Influence of Sonification on Jumping Force during a Skater Jump

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Summary

Auditory stimuli have been shown to enhance sports performance. One study reported a significant increase in average power output during a bench press exercise with an auditory stimulus. Expanding on this concept, we investigated whether sonification of skater jumps could enhance jumping force compared to a control condition. Two distinct auditory stimuli were designed to emphasize the moment of takeoff, landing, and balancing phase of the skater jump motion. One auditory stimulus led to an increase in jumping force compared to the control condition.

Introduction

Auditory stimuli can play an important role in sports and physical performance. They can serve as a motivational factor or also to guide movement execution. Studies found an increased average power output in bench pressing exercises [1] and a higher mean distance covered during the shuttle run test with an auditory stimulus compared to a control condition [2]. In this study we aimed to compare the jumping force during a skater jump movement between two different auditory stimuli each in two different versions and a control condition. We hypothesized that auditory sonification enhances the resulting jumping force in skater jumps.

Methods

After a short warm-up, 17 healthy participants (14 females, BMI 23.7 ± 2.7 kg/m2, aged 33.1 ± 9. 1 years) with no hearing impairment performed skater jumps (Figure 1) for 60 seconds with three different sound conditions.

Figure 1: Different phases of the skater jump movement.

Metronome (CO, control condition), noise (NS), and tonal (TO) were the three conditions. The sound stimuli NS and TO were designed to support specific aspects of the skater jump motion: a phase with increasing complexity and loudness ending with an impact sound for the jump preparation and takeoff, and a softer landing sound with fading tones for the balancing phase. This structure was realized with harmonic, tonal sounds (TO) and with non-musical sounds inspired by the sound of ice skating (NS). Both stimuli started with a normal version (NS1/TO1) and then changed to an enriched version (NS2/TO2) after some repetitions. Jumping with the CO was always performed first, whereas the order of NS and TO was randomized. To measure the resulting jumping force, all skater jumps were performed such that the non-dominant leg landed on the force plate (AMTI OR6 series force plate). Before data recording, the participants listened to the sound stimuli once.

We used repeated measures ANOVA to compare differences in the normalized jumping force with the different sound conditions and versions. Post-hoc comparison was performed with a paired t-test. Statistical significance was set to $p < 0.05$.

Results and Discussion

The repeated measures ANOVA showed a statistically significant difference in the jumping force between conditions ($F(4,149) = 5.447$, $p = 0.0004$), $\eta 2 = 0.13$). Post-hoc analysis showed significant differences between the CO and NS1 ($p < 0.001$) as well as CO and NS2 ($p < 0.001$) but no significant differences between the other conditions (Figure 2).

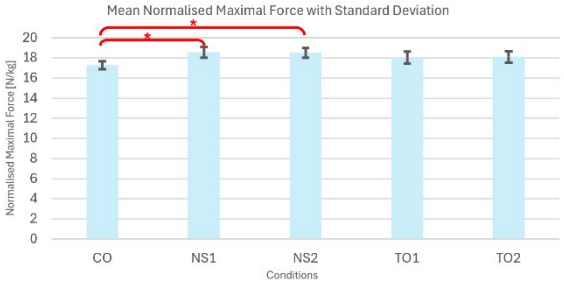

Figure 2: Mean of normalized force of the skater jump.

The significant difference between NS and CO shows a more forceful jump with the NS stimuli. Since NS was inspired by the sound of ice skating, this sound may have triggered a mental movement representation which led to the increased force. The lack of further increase with the enrichment suggests that the sound itself is more important than the enrichment. Greater familiarity with the task could possibly influence these results, as it might allow the participants to focus more on the sounds themselves rather than focusing on the rhythm or the act of landing on the force plate.

Conclusions

Sonification may increase the maximal jumping force in a skater jump. No differences were found between the different versions, implicating that the sound itself is more important than the enrichment. Further research needs to examine how a longer period of familiarization or regular exposure to the sounds affects maximal jumping force.

References

[1] Muriga et al. (2012). *Review of Psychology* **19**: 13-16
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