinations (Duffy, 2005). Perceptual judgements were made by three judges (authors 1, 2, 7). In addition, impact on intelligibility at single word and sentence level, as a coarse index of severity, was defined using the Assessment of Intelligibility for Dysarthric Speech (ASSIDS; Yorkston, Beukelman, & Traynor, 1984). Demographic and injury details are provided in Table 1.

Participant 1 (P1) was a 39-year-old native English-speaking male with mild-moderate spastic dysarthria three months post-trauma. Dysarthria diagnosis was supported by perceptual features of strain-strangled vocal quality, monopitch and pitch breaks, reduced loudness variability, slow speaking rate, equal-excess stress, short phrases, but minimal articulatory imprecision (Duffy, 2005). P2 was a 27-year-old native English-speaking female with moderate ataxic dysarthria 18 months post-trauma. She presented with irregular pitch breaks, vocal tremor, adequate volume, slow speaking rate, equal and excess stress, but minimal/no articulatory imprecision. P3 was a 26-year-old bilingual Mandarin- and English-speaking male with severe flaccid dysarthria 15 months post-trauma. He presented with breathy vocal quality, reduced pitch variability, low volume, slow speaking rate, imprecise articulation, and vowel and consonant prolongations that all judges perceived as being related to severe dysarthria rather than accent.

Three healthy participants were recruited from the University of Sydney community to serve as age- and gender-matched controls for each participant with dysarthria, for those measures that did not have published normative data. All healthy participants reported no history of speech, language, or neurological impairment along with normal hearing and vision (corrected or uncorrected). The human research ethics committees of the Royal Rehabilitation Centre and the University of Sydney approved the experimental procedures and all participants provided informed written consent.

Procedures

Tasks

A subset of tasks from the above speech motor examination (Duffy, 2005) was selected for acoustic measurement of each individual's speech. These same speech samples were used for both the perceptual and acoustic analysis. These included (a) sustained production of the vowel [a], (b) alternating and sequential motor tasks (AMR and SMR; also known as diadochokinesis tasks), and (c) the connected speech task of reading the Grandfather passage. These three tasks were selected as they captured the main features noted in the speech of these individuals and covered a range of speaking contexts. The nonspeech/speech-like tasks of sustained phonation, AMR and SMR allow for assessment of neuromuscular function without the additional cognitive and linguistic demands of connected speech tasks (Wang, Kent, Duffy, Thomas, & Weismer, 2004). Note that all participants were able to read the Grandfather passage without assistance.

Apparatus

All samples were recorded with an Audio-Technica ATM75 cardioid headset microphone 5 cm from the mouth, connected to a desktop computer running free PRAAT software, (http://www.fon.hum.uva.nl/praat/) (Boersma & Weenink, 2010), using the industry-standard sampling rate of 44.1 kHz and .wav file format (see website for instructions for recording, viewing, and editing files in PRAAT). Speech samples for all participants were collected in a quiet environment in a speech pathology clinic room. This is representative of conditions in a standard clinic setting where sound treated rooms are not typically available.

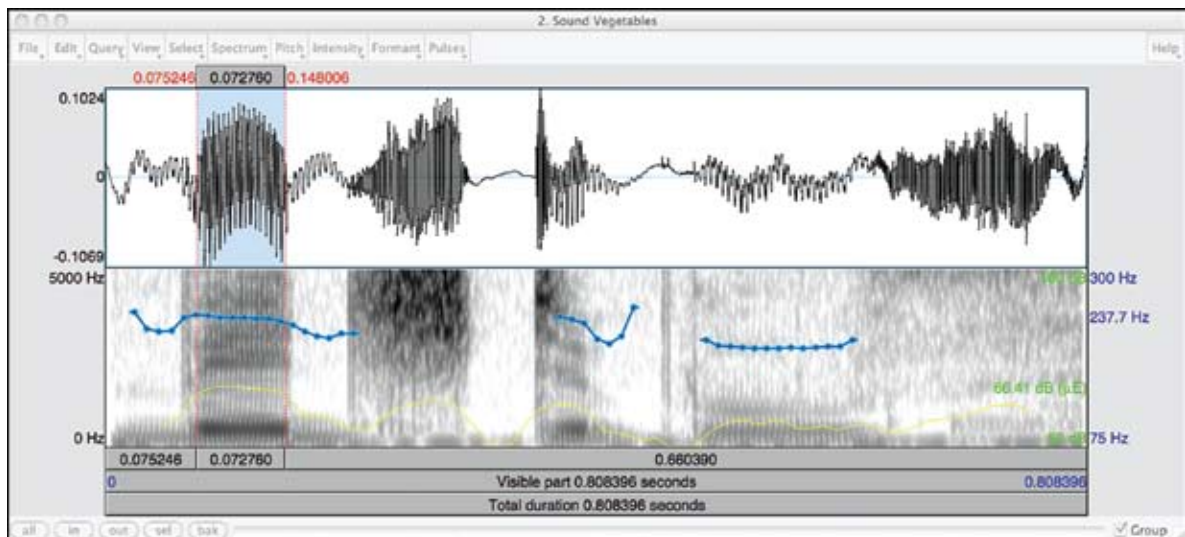| Task/Step	Instruction
Table 2. Instructions for calculating the Pairwise Variability Index for duration, pitch, or loudness of the vowel in words or connected speech	
1	Record your sound file using PRAAT, then Open and View the file. Zoom in to the word you want to measure.
2	Measuring duration, pitch, and loudness: (a) To measure Vowel Duration, highlight the vowel from its onset to its offset (as shown in Figure 1) and the duration of the highlighted segment will be displayed in seconds at the top (0.072760 sec, or 72.76 msec, in Figure 1). Type the value into Column A – Row 1 (A1) of an Excel spreadsheet. (b) To measure Vowel Pitch (i.e., $f0$), with the vowel still highlighted as in (a), go to the Pitch menu and select Get Maximum. Make sure not to include any erroneous pitch data-points at the edges of the vowel for this measure. Copy and paste the value into Column A – Row 1 (A1) of an Excel spreadsheet. (c) To measure Vowel Intensity (i.e., dB), with the vowel still highlighted as in (a), go to the Intensity menu and select Get Maximum Intensity. Copy and paste the value into Column A – Row 1 (A1) of an Excel spreadsheet.
3	Repeat steps 1-3 for each vowel, moving syllable by syllable through the sample and placing each new value into the next row in Column A of the spreadsheet.
4	When you have finished the measures for consecutive vowels in the sample (at least 20 measures, but the more the better), enter =ABS(100*((A1-A2)/((A1+A2)/2))) into the first row of Column B (B1). This will calculate the PVI for the two duration values in A1 and A2.
5	If you measure duration for 20 consecutive vowels, you will have a value in cells A1 to A20. Now, copy the formula from B1 into all the cells in column B, down to the second last row of data (B19). The formula will automatically change to calculate the PVI for each pair of values in Column A (A1-A2, A2-A3, etc).
6	Once you have your 19 PVI values, calculate their average by entering =AVERAGE(B1:B19) into cell B21.

Figure 1. Waveform and spectrogram for the word "vegetables", as displayed in PRAAT, with the first vowel highlighted in the waveform (upper panel). In the spectrogram (lower panel), the top overlaid dotted line represents the fundamental frequency as it changes over the word (displayed in blue within PRAAT), the bottom overlaid line represents the vocal intensity (displayed in yellow within PRAAT). Note the erroneous pitch values just prior to the 'b' and at the onset of the final schwa.

Acoustic measurements

Vocal quality. Vocal quality was assessed during sustained phonation, which represents stable vocal performance with minimal demands for vocal tract adjustments. First, the average duration (msec) was measured over three successive attempts at sustained phonation. Second, a 3-second stretch of the sustained vowel was selected for measurement from the middle of the sustained phonation, not including the first 25 msec or the terminal part of the phonation (Kent et al., 2000). The PRAAT Voice Report function was used to calculate average $f0$, standard deviation of $f0$, jitter (local), shimmer (local), and HNR (http://www.fon.hum.uva.nl/praat/manual/Voice.html; e.g., Kent et al., 2000).

Speech rate and prosody. Speech rate was measured as syllables spoken per second for AMR, SMR, and reading. In connected speech, stress variability was measured with the Pairwise Variability Index (PVI). Instructions for calculating PVI_Dur, PVI_f0 and PVI_dB for the first 20 syllables/vowels in the Grandfather reading are given in Table 2 and Figure 1. Higher PVI values represent greater variation; PVI values close to zero indicate equal stress, monopitch, or monoloudness (i.e., dysprosody).

Reliability of measurement

Inter-rater reliability was calculated on all manual measurements using intra-class correlation coefficients (inter-rater reliability: ICC 2, 1, absolute agreement, single measures). Inter-rater reliability was excellent (≥0.75; Cicchetti, 1994) for vowel duration (ICC: 0.78, 95% CI 0.51 –0.89), vowel peak $f0$ (ICC: 0.78, 95% CI 0.62 –0.86) and vowel peak dB (ICC: 0.75, 95% CI 0.02 –0.92). Absolute agreement resulted in the wide CI band for vowel peak dB however, the average difference in dB measures was not clinically significant at 2.07 dB (SD = 1.12). Intra-rater reliability was also high for the three measures (ICC: 0.85, 95% CI 0.72 –0.93; ICC: 0.92, 95% CI 0.84 –0.96; and ICC: 1.0, 95% CI 0.99 –0.1, respectively).

Results

Each participant presented with prototypical perceptual features consistent with spastic dysarthria (P1), ataxic dysarthria (P2), and flaccid dysarthria (P3) (Duffy, 2005). Acoustic measures are presented in Table 3 along with comparative data from healthy age- and sex-matched adults. The nonparametric Wilcoxin Matched Pairs Signed Ranks test was used to compare the PVI for each syllable pair in a patient's sample with those for the matched control. The relationships between perceptual and acoustic measures are reported below.

Participant 1

Vocal quality

Duration of sustained *ah* was reduced, consistent with the reduced respiratory-phonatory control and short phrase length. P1's average $f0$ was higher than normal, although low pitch has been more often associated with the increased laryngeal tone of spasticity (Duffy, 2005). While variability of $f0$, jitter, and shimmer for the sustained *ah* production were within normal limits, the harmonics-to-noise ratio (HNR) was slightly below the recommended threshold, indicative of mild vocal hoarseness. This likely relates to the perception of P1 having a strained-strangled voice quality.

Speech rate and prosody

P1's speech rate was perceived as mildly slow, consistent with AMR and SMR rates being about 1 syllable/sec below the normal range and 1.7 syllables/sec slower than normal for reading. Prosodic variation in the reading task was measured with the Pairwise Variability Index. PVI_Dur was significantly reduced compared to the control sample, consistent with the perception of mild equalisation of stress. PVI_f0 and PVI_dB were not significantly different to the control, despite the perception of reduced pitch and loudness variation in the reading sample.

Participant 2

Vocal quality

Duration of sustained *ah* was well below the average expected for healthy speakers, suggestive of poor respiratory-phonatory control. P2 displayed irregular pitch breaks and vocal tremor. Average $f0$ was within the normal range but standard deviation of $f0$ was very high, possibly influenced by brief pitch breaks. Jitter was below the

Table 3. Results of acoustic analyses with normative comparisons

Measures	P1 – M (Spastic)	Comparison data	P2 – F (Ataxic)	Comparison data	P3 – M (Flaccid)	Comparison data
Vocal quality						
Sustained /a/						
Average duration (sec)[1]	14.2	25.9	12.76	21.3	9.53	25.9
Average *f0* [2]	174.0	145.2 Range: 121.8–168.6	256.5	243.9 Range: 216.5–271.4	156.2	145.2 Range: 121.8–168.6
Standard deviation *f0* [2]	1.2	1.3 Range: 0.7–2.0	11.4	2.7 Range: 0.6–4.8	2.4	1.3 Range: 0.7–2.0
Jitter (local) [2]	0.54	≤1.04%	0.55	≤1.04%	0.64	≤1.04%
Shimmer (local) [2]	2.87	≤3.81%	3.74	≤3.81%	2.76	≤3.81%
Harmonic-to-noise ratio [2]	19.47	>20	19.38	>20	19.96	>20
Speech rate and prosody						
Alternating Motion Rate tasks [3]						
'pa' repetition (syll/sec)	3.4	Range: 4.5–7.5	2.5	Range: 4.6–8.6	2.5	Range: 4.5–7.5
'ta' repetition (syll/sec)	3.3	Range: 4.4–8.2	2.3	Range: 4.3–8.5	2.5	Range: 4.4–8.2
'ka' repetition (syll/sec)	3.6	Range: 4.4–7.5	2.0	Range: 4.3–7.9	2.3	Range: 4.4–7.5
Sequential Motion Rate task [3]						
'pataka' repetition (syll/sec)	3.6	Range: 4.8–7.2	3.4	Range: 4.8–7.2	2.8	Range: 4.8 – 2.0
Connected speech (Grandfather)						
Speech rate (syll/sec) [4]	2.1	4.3 (± 0.5)	1.4	4.3 (± 0.5)	0.7	4.3 (± 0.5)
Pairwise Variability Indices [5]						
duration	29.3**	46.6	25.8**	47.8	28.5**	58.4
f0	10.4	9.4	9.1	7.0	4.7**	7.3
dB	4.5	3.8	4.5	3.1	3.1**	5.6

Note: Underline = values outside normal range

[1] Colton et al. (2006)

[2] Norms from Multi-Dimensional Voice Program (MDVP; Kay PENTAX, Lincoln Park, USA): MDVP *Jitt* and *Shim* cut-off values are used, but are conservative here as the Jitter and Shimmer measures in PRAAT are less influenced by noise (http://www.fon.hum.uva.nl/praat/manual/Voice.html; Maryn et al., 2009)

[3] Kent (1997)

[4] Tauroza & Allison (1990)

[5] Comparison data from matched controls; controls' duration values are comparable to Low et al. (2000) for "reduced vowel set" sentences; **p<0.01 and *p<0.05 for Wilcoxin Matched Pairs tests between participant and matched control.

threshold for pathological voice, and this was consistent with the absence of any perception of vocal roughness. The value for shimmer was close to the conservative threshold supporting the perception of loudness variations and vocal tremulousness. HNR was slightly below the recommended threshold, indicative of mild vocal hoarseness although this was not noted in the perceptual evaluation.

Speech rate and prosody

Performance on AMR and SMR tasks was characteristic of ataxic dysarthria with fewer syllables per second and the perception of slowed speech rate and disrupted rhythm. Speech rate was considerably reduced in the reading task, compared to healthy adults.

The predominant prosodic features perceived in P2's speech were equal and excess stress, irregular pitch breaks, and higher than normal loudness variation. This participant showed the lowest PVI_Dur value, significantly lower than the control, which is consistent with equal and excess stress. PVI_f0 and PVI_dB were slightly elevated, but not significantly different to the control speaker.

Participant 3

Vocal quality

Duration of sustained *ah* was considerably reduced, suggestive of reduced respiratory-phonatory control and more rapid loss of air with breathiness. Average *f0*, standard deviation of *f0*, jitter and shimmer were within the normal range on *ah* production. HNR was reduced relative to the threshold, suggestive of hoarseness, although the participant was perceived to have a breathy rather than hoarse quality.

Speech rate and prosody

The perception of slowed speech rate was upheld with slowed repetition rates on AMR and SMR tasks and particularly for connected speech, compared to normal. P3's PVI_Dur was significantly reduced compared to the control participant, suggesting equalisation of stress in connected speech, despite this not being reported perceptually. However, the participant was perceived to have vowel and consonant prolongations, which may

correlate with reduced PVI_Dur measures (see Discussion). The significantly reduced PVI_*f0* and PVI_dB values were consistent with the perception of reduced pitch variability and possibly low speaking volume.

Discussion

The aim of this study was to demonstrate the use of a small set of acoustic measures of speech using accessible software and readily executed measurements. By exploring the relationships between various acoustic measures and our perceptions of different aspects of speech and voice quality, we can develop more objective and reliable measures of change with time and with treatment. We can also start to unpack the different acoustic signals that come together to form our perceptions of, at times, more wholistic constructs (Kent, 1997).

We predicted that the individuals with spastic or flaccid dysarthria would demonstrate abnormal vocal quality measures (e.g., jitter, shimmer, HNR), associated with perceived abnormal quality. The individual with ataxic dysarthria and pitch breaks and vocal tremor was expected to show high variability of *f0* on sustained *ah*. All participants were expected to have reduced speech rate in diadochokinetic and connected speech tasks. Reduced PVI_Dur should be associated with perception of equal stress and reduced PVI_*f0* and PVI_dB with perception of reduced pitch and loudness variability in connected speech.

Vocal quality

HNR appears to be a useful indicator of abnormal vocal quality (Bhuta et al., 2004; Kent et al., 2000; Yumoto & Gould, 1982). It has been linked to hoarseness, although here P1 and P3 were perceived to have strained-strangled and breathy quality, respectively. It is possible that HNR is useful as an indicator of pathology, rather than a specific type, or alternatively that the different vocal quality descriptors are difficult to differentiate in clinical practice (Kreiman & Gerratt, 2000). As reported here, previous studies have not found strong links between jitter and shimmer measures and abnormal vocal quality (e.g., Bhuta, et al., 2004; see Thompson-Ward & Theodoros, 1998). Inclusion of HNR in a diagnostic protocol is worthwhile to aid objective identification of abnormal quality or to track changes with intervention, provided recording and measurement methods are controlled across time points.

The measures of average *f0* and standard deviation of *f0* during sustained ah production were equivocal here. P1 had elevated average *f0*, counter to the tendency for reduced pitch with laryngeal spasticity (Duffy, 2005). This was not likely to be due to perceived mild pitch breaks, as these were minimal during the *ah* sample. The average *f0* was 5.2 Hz outside the normal range; possibly the threshold for perceiving high pitch does not correspond precisely with the normal range. As predicted, the elevated variability of P2 supported the perception of irregular pitch breaks and vocal tremor in sustained *ah*.

Speech rate and prosody

The measures of speech rate are by no means novel but are made considerably easier within the visual spectrographic display of PRAAT. As reported numerous times, all participants showed slowed rate in all tasks (Duffy, 2005).

The measures of prosody are less widespread. The PVI is a useful measure that correlates well with perceptions of stress production in words and connected speech (Ballard et al., 2010; Low et al., 2000). Our hypotheses were largely supported with equal stress and monopitch

and monoloudness reflected in reduced PVI values. Kim, Hasegawa, and Perlman (2010) have reported similar findings in spastic dysarthria from cerebral palsy. The lack of a significant difference for PVI_*f0* and PVI_dB for P1 and P2 suggests that poor control over syllable/vowel duration was mainly responsible for the perception of equal stress. This result is not surprising for P2, as her irregular pitch and loudness variations were distributed relatively randomly with respect to the distribution of stress. P1 was perceived to have monopitch and monoloudness, but this was not borne out in the PVI measures.

P3 had significantly reduced PVI for all three measures. While he was not perceived to have equal or excess stress, the reduced duration variability may be related to perceived vowel and consonant prolongations. Such prolongations are also a feature of acquired apraxia of speech, with these individuals disproportionately prolonging vowels in unstressed syllables (Vergis & Ballard, 2012). P3 was perceived to have *consistently* reduced pitch variation, which appeared more related to PVI_*f0* than the irregular pitch variation of P1 and P3.

Conclusions

The aim of this paper was to demonstrate how some acoustic measurements are within easy reach of standard speech pathology clinics and can provide quick objective measures for supporting diagnostic and treatment decisions. While not all measures match squarely onto perceptual constructs, there is value in exploring how different acoustic features may combine to map onto more holistic percepts. We must also be aware that the inherent variability of the pathological speech signal and/or limitations in applying a "generic" software algorithm to pathological speech may at times yield inaccurate measurements. The need to use a good quality microphone, to ensure samples are collected in a quiet environment, and to standardise recording and analysis protocols across time points cannot be overstated.

The measures and methods presented here provide the clinician with a starting point for documenting treatment effectiveness and accountability in a less subjective manner than using perceptual measures alone. We hope that, by documenting some of these methods with illustrative cases, we may encourage and facilitate translation of these techniques into clinical practice (Graham et al., 2006) and, over time, stimulate development of large normative and patient databases for comparison.

Acknowledgments

References

Ballard, K. J., Robin, D. A., McCabe, P., & McDonald, J. (2010). Treating dysprosody in childhood apraxia of speech. *Journal of Speech, Language, and Hearing Research*, *53*, 1227–1245.

Bhuta, T., Patrick, L., & Garnett, J. D. (2004). Perceptual evaluation of voice quality and its correlation with acoustic measurements. *Journal of Voice*, *18*(3), 299–304.

Boersma, P., & Weenink, D. (2010). *PRAAT: Doing phonetics by computer* (version 5.1.31). Amsterdam, Netherlands: Institute of Phonetic Sciences.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, *6*, 284–290.

Colton, R. H., Casper, J. K., & Leonard, R. (2006). *Understanding voice problems: A physiological perspective for diagnosis and treatment* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.

Courson, M., Ballard, K. J., Canault, M., & Gentil, C. (2012, March). *Lexical stress production in French and Australian English speakers: A comparison of healthy adults and adults with acquired apraxia of speech*. Poster presentation at the International Motor Speech Conference, Santa Rosa, California, USA.

Darley, F., Aronson, A., & Brown, J. (1975). *Motor Speech Disorders*. Philadelphia: W.B. Saunders.

Duffy, J. R. (2005). *Motor speech disorders: Substrates, differential diagnosis, and management*. St. Louis, MO: Mosby-Year Book.

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: Time for a map? *Journal of Continuing Education in the Health Professions*, *26*(1), 13–24.

Kent, R. D. (1996). Hearing and believing: Some limits to the auditory-perceptual assessment of speech and voice disorders. *American Journal of Speech-Language Pathology*, *5*, 7–23.

Kent, R. D. (1997). The perceptual sensorimotor examination for motor speech disorders. In M. R. McNeil (Ed.), *Clinical management of sensorimotor speech disorders* (pp. 27–48). New York: Thieme.

Kent, R. D., Kent, J. F., Duffy, J. R., Thomas, J. E., Weismer, G., & Stuntebeck, S. (2000). Ataxic dysarthria. *Journal of Speech, Language, and Hearing Research*, *43*(5), 1275–1289.

Kent, R. D. & Kim, Y. J. (2003). Toward an acoustic typology of motor speech disorders. *Clinical Linguistics and Phonetics*, *17*, 427–445.

Kent, R. D., Weismer, G., Kent, J. F., Vorperian, H.K., & Duffy, J. R. (1999). Acoustic studies of dysarthric speech: Methods, progress and potential. Journal of Communication Disorders, *32*, 141–186.

Kim, H., Hasegawa-Johnson, M., & Perlman, A. (2010). Acoustic cues to lexical stress in spastic dysarthria. In *Proceedings of Speech Prosody 2010*, 100891: 1–4.

Kreiman, J., & Gerratt, B. R. (2000) Sources of listener disagreement in voice quality assessment, *Journal of the Acoustical Society of America*, *108*, 1867–1879.

Ludlow C., & Bassich C. (1984). Relationship between perceptual ratings and acoustic measures of hypokinetic speech. In M. R. McNeil, J. C. Rosenbek & A. Aronson (Eds.), *The dysarthrias: Physiological, acoustics, perception, management* (pp.163-195). San Diego, CA: College Hill Press.

Low, E. L., Grabe, E., & Nolan, F. (2000). Quantitative characterizations of speech rhythm: Syllable-timing in Singapore English. *Language and Speech*, *43*(4), 377–401.

Maryn, Y., Corthals, P., De Bodt, M., Van Cauwenberge, P., & Deliyski, D. (2009). Perturbation measures of voice: A comparative study between Multi-Dimensional Voice Program and Praat. *Folia Phoniatrica et Logopaedica*, *61*(4), 217–226.

Murdoch, B. (2011). Physiological investigation of dysarthria: Recent advances. *International Journal of Speech-Language Pathology*, *13*, 28 – 35.

Tauroza, S., & Allison, D. (1990). Speech rates in British English. *Applied Linguistics*, *11*, 90–105.

Thompson-Ward, E. C., & Theodoros, D. G. (1998). Acoustic analysis of dysarthric speech. In B. E. Murdoch (Ed.), *Dysarthria: A physiological approach to assessment and treatment* (pp. 102–129). Cheltenham, England: Stanley Thornes.

Vergis, M., & Ballard, K. J. (2012). *Quantitative measurement of lexical stress in adults with aphasia with/without apraxia of speech*. Unpublished Honours Thesis, University of Sydney, Australia.

Wang, Y., Kent, R. D., Duffy, J. R., Thomas, J. E., & Weismer, G. (2004). Alternating motion rate as an index of speech motor disorder in traumatic brain injury. *Clinical Linguistics and Phonetics*, *18*(1): 57–84.

World Health Organization (WHO). (2001). *International classification of functioning, disability and health (ICF)*. Geneva: Author.

Yorkston, K. M., Beukelman, D. R., & Traynor, C. (1984). *Assessment of intelligibility of dysarthric speech*. Austin, TX: Pro-Ed.

Yumoto, E., & Gould, W. J. (1982). Harmonics-to-noise ratio as an index of the degree of hoarseness. *Journal of the Acoustical Society of America*, *71*(6), 1544–1550.

Zyski, B. J., & Weisiger, B. E. (1987). Identification of dysarthria types based on perceptual analysis. *Journal of Communication Disorders*, *20*, 367–378.

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Treatment of articulation disorders in children with cleft palate

Evidence for using electropalatography

Sarah Maine and Tanya Serry

THIS ARTICLE HAS BEEN PEER-REVIEWED

Sarah Maine (top) and Tanya Serry

Children born with cleft palate are at a high risk for articulation disorders. Electropalatography (EPG) has emerged as a tool that utilises visual feedback to treat persistent articulation disorders in the cleft palate population. The purpose of this paper is to summarise the current research exploring the use of EPG therapy for children with surgically repaired cleft palate and inform clinicians on the quality of evidence available to guide their clinical practice. A search of the literature identified six articles appropriate for inclusion in the review. The review found that although some evidence exists for the efficacy of EPG therapy, further research should be carried out to form a more robust evidence base prior to initiation of a randomised controlled trial.

Introduction

Children born with a cleft palate are at a higher risk of speech problems than the general population (Hardin-Jones & Chapman, 2008; Peterson-Falzone, Hardin-Jones, & Karnell, 2010). Difficulties with resonance and articulation are the most common areas of speech breakdown within the heterogeneous cleft palate population (Peterson-Falzone et al., 2010). Children with cleft palate are also at an increased risk of developing negative attitudes toward communication. In their study investigating communication attitudes of 10-year-old children with cleft palate, Havstam, Sandberg, and Lohmander (2011) found a statistically significant difference between mean Communication Attitude Test (CAT-S) scores of children with cleft palate compared to their typically developing peers.

Cleft palate

Cleft palate is a craniofacial structural disorder that occurs during the seventh to twelfth week of embryonic development (Lee, Law, & Gibbon, 2009; Siren, 2004). It results from a lack of fusion of the two maxillary processes during the growth period of these structures (Shprintzen, 1995). Clefts may result in a complete cavity of the palate, creating a continuous passage between the oral and nasal cavities (Shprintzen, 1995).

There are many documented variations of cleft palate. The primary distinctions between types of cleft palate relate to unilateral or bilateral clefts with or without cleft lip (Peterson-Falzone et al., 2010; Siren, 2004). Worldwide clefts of the palate and/or lip occur in around 0.13 to 2.53 in 1000 live births every year, with substantial variation across region of birth and gender (Marazita, 2004; Reid, 2004; Wyszynski, 2007). Primary surgical repair of cleft palate is typically carried out between 12 and 18 months of age (Clark, Milesi, Mishra, Ratanje, & Rezk, 2007). Surgical intervention therefore interrupts the typical pattern of speech development at a critical stage. Palatoplasty describes the most common method of surgical repair (Peterson-Falzone et al., 2010) and involves the re-construction of the palate via plastic surgery, often resulting in altered sensation to the palate.

Speech characteristics associated with cleft palate

A cluster of deviant speech production features are commonly associated with cleft palate (Lohmander, Henriksson, & Havstam, 2010; Michi, Yamashita, Imai, Suzuki, & Yoshida, 1993; Pamplona, Ysunza, & Espinosa, 1999; Peterson-Falzone et al., 2010). Compensatory articulation and disordered resonance are reported as the most prominent findings in the speech of the cleft palate population[1] (Lee et al., 2009; Pamplona et al., 2005; Peterson-Falzone et al., 2010). Various authors (Dalston, 1992; Hardin-Jones & Jones, 2005; Peterson-Falzone, 1990) suggest that prevalence of compensatory articulations in children with repaired cleft palate ranges from 22% to 28% (as cited in Lee, Gibbon, Crampin, Yuen, & McLennan, 2007).

Compensatory articulations are reported to result from altered patterns of speech behaviour due to an inability to obtain adequate intraoral pressure secondary to an irregular oral cavity (Lee et al., 2009). They may also occur as a response to limited sensory feedback from oral structures. Some of the most prevalent misarticulations include posteriorly articulated alveolar stops, palatalised affricates, and palatalised sibilants (Gibbon et al., 2001; Hardin-Jones & Chapman, 2008; Lohmander et al., 2010; Michi et al., 1993; Pamplona et al., 1999; Pamplona et al., 2005). Recent developments in technology have resulted in research exploring the role of visual feedback in treatment of articulation errors (Gibbon, Stewart, Hardcastle, & Crampin, 1999).

Electropalatography

Electropalatography (EPG) is a procedure that uses visual feedback to demonstrate lingual contact on the hard palate

using a dynamic, direct approach (Michi et al., 1993). The technique of EPG has evolved into a highly established research tool in the field of speech intervention (Scobbie, Wood, & Wrench, 2004). EPG therapy differs from conventional articulation therapy by providing visual feedback cues to the speaker as well as auditory feedback in the form of voice and kinaesthetic feedback from the articulators (Peterson-Falzone et al., 2010). The real-time nature of EPG permits immediate information about tongue placement and timing of articulatory movements (Gibbon et al., 2001; Gibbon & Hardcastle, 1989; Michi et al., 1993). Through identifying the specific placement of the tongue and its position in reference to the hard palate, EPG allows speakers to alter their linguo-palatal contact in order to produce phonemes with increased accuracy (Gibbon et al., 2001).

Electropalatography has also emerged as a viable tool for the remediation of articulation problems exhibited by the cleft palate population (Fujiwara, 2007; Gibbon & Hardcastle, 1989; Lee et al., 2009). Peterson-Falzone et al. (2010) suggest that the high imageability of the alveolar region of the hard palate facilitates targeting sounds that are incorrectly produced in a more backed position. Moreover, its use in populations such as those with repaired cleft palate, who may have decreased oral sensation, is worthy of consideration due to the device's lack of reliance upon kinaesthetic biofeedback (Peterson-Falzone et al., 2010).

Therapy for articulation disorders in children typically involves using the speaker's auditory feedback to guide emergence of an altered pattern of articulation of any one phoneme (Pamplona et al., 1999; Peterson-Falzone et al., 2010). McAuliffe and Cornwell (2008) discussed the need to implement principles of motor learning when altering phoneme production patterns. In their research with a single subject with an articulation disorder not related to cleft palate, the authors found that incorporating EPG with therapy guided by the principles of motor learning and traditional articulation therapy resulted in positive therapy outcomes when treating lateralised /s/ (McAuliffe & Cornwell, 2008).

The limited research that has been conducted in the field of EPG has demonstrated its potential value as a method of treating persistent articulation errors in children with cleft palate when traditional methods fail (Gibbon et al., 2001). However, no large-scale studies have been conducted to support widespread clinical use of EPG with those who have a repaired cleft palate.

This paper provides a narrative review of the evidence to date that explores whether using EPG is an effective method of treatment of persistent articulation errors in children with surgically repaired cleft palate. It aims to: (a) summarise and critique the current research surrounding the most effective approaches to providing EPG therapy for treating articulation disorders in the cleft palate population and (b) inform clinicians on the quality of evidence available to guide their clinical practice.

Method

The electronic databases Medline Ovid (1996–), EMBASE (1998–), CINAHL, SpeechBITE, Cochrane Library, and PsychInfo were searched for relevant articles. The search terms *cleft palate AND electropalatography OR EPG OR biofeedback AND articulat* therapy OR speech intervention OR speech treatment AND articulat* OR intelligibility OR speech production* produced a final yield of 13 articles after limiting results to English, excluding research on adults, and eliminating duplicates. Six articles were identified that evaluated the use of electropalatography as a speech intervention technique for children with repaired cleft palate and were therefore considered appropriate for inclusion in the review. Table 1 provides further details about the articles selected for review.

Results

Study design evaluation

Systematic searching of the literature revealed the majority of studies conducted in the area of electropalatographic treatment for disordered speech in the cleft palate population are classified by the National Health and Medical Research Council (NHMRC) as being low level evidence (NHMRC, 2009). The NHMRC Evidence Hierarchy is a tool used to identify the relative strength of a study according to its design and the type of research question being posed (NHMRC, 2009). The NHMRC Working Party acknowledges

Table 1. Articles included for review				
Author/s	Sample size	Title	Study design	Level of Evidence[1]
Lohmander A., Henriksson C., & Havstam C. (2010)	1	Electropalatography in home training of retracted articulation in a Swedish child with cleft palate: effect on articulation pattern and speech.	Single subject design	IV
Fujiwara, Y. (2007)	5	Electropalatography home training using a portable training unit for Japanese children with cleft palate.	Case series	IV
Scobbie, J. M., Wood, S. E., & Wrench, A.A. (2004)	1	Advances in EPG for treatment and research: an illustrative case study.	Single subject design	IV
Gibbon, F., Hardcastle, W. J., Crampin, L., Reynolds, B., Razell, R., & Wilson, J. (2001)	12	Visual feedback therapy using electropalatography (EPG) for articulation disorders associated with cleft palate.	Randomised group study, crossover design	IV
Stokes, S. F., Whitehill, T. L., Yuen, K. C. P., Tsui, A. & M. Y. (1996)	2	EPG treatment of sibilants in two Cantonese-speaking children with cleft palate.	Case series	IV
Michi K-I, Yamashita Y., Imai S., Suzuki N., & Yoshida H. (1993)	6	Role of visual feedback treatment for defective /s/ sounds in patients with cleft palate.	Randomised controlled trial	IIa

Note: [1] According to NHMRC Evidence Hierarchy. The NHMRC Evidence Hierarchy is a tool used to identify the relative strength of a study according to its design and the type of research question being posed (NHMRC, 2009).

Table 2. Study details							
Author	Cleft type/s	Language	Articulation error/s present	Baseline data collection	Treatment	Primary outcome measure	Follow-up measures
Lohmander et al. (2010)	Isolated soft & hard palate cleft (n = 1)	Swedish	Palatalised /s/ Palatalised /t/	3 pre-treatment measures	Daily, approx. 10min/day, 5 days a week for 5 months via PTU	CoG values	3 times within 3 months
Fujiwara, Y. (2007)	UCLP (n = 3), BCLP (n = 2)	Japanese	Distorted /s/ Palatalised affricates	Not reported	Daily, approx. 30mins/day for 7–9 months via PTU home training	CoG values, qualitative analysis of EPG frames	Not reported
Scobbie et al. (2004)	Isolated cleft of soft & hard palate (n = 1)	English	Distorted /s/ Distorted /tʃ/	Not reported	Ten 45min sessions over 4 months	Perceptual analysis of single words or isolated phonemes	Not reported
Gibbon et al. (2001)	UCLP (n = 7), BCP (n = 2) Soft palate only (n = 3)	English	Palatalised /s/ Palatalised /t/	Not reported	Four 30 to 45min sessions	CoG values, qualitative analysis of EPG frames	Completed once (6 weeks post-treatment)
Stokes et al. (1996)	UCLP (n = 2)	Cantonese	Not reported	2 pre-treatment measures	Seven weekly 1hour sessions	Perceptual analysis & qualitative analysis of EPG frames-constriction of tongue/location	4 months post-therapy (1 subject only)
Michi et al. (1993)	UCLP (n = 3) and BCLP (n = 3)	Japanese	Palatalised /s/	2–4 pre-treatment measures	Eight weekly 1 hour sessions	Visual analysis of EPG frames	Not reported

Note: UCLP = unilateral cleft lip and palate, BCLP = bilateral cleft lip and palate, BCP = bilateral cleft palate, PTU = portable training unit, CoG = centre of gravity

that the hierarchy is "a broad indicator of likely bias and can be used to roughly rank individual studies within a body of evidence" (Merlin, Weston, & Tooher, 2009, p. 6). They contend that ranking individual studies should be undertaken as an initial step in appraising the evidence of any given topic (Merlin et al., 2009).

The research presented in the six studies comprises primarily small case series and single subject experimental designs. Although single subject experimental designs are considered relatively low-level evidence, they have been acknowledged as an appropriate study design when randomised controlled trials (RCT) are not suitable (Rose, 2010). According to Rose (2010), situations deemed inappropriate for the use of a RCT include when research is in the early stages of development, when the target population contains too few individuals to form a robust sample, and when the client group has a high degree of variability. Hegde (1994, as cited in Lohmander et al., 2010) concurs that single subject designs build strength of evidence for treatment strategies when repeated across different individuals. These reasons are likely explanations for such designs that dominate the EPG literature under review. Table 2 further demonstrates the variability across the six studies.

Although the six studies included in this review provide some important insights into the potential benefits of EPG to treat articulation disorders in those with a repaired cleft palate, a number of limitations exist with the nature of the studies. We contend, however, that there are some viable explanations for what appears to be a relatively low level evidence base. Further, it is valuable to examine the available evidence as a means of advancing understanding and progressing this potentially important area of clinical practice.

Methods of therapy provision

Stokes, Whitehill, Tsui, and Yuen (1996) based their EPG therapy on a combination of traditional methods for treating sibilants outlined by Blache (1989, as cited in Stokes et al., 1996) and conventional EPG therapy methods when conducting therapy targeting /s/ with two children with repaired cleft palate. Michi et al. (1993) utilised a similar training schedule. Each of the studies found an improvement in production of targeted phonemes using visual comparison of EPG frames. These findings suggest that EPG may play a successful role in treating persistent articulation disorders when coupled with traditional methods.

CleftNET Scotland argued that practical and financial difficulties are one of the primary factors limiting access to EPG treatment (Gibbon et al., 1998). Jones and Hardcastle (1995) developed the EPG-3, a portable training unit (PTU), in order to improve access to EPG therapy. Fujiwara (2007) found marked changes in the EPG patterns of four out of five participants when using the EPG-4. Fujiwara (2007) found delivering therapy through PTU to be especially beneficial for clients residing in remote locations.

Lohmander et al. (2010) also reported improvements in their subject's articulation of /t/ and /s/ in words and sentences following therapy conducted in the home environment using a PTU. Moreover, Lohmander et al. reported improvements to their subject's speech at word level after just 8 hours of therapy, indicating that EPG via PTU has the potential to produce rapid success.

In their randomised controlled trial, Michi et al. (1993) found participants with excessive posterior tongue elevation progressed more rapidly with EPG therapy, whereas participants with less severe misarticulations at the onset of

treatment demonstrated similar progress with EPG therapy and non-EPG therapy. This finding strengthens previous research suggesting EPG therapy is most advantageous when treating articulation disorders that are not responsive to traditional methods (Lohmander et al., 2010; Fujiwara, 2007).

Therapy frequency and intensity for motor-based activities have been shown to impact treatment outcome effects when using EPG to treat articulation disorders not related to cleft palate (McAuliffe & Cornwell, 2008). However to date, research has not examined ideal dosage of EPG therapy with particular reference to targeting typical cleft palate articulation errors. In their 2001 study, Gibbon et al. reported that when compared with non-EPG therapy, EPG therapy is "more efficient in bringing about positive change in articulation patterns" (p. 57) with only a few therapy sessions. This preliminary evidence suggests that EPG may be an efficient method of delivering articulation therapy to children with repaired cleft palate.

Discussion

This paper summarises the current research exploring the use of EPG therapy for children with surgically repaired cleft palate. Among the six studies reviewed, a significant amount of variability was found. By comparing and contrasting the findings of each study, a limited evidence base can be formed to guide clinical practice in this growing area of speech pathology treatment. The remainder of this section discusses each study's methods, findings, and conclusions in order to provide direction for future research.

Sampling

Notable disparity between cleft types, specific articulatory behaviours, and previous speech pathology intervention were evident across the sample populations of the studies being reviewed. Such variation is likely to be a consequence of subject recruitment difficulties (Lee et al., 2009). Lohmander et al. (2010) contend that the small number of children considered eligible for EPG intervention makes it challenging to obtain a significant sample size in order to conduct a study that would meet the criteria for a higher level of evidence.

Baseline data

The majority of studies did not provide adequate baseline measures of their subjects' speech prior to EPG treatment (Gibbon et al., 2001; Scobbie et al., 2004; Stokes et al., 1996). For example, Gibbon et al. (2001) did not report a pre-treatment measure of articulatory accuracy. Baseline data provides stable pre-treatment production patterns in order to provide a valid account of changes produced by the treatment. Without an accurate impression of pre-treatment articulatory performance, the results may have shown fallacious improved outcomes (Portney & Watkins, 2009).

Outcome measures

The primary outcome measure for the majority of studies conducted in this field of research is correct articulation of speech sounds targeted in therapy (Lee et al., 2009). However, differences between how the researchers defined and measured correct articulation render the results somewhat incomparable.

Fujiwara's primary outcome (articulatory accuracy of /t/) was assessed using the centre of gravity (CoG) value. CoG values are obtained by calculating the "relative

concentration of electrodes in the anterior-posterior dimension" on the EPG frame (Hardcastle & Gibbon, 1997, as cited in Fujiwara, 2007, p. 67). Lohmander et al. (2010) and Gibbon et al. (2001) also used CoG measures to quantitatively measure change over time.

It has been argued that the type of speech material used in the assessment of speech intelligibility may impact the reliability of results obtained (Klinto, Salameh, Svensson, & Lohmander, 2010). Klinto et al. contended that word naming is the most reliable method of assessing speech intelligibility of children with cleft palate.

A standardised articulation test for Swedish speakers (SVANTE) was implemented by Lohmander et al. (2010) in order to assess articulatory accuracy before and after treatment. Gibbon et al. (2001) also obtained speech intelligibility ratings prior to treatment. The positive relationships shown between listeners' perceptual ratings and standardised articulation test findings added strength to the authors' arguments about the validity of results obtained (Gibbon et al., 2001; Lohmander et al., 2010).

Generalisability

Children with cleft palate are a heterogeneous population. Different types of clefts, types of surgical intervention, age of repair, severity of articulation disorder, and general speech and language development all impact on the resultant speech behaviour of a child with cleft palate (Peterson-Falzone et al., 2010). Additionally, around 50% of those with a cleft palate have co-occurring syndromes. These introduce more complex factors for consideration such as presence of further craniofacial abnormalities and variable cognitive ability (Peterson-Falzone et al., 2010) when reflecting on speech treatment outcomes. It is important to note that the studies reviewed did not include children with cleft palate as part of a syndrome in their samples. As such, the combined results found are not generalisable to the entire cleft palate population (Lee et al., 2009).

Follow-up

The majority of studies investigating the use of EPG as a treatment for cleft palate speech disorders did not provide satisfactory follow-up measures for it to be deemed successful as an enduring method of treatment for articulation disorders. Without adequate follow-up, it is difficult to demonstrate that subjects will continue to show improvements from the treatment or maintain its effects, thus limiting the reliability of the study (Lee et al., 2009). For example, Gibbon et al. (2001) provided only one follow-up measure post-EPG treatment.

Special considerations

Stokes et al. (1996) provided some evidence that patterns of emergence of fricatives and affricates differ across languages. They referred to this as different "cross-linguistic routes of development" (p. 276). For example, in Cantonese there is evidence to demonstrate that children commonly affricate /s/ to /ts/ as their phonetic system develops. This is an uncommon occurrence in developing English, and suggests that phonetic development in disordered speech may be dependent on patterns of typical development in individual languages (Stokes et al., 1996). Such variations must be taken account of when considering the cleft palate population. To demonstrate, retracted articulation of palatal sounds is a universal finding among children with cleft palate (Trost, 1981; Whitehill, Stokes & Yonnie, 1996, as cited in Fujiwara, 2007). However, slight differences in

production of palato-alveolar and alveolar phonemes exist across languages and are important to acknowledge when considering treatment using EPG (McLeod & Roberts, 2005, as cited in Fujiwara, 2007).

Lohmander et al. (2010) gathered EPG patterns of typically developing adult Swedish speakers prior to treatment in order to compare outcomes post-treatment to the norm for the Swedish speaking population. Comparing outcomes to native speakers' norms of production was found to be especially important when quantitative analysis of results was performed, as subtle differences between CoG values and timing of linguo-palatal placement were not always identified by listeners' perceptual ratings (Lohmander et al., 2010).

Conclusions and future research

Although a limited set of research exists for the potential benefits of EPG to treat articulation disorders in those with a repaired cleft palate, some promising albeit preliminary findings have been made about the viability of using EPG to significantly enhance the speech intelligibility of children with cleft palate (Fujiwara, 2007; Lee et al., 2009; Lohmander et al., 2010; Michi et al., 1993; Stokes et al., 1996). In particular, EPG therapy has been found to produce faster improvements to articulation errors that are resistant to conventional articulation therapy in the cleft palate population (Fujiwara, 2007; Gibbon et al., 2001; Lee et al., 2009).

The importance of collecting baseline data prior to the treatment phase in single subject experimental designs has been acknowledged (Rose, 2010). Further research should obtain stabilised pre-treatment production patterns in order to provide a valid account of changes produced by the treatment. Additionally, follow-up measurements should be obtained to ensure the changes are permanent (Lee et al., 2009).

Future research in this area should focus on the factors that may influence therapy outcomes, for example, therapy environment, intensity and duration of sessions and method of therapy provision. Prior to the initiation of a RCT, Gibbon and Paterson (2006) state that controlled group studies should be carried out to ascertain whether EPG therapy is more beneficial than the current methods of treatment for improving longstanding articulation disorders associated with cleft palate. Discovering the ideal conditions for EPG therapy would potentially allow a suitably designed RCT to be carried out in the future (Lee et al., 2009).

As different languages have slightly different norms of production of certain phonemes, all research completed should compare production patterns to that of the typically speaking population. Generalisation to contexts outside the clinic must occur in order for a meaningful improvement in communication to be achieved (Gibbon & Paterson, 2006). Further studies should assess intelligibility both at a spoken word level (Klinto et al., 2010) and in conversational settings to ensure carryover of the change in production pattern (Gibbon & Paterson, 2006).

Current clinical guidelines in the United Kingdom suggest EPG therapy is appropriate for treating articulation errors in children with cleft palate who have had little success when treated previously with conventional articulation therapy methods (National Institute of Clinical Excellence, 2002). This review found there is limited evidence for the widespread use of EPG for treatment of persistent articulation disorders associated with cleft palate at this stage. Future research should aim to increase knowledge about the factors that result in most effective treatment outcomes for the cleft palate population prior to combining these elements and conducting a large-scale randomised controlled trial.

References

Clark, L., Milesi, R., Mishra, R., Ratanje, M., & Rezk, M. (2007). *Bridging the gap: Promoting speech in children with cleft.* La Trobe University, retrieved from http://www.latrobe.edu.au/hcs/projects/Cleft_Palate/GeneralInformation.html

Dalston, R.M. (1992). Acoustic assessment of the nasal airway. *The Cleft Palate-Craniofacial Journal*, *29*(6), 520–526.

Fujiwara, Y. (2007). Electropalatography home training using a portable training unit for Japanese children with cleft palate. *Advances in Speech-Language Pathology*, *9*(1), 65–72.

Gibbon, F., Crampin, L., Hardcastle, W., Nairn, M., Razzell, R., Harvey, L., & Reynolds, B. (1998). Cleftnet Scotland: A network for the treatment of cleft palate speech using EPG. *International Journal of Language and Communication Disorders*, *33*, 44–49.

Gibbon, F., & Hardcastle, W. (1989). Deviant articulation in a cleft-palate child following late repair of the hard palate: A description and remediation procedure using electropalatography. *Clinical Linguistics and Phonetics*, *3*, 93–110.

Gibbon, F., Hardcastle, W. J., Crampin, L., Reynolds, B., Razell, R., & Wilson, J. (2001). Visual feedback therapy using electropalatography (EPG) for articulation disorders associated with cleft palate. *Asia Pacific Journal of Speech, Language and Hearing*, *6*, 53–58.

Gibbon, F., & Paterson, L. (2006). A survey of speech and language therapists' views on electropalatography therapy outcomes in Scotland. *Child Language Teaching and Therapy*, *22*, 275–292.

Gibbon, F., Stewart, F., Hardcastle, W., & Crampin, L. (1999). Widening access to electropalatography for children with persistent sound system disorders. *American Journal of Speech-Language Pathology*, *8*, 319-334.

Hardin-Jones, M., & Chapman, K. L. (2008). The impact of early intervention on speech and lexical development for toddlers with cleft palate: A retrospective look at outcome. *Language, Speech, and Hearing Services in Schools*, *39*, 89–96.

Hardin-Jones, M. A., & Jones, D. L. (2005). Speech production of preschoolers with cleft palate. *Cleft Palate-Craniofacial Journal*, *42*(1), 7-13.

Havstam, C., Sandberg, A. D., & Lohmander, A. (2011). Communication attitude and speech in 10-year-old children with cleft (lip and) palate: An ICF perspective. *International Journal of Speech-Language Pathology*, *13*(2), 156–164.

Jones, W., & Hardcastle, W. J. (1995). New developments in EPG3 software. *European Journal of Disorders of Communication*, *30*, 183–192.

Klinto, K., Salameh, E., Svensson, H., & Lohmander, A. (2010). Research report: The impact of speech material on speech judgement in children with and without cleft palate. *International Journal of Language and Communication Disorders* [early online article], 1–13. doi: 10.3109/13682822.2010.507615

Lee, A., Gibbon, F., Crampin, L., Yuen, I., & McLennan, G. (2007). The national CLEFTNET project for individuals with speech disorders associated with cleft palate. *Advances in Speech-Language Pathology*, *9*(1), 57–64.

Lee, A. S., Law, J., & Gibbon, F. E. (2009). Electropalatography for articulation disorders associated with cleft palate (Review). *The Cochrane Library*, Issue 4.

Lohmander, A., Henriksson, C., & Havstam, C. (2010). Electropalatography in home training of retracted articulation in a Swedish child with cleft palate: Effect on articulation pattern and speech. *International Journal of Speech-Language Pathology*, *12*(6), 483–496.

McAuliffe, M. J., & Cornwell, P. L. (2008). Intervention for lateral /s/ using electropalatography biofeedback and an intensive motor learning approach: A case report. *International Journal of Language and Communication Disorders*, *43*, 219–229.

Marazita, M. L., & Mooney, M. P. (2004). Current concepts in the embryology and genetics of cleft lip and cleft palate. *Clinics in Plastic Surgery*, *31*, 125–140.

Merlin, T., Weston, A., & Tooher, R. (2009). Extending an evidence hierarchy to include topics other than treatment: Revising the Australian "levels of evidence". *BMC Medical Research Methodology*, *9*, 34.

Michi, K. I., Yamashita, Y., Imai, S., Suzuki, N., & Yoshida, H. (1993). Role of visual feedback treatment for defective /s/ sounds in patients with cleft palate. *Journal of Speech and Hearing Research*, *36*, 277–285.

National Health and Medical Research Council (NHMRC). (2009). *NHMRC Levels of evidence and grades for recommendations for developers of guidelines*. Adelaide: Author.

National Institute for Clinical Excellence (NICE). (2002). *Interventional procedures overview of electropalatography*. London: Bazian.

Neumann, S., & Romonath, R. (2011). Effectiveness of nasopharyngoscopic biofeedback in clients with cleft palate speech: A systematic review. *Logopedics Phoniatrics Vocology* [early online article], 1–12. doi: 10.3109/14015439.2011.638669

Pamplona, M. C., Ysunza, A., & Espinosa, J. (1999). A comparative trial of two modalities of speech intervention for compensatory articulation in cleft palate children, phonologic approach versus articulatory approach. *International Journal of Pediatric Otorhinolaryngology*, *49*, 21–26.

Pamplona, C., Ysunza, A., Patino, C., Ramirez, E., Drucker, M., & Mazon, J. J. (2005). Speech summer camp for treating articulation disorders in cleft palate patients. *International Journal of Paediatric Otorhinolaryngology*, *69*, 351–359.

Peterson-Falzone, S. J. (1990). A cross-sectional analysis of speech results following palatal closure. In J. Bardach & H. L. Morris (Eds.), *Multidisciplinary management of cleft lip and palate* (pp. 750– 756), Philadelphia, PA: W. B. Saunders.

Peterson-Falzone, S. J., Hardin-Jones, M. A., & Karnell, M. P. (2010). *Cleft palate speech* (4th. ed.). St Louis, MI: Mosby.

Portney, L. G., & Watkins, M. P. (2009). *Foundations of clinical research: Applications to practice* (3rd.ed.). Upper Saddle River, NJ: Pearson Education.

Reid, J. (2004). A review of feeding interventions for infants with cleft palate. *Cleft Palate-Craniofacial Journal*, *41*(3), 268–278.

Rose, M. (2009). Single subject experimental designs in health research. In P. Liamputtong (Ed.), *Research methods in health: Foundations for evidence-based practice* (pp. 199–240), South Melbourne: Oxford University Press.

Scobbie, J. M., Wood, S. E., & Wrench, A. A. (2004). Advances in EPG for treatment and research: An illustrative case study. *Clinical Linguistics & Phonetics*, *18*(6–8), 373–389.

Shprintzen, R. J. (1995). A new perspective on clefting. In R. J. Shprintzen & J. Bardach (Eds.), *Cleft palate speech management: A multidisciplinary approach* (pp. 1–15). St Louis, MI: Mosby-Year Book.

Siren, K. (2004). Cleft lip and palate. In L. Schoenbrodt (Ed.), *Childhood communication disorders: organic bases* (pp.187–225). Clifton Park, NY: Thompson Delmar Learning.

Stokes, S. F., Whitehill, T. L., Tsui, A. M. Y., & Yuen, K. C. P. (1996). EPG treatment of sibilants in two Cantonese speaking children with cleft palate. *Clinical Linguistics and Phonetics*, *10*, 265–280.

Trost, J.E. (1981). Articulatory additions to the classical description of the speech of persons with cleft palate. *Cleft Palate Journal*, *18*, 193-203.

Wyszynski, D. F. (2002). *Cleft lip and palate: From origin to treatment*. New York: Oxford University Press.

1 Disordered resonance in cleft palate speech is not specifically addressed in this review as it is not amenable to EPG treatment. Please refer to Neumann and Romonath (2011) for a systematic review on current research relating to the use of nasopharyngoscopic biofeedback to treat velopharyngeal insufficiency in cleft palate speech.

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Clinical insights

Adapting speech pathology practice: Delivering parent education groups using technology

Corinne Loomes and Alice Montgomery

Corinne Loomes (top) and Alice Montgomery

This paper discusses parent education groups for families with children who have sensory disabilities. Families living in rural and remote areas participated in group sessions via videoconference. The technology required to provide parent groups for families located across Australia is discussed, with three different telepractice methods reported. The parent groups used The Hanen It Takes Two to Talk® program as the structure of the parent groups, and the adaptations required to use this existing program in a telepractice format are described.

Many families with children who have disabilities have limited or no access to support services (Senate Committee, 2002). Metropolitan areas offer some opportunities for these families to meet and support one another, for example, playgroups for children with disabilities, and parent education groups. Socialising with other families provides support and can have a powerful and positive impact (Crinc & Stormshak, 1997). Families in similar situations can provide each other with encouragement, understanding, and humour (Atkins, 2009). However, the reality for one-third of Australians is that they live in rural and remote areas (Australian Bureau of Statistics, 2009). Living outside of a metropolitan area can mean that these families miss out on meeting with others to share experiences.

Considering the fact that approximately 2 in 1000 children have significant permanent hearing loss (Russ et al., 2003), it is easy to see how a specialised service for hearing impaired children in remote locations might be difficult to find. Where services are available, some of the established difficulties for professionals working in remote locations include: large and generalist caseloads; vast distances to cover; difficulties accessing some areas due to weather conditions; and high staff turnover (McCarthy, 2010). Telepractice can offer specialised services to be delivered from large metropolitan centres and accessed by all Australians.

Developments in technology enable services to be provided using telepractice solutions previously not possible. Theodoros (2011) suggests speech pathologists need "to engage and embrace this change in order to develop and diversify within the 21st century". Speech pathologists are currently using telepractice for various individual clinical purposes, for example, to assess speech and language in children (Waite, Theodoros, Russell, & Cahill, 2010), stuttering intervention (O'Brian, Packman, & Onslow, 2008), and parent education (Baharav & Reiser, 2010). Other professionals are also utilising telepractice to connect families – for example, child health nurses facilitating a new mothers' support group (Nyström & Öhrling, 2006). The telepractice solutions described in this paper illustrate how telepractice can be used to deliver parent education groups to families living distantly from one another.

Technology: changing the service delivery options

The Royal Institute for Deaf and Blind Children's RIDBC Teleschool is based in Sydney, NSW, and is a dedicated team to support families with hearing and/or vision impairment across Australia. RIDBC Teleschool offers weekly telepractice sessions with a consultant via videoconference to enrolled families. This is supported by resources, lesson plans, phone calls, and emails as required. In 2009 RIDBC Teleschool began using a telepractice model to provide parent education groups to rural and remote families.

The parent education groups were designed to create an environment for remotely located families to support each other while learning about communication. "It Takes Two to Talk®: The Hanen Program® for Parents" (Conklin, Pepper, Weitzman, & McDade, 2007) was chosen because it is a family-focused early language intervention program with a strong evidence base. The It Takes Two to Talk program is a comprehensive package providing detailed instructions for each group and individual session. It contains pre-prepared PowerPoint slides, as well as various videos to share with participants. Some group tasks suggest breaking the group into pairs or fours to complete activities. Participants also have individual sessions which are video-recorded so that they can be replayed during the session to comment on the interactions captured. There are two major issues to consider when delivering It Takes Two to Talk to families via telepractice: the availability of appropriate technology, and adapting the It Takes Two to Talk program to suit telepractice service delivery. Several options were trialled with three different groups of parents, and are discussed below.

Three technology solutions for telepractice service delivery

1. Videoconferencing using ISDN

The first It Takes Two to Talk group made use of videoconferencing facilities with an ISDN (Integrated Services Digital Network) connection. Individual and group sessions were held at local videoconferencing studios. For the group sessions a virtual bridge, which is a private network that is created to connect specific videoconferencing sites, was used to connect the four families and the presenter.

In order to share PowerPoint slides and videos with the families during the group sessions the presenter used a document camera. The document camera connects simultaneously to the videoconferencing equipment and a computer. It allows information presented on the computer to be viewed by the group participants via the television monitor at their conference site. A key component of the It Takes Two to Talk program involves individual sessions, where the parent is filmed interacting with their child. This video is then played back to the parent during the session to analyse the interactions. It was still possible to provide immediate feedback in the individual session by recording the session occurring at the parent's site, and then replaying it to the parent for discussion. In this method, the individual session was captured using a VHS recorder.

At the end of the course parents were asked to complete a questionnaire about their experience. Parents were satisfied with the technology used and thought that it provided very high-quality audio and video. Parents also reported how much they enjoyed the group sessions and connecting with other families over videoconference. Some parents commented that it was difficult for them to attend sessions at a local studio and would have preferred a home-based service. They reported that it took some time to feel confident using specific strategies for telepractice communication, for example, introducing themselves to engage the voice activated picture display, where the person talking is the person seen by all participants, and muting microphones to maintain the picture on the speaker rather than have the picture display changed by background noises.

2. Videoconferencing using web-based software

Alterations to the telepractice model were made based on parent feedback from the videoconferencing method described above. This second parent group used web-based conferencing. Many conferencing programs are available, and for this group Sightspeed Business (2004–2009) was chosen. Sightspeed Business provided the capacity to connect multiple sites and share files and computer desktops while connected. As the conferencing program was web-based, all families could participate at home, provided they had access to a computer and adequate upload/download speed.

In this It Takes Two to Talk group four families enrolled at RIDBC Teleschool combined with four metropolitan families. The metropolitan families attended group sessions at the RIDBC campus in Sydney. The remote families connected to the group using Sightspeed Business. By sharing the presenter's desktop, PowerPoint slides and video clips could be viewed simultaneously by all participants.

Delivering the It Takes Two to Talk program by telepractice

Sightspeed Business did not provide the capacity to record and play back video instantaneously. To counteract this problem, families attended a local studio for individual sessions (see videoconferencing using ISDN).

Parent feedback from the questionnaire was again positive. All families reported how much they had enjoyed connecting with other families with one participant in rural Victoria commenting "it's great to know there is someone else out there!". In using web-based conferencing, more technology problems were encountered than in method 1. Some predictable difficulties occurred since transmission relied on the quality and speed of the families' individual internet connections. The biggest challenge, however, was preventing significant amounts of audio feedback and echo. A number of solutions were trialled and use of an FM transmitter with a Direct Audio Input (DAI) connected to the clinician's laptop allowed for clearer transmission of the audio signal. Although this solution was found to improve audio quality greatly, feedback reoccurred occasionally. Two presenters were then used: one to present and one to manage and troubleshoot the technology. This is in contrast to other methods, where one presenter was able to manage both the material and technology.

3. Combining videoconferencing with on-site sessions

The telepractice service delivery model was altered in two ways in the third method as a result of parent feedback. First, a residential component was added, to further facilitate social support opportunities. Second, the group sessions delivered remotely used in-home videoconferencing technology. Three families were accommodated at the RIDBC campus in Sydney and attended the first three group sessions and an individual session while on site.

All the participants had dedicated in-home videoconference equipment supplied on loan by RIDBC Teleschool. This equipment utilised the cellular network for transmission of the signal. The remaining group sessions used a multipoint connection that was created by using RIDBC Teleschool's videoconference camera with specialist software installed. This camera and software has the capacity to link sites using ISDN and/or cellular connections. PowerPoint slides and videos were shared with families as per method 1, and participants could now see all participants and slides simultaneously. Individual sessions were recorded using computer software. The footage was reviewed during the session using the document camera that transmitted directly from the computer.

Using dedicated videoconferencing equipment ensured a high-quality picture and audio for all group and individual sessions which was confirmed by all participants on the questionnaire. Parents again highlighted how positive it had been to meet and connect with other families in a similar situation. They also reported that the residential component had provided opportunities for them to socialise with the other parents. Parents said they felt more confident and open in sharing during later group sessions.

Delivering the It Takes Two to Talk program by telepractice

Apart from mastering the technology required for successful telepractice, it was also important to ensure that the content of the course was maintained, while altering the presentation to suit the service delivery mode. The It Takes Two to Talk program outlines six minimum requirements for an adapted program (summarised in Box 1). All requirements for the program were maintained in each method described and essentially telepractice changed only the relative location of the presenter and participants.

Box 1. Minimum requirements when adapting It Takes Two to Talk: the Hanen Parent Program
1. Ensure a recent assessment of each child is available.
2. Conduct and record a pre-program consultation.
3. Develop individual goals for the children collaboratively with parents.
4. Provide a minimum of 4 group sessions and a minimum of 10 group hours.
5. Use full teaching cycles as per the program.
6. Conduct one or more individual sessions involving coaching and feedback.
Source: Conklin et al., 2007, p. 562.

Additional planning was required to deliver some of the practical elements of the program, including facilitating group discussions and modifying group activities. For example the "icebreaker" task is usually done in groups of four. However, telepractice does not allow for participants to hold separate discussions using the same multipoint connection. In each of the methods, all participants were involved in the activity together (Conklin et al., 2007, p. 113). Some adaptation in the role play activities was also required. For example, in method 1 presenters modelled role-play activities, as only one site could be seen at a time. In method 3 it was possible to have participants from different locations work together on the role play activities.

In the "Birthday Game" (Conklin et al., 2007, p. 119) participants are asked to form a line in the order of their birthdays without talking. When conducting this activity by telepractice, participants were still able to determine their birth order without speaking. However, instead of forming a line, they wrote a number on a piece of paper, and displayed it to the group to indicate their place in the "line". This worked successfully in all three telepractice methods described.

Discussion in pairs was possible. In method 1 two pairs were formed by members of the same family at the same location. The remaining 2 participants (in separate locations) used the videoconference equipment for their discussion. All other participants muted their microphone so their discussion did not interrupt the videoconference pair. They also turned the speaker volume down, so they weren't hearing the discussion of the videoconferencing pair. At other times discussions were conducted as a whole group.

Other practical considerations include advanced planning, for example, booking rooms for the telepractice sessions, and sending out resources and handouts required for each session well in advance. Reviewing the program for each week ahead of time and making modifications to activities was also very important. Often a backup plan was required to enable the session to continue despite technology problems, for instance, having videos available in multiple formats in case of technology problems.

Another consideration is the number of participants. The group numbers were smaller than typical for the It Takes Two To Talk program. While this was mainly due to the family availability and suitability for each course, the smaller

number allowed us to manage any technology problems. This discussion highlights some key practical and pedagogical considerations that are required to make the telepractice model successful and illustrates modifications that might be made in telepractice sessions on other topics or within other areas of speech pathology.

Conclusion

Our aim of providing an It Takes Two to Talk program to parents was to connect rural families and provide a high-quality parent education program. For families enrolled in RIDBC Teleschool, this required the use of technology to deliver parent courses. When speech pathology services can use technology to offer group sessions to support communities of people from similar circumstances across wide distances, then rural and remote families are truly receiving services comparable to their metropolitan counterparts. RIDBC Teleschool's initial investigations in using telepractice to deliver parent education groups have been technology-based. Each telepractice method described was trialled to establish which technologies can be used to effectively deliver parent education groups. Future research should investigate the effectiveness of telepractice parent education groups as compared to those delivered face to face. This should not only look at parent satisfaction, but also examine the changes in the communication skills of the children participating while using different modes for delivering the parent education groups.

References

Atkins, V. (2009). Family involvement and counselling in serving children who possess impaired hearing. In R. Hull (Ed.), *Introduction to aural rehabilitation* (pp. 89–106). San Diego, CA: Plural Publishing.

Australian Bureau of Statistics. (2009) *Australian social trends: 2008*. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Chapter3002008

Baharav, E., & Reiser, C. (2010). Using telepractice in parent training in early autism. *Telemedicine and e-Health*, *16*, 727–731.

Conklin, C., Pepper, J., Weitzman, E., & McDade, A. (2007). *It Takes Two to Talk: The Hanen program for parents* (5th ed.). Toronto, Canada: Hanen Centre Publication.

Crinc, K., & Stormshak, E. (1997). The effectiveness of providing social support for families of children at risk. In M. J. Guralnick (Ed.), *The effectiveness of early intervention* (pp. 209–226). Baltimore, MD: Paul H. Brookes Publishing.

McCarthy, M. (2010). Telehealth or tele-education? Providing intensive, ongoing therapy to remote communities. In A. Smith & A. Maeder (Eds.), *Selected papers from Global Telehealth 2010* (pp. 104–111). Netherlands: IOS Press.

Nyström, K., & Öhrling, K. (2006). Parental support: Mothers' experience of electronic encounters. *Journal of Telemedicine and Telecare*, *12*, 194–197.

O'Brian, S., Packman, A., & Onslow, M. (2008). Telehealth delivery of the Camperdown Program for adults who stutter. *Journal of Speech, Language, and Hearing Research*, *51*, 184–195.

Russ, S., Poulakis, Z., Barker, M., Rickards, F., Saunders, K., & Oberklaid, F. (2003). Epidemiology of congenital hearing loss in Victoria, Australia. *International Journal of Audiology*, *42*, 385–390.

Senate Committee. (2002). *Employment, workplace relations, and education references: Education of students with disabilities*. Retrieved from http://aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=eet_ctte/completed_inquiries/2002-04/ed_students_withdisabilities/report/index.htm

Sightspeed Business (2004–2009). [computer software]. Berkeley, CA: Sightspeed. Retrieved from www.sightspeed.com/business.html

Theodoros, D. (2011, June). *A new era in speech pathology practice: Innovations and diversification*. Paper presented at the Speech Pathology Australia National Conference Diversity & Development, Darwin, Australia. Retrieved from http://www.speechpathologyaustralia.org.au/library/2011_Conference/Prof_Deb_Theodoros_Abstract.pdf

Waite, M., Theodoros, D., Russell, T., & Cahill, L. (2010). Internet-based telehealth assessment of language using the CELF-4. *Language, Speech, and Hearing Services in Schools*, *14*, 445–458.

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Clinical insights

No boundaries: Perspectives of international Skype delivery of the Lidcombe Program

Shane Erickson

Shane Erickson

Given the barriers that influence many clients' access to stuttering treatment, clinicians and researchers are seeking effective alternative treatment delivery models. Positive outcomes from trials reporting the telehealth delivery of stuttering treatment has meant clients can avoid many of these access issues and conveniently receive treatment. Despite little reported evidence to support the use of Skype, evidence for delivery methods such as using a telephone would seem to indicate that it is a viable alternative to face-to-face treatment. This clinical insight reports the perspectives of experienced stuttering clinician Dr Brenda Carey and her client about the use of Skype to deliver the Lidcombe Program internationally.

While data regarding the incidence and prevalence of stuttering are limited, most studies have suggested that around 1% of people stutter (e.g., Craig, Hancock, Tran, Craig, & Peters, 2002). Typically developing before the age of four, stuttering has been observed in all cultures, races, historical periods, and languages (Ardila, 1994). The current consensus is that ideally stuttering should be treated in the preschool years (Jones et al., 2005). This is primarily based on the fact that neural plasticity decreases with age and as such stuttering becomes less tractable. Early, effective intervention appears crucial in preventing the significant impact of stuttering, with the potential for it to become a chronic condition by adulthood, significantly disrupting life on a daily basis (Onslow, 2000).

Presently, the Lidcombe Program (Onslow, Packman, & Harrison, 2003) is the most efficacious treatment for children who stutter. Randomised controlled trials have shown that this parent-delivered, behavioural treatment is most effective with children younger than 6 years of age (Jones et al., 2005). Traditional delivery requires parents to travel weekly to clinics specialising in this treatment.

Access to treatment is a significant issue for many clients who stutter and their families. Doolittle and Spaulding's (2006) review of the importance of telemedicine health care identified that many people do not have access to appropriate services for their needs. Major disparities exist

between and within countries due to economic, political and in particular, geographical factors. Lifestyle factors also present as a barrier for clients, with significant direct costs such as transportation and accommodation, and indirect costs including time off work for clients and family members or even childcare costs (Doolittle & Spaulding, 2006).

While the Lidcombe Program has gained widespread acceptance among speech pathologists in Australia (Onslow et al., 2003), this isn't necessarily the case around the world. The treatment has been introduced and accepted by clinicians in the United Kingdom, South Africa, Canada, New Zealand, and Germany. Additionally, there is some uptake by clinicians in other European countries like Denmark and the Netherlands. However, client access in some countries (including the United States) has likely been affected by a preoccupation with treatments influenced by the diagnosogenic theory of stuttering (that it is caused by parents inappropriately drawing attention to their child's dysfluencies) which directly opposes the principles of the Lidcombe Program.

To combat access issues, speech pathology services in other areas of the profession have been delivered via telehealth for more than three decades. However, published data regarding telehealth implementation in the field of stuttering is limited and only dates back to 1999. Harrison, Wilson, and Onslow's (1999) single case study successfully adapted the Lidcombe Program to be delivered over the telephone for a family isolated from treatment services. The positive outcome has more recently been confirmed by phase I and phase II trials of telehealth delivery of the Lidcombe Program (Lewis, Packman, Onslow, Simpson, & Jones, 2008; Wilson, Onslow, & Lincoln, 2004). Presently, a randomised controlled trial is underway comparing in-clinic delivery of the Lidcombe Program with Internet delivery using Skype.

In Melbourne, experienced speech pathologist Dr Brenda Carey has delivered the Lidcombe Program via Skype when families were unable to access in-clinic sessions. This has resulted in clients from places like China, United States, India, Singapore, Italy, and indeed rural Australia receiving this treatment. One such client is Jenny (pseudonym) and her son Tom (pseudonym) who live in South Africa. The following are the perspectives of Dr Carey and Jenny about their experiences of the Skype-delivered Lidcombe Program.

Establishing contact

Jenny (J): I read about the Lidcombe Program on the Internet. It just sounded so child centred and positive. I

emailed Professor Mark Onslow (of the Australian Stuttering Research Centre) to ask him if he knew of Lidcombe therapists in South Africa. He gave me a few ideas but also said the option of telehealth was available.

Dr Brenda Carey (BC): As a specialist stuttering clinician and member of the Lidcombe Program Trainers' Consortium I have used the Lidcombe Program in clinic for many years, and am aware of the outcomes from telehealth trials. My doctoral and subsequent research has involved the delivery of stuttering treatments using telehealth models. When approached by this family experiencing access barriers to the Lidcombe Program, I was willing to provide this service. I had previously treated adults who stutter using the Camperdown Program, over the phone, and a few children living internationally who were unable to access the Lidcombe Program.

Access to the Lidcombe Program in South Africa

J: I chatted to two speech therapists in South Africa. The first one saw the Lidcombe Program as simply "good speech therapy" rather than a distinct approach. I then spoke to another therapist who didn't seem specifically trained in the Lidcombe Program either. I did try making further enquiries but couldn't find anyone who described themselves as a Lidcombe therapist.

BC: I know she had difficult fining a clinician who had Lidcombe Program training, and when she did, the program was offered as an adjunct to another treatment, not as recommended by the "Clinician's Guide to the Lidcombe Program" (http://sydney.edu.au/health_sciences/asrc/docs/lidcombe_program_guide_2011.pdf).

Advantages of Skype delivery

BC: For some clients telehealth may be the only service delivery model available. It may also be the only opportunity to access treatment that has randomised controlled trial evidence (Jones et al., 2005). A telehealth service is also timesaving as there is no need to drive to a clinic or wait in the clinic waiting room. Finally, children and parents are more likely to feel comfortable to receive treatment in their own homes.

The clinician achieves greater insight into the child's world. The treatment is conducted in the child's environment, and it's not unusual for the child to bring into the session toys, family members, and pets. As a result, the clinician also sees a larger and more representative sample of the child's speech.

J: Well, I think it allowed me direct access to someone like Brenda (even though she was on the other side of the world) who is obviously so highly skilled and respected in delivering the Lidcombe Program.

Tom's initial presentation

BC: Jenny described Tom (age 4;0 years) as a highly communicative, creative, and imaginative child. She expressed concern about Tom's stuttering which had been present for more than a year, and the possible impact it may have on him in the future, should it become "entrenched". Jenny had read extensively about stuttering and was well informed about the varied treatment approaches. She did not feel that Tom was aware of his stuttering, and in line with what she had read, had made

every attempt not to draw attention to it, fearing this might make it worse. She described a close, supportive family with a positive family history of stuttering.

Recordings of Tom confirmed that his stuttering was frequent and he displayed a range of repetitive stuttering behaviours. His percentage of syllables stuttered in a 10-minute conversation with his father was 20 %SS, Severity Rating (SR) of 7.

J: I first noticed that Tom was struggling with certain words when he was nearly three. Initially I hoped it would just go away and certainly there were periods when it improved; however, it never disappeared completely. Over a number of years I read up as much as I could about stuttering, but was fairly ambivalent about what therapy, if any, to embark on. This was exacerbated by the fact that sometimes his speech would improve, only to worsen a little later.

Dr. Brenda Carey providing Skype treatment to a pre-school child who stutters
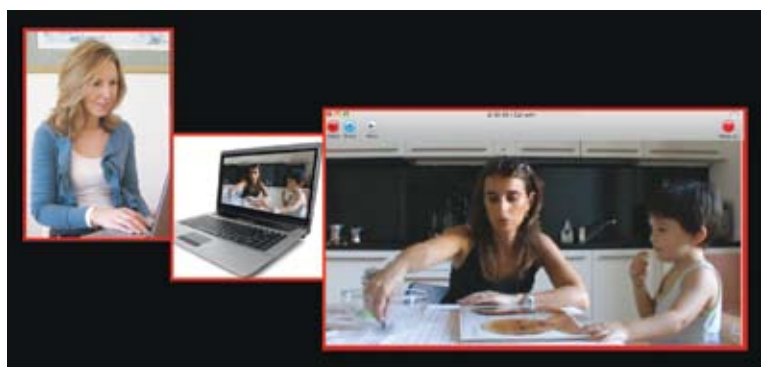
Building a relationship

J: From the very start of treatment I felt Brenda was right there in the trenches with us – not managing the issue in a detached way. Of course the irony of it was that she was actually thousands of miles away yet we had this sense of real partnership with her. In fact, my husband even found that he was no longer allowed to insult the Australian nation during rugby matches on the TV – he had to qualify his comments by adding "except Brenda of course" or get dirty looks from Tom and me!

BC: I felt a constructive and supportive relationship was quickly established that was not impeded by the delivery model. Jenny was clearly engaged in her son's treatment. Parental motivation, creativity, persistency, and belief in the treatment are always contributors to success and this parent had all of these qualities in spades!

Delivering treatment via Skype

BC: While Tom was present at every consultation, he usually only remained on camera for a short time. During these times severity ratings were discussed and confirmed and I demonstrated aspects of therapy. To augment this, Jenny recorded and emailed weekly speech samples of Tom's spontaneous and treatment conversations. Jenny's excellent compliance afforded me the opportunity to hear his speech in a variety of commonly occurring situations.

J: I think telehealth has a huge amount to offer. I found it so convenient and incredibly stress free. My son and I were in our own home so there was none of the settling in period that might occur when working in a therapist's rooms. My son is also terribly interested in technology so the idea that he got to chat to an interested (and interesting!) adult via Skype on a weekly basis was a huge treat for him.

I never really had any doubts – as soon as the process of telehealth was explained to me, it seemed like such a viable, sensible option. I had read a lot about Brenda via the Internet and during an initial conversation felt that she completely "got" our situation – she was so obviously highly skilled and incredibly empathetic too.

Treatment delivery difficulties

J: We had a few times when technical difficulties arose. Luckily my husband is very au fait with IT so we were usually able to resolve any problems quickly. When we started the therapy I hadn't really used Skype before but lots of people use it to stay in touch with friends and family. Previously, I would have advised others considering telehealth to make sure they have access to good technical help; however, now that the technology is so mainstream I think this is less important as so many people have access to Skype at home and it seems less complex.

BC: Parents might find it a little harder to learn Lidcombe Program practices when demonstration is restricted. The clinician needs to rely on effective verbal communication even more. For example, during an in-clinic session a clinician typically demonstrates with toys or books how to provide the contingencies to the child. This is more difficult over Skype. Additionally, extra flexibility in scheduling client appointments may be required if treating clients in the northern hemisphere, due to time differences. Finally, there are technological issues, for example poor Internet connection.

Tom's progress

BC: Overall, Tom has reduced his stuttering markedly. However, this has taken many weeks longer than the mean from in-clinic outcome studies. While this is consistent with Tom's high pre-treatment severity, it is also possible that the delivery model may have been a contributor. As can be common to Lidcombe Program clients, there have been small exacerbations along the way, and weeks during which severity ratings (SR) have plateaued. Tom currently sits at a SR 2 (0.7 %SS), and we continue to aim for SR 1 (no stuttering).

J: His progress was really fast at first. After that, we did have a few plateaus which Brenda managed by changing strategy or sometimes suggesting a short therapy holiday, to give us more energy to tackle the issue later on.

Face-to-face versus telehealth for Tom?

BC: Of course this is impossible to know. Children with high severity typically take longer to complete the Lidcombe Program, and Skype delivery might have extended this further.

J: I found the Skype-delivered treatment so convenient and stress free that I think it's superior! Had we embarked on the treatment in South Africa, I would have needed to drive at least an hour to access treatment. Engaging with a therapist via Skype was new for me; however, I felt such a sense of trust in Brenda, certainly on a professional level, as it was clear that she was a highly esteemed and qualified practitioner.

Required clinician skills

BC: Clinicians need a high degree of in-clinic experience with the Lidcombe Program, and must be confident that they have met the program's clinical benchmarks for a large number of clients. They also need to be confident with the technology.

I would suggest that clinicians first exhaust all other avenues to access the Lidcombe Program in-clinic. Outcomes from an RCT of the Lidcombe Program delivered over the phone (Lewis et al., 2008) show it is a less efficient delivery model, and takes on average three times longer to reach stage 2. Until research outcomes are available for the Lidcombe Program over Skype, we should be very conservative in its use.

The last word...

J: I think Skype has incredibly exciting potential in allowing clients to access health care that simply wouldn't be an option otherwise. I am just so grateful that we were able to find the exact help that Tom needed.

BC: I think and hope that there will be an increasing range of evidence-based treatment delivery alternatives for people who stutter. I see the potential benefits might be greatest if webcam Internet treatments can be developed for adolescents. Computers are such an integral part of their lives, and viewed so favourably by them. We are working on this at the Australian Stuttering Research Centre at present and hope to have our phase I trial results published soon.

References

Ardila, A. (1994). An epidemiologic study of stuttering. *Journal of Communication Disorders*, *27*, 37–48.

Craig, A., Hancock, K., Tran, Y., Craig, M., & Peters, K. (2002). Epidemiology of stuttering in the community across the entire lifespan. *Journal of Speech, Language, and Hearing Research*, *45*, 1097–1105.

Doolittle, G. C., & Spaulding, R. J. (2006). Defining the needs of a telemedicine service. *Journal of Telemedicine and Telecare*, *12*, 276–284.

Harrison, E., Wilson, L., & Onslow, M. (1999). Distance intervention for early stuttering with the Lidcombe Programme. *Advances in Speech Language Pathology*, *1*(1), 31–36.

Jones, M., Onslow, M., Packman, A., Williams, S., Ormond, T., Schwarz, L., & Gebski, V. (2005). Randomised controlled trial of the Lidcombe programme of early stuttering intervention. *British Medical Journal*, *331*(7518), 659–667. doi: 10.1136/bmj.38520.451840.E0

Lewis, C., Packman, A., Onslow, M., Simpson, J. M., & Jones, M. (2008). A phase II trial of telehealth delivery of the Lidcombe Program of Early Stuttering Intervention. *American Journal of Speech Language Pathology*, *17*(2), 139–149. doi: 10.1044/1058-0360(2008/014)

Onslow, M. (2000). Stuttering treatment for adults. *Current Therapeutics*, *41*(4), 73–76.

Onslow, M., Packman, A., & Harrison, E. (2003). *Lidcombe program of early stuttering intervention: A clinician's guide*. Austin, Texas: Pro-Ed.

Wilson, L., Onslow, M., & Lincoln, M. (2004). Telehealth adaptation of the Lidcombe Program of Early Stuttering Intervention: Five case studies. *American Journal of Speech-Language Pathology*, *13*, 81–93.

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Webwords 44

Life online

Caroline Bowen

Revisiting the world of information and communication technology (ICT) and the speech-language pathologist (Bowen, 1999; 2003) in 2012, three main themes emerge. First, most of the useful personal, recreational, business, and professional web applications can be sourced for no cost or at a very low cost and conquering their use is easy but potentially time-consuming.

Second, despite fears that the language of the Internet (Crystal, 2001) would destroy English and other languages, the language that appears in our browsers is essentially the same as it was in pre-Internet days with just a few changes relating to an increase in stylistic range, flexibility in the use of punctuation and capitals, and a grammatical informality not found in written English since the Middle Ages (Crystal, 2008). There are new written forms and novel word usages associated with blogging, emailing, chatting, and texting, and new expectations of how words might be interpreted. How ever did Webwords anticipate that an image search for "Middle Ages" might yield pictures of vibrant Threshold Generation party animals living well, exercising regularly, and getting a good chuckle out of scrapping their retirement plans?

The Internet has boosted the lexicon by some 200–300 words. There are CamelCase words: eBay, PayPal, and WikiLeaks; portmanteau words (Carroll, 1871): bit (binary digit), malware (malicious software), modem (modulate demodulate), and pixel (picture element); acronyms: FCOL;

abbreviations: GIF, meg, net; memes; and computerese – the Tech Speak of computer geeks: "You'll *love* this! At the end of '88 I was *still* running the old IBM OS/2 SE 1.0 on an AT/099 with an ST251-1. Hilarious or what?"

Third, online social networking – connecting with others and sharing information via the Internet – in our field is increasing. At the same time, WC3's **semantic web**[1], currently in development and frequently called Web 3.0, is already changing life online. But it is not quite time for a Web 2.0 ("social web") retrospective.

The purpose of this feature-length Webwords is to suggest ways that modestly net-savvy and computer literate speech-language pathologists can utilise, enjoy, and reap the benefits of web technologies without spending a fortune. It includes an explanation of Web 1.0 and Web 2.0 and a tour of the so-called Web 2.0 technologies with links to more detailed information; the interesting ways our SLP/SLT professional associations and colleagues use these tools; and the lowdown on creating professionally oriented blogs, wikis, Internet forums, and electronic mailing lists, or websites.

Read/write web

The date 6 August 1991 marked the debut of the world wide web as a publicly available service on the Internet. "Web 1.0" or "Web", refers to its first stage, in which html pages were connected with revolutionary hypertext links (hyperlinks) and web-based email came into its own, impacting the dissemination of knowledge within and across settings. **Tim Berners-Lee**[2], who invented it, is serious about accessibility (Berners-Lee, 2002; Bowen, 2012), and it is timely, in the **National Year of Reading**[3], to be reminded that he wanted it to be the "Read/Write Web" where anyone, anywhere could meet and read and write.

Connecting people

Digital doyenne Darcy DiNucci coined the term "Web 2.0" in 1999. It persists despite Berners-Lee's criticism that, "nobody even knows what it means". When asked in 2006 if he agreed that "Web 1.0 is about connecting computers, while Web 2.0 is about connecting people", Berners-Lee replied, "Totally not. Web 1.0 was all about connecting people ... If Web 2.0 for you is blogs and wikis, then that is people to people. But that was what the Web was supposed to be all along".

Years later, there remain two difficulties with the notion of the Web 2.0 websites being qualitatively different from the Web 1.0 websites. One, Web 2.0 is still not different from Web 1.0, but rather continues as an extension of the original plan, and two, the Web 2.0 websites are so dissimilar from each other in terms of content that it is odd to classify them as belonging in a single category.

Caroline Bowen

Web content classification

Folksonomy is one webword you probably don't like, and you definitely don't want to say it with a blocked nose. A portmanteau of folks and taxonomy, it refers to a web content classification process called collaborative tagging or social bookmarking. In it, producers-and-consumers or professionals-and-consumers ("prosumers", either way) cooperate in the creation and management of tags in order to annotate, group, and find web content. Folksonomies have been popular since 2004 on social websites like **43 Things**[4] where over 3 million people "list their goals, share their progress, and cheer each other on". Folksonomies, tagging, blogging, and social networking (e.g., via Facebook, Linkedin, RSS feeds, Twitter, and You Tube) are among the defining characteristics of **Web 2.0**[5] and its toolkit.

Toolkit

Podcasts

The American Speech-Language-Hearing Association (ASHA) was the first speech pathology professional association to launch a website and lead the charge in embracing Web 2.0 (Fisher, 2009). Its use of a blog, RSS feeds, and informational **podcasts**[6] to promote and publicise its activities, publications, and services is extensive. Podcasting is a convenient means of automatically downloading audio or video files to a computer. The files can be played on the same computer or transferred to a portable MP3 or video player. Podcasts can be expensive and technically challenging for non-experts but can be **monetized**[7] by advertisers or sponsors.

RSS feeds

A subscription to an RSS (really simple syndication) web feed, such as the **ASHA journals RSS**[8] feeds, the Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA) **RSS**[9] feeds, or the **MedWorm Speech Therapy RSS**[10] feeds takes moments. Web content is delivered or "pushed" to the subscriber's free reader (e.g., Google Reader, Yahoo, Microsoft Outlook, or Live Bookmarks). It costs nothing for an organisation or individual to generate the feed and if prominent news aggregators (e.g., DecaPost, Drudge Report, Google News, or the Huffington Post) pick it up, the message reaches an extended readership.

Video sharing

YouTube is a video-sharing website where users can upload, view, and share clips. Unregistered users are able to watch the videos, while registered users can upload an unlimited number of videos. CASLPA has its own CASLPA YouTube Channel, a low-budget, less technically demanding alterative to podcasting that has been active since March 2010. YouTube competes with many other free or low-cost video hosting sites such as Animoto, Flickr, Screencast, Slideshare, and Vimeo, and videos can also be uploaded to personal and work websites. Speechwoman smiled on **Firm Foundations**[11], also in Canada, for an excellent example of videos made by teachers and uploaded to a section of a school district website, to demonstrate phonological awareness training and other early literacy skills.

Facebook

Facebook is a free social networking service. Facebook users can join networks organised by location, workplace, or school, to connect with family, friends, colleagues, and people with compatible interests. Many organisations have a public presence on Facebook to connect all of their employees or members, while some have found advantages in using an internal, secure version of Facebook for private collaboration. Five mutual recognition agreement (MRA) signatories are on Facebook: ASHA, CASLPA, the New Zealand Speech-language Therapists' Association (NZSTA), the Royal College of Speech and Language Therapists (RCSLT), and Speech Pathology Australia (SPA); but at last count, not the Irish Association of Speech & Language Therapists (IASLT).

Twitter

All six MRA signatories tweet. Twitter is a free social networking micro-blogging service in which users send and read updates or "tweets" of no more than 140 characters. Guidance (Twetiquette and more) is provided in Tanya Coyle's **Twitter for SLPs**[12] series and Jessica Hische's **mom, this is how twitter works**[13] is, as she says, not just for moms. Potential professional uses include brainstorming and efficient provision of updates and announcements to an "in" group. For example, Shareka Bentham and Tanya Cole at **SLPChat**[14] cleverly unite the blogging tool WordPress with Twitter for the purposes of SLP/SLT discussion within a small (so far) following.

Blogs

A blog (web log) is a personal journal published on the web, typically composed by a blogger working alone or with one or a very small band of collaborators. Blog entries usually appear in reverse chronological order so that the blogger, blog visitor, or follower sees the most recent post first and has to scroll down for earlier entries. The better blogs, like **ASHAsphere**[15], are interactive and allow comments and messages using graphical user interface (GUI) controls (also called widgets) such as windows or text boxes. Bloggers of interest to SLPs/SLTs, judging by their followings, are **Martin J Ball and Nicole Müller**[16] and Judith Stone-Goldman on WordPress, and Dorothy Bishop, Madalena Cruz-Ferreira, David Crystal, **Sharynne McLeod**[17], and John Wells on Blogger. Their respective blog rolls provide many leads to other professionally stimulating journals.

Some SLPs/SLTs have developed blogs as resource sites. Heidi Hanks is Mommy (of four) Speech Therapy, Paul Morris issues The Language Fix, Jenna Rayburn shares her Speech Room creations, Mirla Raz reviews apps for speech therapy, Sean Sweeny "looks at technology through a language lens" and provides a collaborative document at Google Docs called The SLP Apps List which anyone can edit (note also the October 2011 ASHA Leader's Apps: An Emerging Tool for SLPs by Jessica Gosnell and the Speaking of Apps message board on the Speaking of Speech site), Rhiannon Walton has therapy ideas and videos, and Pat Mervine uses Blog.com for her blog on the Speaking of Speech site. All the sites mentioned in the two preceding paragraphs, and those that follow are hyperlinked in the web version of Webwords 44 at **www. speech-language-therapy.com**[18].

Wikis

The word "wiki" comes from the Hawaiian word for "quick", so Wikipedia is a portmanteau of quick/wiki and encyclopaedia. A wiki is a website whose content is easily editable within the wiki-editor's browser. Usually there is an "edit" button on every page of a wiki and it is configured to

let anyone with or without a password (as in the case of Wikipedia), or only people with passwords, to edit any page, including other people's posts, as in Wikispaces, Wikidot and Tiki Wiki CMS Groupware.

The Wikispaces service from Tangient LLC houses the resource rich **Universal Design Technology Toolkit**[19] maintained by Joyce Valenza and Karen Janowski. Michał Frąckowiak's Wikidot is the third largest wiki host, or wiki farm to date. On Wikidot, all education sites, such as The Special Ed Wiki, are provided at no cost, **modestly priced**[20] paid-for sites are available, and there is a no-obligation sandbox where people can try their hand. Tiki Wiki is a community-managed, open development project, with an official Tiki Software Community Association as the legal steward. A nice feature of Tiki Wiki is its beginners' guide called, "Tiki for ~~Dummies~~ *Smarties*" by Rick Sapir, featuring – last time Webwords looked – 468 pages, from 168 contributors, read by 7,965,240 smarties, in 6 languages!

Internet forums, message boards, and electronic mailing lists

An Internet forum, or message board, like the open source **phpBB**®[21], and the paid-for or free Boardhost and free Zeta Boards (no learning curve, no boundaries, no stress, and no languages other than English!), is a website that allows people to engage in discussion in the form of posted messages ("posts"). Unlike chat rooms, messages are at least temporarily archived, and depending on the setup messages may need to be approved by a moderator before becoming visible to forum members and visitors.

The primary difference between forums and mailing lists, such as LISTSERV®, is that mailing lists automatically deliver new messages to subscribers, while forums require subscribers to visit the forum's website to view new posts. **LISTSERV® Lite Free Edition**[22] is a freeware version of LISTSERV Lite, limited to a maximum of 10 mailing lists with up to 500 subscribers each. It is available for users who want to run hobby or interest-based email lists and do not derive a profit, directly or indirectly, from using the software. Software is available that conveniently combines forum and mailing list features allowing participants to post and read by email or in a browser, depending which they prefer. Both Google Groups used by Info-CHILDES and Stutt-L, and Yahoo! Groups, home of a-p-d and phonological therapy use this formula.

Cloud computing

Like the progression from Web 1.0 to Web 2.0 to Web 3.0, the advent of cloud computing has been more of an evolution than a revolution and users of Amazon, Facebook, G-mail, Google docs, iTunes, and Twitter, for example, have already experienced it. **Crikey**[23] explains that cloud computing is the provision of computing (using and improving computer hardware and software) as a service rather than as a product. Shared resources, software, and information are provided to computers and other devices as a utility over a network, typically the Internet. Utility computing is the packaging of computational resources, such as computation, storage, and services, as a low-cost

metered ("rented") service. Microsoft offers a cloud-based collaboration and communication suite, Office 365 for cents per day, competing with Google Apps for Business and IBM Lotus. Most of the suite vendors offer free trials, and some users opt for and stay with free secure suites such as free Google Apps and R360. Cloud computing is often presented as a form of green computing, but to date there is no empirical support for this claim.

Bookmarking and sharing

Cloud-powered online bookmarking and sharing tools like Diigo and Firefox Sync enable subscribers to organise, annotate, and group bookmarks with ease. A toolbar is used to seamlessly add and annotate a link, then return to the site of interest; tag sites with multiple category names rather than the single category folders for favourites or bookmarks provided by browsers (e.g., Explorer, Firefox, Safari, Opera, and Chrome). Users can view their bookmarks in a web-based account from any browser or computer; and find more sites by searching within the network or by tag.

Open source

Many of the software programs, including content management systems like Drupal, Joomla, WordPress, and Tiki Wiki, that people use to create blogs, wikis and websites are classified as "open source", as defined by the **Open Source Initiative**[24], and are published under creative commons[25] licences.

Australians who are new to online publishing will find helpful information about legal sharing, remixing and reusing content, and on protecting and disseminating their own intellectual property, on the Creative Commons Australia site and the **Copyright Agency Limited**[26] site. Constructing any category of Creative Commons License is as simple as filling out an online form. It lets the licensee retain copyright *and* allows people to copy and distribute the work as specified by the copyright holder. Once the form has been completed the licensee is given the HTML needed in order to add the license information to the relevant website site and information on how to select a license on one of several free hosting services that have incorporated Creative Commons.

Websites

Small, professionally managed sites

For SLPs/SLTs who want a web presence in the form of a small website there are advantages in hiring and briefing a designer to get the job done professionally. The main recurring costs are for DNS registration and re-registration, hosting, and the designers' fees. A well-chosen web designer is able to offer a range of services that may include an inexpensive, attractive, navigable, secure, custom-made site uniquely designed and built to the client's specifications, website hosting including arranging DNS registration (e.g., with TPP Internet who provide pricing information for Australian .au, New Zealand .nz, and Global.com, .net, .org, .biz, and .info domain names), eCommerce tools, database development, custom and web promotions. Examples of such paid-for sites, some by professional developers and others by experienced

amateurs, in Australia include Speech Moves made in Drupal by Bea Pate, and Melvin Speech Pathology made in Joomla by Meehan Design.

Free, self-managed sites

Rather than a fully paid-for small site, SLPs/SLTs can build a web presence with a free editor such as Weebly (e.g., Voice Energetics by Sarah Wilmot), PageBreeze (e.g., Corella Speech Pathology by Benjamin Jardine and Sally Hodson), WordPress (e.g., Jigsaw Speech, Language and Literacy by Bethany Stapleton), or Google Sites (e.g., Belinda Neimann Speech Pathologist by Belinda Neimann). They can be enhanced with royalty-free images from sources that include Wikimedia Commons **Pictures and Media**[27] and Microsoft Office Images. An account with **Jumpstart**[28] provides an opportunity to plan the architecture of a website and practice browser-based project website construction, alone or with one other collaborator. The natty thing about Jumpstart is that once you have everything looking just right, the whole site can be exported straight into a free editor such as WordPress. The owner can choose whether to locate their site on a free hosting site, with or without advertising, or to buy a plan with a web hosting provider such as Digital Pacific, iiNet, or Melbourne IT in Australia, just as long as the bandwidth that comes with the plan is adequate.

Larger sites

Bandwidth is a significant determinant of hosting plan prices, and most hosting plans have bandwidth requirements measured in months. The high price of bandwidth in Australia drives many site owners overseas. For example, Lycos provides 300GB per month for under US$9.00 ($108.00 per annum) and 500GB per month for under US$12.00 ($144.00 per annum) to anyone worldwide. Compare this with a "reasonably priced" Australian host charging an annual fee of A$286.00 for 1GB data traffic per month (plus an establishment fee in the first year), A$815.00 for 30GB per month and A$1,000.00 for 70GB per month. Add to these charges design and development, setting up a content management system (CMS) such **Drupal**[29], **Joomla!**[30] or **Mambo**[31], CMS training, technical support, search engine optimisation, social marketing, and additional applications such as tracking, messaging, and making a site mobile friendly, and the costs are substantial.

By sharing the load with the host, developer, and designer a site owner who wants to keep their business in Australia can establish a site with a budget of A$3,500 to A$4,000 for the first year and expect to pay about A$1,000.00 in subsequent years provided that monthly bandwidth does not exceed 70KB. The host would design the site and the owner would populate it, saving him or herself some A$4,000.00 in copy writing for a site of about 100 HTML pages. Potentially, costs can be defrayed by accepting paid advertising, seeking donations, or charging for downloads.

References

Berners-Lee, T. (2002). *The world wide web – past present and future: Exploring universality*. Japan Prize Commemorative Lecture.

Bowen, C. (1999, February). Webwords 1: Getting to know the Internet. *ACQuiring Knowledge in Speech, Language and Hearing*, *1*, 29–30.

Bowen, C. (2003). Harnessing the net: A challenge for speech language pathologists. The 2003 Elizabeth Usher Memorial Lecture. In C. Williams & S. Leitao (Eds), *Nature, nurture, knowledge: Proceedings of the Speech Pathology Australia National Conference, Hobart*, 9–20.

Bowen, C. (2012). Webwords 43: Alternative and augmentative communication. *Journal of Clinical Practice in Speech-Language Pathology*, *14*(2), 93–94.

Carroll, L. (1871). *Through the looking glass (and what Alice found there)*. London: Hepburn.

Crystal, D. (2001). *Language and the Internet*. Cambridge: Cambridge University Press.

Crystal, D. (2008). *Txtng: the Gr8 Db8*. Oxford: Oxford University Press.

DiNucci, D. (1999). Fragmented future. *Print*, *53*(4), 32.

Fisher, W. (2009). Forging a new trail with a Web 2.0 Compass. Lawrence, Kansas: Allen Press. Retrieved from https://www.facebook.com/note.php?note_id=109700939472

Links

1. http://www.w3.org/2001/sw
2. http://www.w3.org/People/Berners-Lee
3. http://www.love2read.org.au
4. http://www.43things.com
5. http://en.wikipedia.org/wiki/Web_2.0
6. http://asha.peachnewmedia.com/ashapodcast
7. http://www.websitemagazine.com/content/blogs/posts/pages/create-and-monetize-podcasts-on-any-budget.aspx
8. http://www.asha.org/sitehelp/rss
9. http://www.speechandhearing.ca/en/component/bca-rss-syndicator/?feed_id=2
10. http://www.medworm.com/rss/medicalfeeds/therapies/Speech-Therapy.xml
11. http://www.nvsd44.bc.ca/Firmfoundations/main.html
12. http://lexicallinguist.wordpress.com/2011/02/21/nomenclature-and-basic-functions-of-twitter
13. http://www.jhische.com/twitter
14. http://slpchat.wordpress.com
15. http://blog.asha.org
16. http://clinicallinguistics.wordpress.com/author/clinicallinguistics
17. http://speakingmylanguages.blogspot.com.au
18. http://www.speech-language-therapy.com
19. http://udltechtoolkit.wikispaces.com
20. http://www.wikidot.com/plans
21. http://www.phpbb.com
22. http://www.lsoft.com/download/listservfree.asp
23. http://www.crikey.com.au/2010/07/13/crikey-clarifier-what-is-cloud-computing/
24. http://opensource.org/
25. http://creativecommons.org/
26. http://www.copyright.com.au
27. http://commons.wikimedia.org/wiki/Category:Images
28. https://www.jumpchart.com
29. http://drupal.org
30. http://www.joomla.org
31. http://mambo-foundation.org

Like all Webwords columns, this one is available on-line at www.speech-language-therapy.com with featured and additional links.

SPAD (Speech Pathologists in Adult Disability) Top 10

SPAD is a support network and special interest group for those with an interest in communication and/or dysphagia for adults with intellectual and/or physical disabilities. SPAD provides a forum for speech pathologists to share ideas and resources about communication and dysphagia. Current members of SPAD include people working for Ageing Disability & Home Care (NSW Government), health settings including acute and rehabilitation, the Northcott Society, the Cerebral Palsy Alliance, private practitioners, and students. We have four meetings each year and the dates are advertised on our wiki (see link below) and on the Speech Pathology Australia website.

We would like to thank Yvonne Pearce, Bettina Bacall-Arenstein, and Margaret Trzcinka for sharing their top resources.

SPAD members love bits of technology that help us connect SPAD members across large distances (even internationally!)

1   Websites and wikis

SPAD has used a website to share meeting agendas and minutes in the past and now uses a wiki site: http://spadgroup.wikispaces.com. What is a wiki and why do we use it? Visit the site to find out! Or you can watch the video on YouTube called "Wiki's in Plain English" from www.commoncraft.com

2   Teleconferencing and videoconferencing

The SPAD team (organising committee) often use teleconference to meet and discuss plans for SPAD meetings. This often saves a lot of travelling time! During interest group meetings we can also have members join via phone. Although these people may miss out on the full interaction of the session, teleconferencing allows them to hear the information first hand and ask questions. Videoconferencing sites across the state mean that SPAD members can join meetings, interact, and present across large distances. Our evaluations have shown that while there can be hiccups with technology, both rural and metropolitan members find that it is worth the effort to use teleconferencing and videoconferencing for meetings.

3   Twitter

Twitter is not just a social tool. The health industry is rapidly discovering that sites such as Twitter can provide a new avenue for professional networking and learning. Speech Pathology Australia has developed a Social Media Guide for Speech Pathologists which is a valuable resource for those exploring the benefits of social media for professional networking: http://www.speechpathologyaustralia.org.au/my-spa/social-media

You can follow SPAD on Twitter: @SPADite

SPAD members love useful things that help create materials and support augmentative and alternative communication (AAC).

4   Boardmaker Plus!

Boardmaker Plus! starts at $499 from Spectronics. This program is probably on the list of every speech pathologist who works in the area of AAC so we couldn't leave it off ours. There are also a number of other programs that can help you create materials for communication supports, such as SoftPics ($190 from Spectronics) or Picture This... Pro Photo Library ($152.90 from Spectronics). http://www.spectronicsinoz.com/

5 Google Images

While we always need to be aware of copyright for images sourced from Google Images, this can be an invaluable tool to find an image in a hurry. Google street view can be a valuable time saver when you need a photo of a building (such as a day program, doctor's building, or shops). http://images.google.com/

6 Australian Sign Language (Auslan) Signbank

The Auslan Signbank is a language resources site for Auslan, the language of the Deaf community in Australia. SPAD members find it helpful using Auslan signs in conjunction with resources from Key Word Sign Australia in an AAC system.

In the Auslan Signbank you can search for a sign using an English keyword or browse keywords alphabetically. This site is great to be able to see how signs are produced when still photos or line drawings are not adequate. The Signbank is useful when preparing for a Key Word Sign workshop and to keep our key word sign repertoire up to date!

You can gain free access to the Signbank video clips at www.auslan.org.au

SPAD members love plain English, easy English, and accessible stuff!

7 Plain English and accessible information resources

SPAD is committed to promoting the benefits of plain English, easy English, and accessible information. Here are *some* of our favourite resources and where to find them (*free*):

- NSW Council for Intellectual Disability: Health Information Fact Sheets in Easy English http://www.nswcid.org.au/health/ee-health-pages/easy-fact-sheets.html

- Resources from Scope Victoria: Easy English Writing Style Guide and Images for Easy English http://www.scopevic.org.au/index.php/site/resources
- Government of South Australia: The Plain English Good Practice Guide http://www.saes.sa.gov.au/index.php?option=com_content&view=article&id=20&Itemid=5

SPAD members love books and videos too! These are some of our favourites.

8 Cichero, J., & Murdoch, B. E. (Eds.) (2006). *Dysphagia: Foundation, theory and practice*. West Sussex, UK: John Wiley & Sons. ISBN-13: 978-1861565051.

This well-known text has valuable information about assessment and intervention strategies for adults with dysphagia.

9 Dossetor, D., White, D., & Whatson, L. (Eds.) (2011). *Mental health of children and adolescents with intellectual and developmental disabilities: A framework for professional practice*. Hawthorn East, Vic.: IP Communications.

Available from http://www.ipcommunications.com.au

"This is a book by clinicians, for clinicians" (back cover). This book presents a framework for clinicians on the important topic of the mental health of people with intellectual disabilities.
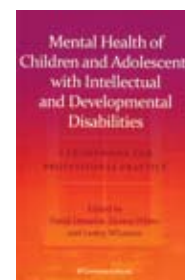
10. *Listening to those rarely heard. A video package* developed by Jo Watson and Rhonda Joseph from Scope Victoria.

A$100 from Scope, Victoria. http://www.scopevic.org.au/index.php/site/resources/listeningtothoserarelyheard

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Developmental stuttering

A paediatric neuroimaging study

Libby Smith

Libby and a research participant prepare for a magnetic resonance imaging (MRI) scan

Libby Smith

Neuroimaging studies conducted over the last decade have consistently found differences in brain anatomy and brain activation patterns during speech between people who stutter and fluent speakers (Beal, Gracco, Lafaille, & De Nil, 2007; Cykowski, Fox, Ingham, Ingham, & Robin, 2010; Foundas, Bollich, Corey, Hurley, & Heilman, 2001; Fox et al., 1996; Neumann et al., 2003; Sommer, Koch, Paulus, Weiller, & Buchel, 2002; Watkins, Smith, Davis, & Howell, 2008). It is likely that a complex interaction of genetic and environmental factors influence the development of brain structure and function in children who stutter, altering the normal functioning motor speech networks in the brain (Watkins, Gadian, & Vargha-Khadem, 1999).

Brain activation studies (using positron emission tomography [PET] or functional magnetic resonance imaging [MRI]) reveal that people who stutter use the speech motor areas in the left side of their brain less than fluent speakers and use their right side more than fluent speakers (Brown, Ingham, Ingham, Laird, & Fox, 2005; Watkins et al., 2008). These findings suggest that people who stutter may use a compensatory network for speech due to inadequate function in the normal speech areas in the left hemisphere of the brain (Preibisch et al., 2003; Sommer et al., 2002).

Recent research using diffusion tensor imaging (a type of MRI) has found that a particular white matter fibre tract (a bundle of nerve fibres that carries messages from one part of the brain to another) in the left hemisphere differs in people who stutter compared to fluent speakers (Chang, Erickson, Ambrose, Hasegawa-Johnson, & Ludlow, 2008; Cykowski et al., 2010; Sommer et al., 2002; Watkins et al., 2008). Researchers are not yet sure what causes tracts to differ in these images, but it may be due to abnormalities in the protective sheath (myelin) that helps nerve fibres carry messages (Cykowski et al., 2010). This leads to the intriguing conclusion that stuttering might be caused by a problem with the formation of the myelin sheath during brain development (myelogenesis) (Cykowski et al., 2010). Unlike much of the brain that develops before birth, the particular fibre tract implicated in these studies undergoes myelination during the first two years of life (Yakovlev & Lecours, 1967). It connects brain areas important for speech which integrate auditory and speech motor information (Cykowski et al., 2010). Impaired myelination would interrupt the normal functioning of this connection.

Despite stuttering being a developmental disorder, neuroimaging research has so far predominantly involved adults who stutter and they participate many years after stuttering onset. There remains a possibility that the brain differences reported in neuroimaging studies involving adults may be a consequence of stuttering behaviour of the individuals over time, rather than a result of abnormal development in the early post-natal period. By including

children as young as possible in our current project, we hope to gain a better understanding of the neurological markers of stuttering present in the early years.

Our research

During the last three years Libby Smith (PhD student) has been working with Professor Sheena Reilly and Dr Angela Morgan from the Murdoch Childrens Research Institute at the Royal Children's Hospital in Melbourne and Dr Alan Connelly from the Brain Research Institute to investigate brain activation and brain structure in children who stutter.

The specific aims of this project are to describe differences between children who stutter and typical speakers in three areas:

- brain activation during speech
- brain anatomy of the speech areas
- white matter fibre pathways that connect different regions involved in speech motor processing.

The data collection phase of this project is now complete. Participants (15 children who stutter and a control group of 18 children with typical speech) attended two appointments. The first involved speech, language, and IQ screening to accurately determine the presence or absence of stuttering and ensure the children had no concomitant speech, language, or cognitive issues. The second appointment was the MRI scanning session where a series of functional and structural MRI images were acquired.

Strengths and challenges

We found that most children enjoyed having a brain scan because they could keep some pictures of their brain to take home and show their friends and they were able to bring a DVD to watch while most of the pictures were being taken.

Nonetheless, scanning young children has presented us with significant challenges. It is important to make sure the children understand the task they are required to perform during the functional imaging scan. For this study, children were required to listen to short sentences through earphones, and then either listen only, or repeat the sentence out loud, according to the instructions. The children rehearsed the task using practice items outside the scanner before the session. Each picture took somewhere between 2 minutes and 8 minutes to acquire. During this time the children needed to keep their head extremely still, otherwise the images would be "blurred". They could "have a wriggle" between pictures, but the whole session could take up to 1 hour. These factors placed limitations on the age of children who could participate. While it would have been interesting to include children from the age of 3 or 4 when they first begin to stutter, most children this young would not be able to cope with the demands of the task or to stay still for the required amount of time. In this study we included children aged between 5 and 10 years. Most children find it easier to keep still when they are watching a DVD; however, some children will have difficulty lying still regardless. Up to 25% of our data was discarded in the end due to excessive movement.

What's next

We are now in the process of analysing the data and are looking forward to seeing the results. While this is a small study in neuroimaging terms, it signifies an exciting step in the quest to unlock the mysteries of the stuttering brain. We also hope the results will contribute to advancing the long-term goal of developing treatments that consider the underlying mechanisms of developmental stuttering rather than simply addressing the symptoms.

References

Beal, D. S., Gracco, V. L., Lafaille, S. J., & De Nil, L. F. (2007). Voxel-based morphometry of auditory and speech-related cortex in stutterers. *Neuroreport*, *18*(12), 1257–1260.

Brown, S., Ingham, R. J., Ingham, J. C., Laird, A. R., & Fox, P. T. (2005). Stuttered and fluent speech production: An ALE meta-analysis of functional neuroimaging studies. *Human Brain Mapping*, *25*(1), 105–117.

Chang, S. E., Erickson, K. I., Ambrose, N. G., Hasegawa-Johnson, M. A., & Ludlow, C. L. (2008). Brain anatomy differences in childhood stuttering. *NeuroImage*, *39*(3), 1333–1344.

Cykowski, M. D., Fox, P. T., Ingham, R. J., Ingham, J. C., & Robin, D. A. (2010). A study of the reproducibility and etiology of diffusion anisotropy differences in developmental stuttering: A potential role for impaired myelination. *NeuroImage*, *52*(4), 1495–1504.

Foundas, A. L., Bollich, A. M., Corey, D. M., Hurley, M., & Heilman, K. M. (2001). Anomalous anatomy of speech-language areas in adults with persistent developmental stuttering. *Neurology*, *57*(2), 207–215.

Fox, P. T., Ingham, R. J., Ingham, J. C., Hirsch, T. B., Downs, J. H., Martin, C., … Lancaster, J. L. (1996). A PET study of the neural systems of stuttering. *Nature*, *382*(6587), 158–162.

Neumann, K., Euler, H. A., von Gudenberg, A. W., Giraud, A. L., Lanfermann, H., Gall, V., & Preibisch, C. (2003). The nature and treatment of stuttering as revealed by fMRI: A within- and between-group comparison. *Journal of Fluency Disorders*, *28*(4), 381–410.

Preibisch, C., Neumann, K., Raab, P., Euler, H. A., von Gudenberg, A. W., Lanfermann, H., & Giraud, A. L. (2003). Evidence for compensation for stuttering by the right frontal operculum. *NeuroImage*, *20*(2), 1356–1364.

Sommer, M., Koch, M. A., Paulus, W., Weiller, C., & Buchel, C. (2002). Disconnection of speech-relevant brain areas in persistent developmental stuttering. *Lancet*, *360*(9330), 380–383.

Watkins, K., Gadian, D. G., & Vargha-Khadem, F. (1999). Functional and structural brain abnormalities associated with a genetic disorder of speech and language. *American Journal of Human Genetics*, *65*(5), 1215–1221.

Watkins, K., Smith, S. M., Davis, S., & Howell, P. (2008). Structural and functional abnormalities of the motor system in developmental stuttering. *Brain*, *131*, 50–59.

Yakovlev, P., & Lecours, A. (1967). The myelogenetic cycles of regional maturation of the brain. In A. Minkowski: (Ed.), *Regional development of the brain in early life* (pp. 3–70). Oxford: Blackwell.

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Around the journals

Fast ForWord Language intervention in school-age children

Gillam, R. B., Loeb, D. F., Hoffman, L. M., Bohman, T., Champlin, C. A., Thibodeau, L., Widen, J., Brandel, J., & Friel-Patti, S. (2008). The efficacy of Fast ForWord Language intervention in school-age children with language impairment: A randomized controlled trial. *Journal of Speech, Language, and Hearing Research*, *51*(1), 97–119. SpeechBITE rating: 8/10

speechBITE review – Katherine Salmon and Tricia McCabe

Do language impairments reflect a deficit in auditory temporal processing skills? Fast ForWord Language (FFW-L; Scientific Learning Corporation, 1998) operates on the hypothesis that they do. FFW-L is an approach to language intervention designed to improve auditory temporal processing skills in school-age children with language impairments. Until now, few studies have compared FFW-L to alternate interventions. Furthermore, the utility of using acoustically modified speech to remediate language impairments has been questioned (e.g., Cohen et al., 2005; Pokorni, Worthington, & Jamison, 2004).

This study compared the efficacy of Fast ForWord Language (FFW-L) to three other interventions – academic enrichment (AE), computer-assisted language intervention (CALI), and individualised language intervention (ILI) – to determine whether FFW-L was more effective than the other interventions for improving language and auditory processing skills.

The current research attempted to address the limitations of previous research, in particular, the fact that none of the previous trials evaluating FFW-L directly measured changes in temporal auditory processing.

This study also included a larger group of participants (216 children diagnosed with language impairment) than previously reported. Participants were followed for 6 months following completion of the treatment phase and the study compared FFW-L to a variety of alternative interventions. The selection of 3 comparison interventions and FFW-L, all presented 5 days per week for 6 weeks for 80 minutes per day, allowed comparisons to be made between (a) computer-delivered versus human-delivered services, (b) modified speech versus unmodified speech, and (c) specific versus nonspecific intervention goals. Gillam and colleagues hypothesised that based on the temporal processing deficit hypothesis (Tallal, 2004) children assigned to the FFW-L intervention would have better outcomes than children in the other three interventions.

The results of the study showed no difference across the four groups on receptive and expressive language and auditory processing. That is, the children in all four interventions made similar improvements on the language and auditory processing measures. However, children in the FFW-L and CALI interventions did make greater improvements on a measure of phonological awareness than children randomised to the ILI and AE interventions at the six-month follow-up.

One important finding was that the primary measures of language and auditory processing improved significantly across all groups at all data points. However, without a no-treatment control group, we cannot assess the extent to which intervention or alternatively natural change over time contributed to improvements observed. In short, there is no additional benefit of FFW-L compared with another computerised intervention or intervention delivered by a SLP or a general intervention focusing on academic enrichment. Even though these results did not support the temporal auditory processing hypothesis, the authors emphasised that this does not mean that auditory processing skills are not important for language development and a necessary part of listening to speech (Gillam et al., 2008).

SpeechBITE ratings

Eligibility specified: Y
Random allocation: Y
Concealed allocation: Y
Baseline comparability: Y
Blind subjects: N
Blind therapists: N
Blind assessors: Y
Adequate follow-up: Y
Intention-to-treat analysis: Y
Between-group comparisons: Y
Point estimates and variability: Y

References

Cohen, W., Hodson, A., O'Hare, A., Boyle, J., Durrani, T., McCartney, E., … Watson, J. (2005). Effects of computer-based intervention through acoustically modified speech (Fast ForWord) in severe mixed receptive-expressive language impairment: Outcomes from a randomized controlled trial. *Journal of Speech, Language, and Hearing Research*, *48*, 715–729.

Pokorni, J. L, Worthington, C .K., & Jamison, P. J. (2004). Phonological awareness intervention: Comparison of Fast ForWord, Earobics, and LiPS. *Journal of Educational Research*, *97*, 147–157.

Tallal, P. (2004). Improving language and literacy is a matter of time. *Nature Reviews: Neuroscience*, *5*, 721–728.

Online treatment of speech and voice in people with Parkinson's disease

Constantinescu, G., Theodoros, D., Russell, T., Ward, E., Wilson, S., & Wootton, R. (2011). Treating disordered speech and voice in Parkinson's disease online: A randomized controlled non-inferiority trial. *International Journal of Language & Communication Disorders*, *46*(1), 1–16. SpeechBITE rating: 6/10

speechBITE review – Vivian Kan and Tricia McCabe

A significant proportion of the Parkinson's disease (PD) population experiences hypokinetic dysarthria (Ramig, Fox, & Sapir, 2004) which negatively affects patients' quality of

life. The Lee Silverman Voice Treatment (LSVT®) has been proven to be an effective treatment for hypokinetic dysarthria in people with PD (Wenke, Cornwell, & Theodoros, 2010). However, the relatively low number of LSVT qualified speech-language pathologists (SLPs), low caseload priority for people with PD, and the physical difficulties people with PD experience in travelling to services are all barriers that hinder the delivery of speech pathology services to this population. Telehealth presents a promising mode of service delivery that could increase access to services and support gains in speech and quality of life.

The present study was designed to investigate the validity and reliability of online delivery of LSVT for speech and voice disorders associated with PD. Constantinescu and colleagues employed a single-blinded, randomised controlled trial to compare online and face-to-face treatment of LSVT. Thirty-four participants who had been diagnosed with PD were included: 18 participants had mild hypokinetic dysarthria while 16 had moderate dysarthria. The participants were stratified and randomly assigned to a treatment group, resulting in 17 participants in each group (9 participants with mild dysarthria and 8 with moderate dysarthria in each group). Four SLPs were randomised to both treatment environments. No patients were assessed by their treating clinician during post-treatment assessments which allowed for blinding of the SLPs to the participants' treatment group.

Therapy for both groups adhered to the LSVT program. A PC-based videoconferencing application was developed for the online environment. The system allowed for: videoconferencing in real time; presentation of phrases and reading material during session tasks; the ability to adjust the remote web cameras to maximise the viewing; high-quality audio and video recordings; and calibrated average measures of sound pressure level (SPL), and fundamental frequency (Hz) and duration (sec) through the use of an acoustic speech processor. LSVT was administered following standard practice in the face-to-face treatment environment.

The key outcome measures for the two LSVT service delivery models were: SPL in a monologue, acoustic measures from the LSVT evaluation protocol, and perceptual speech and voice judgements by two independent SLPs using direct magnitude estimation. The Assessment of Intelligibility of Dysarthric Speech (Yorkston & Beukelman, 1981) was used also as a secondary measure looking at intelligibility and communication efficiency.

Treatment gains made in the online LSVT environment were comparable to gains made by administering LSVT face-to-face. This study confirms that online delivery of LSVT is equivalent to face-to-face delivery. Additionally, participants in the online treatment reported the treatment to be "very good" and that they were "more than satisfied".

The paper's robust study design provides confidence in the online delivery of LSVT for people with PD. However, as online treatment was administered using a specifically designed videoconferencing application, the results cannot be easily transferred to clinical practice. Technological development is necessary before clinicians will have the opportunity to deliver LSVT in an online environment similar to that of the present study. Similarly, development of technology is needed to design studies that yield significant results while using easily accessible forms of technology. Further research is also required to explore online treatment for people at more advanced stages of PD and with moderate to severe hypokinetic dysarthria.

SpeechBITE ratings

Eligibility specified: Y
Random allocation: Y
Concealed allocation: N
Baseline comparability: N
Blind subjects: N
Blind therapists: N
Blind assessors: Y
Adequate follow-up: Y
Intention-to-treat analysis: Y
Between-group comparisons: Y
Point estimates and variability: Y

References

Ramig, L., Fox, C., & Sapir, S. (2004). Parkinson's disease: Speech and voice disorders and their treatment with the Lee Silverman Voice Treatment. *Seminars in Speech and Language*, *25*, 169–180.

Wenke, R. J., Cornwell, P. & Theodoros, D. G. (2010) Changes to articulation following LSVT(R) and traditional dysarthria therapy in non-progressive dysarthria. *International Journal of Speech Language Pathology*, *12*, 203–20.

Yorkston, K. M., & Beukelman, D. R. (1981). *Assessment of intelligibility of dysarthric speech*. Austin, TX: Pro-Ed.

Speech pathology resources

Roddam, H., & Skeat, J. (Eds.) (2010). *Embedding evidence-based practice in speech and language therapy: International examples*. West Sussex, UK: John Wiley & Sons. ISBN 978 0 470 74329 4; pp. 246; A$59.95; http://au.wiley.com

Jade Cartwright

This book makes a timely and practical contribution to the growing evidence based practice (EBP) literature in the speech pathology field. Its target audience is practising speech pathologists who are committed to embedding EBP into their routine clinical decision-making and who would like to share in diverse exemplars of EBP innovations and successes from around the world.

The book highlights and addresses the reality that EBP is a necessity in routine clinical practice and that clinicians require knowledge, skills, and practical support to embed EBP into their clinical roles. It is clear that the editors, Dr Hazel Roddam and Dr Jemma Skeat have selected contributions to the book with care, providing a broad mix of EBP perspectives and experiences from clinicians, researchers, and managers. Real-life EBP scenarios are presented from diverse contexts and across the range of speech pathology practice, including adult and paediatric settings; from a number of clinical areas such as voice, fluency, speech, dysphagia, and alternative and augmentative communication (AAC). Furthermore, examples addressing more professional aspects of EBP implementation concerning university education, clinical supervision, and leadership are included.

Overall, the tone of the book is positive, celebratory, and encouraging. While the well-known challenges and barriers to EBP are made apparent, they are dealt with in a proactive way, providing clinicians with practical evidence that while EBP isn't always easy, it is possible. The book is divided into six sections that flow cohesively and take the clinician on a journey through all stages of the EBP cycle.

The first three sections set the scene, providing the definitions and foundation knowledge required for using EBP in practice. The barriers that clinicians face are addressed, while facilitators and practical ways of creating a supportive culture and environment for EBP in any workplace are identified. In sections four and five, the focus moves beyond EBP knowledge to more practical aspects of translation and application of evidence to meet clinical challenges. The examples in this section are creative and innovative, showcasing a range of "individual and organisational strategies for embedding EBP" (p. 7). The final section ties the preceding discussion together and presents a clear and achievable vision for the future. Overall, the book provides an excellent platform for clinicians to critically reflect on their own use of EBP and will inspire many to plan, undertake, or disseminate the results of their own implementation projects.

As a clinician and academic with a keen interest in EBP and its translation to everyday practice I feel that this book has made an extremely valuable contribution to the field, showcasing how far the profession has come. It has practical and professional relevance to both practicing and student clinicians, as well as academics and researchers, reminding us of why evidence is so important for professional practice and how the EBP mantra can be achieved. The collective and reflective nature of the book makes it an enjoyable and informative read for us all.

Introducing the JCPSLP Committee 2013–2014

Editors

Jane McCormack

Jane McCormack is a lecturer in the speech pathology program at Charles Sturt University. She is interested in speech and language development in children, inter-professional practice, rural and regional service delivery, clinical education, and application of the International Classification of Functioning, Disability and Health to speech pathology practice. Jane has acted as a reviewer for national and international speech pathology journals and recently co-edited the conference proceedings special issue of the *International Journal of Speech-Language Pathology* with Anna O'Callaghan. Jane is looking forward to working with the *JCPSLP* editorial committee in 2013–14.

Anna O'Callaghan

Anna O'Callaghan is a lecturer in the division of speech pathology at The University of Queensland. She is interested in speech and language disorders in adults, specifically adults with traumatic brain injury, innovations in service delivery, clinical care guidelines, and professional issues related to speech pathology practice. Anna has acted as a reviewer for national and international journals and recently co-edited the conference proceedings of the *International Journal of Speech-Language Pathology* with Dr Jane McCormack. Anna is looking forward to continuing to create exciting and innovative *JCPSLP* editions alongside Jane and the *JCPSLP* editorial team.

Committee members

Jade Cartwright

Jade Cartwright is a lecturer at Curtin University, with clinical, teaching, and research interests in the areas of dementia, progressive neurological disorders, aphasia, and quality of life. She is currently completing her doctorate part-time in the area of primary progressive aphasia. Jade has been actively involved with Speech Pathology Australia since graduating from Curtin in 2000 and is the current Vice President of the WA branch. This is her second year on the *JCPSLP* editorial committee.

Natalie Ciccone

Natalie holds a PhD in speech pathology and has worked clinically in hospital and rehabilitation settings. She is currently employed as a lecturer within the speech pathology program at Edith Cowan University. Natalie's main area of research interest lies in working with adults with neurogenic communication disorders, and is particularly focused on issues of treatment effectiveness and service delivery and applying theoretical knowledge to improve treatment outcomes.

Deborah Hersh

Deborah, PhD, has over 20 years of clinical and research experience in speech pathology in the UK and Australia. She has presented and published in the areas of discharge practice, professional client relationships, clinical ethics, group work for chronic aphasia, and goal setting in therapy. Deborah started the Talkback Group Program for Aphasia in 1995 and established the Talkback Association for Aphasia Inc. in 1999. She is a Fellow of Speech Pathology Australia and a senior lecturer in speech pathology at Edith Cowan University in Perth.

Elizabeth Lea

Elizabeth holds a Masters degree in Speech Pathology from La Trobe University and Bachelor degrees in Arts and Science (Monash University). She is passionate about augmentative and alternative communication and has worked in schools, the disability sector, and private practice. Elizabeth works at The Communication Toolbox, a private practice she established that specialises in the use of technology for communication.

Carl Parsons

Dr Carl Parsons has published more than 100 articles on communication disorders in international refereed journals. Carl was awarded the Elinor Wray Award by Speech Pathology Australia in 1987. He is a patron and life member of the Down Syndrome Association of Victoria, the director of the Centre for Advanced Assessment and Therapy Services, the director of National Programs for the Andrew Fildes Foundation for Language-Learning Disabilities (now called SHINE), and the director of Integrated Services at Port Phillip Specialist School.

David Trembath

David is a postdoctoral research fellow at the Olga Tennison Autism Research Centre, School of Psychological Science, La Trobe University. He has worked as a speech pathologist, clinical educator, lecturer, and consultant in the field of disability, and has a particular interest in the provision of augmentative and alternative communication supports. David's current research is focused on the development and evaluation of evidence-based communication interventions and supports for children, adolescents, and adults with autism and other developmental disabilities, as well as projects aimed at supporting the integration of research and practice.

Samantha Turner

Samantha is currently completing a PhD at The University of Melbourne, and her project is focused on large families with speech and language disorders. She has worked with children presenting with a range of neurodevelopmental disorders both as a speech pathologist and clinical researcher. She is interested in understanding the causes of these disorders and providing early intervention for young children.

JCPSLP notes to authors

The Journal of Clinical Practice in Speech-Language Pathology (*JCPSLP*) is a major publication of Speech Pathology Australia and provides a professional forum for members of the Association. Material may include articles on research, specific professional topics and issues of value to the practising clinician, comments and reports from the President and others, general information on trends and developments, letters to the Editor, and information on resources. Each issue of *JCPSLP* aims to contain a range of material that appeals to a broad membership base.

JCPSLP is published three times each year, in March, July, and November.

Issue	Copy deadline (peer review)	Copy deadline (non-peer review)	Theme*
Number 2, 2013	3 December 2012	1 February 2013	Clinical education
Number 3, 2013	12 April 2013	27 June 2013	Inter-Professional Education and Practice
Number 1, 2014	1 August 2013	14 October 2013	TBA refer to our website

* articles on other topics are also welcome

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With rare exceptions, we do not publish material that has already been published.

Articles will be checked by a copy editor to ensure consistent presentation and standard of English.

Length

Articles should not usually exceed 3500 words (including tables and references). This is equivalent to approximately 11 double-spaced pages. Longer articles may be accepted, at the discretion of the editors. For further information go to **http://www.speechpathologyaustralia.org.au**

Format

The article should be submitted electronically via email (as an attachment). One hard copy and a copy on disk (preferably in Microsoft Word) is required if the article contains symbols (e.g., phonetic font).

The title page should contain the title of the article, the author's name, profession, employer, contact phone number, and correspondence address, as well as a maximum of five key words or phrases for indexing. Please provide brief biographical details (up to 15 words) for all authors.

The format must be double spaced with 2.5 cm margins, in a serif face (such as Times or Courier), each page numbered sequentially.

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Peer review

Articles submitted to *JCPSLP* generally undergo a double-blind peer-review process. The article will be sent to two expert reviewers. The authors will be provided with information from the review process and will be invited to revise and resubmit their work if this is indicated. The sentence "This article has been peer-reviewed" will appear after the title for all peer-reviewed articles.

Style

Clear and concise writing is best. Use short sentences and paragraphs and plain English.

Reproduce any quotations exactly as they appear in the original and provide the page number(s) for the pages you have quoted from.

References, which should be kept to a minimum, should follow the American Psychological Association (APA 6th ed.) style.

The title should be kept as short as possible (maximum 80 characters).

Headings should be short. Within the article a maximum of two levels of headings should be used. For first level headings use all capitals, centred with one line space above and one line space below. For second level headings use a capital letter for the first letter of the first word only, centred with one line space above and one line space below.

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