Understanding Systems

that are intended to support human cognition

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Systems that support human cognition
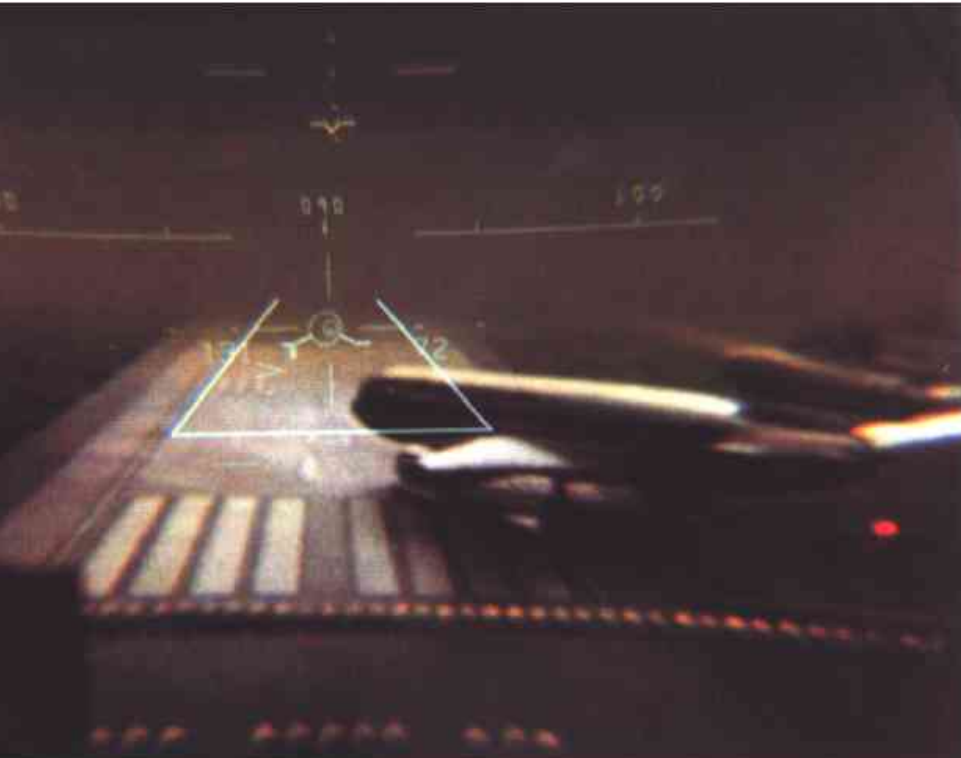
We do not really understand HOW such systems support human cognition

we did, perhaps we could be designing more intuitive systems and interfaces
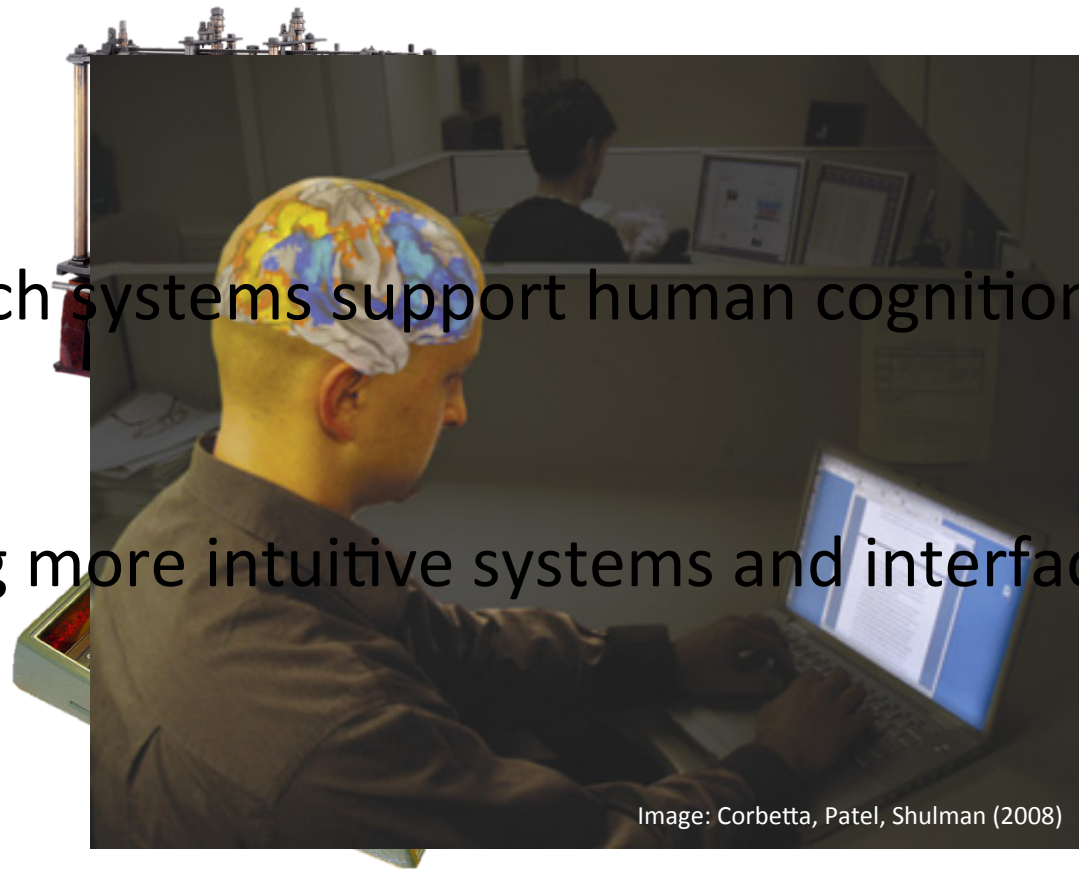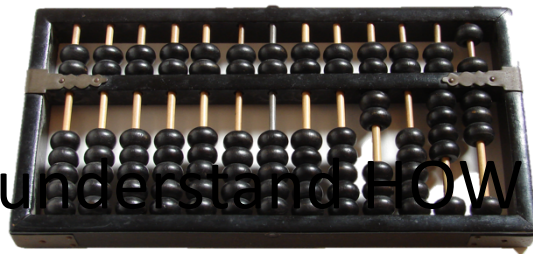
Image: Corbetta, Patel, Shulman (2008)

Images: Wikimedia Commons

Cognition: Keep the aircraft controlled, collision avoidance, descent speed maintainence...

Inattentional Blindness

aines, R. F. (1991) A breakdown in simultaneous information ocessing In *Presbyopia research* 171-175 Springer US.

Wickens, C. D., Alexander, A. L. (2009). Attentional tunneling and task management in synthetic vision displays. In *The International Journal of Aviation Psychology*, 19(2), 182-199.

Apparent Challenges

- design cannot easily anticipate how human cognition is reshaped by new technology

- failures could be rare, but nonetheless deadly

- when new technology is introduced to support cognition:
  - how should we evaluate it?
  - what should we evaluate it for?

The diminishing value of "mental workload"
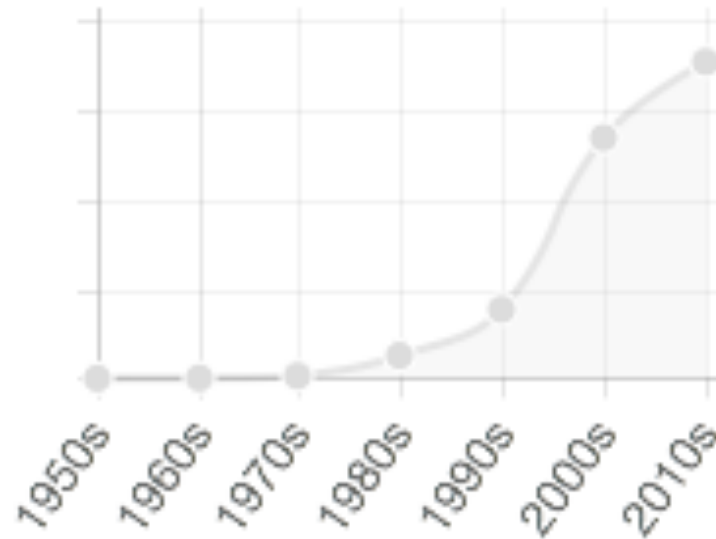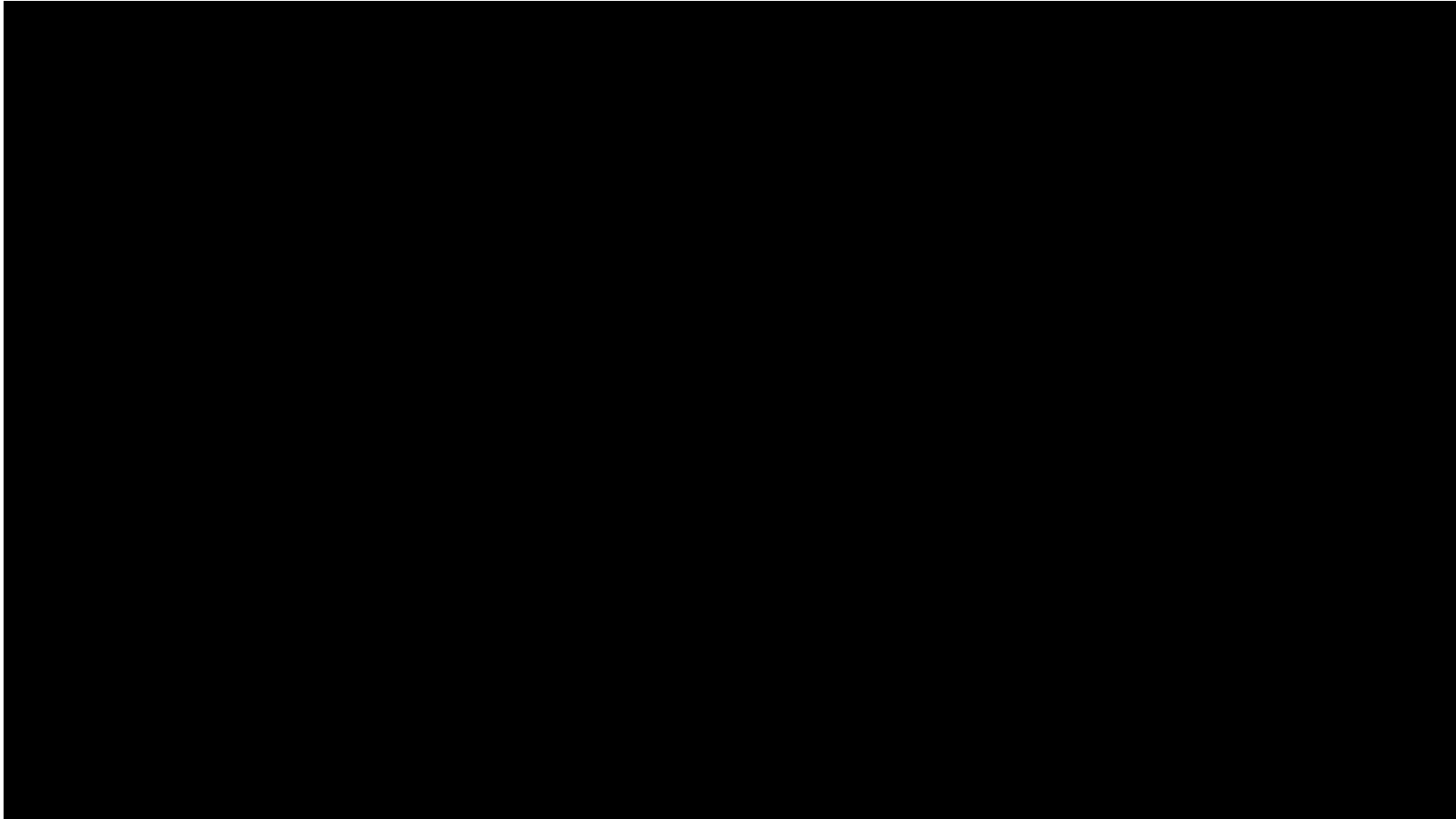

ACM library search performed on 2018-02-08
for "mental workload"

Case Study 1: In-Vehicle Notifications

Fagerlönn, J., Lindberg, S., & Sirkka, A. (2015). Combined Auditory Warnings For Driving-Related Information. In *Proceedings of the 10th Audio Mostly Conference: A Conference on Interaction with Sound*, http://doi.org/10.1145/2814895.2814924

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Sound Design

Liljedahl, M., & Fagerlönn, J. (2010). Methods for Sound Design: A Review and Implications for Research and Practice. In *Proceedings of the 5th Audio Mostly Conference: A Conference on Interaction with Sound* (p. 2:1--2:8). http://doi.org/10.1145/1859799.1859801

- simulate expected environment

- interviews with professional drivers

- focus groups

- subjective questionnaire for "mental workload"

- quantitative user study

  - (i.e., test reaction times and discrimination accuracy)
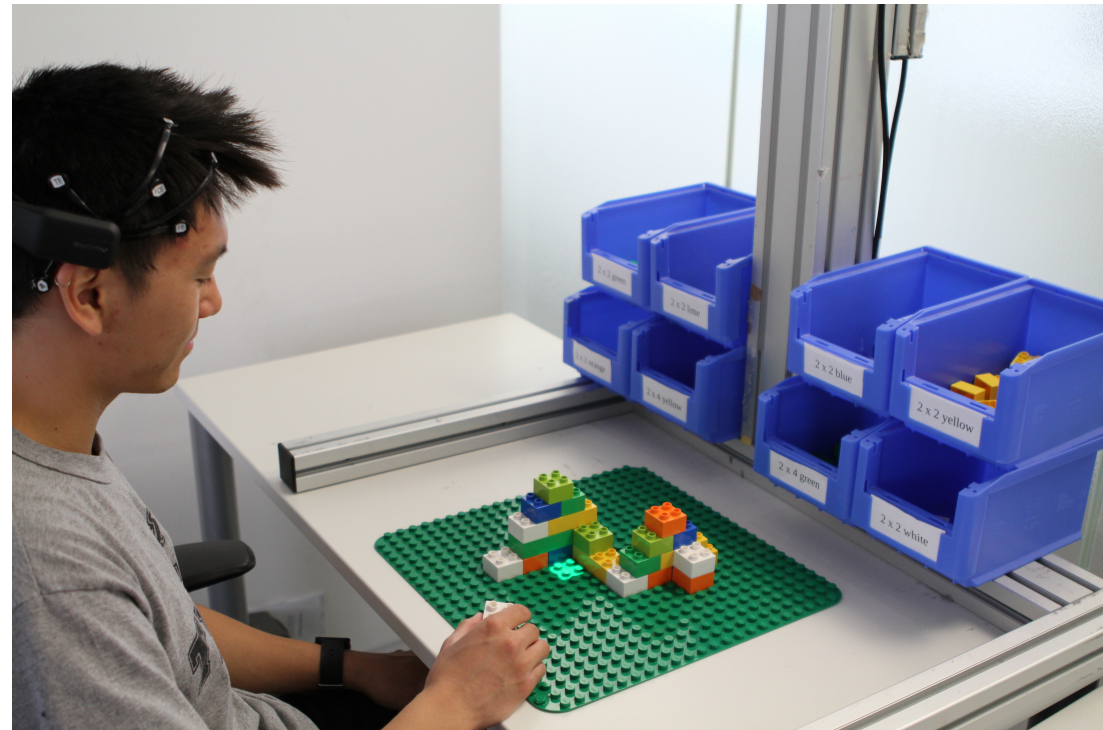
  - verbal commands are preferred

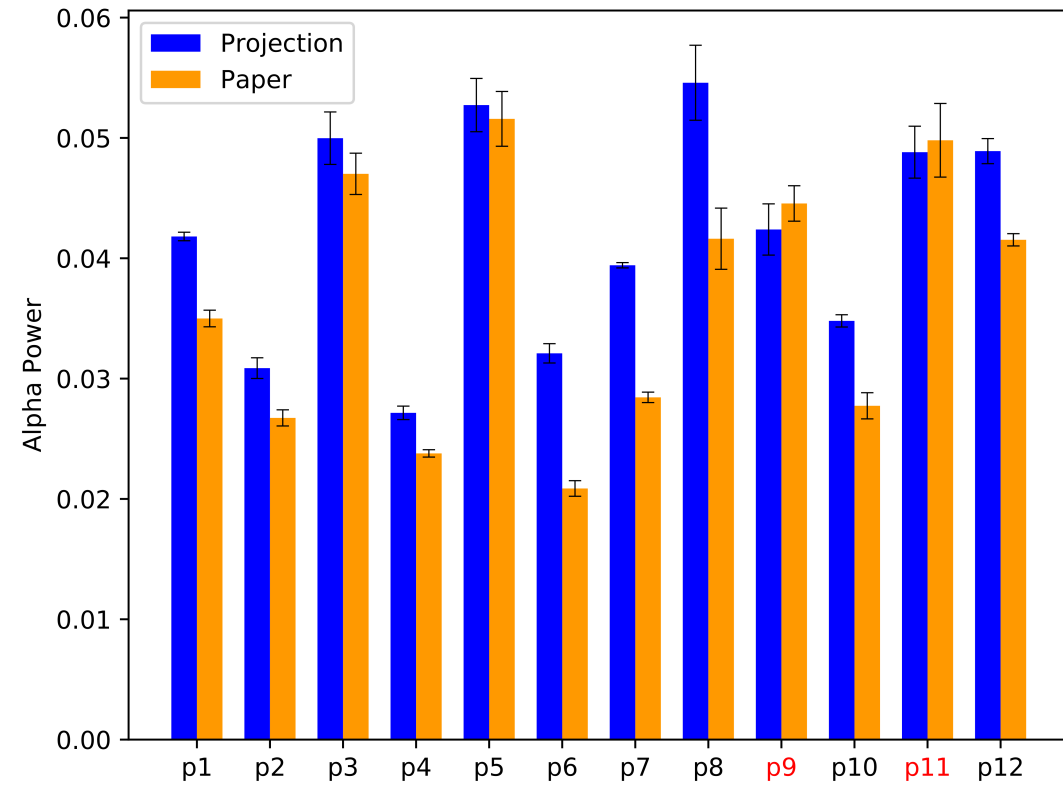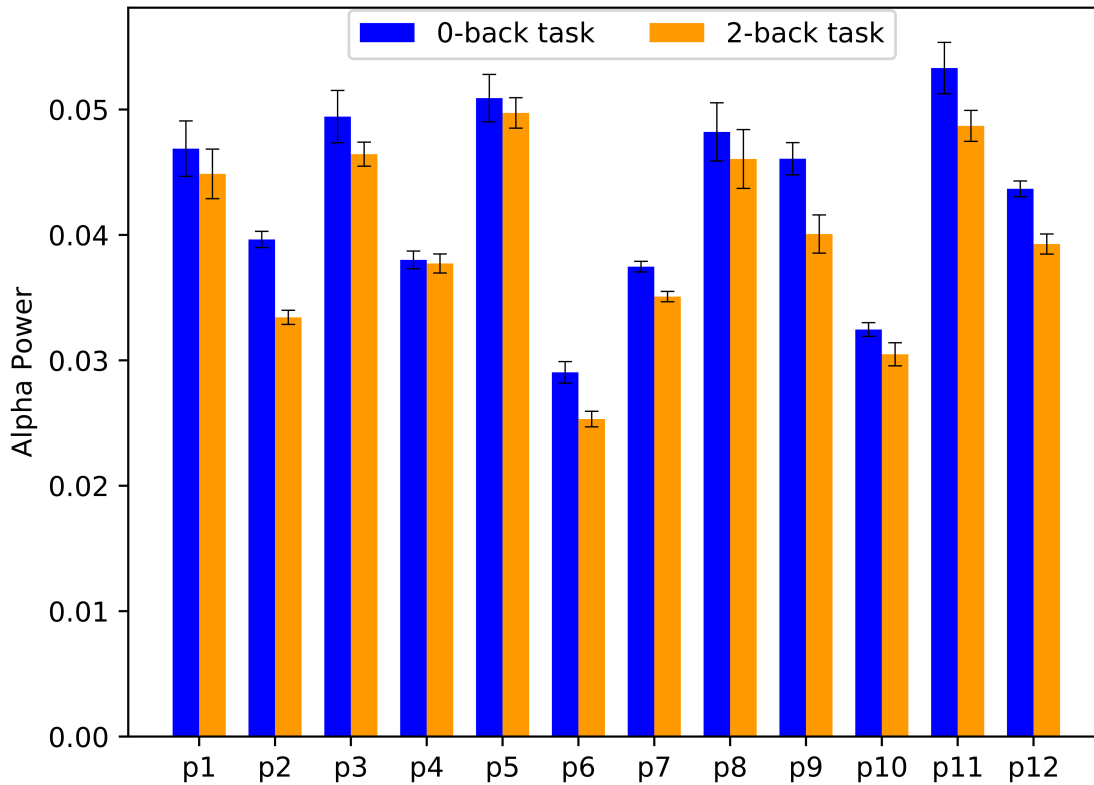# How do brain responses (i.e., ERPs) discriminate?

background discrimination
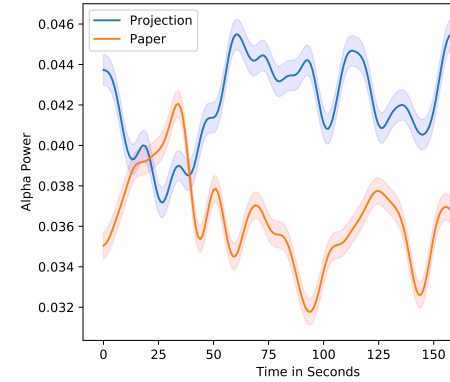*re-orienting attention*
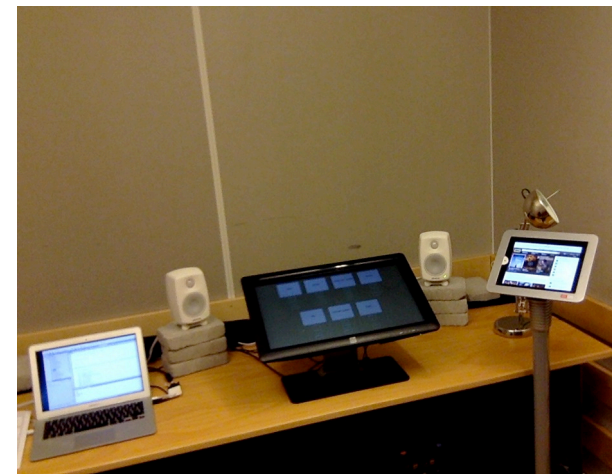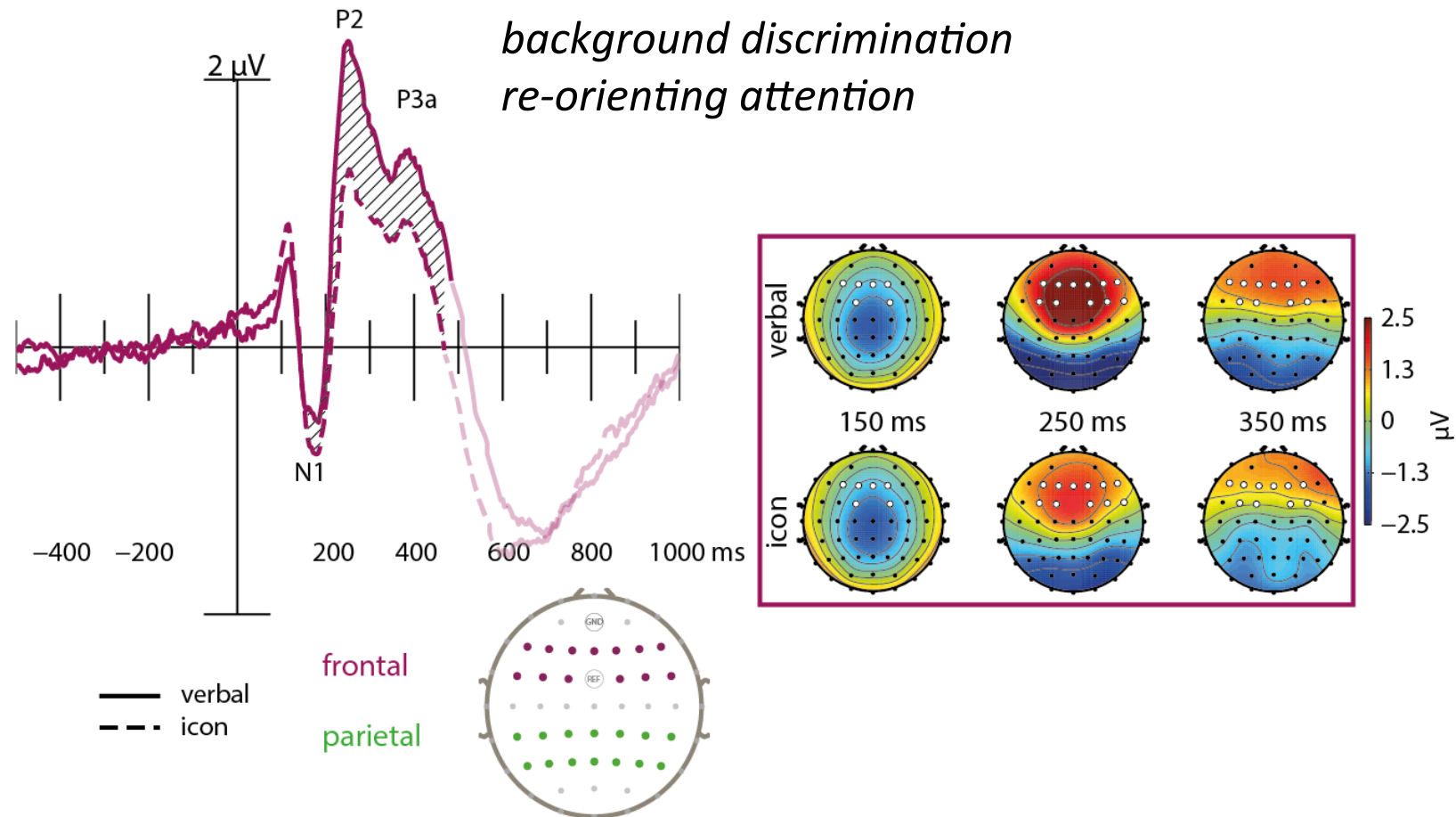
How do brain responses (i.e., ERPs) discriminate?
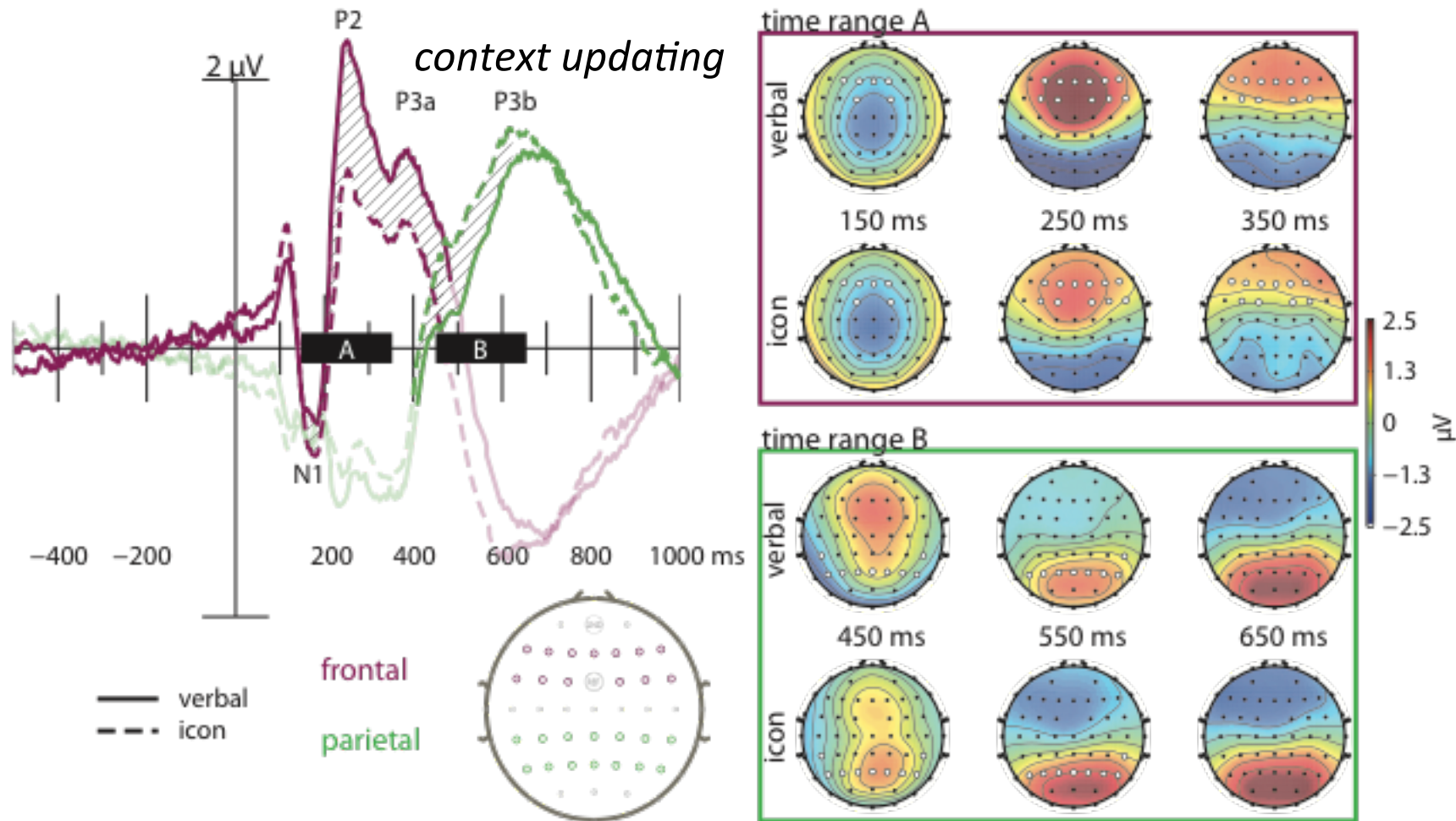
Case Study 2: *in situ* displays

Corresponding neural correlates for visuo-spatial working memory

Take Home Message

- We can do better than merely design systems to reduce "mental workload"

- evaluations with mobile neuroimaging techniques (e.g., EEG, fNIRS) could discriminate for cognitive functions

- Open challenges:

  - how can this be integrated into the design pipeline?

  - what should we evaluate a system for if the design for cognitive support is ill-specified?

Thank you for your attention

www.humanmachinesystems.org
www.hcilab.org

- Case Study 1: **Use the Right Sound for the Right Job**
  Glatz, Krupenia, Bülthoff, Chuang. Thursday 11am
  518AB, Papers: Interruptions

- Case Study 2: **Assessing EEG as Measure for Cognitive Workload to Evaluate Assistive Technologies for Manual Assembly**
  Kosch, Funk, Schmidt, Chuang. (under review)