Go High or Go Low: Adaptation to Different Error Distributions in Sentence Processing

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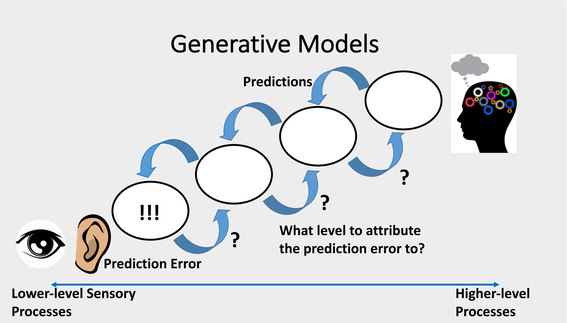
Background & Question

- Processing draws on expectations based on previous experience (for review, see Kuperberg & Jaeger, 2016).
- When violated by the input, these expectations seems to be adaptable (Dell & Chang, 2013; Jaeger & Snider, 2013), e.g., reflected in lexical (Brown-Schmidt, 2009; Creel et al, 2008) and syntactic processing (Fine et al, 2013; Kaschak & Glenberg, 2004; Ryskin et al., 2017).
- But what determines to what level of the predictive process an unexpected observation is attributed?



Adaptation to Garden-path Sentences

Garden-path Sentences: Longer reading times for the disambiguation region when it does not confirm the expected parse (e.g. a **Relative Clause** parse when expecting a **Main Verb**)

a) The experienced soldiers warned about the dangers **before the midnight** raid. (**MV /Ambiguous**)
b) The experienced soldiers warned about the dangers **conducted the midnight** raid. (**RC /Ambiguous**)
c) The experienced soldiers warned about the dangers **before the midnight** raid. (**MV/Unambiguous**)
d) The experienced soldiers warned about the dangers **conducted the midnight** raid. (**RC/Unambiguous**)

Garden-path (GP) Effect: **Structure** (**MV** vs. **RC**) * **Ambiguity** (Ambiguous vs. Unambiguous)

Adaptation in Garden-path Sentence Processing: With increasing exposure to RCs, the GP effect on RCs decreases.

Adaptation Effect: **GP Effect** * **Item Order** (number of critical trials read so far)

Predictions

Question: Do only syntactic expectations change or can comprehenders condition lexical expectations on these adapted syntactic expectations?

Exp. 1:
- Critical sentence (**MV** or **RC**) disambiguated with **different** words so that prediction error can only lead to adjustment at the level of syntactic processing.

Prediction:
- Adaptation will more likely occur for second-pass but not first-pass reading times.

Exp. 2&3:
- Critical sentences (**MV** or **RC**) disambiguated with **same** words ('**and**' & '**became**' in 2; '**before**' & '**became**', in 3).

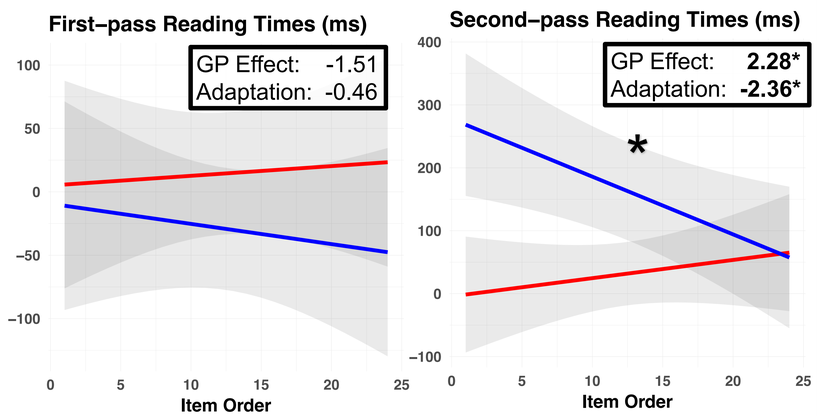
Prediction:
- If comprehenders can adapt syntactically-conditioned lexical expectations → adaptation of first- and second-pass reading times
- If not → only adaptation of second-pass reading times

Discussion

- Replicated (three times) syntactic adaptation during natural reading → **syntactic adaptation not artifact of self-paced reading**
- Even when prediction error informative about lexical statistics → **no adaptation of first-pass reading times**
- Why?
  - First-pass measures less malleable (but see Yan & Farmer, 2015);
  - Lexical expectations are not adaptive (unlikely: Creel et al, 2008, Yan & Farmer, 2015)
  - Syntactically-conditioned lexical expectation are not adaptive either because
    - There are limits to adaptation (tractability)
    - The utility of such adaptation is low (low informativity, or variance in informativity, of syntactically-conditioned lexical expectation)
- **Future directions**: will increase in the need to rely on top-down predictions (e.g. with degraded stimuli) lead to adaptation in lexical/pre-lexical processing emerge with the same paradigm?

Exp. 1: Not Repeating Words of Disambiguation

The experienced soldiers …
… (**a variety of lexicalization**)... (**MV /Ambiguous**)
… (**a variety of lexicalization**)… (**RC /Ambiguous**)
… (**a variety of lexicalization**)… (**MV/Unambiguous**)
… (**a variety of lexicalization**)… (**RC/Unambiguous**)

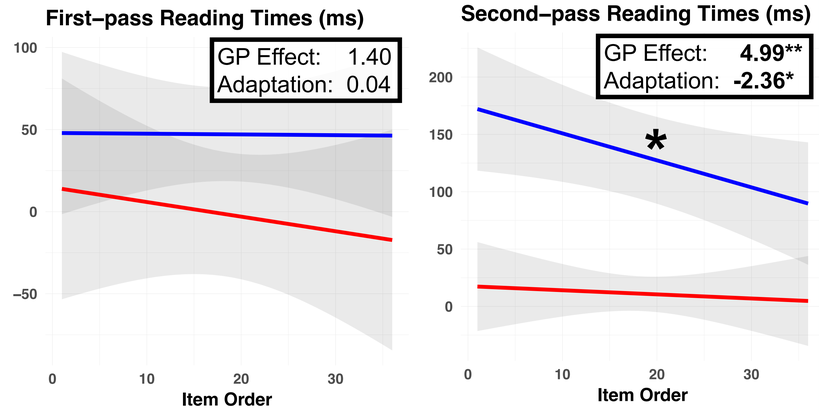


24 Critical Trials, 72 Fillers, 93 Subjects

Figure 1: Ambiguity effect on disambiguation region by Structure as a function of Item Order (Adaptation effect). (*, p < .05, **, p < .01). Analyses on words of disambiguation exhibit the same pattern.

Exp. 2: Repeating Words of Disambiguation ('became' & 'and')

The experienced soldiers …
… **and** returned to camp. (**MV /Ambiguous**)
… **became** worried about them. (**RC /Ambiguous**)
… **and** returned to camp. (**MV/Unambiguous**)
… **became** worried about them. (**RC/Unambiguous**)

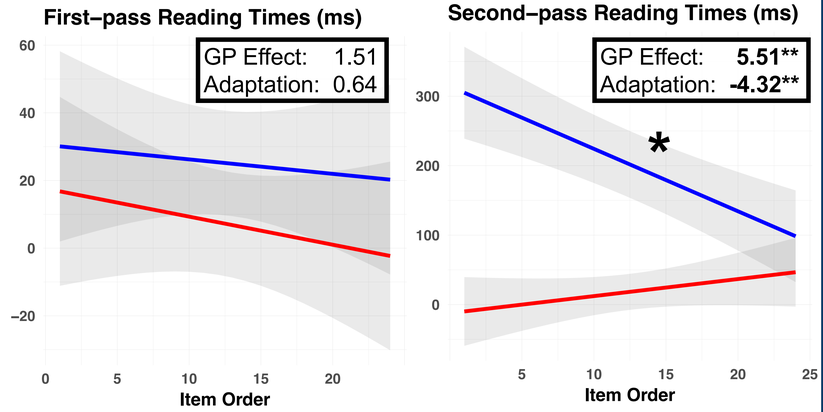


36 Critical Trials, 84 Fillers, 60 Subjects

Figure 2: Ambiguity effect on words of disambiguation ('became' & 'and') by Structure as a function of Item Order (Adaptation effect). (*, p < .05, **, p < .01).

Exp. 3: Repeating Words of Disambiguation ('became' & 'before')

The experienced soldiers …
… **before** the midnight raid. (**MV /Ambiguous**)
… **became** worried about them. (**RC /Ambiguous**)
… **before** the midnight raid. (**MV/Unambiguous**)
… **became** worried about them. (**RC/Unambiguous**)



24 Critical Trials, 72 Fillers, 91 Subjects

Figure 3: Ambiguity effect on words of disambiguation ('became' & 'and') by Structure as a function of Item Order (Adaptation effect). (*, p < .05, **, p < .01).