Assessing Cognitive Acuity During Dynamic Activities: The Dynamic Auditory Stroop Test (DAST)

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Introduction

- Altering plantar sensation can have effects on cognitive performance and brain activity. [1]
- Dual-task protocols assess attention and individual allocation of cognitive resources. [2]
- Textured insoles optimize cognitive resources by reducing prefrontal activation, freeing up mental capacity for other tasks. [3]
- The Dynamic Auditory Stroop Test (DAST) employs auditory cues to assess cognitive function during Running. [4]

Fig. 1. Audio cues are played in stereo, indicating their congruence.

Methods

- **Sample:** 19 male participants (ages 19-27)
- **Insole Conditions:** Subject's own insole (control I1) and three textured insoles (varying roughness I2, I3,I4).
- **Perceived Roughness Assessment**: Visual Analog Scale (VAS) used to subjectively rate insole roughness on a 0-10 scale (VAS).
- **Dynamic Auditory Stroop Test (DAST):** Participants ran while responding to auditory Stroop cues

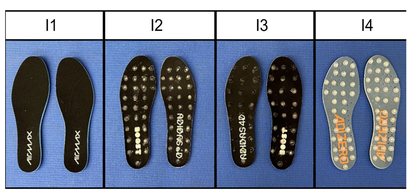
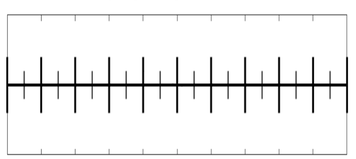


Fig.2: Different textured insoles with varying roughness



Lowest Surface Roughness — **Highest Surface Roughness**

Fig.3: The visual analog scale (VAS)

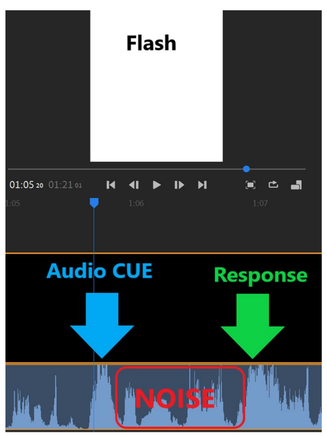


Fig. 4. Analysis of Audio Cues and their response time

- The test consisted of **16 randomized auditory cues** ("Right" and "Left") presented through a headset.[4]
- Participants responded verbally with **"Correct" or "Wrong"** based on the **congruence** between the word and its location.
- Each participant completed four trials, one for each insole condition (I1, I2, I3, I4), with randomized order and breaks between trials.
- **Data Collection:** Response accuracy and latency recorded.
- **Data Analysis:** Latency compared across insole conditions; relationship between perceived roughness (VAS) and response latency analyzed.

Results

- **Perceived Roughness Assessment :** Perceived insole roughness increased from smooth control (I1) to textured insoles (I2, I3, and I4), with I2 and I3 having similar VAS ratings.

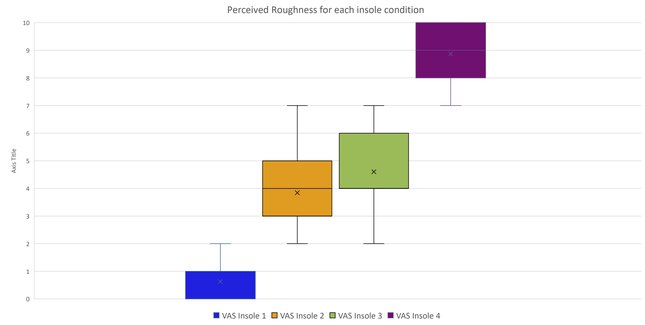


Fig. 5. Mean perceived surface roughness for each insole condition

- **Data filtering:** Filtered from a range of 0.5 to 2.5 seconds, based on the distribution of latency data to remove outliers.
- Data from Insoles 2 and 3 were combined due to their similar VAS scores, treating them as a single condition.
- Insole 1 latency distribution data exhibited greater variability compared to the other insoles.

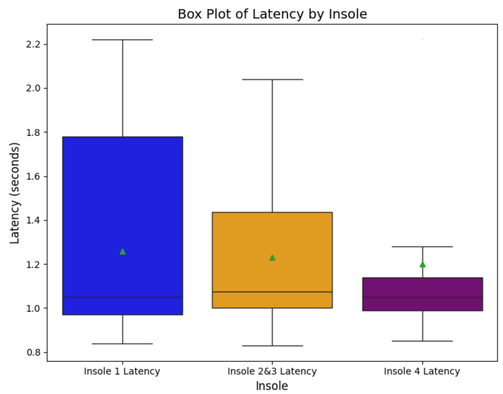


Fig. 6. Distribution of Response Latencies for different insole conditions

- **Audio-Stereo congruence:** Incongruent stimuli showed slightly increased latency compared to congruent stimuli.

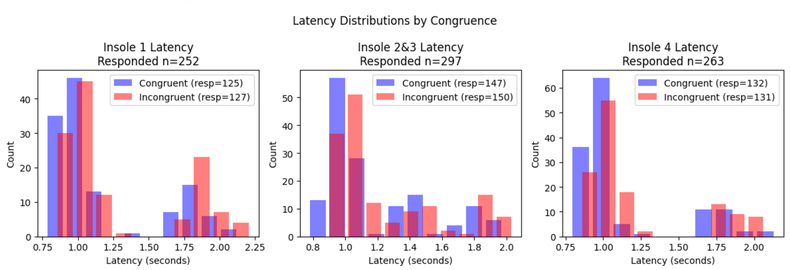


Fig. 7. Distribution of Response Latencies for Congruent and Incongruent Audio-Visual Stimuli.

Results

- **Response latency:** decreased with increasing perceived roughness (VAS score), following a strong inverse quadratic relationship ($R^2 = 1$).

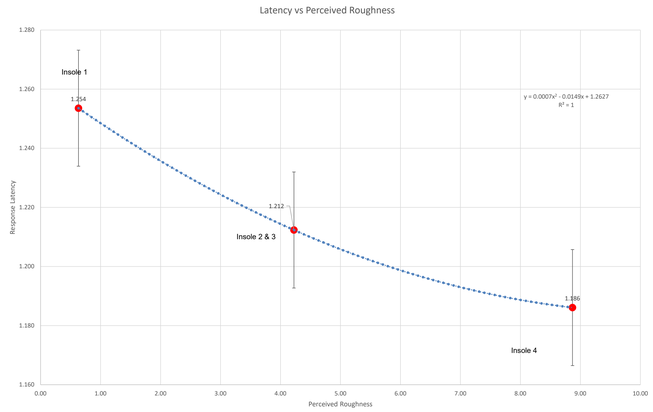


Fig. 8. Polynomial mixed-effect regression model correlating Latency and Perceived Roughness

Summary, Conclusions and Future Directions

- Insoles 2 and 3 had similar VAS scores, making them difficult for subjects to distinguish.
- Decreased latency may reflect heightened attention and improved cognitive performance.
- **Comparison with previous studies:** These results align with previous findings from the Balance and Stability Test (BAST) and Dynamic Adjusted Lane Test (DALT), where textured insoles initially outperformed the control condition.
- **Potential benefits:** Textured insoles may enhance cognition, balance, and performance across various populations.

References

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