Telepractice: New and Emerging Technologies That Promise Change

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Disclosure: The SimuCase™ technology and research referenced in this article is manufactured under license from Case Western Reserve University by SpeechPathology.com. Stacy Williams is co-inventor of this technology and has a financial interest in its continued development and implementation.

The use of telecommunication technologies for providing clinical services in speech-language pathology via telepractice has been in place for decades (American Speech-Language-Hearing Association, 2005c). However, the sophistication of the technology used to successfully implement telepractice models of clinical service delivery continues to evolve and improve over time. This article reviews new and emerging technologies that promise change for speech-language pathologists in the area of telepractice. Current research and development for both near and far emerging technologies will be discussed, including potential future clinical applications and links to online technology demonstrations.

"Technology feeds on itself. Technology makes more technology possible." —Alvin Toffler, *Future Shock*

The use of telepractice within the field of speech-language pathology and audiology has proven to be an effective means for providing assessment, intervention, and/or consultation services (American Speech-Language-Hearing Association [ASHA], 2005b). Starting with the use of basic telecommunication media, telepractice technologies have continued to advance and develop from the telephone to high-definition videoconferencing systems (ASHA, 2005c). A few states currently have policies and regulations for telepractice service delivery models in the area of speech-language pathology and many others are working toward developing future policies (Brannon, 2012).

The popularity of using telepractice to deliver services to clients with communication disorders in remote areas or to underserved populations is due primarily to technological advances. Widespread Internet connectivity, affordable computer-based systems, high-resolution graphic displays, and voice over Internet protocol (VOiP) capabilities have made telecommunications accessible and affordable. In addition to advances in computer hardware and software, improvements in bandwidth and online security practices have led to the growing number of speech-language pathologists (SLPs) and audiologists using telepractice (ASHA, 2005c).

Most often, telepractice service delivery links the SLP to the remote client via synchronous (real-time) interactions using two-way audio and video connections (ASHA, 2010). The use of these high-resolution videoconferencing systems allows the SLP professional and client high levels of interactivity, given optimal bandwidth and network connection speeds.

Supplemental web-based applications—such as online remediation materials, collaboration tools (e.g., Google Docs, DropBox, etc.) and/or other telecommunication equipment (fax, e-mail, document scanners, etc.)—are used to provide additional feedback and documentation for both the clinician and the client, thereby enhancing services (ASHA, 2010).

The following is a brief overview of the current telepractice models of clinical service delivery currently being used by SLP professionals (ASHA, 2005a; Dudding, Crutchley, Juenger, Grogan-Johnson, & Alvares, 2012):

- The Mobile Telepractice Model—uses mobile, handheld technology and/or tablet-based computers to communicate with clients via live video chats and web-based intervention tools or apps. Technology in this model includes: Apple iPhone, Apple iPad, Samsung Galaxy, Motorola Xoom, Motorola Android.
- The Desktop Telepractice Model—uses videoconference equipment and software that allows two or more participants located at different sites to interact using personal computers with web cameras and external microphones to transmit and receive audio and video.
- The Portable (Dedicated) Telepractice Model—uses high-definition video, audio, and image sharing to connect SLP professionals to their clients across multiple locations using customized systems, such as those provided by Cisco, Polycom, or other video-collaboration providers. This model offers a high-end telepresence solution. The systems can be secured to a cart to provide flexibility within the virtual clinic setting for the both the SLP and the client.
- The Immersive Virtual Telepractice Model—uses an immersive virtual meeting environment to provide SLPs and their clients with the highest quality audio and video technology for a "real-as-life" online collaboration experience. These systems are often located in a dedicated virtual conference room with theater-like screens to project the client and/or SLP professional.

The selection of the telepractice service delivery model that best meets a program's needs should be based on criteria. The following is suggested criteria to consider: (a) the type of services offered; (b) the clinical setting required to deliver optimal services; and (c) the client's individual needs given the type of communication disorder being remediated (ASHA, 2005a).

The primary advantage of telepractice videoconferencing technology is that it allows SLP professionals to provide services without boundaries, reaching remote and rural areas with underserved populations who have a variety of communication disorders (ASHA, 2005b). However, each of these models requires an understanding of the technology and equipment, experience in management of the virtual environments, continual funding to maintain the technology, and ongoing technical support available at both sites to ensure optimal point-to-point communications (ASHA, 2005c). SLPs engaging in telepractice must conform with state licensing requirements, assure security of client information, and comply with regulations for third-party reimbursement.

Additional clinical competencies are required to ensure high levels of client participation with the telepractice environment. These telepractice clinical competencies include (ASHA, 2005a; Towey, 2012):

- Maintaining eye contact with remote clients
- Establishing and maintaining client engagement
- Achieving high levels of client presence or levels of immersion within the virtual clinical setting free of distraction
- Using interactive equipment and applications without interfering with service provisions (e.g., digital camera movements, directional microphones, variable bandwidth speeds, online intervention materials, etc.)

- Analyzing generalization and transfer of newly learned skills through online client practice

As telepractice continues to expand as a method of service delivery in communication sciences and disorders, graduate students and those professionals engaged in telepractice will need to advance in their technical knowledge and skills. This will certainly be the case as new and emerging technologies push the professions forward in service delivery and clinical education.

This article presents new and emerging telepractice technologies featured in the internationally recognized *New Media Consortium (NMC) Horizon Report: 2012 Higher Education Edition* (Johnson, Adams, & Cummins, 2012). This report highlights the latest emerging technologies that have the greatest potential for impact and change in the area of education and clinical applications. NMC (and its research partners) is comprised of more than 450 technology professionals, faculty leaders, teachers, and other allied health professionals and industry leaders from more than 30 countries (Johnson et al., 2012). Their recommendations and insights have helped support future research initiatives and prepare professions, such as speech-language pathology, for emerging technologies that promise change in service delivery models and client interventions.

According to the *NMC Horizon Report*, people expect to work and learn on their own time (Johnson et al., 2012). There is an expectation for early and immediate access to information; this is due in part to the emergence of cloud-based computing. *Cloud-based computing* allows data and documents to be stored on the Internet rather than locally on a computer. In addition to retrieving information, people seek up-to-the-moment analysis and feedback within a collaborative-based model (Johnson et al., 2012). In other words, people are seeking "just-in-time" or "found-learning" opportunities that promote dynamic group feedback and interaction. There is also a strong desire for more challenge-based/active learning experiences, both within and outside of the clinical educational setting (Johnson et al., 2012). This supports the educational movement toward learner-centered environments in which the learner decides the course of learning.

Applying this learning model to the clinical setting means provision of service is client-centered—clients have control of their own levels of engagement within the clinical setting and implement their own strategies to overcome individual challenges. The ultimate goal for clients is to connect their intervention goals and objectives with their own lives and become more excited to learn and immerse within an online remediation environment.

Given these trends and the emergence of new technologies, it is predicted that telepractice will undergo significant change within the next 1–5 years. For purposes of this article, these technologies are categorized as near-emerging versus far-developing technologies based on their dates of approximate availability. *Near-emerging* technologies are those that will become available to SLP professionals within the next 6 months–2 years. *Far-developing* technologies are those that will become available to SLP professionals in 3 years and beyond. It should be noted that the technologies highlighted in this article are meant to promote an awareness of technology currently under research and development rather than to promote one particular product or method. The description of each technology will include a discussion of possible relevance to teaching, learning, and creative problem-solving as it relates to future telepractice applications.

Near-Emerging Technologies

Mobile and Tablet Computing

According to a recent study by Distimo, it is estimated that over 44 billion mobile- or tablet-based applications (apps) will be downloaded by 2016 (Johnson et al., 2012). This technology has changed the way users think about and use software applications, focusing primarily on individual learning tools designed to meet one particular need. The best apps are

able to integrate user profile information, location data, motion-capturing input, social networking, and web searching into one seamless experience (Johnson et al., 2012). As more apps are able to converge all of these elements, SLP professionals will be able to use mobile devices in a new way for future telepractice applications.

Imagine a videoconferencing app for clients that records and annotates their everyday experiences so SLP professionals can follow along, provide real-time support/feedback, and measure transfer of clinical skills within real-world settings. This app could also allow clients to add, edit, and delete annotations in their videorecordings of a clinical practice session for follow-up.

In addition to mobile (hand-held) devices, tablet-based computing is also on the rise in a variety of areas, including videoconferencing, web browsing, and social networking (Johnson et al., 2012). Because of the ease of use, portability, and large graphic displays, tablet-based computing is ideal for learning on the go. In 2011, Germany's Orkin Design released a new tablet concept, the roll-down laptop tablet and TV all in one (Ridden, 2011). This new tablet design, which includes built-in speakers, camera, directional microphone, USB ports, and a LAN port, will be ideal for portable videoconferencing.

Serious Games and Simulation Learning Experiences

According to PopCap Games Social Gaming Research (Information Solution Group, 2011), over 118 million people participated in online social games in the United States and the United Kingdom combined last year. PopCap research showed 81 million people played at least once a day, with the average American gamer being 35 years of age. According to PopCap, female social gamers continued to outnumber male counterparts by 55% to 45% respectively. The critical aspects to online games for learning purposes are that they are engaging and appealing for all ages and gender types. Games are primarily goal oriented and promote collaboration within groups (Gibson, Aldrich, & Prensky, 2007).

Serious games, unlike social games, are created for an educational or clinical purpose, not for the sole purpose of entertainment or amusement. Serious games are engaging, immersive learning experiences targeting specified learning goals and outcomes (Gibson et al., 2007). Serious games are simulations that mimic real situations and scenarios; they have been proven beneficial for those users who are practicing training situations or transferring newly learned skills from an educational or clinical setting to a real-world setting (Gibson et al., 2007).

Serious games and simulations provide immediate feedback and are highly engaging to users so that users are motivated to do better to succeed. The power of this technology is in how users experiment and explore within "real-world" situations and how they learn from their failures in a safe environment (Gibson et al., 2007).

Imagine being able to offer clients the opportunity to complete an online simulation for any everyday scenario, such as ordering at a fast food restaurant or interacting with peers in a school cafeteria setting. SLP professionals would be able to observe real-time client behaviors in a variety of simulated settings. Or, imagine serious game applications that could provide clinical outcome measures for how skills generalize in real-world situations. Research studies continue to show that serious games and simulations expand learning outside the game environment, which is why this area of technology development continues to interest educators and other health-care professionals (Gibson et. al, 2007). A Williams (2007b) survey supports these findings. When surveying SLP clients and asking them to compare traditional SLP interventions to simulation-based interventions, the clients reported that, in comparison to traditional intervention techniques, virtual simulations sounded more engaging with real-world application and would be more helpful in keeping them focused on practice outside the clinical setting.

SimuCase™ is one simulation program released by Speechpathology.com in partnership with Case Western Reserve University (Williams & Schreiber, 2010). This app, built off a

serious simulation gaming model, provides SLP professionals the opportunity to practice the assessment process with virtual patients prior to working with real clients. Although more of these simulations will be developed in the future, they can be extremely difficult to design well. Readers are encouraged to stay on the lookout for new simulation apps targeting both the SLP professional as well as clients with communication disorders.

Gesture-Based Computing

New explorations into the use of gesture-based technology continue due to the development of sophisticated gaming systems such as Microsoft's X-Box Kinect, the Nintendo Wii, and the Sony Playstation 3. The latest version of Microsoft's X-Box Kinect allows users to input system information through motion capturing of gross motor movements. As this technology continues to evolve, it is expected that players will be able to control devices and situation outcomes through more subtle movements, such as facial expressions. Gesture-sensing technology with voice recognition capabilities will lead to additional innovation with future virtual assistants and digital communication partners, like Siri, Apple's latest iPhone voice recognition virtual agent (Johnson et al., 2012).

Gesture-based computing will radically change the way technology users interact with computers and how we communicate with each other in the future. How will this technology impact telepractice? Initial research into the use of digital puppets for intervention has shown promise for future research (Williams, 2007b). Williams created three-dimensional animated characters with audio lip-syncing capabilities. These digital characters can be controlled and operated by SLP professionals using simple motion-capturing equipment with a headset microphone and/or simple swiping movements on a tablet PC. Animated characters, which can be used for a variety of intervention purposes, have the potential to increase a client's level of engagement and participation during online telepractice sessions (Williams, 2007b).

Far-Developing Technologies

Some technologies that are later emerging and yet have implication for the future of telepractice include augmented reality displays, immersive virtual reality, and interactive robots.

Augmented Reality Head Mounted Displays

Project Glass, a technology currently under development at Google X Lab, aims to create an augmented reality, head-mounted display for users (Newman, 2012). *Augmented reality* combines the physical, real-world environment with a computer-generated world; it enhances the physical, real-world environment with sensory input, such as sound, video, graphics, or location (GPS) data (Graham, Zook, & Boulton, 2012). According to Albanesius (2012), users wear a futuristic pair of eyeglasses or contacts that would display image recognition information directly onto the lens of the eye (hands-free). This technology would be able to interact with the Internet to gather information in real-time or use natural language voice commands to activate additional search parameters. *Time* magazine referred to the Google Glass project as one of the best innovations in 2012 (Goldman, 2012). This type of futuristic technology with videoconferencing capabilities would allow SLP professionals to take part in "just-in-time" or "found-learning" opportunities with their clients, using real-world situations to assist with the transfer of newly learned skills. This technology will assist clients in identifying objects, people, locations, and social nuances—including reading facial expressions and other nonverbal cues within a variety of social interactions (Newman, 2012).

In June 2012, a prototype of Google Glass was previewed, with skydivers and bikers wearing the glasses to provide a live video stream from their point of view with real-time audio commentaries.

Immersive Virtual Reality Cave Automatic Virtual Environments (CAVEs)

In January 2012, Microsoft shared its latest technology innovation from their Edison Labs in Redmond, WA: a Holodeck prototype (Vox Media, 2012). For those who are not *Star Trek* fanatics, the *Holodeck* is an enclosed room where objects and people are simulated through projected holographic images. Sounds and smells are simulated respectively and users are able to navigate within the room without running into walls via treadmills embedded within the floor. Users would operate the Holodeck for training, diagnostics, and recreation purposes. The primary use of the Holodeck was to recreate or simulate situations for analysis, experimentation, or exploration (Gresh & Weinberg, 1999).

The closest technology to the Holodeck currently are immersive virtual reality CAVEs, which can be described as large theater-like rooms where the walls and the floor are made up of projection screens displaying images and interactive settings (Cruz-Neira et al., 1992). Users wear special glasses inside the CAVE to see the three-dimensional renderings generated. Systems like these have existed since the early 1990s, but the limitations to this technology continue to be cost, space, and limited interactive content (Cruz-Neira, Sandin, DeFanti, Kenyon, & Hart, 1992). The goal of these immersive virtual reality CAVEs has always been to provide an immersive, virtual reality training environment for a variety of everyday situations within any clinical setting (e.g., home, clinic, hospital). Williams (2007a) created a virtual reality theater for speech-language pathology at Case Western Reserve University. Her preliminary research demonstrated that while this type of technology is very costly to implement, it does show promise in providing a means to measure generalization of skills without leaving the clinical setting (Williams, 2007a).

Applications like these and other forms of virtual reality currently being examined show that virtual reality interventions provide a significant benefit compared to traditional intervention methods (Ervin & Owen, 2012). Similar findings have been documented in the areas of autism, cerebral palsy, fluency, public speaking, and a variety of other allied health areas (Hoffman, 2004).

Socially Interactive Robots

Fong, Nourbakhsh, and Dautenhahn (2010) define *socially interactive robots* as robots that display the following human-like social abilities or characteristics:

1. Expressing and/or perceiving emotions
2. Communicating with high levels of dialogue
3. Establishing/maintaining social relationships
4. Using natural cues (eye gaze, gestures)
5. Exhibiting distinctive personality and character
6. Learning/developing social competencies

These interactive robots would be used as a research platform, as an educational tool, and as a therapeutic aid to engage people in social interactions and to measure communication outcomes for SLPs and audiologists (Fong et al., 2010). Although socially interactive robots have already been used with some levels of success, much work remains in order to increase their overall effectiveness in creating natural, unconstrained interactions with people (Kozima, Nakagawa, & Yasuda, 2007). Robotic technology has the potential “to engage interpersonal communication in real social contexts where spontaneous communicative actions can be observed, responded to, and gradually situated in” (Kozima et al., 2007).

Summary

The use of telecommunication technologies for providing SLP clinical services via telepractice has been in place for decades (ASHA, 2005c). However, the sophistication of the technology used to successfully implement telepractice models of clinical service delivery

continue to evolve and improve over time. New and emerging technologies promise change for SLP professionals, which will require new technical and online clinical skills to effectively offer telepractice services in the future to clients and families with communication disorders. New research will be needed when these technologies are ready for clinical implementation in order to expand the evidence base for telepractice.

This new generation of educational technology provides both opportunities and challenges for the SLP profession. While learning these new skills may seem daunting to some, the promise they offer patients with communication disorders makes it worth the effort.

Additional Video Resources

- Roll-down laptop tablet and TV (Orkin Design): www.youtube.com/watch?v=6w92xDCLh7I
- Immersive simulation environments (Cave Western Reserve University): www.youtube.com/watch?v=R3WLJq5BucM
- SimuCase™: www.youtube.com/watch?v=HfFd5GyTJJo
- Demonstration of digital puppetry and its potential clinical applications (Little Mountain): www.youtube.com/watch?v=kGheVDoOaXY
- Google Glass: www.youtube.com/watch?v=D7TB8b2t3QE
- SLP immersive CAVE project (Case Western Reserve University): www.youtube.com/watch?v=CYdDAF3r1A0
- Socially interactive robots and their potential (Hanson Robotics): www.youtube.com/watch?v=sSkfspliSrk

Acknowledgment

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