The role of conflict processing in multisensory perception: Behavioural and EEG evidence

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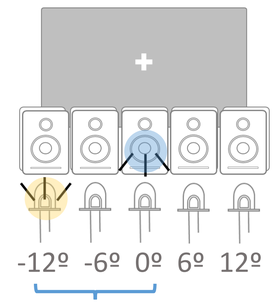
Introduction

- Multisensory processing involves solving the **causal inference problem**: to decide whether sensory cues should be integrated (as they refer to the same object/event) or segregated.[1,2]
- During this process, these two internal perceptual models (integration/segregation) are entertained.
- We propose that this engages a competition between the model representations that involves brain mechanisms of **conflict processing**.[3]
- To test this hypothesis, in this experiment we studied if the brain mechanisms associated with conflict play a role during multisensory processing.

Methods

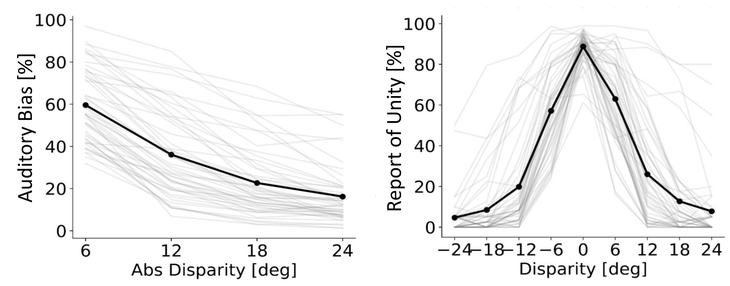
Participants answered the **location of the sound** and if both stimuli came from the **same location**



Disparity: distance between stimuli (sound – light)

	Fixation	Delay	Localization response	D	Unity judgment	ISI
EXP 1 (RT)	1-1.5s	0.1s	0s	1.5s (or until response)	0.4s	Until response	0.5s
EXP 2 (EEG)	0.75-1.25s	0.1s	1s	2s (or until response)	0.4s	Until response	0.5s

Paradigm validation [2,4]



Predictions

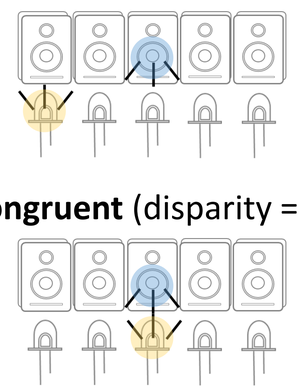
We expected higher reaction time (RT) and theta power (5-7 Hz) for:

- **Incongruent vs congruent** trials.
- **Intermediate disparities** compared to no or large disparities.

Reaction Time Results (n=55)

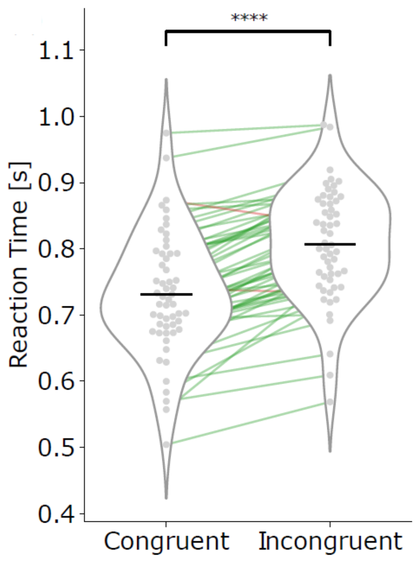
RT as a function of congruency

Incongruent (disparity ≠ 0)



Congruent (disparity = 0)

Slower reaction time (RT) for **incongruent** compared to **congruent** trials



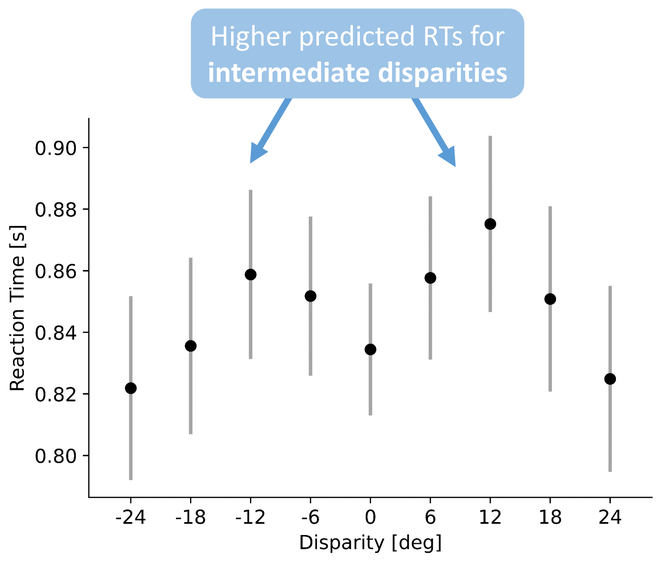
RT as a function of disparity

Higher predicted RTs for **intermediate disparities**

Linear Mixed Model
considering the fixed variables:

- Disparity
- Unity
- Location response

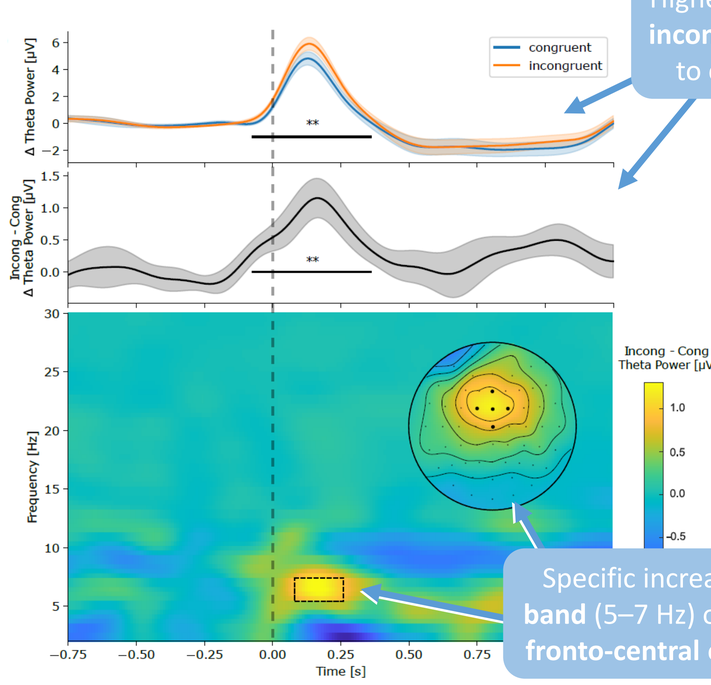
And "participants" as a random effect.



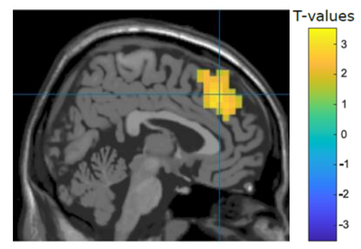
EEG Theta Power Results (n=49)

Theta as a function of congruency

Higher theta power for **incongruent** compared to **congruent** trials



Source localization cluster



Specific increase in the **theta band** (5–7 Hz) originated from a **fronto-central** electrode cluster

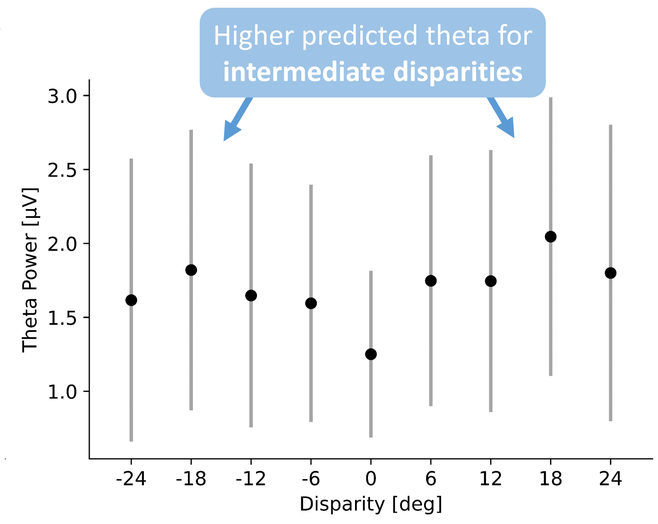
Theta as a function of disparity

Higher predicted theta for **intermediate disparities**

Linear Mixed Model
considering the fixed variables:

- Disparity
- Unity
- Location response

And "participants" as a random effect.



Discussion

- Consistent with our hypotheses, **incongruent trials** led to **slower RTs** and **higher fronto-medial theta power**, both indicative of conflict.
- We also predicted that **intermediate disparities** would yield slower RTs and higher theta power when compared to congruent stimuli and to large disparities, due to the steeper competition between causal models. Although this prediction was only validated in the RT study, the EEG results also displayed the anticipated trend.
- In conclusion, our findings suggest a potential involvement of the conflict mechanisms in multisensory integration of spatial information.

Download the poster and find more info!

[1] Shams L, Beierholm UR. Causal inference in perception. Trends Cogn Sci 2010.
[2] Körding KP et al. Causal inference in multisensory perception. PLoS One 2007.
[3] Botvinick MM et al. Conflict monitoring and cognitive control. Psychol Rev 2001.
[4] Wallace MT et al. Unifying multisensory signals across time and space. Exp Brain Res 2004.