Effects of a non-informative auditory feedback over touch in the blindness

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Introduction

The mechanisms underlying passive and active touch are different, with active touch leading to an attenuation of afferent somatosensory information to the cortex. This is known as *movement-related sensory gating* and could be responsible for a worse encoding [1,2,3]. When we have multisensory information one sense can dominate the perception according to its reliability [4]; if noise is added to the signal, its reliability changes, thus their dominance [5]. When there is ambiguation, we integrate multisensory information to infer the most likely interpretation of the sensory input [6]. However, this process is vulnerable to the loss of a sensory modality: the lack of visual calibration over the tactile and audio modality can modulate their integration, with blind individuals showing a reduced multisensory interaction [7].

How a non-informative sound might affect the tactile performance during passive and active touch in blind and sighted individuals?

Method

Participants:

- 18 sighted : 12 women; age mean +- SD: 35.11 +- 11.72
- 18 blind: 10 women; mean age +- SD: 41.67+- 11.9 years)

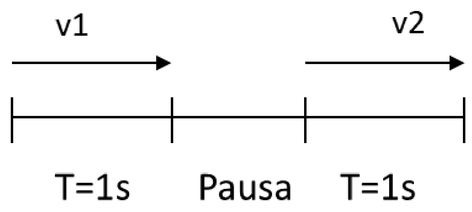
Conditions:

Passive and Active

- Unimodal tactile (T)
- Bimodal audio-tactile (AT)

Task:

2AFC - Sequence of two movement with different speeds and to discriminate which was faster between the two.

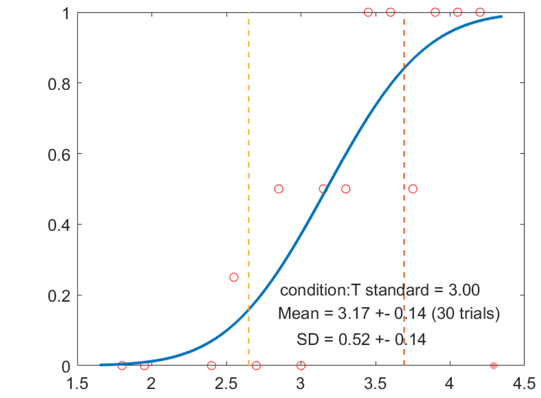


Standard velocity: 3 cm/s
Comparison speed: QUEST [6]

Stimulation:

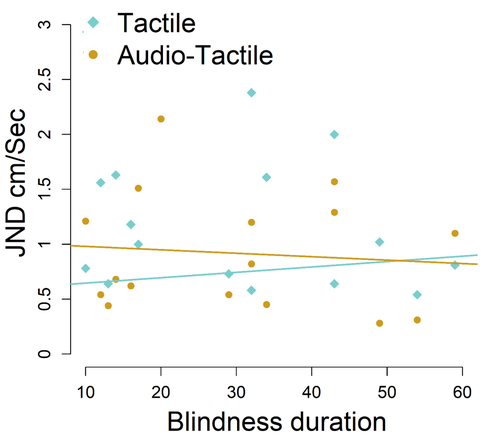
-Tactile stimulus: 10 cycles/cm
-Tactile area of stimulation: fingertip of index

Results

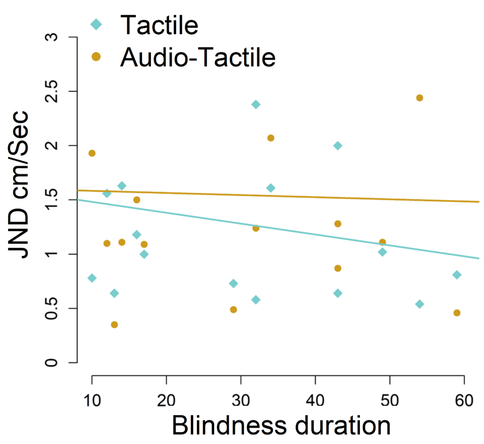


Data fitted to Cumulative Gaussians
Threshold or just noiceable difference (JND) from the SD of the psychometric curve

BLINDNESS DURATION - PASSIVE CONDITION

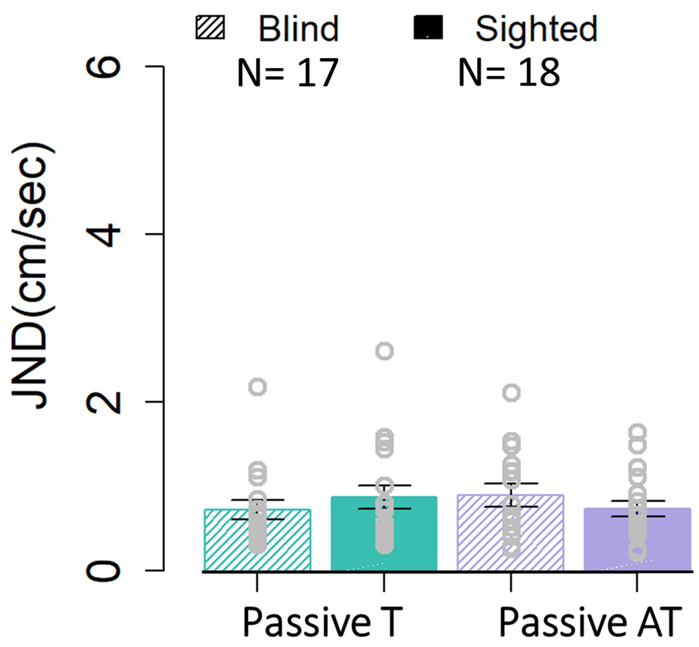


BLINDNESS DURATION - ACTIVE CONDITION

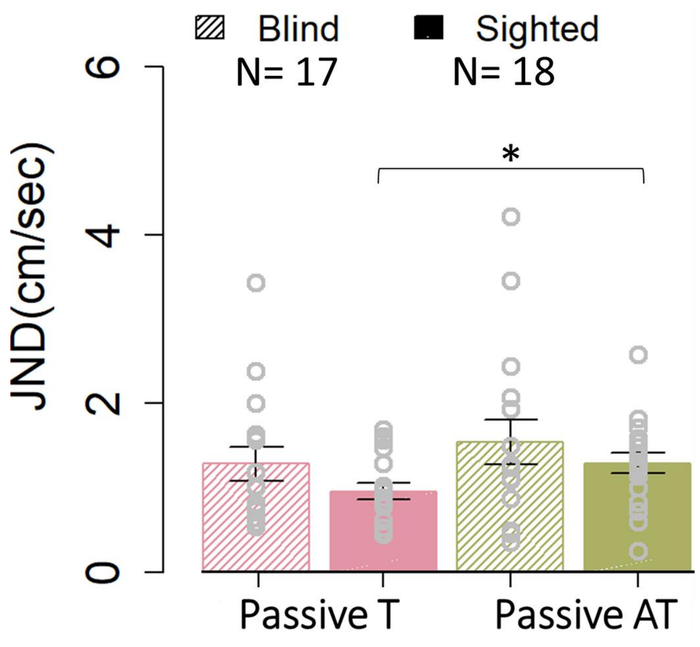


No correlation blindness duration and performance

PASSIVE CONDITION



ACTIVE CONDITION



Significant difference between T and A-T conditions in the active condition (p=.0462) only for the sighted group

Conclusions

Sighted individuals:

- No differences between the tactile and audio-tactile conditions during passive touch

  In our case, tactile information might be reliable enough not to require extra sensory information.

- **Significant difference between the tactile and audio-tactile conditions during active touch**

  The somatosensory gating, as it reduced the amount of sensory information processed by the cortex [2], might increase the ambiguity of tactile information, making sighted participants more vulnerable to the noise of the auditory signal.

Blind individuals:

- No differences between the T and A-T conditions during passive touch
- **No differences between the T and A-T conditions during active touch**

  Our results support the presence of reduced audio-tactile interactions in blind individuals [7] and suggest that it might be responsible for higher resistance to noisy interference, despise the somatosensory gating originating from the self-generated movement in this group

References

1. Elaine Chapman, C., Tremblay, F., & Ageranioti-Bélanger, S. A. (1996). Role of Primary Somatosensory Cortex in Active and Passive Touch. Hand and Brain, S 1, 329–347.
2. (Chapman, C. E. (1994). Active versus passive touch: Factors influencing the transmission of somatosensory signals to primary sornatosensory cortex. Canadian Journal of Physiology and Pharmacology, 72(5), 558–570.
3. Kurz, M. J., Wiesman, A. I., Coolidge, N. M., & Wilson, T. W. (2018). Haptic exploration attenuates and alters somatosensory cortical oscillations. *Journal of Physiology*, *596*(20), 5051–5061. https://doi.org/10.1113/JP276263
4. Ernst, M. O., Banks, M. S., & Bülthoff, H. H. (2020). *Ernst touch can change visual slant perception NNe_2000.pdf*. 19–21.
5. Ernst, M. O., & Bülthoff, H. H. (2004). Merging the senses into a robust percept. *Trends in Cognitive Sciences*, *8*(4), 162–169. https://doi.org/10.1016/j.tics.2004.02.002
6. Parise, C. V., & Ernst, M. O. (2017). Noise, multisensory integration, and previous response in perceptual disambiguation. *PLoS Computational Biology*, *13*(7), 1–20. https://doi.org/10.1371/journal.pcbi.1005546
7. Occelli, V., Bruns, P., Zampini, M., & Röder, B. (2012). Audiotactile integration is reduced in congenital blindness in a spatial ventriloquism task. Neuropsychologia, 50(1), 36–43.

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