

## Introduction

What is the role of the right hemisphere in processing metaphors?

One theory suggests that metaphor processing in the RH is part of a more general function of the RH, coarse semantic coding (Beeman, 1998). The LH mediates semantic relationships between words having high semantic feature overlap, whereas the RH activates a broader semantic network of more distantly related words.

## Method

- We used the N400 which is an ERP measure of semantic processing to investigate this question.
- We used a divided visual field (DVF) for the presentation of stimuli. With this method, items presented to the left visual field are initially processed in the right hemisphere (LVF/RH) and items initially presented to the right visual field are processed in the left hemisphere (RVF/LH).

## Participants

- 13 right-handed, native English-speaking undergraduates from Colorado State University; with normal or corrected vision; no history of brain injury, neurological conditions or psychiatric conditions participated for partial course credit.

## Design

### Task

ERPs were collected while participants viewed 120 sentences and responded to corresponding comprehension questions by pressing a response key.

### Procedure

The stem sentences were presented centrally, one word at a time for 28ms per character followed by a fixation symbol in the middle of the screen for 200ms. The sentence final word was then presented to either the RVF/LH or LVF/RH and shown for 200ms. Metaphor, literal and anomalous endings were presented randomly and in equal numbers. Each sentence was then followed by the comprehension question presented centrally for 4s. Participants answered the questions using a response box.

## Equipment & Analysis

**Electrodes:** 128-electrode Electrical Geodesics Inc. cap

**ERP acquisition & Data processing:** EGI Net Station

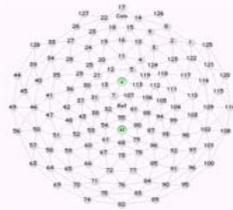
**A/D conversion rate:** 250 samples/sec

**Epoch:** From 100 ms before the stimulus appeared on screen till 600 ms after.

**Data Analysis:** Data analyzed from electrodes 6(close to Fz) and 62(close to Pz)

**Reference:** Average

**Eye blink detection:** Rejected epochs that exceeded 80  $\mu$ V.



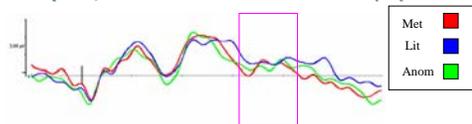
ERP Sites Analyzed (shown in green)

## Hypothesis

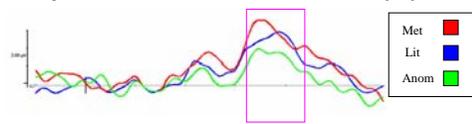
It was predicted that metaphor and anomalous endings presented to the right visual field (RVF/LH) will produce larger N400 amplitudes than the literal endings. When presented to the left visual field (LVF/RH) the endings will produce equal or smaller N400 amplitudes. A similar finding has been obtained with jokes, which are also thought to recruit the right hemisphere (Coulson & Williams, 2004).

## Results – N400 Effects

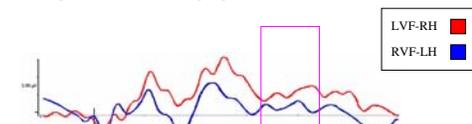
### Metaphor, literal & anomalous N400-ch6 (Fz)



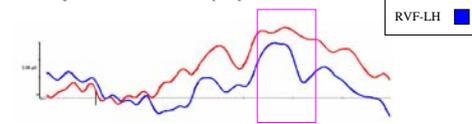
### Metaphor, literal & anomalous N400-ch62 (Pz)



### Metaphor N400-ch6 (Fz)



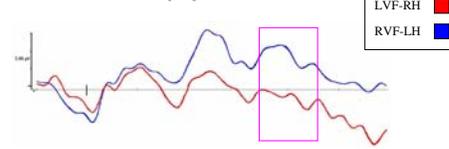
### Metaphor N400-ch62 (Pz)



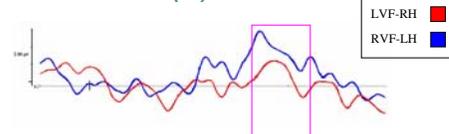
- The metaphor sentences produced a larger N400 effect in the left hemisphere.
- The right hemisphere produced a smaller N400 effect for metaphors which provides support for the notion that the RH is specialized for processing metaphors



### Literal N400-ch6 (Fz)

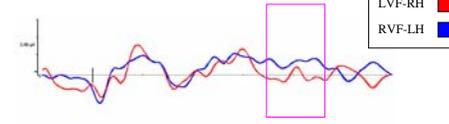


### Literal N400-ch62 (Pz)

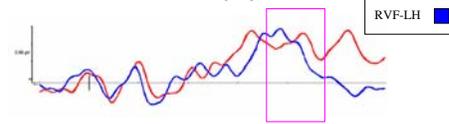


- The literal sentences produced a larger N400 effect in the right hemisphere which was the opposite effect found with metaphors.

### Anomalous N400-ch6 (Fz)

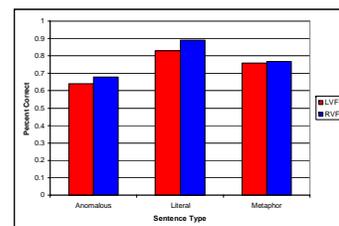


### Anomalous N400-ch62 (Pz)



- Sentences with anomalous endings produced mixed results across the scalp.

## Results – Comprehension Questions



- No significant differences in comprehension questions between the left and right hemispheres.

## Discussion

It has long been known that language processing is lateralized to the left hemisphere (LH) of the brain in most right-handed individuals. However, recent work has highlighted the possible contribution of the right hemisphere (RH) to various aspects of language processing, including metaphor processing.

It is also known that the N400 amplitude correlates with increasing semantic processing difficulty, including the processing of stimuli such as metaphors or even jokes (Coulson & Williams, 2004).

Our findings supported this:

- Larger N400 amplitudes were found for metaphors compared to literal sentences processed initially by the left hemisphere (RVF/LH).
- When presented to the left visual field (LVF/RH), the metaphors produced equal or smaller N400 amplitudes.
- This suggests that the right hemisphere has less trouble processing the metaphors.
- These findings support the coarse semantic coding hypothesis and the notion that the RH is specialized for processing metaphors and has a unique contribution to language processing.

This idea is also supported by neuropsychological work with RH damaged populations (Brownell et al., 1990), divided visual field studies (Anaki, Faust & Kravetz, 1998), positron emission tomography work (Bottini et al., 1994), and preliminary fMRI work (Rapp et al., 2001).

## References

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