EARS DRIVE HANDS: SONIFICATION OF LIQUID EFFECTS INDUCED BY AQUATIC SPACE ACITIVIES CONTRIBUTES TO COGNITIVE REPRESENTATION

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INTRODUCTION; Aquatic Space Activities (ASA) as a self-induced cyclic motion in water, induces pressure changes, resulting in buoyancy and momentum changes of water mass while the surrounding is resisting the motion which is controlled by cognitive act of information transformation performed by a behavior directing system under the condition of limited energy reservoirs. Instructors often report that novices executing ASA, including head-above-water, get exhausted quickly. One reason might be that the water motion is perceived improperly and e.g. a tapping like motion is executed to forcefully. However, the communication is difficult about what is appropriate. Optimal ASA behavior demands polymodal sensory integration and there are some hints that the auditory information is an essential channel (Effenberg, 2005). Listening to the water motion induced by hand-water-interaction is possible using sonification, which is a means to transfer any non-acoustic signal to sound (Herman et. al., 2012). Although the neurobiological mechanisms that mediate the behavioral effects of corresponding auditory effect stimuli are still unknown, sonification might have a potential to enhance the accuracy of existing motion perception as well as motor control. This may aid the person with no talent for feel of water to execute ASA properly, when e.g. advised to swim. Via real time sonification movement perception can be enhanced in terms of temporal precision and multi-channel integration. Resulting movement sounds contain structural analogies to visual and proprioceptive percepts enhancing audio-proprioceptive integration and enabling the tuning of the multimodal perception. The goal, here, is to introduce the setup of real time measuring pressure changes and sound production while executing ASA.

METHODS; The unsteady flow effects were quantified via Piezo-probes (2 per hand) which were connected to pressure sensors. A SuperCollider program transformed the pressure-differences into functional sounds presented via loudspeaker. Action and sound were videotaped simultaneously. Two event-based parameter-mapping sonification schemes were selected. The study of real-time sonification was focused on the symmetry while executing hand-water-interaction in head-out-positon.

RESULTS; The quality of the real-time aspect was checked quantitatively. The time lag from the first action of hand and sound heard via loudspeaker was 0,123 ± 0,027 s. The delay of 123 ms is not far from reaction threshold of sportive actions. A questionnaire revealed that the two sounds did not create negative emotions while the persons agreed to become familiar with the sounds and the likeliness to rehears over longer periods with sonification of the pressure data was ranked: fully agreed

DISCUSSION; The failure to produce a normal movement pattern is not just a sign of a dysfunction in "motor programming" or movement execution because the alignment of the motor-efference copy mechanism with expected sensory feedback needs to be considered. The Piezo-probe based tool for sonification in various aquatic actions can be advised as a major step to enhance perceptions of effects of unsteady flow and it may be quite useful in designing behavioral therapies aimed at intervening sensorimotor integration and control.

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