

Auditory feedback affects perception of effort when exercising with a Pulley machine

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Summary—In this paper we describe an experiment that investigates the role of auditory feedback in affecting the perception of effort when using a physical pulley machine.

Specifically, we investigated whether variations in the amplitude and frequency content of the pulley sound affect perception of effort. Results show that variations in frequency content affect the perception of effort.

Introduction

Several studies in multisensory research show how variations in auditory feedback affect the perception of a multimodal experience. A classic example is the parchment skin illusion, where the interactive variation of auditory feedback affects subjects' perception of hand dryness when performing the action of rubbing hands in front of a microphone [1].

In this paper we are interested in investigating whether auditory feedback affects the perception of effort when using a pulley machine like the one shown in Figure 1.



Figure 1 The Pulley machine used in the experiment.

The microphone is placed behind the handle and the real weight is hidden to user's sight.

To achieve this purpose, we augmented the pulley machine shown in Figure 1 with a contact microphone, capturing the friction sound obtained when performing a pulley action. The microphone was connected to a Fireface 800 interface, and the captured sound manipulated in realtime using the Max software by Cycling 74 [2]. The manipulated auditory feedback was delivered to the subjects using a pair of Sennheiser HD

600 headphones. Specifically, the friction sound was manipulated in realtime by altering the amplitude level (low, medium and high) and the frequency components (no alteration, lowpass filter at 1000 Hz and highpass filter at 1000 Hz), giving a 3x3 experiment design.

12 subjects (9 male, 3 female, all students at Aalborg University Copenhagen) participated to the experiment.

The experiment took place in the gym of the university, providing ecological conditions but also additional noise that could affect the results. Three subjects performed the experiment when an additional person was training on a treadmill. All other subjects performed the experiment only in presence of the experiment's runners.

Each of the 9 conditions was presented randomly five times, for a total of 45 trials. Subjects were asked to pull the machine one time, and after each trial subjects were asked to rate their perception of effort using the Borg test [3]. Specifically, after each trial subjects were asked to assess their feeling of exertion on a scale from 6 to 20, where 6 means no exertion at all, and 20 maximal exertion.

Results and discussion

Results show a significant difference for variations of frequency content. Specifically, for all levels of amplitude the use of a lowpass filter at 1000 Hz produced a significantly higher exertion compared to a highpass filter at the same frequency.

Overall changes of amplitude did not produce a significant difference in level of exertion.

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