

Theme IV: Motor Control of Speech and Language

Poster #143

Sonifying handwriting movements as real-time auditory feedback for the rehabilitation of dysgraphia

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ABSTRACT

Although almost all motor activities are silent, the modality of sound can be used to inform about the correctness of the ongoing movement, without interfering with the visual and proprioceptive feedback. Furthermore, the dynamic features of sounds make them particularly relevant for informing about the spatiotemporal characteristics of movements. Finally, because of their (potentially) playful character, sounds are potentially efficient for motivating patients, children for instance, in particular need of such assistance. From these theoretical considerations, we proposed to sonify handwriting movements in order to facilitate the rehabilitation of dysgraphia. Dysgraphia refers to mechanical difficulties in handwriting production related to a lack of motor control in children having neither neurological nor other motor deficits. Nowadays, handwriting movements can be recorded with graphic tablets at high temporal and spatial resolution. Two challenges appeared: first, finding the relevant variables associated with the different sounds; second, finding the appropriate auditory dimension(s) on which to map the handwriting movements. We hypothesized that sound is well suited to inform about hidden variables of handwriting movement (which cannot be supplied by vision) and we decided to sonify two kinematic variables: the instantaneous tangential velocity and the unexpected velocity peaks. Unexpected velocity peaks have been shown to be directly related to non-fluent handwriting movements. Finally, the pressure applied by the pen on the graphic tablet was associated with the global volume of the sound. We are currently testing these movement/sound associations in seven dysgraphic children in a longitudinal protocol of handwriting rehabilitation. The experiment is divided into six 20-minutes weekly sessions. Each session is organized in identical manner, including a pre-test without sound, a practice with auditory feedback and a post-test without sound. In the pre- and post-tests, tasks are strictly identical and thus can be used to follow the rehabilitation evolution, within and between sessions. Preliminary data from the three first sessions revealed a positive effect of the sonification procedure: Dysgraphic children appeared to be able to write faster and with more fluent movements. These first promising results will be soon completed with an additional control group in which other dysgraphic children will run the same protocol without auditory feedback, in order to confirm the positive effect of adding sounds. We propose that sounds may be used as a palliative way to inform about kinematics of handwriting movements and, maybe, to assist movement rehabilitation in general.