

We make predictions about eye of origin of visual input: Visual mismatch negativity from binocular rivalry

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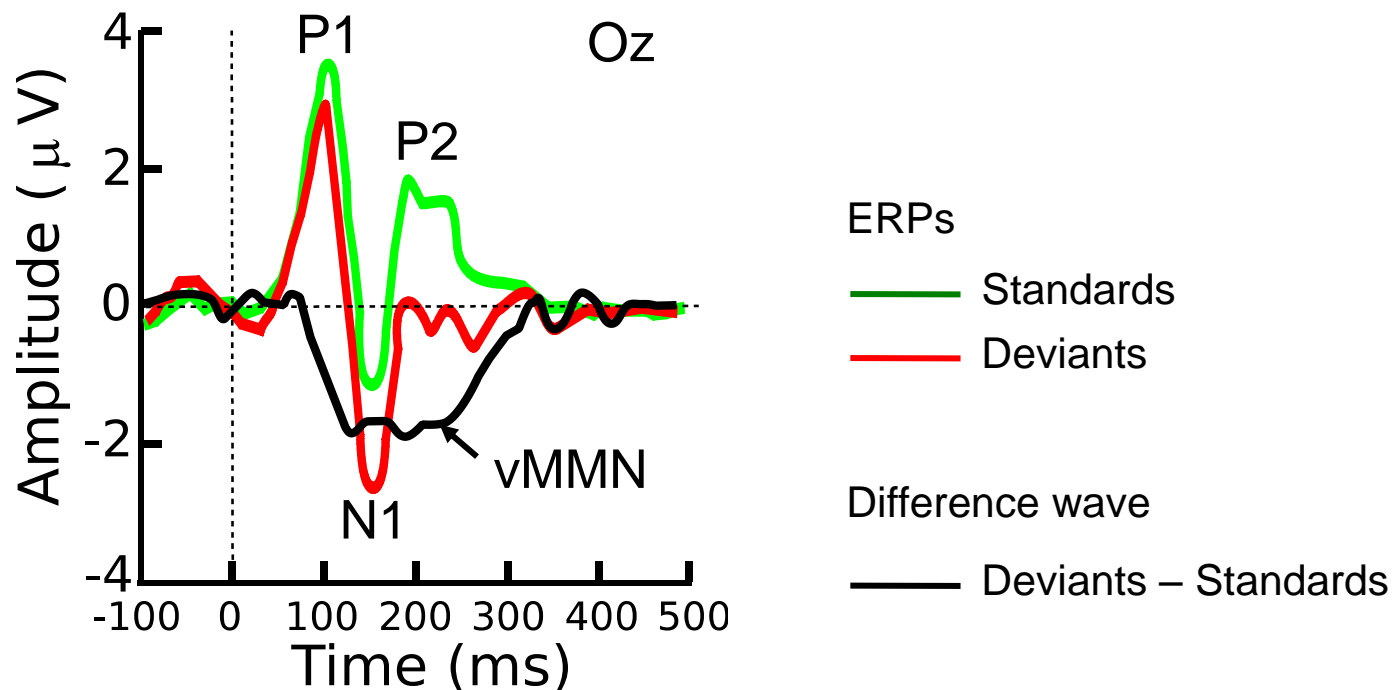
How do we know we make predictions about sensory input? Behavioural evidence

- Faster and more accurate responding to stimuli in a sequence with task-irrelevant properties that follow certain rules (**standard** stimuli) than to stimuli with properties that violate the rules (**deviant** stimuli)



How do we know we make predictions about sensory input? EEG evidence

- Greater negative voltage recorded from scalp electrodes (electroencephalography, EEG) from about 150 ms to about 400 ms after onset of a deviant stimulus—the **mismatch negativity (MMN)** for auditory stimuli and the **vMMN** for visual stimuli



After Kimura, Katayama, Ohira, and Schröger (2009)

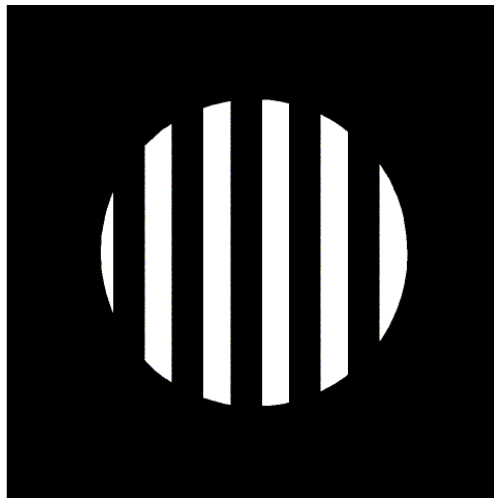
What is binocular rivalry?

- Unchanging visual input yields changing visual perception
- Mostly see one image, rather than both
- What is seen is unpredictable

Left eye



Right eye



Perception



What is eye of origin?

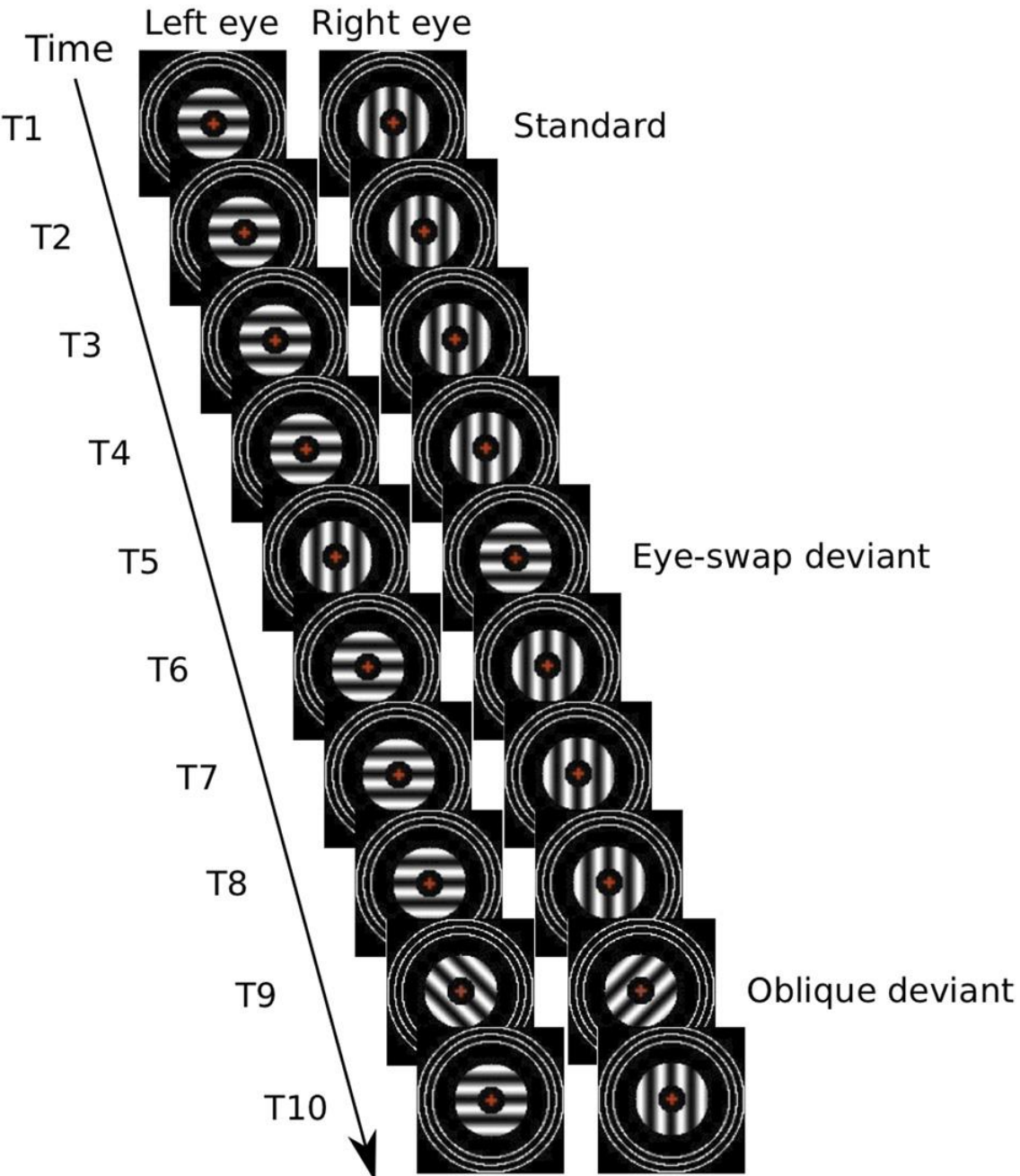
- When two stimuli are presented one to each eye, each stimulus has an eye of origin
- Eye-of-origin information is retained by some areas of the visual system and lost from others
- Eye of origin is vital for one aspect of binocular vision: stereopsis



Why is it interesting if we make predictions about eye of origin?

- People cannot tell which rival stimulus is presented to which eye (without closing one eye)
- Theory is that predictions are made about sensory information of which we are unconscious (Hohwy Roepstorff, & Friston, 2008)
- Can one generate a vMMN to swapping rival images between the eyes?



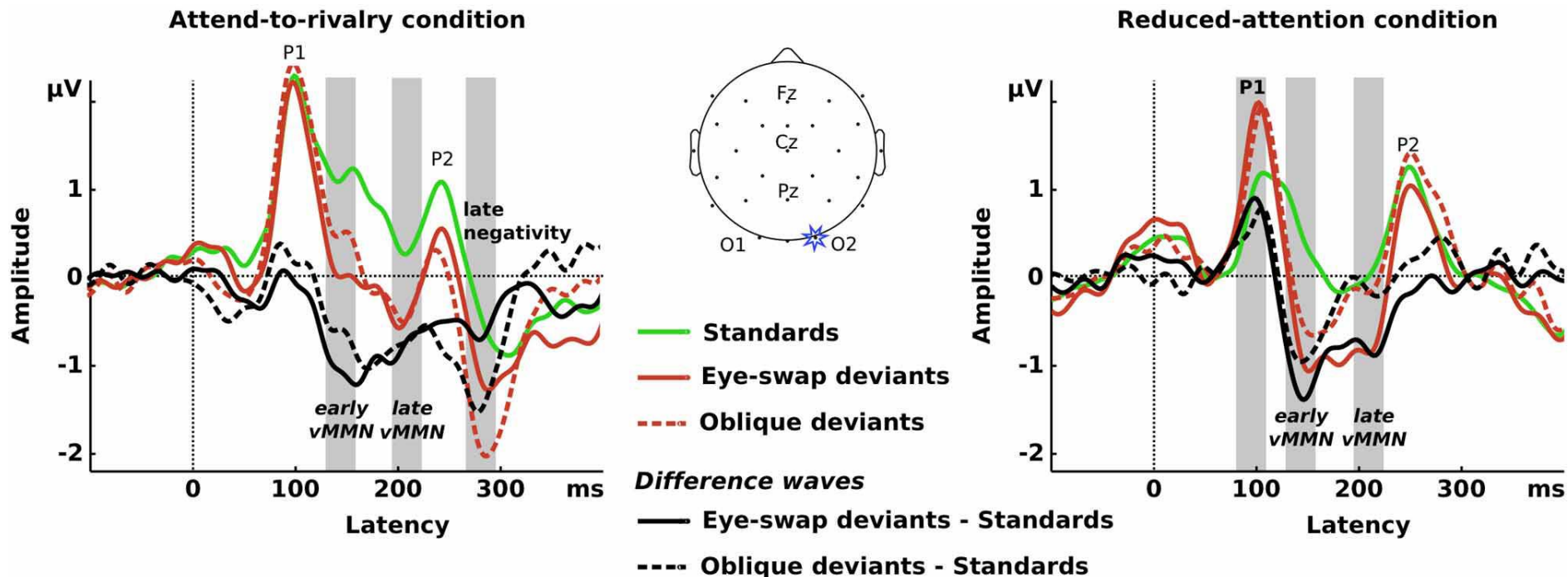


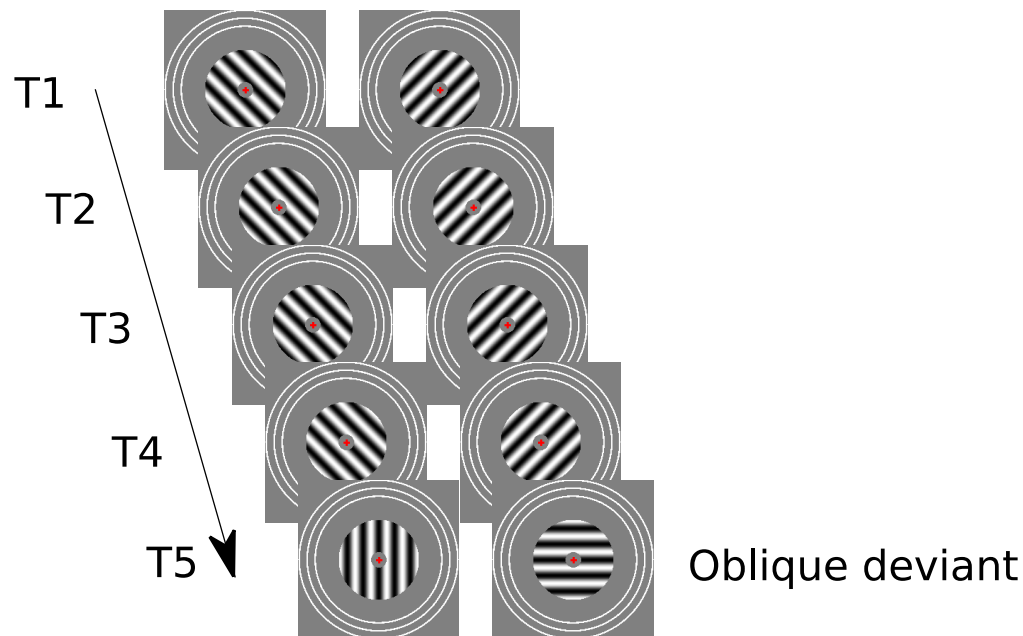
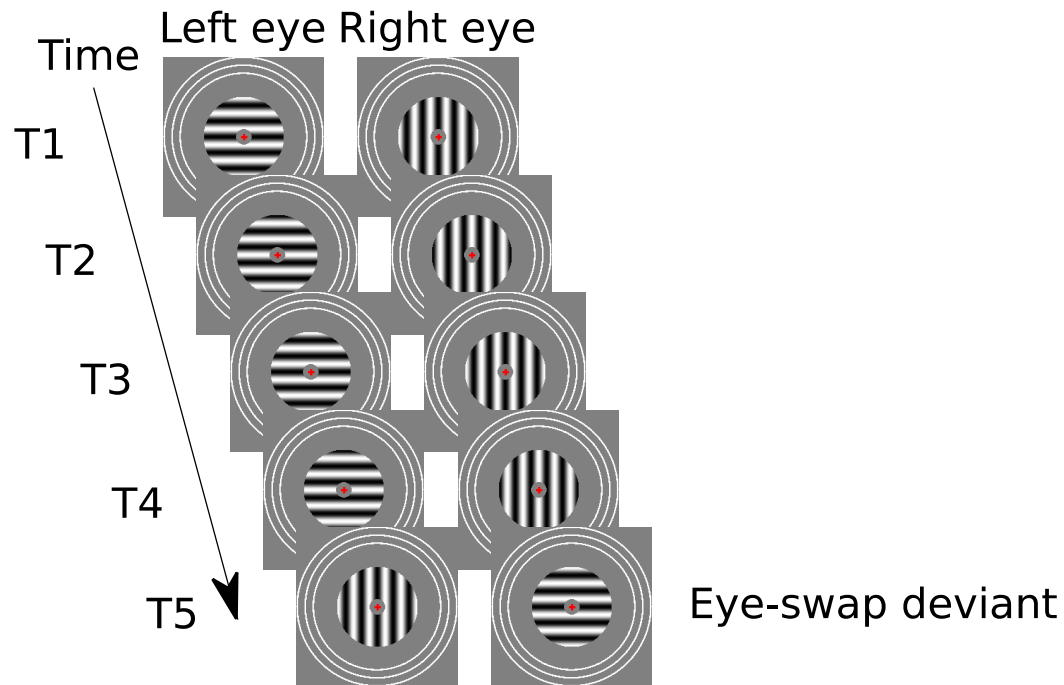
Experiment 1

- van Rhijn, Roeber, and O'Shea (2013) generated sequences of standards and deviants that were either unpredictable swaps of the images between the eyes (**eye-swap deviants**) or were unpredictable changes of orientation of the images in the two eyes (**oblique deviants**)
- Participants either tracked the rival stimuli or performed a 2-back task at fixation

Experiment 1: Results

- There is a convincing vMMN from about 140 ms to 320 ms when attention is on the rival stimuli and to about 250 ms when not



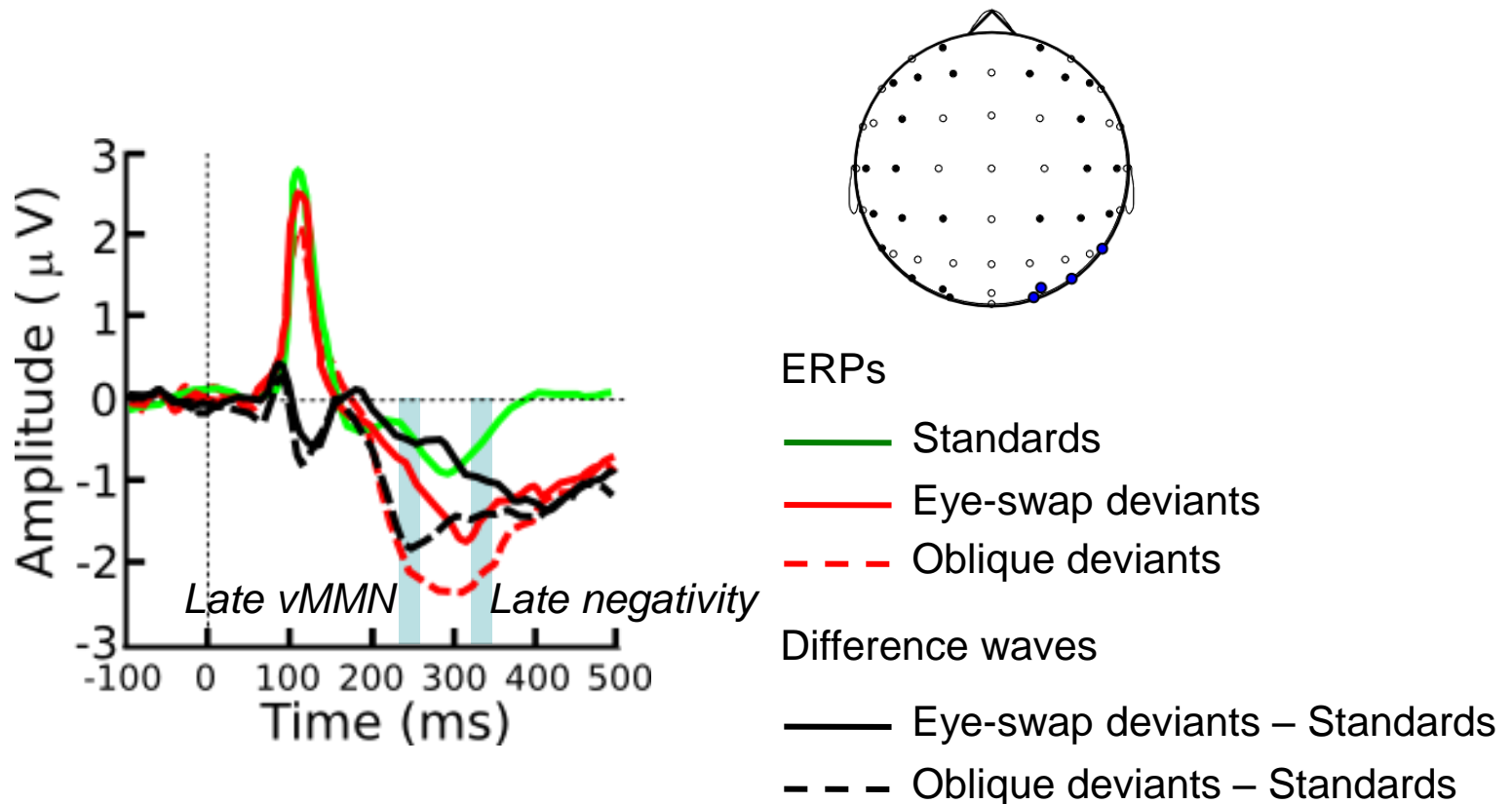


Experiment 2

- Jack, Roeber, and O'Shea (2012) conducted a similar study to that of van Rhijn et al. (2013) except for testing the two sorts of deviants in separate blocks, and for using oblique gratings as standards in some blocks
- Participants tracked rivalry

Experiment 2: Results

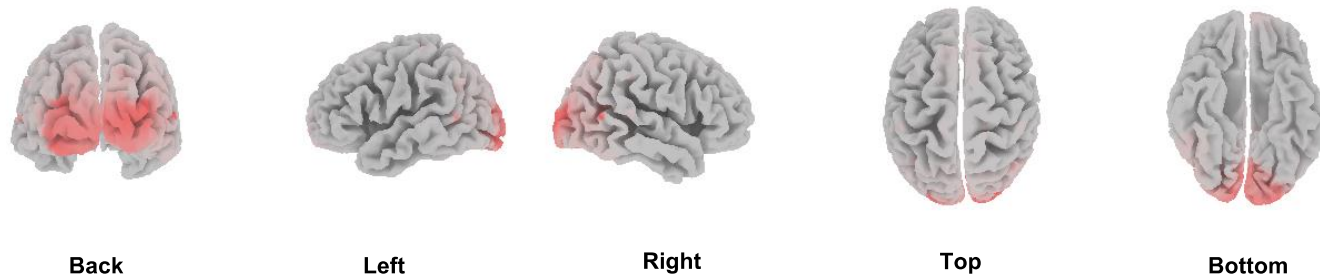
- Similar vMMNs to those in Experiment 1, but longer lasting (to > 500 ms)



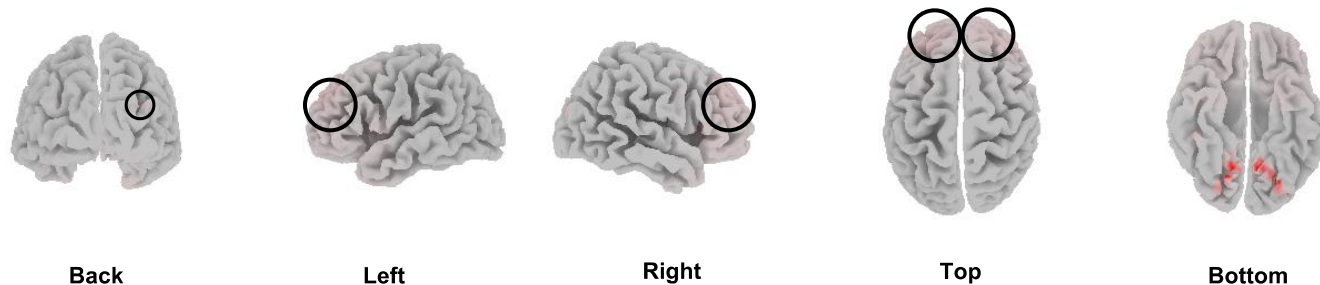
Experiment 2: Results

- Clear source of oblique vMMN in visual cortex (V2)
- Weaker source of eye-swap vMMN in visual cortex (V1, V2) and in prefrontal cortex

a) sLORETA Maps for Orientation vMMN (240 to 260 ms)

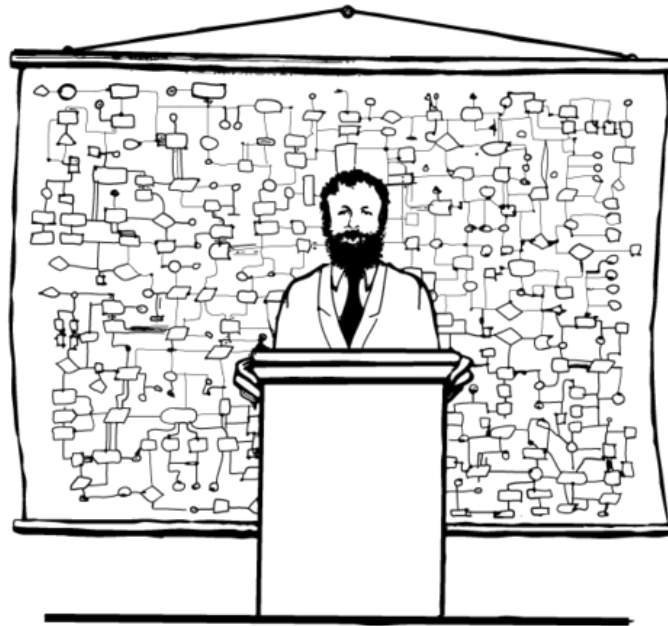


b) sLORETA Maps for Eye-Swap vMMN (310 to 330 ms)



Discussion

- The sources are consistent with a model of the vMMN by Kimura (2012) involving bottom-up processing of deviants by the visual cortex and top-down processing of the predictive model by the prefrontal cortex



“Now that you have an overview of the system,
we’re ready for a little more detail”

Conclusions

- There is a vMMN from eye of origin
- The eye-of-origin vMMN does not require consciousness because we are not conscious of eye of origin
- In this case, we makes predictions about a stimulus property of which we are not conscious, confirming theory
- The EEG sources seem to show that eye of origin is encoded in the visual cortex and that a prediction is generated in the prefrontal cortex

I thank

- My collaborators:
 - Urte Roeber
 - Brad Jack
 - Manja van Rhijn



I thank

- *You* for your most gracious attention!



<http://neenjames.com/wp-content/uploads/2012/02/asleep.png>

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