

# Synchronization between eye blinking and task structure during an auditory attention task

Stefan E. Huber, Markus Martini, Pierre Sachse  
University of Innsbruck – Department of Psychology



# Background

- Haathi, H., & Wourinen, T. A. (1919). **Beobachtungen und Versuche über den Lidschlag beim Menschen.** *Skandinavisches Archiv für Physiologie*, 38(2), 62.
- Ponder, E., & Kennedy, W. P. (1927). **On the act of blinking.** *Quarterly Journal of Experimental Physiology*, 18(2), 89.
  - „In general all that is necessary to occasion a change in the rate of blinking is a change in the degree of attention of the subject, using the word in its psychological sense.“

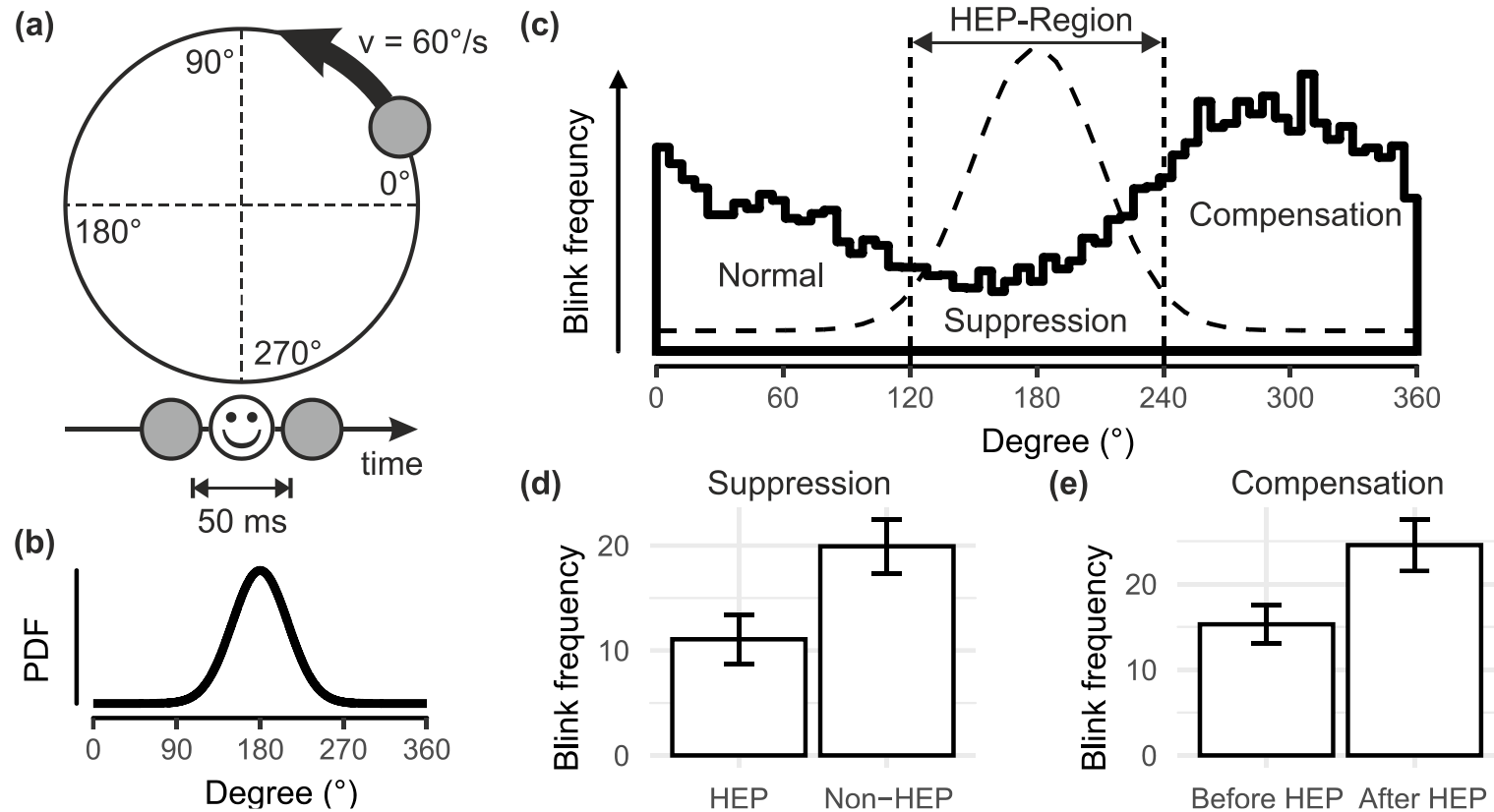


# Background

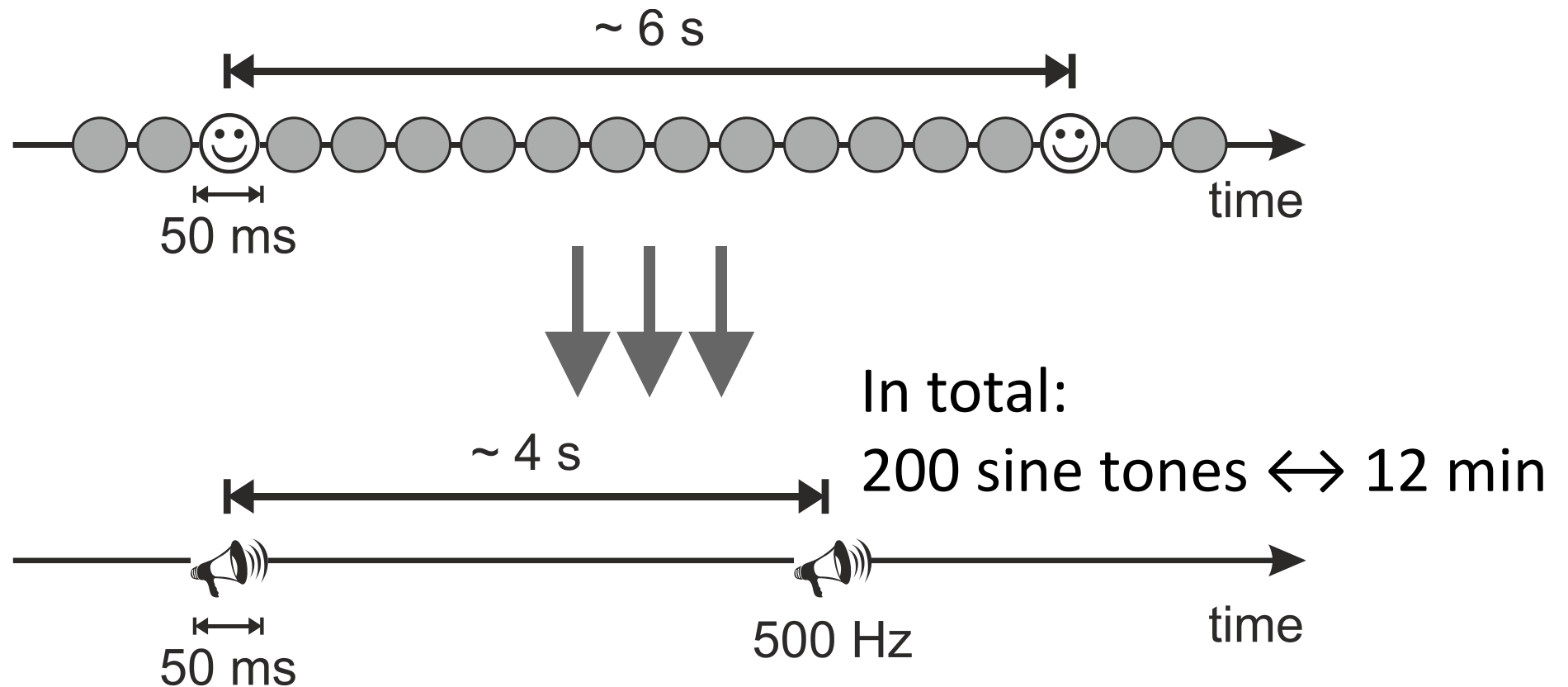
- Oh, J., Jeong, S.-Y., Jeong, J. (2012). **The timing and temporal patterns of eye blinking are dynamically modulated by attention.** *Human Movement Science*, 31(6), 1353.
- Kobald et al. (2019). **Eye blinks are related to auditory information processing...** *Psychological Research*, 83(6), 1281.
- Hoppe, D., Helfmann, S., & Rothkopf, C. A. (2018). **Humans quickly learn to blink strategically in response to environmental task demands.** *PNAS*, 115(9), 2246.



# Hoppe et al. (2018):

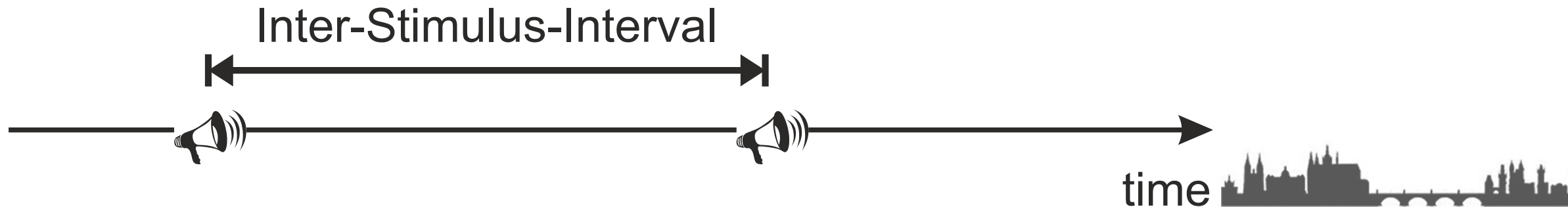
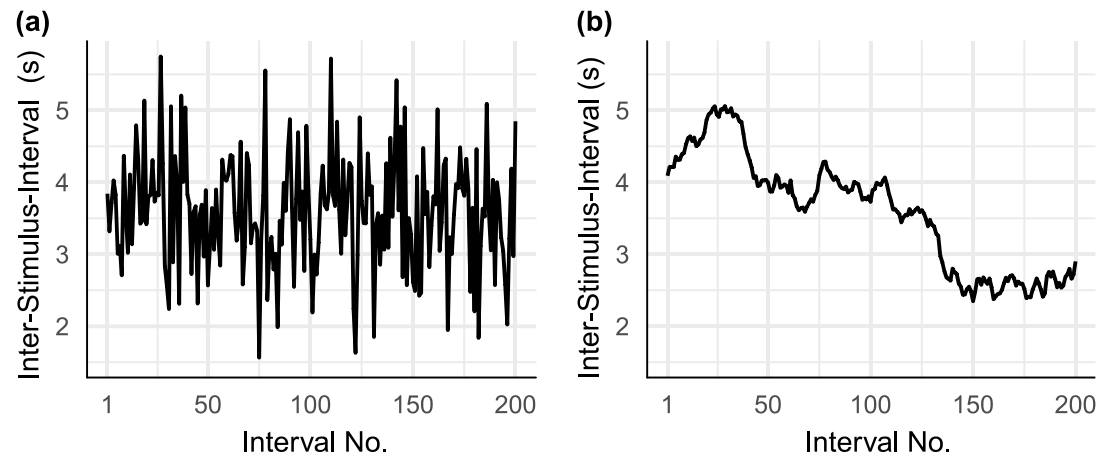


# Method: Auditory attention task



# Method: Variables

- ***Valence* or signal characteristic:** Reaction required?
- ***Predictability:***



# Method: Participants & Hypotheses

- 55 students in 3 groups

- Expectations:

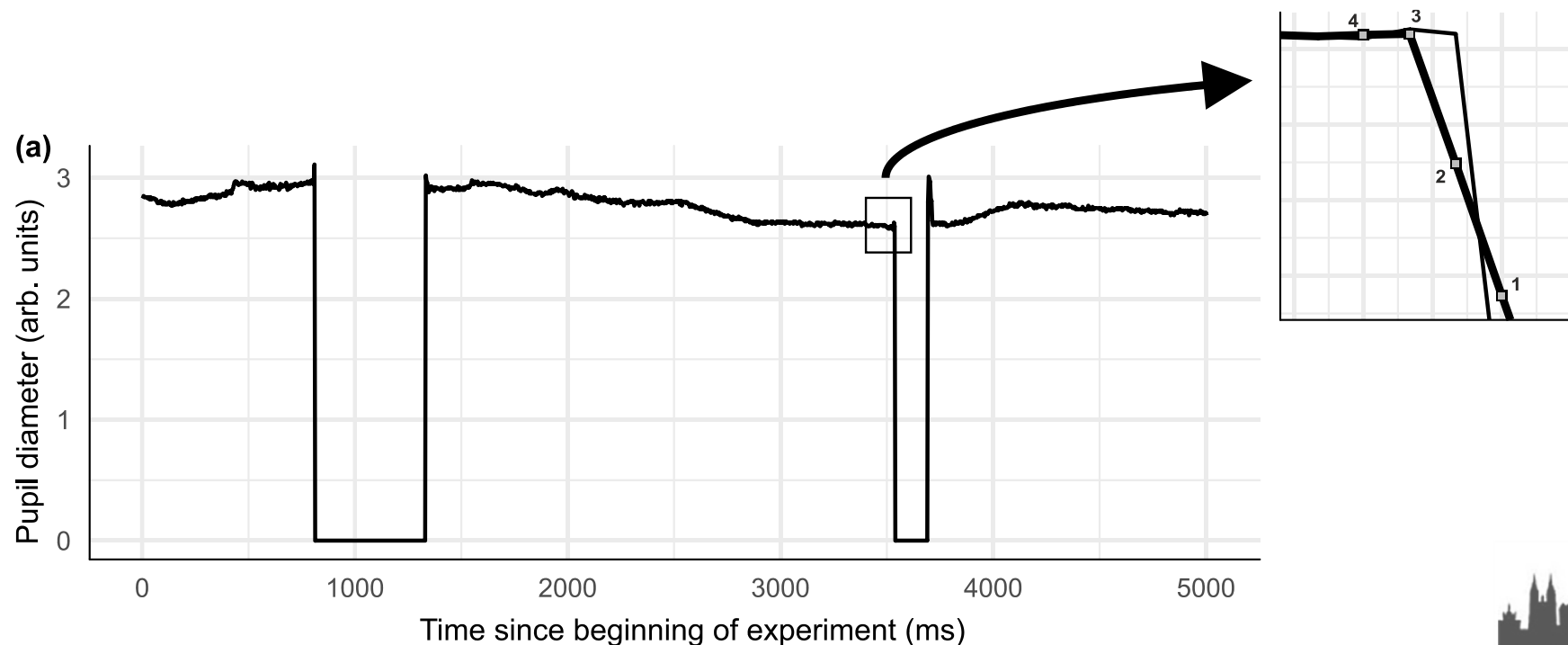
Very small, small, big, very big impact of predictability and valence

time ↓	signal characteristic	group		
		A	B	C
	low	no stimuli	no stimuli	high predict.
	high	low predict.	high predict.	high predict.
	low	high predict.	low predict.	low predict.



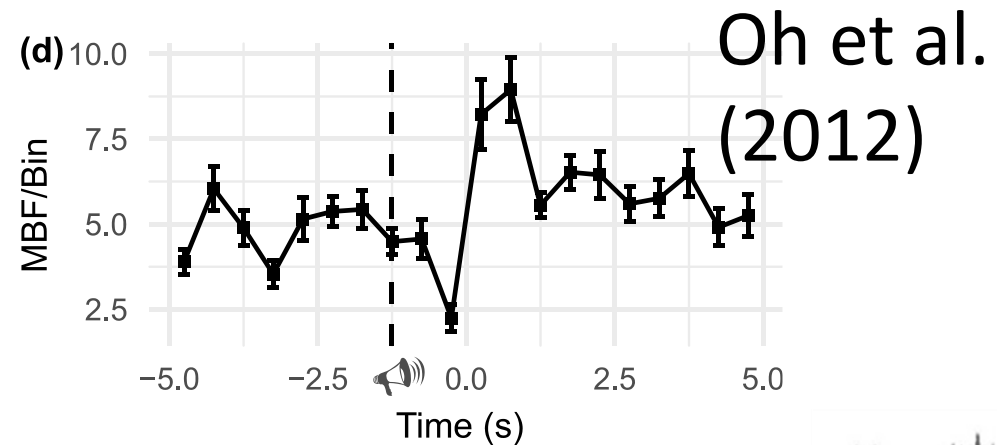
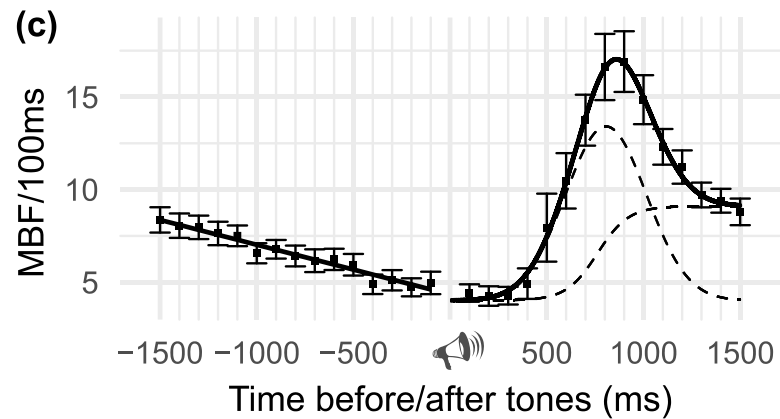
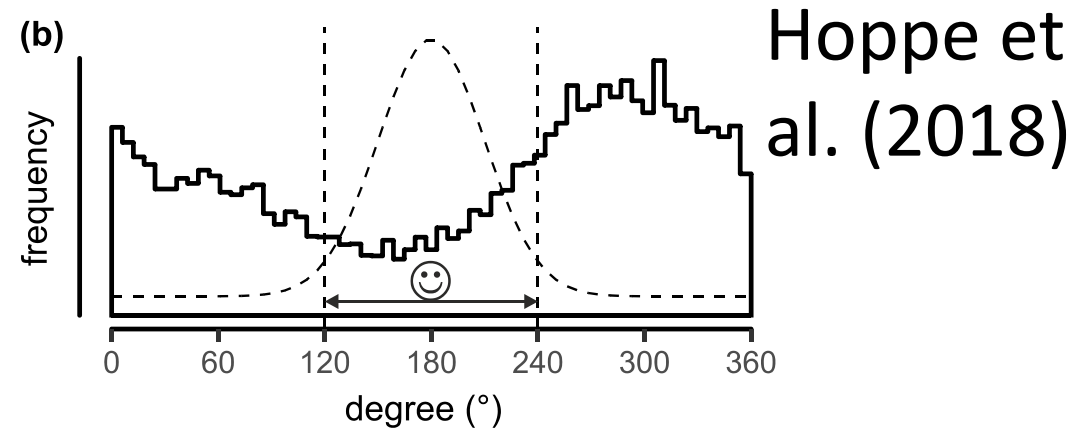
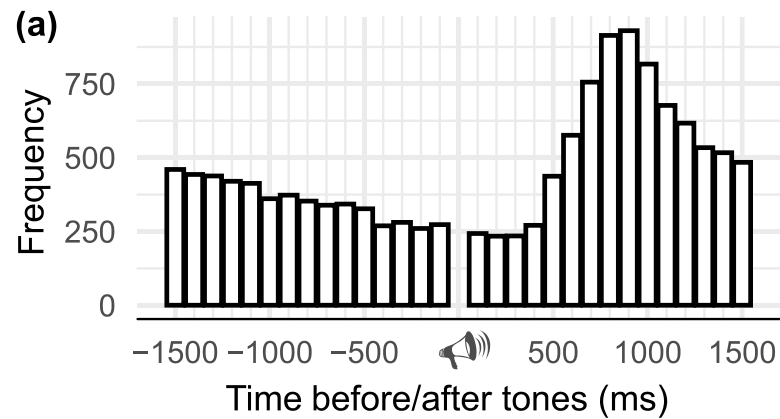
# Method: Blink detection

- Eye tracking + blink detection algorithm based on pupillometric noise by Hershman et al. (2018), *Behavior Research Methods*, 50, 107.

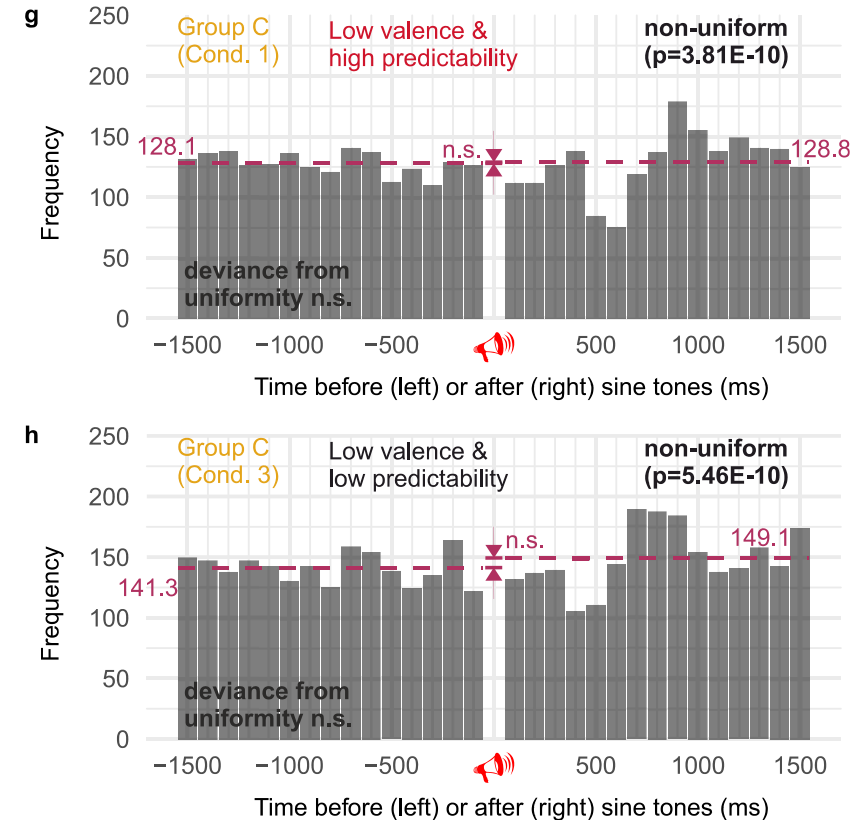
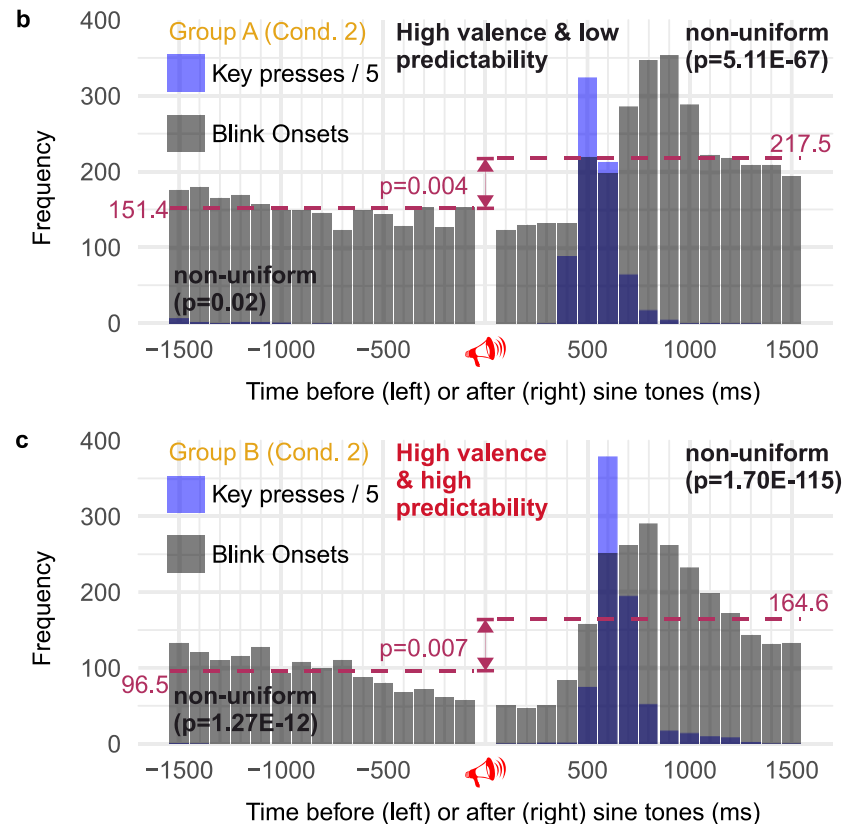




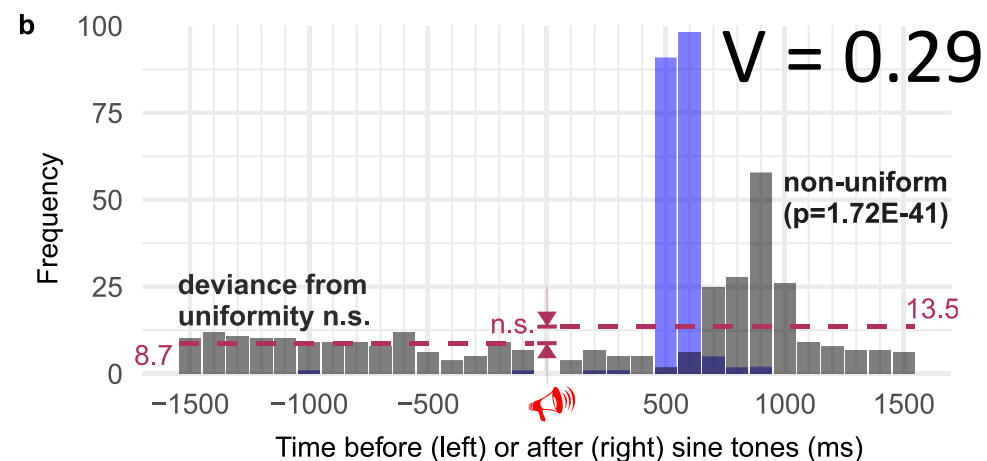
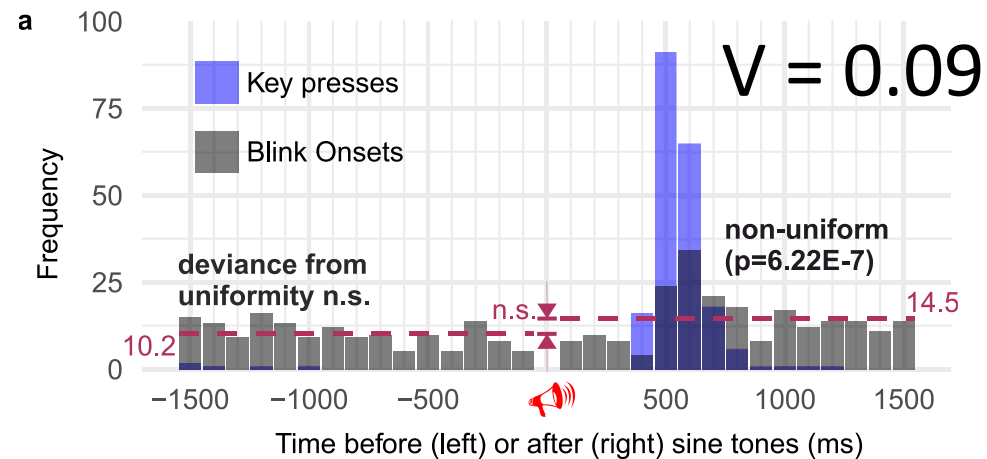
# Results: high valence conditions



# Results: impact of predictability and valence



# Results: individually



## Cramer's V

A	B	C
no stimuli	no stimuli	$0.14 \pm 0.01$
$0.16 \pm 0.01$	$0.23 \pm 0.03$	$0.21 \pm 0.01$
$0.10 \pm 0.01$	$0.15 \pm 0.02$	$0.11 \pm 0.01$

$n_p: p < 0.05$

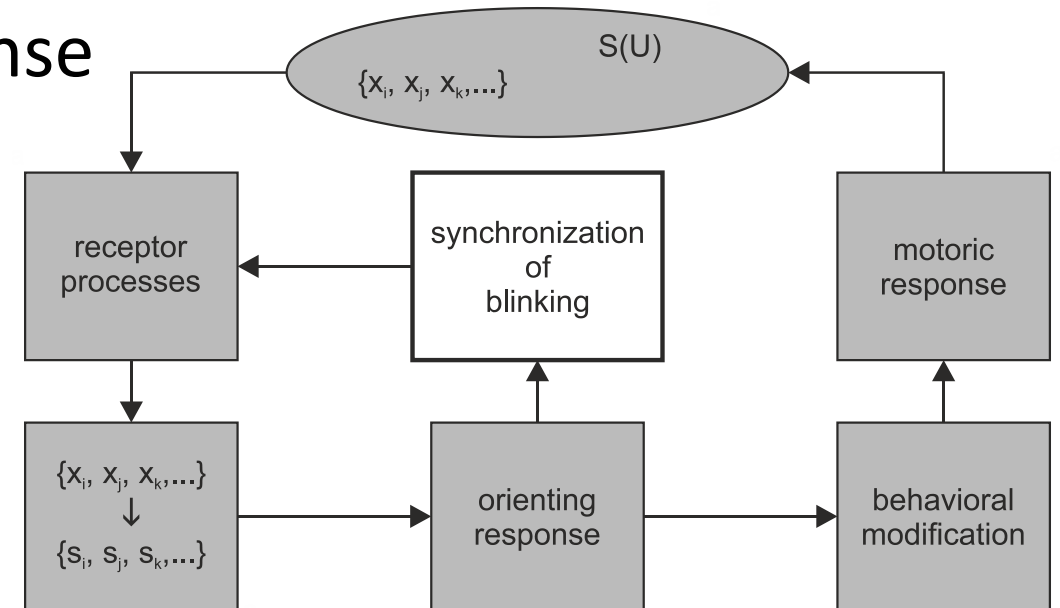
no stimuli	no stimuli	5/18 (1.5E-3)
17/18 (1.3E-21)	18/19 (6.9E-23)	18/18 (3.8E-24)
6/17 (1.2E-4)	7/19 (2.3E-5)	5/17 (1.2E-3)

$$(P) = \sum_{k > n_p}^n \binom{n}{k} \alpha^k (1 - \alpha)^{n-k}, \alpha = 0.05$$



# Discussion

- Mechanism?  $\leftrightarrow$  Orienting Response
- Open issues:
  - Interactions with motor processes
  - Other Modalities (tactile, proprioceptive, vestibular etc.)
  - Taxonomy of attention
  - Various forms of eye blinking



# Conclusion

- Bonnef, Y. S., Adini, Y., & Polat, U. (2016). **Contrast Sensitivity revealed by spontaneous eyeblinks: Evidence for a common mechanism of oculomotor inhibition.** *Journal of Vision*, 16(7), 1.

*„Spontaneous eyeblinks are known to serve important physiological functions, and recent evidence shows that they are also linked to cognitive processes. It is yet unclear whether this link reflects a crude rate modulation or, alternatively, an automatic and precise process, tightly linked to the low-level properties of sensory stimuli.“*



# More?

- Huber, S. E., Martini, M., & Sachse, P. (2021?). Patterns of eye blinks are modulated by auditory input signals in humans. *Submitted*.
- Huber, S. E. (2021). *Die Verkörperung der Aufmerksamkeit. Erste Überlegungen und Untersuchungen zu einer allgemeinen Theorie menschlichen Blinzeln*s. Innsbruck: innbruck university press.
- **E-mail: s.huber@uibk.ac.at**

