

Affectedness as a factor in online sentence processing: ERP data

1. Linguistic Backgrounds – Events & Affectedness in Language

Different kinds of events

- 1) a. The **doctor** greeted the **boy**. → no change implied for the *boy*
- b. The **doctor** treated the **boy**. → the *boy* potentially changes
- c. The **doctor** cured the **boy**. → the *boy* necessarily changes

- Verbs imply different degrees of change of state (= ‘affectedness’) for object arguments. Affectedness is a central element of linguistic theory at the semantics/syntax interface [1] & for the linking of verbs and their arguments.

Affectedness & acceptability patterns in German nominalisations (cf. [2])

2) Context: The doctor (a) greeted / (b) treated / (c) cured the boy.

- Continuation: a. Die Begrüßung des **✓Jungen** / **✓Arztes** ...
 the ‘greeting’ the_{Gen} **boy’s** / **doctor’s**
- b. Die Behandlung des **✓Jungen** / **≈Arztes** ...
 the ‘treatment’ the_{Gen} **boy’s** / **doctor’s**
- c. Die Heilung des **✓Jungen** / **??Arztes** ...
 the ‘cure’ the_{Gen} **boy’s** / **doctor’s**

Affectedness

low

mid

high

* Which impact does affectedness as a linguistic interface phenomenon (semantics ↔ syntax) have on

- a. Lexical-semantic processing? → Nominalisation segments (not presented here)
- b. Processing of predicate/argument linking? → Genitive segments (‘boy/doctor’)

Affectedness

low

mid

high

* Which ERP components does this interface processing correlate with? → Discussion about ‘division of labour’ between

- ‘Lexicon/Meaning’ (N400)
- ‘Structural integration’ (P600)
- ‘Semantic composition’ (‘Anterior Midline Field’ found in MEG studies [3])

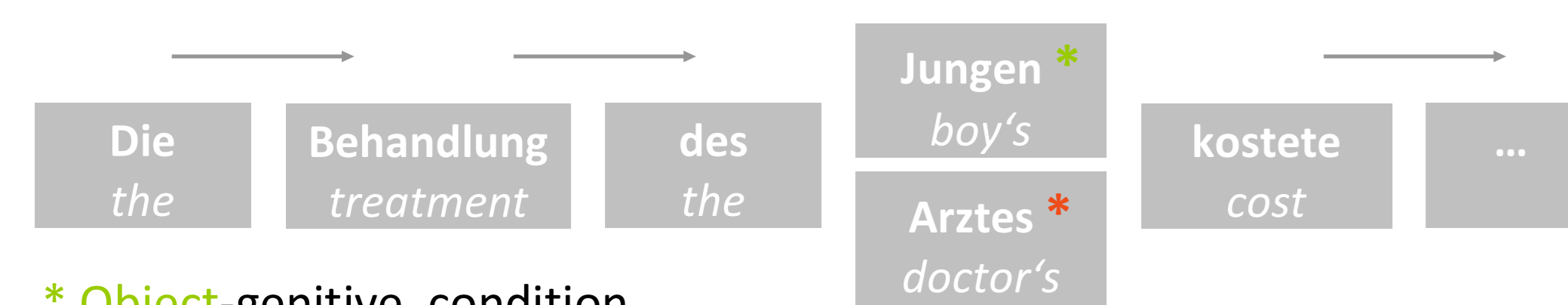
3. ERP-Experiment

Trial-structure & task

1. Context sentence

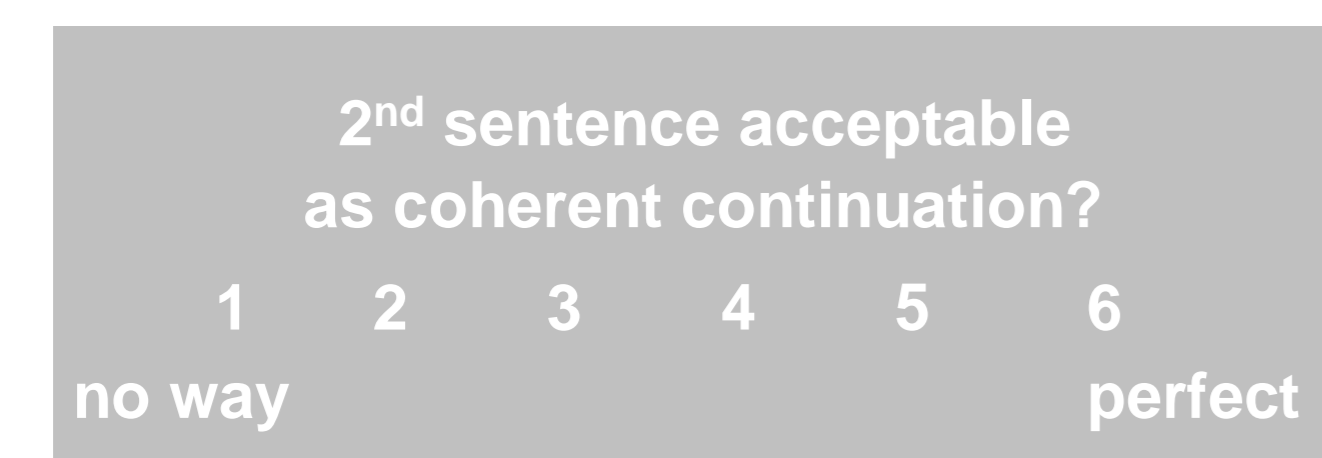
Der Arzt verwendete beim dem Jungen eine neue Methode.
 the doctor used with the boy a new method

2. Continuation sentence (RSVP – 600ms SOA)



- * Object-genitive condition
- * Subject-genitive condition

3. Acceptability rating



Materials & participants

- 84 ung-nominalisations of different affect. levels
- Each in both conditions → 168 sentence pairs
- Affectedness levels rated by native speakers
- 26 German native speaking participants

Analysis

- Segments on genitives (-200/1200 ms)
- 16 regions of interest, average reference
- Bayesian wavelet-based functional mixed model [4, 5] via custom-programmed R-interface
- Covariates of interest:
 - a. Genitive interpretation (object vs. subject)
 - b. Affectedness-level of nominalisations (numeric)
 - c. Rating (numeric)
 - d. Interactions of a:b & a:c
- Random effect for participants
- Control covariates:
 - * Word length & frequency, list position ...

Affiliations

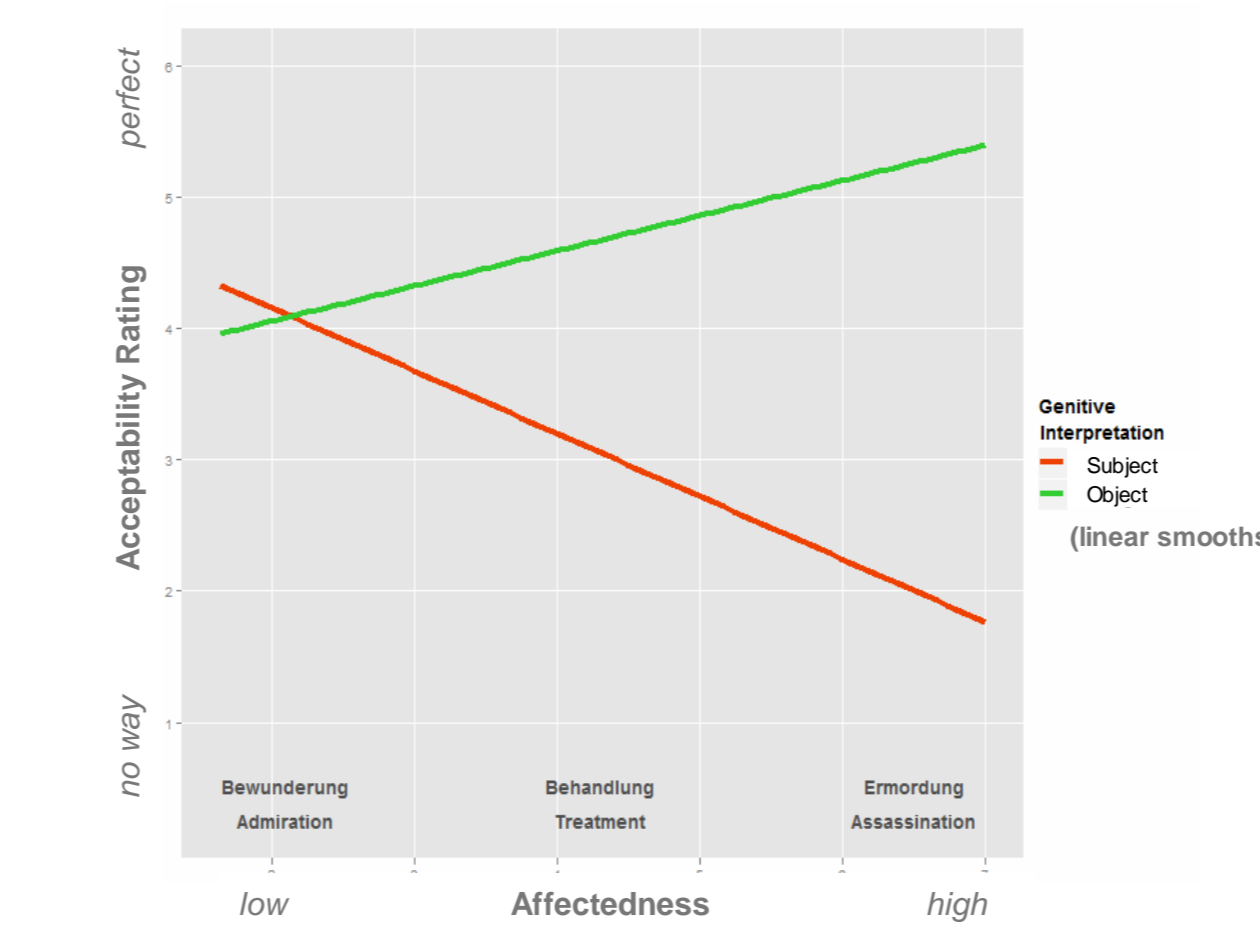
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References

- [1] Beavers, J. (2011). On Affectedness. *Natural Language and Linguistic Theory*, 29, 335-370.
- [2] Ehrich, V., & Rapp, I. (2000). Sortale Bedeutung und Argumentstruktur: ung-Nominalisierungen im Deutschen. *Zeitschrift für Sprachwissenschaft*, 19, 245-303.
- [3] Pylkkänen, L., & McElree, B. (2007). An MEG Study of Silent Meaning. *Journal of Cognitive Neuroscience*, 19, 1905-1921.
- [4] Morris, J.S., & Carroll, R.J. (2006). Wavelet-Based Functional Mixed Models. *Journal of the Royal Statistical Society, Series B*, 68, 179-199.
- [5] Davidson, D.J. (2009). Functional Mixed-Effect Models for Electrophysiological Responses. *Neurophysiology*, 41, 71-79.
- [6] Kaan, E., & Swaab, T.Y. (2003). Repair, Revision and Complexity in Syntactic Analysis: An Electrophysiological Differentiation. *Journal of Cognitive Neuroscience*, 15, 98-110.

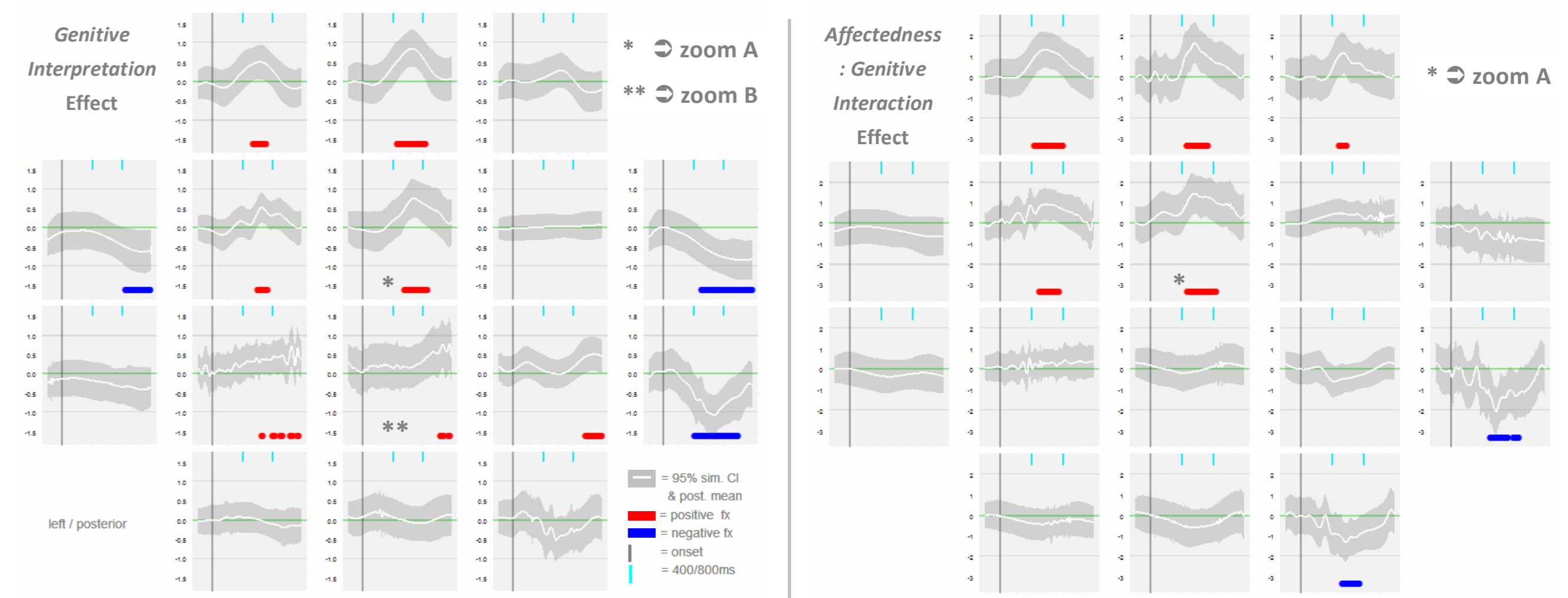
2. Questions

4a. Results – Ratings



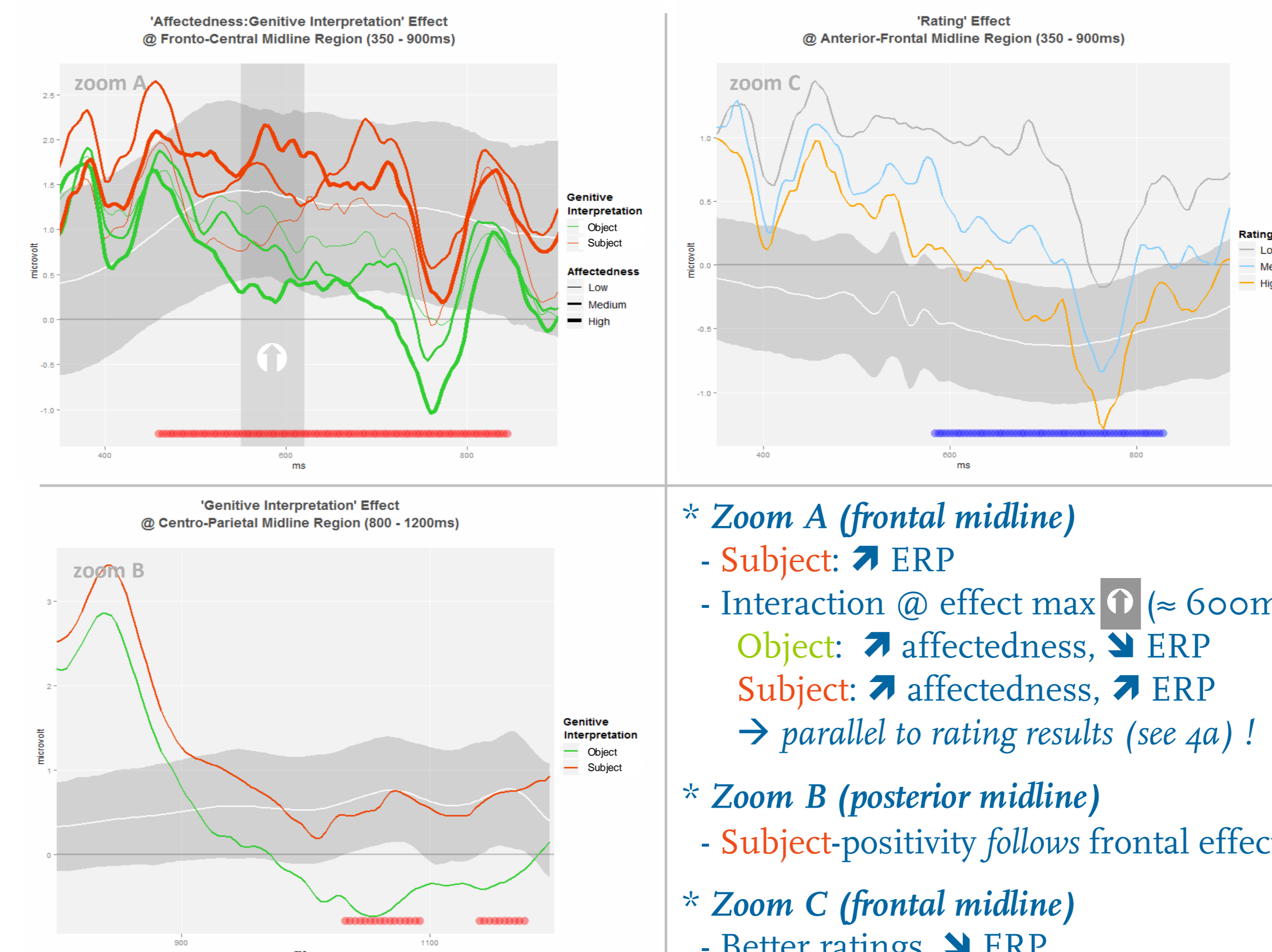
- * Object-genitives better accepted than subject-genitives
- * Interaction ‘Genitive:Affectedness’
 - Objects ↗ affectedness, ↗ ratings
 - Subjects ↗ affectedness, ↘ ratings
- * Equal acceptability at low levels of affectedness

4b. ERP Results – Selected Effects Across Regions of Interest



- * Genitive Interpretation effect
 - Frontal positivity for Subject-Genitives @ left/midline ROIs (≈ 550-850ms)
 - Later posterior positivity (≈ 1030ms –)
- * Affectedness:Genitive Interaction effect
 - Positivity @ frontal left/midline ROIs (≈ 460-800ms), no posterior positivity
- * Rating effect (coded bad to good!)
 - Frontal midline neg. (≈ 500-850ms)
 - Parallel/later posterior effects

4c. ERP Results – Zooms



- * Zoom A (frontal midline)
 - Subject: ↗ ERP
 - Interaction @ effect max (≈ 600ms)
 - Object: ↗ affectedness, ↘ ERP
 - Subject: ↗ affectedness, ↗ ERP
 - parallel to rating results (see 4a) !
- * Zoom B (posterior midline)
 - Subject-positivity follows frontal effects
- * Zoom C (frontal midline)
 - Better ratings, ↘ ERP

5. Summary

- * Depending on genitive interpretation, affectedness had differential impact on linking process, reflected by
 - Ratings & frontal ERP-component
- * Ratings and frontal ERP-patterns are consistent with each other & with independent reading time data
- These ERP effects are in P600 time window, but with frontal distribution
 - Related to semantic composition (AMF – [3]) or discourse complexity [6], mediated by affectedness?
 - Influence of task?
- * Posterior positivity follows frontal one & does not show interaction pattern
- * No effect on N400 !