Prediction failure blocks the use of local semantic context

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Introduction & Background

Predictive Mechanisms in Language Comprehension

- Early theories of predictive mechanisms in language comprehension were abandoned.
- Prediction is too prone to failure and too costly to be of use (Fischler & Bloom, 1980; Forster, 1981; Gough, Allford, & Holley-Wilcoxon, 1981; Morris, 2006; Stanovich & West, 1981, 1983).
- More recent evidence has put prediction on firmer empirical footing (see Kutas, DeLong, & Smith 2011 and Van Petten & Luka 2012 for review).
- But unaddressed are the early questions about prediction as a costly mechanism.

Questions

- What are the costs of prediction failure?
- How does the comprehension system recover from failed predictions?

Prediction and Prediction Failure

Prediction

- Speeds reading times (Ehrlich & Rayner, 1981; Rayner, Ashby, Pollatsek, & Reichle, 2004).
- Reduces N400 amplitude (Kutas & Hillyard, 1984; Kutas, Lindamood, & Hillyard, 1984).

Prediction Failure

- Slows response times (Schwanenflugel & Shoben, 1985).
- Increases N400 amplitude.
- Elicits late frontal potentials (DeLong et al., 2011; Federmeier et al., 2007; Otten & van Berkum, 2008).
- Diminishes when the proportion of successful predictions is low (Lau, Holcomb, & Kuperberg, 2013), suggesting ongoing costs.
- Question: What kind of processing deficits underlie this reduction in use of predictive mechanisms?

Potential Recovery Mechanisms

The Present Study

- We test whether the parser continues to use local context to make predictions when it is recovering from a recent prediction failure.

Rapid Recovery

- Prediction failure is not costly to the system.
- Immediate use of local semantic context to facilitate a new word regardless of recent prediction failure.

Protracted Recovery

- Prediction failure is costly, requiring time for the system to recover.
- No use of local semantic context to facilitate a new word following prediction failure.

Event Related Potentials

Method

Design

- Word-by-word rapid serial visual presentation. 30 native Italian speakers. 40 items. 200 fillers.
- 2 Article Gender (Congruent [0.76 avg. cloze] vs. Incongruent) x 2 Adjective (Predictive [0.92 avg. trans. prob.] vs. Neutral).

- Congruent: Il poliziotto è andato in pensione, dopo aver prestato per anni…
- Incongruent: Il sollevamento pesi serve a sviluppare non la resistenza, ma…
- Weighting aims to increase not endurance, but…(Predict: strengthless)

Predictive: un nosoro
Neutral: un onora

Eroencephalography

- 64 channel ANT Neuro system
- ERPs were timelocked to the noun onset, window -200 to 1000 msec.
- Filtering 0.01-30 Hz, re-referenced to average, baseline corrected, artifact rejection at >35%

Summary

When Predictions are Successful

- Target nouns occurring after predictive adjectives were less negative than after neutral adjectives when article gender was congruent with the predictive context.
- Local semantic context is used while prediction is successful.

When Predictions Fail

- Target nouns occurring after predictive and neutral adjectives did not significantly differ when article gender was incongruent with the predictive context.
- Prediction failure blocks the use of local semantic context.

Conclusions

Costs of Prediction Failure

- Prediction is not a cost free mechanism.
- Processing slowdowns (though fragile) and late frontal ERPs suggest that prediction failure may have an immediate cost.
- But there are also additional ongoing costs to prediction failure.

Implications for Recovery Mechanism

- Recovery from prediction failure is not immediate.
- Recovery is a protracted process.

Potential Recovery Mechanisms

Selected References