Creative Vocal Systems for Engaging Speech Therapy

Andrew Johnston
Creativity and Cognition Studios
University of Technology Sydney
andrew.johnston@uts.edu.au

Dharani Perera-Schulz
Monash University
Clayton, Australia
dharani.perera@monash.edu

Kirrie Ballard
Faculty of Health Science
University of Sydney
Australia
kirrie.ballard@sydney.edu.au

Adina Levy
Faculty of Health Science
University of Sydney
Australia
alev5033@uni.sydney.edu.au

ABSTRACT
In this paper we describe ongoing work investigating the design and use of computer-based creative vocal systems for speech therapy which enhance motivation and lead to more effective therapeutic outcomes. Preliminary findings from a pilot study which examines the experiences of a young speech therapy client and her parents with one such system are outlined. Of particular interest is the apparent need for systems to strike a balance between providing accurate, unambiguous feedback while also encouraging playful, engaged interaction.

Author Keywords
Speech therapy, creativity, interaction design.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION AND BACKGROUND
In this paper we describe ongoing work investigating the design and use of computer-based creative vocal systems for speech therapy which enhance motivation and lead to more effective therapeutic outcomes.

A significant component of many current speech therapy techniques is intensive repetitive practice (Fox et al. 2006, Maas et al. 2008, Hailpern 2008). Speech therapy clients are often required to practise repetitive speech exercises during therapy sessions and at home. The intensive repetitive practice model can be very tedious for clients and the frequent visits to the speech pathologist required by this model can be costly, particularly for those living in rural areas (Bourke, et al 2004, Fox et al. 2006).

Computer systems, designed to give speech pathologists and their clients feedback on vocal performance, have been developed. The focus of digital feedback systems for speech therapy has been on providing accurate, unambiguous feedback to the client, generally in the form of standard mathematical visualisations or animations of the speech production apparatus (tongue, jaw, etc). Examples include "Say and See" (Hutchins 1992) and the work of Georgopoulos et al. (1999).

There are indications that using these systems can lead to positive outcomes (Ballard et al 2007, Ballard et al. in press, Georgopoulos 1999; Hailpern et al 2008; Hailpern 2009; Hutchins 1992). However, a key drawback of current feedback systems is that they may not be very motivating as they provide patients with little scope to explore. In many systems the interaction is limited to the patient correctly producing the desired results, for which the system will reward them with higher scores or perhaps simple pre-rendered animations.

We are seeking to apply another approach, in which speech therapy clients use audio-visual systems in more creative ways. The systems we develop encourage patients to use their voice to create audio-visual artworks and performances. That is, rather than have the system evaluate their voice, patients will use their voice to create visuals and sound using the computer. The systems are developed in consultation with speech pathologists so that the vocalisations that the computer responds to have therapeutic value.[1]

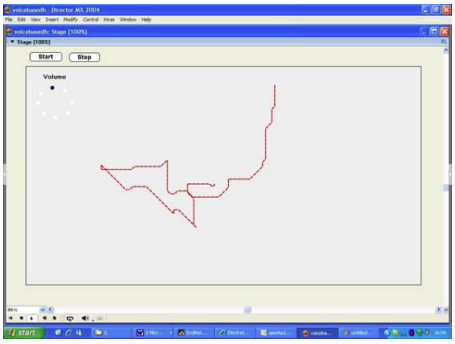

Figure 1. Screenshot of software developed by Perera which enables the creation of digital sketches using the voice (Perera *et al* 2009, p.84).

This approach is under-explored but not without precedent in this area. Perera et al. (2009) have shown that the use of voice to create digital art can lead to the

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[1] Note that our focus is on designing to enhance motivation and engagement with existing speech therapy exercises – not on developing new speech therapy exercises.

development of better control of the voice (figure 1). Hailpern et al. (2008, 2009) investigated the use of abstract audio-visual feedback to assist the speech production of children with Autism Spectrum Disorder (ASD). The audio-visual feedback (figure 2) helped make acoustic properties of the vocalisations more apparent to the speech pathologist. Importantly, they also successfully stimulated engagement and motivated the clients to practise speech techniques.

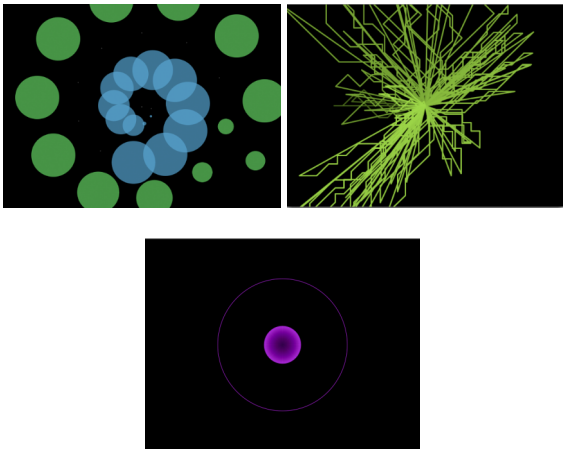

Figure 2. Abstract visuals used as feedback to encourage engagement of children with Autism Spectrum Disorder (Hailpern *et al* 2009, p. 455)

In addition, initial work by Bongers and Smith (2011) indicates that the use of multimodal interfaces for musical expression can improve motivation of patients who are undergoing rehabilitation from spinal chord injuries.

While this approach shows promise, the question of how to design feedback and audio-visual responses for creative engagement remains unanswered. There are no clear design criteria for researchers and designers working in this area and little or no empirical evidence linking software characteristics with either the outcomes of speech therapy treatment or the experiences (motivation, engagement, etc) of patients, pathologists and parents/carers.

We are using a practice-based research approach to help identify design criteria for creative vocal systems for use in speech therapy. We are developing prototype systems in collaboration with speech pathologists, patients and parents/carers. Through evaluation of the systems and users' experiences with them we are identifying key design criteria and linking these with system characteristics.

PILOT STUDY

A pilot study is underway examining the use of two creative vocal systems, *Touching Dialogue* and *Voice Art*, developed by Johnston and Perera. Both systems use analysis of vocalisations to create different kinds of art. *Voice Art*, originally developed for individuals with upper-limb disabilities, allows speech therapy clients to draw with their voice. *Touching Dialogue* was developed for acoustic musicians, and provides complex audio-visual responses which vary in response to the volume, pitch and timbre (tone) of vocal input (figure 3). Johnston's work has shown that *Touching Dialogue* engaged and motivated musicians to explore new kinds of music (eg. Johnston 2008, 2009).

Both systems have been modified for use in speech therapy sessions based on consultations with speech pathologists.

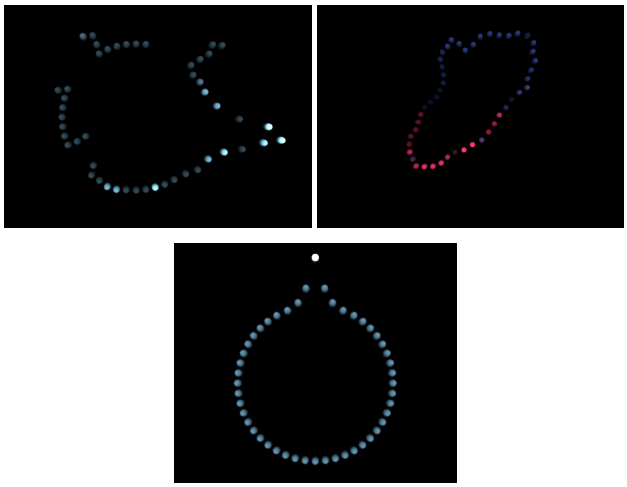

Figure 3. Screenshots from *Touching Dialogue*.

The *Touching Dialogue* prototype has been trialled with a 9-year-old child with ataxic dysarthria. The child participated in a series of speech therapy sessions over a period of two months. During the sessions the *Touching Dialogue* software was used, primarily as a feedback tool, but also as part of more playful activities. In addition, the child was asked to use the software during the week when doing various exercises devised by the speech pathologist.

A series of interviews was conducted with the child, her parents and the speech pathologists. In addition, the authors attended several speech therapy sessions in the child's home in order to observe the use of the software in context.

Analysis of the qualitative data is still underway, but initial indications are that the child found *Touching Dialogue* interesting and engaging. Comments by her parents back up this observation, with her mother saying that the child found using the software "much more interesting" than "just doing the exercises".

There is also evidence that the child found the software interesting and fun to play with. (In fact at one stage her sister also joined in.) Her mother confirmed that her daughter enjoyed, "playing around with different sounds", and also moving the on-screen spheres around with the mouse to make different shapes. It was also interesting to note that after some time, the parents "moved her on" from this playful interaction to the more structured exercises provided by the speech pathologists.

This points to an interesting tension between two conceptions of the software which we are still grappling with: the software as tool for providing feedback, versus the software as toy for encouraging playful engagement with the voice. While we, as interaction designers, are motivated to explore more artistic, playful interactions

with the software, this may not align with the expectations of parents and speech pathologists for more straight-forward unambiguous feedback.

The way the software is introduced to the child and the types of exercises (or maybe games) that are set will also have an impact upon how the tool/toy is accepted and perceived. In this study the child was provided with exercises and asked to use the software while they did them. In order to explore the degree to which the software is intrinsically interesting and stimulates play, it would be interesting to introduce the software simply as something that responds to the voice and let the child play with it in whatever way they see fit. Exploring the degree to which structured activities are necessary to achieve therapeutic outcomes is likely to be a key issue in future research. The challenge as we see it is to identify interaction/feedback strategies which can motivate exploratory, playful behaviour while also providing scope for more structured activities if need be.

CONCLUSIONS AND FUTURE WORK

In this paper we have described some initial work developing interactive tools/toys for use in speech therapy. We believe that there is considerable scope for systems of this type to help motivate and engage speech pathology clients and lead to more effective outcomes. While the initial indications are that our systems can lead to playful, exploratory interaction, there remains a tension between the 'system as tool' and the 'system as toy'. We would be interested to discuss this issue further with workshop participants, and explore the different perspectives that speech pathologists and their clients in rural areas might bring to our project.

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