Recovering from syntactic and semantic violations: The relationship between eye movements and brain responses

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Introduction

Integration difficulties in sentence processing elicit:

> Longer gaze durations and regressive saccades
> N400s and P600s in the ERP

These results are difficult to reconcile because sentences are typically presented in an auto-paced word-by-word paradigm (RSVP) in ERP studies. We recorded eye movements and EEG in natural reading to answer the question:

What is the relationship between these effects?

Design

Syntactic and semantic violations in medial and final position (adapted to German from [1]):

Medial: The$_{MASC/FEM}$ deteriorating/investigative **farm**$_{MASC}$ needs repairing.

Final: The experienced star plays the$_{FEM/NEUT}$ difficult/electric **role**$_{FEM}$.

Participants read these sentences in RSVP (N=24) or naturally from left to right (N=48). Eye movement artifacts were removed with Independent Component Analysis [2]. ERPs were analyzed with randomization tests [3].

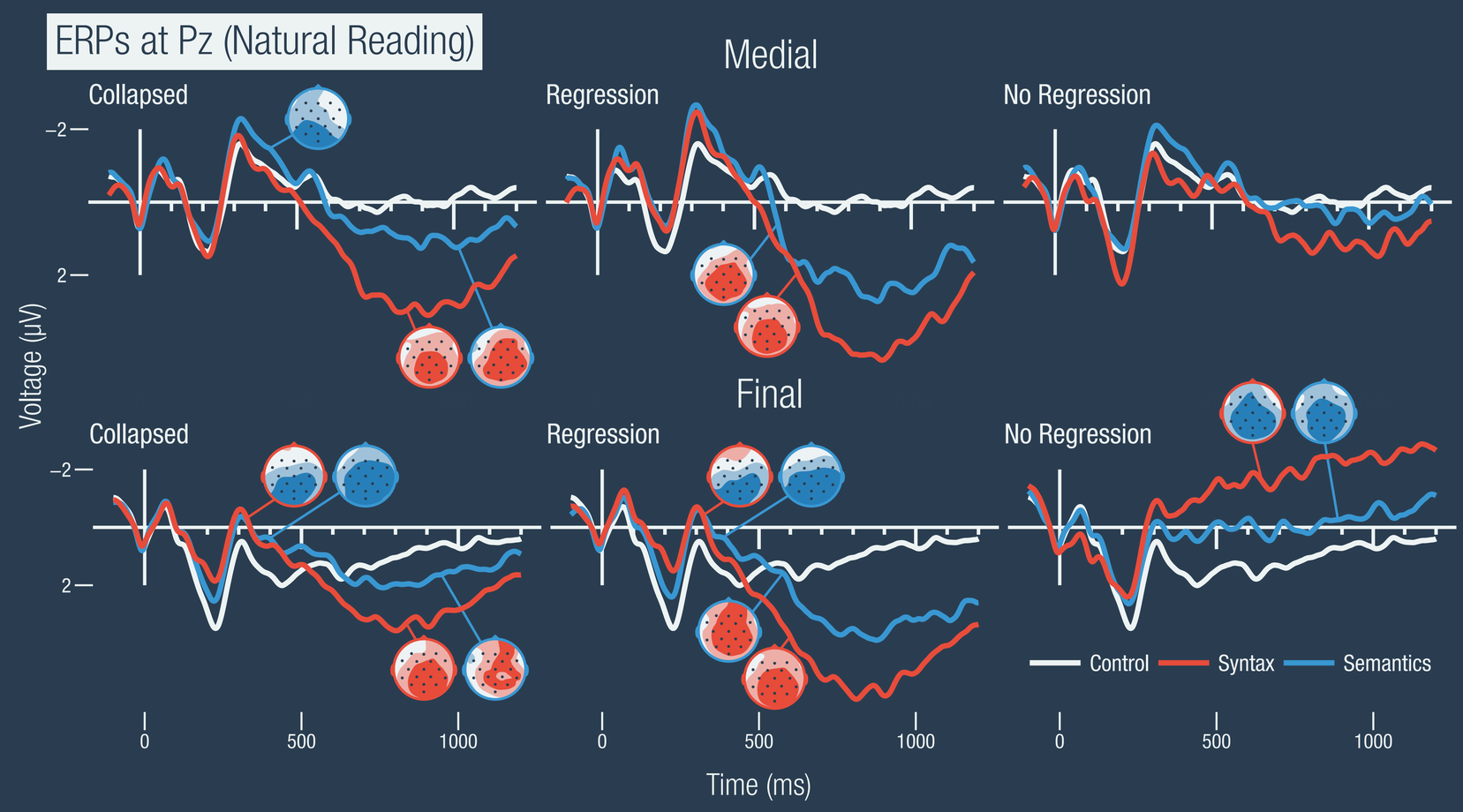
Eye Movements

	Baseline	Syntax	Semantics
Regressions			
Medial	16%	51%	30%
Final	35%	69%	55%
Gaze Duration			
Medial	338 ms	361 ms	379 ms
Final	315 ms	302 ms	339 ms

ERP

	RSVP		Natural Reading	
	Syntax	Semantics	Syntax	Semantics
Medial	P600	N400	P600	N400 P600
Final	N400 P600	N400 P600	N400 P600	N400 P600

ERPs at Pz (Natural Reading)



Separate analyses uncovered different brain responses to a violation depending on whether it elicited a regression:

> P600 or N400-P600 when violation elicited regression
> No effects in sentence-medial violations without regression
> Sustained centro-parietal negativities in sentence-final violations without regression

Summary

> Regressions are strongly associated with the P600, which is an indicator of recovery processes
> When readers do not make a regression, they may try to make sense of the sentence without exploring alternative interpretations

References

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