NEURAL ACTIVITY LINKED WITH VISUAL AWARENESS AND TASK-RELEVANCE IN A NOVEL 2X2 DESIGN

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NEURAL CORRELATES OF CONSCIOUSNESS (NCCs)

What is the neural difference between conscious and nonconscious processing?

PUT DIFFERENTLY…

"The minimal set of neuronal events jointly sufficient for a specific conscious percept"

-Christof Koch

GLOBAL NEURONAL WORKSPACE THEORY (GNWT)

- Sophisticated nonconscious processing
- Neurons with long axons, synapsing with fronto-parietal areas
- Widespread information sharing

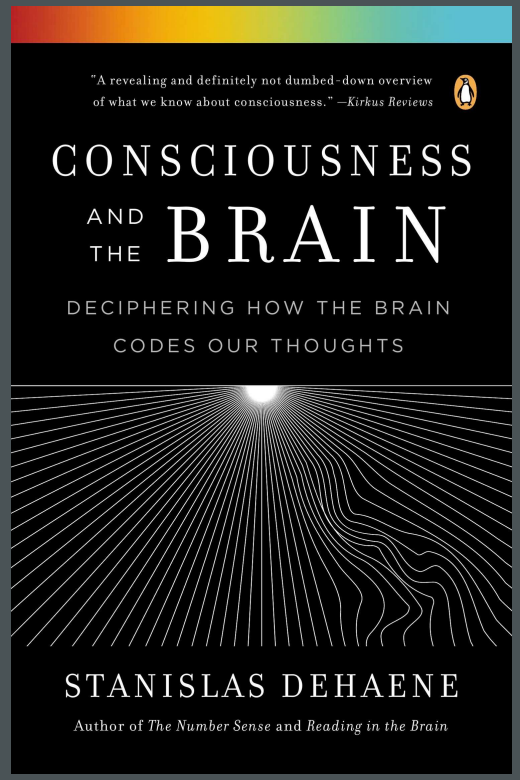
SUPPORT FOR GNWT

- Dehaene S. 2014 Consciousness and the Brain: Deciphering how the brain codes our thoughts. New York, NY: Penguin Books.
- Del Cul, A., Baillet, S. & Dehaene, S. Brain Dynamics Underlying the Nonlinear Threshold for Access to Consciousness. PLoS Biology 5, e260 (2007).
- Dehaene S, Changeux JP. 2011 Experimental and theoretical approaches to conscious processing. Neuron 70, 200–27.
- King, J.-R., Pescetelli, N. & Dehaene, S. Brain Mechanisms Underlying the Brief Maintenance of Seen and Unseen Sensory Information. Neuron 92, 1122–1134 (2016).
- Dehaene, S., Charles, L., King, J.-R. & Marti, S. Toward a computational theory of conscious processing. Current Opinion in Neurobiology 25, 76–84 (2014).
- Sergent, C. & Dehaene, S. Neural processes underlying conscious perception: Experimental findings and a global neuronal workspace framework. Journal of Physiology-Paris 98, 374–384 (2004).
- Dehaene S, Naccache L. 2001 Towards a cognitive neuroscience of consciousness: basic evidence and a workspace framework. Cognition 79, 1–37.

and more…

NCC ACCORDING TO GNWT

- Fronto-parietal ignition [fMRI]
- P3b ERP [EEG]
- Long-range synchrony [ECoG]
- Late gamma-band [ECoG, MEG]

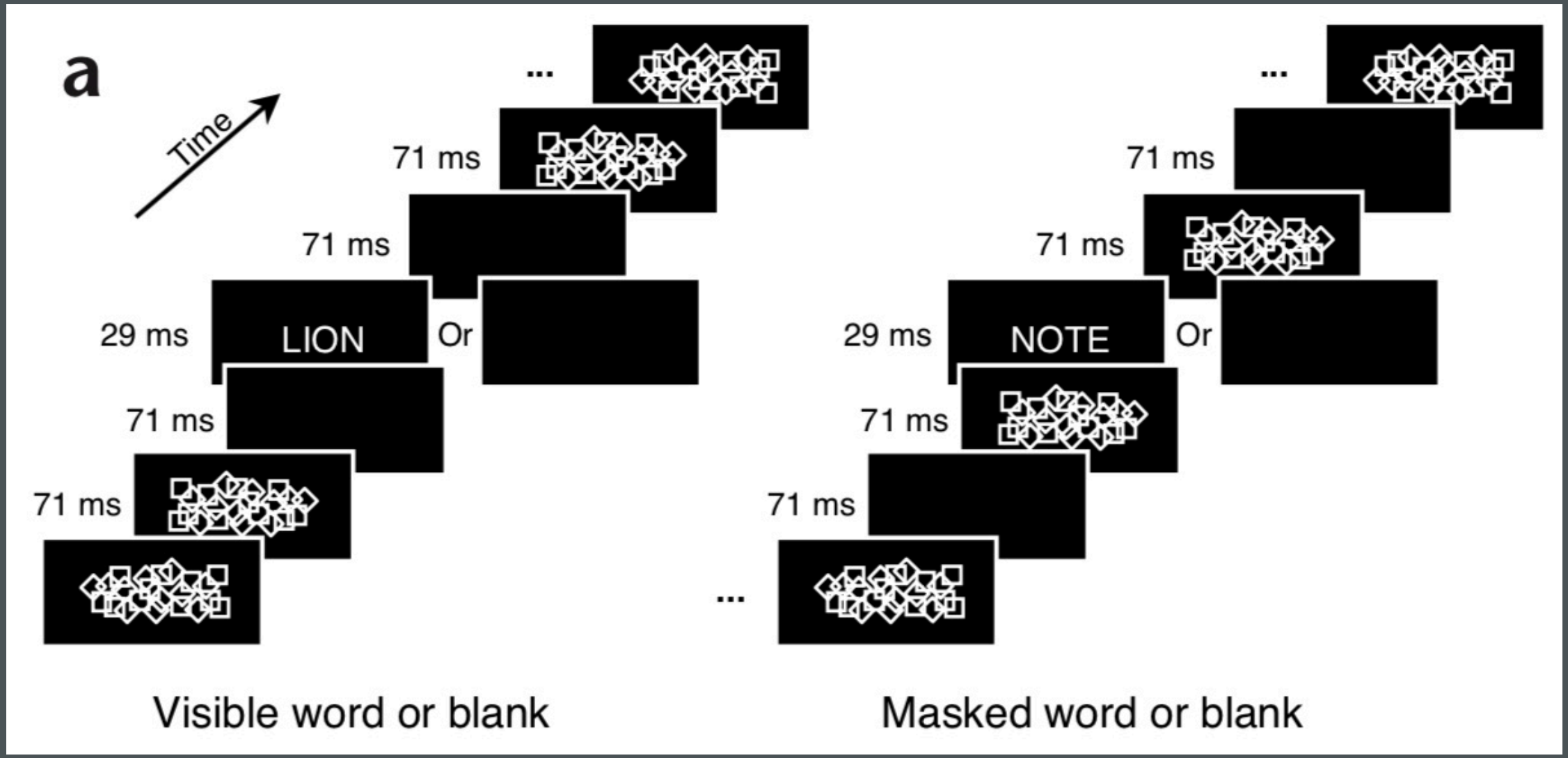


DEHAENE ET AL. (2001) NATURE NEUROSCIENCE

Cerebral mechanisms of word masking and unconscious repetition priming

Purpose: contrast neural activity between seen and unseen words

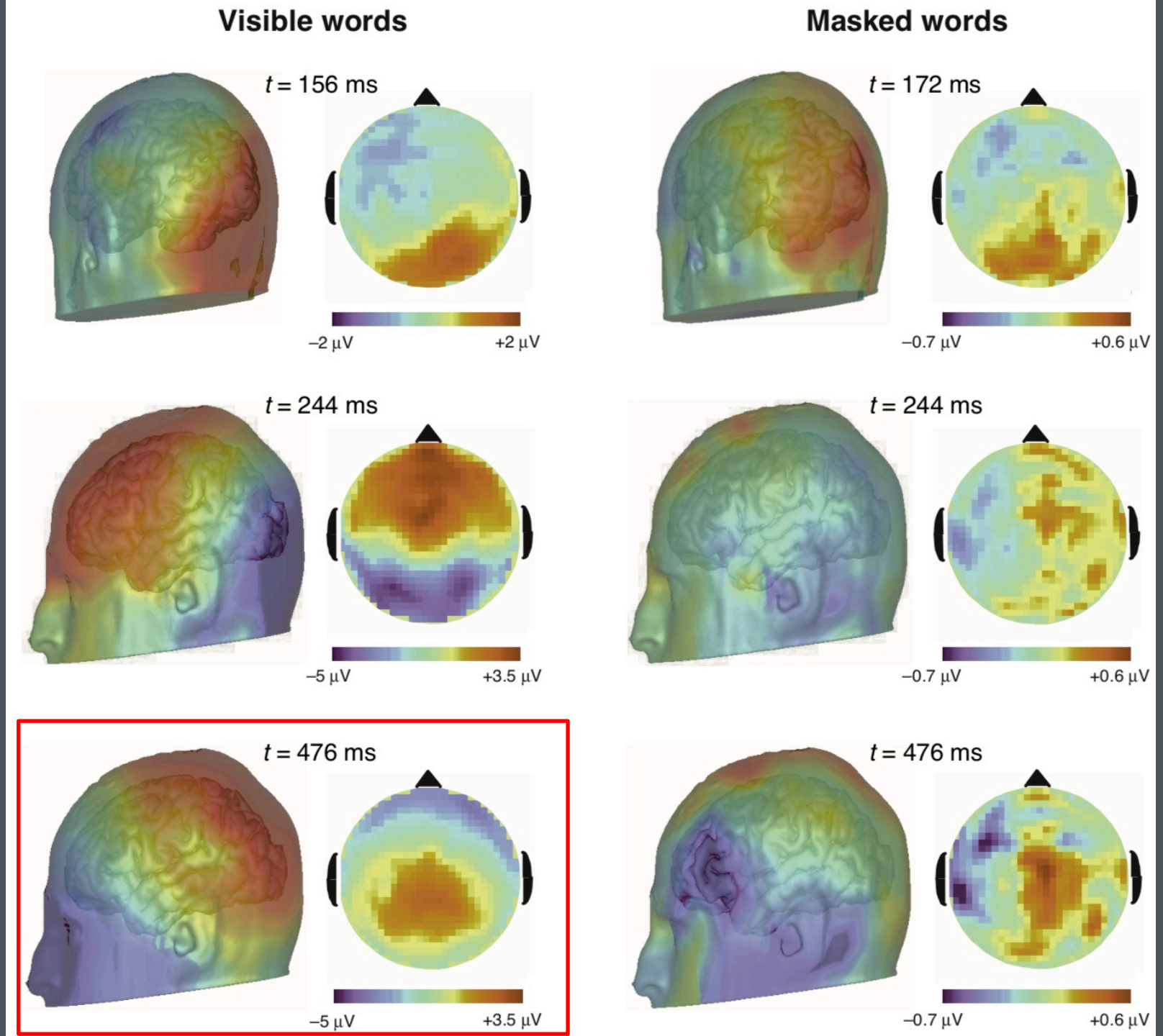
Dehaene et al. (2001)



P1

N1

P3b



P1

N1

P3b

BUT…

Stimuli are always task-relevant!

SOLUTION

Manipulate task-relevance

TASK-RELEVANCE

- **Task-irrelevant blocks [detection]**
  - Respond to nontarget ***red ovals*** on 20% of trials

- **Task-relevant blocks [discrimination]**
  - Respond to target ***animals/objects*** on 100% of trials

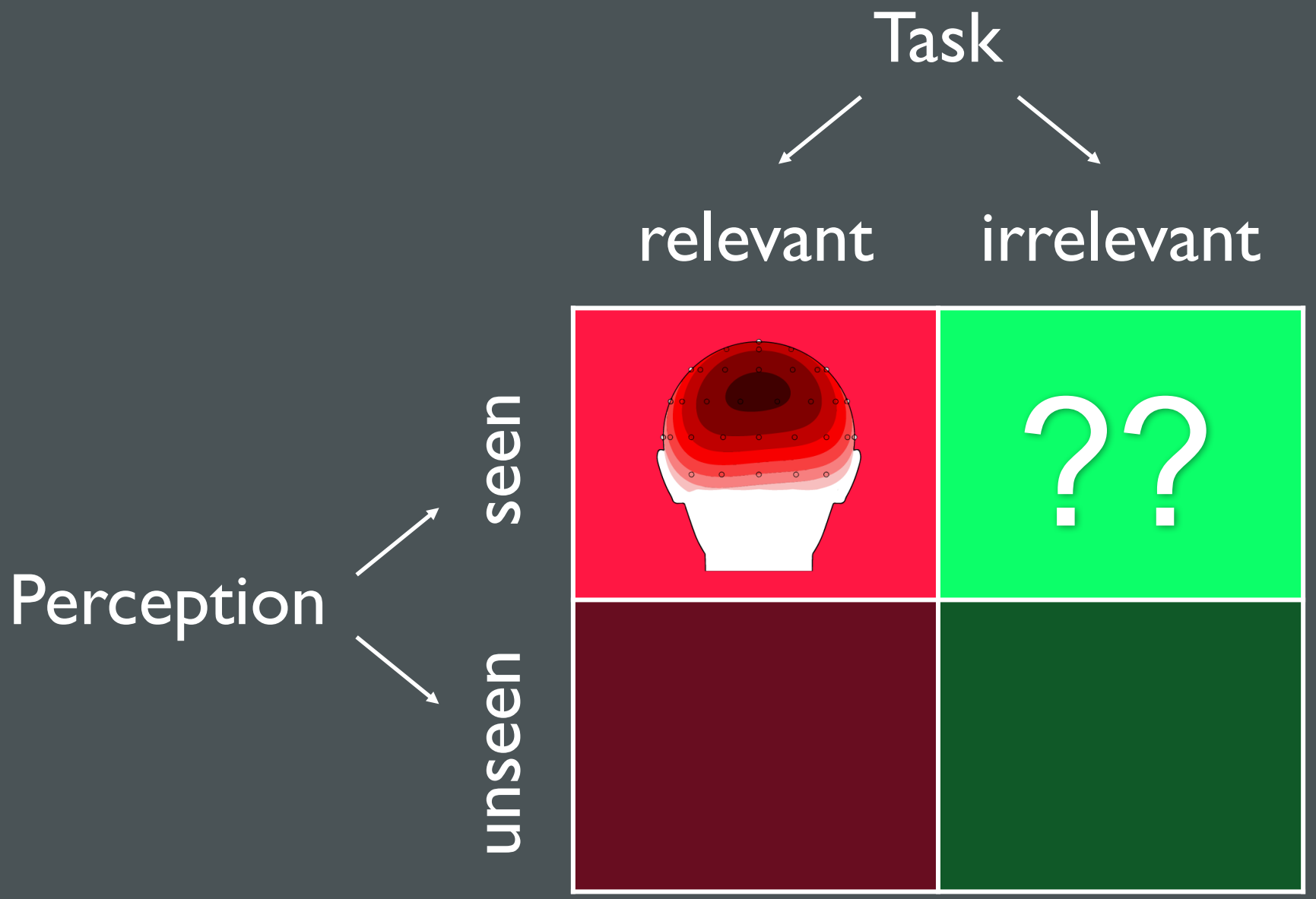
SO…

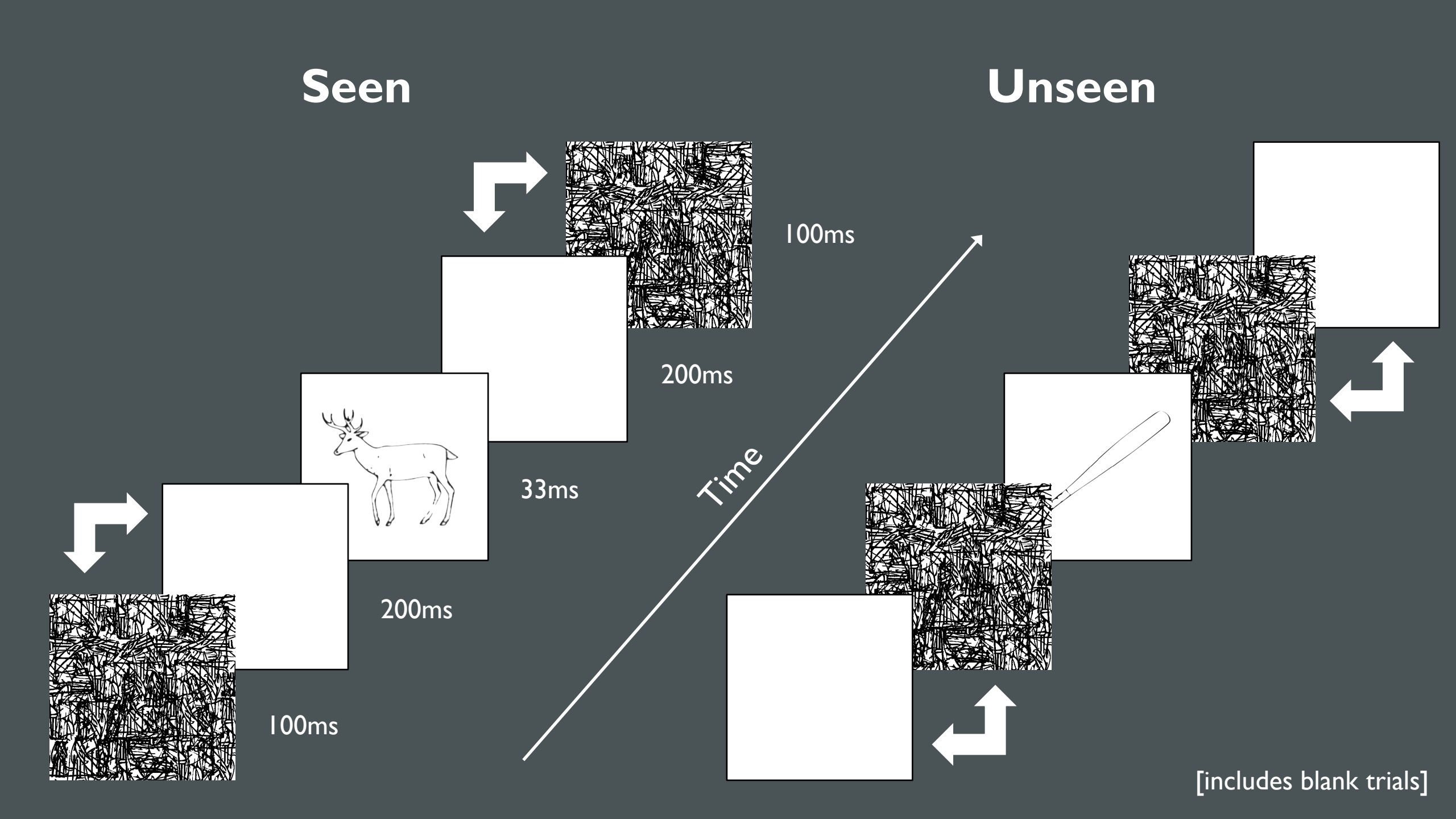
Manipulate perception AND task:

2 x 2

Perception
- Seen [lightly masked]
- Unseen [heavily masked]

Task
- Relevant [report]
- Irrelevant [no report]


Task
relevant
irrelevant
Perception
seen
unseen
??


Seen
Unseen
100ms
200ms
33ms
200ms
100ms
Time
[includes blank trials]

PROCEDURE

1. 4x task-irrelevant blocks
2. Incidental Memory Test → 8x seen, 8x unseen, 8x foils

   Did people actually see animals/objects when they were not asked to report on them?
3. 4x task-relevant blocks

INCIDENTAL MEMORY TEST

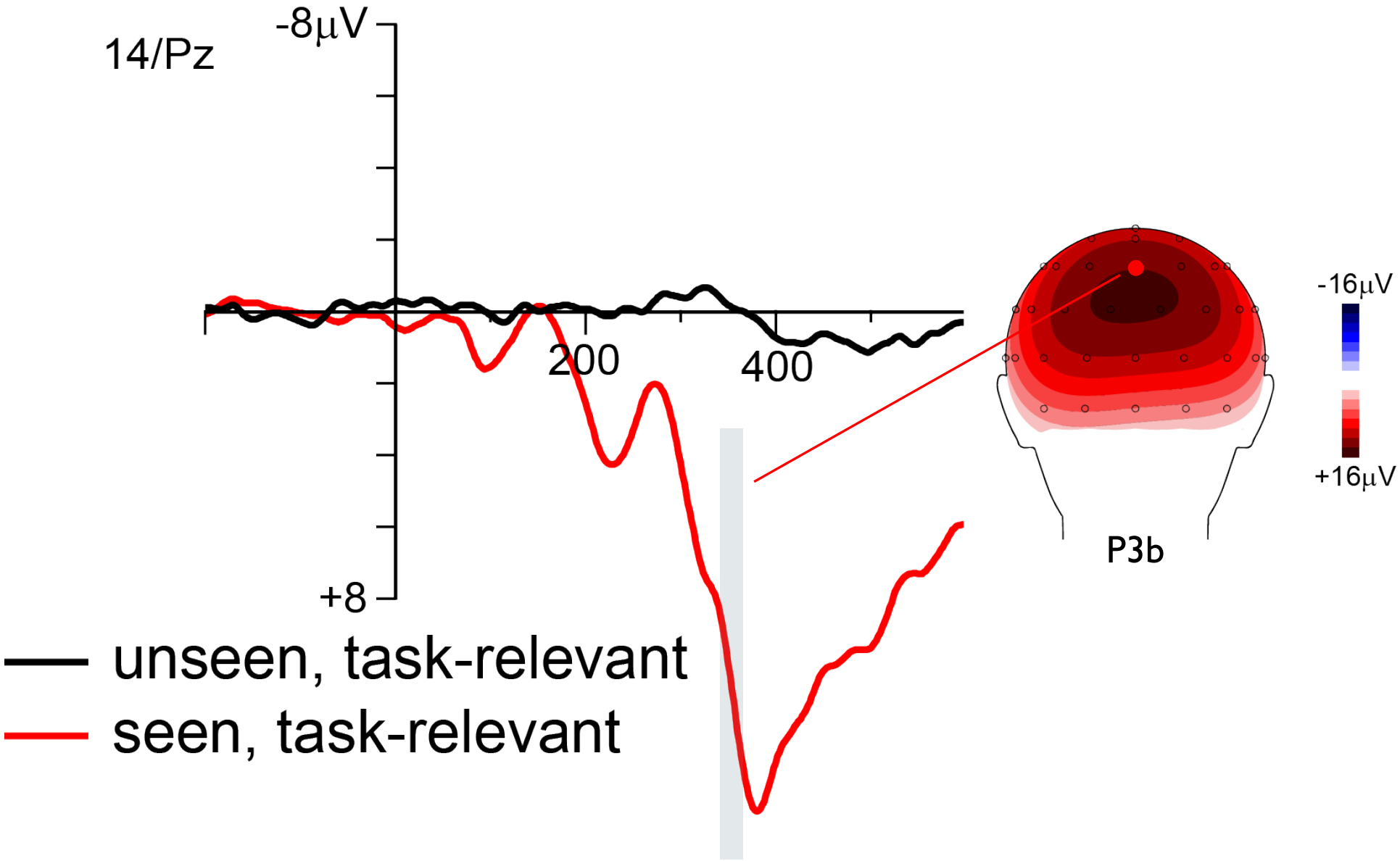
Average accuracy = 93.452%

GNWT PREDICTS...

Same awareness-related activity in both relevant and irrelevant conditions

(after blank subtraction)

n=14



(after blank subtraction)

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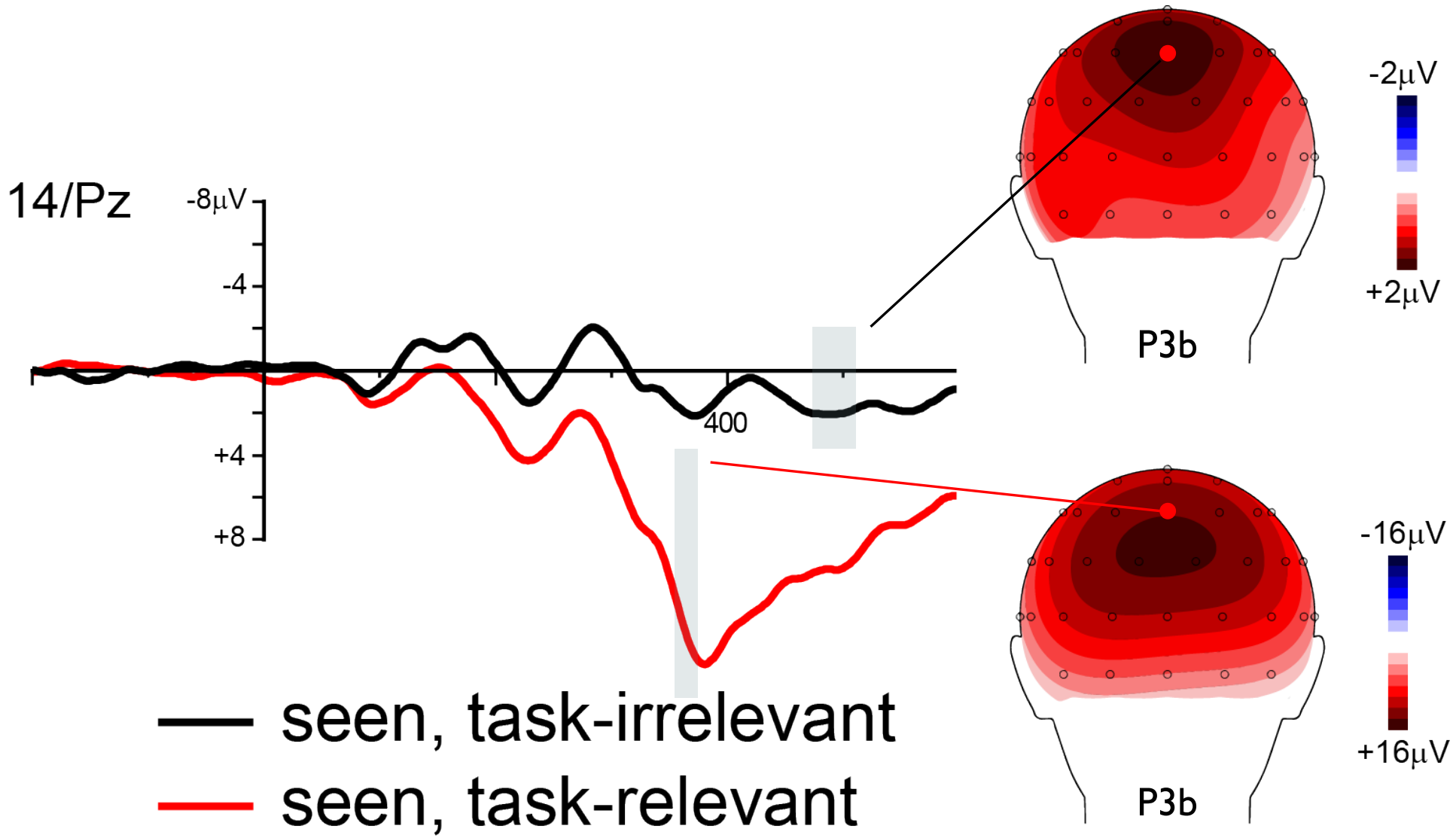
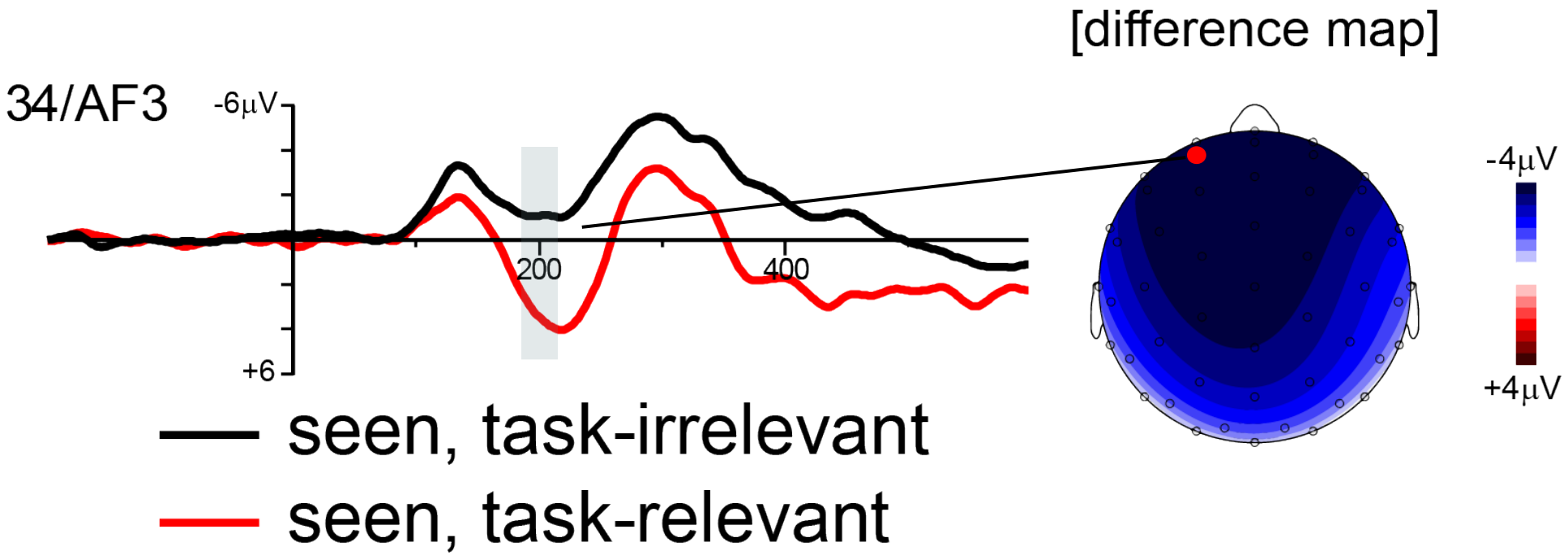


(after blank subtraction)

n=14



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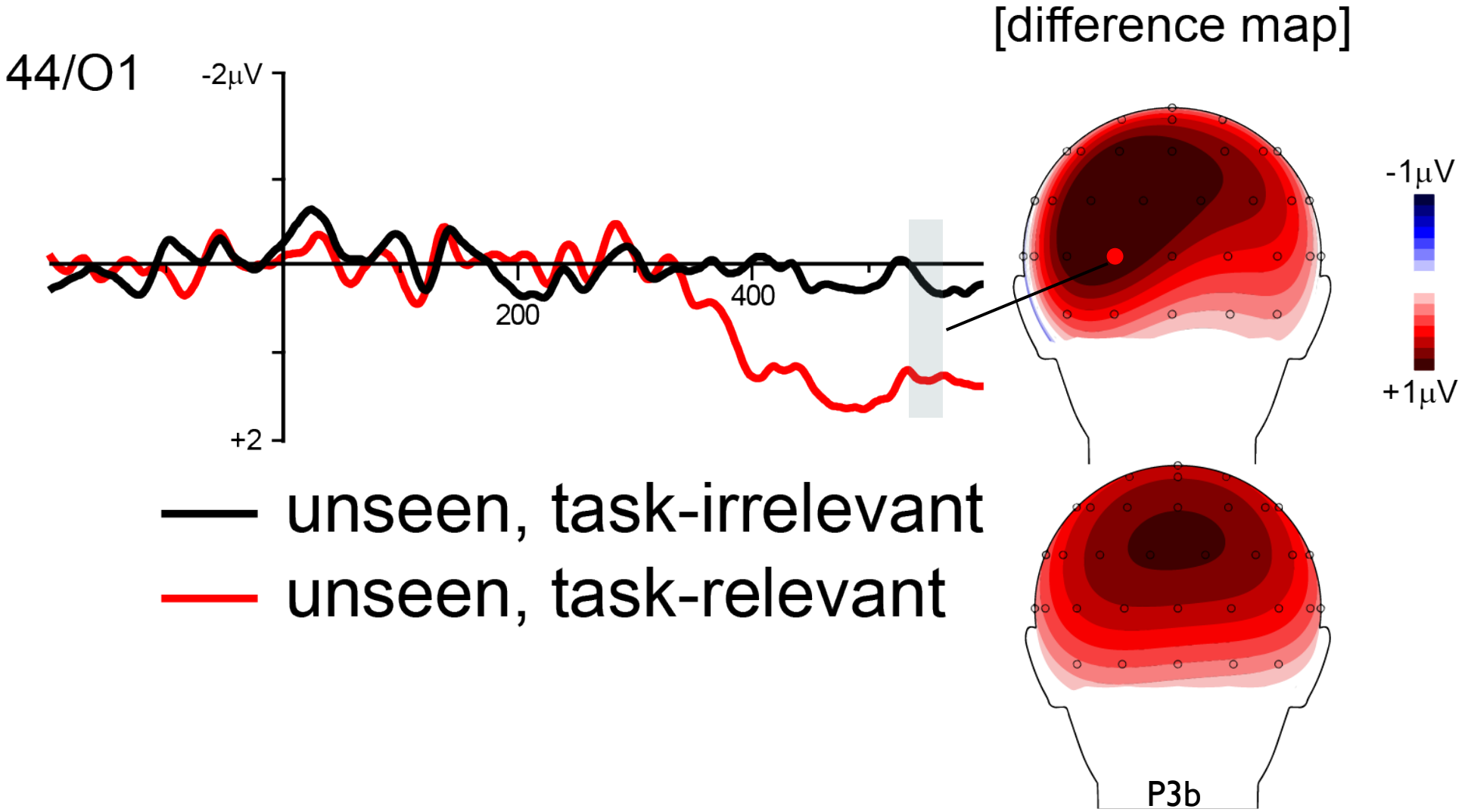
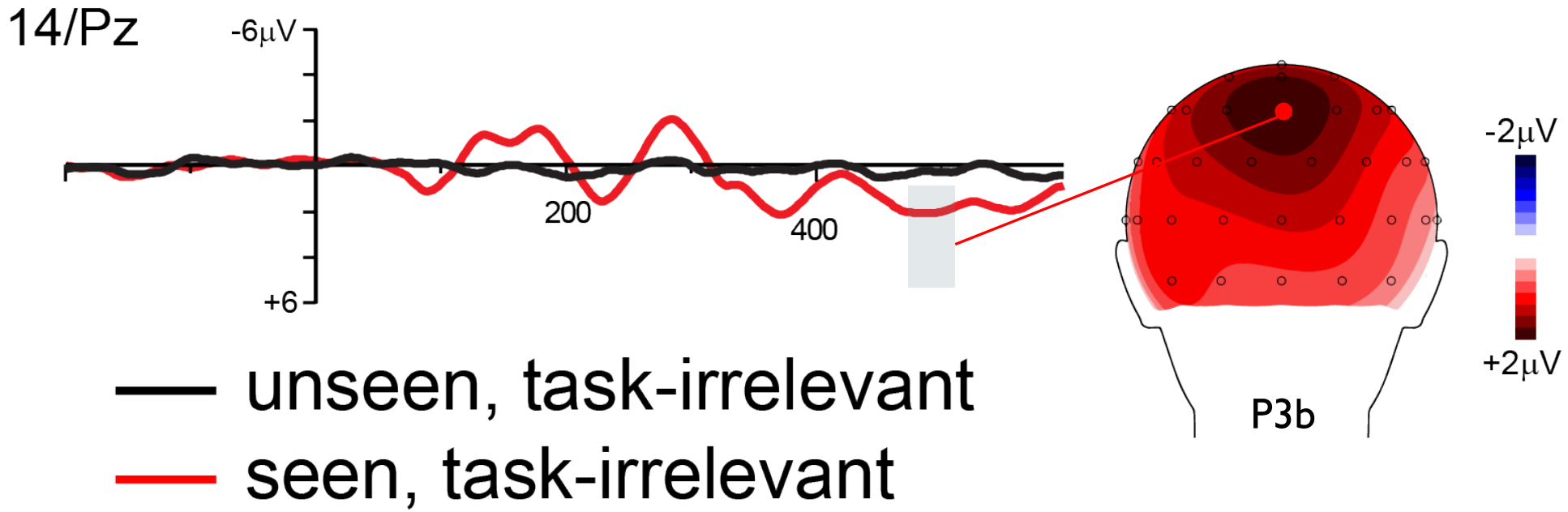


(after blank subtraction)

n=14



SUMMARY/INTERPRETATIONS

- Cannot refute or fully support GNWT

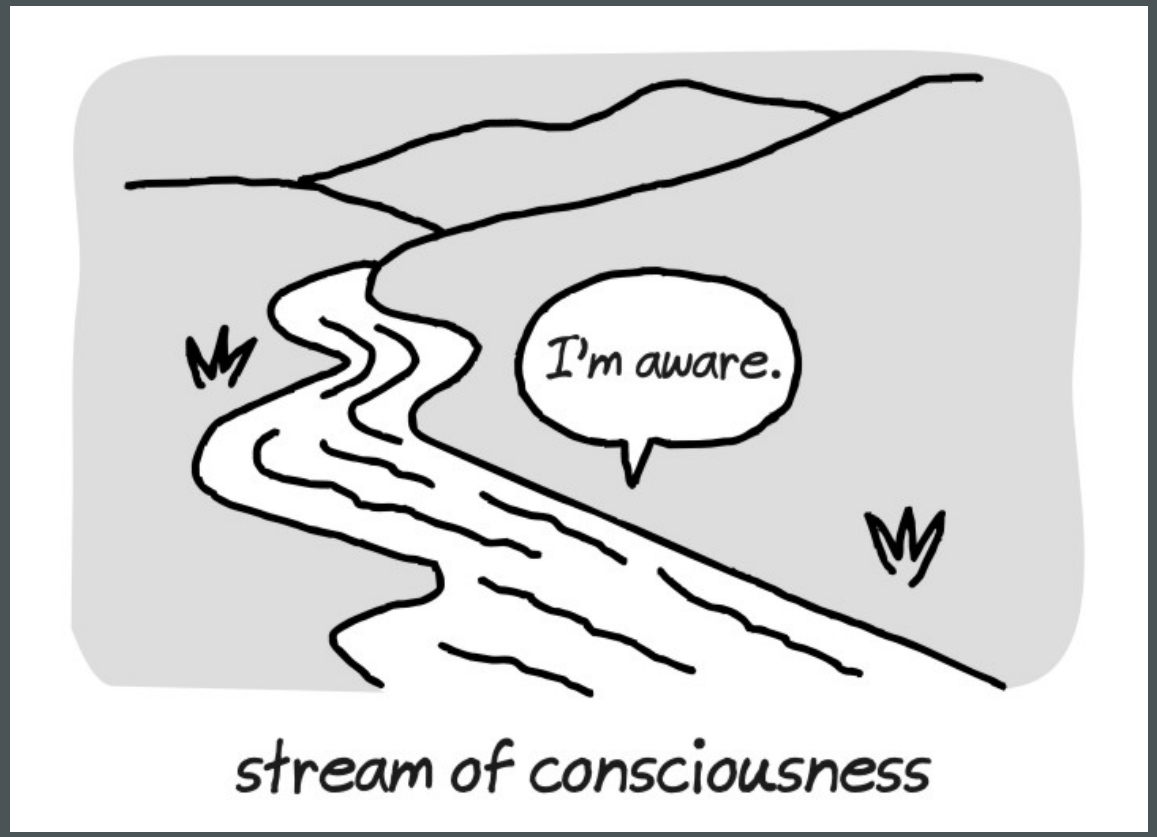
SUMMARY/INTERPRETATIONS

- P3b seemingly related to perception *and* task
- Animals/objects task-irrelevant enough?

FUTURE DIRECTIONS

- Higher unseen signal/noise ratio
- Task design
- Threshold
- Neural classifier/decoder

THANK YOU FOR BEING HERE



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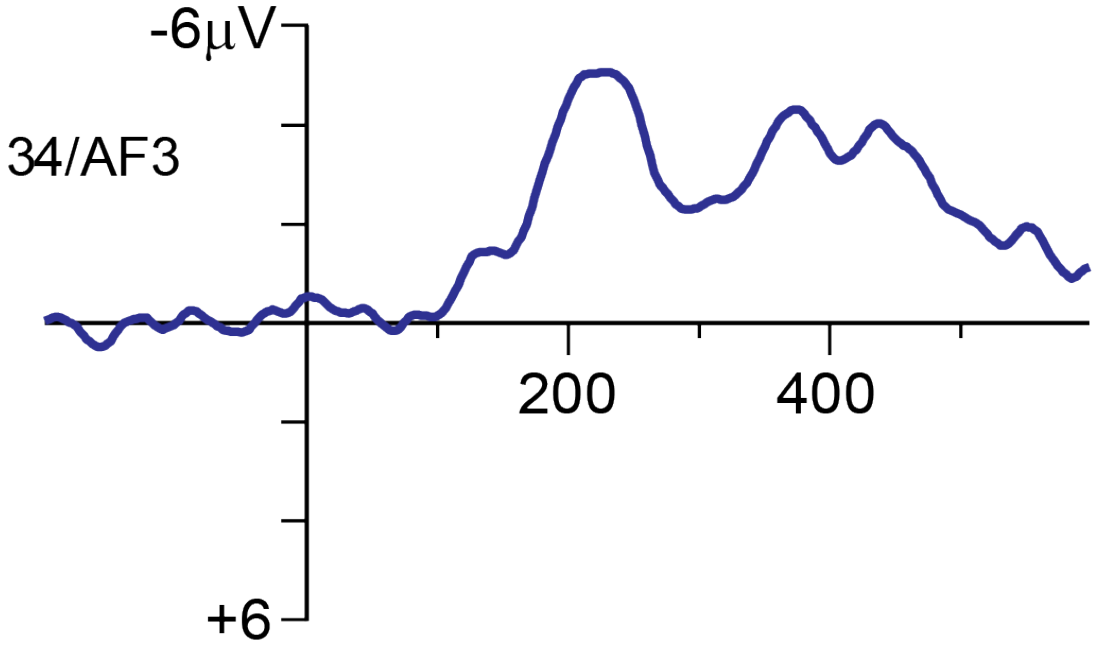
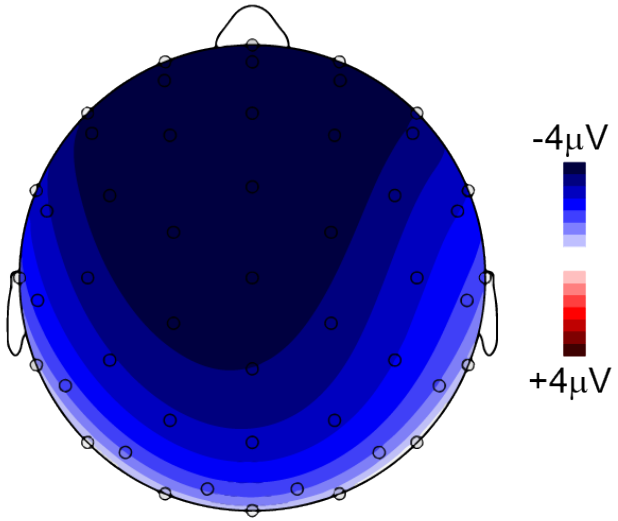
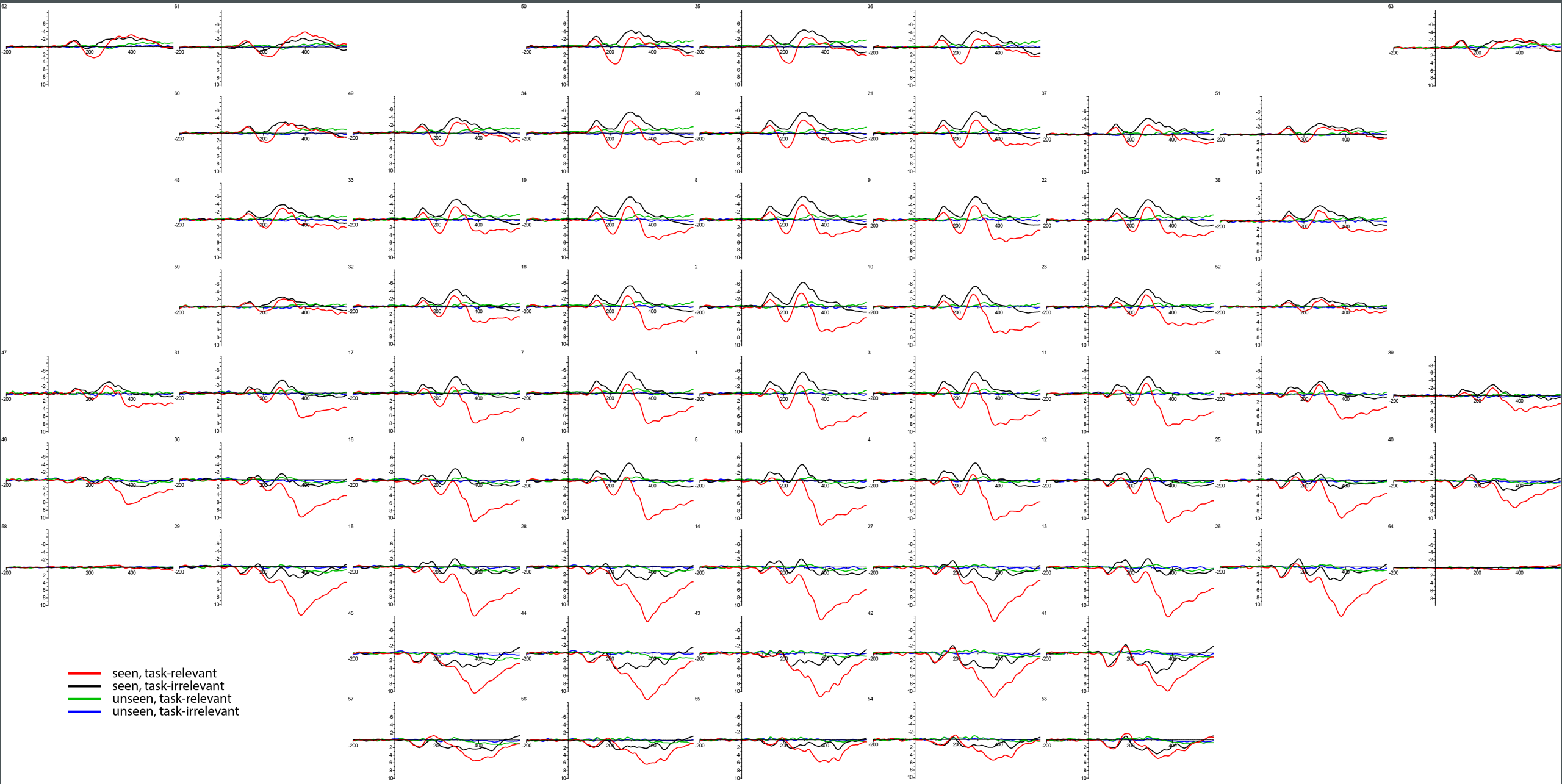


[difference map]



seen, task-irrelevant MINUS seen, task-relevant


seen, task-relevant
seen, task-irrelevant
unseen, task-relevant
unseen, task-irrelevant