

Syntactic-Adaptation vs Task-Adaptation: The Case of Object Relative Clauses

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Syntactic Adaptation

Comprehenders have been argued to rapidly adjust to the statistics of the syntactic environment:

Fine et al. (2013) found that susceptibility to garden paths decreased relative to the number of similar garden path sentences a subject had already seen

Fine et al. characterize this syntactic adaptation as

- **Rapid and Incremental:**
→ trial-to-trial adaptation
- **Statistically Sensitive:**
→ processing difficulty scaled to Surprisal of a syntactic structure in the local environment

Object Relative Clauses (ORCs)

- ORCs are read slower than Subject RCs (Gordon, Hendrick, Johnson, 2001)

The chef [that **the waiter** **distracted** ____] poured...

High Surprisal Retrieval

- Staub et al. (2016) argued that ORC difficulty is best understood via Surprisal
 - Found primary difficulty at Relative NP
 - Makes ORCs an attractive test for statistically-based adaptation
- Wells et al. (2009) found exposure-based facilitation similar to Fine et al. for ORCs in SPR
 - However, Wells et al.'s findings are
 - **Not fully incremental:** consist of pre- and post- test values
 - **Long-term:** four sessions
 - Show the statistically-sensitive ORC vs SRC interaction **only at the Main Verb** (much later than Staub et al.)
 - potentially subject to SPR task-based strategies

Task-Effects in Self-Paced Reading

Fine et al. and Wells et al. rely on **Self-paced reading** (SPR)

SPR is unpracticed, with substantial variation in **task strategies** and additional risk of **task-specific mis-parsing**:

- Artificially slow compared to natural reading
- Additional reliance on regions as guides to prosodic/syntactic grouping (Adams et al. 1998)
- Lack of regression and parafoveal information contributes to deviance from natural reading

But, natural reading is a highly practiced skill for educated, adult subjects

- Relatively little strategic variation between subjects

→ Syntactic Adaptation should be tested in Eyetracking

Present Analysis

The present analysis attempts to replicate and extend Wells et al. using eyetracking data from Staub, Dillon, Clifton (2016) to look for the **rapid, incremental, and statistically-sensitive** adaptation suggested by Fine et al.

Analysis Overview

Prediction: Statistical Syntactic Adaptation should manifest as an interaction of ORDER X RC TYPE (facilitation for later ORC trials, but reduced or no facilitation for SRCs), because:

- Relative NP region of an ORC disambiguates to an ORC structure → NP has high syntactic Surprisal
 - Many ORCs in the environment should lead to reduced Surprisal of resolving to an ORC and faster reading times
- NP region in SRCs does not disambiguate any syntactic information → SRC NP has low syntactic Surprisal
 - Smaller margin for improvement

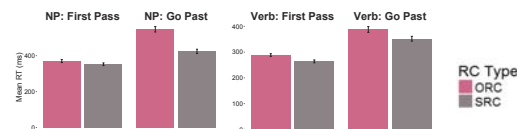
- (1) a. **ORC:** The chef [that the waiter distracted ____] poured the flour onto the counter.
b. **SRC:** The chef [that ____ distracted the waiter] poured the flour onto the counter.

ORDER: The number of tokens a participant had seen from that construction (ORCs count for ORCs, but not for SRCs)

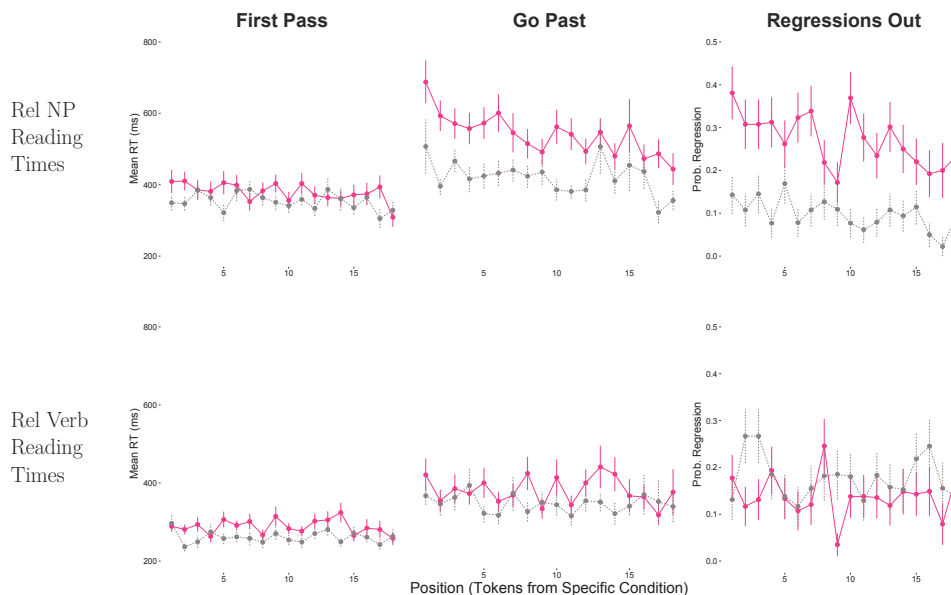
Prior Findings from Staub et al. (2016)

- Substantial ORC penalty at Relative NP, significant in both First Pass and Go Past
- Smaller ORC penalty at Relative Verb, but still present

Conclusion: In line with Expectation-based theories, the locus of difficulty in ORCs is on the NP



Order Analysis



Main Effects:

- ORDER effect is significant in Go Past at the NP ($\beta = -5.19, SE = 1.7$)
- RC TYPE is significant at the Rel NP in First Pass ($\beta = 18.66, SE = 9.14$) and Go Past ($\beta = 117.35, SE = 13.53$)
- Neither ORDER or RC TYPE are significant at the Verb Region in First Pass or Go Past

Crucial Interaction:

		β	Std.Error	t
Combined	NP First Pass	-0.51	1.26	-0.41
Data	NP Go Past	-3.09	2.59	-1.19
	V First Pass	0.53	1.01	0.52
	V Go Past	0.63	2.18	0.29
Exp1	NP Go Past	-4.08	3.06	-1.33
Exp2	NP Go Past	-0.74	4.55	-0.16

Summary of Results

- Later trials do show faster reading times
- **No evidence that trial order effect differed for ORCs vs SRCs**
Contra predictions of a statistically-based account
- Additionally, adaptation effects are concentrated in regression-based measures [Go Past, p(regression)]
 - Consistent with less revision, rather than ease constructing an initial analysis
 - Potentially surprising for Expectation-based theories
- Relative NP is more sensitive to ORDER effects than the Verb

Potential Reasons for Divergence from Previous Work

The present results differ from both Fine et al. (2013) and Wells et al. (2009)

- Adaptation in previous studies may have been specific to SPR
- Adaptation may not apply equally to all constructions

Fine et al.: MainV / RelativeV Garden Path
Wells et al. and Current Data: ORCs vs SRCs

Perhaps ORCs have slower adaptation than Garden Paths

- Surprisal difference between ORCs and SRCs may be too small to observe the crucial interaction
- OR
- Syntactic adaptation may be restricted to particularly difficult or ambiguous sentences

Conclusion

- No evidence for statistically-based adaptation for ORCs vs SRCs in naturalistic reading
- Currently, task adaptation and experimental fatigue are sufficient to explain apparent priming for ORCs
 - Although, priming by structure-activation is still a possible explanation

Future Work

- Eyetracking experiment with multiple measures of experimental fatigue, to isolate any adaptation
- Comparison of adaptation-potential of ORC/SRCs with other syntactic constructions
- Direct comparison of ORC adaptation in comprehension to production adaptation

References

[1] Fine, Jaeger, Farmer, Qian. (2013). *PLoS one*. [2] Gordon, Hendrick & Johnson (2001). *JEP*. [3] Staub, Dillon, & Clifton. (2016). *Cognitive Science*. [4] Wells, Christiansen, Race, Acheson & MacDonald. (2009). *Cognitive Psychology*. [5] Adams, Clifton, & Mitchell. (1998). *Psychonomic Bulletin & Review*.

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