EFFECT OF VISUAL, PROPRIOCEPTIVE, OR AUDITORY FEEDBACK ON ARM KINEMATICS WHILE POURING WATER FROM KETTLE TO GLASS

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Introduction

The age-related decline in eyesight and muscle strength may increase the risk for burns when attempting to pour hot water from a kettle to glass [Redlick, 2002]. We therefore aimed to quantify the performance of pouring water in the presence of three isolated feedbacks: visual, proprioceptive, or auditory.

Methods

In an ongoing research, 30 healthy adult subjects are tested in a motion capture laboratory. Six reflective markers are placed on the upper arm and forearm of each subject. Also, 3 markers are located on a kettle. A six-camera motion capture system (Qualisys Medical AB, Sweden) is used to stream the markers coordinates in real time, and automatically identify them. Real-time output is then streamed to LabView (National Instruments, USA), where the 6DOF kettle is recognized. Each subject is instructed to pick up the kettle from a marked position and pour its content (200ml water at room-temperature) to a fixed glass and place the kettle back on the table, place on the table. The subject repeats this activity 13 times blindfolded and touching the glass with the free hand (proprioceptive feedback), then 13 times blindfolded and a beeping is activated when the bottle is at the correct location above the glass (auditory feedback), and finally, 3 times with only visual feedback. This is a randomized AB/BA design where 15 subjects will first perform the task with the proprioceptive feedback and then with the auditory feedback and 15 subjects will perform the reversed order.

In order to produce the auditory signal, the LabView code is used to calculate the position of the tip of the kettle in regard to the glass rim. Pre-trial attempts were performed to determine the boundaries of a "safety zone" and when the tip of the kettle enters these boundaries, a 300Hz 5msec beeping sound is activated. Kinematics of movement are analysed for consecutive trials and between the different feedback conditions.

Results

Interim results show increased smoothness of the movement, quantified by number of movement units [Chang, 2006], with practice. Also, the auditory feedback increase the success rate of performing the task compared to the proprioceptive feedback.

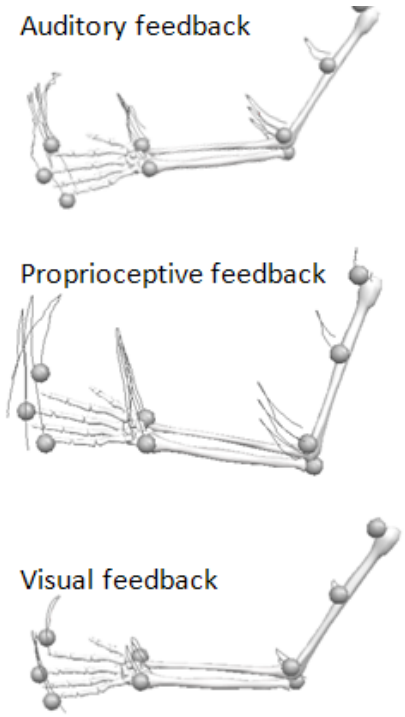

Figure 1: An example of the movements of the upper limb and the kettle (3 markers on the left side of each frame) during a task of pouring water to a glass in the presence of visual, auditory or proprioceptive feedback.

Discussion

Our results suggest that an auditory guidance of the kettle may reduce the risk for burns in visually-impaired individuals.

References

Chang JJ *et al*, Disabil Rehabil, 28, 1507–16, 2006.

Redlick F *et al*, Burn Care Rehabil, 23, 351-6, 2002.