

Neural signatures of visual word form perception in an inattention blindness paradigm

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The 3 NCC problem

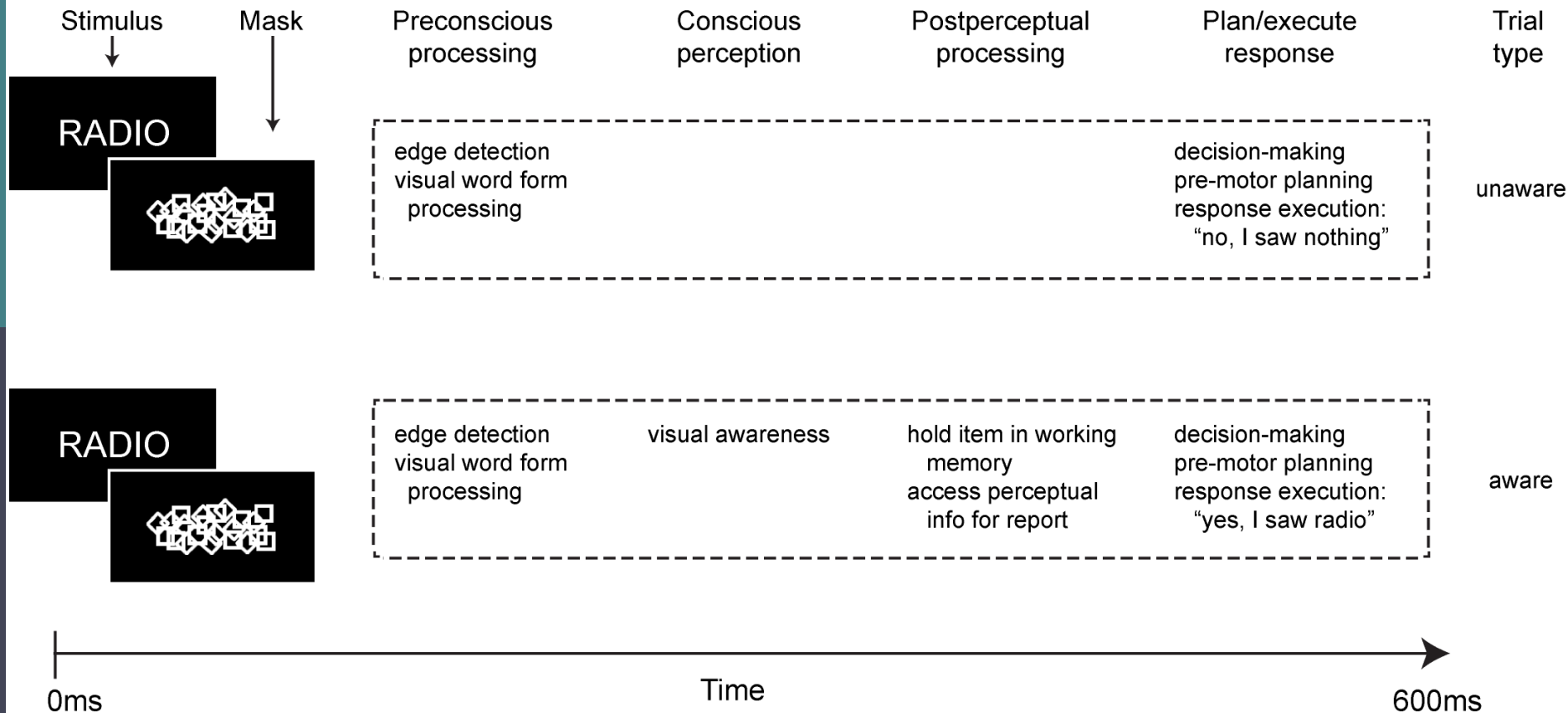
When contrasting “aware” vs. “unaware” conditions, it’s difficult to distinguish...

- ❑ Preconscious processing (necessary but not sufficient)
&
- ❑ Postperceptual processing (sufficient but not necessary)
from...
- ❑ NCC-proper (necessary *and* sufficient)

Paradigm comparison

Backward masking paradigm (at threshold)

Task = after each trial report percept, e.g. did you see a word (Y/N)? can you identify the word?



Inattentional Blindness (IB) paradigm

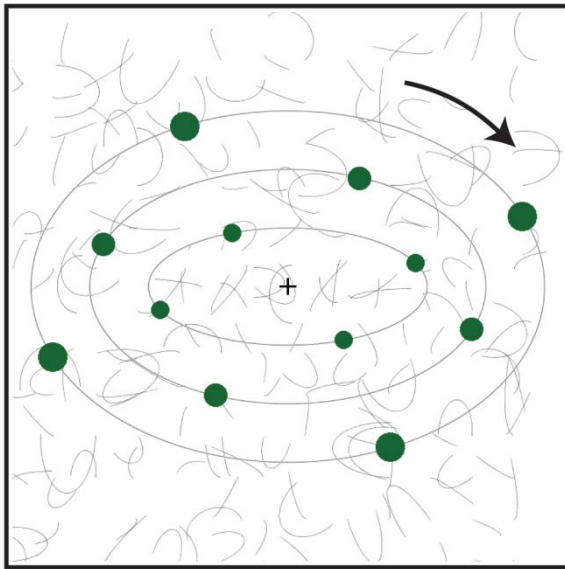
Video example of stimuli:

<https://youtu.be/FONIOaZXzEg>

Inattentional Blindness (IB) paradigm

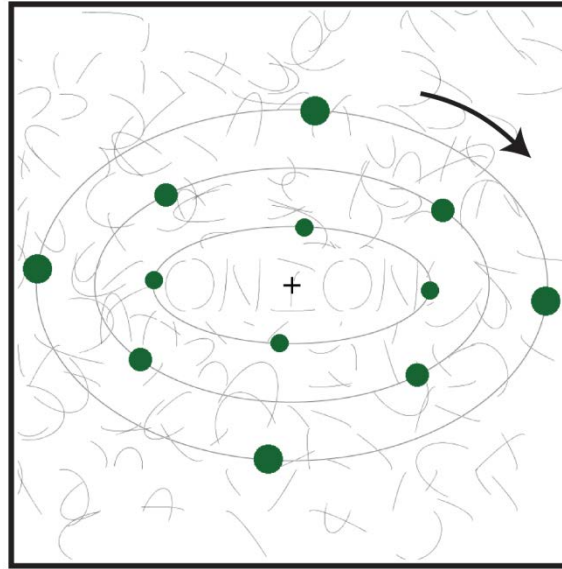
Words (22.5%)
Consonants (22.5%)
Scrambled (45%)
Animal Words (10%)

Scrambled



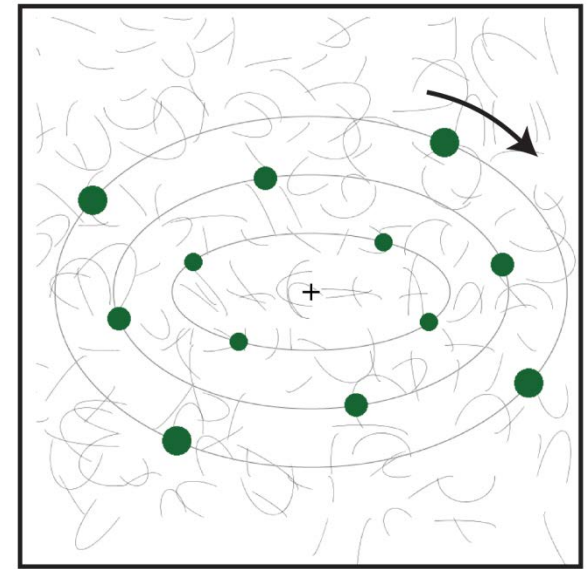
600-800ms

Animal Words (10%)



300ms

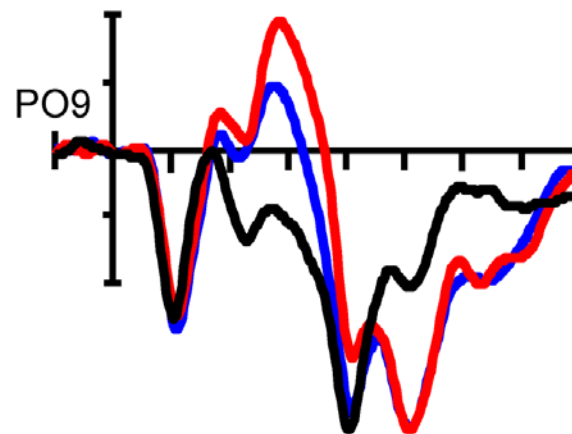
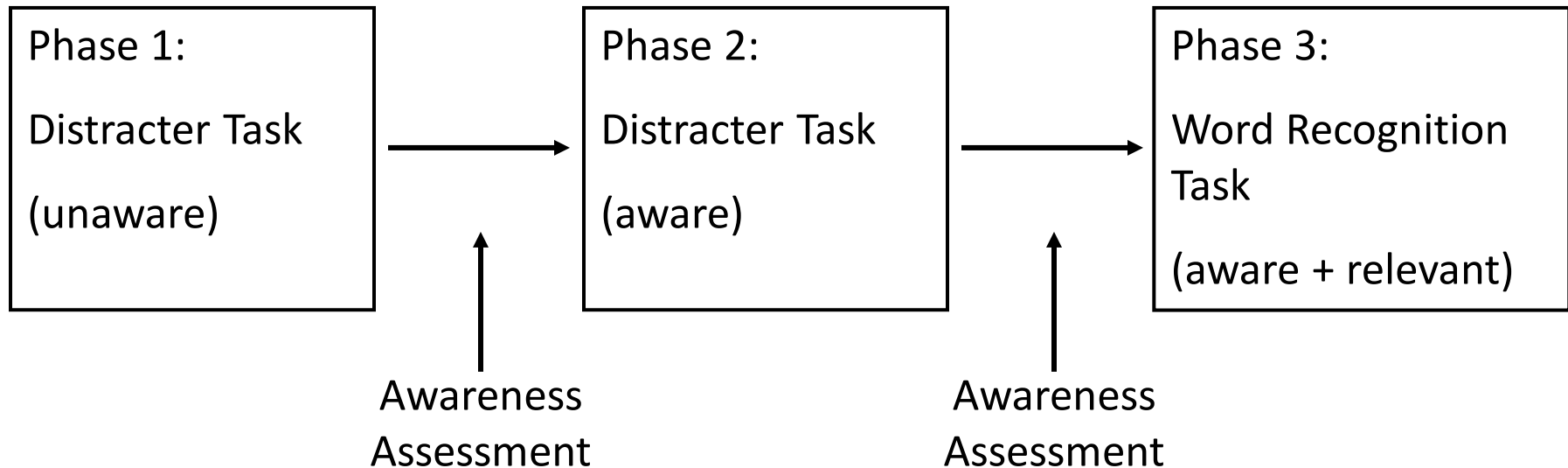
Scrambled



600-800ms

Time-lock ERPs

Procedure



of stimuli per phase:

— Words: 180

— Consonants: 180

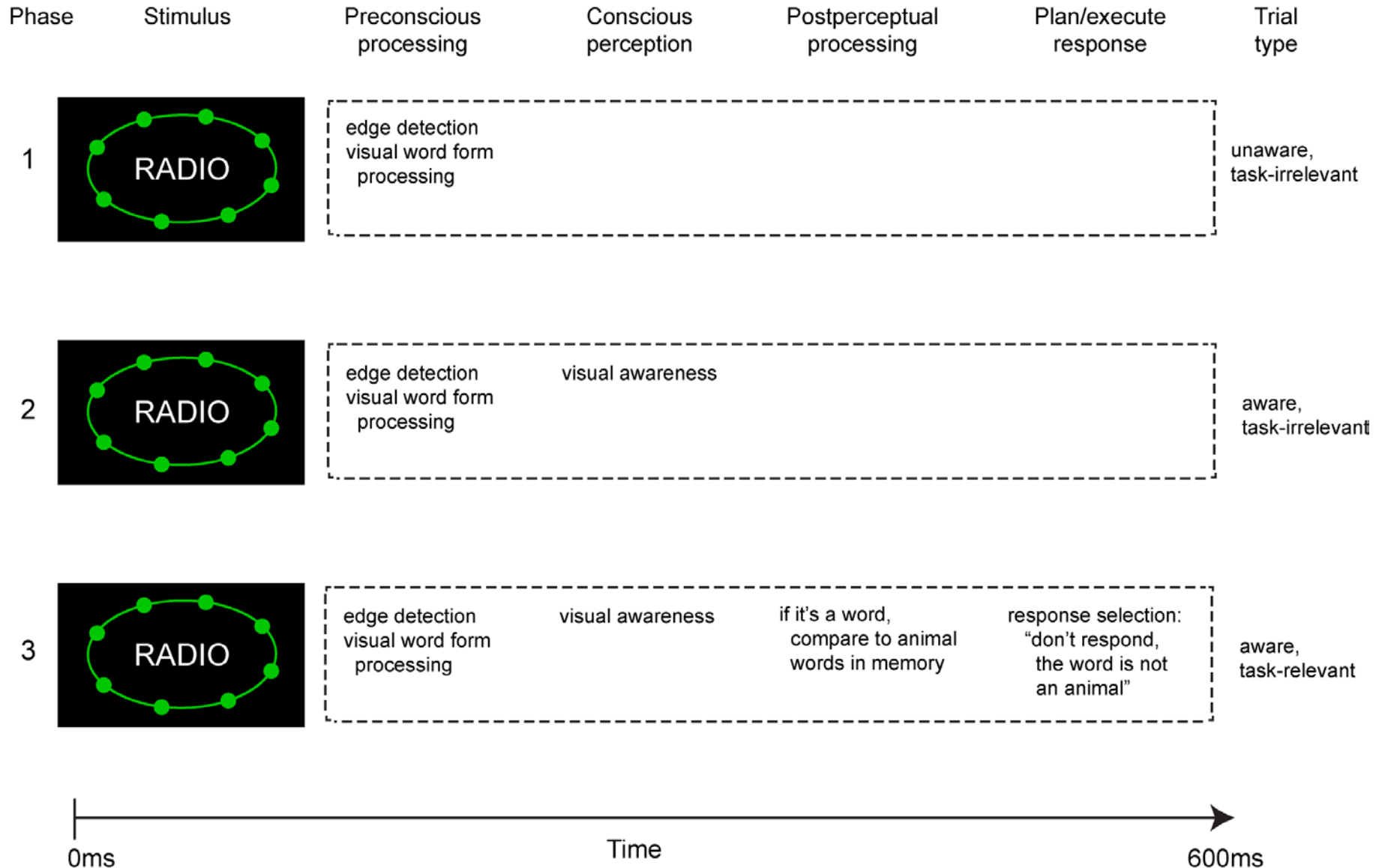
— Scrambled: 360

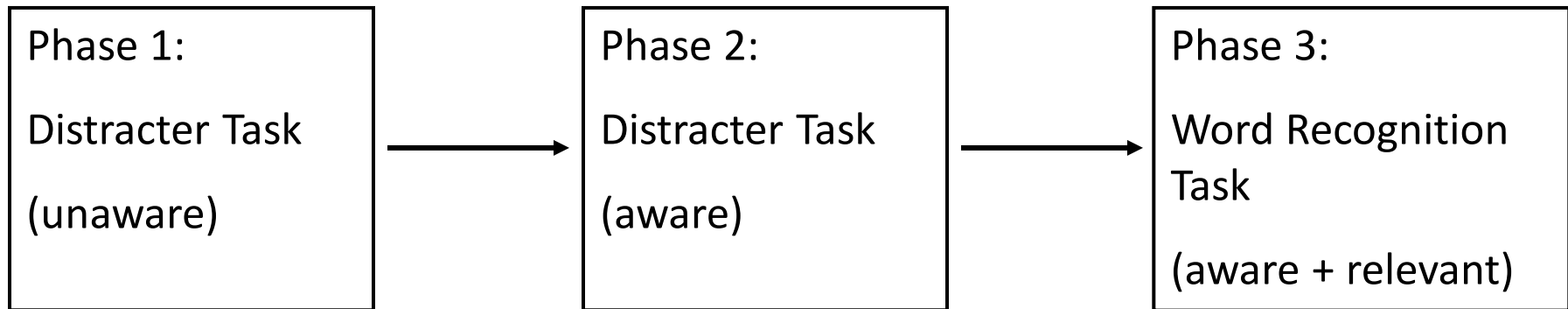
Animal Words: 80

- IB to shapes: Pitts, Martinez, & Hillyard (2012) *JCogNeuro*
- IB to faces: Shafto & Pitts (in press) *JNeurosci*

Inattentional blindness paradigm

Tasks: phase 1 & 2 = detect bright green-disc targets; phase 3 = detect animal words



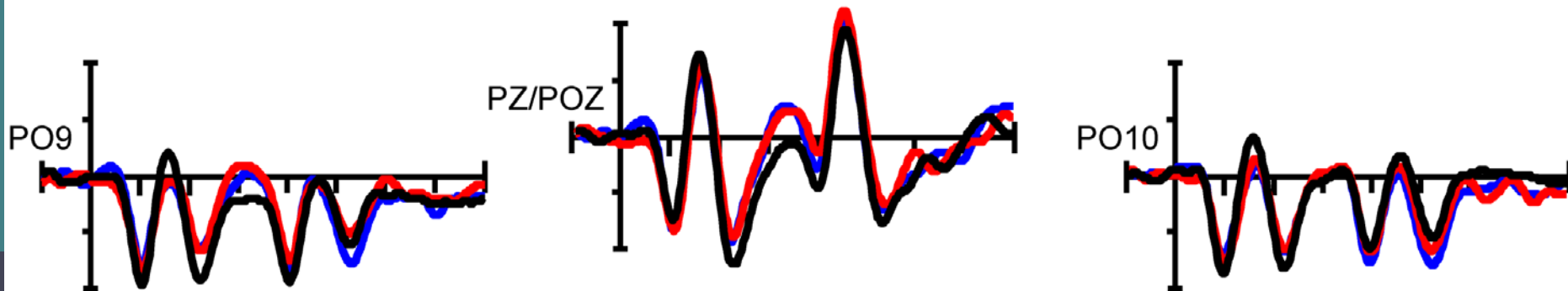
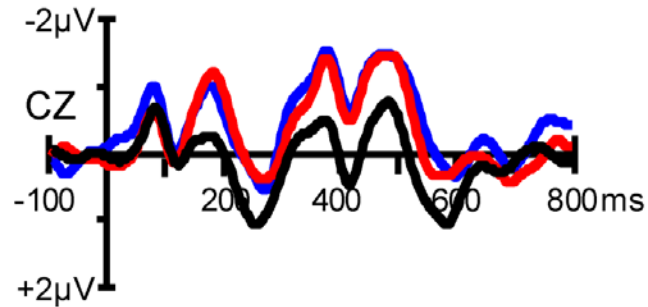


Main Questions:

- N250 and N400 during inattention blindness (Phase 1)?
(Appelbaum et al., 2009; Luck, Vogel, & Shapiro, 1996)
- P300 when subjects are aware of words (Phase 2) or only when words must be reported (Phase 3)?
(Dehaene & Changeux, 2011)
- ERPs uniquely associated with awareness (Phase 2 vs. Phase 1), e.g. visual awareness negativity (VAN)?
(Railo, Koivisto, & Revonsuo, 2011)

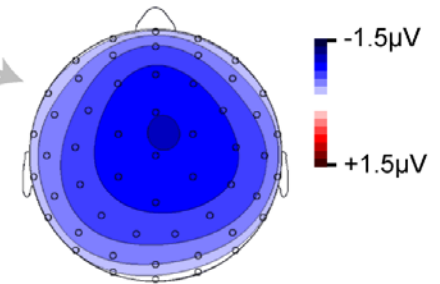
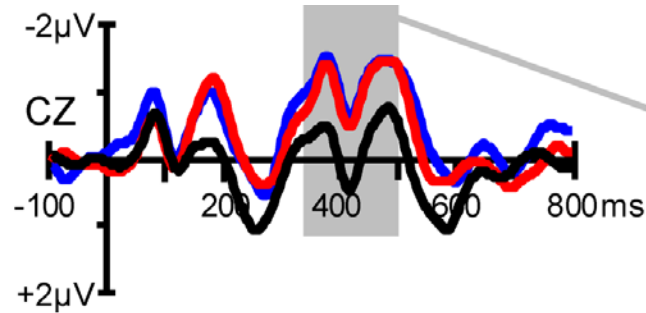
Phase 1 (unaware, task irrelevant)

- Words
- Consonants
- Scrambled

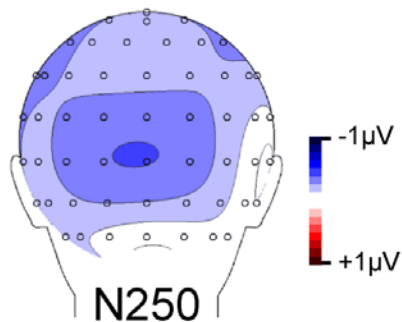
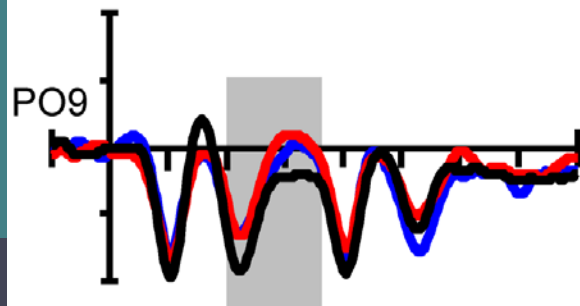


Phase 1 (unaware, task irrelevant)

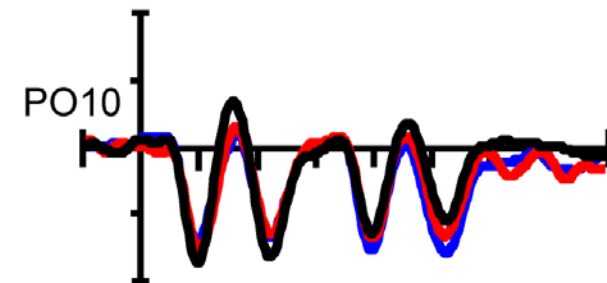
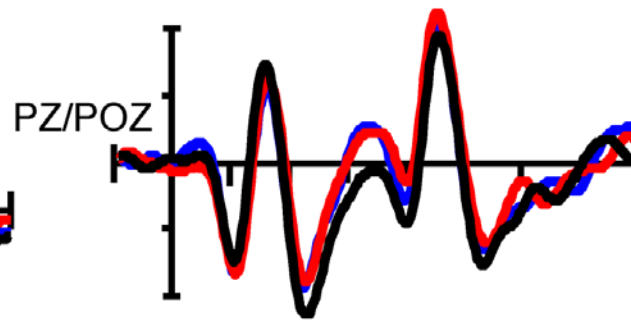
— Words
— Consonants
— Scrambled



N400

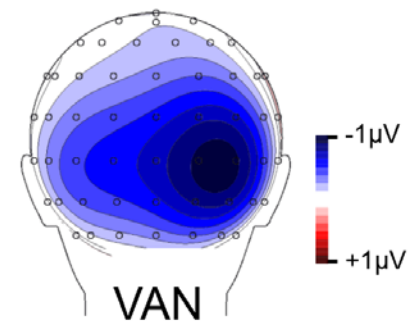
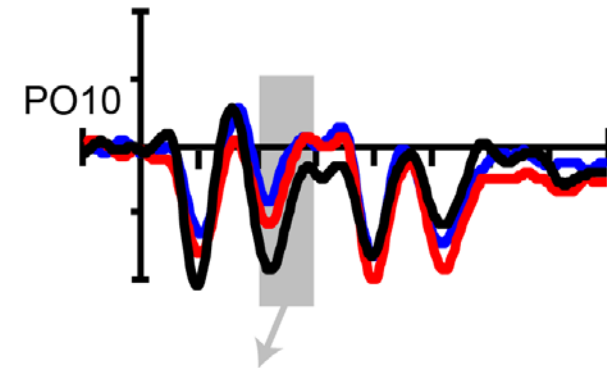
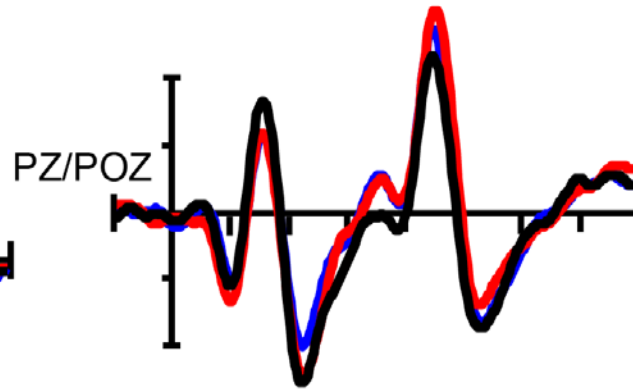
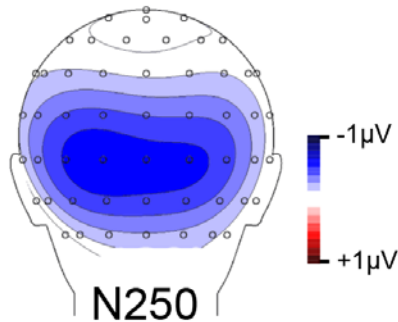
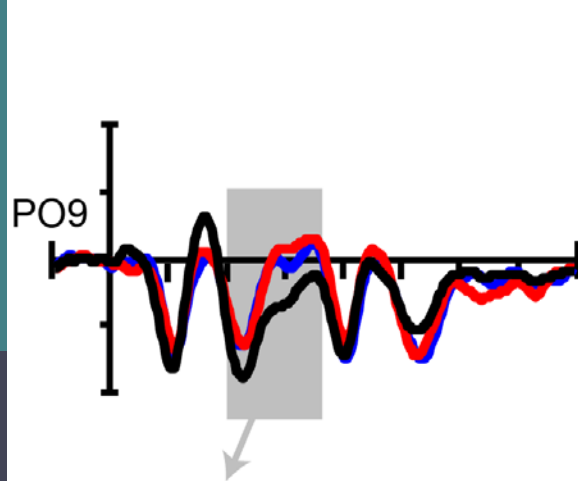
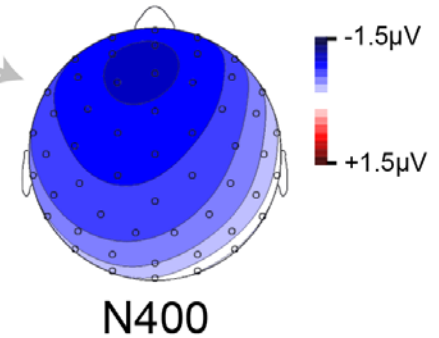
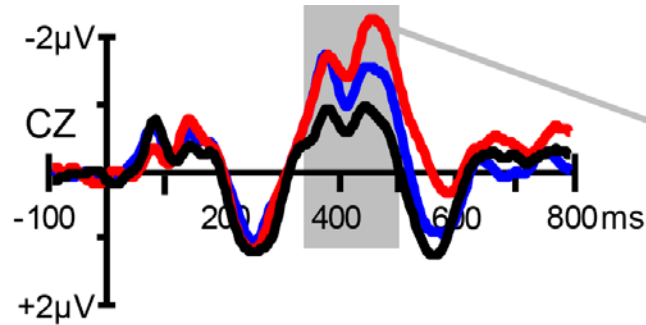


N250



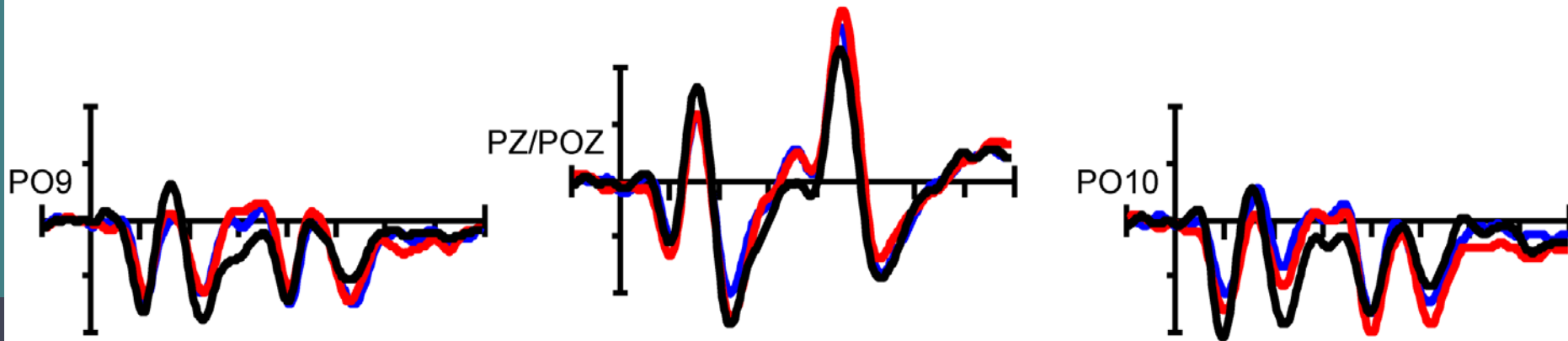
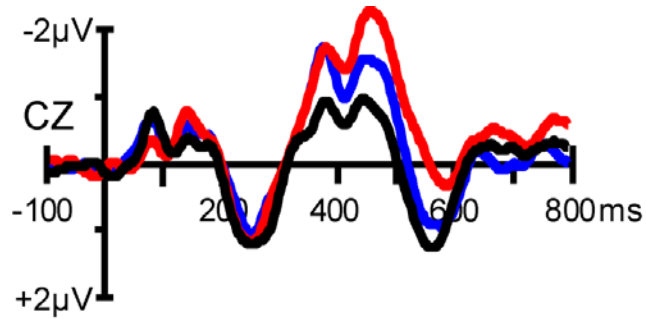
Phase 2 (aware, task irrelevant)

- Words
- Consonants
- Scrambled



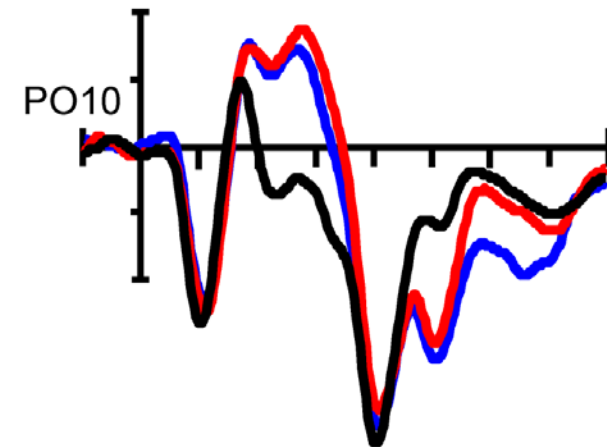
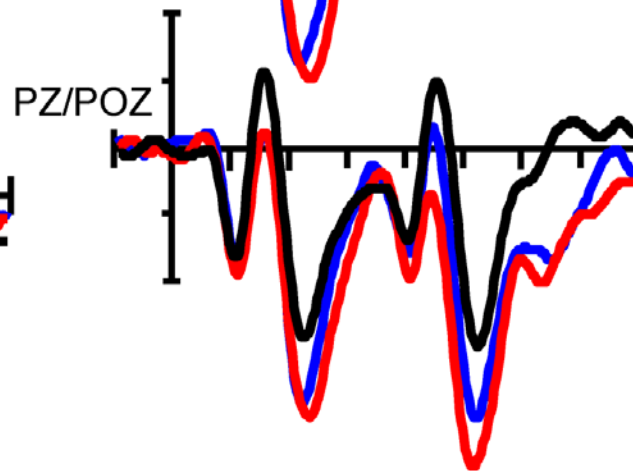
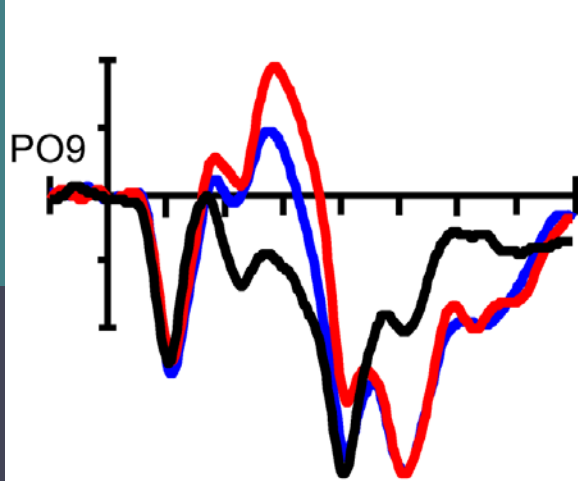
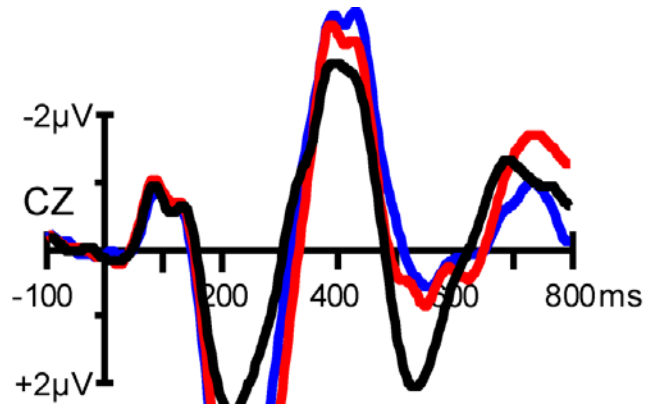
Phase 2 (aware, task irrelevant)

- Words
- Consonants
- Scrambled



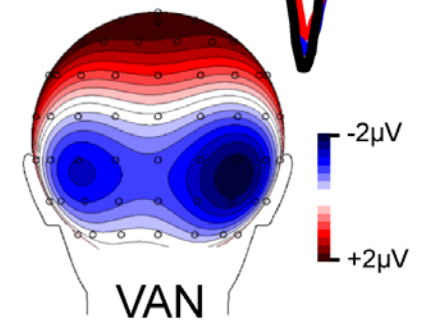
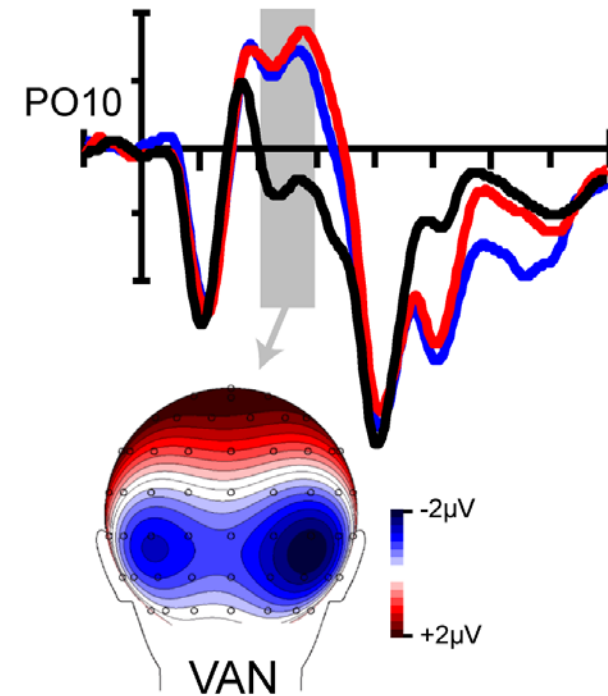
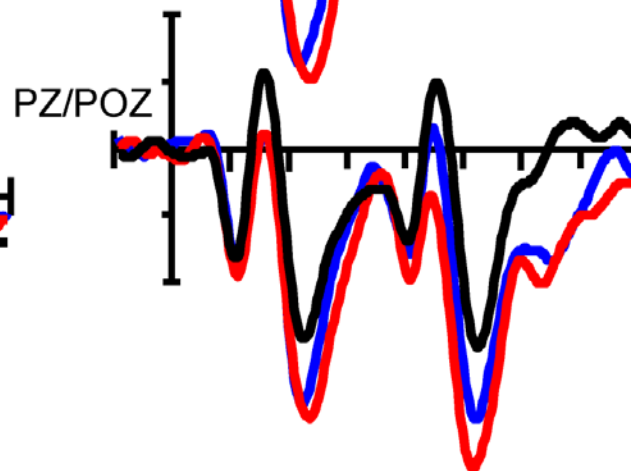
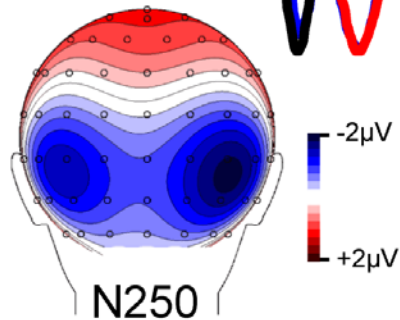
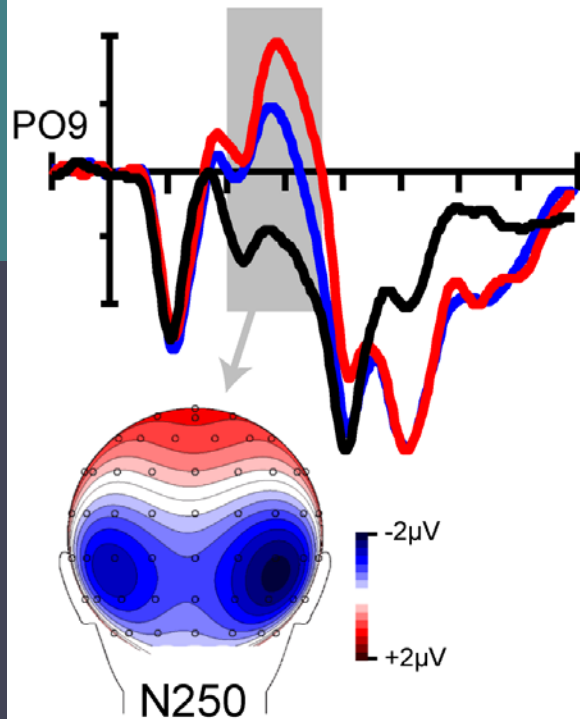
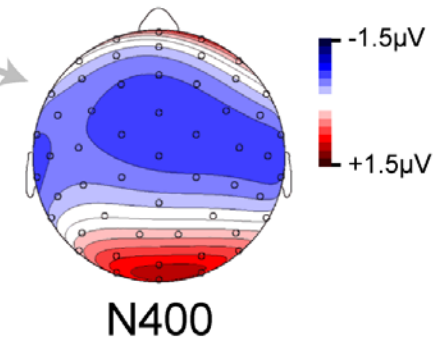
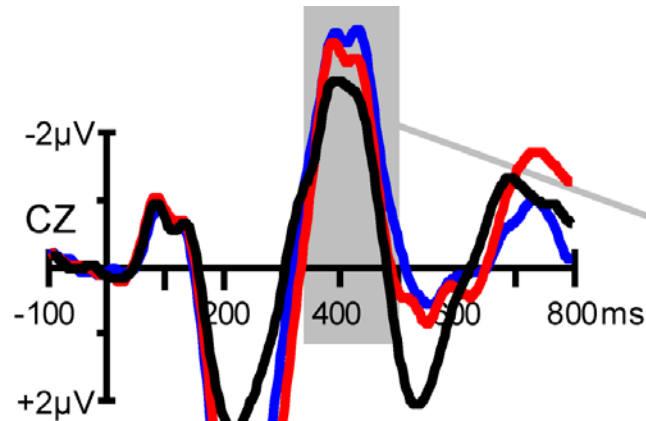
Phase 3 (aware, task relevant)

- Words
- Consonants
- Scrambled



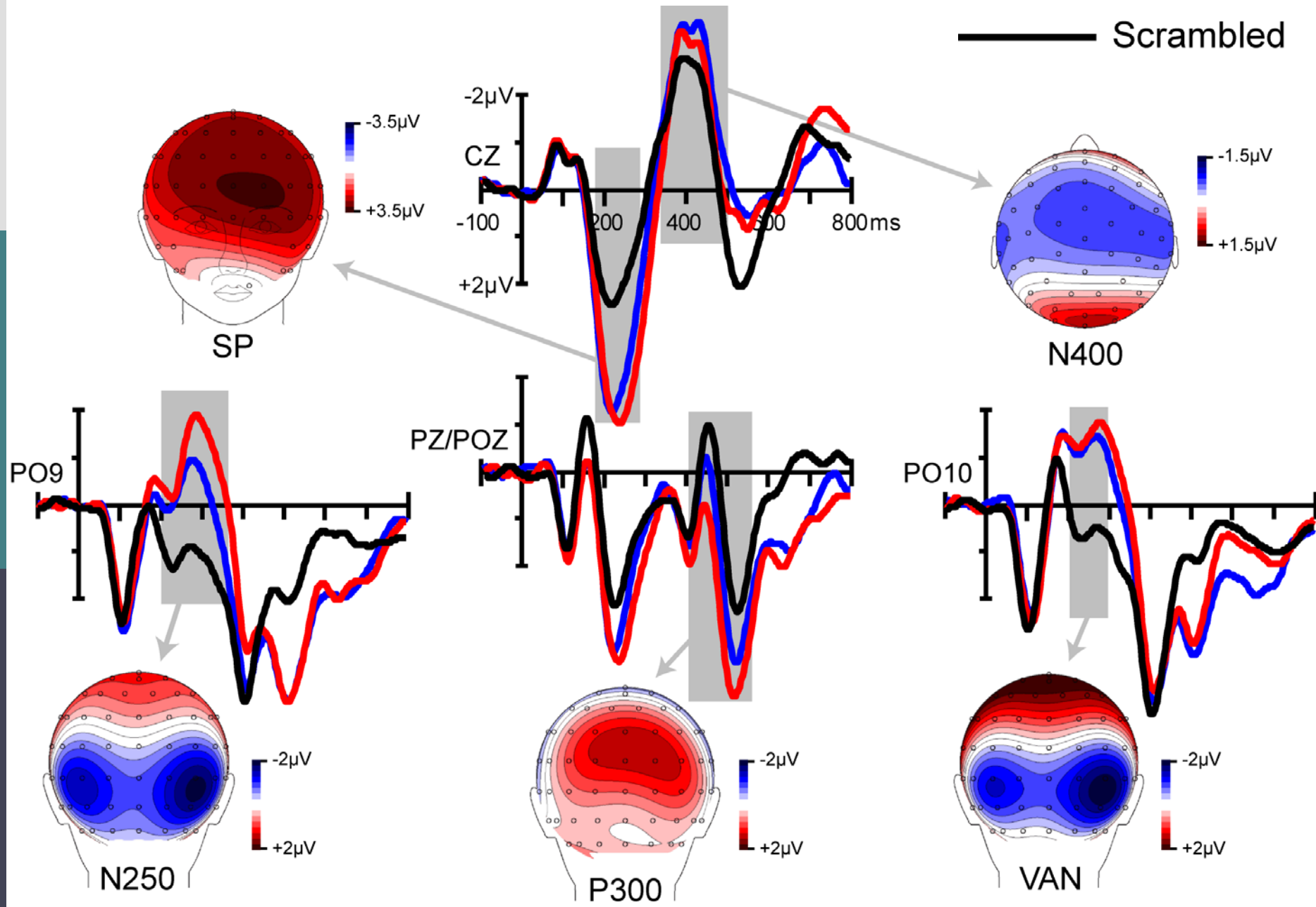
Phase 3 (aware, task relevant)

— Words
— Consonants
— Scrambled



Phase 3 (aware, task relevant)

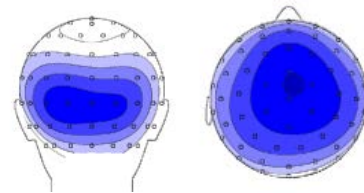
— Words
— Consonants
— Scrambled



Summary

- N250 and N400 *regardless* of whether subjects are aware of the word forms.

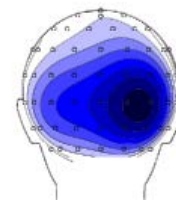
- Phase 1 (unaware, task irrelevant)



preconscious
processing

- VAN (and word vs. consonant ERP difference) *only when* subjects are aware of the word forms.

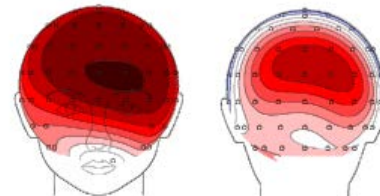
- Phase 2 (aware, task irrelevant)



NCC proper ?

- Frontal activity and P300 *only when* words are task relevant.

- Phase 3 (aware, task relevant)

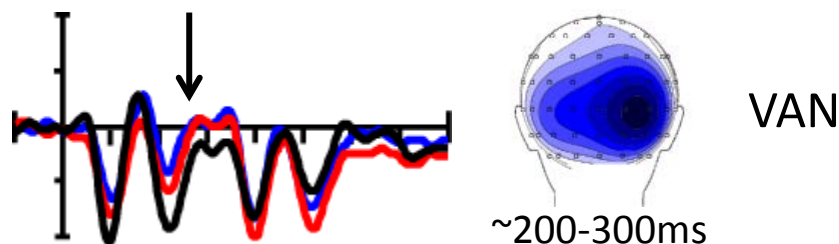


postperceptual
processing

Conclusions & Future Directions

Results consistent with our previous IB experiments (shapes, faces)

- extensive preconscious processing during IB
- wide-spread cortical “ignition” only when percepts are reported
- modest effects related to awareness *per se*



- IB paradigm shows promise for addressing 3 NCC problem
 - results are “theory-of-consciousness-agnostic”
- Try IB paradigm with fMRI, ECoG, TMS, tDCS, fNIRS, etc. ...?

Thank you for your attention and awareness!

Collaborators:

- ❑ **Steve Hillyard**
- ❑ Antígona Martínez
- ❑ Enriqueta Canseco-Gonzalez
- ❑ **Kathryn Schelonka**
- ❑ **Chris Gaulty**
- ❑ Juliet Shafto
- ❑ Jennifer Padwal
- ❑ Daniel Fennelly
- ❑ Stephen Metzler

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- ❑ KIBM
- ❑ NIMH
- ❑ NSF
- ❑ **Reed College**



SCALPLAB

Sensation Cognition Attention Language Perception



WWW.THEASSC.ORG

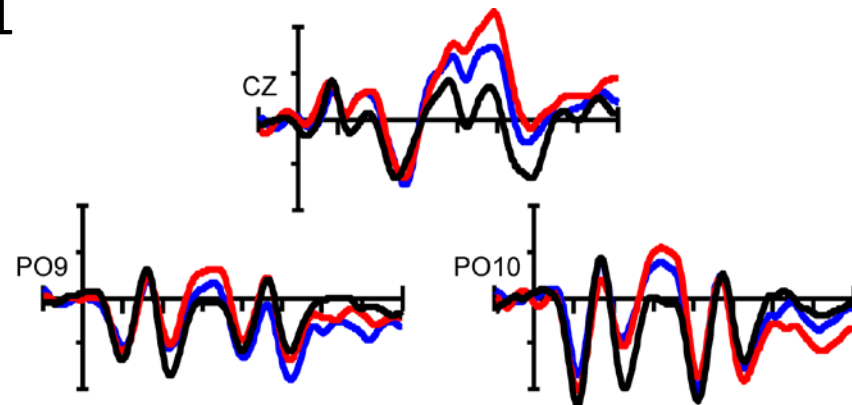
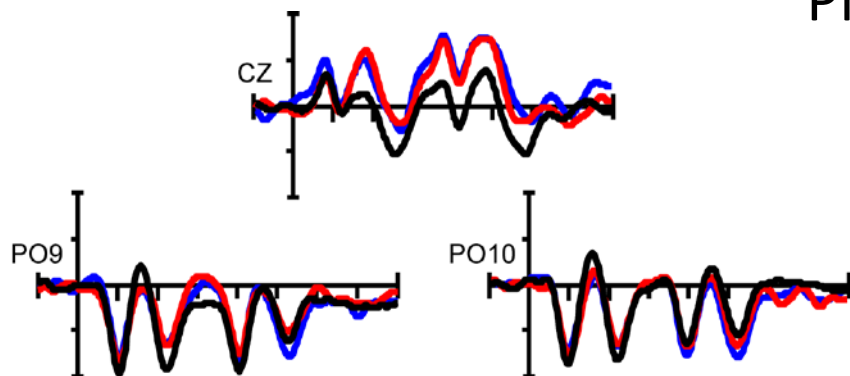
www.reed.edu/psychology/scalp

#ASSC19

IB subjects

Noticer subjects

Phase 1



Phase 2

