Isolating neural signatures of conscious perception with perceptually bistable stimuli

Michael Pitts, Gray Davidson, & Phoebe Bauer
Psychology Department
Reed College

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How to measure brain activity during bistable perception

- Stimuli: static
- Task: press button when perception changes
- Analyze brain activity just prior to button-press. (Basar-Eroglu et al., 1993)
  - ERPs: broad positive wave (P3-like) preceding button-press

- Stimuli: intermittent
- Task: press button when perception changes
- Analyze brain activity elicited by stimulus. (Kornmeier & Bach, 2004)
  - ERPs: compare perceptual change ("reversal") vs. no-change ("stability")
Possible Percept

Stimulus

“reversal negativity” (RN)


*also late positive component (LPC)
Will the RN generalize to other bistable stimuli?

Are the ERP effects (RN & LPC) related to perceiving or reporting the change?

Task: report percept on each trial (instead of reporting perceptual switches)

Pitts et al. (2009) *Psychophysiology*
Possible contrasts in bistable perception studies

- reversal vs. stability
  - neural correlates of *change* in conscious perception
    [control condition: physical alternation]

- percept A vs. B
  - neural correlates of conscious *content*
    [control condition: physical alternation]

- bistable perception vs. physical alternation ("replay")
  - neural correlates of ambiguity/conflict?
Binocular rivalry: percept A vs. B

- C1 = afferent input to V1
- C1 amplitude ↑ for high spatial frequencies

Pitts, Martinez, & Hillyard (2010) *Journal of Vision*
Binocular rivalry: percept A vs. B

Physical Alternation

Task: Do you see Red or Green?

Binocular rivalry: percept A vs. B

Task: Do you see Red or Green?

Binocular Rivalry

Physical Alternation

- High SF Stimulus
- Low SF Stimulus

Binocular Rivalry

- High SF Perception
- Low SF Perception

Pitts, Martinez, & Hillyard (2010) *Journal of Vision*
Face-vase: percept A vs. B

Bauer & Pitts (in preparation)
Face-vase: reversal vs. stability

Bauer & Pitts (in preparation)
Auditory bistable perception?

Stimulus sequence:

- **Trial 1**
  - Tone 1 (400ms)
  - Tone 2 (400ms)
  - ISI (500-900ms)

- **Trial 2**
  - Tone 1 (400ms)
  - Tone 2 (400ms)
  - ISI (500-900ms)

- **Trial 3**
  - Tone 1 (400ms)
  - Tone 2 (400ms)
  - ISI (500-900ms)

Example percepts:

- "Ascending"
- "Descending"

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Davidson & Pitts (2014) *Frontiers in Human Neuroscience*
Auditory bistable perception!

Davidson & Pitts (2014) *Frontiers in Human Neuroscience*
Results summary: stages of processing

Perceptual content
- rIPL
- PRP
- C1
- P1
- feedback-to-V1
- N170
- etc...

Perceptual change
- RN
- aRN
- LPC
- aLPC

Time (msec)
- 0
- 100
- 200
- 300
- 500+

Stimulus-onset
At which stage of processing does perceptual awareness arise? Which are candidate NCCs?

perceptual content
feedback-to-V1
N170 etc...

perceptual change
RN aRN
LPC aLPC

stimulus-onset

Time (msec)
Neural correlates of consciousness or reporting?

  - many studies of conscious perception → reporting-task confounds

- binocular rivalry without report - Frässle et al. (2014) *Journal of Neuroscience*
  - set competing stimuli in motion, in opposite directions
  - measure eye movements (optokinetiic nystagmus, "OKN")
  - verify OKN in report condition, then use in no-report condition
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Next steps...

- Combine Frässle et al.'s OKN method with our rivalry paradigm
  - high SF vs. low SF & reversal vs. stability
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Thank you!

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- Antígona Martínez
- Phoebe Bauer
- Gray Davidson
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