

VocSyl: Visualizing Syllable Production for Children with ASD and Speech Delays

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ABSTRACT

Communication disorders occur across the lifespan and encompass a wide range of conditions that interfere with individuals' abilities to hear (e.g., hearing loss), speak (e.g., voice disorders; motor speech disorders), and/or use language (e.g., specific language impairment; aphasia) to meet their communication needs. Such disorders often compromise the social, recreational, emotional, educational, and vocational aspects of an individual's life. This research examines the development and implementation of new software that facilitates multi-syllabic speech production in children with autism and speech delays. The VocSyl software package utilizes a suite of audio visualizations that represent a myriad of audio features in abstract representations. The goal of these visualizations is to provide children with language impairments a new persistent modality in which to experience and practice speech-language skills.

ACM Classification Keywords

H5.2 [Information Interfaces and Presentation]: Screen design, Voice I/O. K4.2 [Social Issues]: Assistive technologies for persons with disabilities

General Terms

Human Factors

Author Keywords

Autism, Visualization, Speech Delays, Syllables

1.INTRODUCTION & JUSTIFICATION

Children's speech-language impairments serve as one of the most prevalent early childhood developmental challenges with approximately 24% of all children affected [2]. These impairments, combined with delays in social and interpersonal skills, can result in severe difficulty in communication and increased anxiety during human-to-human interaction [3]. The ability to combine syllables, whether as word combinations (e.g., more juice) or as one multisyllabic word (e.g., doughnut), represents an important developmental milestone that is delayed or impaired in a variety of clinical groups including children with apraxia of speech, autistic spectrum disorders (ASD), and children identified as late-talking

toddlers [8,14]. In fact, challenges with multisyllabic words may represent a residual difficulty for some adolescents and adults with a history of phonological difficulties [5,13]. The importance of facilitating multisyllabic productions not only relates to speech intelligibility but also to optimizing language growth.

This research focuses on the development and design of the **VocSyl** software package. Based on existing research, VocSyl utilizes abstract visualizations of voice to encourage and shape the vocalizations (specifically syllable production) of children with ASD and speech delays. We hypothesize that by changing vocalizations and clinicians' models from a modality that is amorphous and fleeting to one that is persistent and informative/reflective we can help increase the linguistic abilities of children struggling to combine syllables into words and phrases.

1.1.HCI and Voice Visualizations

Since the 1990's, the Human Computer Interaction (HCI) community has examined how computers can aid in diagnosis of ASD [7]. HCI researchers have also studied audio perception [16], vocalization of infants[4], and teaching of human-to-human interaction to high-functioning children with ASD [17]. Elements of play have also been studied demonstrating that technology/computers can reduce the apprehension caused by human-to-human interaction [10]. Our prior work [6,9] illustrates the potential of abstract visualizations of voice (pitch, volume, and duration) to increase the rate and duration of speech-like vocalizations in low functioning children with ASD. However, [6,9] did not focus on shaping vocalizations. This research seeks to pick up where we had left off; using abstract visualizations of voice, to shape and teach word production in children with ASD and other speech delays.

2.VOCSYL

The aim of this project is to develop, implement, and measure the effectiveness of software tools for facilitating multisyllabic speech production in children with speech-language disabilities, specifically low and moderate functioning children with autism. In addition to the novel software and empirical data we plan to generate, this cross-disciplinary project will provide an innovative and important approach to developing treatment for children with speech and language disabilities. To this end, we have built VocSyl a software package that provides real-time visual feedback in response to vocal pitch, loudness, duration, and syllables (See Figure 1). Such a re-interpretation of voice will allow for both a new understanding of one's vocalization by audio/visual feedback and will also allow for a tangible comparison to models presented by clinicians. In other words, a child will be able to both see and hear

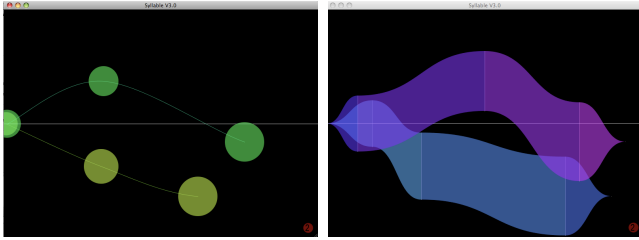


Figure 1. Two visualizations of the word “basketball,” each with a model and a differently pronounced response
relative changes in pitch are in the Y axis, time is the X axis, volume is represented a size, and syllables are each circle or color change

word models by a clinician, and then use real-time visualization of their own voice to assist in learning proper vocalization and speech techniques (specifically in multi-syllabic production).

VocSyl detects vocalization’s syllables [12], pitch [15], volume and changes in duration for visualization. VocSyl was built as an open source visualization system in Java™ utilizing the Processing API. In addition, a more portable, closed platform, solution is being built for the iPhone/iPad in conjunction with Antares[1]. Both platforms translate audio, in real time, into visualization that can be customized through end user controls and code (for the Java version).

3.Future Software & Evaluation

We will create software tools to facilitate speech acquisition through implementation of the Task Centered User Interface Design (TCUID) process [11]. This process involves working with the target group for the full development phase, with the goal of shaping the design through their feedback and experiences. This approach emphasizes building not what engineers think is needed, but what the intended users demonstrate they need. In effect, the users become part of the development team. We will be using TCUID with three groups of children; Autistic Spectrum Disorder with speech delays, speech delayed only, and typically developing. This will allow us to design software to take into account the needs of each population group, and determine what aspects of the computer software are more universally understood.

4.CONCLUSION

This project aims to address critical needs in the speech and language development of children with Autism and Speech Delays. The VocSyl software package builds on existing research, and creates a configurable real-time visualization suite of vocalizations. We have built our software in both a desktop open-sourced solution, as well as a closed iPhone/ iPad system for multiple avenues of dissemination. In addition we outlined a plan for integrating feedback from children with ASD and speech delays.

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