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Virtual Reality: An Exciting New Tool to Enhance Stuttering Treatment

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Among a myriad of choices available to persons seeking stuttering treatment is an exciting new virtual reality tool to augment traditional treatment for stuttering. Virtual Reality (VR) is "an advanced form of human-computer interface that allows the user to 'interact' with and become 'immersed' in a computer-generated environment in a naturalistic fashion" (Schultheis, Himelstein, & Rizzo, 2002, p. 379). Users can interact with VR environments via visual, auditory, tactile, and olfactory senses. These interactions contribute to the person's feeling of *presence* in the VR .

The most common method for enhancing VR immersion is to use a Head-Mounted Display (HMD). The HMD contains display screens, specialized optics, and tracking systems that allow the VR environment to move when the user's head moves. Earphones within the HMD present localizable sounds consistent with the computer-generated VR visuals displayed in the HMD. In some environments, a second tracker or joystick allows navigation around the VR environment (for example, in the virtual audience environment a joystick is used to advance PowerPoint®slides.)

VR in Rehabilitation

VR technology has been used to enhance the assessment, treatment and generalization of numerous disorders (Schultheis, Himelstein, & Rizzo, 2002), some of which share important characteristics with stuttering. Persons who stutter frequently report increased fear and anxiety associated with speaking, and certain stuttering treatment approaches involve desensitizing clients to feared speaking situations. VR has been used in the desensitization treatment of disorders associated with fear and anxiety including: acrophobia (Rothbaum et al., 1995a, 1995b; Emmelkamp et al., 2002), anxiety disorders (Rothbaum & Hodges, 1999), fear of flying (Banos et al., 2002; Maltby, Kirsch, Mayers, & Allen, 2002), Social Phobia (Anderson, Rothbaum, & Hodges, in press) and post traumatic stress disorder (Rothbaum et al., 1999a; Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001). In Virtual Reality Environments (VREs) that have been developed for the treatment of fear of public speaking, the therapist can control the reaction of virtual audiences while the client practices a speech. There are both a small group audience (similar to a boardroom meeting) and a large group audience (similar to a lecture hall). Data from case reports are promising (Anderson, Rothbaum, & Hodges; Pertaub, Slater, & Barker, 2001; Jo et al., 2001).

VR technology has been applied to the assessment and rehabilitation of disorders that often have communicative components, including: traumatic brain injury (Christiansen et al., 1998; Zhang et al., 2003; Grealy, Johnson, & Rushton, 1999; Schultheis & Rizzo, 2001), stroke (Merians et al., 2002), Parkinson's disease (Albani et al., 2002), cerebral palsy (Reid, 2002), and autism (Max & Burke, 1997). Stuttering treatment may involve learning new speech motor movements, and VR technology has been used to improve motor learning in patients with Parkinson's disease (Albani et al., 2002: Rovetta, Lorini, & Canina, 1998) and stroke (Jack et al., 2001). VR has also been successfully applied to the distraction from pain (Gershon et al., 2001; Hoffman, Doctor, Peterson, Carrougher, & Furness, 2000; Schneider & Workman, 1999).

The medical/psychiatric applications of VR are increasing and there have been a number of case reports and controlled studies to document its effectiveness. VR exposure was used successfully to treat a college student with a fear of heights using a virtual elevator program (Rothbaum et al., 1995b) and a case of claustrophobia (Botella et al., 1998). Rothbaum and colleagues (1995a) reported a controlled study in which a VRE was incorporated in the treatment of acrophobia (fear of heights). Participants were repeatedly exposed to virtual bridges of varying heights and stability, outdoor balconies of varying heights, and a glass elevator that ascended 50 floors. VR exposure was effective in significantly reduc-

ing fear of and improving attitudes toward heights in the real world, whereas no change was noted in the untreated control group. Seven of the 10 VR exposure treatment completers exposed themselves to height situations in real life during treatment, although they were not instructed to do so. An independent replication compared VR exposure with in vivo exposure therapy (Emmelkamp et al., 2002) and found that VR based exposure was as effective as in vivo exposure in reducing anxiety and avoidance. In fact, following only two sessions of VR, participants were found to have reached a ceiling, having successfully overcome their fear and diminishing the potential effect of the in vivo exposure. VR was also useful in a case study treating a spider phobic (Carlin, Hoffman, & Weghorst, 1997). The efficacy of VRE for the fear of flying (FOF) has been reported in several case studies (Rothbaum, Hodges, Watson, Kessler, & Opdyke, 1996; Smith, Rothbaum, & Hodges, 1999) as well as a controlled trial (Rothbaum, Hodges, Smith, Lee, & Price, 2000).

Stuttering Treatment

Treatment of stuttering generally falls into two categories: fluency shaping or stuttering management (Guitar, 1998). Fluency shaping techniques include slowing speech rate, altering breathing patterns to support speaking, speaking with continuous phonation, and maintaining a "light contact" between the articulators involved in speech production (Webster, 1980). Stuttering modification techniques include (a) helping persons who stutter identify and reduce tension in their vocal tracts; (b) systematic desensitization to feared words, listeners, and situations; and (c) teaching methods for managing stuttering such as "pulling out" of the stuttering moment by elongating a sound or moving the articulators into the appropriate positions prior to speaking the intended word (Van Riper, 1973).

Both treatment approaches require that clients learn new speech-related motor movements and apply them in their lives. For example, in fluency shaping treatment clients may learn to move their lips, tongue, jaw, and vocal cords more slowly and with lighter contact. In stuttering management, clients learn to move their articulators with less tension and/or to change the movements associated with their stuttering; in addition, attitudes about stuttering are addressed via discussion and systematic desensitization to feared situations. Clearly, principles of motor learning (Schmidt, 1991) are important to consider in stuttering treatment. The goal is to make the newly learned movements automatic and to reduce the need for conscious control over articulatory movements. There are several principles that guide motor learning from the conscious to the automatic levels. For example, in order for new motor movements to become automatic, they must be practiced frequently and systematically. Additionally, the learner must receive feedback regarding the accuracy and adequacy of the movements being practiced. Ultimately, success occurs when clients engage in the new behaviors effortlessly, and the new speech pattern is used in all settings, while being reinforced by positive outcomes and positive listener reactions.

Strategies for achieving broad generalization of treatment effects are critical to both stuttering treatment approaches. Stokes and Baer (1977, p. 350) defined generalization as: "The occurrence of relevant behavior under different non-training conditions (i.e., across subjects, settings, people, behaviors, and/or time) without the scheduling of the same events in those conditions as had been scheduled in the training conditions." As Gregory (1995, p. 199) notes, "the essence of effective therapy is transfer" of treated behaviors to "real-life" situations because treatment that does not generalize beyond the therapy room cannot be considered effective. Common techniques used in stuttering treatment to promote generalization include: (a) varying the setting in which fluency shaping or stuttering modification techniques are practiced and (b) having the client practice techniques with different listeners (Culatta & Goldberg, 1995; Manning, 2001; Finn, 2003). Although stuttering varies from person to person, certain speaking situations and listener attributes tend to exacerbate stuttering. These situations are often targeted during the generalization phase of treatment and include: talking to persons in authority, speaking under time pressure, addressing large audiences, participating in group discussions, talking on the telephone, and participating in situations that require specific answers (Ornstein & Manning, 1985; Mahr & Torosian, 1999; Blood, Blood, Tellis, & Gabel, 2001).

To summarize, regardless of the approach taken, generalization of treatment effects is an essential and often challenging part of the treatment process (ASHA, 1995). Clients typically must demonstrate the use of acquired techniques in different settings, with different communication partners, and in different communication situations in order for treatment to have generalized (Stokes & Baer, 1977; Ingham, 1984).

Client Confidentiality

There are many challenges to incorporating generalization into stuttering treatment. The first challenge involves maintaining client confidentiality. Stuttering is a visible and audible disorder in most persons who stutter. If the client practices techniques with unfamiliar listeners in settings outside the clinic, then the fact that they stutter is likely to become known to the unfamiliar listener. Additionally,

clinicians tend to use similar places with multiple clients (e.g., the nice waitperson at the restaurant around the corner), such that the mere presence of someone with the therapist may compromise client confidentiality. Learning to stutter openly and to identify oneself as someone who stutters is a goal in stuttering management. Clients are often reticent to practice this goal in front of unfamiliar listeners. In fluency shaping treatment, clients may be reticent to practice newly learned techniques (e.g., slowed speaking rate) with unfamiliar listeners. Finn (2003) suggested that the development of "interim steps" in the therapeutic process enhances transfer of new behaviors from the clinic to the real world, regardless of the treatment approach employed. While Finn (2003) did not describe specific steps, he noted that the jump between clinic and real-world situations is often large and foreboding to clients who stutter, forming a potentially significant barrier to treatment success. VREs offer such an interim step, in which many of the challenges such as unfamiliar people and specific speaking situations may be utilized without compromising the confidentiality of the client.

Treatment Efficacy

Treatment efficiency and cost effectiveness represent the second challenge to generalization. It is often not efficient for clinicians to escort clients to venues outside the clinic and it can be difficult to create situations that routinely induce fear, anxiety, and stuttering in the clinic. For example, while most persons who stutter fear speaking in front of audiences it is often difficult to assemble an audience for each client who needs to practice with one, especially in private practice. Similarly, it may be awkward to have one's therapist along for a job interview. Consequently, if environments cannot be set up in a cost effective manner, then the clients may not get enough opportunities to practice new speaking techniques, and practice is an important variable in motor learning. Predictably, without such practice the success of an intervention is likely to decrease. Using VRE technology, clinicians can create challenging environments and provide immediate feedback regarding performance. Learning in VR has been shown to generalize to real world settings (Rothbaum et al., 1995a) for other disorders, and, thus, it is expected to generalize with persons who stutter as well. At the Stuttering Research Lab at George Washington University, we are currently studying the effects of virtual and real audiences with persons who stutter.

Environmental Issues

Another major challenge to treatment generalization is the clinician's lack of control over the environment. Encounters with strangers are unpredictable and can be negative, leading to detrimental effects on generalization. Lack of control during the generalization phase may be a contributing factor to "the astonishing shortage of research on procedures that might assist generalization" in stuttering treatment (Ingham, 1984, p. 447). The situation remains similar today, with a relatively small number of articles in the research literature addressing generalization (Hillis & McHugh, 1998). Generalization effects are difficult to study when the researcher does not have control over many of the variables that are likely to influence the outcome. VREs may allow for the systematic planning, delivery, and study of generalization effects. In VR, the action is preprogrammed and is under the control of the treating professional. Nothing occurs in unpredictable ways, no untoward reactions early in generalization, unless directed by the treating professional. Thus, early failures that may interfere with treatment progress may be minimized, while challenging environments and reactions can be introduced at appropriate times to maximize therapeutic generalization.

Obtaining generalization of treatment effects is challenging (Boberg, 1981; Culatta & Goldberg, 1995) and relapse is common (Martin, 1981; Craig, 1998; Hancock & Craig, 1998). In addition, measuring the effects of generalization strategies is difficult (Ingham, 1980, 1984). VR offers a process for alleviating many of these challenges to generalization in the treatment of stuttering. If VR technology currently under study in our lab proves effective with adults who stutter, then the generalization strategies developed will be expanded to include adolescents and younger children.

Getting Started in VR

For clinicians interested in adding VR to their treatment regimens there are a number of issues to keep in mind. First, VRE software is preprogrammed, which mandates that the communication must have high predictability, because the program cannot respond to the entire range of human speech. Thus, certain interactions are easier to create than others, such as situations in which clients do not reasonably expect to be in control anyway. Situations such as ordering food, being waited upon in a store, and answering survey questions can be added to VR, because in many ways these interactions are highly predictable.

The possibility that some aspect of the virtual environment will not match the actual situation experienced by a client is real. This is precisely why VR environments are not yet designed as stand alone treatments, but rather are tools for professionals who use their training and professional judgment when employing them in treatment.

In a small percentage of persons, immersion in VREs may induce simulator sickness. Screening out persons who get car sick and those that are pregnant can reduce the risk significantly. The assessment of simulator sickness is complicated by the overlap in symptoms with anxiety.

The sense of presence or immersion is critical, and some people do not experience it; therefore, VR is likely to be less useful for their treatment. Immersion can be measured via standardized questionnaires, and clients/subjects with low immersion scores identified, allowing more useful treatment strategies to be employed with these persons.

The cost of VR technology has decreased in recent years, but is still expensive. It costs approximately $10,000 for the combined hardware and software for an application. Equipment can be leased as well as purchased.

Stuttering Research at GW

Ongoing research studies involve the use of virtual audiences and the development of new VREs for evaluating and treating persons who stutter. We are currently evaluating the stability of stuttering, communication apprehension, speech naturalness, and speaking attitudes with repeated exposures to different types of virtual and real audiences.

In conjunction with collaborators at VirtuallyBetter, Inc. (Decatur, GA) we are developing a new VRE for use in stuttering treatment. The development of the virtual job interview, with challenging and facilitative interviewers, is funded by a Small Business Technology Transfer (STTR) grant from NIH/NIDCD. We expect that the virtual job interview will have application to a broad range of rehabilitation and business situations.

Future directions for our research include developing VR environments of interest to adolescents who stutter and a standardized "real world" assessment tool for use in stuttering evaluations.

Conclusion

Virtual Reality technology has been used successfully in the treatment of many neurologic, psychiatric, and behavioral disorders. Its use in the treatment of communication disorders is just beginning (see Besing, Koehnke, & Abouchacra, 2003; Self, Scudder, & Weheba, 2003 for recent examples). Under the guidance of skilled clinicians who are educated in its judicial use, VR technology has the potential to make stuttering treatment more efficient, effective, and functional.

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Establishing the Validity of Stuttering Treatment Effectiveness: The Fallibility of Clinical Experience

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Recently, there has been much discussion about an evidence-based approach to stuttering treatment: an approach that ideally refers to an empirically driven, measurement based, and client sensitive approach to treatment (Finn, 2003). At the same time, some cautions have been raised about fully embracing this approach, because it may be too limiting (e.g., Bernstein Ratner, 2004). But, if we do not use an evidence-based approach, then what is the alternative? One suggestion is that we should use a more clinically-driven approach. Indeed, Division 4 has made such a suggestion as witnessed in the practice guidelines published in 1995, where it was argued that empirical evidence may be too limiting a basis for determining a treatment approach and that clinical experience or common practice could be one basis for deciding how to manage stuttering (ASHA). The main purpose of this article is to suggest that clinical experience is an insufficient basis for determining treatment effectiveness, because of problems related to cognitive factors and environmental influences that could lead to potentially erroneous beliefs and poor decisions.

To suggest that clinical experience is insufficient may seem like an absurd position, because it is practically self-evident that we learn and gain much from that experience. Without a doubt, experience is a superb teacher. For example, based on clinical experience, we learn to conduct assessment and treatment procedures with much greater efficiency and skill than when we started in the profession. The drawback of clinical experience, however, is that it is a questionable basis for determining the validity of assessment and treatment outcomes. The reasons pertain to two factors that limit our ability to learn from clinical experience: one is a well-established set of cognitive factors and the other consists of limits that are often imposed by environmental influences (Garb & Boyle, 2003). These two sets of factors become especially problematic under conditions of uncertainty.

It is well known that people are more likely to develop dubious beliefs and make bad decisions under conditions of uncertainty (Vyse, 1997), and those kinds of conditions certainly appear to be evident in the area of stuttering. First, despite years of scientific research, stuttering is a disorder that is still not well understood (Bloodstein, 1995). Second, there have been several surveys showing that speech-language pathologists are uncertain or have little confidence about how to manage the disorder (e.g., Blaker, Harbaugh, & Finn, 1996, 1997). Third, the literature presents a conflicting picture: treatment approaches that are recommended are not the same as the treatment approaches that actually have supportive evidence (Cordes, 1998). Finally, the historical record on the effectiveness of stuttering treatment often reveals a less than positive past (Wingate, 1997).

In this context of uncertainty, there are two types of cognitive factors that can have a limiting effect on our ability to learn from experience: confirmation bias and heuristics. Confirmation bias refers to when we knowingly, or unknowingly, seek information that will support, but not necessarily counter, our beliefs. Furthermore, when we do encounter disconfirming or negative evidence, research shows, we either ignore it or—even more alarmingly and often times more likely—we will reinterpret