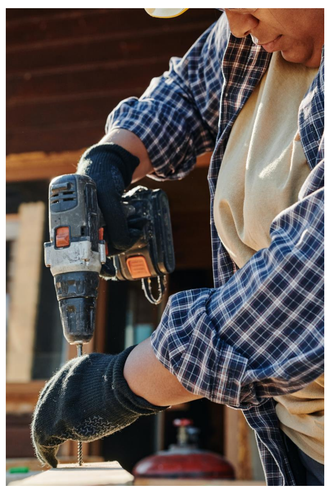
Influences of hand-arm vibration on human cognition

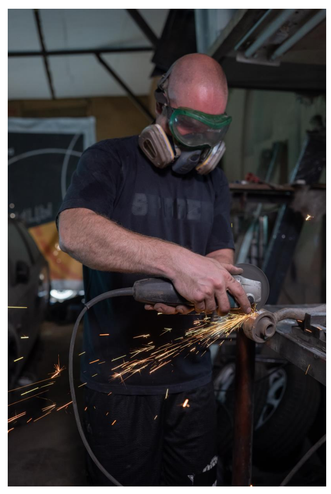
A. Voormann[1], A. Rodríguez[1], A. Lindenmann[2], D. Fotler[2], S. Matthiesen[2], & A. Kiesel[1]

[1] University of Freiburg, [2] Karlsruhe Institute of Technology

Occurence of hand-arm vibration

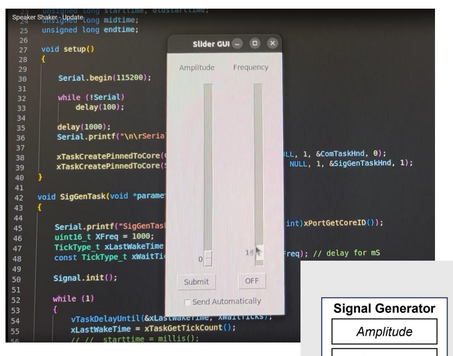
- Vibration as multisensory perceptual construct: can be detected via touch, vision, and hearing
- Hand-arm vibration occurs mostly when using a power tool or holding a workpiece that is currently under workmanship
- In many cases vibration cannot be avoided nor can the activities be replaced by other technologies (e.g., grinding, drilling)
- But especially in those cases, it is essential for the craftsmen to be attentive in order to avoid accidents or damages

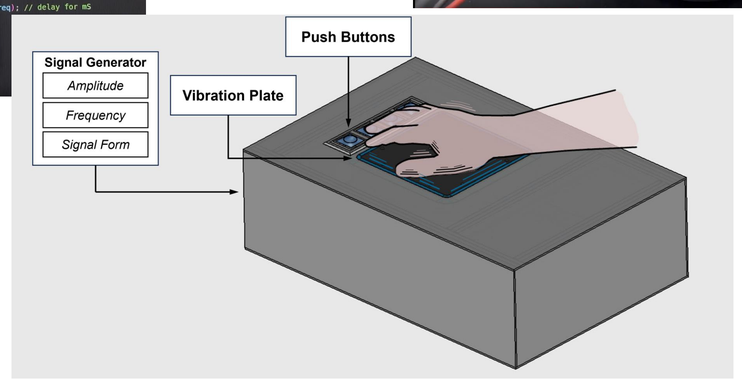




Vibration and Cognition

- Whole-body vibration used as a training method that stimulates the human neuromuscular system (Wen et al., 2023)
  - improvement of the performance in a Stroop task (Regterschot et al., 2014)
  - impairments in attention and concentration in complex tasks (Gritschmeier, 2021)
  - No impact on short-term memory performance but higher increased subjective difficulty (Ljungberg et al., 2004)
  - Stroop task with bus drivers: higher hand-arm vibration acceleration led to an increased interference time (Rahmani et al., 2021)
- Most studies assess performance <u>after</u> the experience of vibration
- Affect impacts cognition (e.g. Dreisbach & Goschke, 2004), yet the impact of vibration comfort and discomfort is unknown.





Impacts of hand-arm vibration

- Depend on amplitude, frequency, the duration of the exposure, vibration input direction, type and sensitivity of the tissues
- Sleeping disturbances and physical harm effects especially in hand and arm (Issever et al., 2003)
- Reduction in fine hand motor performance, finger temperature (Forouharmajd et al., 2017)
- Attention, motivation, and fatigue impact the perceived vibration comfort, discomfort, and intensity (Hägele, 2023)
- Long term effects: Hand-arm vibration syndrome

Planned research program

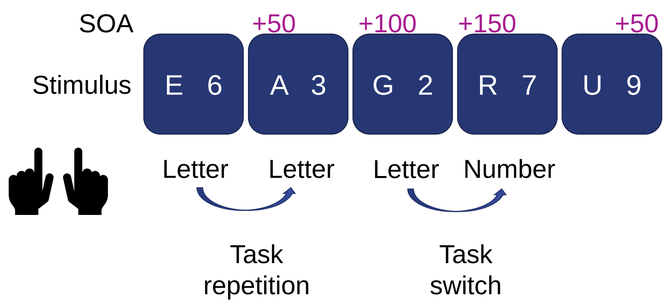
➢ How is cognitive performance influenced when participants experience at the same time hand-arm vibration?

a) Which type of vibration has an effect on the performance in cognitive tasks?
   - Constant intensity
   - Predictable change of intensity
   - Unpredictable change of intensity

b) How does vibration comfort and discomfort effect performance in cognitive tasks?

c) Does the perceived increase in task difficulty while experiencing hand-arm vibration impact the choice behavior in self-organized task-switching?
   - Task-switching costs
   - Cost balancing in task-selection

Self-organized task-switching



Switch-costs and switch-SOA are similar in size

➢Participants are quite good to tradeoff their switch-costs with the waiting time for the repetition stimulus.
(Mittelstädt et al., 2018)

Contact

Anne Voormann
University of Freiburg
anne.voormann@psychologie.uni-freiburg.de

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