

Increasing Heart Rate and Anxiety Levels with Vibration and Sound: Useful to Alert Road Users?



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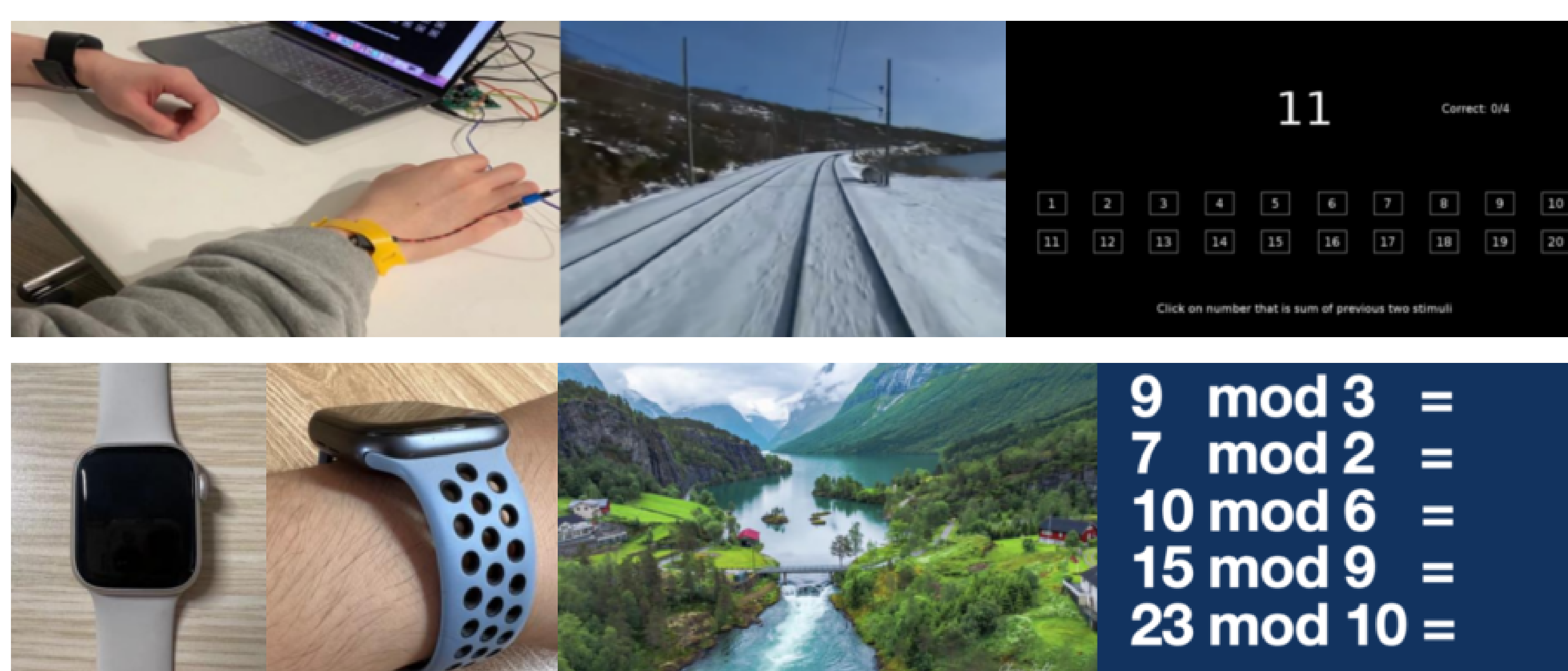
This work presents two studies evaluating the influence of presentation of a fast heartbeat in form of vibration on the wrist or sound or a combination of the both on heart rate and anxiety levels. Results showed that the presentation of fast heartbeat as vibration and sound and their combination led to increased anxiety levels and increased heart rate. Could this potentially lead to increased alertness in road users?

Introduction

Inattention on the road can lead to potentially harmful situations. Haptic and auditory cues have been used on the road to present road users with notifications and warnings of potential hazards. The same modalities have also been used in other situations to calm people, for example by presenting a slow heartbeat as vibrotactile or audio cues. But could they also be used to increase overall alertness by increasing heart rate without pointing to a specific hazard? We conducted two studies to examine the influence of the presentation of a fast heart beat with vibrotactile and/or auditory cues on heartbeat and anxiety levels in both calm and stressful non-traffic situations.

User Studies

Two studies evaluated the influence of vibration on heartbeat and anxiety levels, in the second experiment audio cues were added as well. In both studies, participants watched a calm video in the calm state (train ride / landscape) and did a maths test in the stressed state (Paced Auditory Serial Addition Test / modular arithmetic task), and each state was tested without and with cues. In the first experiment (N=8), both hands were tested using the Empatica device to collect heartbeat and Haptuator Mark II vibrotactile actuator for vibration, while in the second experiment (N=12), vibration and audio cues were presented on the non-dominant hand using a smartwatch, while another watch collected the heart rate on the dominant hand.

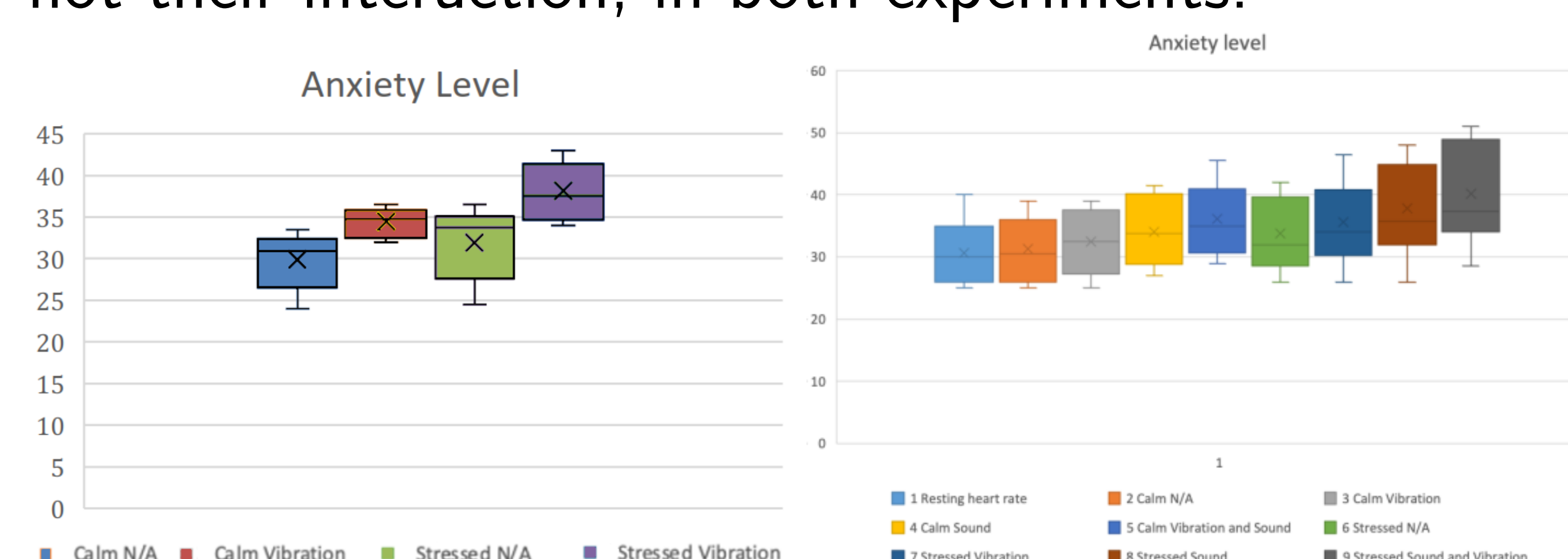


Results

Results showed statistically significant differences for heart rate between the calm and stressed state and between modalities in both experiments, but not for any interaction.



Additionally, anxiety levels showed statistically significant differences between states and modalities, but not their interaction, in both experiments.



In the first experiment, no statistically significant differences between left and right hand were found.

Discussion

The presentation of a fast heartbeat with vibration and/or sound led to higher heartbeat and higher anxiety levels, in both calm and stressed situations. For this approach to be usable in traffic situations, the fast heartbeat presentation would have to lead to higher alertness, increasing overall situational awareness, without increasing anxiety to a level that would decrease the user's ability to appropriately react to traffic demands. More research is needed to assess the impact of this approach on, for example, driving or cycling performance as well as work load, to fully decide if this approach could be a beneficial way to increase alertness in road users.