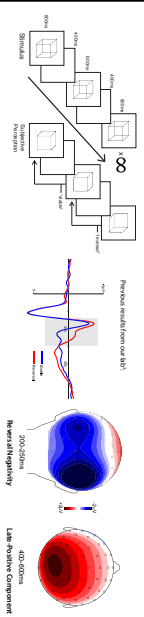




## Background

Bistable figures can be perceived in two mutually-exclusive configurations despite the physical stimulus remaining identical, affording a unique opportunity to isolate brain processes related to subjective perception.

When bistable figures are repeatedly flashed on a screen, reversals of perception occur upon stimulus onset, allowing time-locked EEG to reveal neural signatures related to these reversals?



Two event-related potential (ERP) signatures of perceptual reversals:

**Reversal Negativity (RN):** the primary component of interest, occur between 150-300ms, maximal across right posterior scalp regions, thought to reflect the change in the perceptual configuration of the stimulus

**Late-Positive Component (LPC):** broadly distributed positively ascending the P3a beginning around 350ms, thought to reflect post-perceptual processes such as updating of the current stimulus representation in working memory

Ambiguity exists at many levels of processing from perceptual to conceptual. For example, sentences such as "The chicken is ready to eat" could be considered bistable linguistic/conceptual analogues of perceptually bistable figures.

**Objective: Does a Reversal Negativity occur when one's conceptual interpretation of a bistable linguistic stimulus is reversed?**

## Methods: Participants, Stimuli, EEG

**Subjects (N=24)**

24 healthy, right-handed Reed College students between the ages of 19-24. All participants were native English speakers.

**Stimuli**

Three bistable figures with disambiguated variants

Disambiguated Stimulus



Three bistable sentences with disambiguating images:

"The chicken is ready to eat"



**EEG/ERP Methods**

- 64 channels, equidistant
- 500Hz sampling rate
- Bandpass filter 0.1-150Hz
- 1000 samples per channel
- Average method referenced
- Artifacts rejected > 50µV
- Baseline correction: -200-0ms

"She hit the man with the umbrella."



## Methods: Procedure

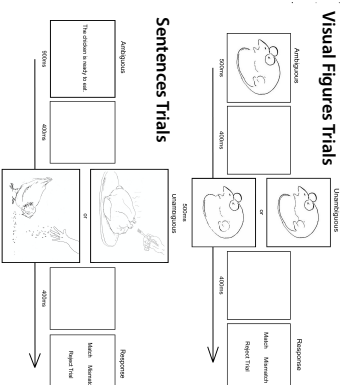
To time-lock EEG recordings to conceptual reversals, we presented an ambiguous sentence followed by a disambiguating image.

No previous EEG studies have employed paired unambiguous-ambiguous stimulus presentation.

→ Necessary to replicate previous findings for visual reversal using this paradigm.

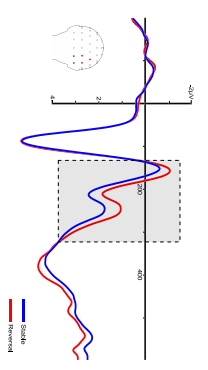
On each trial, the participant forms an interpretation of the ambiguous stimulus and then indicates whether the unambiguous stimulus matches or mismatches this interpretation.

- 6 Bistable stimuli × 3 blocks per stimulus × 180 trials per block = 3240 trials
- One ambiguous stimulus and its variants presented in each block
- Each disambiguating stimulus presented an equal number of times
- Visual and sentence blocks grouped together (VVVSSS-VV-SSS)
- Order of stimuli counterbalanced across participants

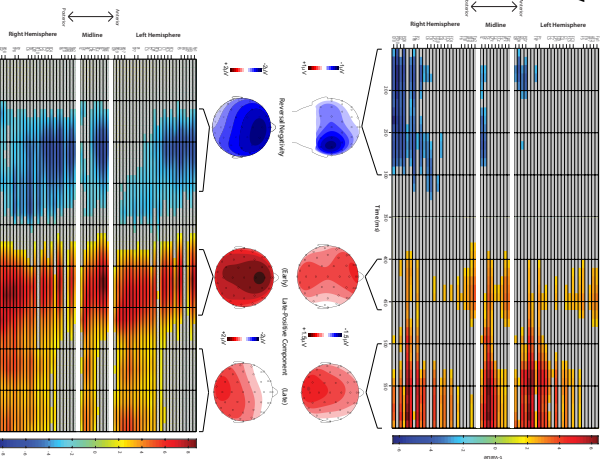
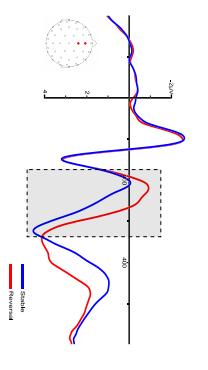


## Main ERP Results and Mass Univariate Analysis

**Visual Figures: Perceptual Reversal Negativity**

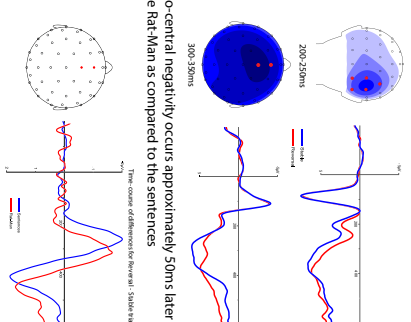


**Sentences: "Conceptual" Reversal Negativity?**



## Rat-Man: A Closer Look

Reversals of the Rat-Man figure resulted in a typical posterior reversal negativity, as well as a subsequent fronto-central negativity similar to that observed for the ambiguous sentences



Fronto-central negativity occurs approximately 50ms later for the Rat-Man as compared to the sentences

## Summary / Discussion

**Main Findings:**

- Replicated Visual RN using novel paradigm, validating our paradigm for use with bistable sentences
- Widespread fronto-central negativity in response to reversals of sentences from 200-350ms
- Maximal at ~275ms vs ~250ms for the Visual RN
- LPC present for visual figures and sentences
- Similar ERPs for all sentences despite different types of ambiguity

**Open Questions:**

- Is this a "conceptual" reversal negativity?
- What is actually being reversed? At what level of representation?
- Is this component sensitive to ambiguity specifically or incongruities of meaning more broadly?
- Why does the Rat-Man display both effects?
- 6/24 participants displayed only a posterior RN with no fronto-central negativity
- Conceptual RN occurs ~50ms later as compared to sentences, a result of visual ambiguity causing longer processing time before semantic information is extracted?

## References

1. Kornmeier, J., & Balcia, W. (2012). Ambiguous figures: What happens in the brain when perception changes? How the Stimulus, Percept, and Response are related. *Frontiers in Human Neuroscience*, 6, 1-12.

2. Kornmeier, J., & Balcia, W. (2014). Early reversal in early N1b/early N2b reflects the processing of a global phenomenon. *Frontiers in Human Neuroscience*, 8, 1-12.

3. Kornmeier, J., & Balcia, W. (2015). Neural correlates of perceptual reversal in a bistable figure. *Reed College*.

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