Speech movements as the basis of speech therapy for dysarthria in Parkinson disease (PD) and apraxia of speech (AOS)

Therapeutic options are limited at present for those with motor speech disorders. The majority of existing therapy techniques are focused on relearning perceptual targets. Therapeutic monitoring and understanding the nature of underlying articulatory adjustments play a secondary role. Dysarthria and apraxia of speech (AOS) are primarily speech movement disorders, however, and targeting speech movements might lead to more efficient motor speech recovery. Articulatory visualizations might be particularly advantageous for those individuals who cannot fully utilize the auditory and/or somatosensory feedback due to disease or age-related sensory changes.

The first step in speech motor therapy development is to identify population specific motor/ movement targets. We hypothesised that for patients with PD, who demonstrate a pattern of overall movement reduction, articulatory targets are based on kinematic measures of movement range[1]. In contrast, patients with AOS often present with the disorder of place of articulation with high degree of between repetition variability of speech movements. Their therapy target is to reduce tongue movement position variability, expressed as the reduction of the positional targets for speech sounds [2]. The therapy targets are abstracted into interactive game scenarios that provide feedback about the movement target and incorporate the principles of motor learning (e.g., reduced schedule of feedback and self-control of feedback) [3,4]. We hypothesise that using game-based visualization will result in effective learning of speech movement targets and improved speech intelligibility.

METHOD

Subjects: 5 patients with PD and 5 patients with AOS due to stroke will be presented (data collection is ongoing). A clinical evaluation includes speech intelligibility and apraxia of speech evaluations as well as the baseline examining the movement patterns and perceptual (error) judgements of their speech.

Data collection and analysis: Movement data is collected using the Wave Speech Research System (NDI, Canada). Movements of the head and tongue (plus jaw) are recorded with 5 and 6 degree of freedom (DOF) sensors are obtained at 100 HZ. The head movements are subtracted from those of the tongue in real time. The gaming module (Unity) is connected to the Wave [5]. The gaming module is designed to analyse speech targets (e.g., movement range, movement variability) and set up the next target based on the ranges of the current speaker performance. The game is activated after the patient produces the desired target and displays the extent to which the set target is achieved. Summary feedback is provided at the end of each practice block.

RESULTS/ CONCLUSIONS

The presentation will review the milestones in the development of the game-based visualizations and summarize the effect of the novel approach on learning of the speech targets using a single case study methodology. Preliminary results available for patients with PD show that they are able to consistently increase the range of motion in sentences presented with visual feedback via game as compared to sentences practiced without the visualization.

Supported by recent technological developments in real-time speech movement tracking, game-based visualizations demonstrate a potential therapeutic benefit in patients with PD or AOS due to stroke.

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