Distinct neural processes engaged during temporal sequencing and coherence building in discourse
Wonja M. Fairbrother1, Martin Paczynski1, Eric C. Fields12,3, Gina R. Kuperberg12,3

1 Department of Psychology, Tufts University, 2 MGH/HMS Athinoula A. Martinos Center for Biomedical Imaging, 3 Department of Psychiatry, Massachusetts General Hospital

Introduction
In the real world, causes always come before effects. During communication, however, events can be described in either this canonical temporal order using causal connectors such as “and so”, or in non-canonical order using connectors like “because”. Using event-related potentials (ERPs), we determined when causal coherence is established for events presented in and out of canonical sequence, during online discourse processing.

Our Questions:
1. Does causal coherence, established at the situation level, influence lexico-semantic processing of upcoming words?
2. Are the mechanisms that establish causal coherence and temporal ordering across events distinct from one another?
3. Are either of these mechanisms specifically influenced by readers’ general verbal working memory capacity?

Critical Word

**A. Effect of Coherence**

An anteriorly distributed negativity effect between 400-500ms to mid-sentence critical words. This effect was not modulated by causal coherence.

**B. Effect of Canonicity**

A centro-posterior N400 effect to causally incoherent (versus coherent) mid-sentence critical words.

Results

**Sentences**

- **Coherent**: Fred was hungry because he had a meal.
- **Incoherent**: Fred had a meal because he was hungry.

**Sentence Final Word**

- **Coherent**: ... so he had a meal that afternoon.
- **Incoherent**: ... because he was hungry that afternoon.

Presentation & Recording

- **Stimuli**
  - Canonical Order: Fred was hungry and so he had a meal.
  - Noncanonical Order: Fred had a meal because he was hungry.

- **45 scenarios per condition**
- **45 non-causal filler sentences per list**
- **Stimuli matched for LSA, frequency, and length**

**Design**

- **Causally coherent Causally incoherent**
- **Presentation & Recording**
  - High WM Span: 450 ms (100 ms ISI)
  - Low WM Span: 500 ms (100 ms ISI)
- **Working Memory**
  - High WM Span: 300-500ms, averaged across electrodes within the prefrontal region of interest. This effect was seen on both the critical word and the sentence-final word. It was not modulated by either Canonicity or Causal Coherence.

Conclusions

1. Causal coherence, established at the situation level, influences lexico-semantic processing of upcoming words during word-by-word discourse comprehension. Additional neurocognitive processes are recruited when causal incoherence is unambiguously established using a causal connector.
2. The neurocognitive mechanisms that establish causal coherence and temporal ordering across events are distinct and do not interact with one another.
3. Neither of these mechanisms are specifically influenced by readers’ general verbal working memory capacity. Rather, increased working memory capacity may more generally enhance top-down attentional influences on perceptual processing of upcoming words in discourse.

Working Memory

**A. Effect of Coherence**

A posteriorly distributed Late Positivity effect to causally incoherent (versus coherent) mid-sentence critical words.

**B. Effect of Canonicity**

A widely distributed prolonged N400 effect to sentence-final words in causally incoherent (versus coherent) scenarios.

References


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After ERP recording, participants’ working memory span was measured with a modified Automated Reading Span (RSPAN) Task using letter recall accuracy as a dependent measure.