STEADY-STATE EVOKED POTENTIALS TO RESEARCH MULTISENSORY INTEGRATION

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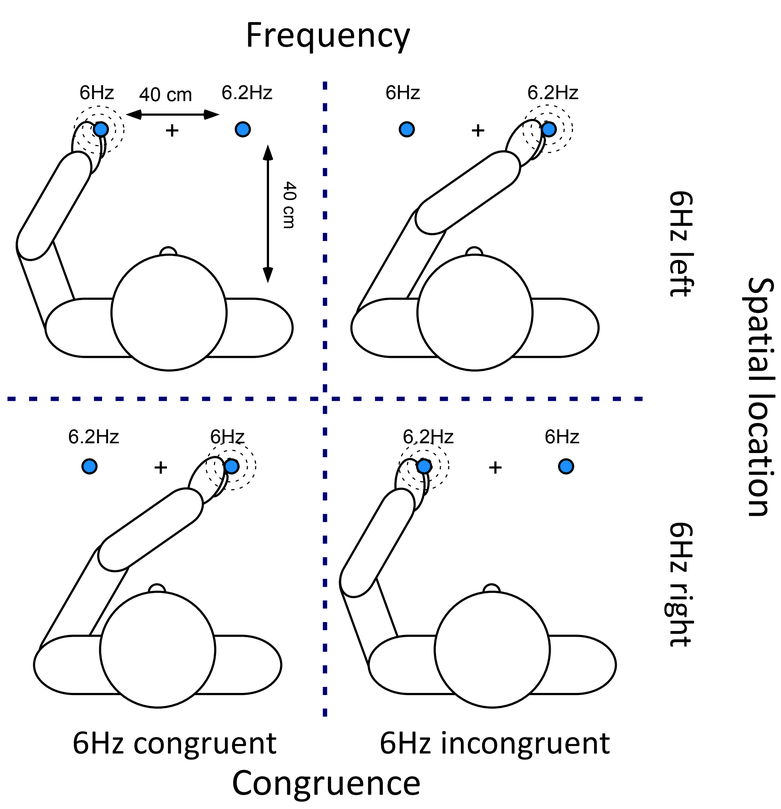
INTRODUCTION

We integrate information from different sensory modalities to form a coherent representation of our surroundings. In animals, such multisensory integration is thought to rely on the existence of multimodal neurons able to respond to sensory inputs from different modalities. The presumably same multisensory integration mechanisms occurs in humans. Essentially, when two sensory different stimuli occur close to a body part, the processing appears to be facilitated. This is reflected in behavioural measures, BOLD activity, and event related potentials. However, these effects can also be explained by spatial attention and might not be due to solely multisensory integration. In order to disentangle the effects from spatial attention from the multisensory integration, we apply the steady-state evoked potential (SSEP) methodology. SSEP allows to tag the cortical activity elicited respectively by different stimuli presented simultaneously using different stimulation frequencies, and, thereby, to track and characterize the cortical response to each stimulus independently, as well to use long-lasting stimulations.

METHODS



Visual stimulation: Blue LED light, varying sinusoidal at 6 and 6.2 Hz

Vibrotactile stimulation: Haptuator delivering sinusoidal stimulation at 256 Hz modulated at 21 Hz

Stimulations: 10 trains of 16 sec per condition

Experiment 1: vibrotactile is **task irrelevant**

N=10 healthy subjects

Task: reporting temporal order of interruptions in the visual stream

Experiment 2: vibrotactile is **task relevant**

N=15 healthy volunteers

Task: reporting side and temporal order of interruption which occur one visual stream AND in the vibrotactile stream of stimulation

Experiment 3: multisensory integration is modulated by **spatial attention**

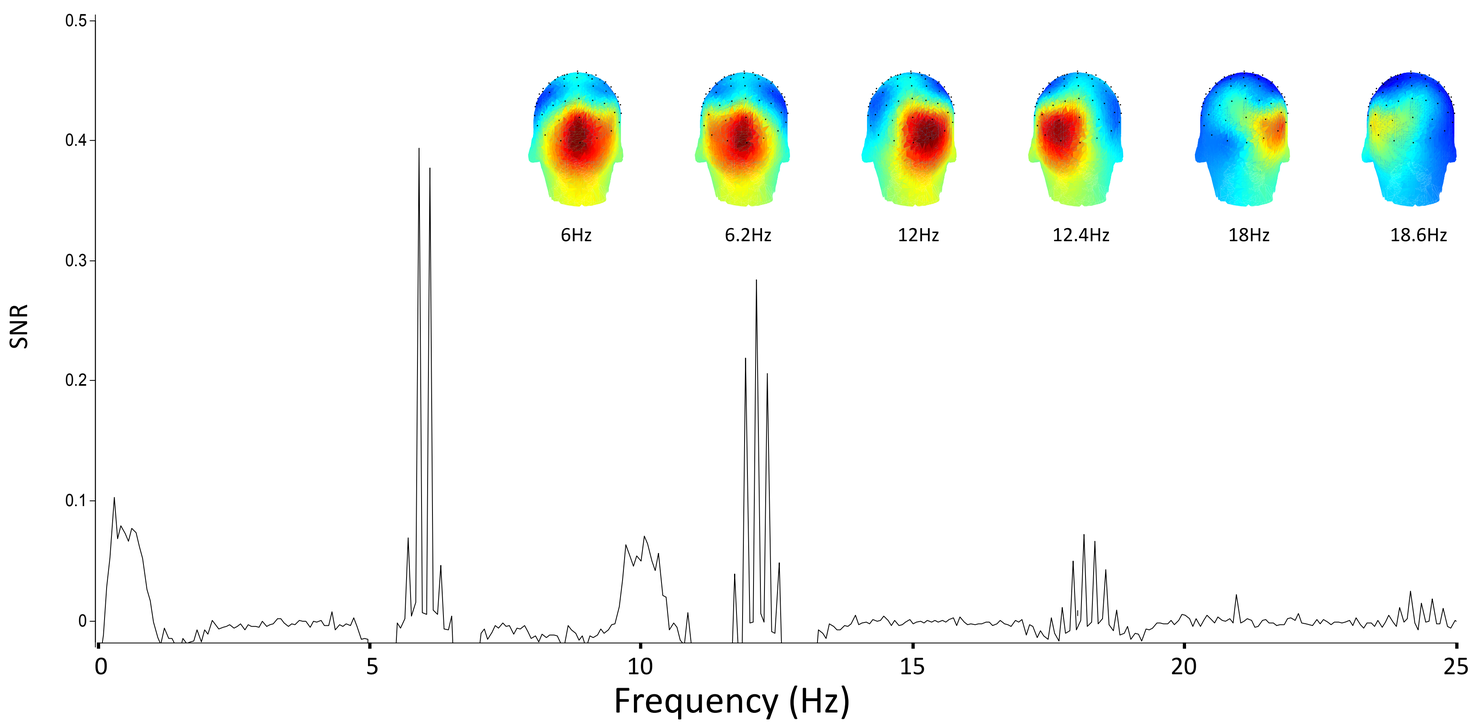
N=8

task: reporting side and temporal order of interruption which occur one visual stream AND in the vibrotactile stream of stimulation

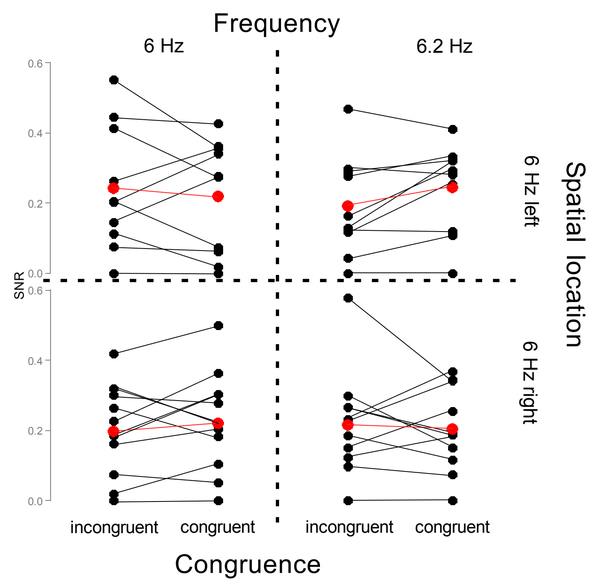
Attention is directed to the left or the right side of space

RESULTS

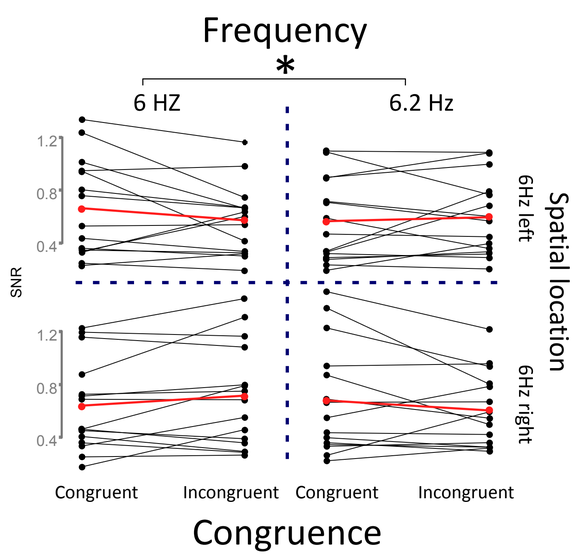
Frequency spectrum



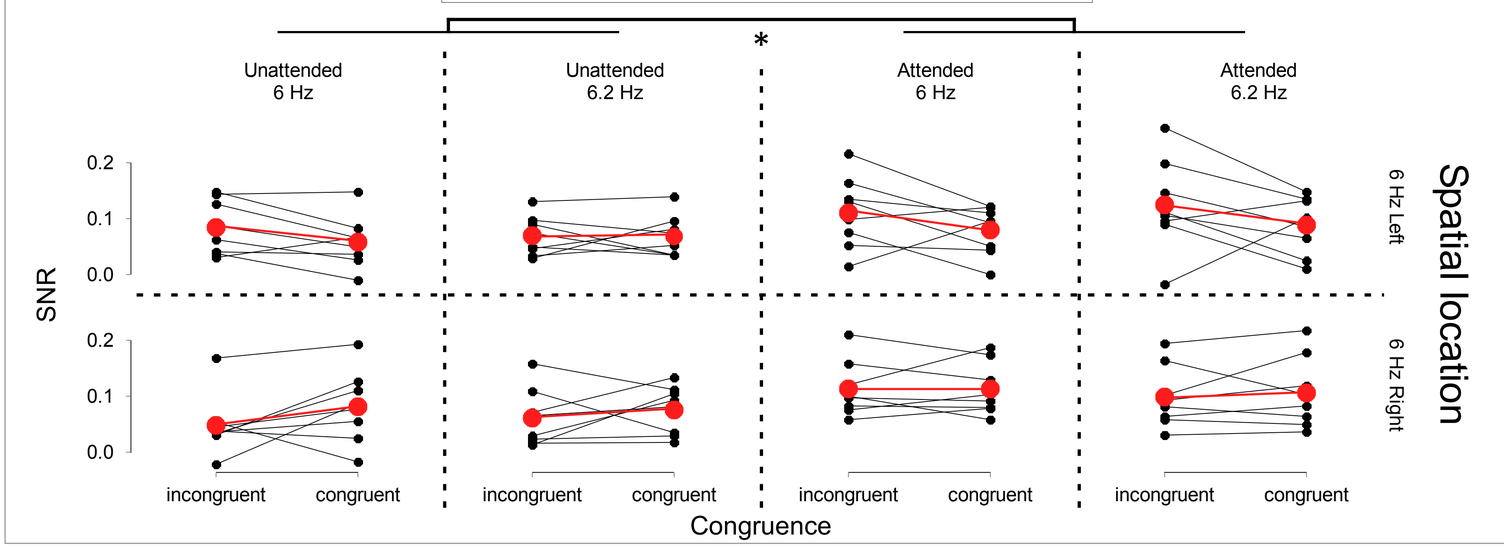
Experiment 1: vibrotactile is **task irrelevant**



Experiment 2: vibrotactile is **task relevant**



Experiment 3: multisensory integration is modulated by spatial attention



CONCLUSION

Studying multisensory integration using SSEP to modulate the processing of visual stimulation appears to be unsuccessful with the tested experimental set-up. Several reasons can be identified to explain the lack of modulation: First of all, the lack of modulation can be due to the frequencies used in the design. Secondly, using SSEP allows for presenting multiple stimulations of the same modality simultaneously, whereas multisensory integration has traditionally been studied using single stimulation streams. Yet another difference is the use of sustained stimulation as compared to brief transient stimulation used in ERP, fMRI and reaction time studies. One last possibility is that the stimulations only elicit lower order visual cues, and stimulating higher order regions might be necessary to see a modulation due to spatial congruency. In conclusion, we do not manage to modulate the visual information processing by spatial congruency, varying the implication of the different sensory modalities in the task, or spatial attention. This goes against the widely accepted spatial rule in multisensory integration.