Fool me once: Readers "adapt" to NP/Z garden paths but not ORCs

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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 reading times on disambiguating material in garden path sentences decreased as a function of 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

Current: Does adaptation obtain when compared to both within and between subject frequency controls?

Adaptation Predictions

Adaptation studies most commonly use garden paths (Fine et al., 2013; Tooley & Traxler, 2018) or Object Relative Clauses (Wells et al., 2009)

- e.g., Wells et al. exploit the fact that Object RCs, (1), are read slower than Subject RCs

(1) The chef [that **the waiter** **distracted** ___] poured...
High Surprisal **Retrieval**

Predictions for ORCs:

Between-Subjects: ORCs should be more facilitated when they are frequent than when they are rare in context

- Order x Frequency interaction

Within-Subjects: At *that*, ORC-compatible and SRC-compatible continuations compete for expectation/Surprisal (Levy, 2008)

- As ORC continuation Surprisal decreases, Surprisal of the SRC continuation should increase
  → SRCs predicted to become harder as ORCs are facilitated
- Order x Construction interaction

Conflicting Adaptation Results

Wells et al. test both within and between subject predictions by presenting many RCs to a target group and none to a control group

- Exposure to RCs increased facilitation specifically for ORCs in an end-of-exp self-paced reading task
  - Relative to the control group with no exposure
- Both within and across-group findings consistent with adaptation

However, tests of adaptation have been inconsistent:

- Stack et al. (2018) fail to replicate Fine et al. findings for garden paths
- Prasad & Linzen (CUNY '19) find:
  - Within-subject results consistent with adaptation for garden paths in self-paced reading
  - But fail to support between-subject predictions
    → Argue that prior adaptation results were due to task adaptation to self-paced reading

Resolving conflicting findings:

- Eyetracking to minimize task adaptation
  - Self-paced reading is unpracticed, unlike natural reading
  - Task adaptation is particularly dangerous when the effect of interest is also adaptation
- Compare ORCs and Garden Paths directly for construction differences

Design

Paired Experiments (N=72) —reading and production components

Eyetracking:

	ORC	SRC	Complement	NP/Z → Z	NP/Z → NP	NP/Z → Z comma
Exp. 1	**32**	8	8	**8**	0	0
Exp. 2	**8**	8	0	**32**	8	8

Target	**ORC:** The botanist [that the statistician consulted] ...	**NP/Z → Z:** While the artist sketched the deer in the field munched grass ...
Competing Control	**SRC:** The botanist [that consulted the statistician] ...	**NP/Z → NP:** While the artist sketched the deer in the field **the herd** munched...
Non-Competing Control	**Comp:** The botanist believed [that the statistician consulted the manual ...	**NP/Z comma:** While the artist **sketched,** the deer in the field munched...

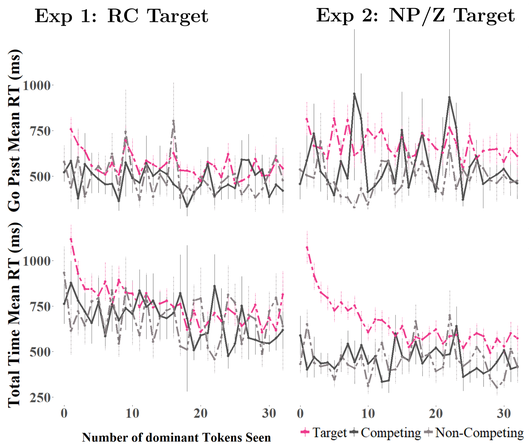
Order: The number of tokens a participant had seen relative to the number of dominant tokens (ORCs or Zs)
(e.g., in Exp 1. SRCs & Comp which appear before any ORCs have position 0; SRCs & Comp between ORC_1 and ORC_2 are position 1, etc...)

Before-and-After Sentence Completion Task

- Production-based measure of adaptation (i.e. comprehension-to-production priming)
  - If adaptation is possible in principle and simply doesn't appear in comprehension (eye tracking), then it should obtain in production
- Included dative fragments as a control
  - Datives are well-known to participate in priming → Even if targets resist priming, it should appear with datives
  - 32 PO datives were also included in the eye tracking sentences to match exposure to ORCs

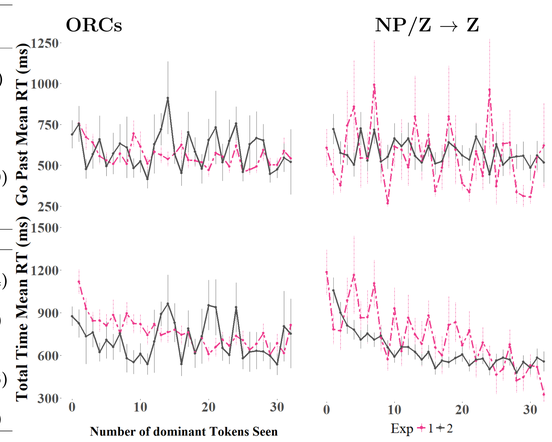
(1) a. RC: The brilliant inventor that ____
b. NP/Z: While the motorcycle rider parked ____
c. Dative: The reclusive novelist gave ____

Within Subjects



	Go Past β (SE)	*TotalTime* β (SE)
ORC vs SRC		
SType	**68.30(21.68)**	**69.63(21.93)**
Order	**-2.35(1.17)**	**-7.70(1.43)**
STypeXOrder	2.65(2.00)	-1.58(2.27)
ORC vs Comp		
SType	**137.26(41.91)**	**141.66(46.59)**
Order	-1.035(1.77)	**-6.97(2.06)**
STypeXOrder	-5.29(3.83)	-3.04(4.87)
Z vs NP		
SType	**157.20(40.26)**	**225.96(27.84)**
Order	-1.31(1.48)	**-4.78(1.09)**
STypeXOrder	-2.98(3.48)	**-12.62(2.36)**
Z vs Z comma		
SType	**203.59(42.44)**	**233.09(26.76)**
Order	-0.94(1.43)	**-4.95(1.08)**
STypeXOrder	-3.62(3.27)	**-11.67(2.36)**

Between Subjects



	Go Past β (SE)	*Total Time* β (SE)
ORCs		
Exp	25.40(45.40)	62.61(69.46)
Order	**-3.99(-4.00)**	**9.13(1.12)**
ExpXOrder	2.16(2.25)	**5.33(2.08)**
Zs		
Exp	-2.22(3.29)	**-15.08(2.08)**
Order	13.13(62.41)	-89.23(58.99)
ExpXOrder	-0.60(3.59)	3.69(2.28)

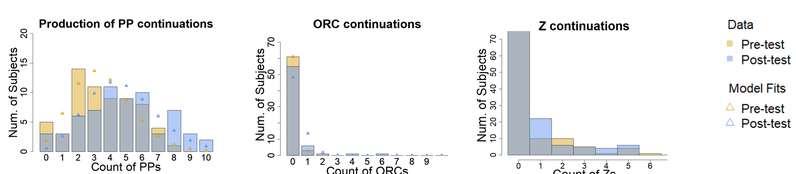
Within Subject Conclusions:

- No critical SType x Order interaction
  - Except for NP/Zs in Total Time
- Effects that exist primarily in late measures
  - Unexpected for prediction-based theories like adaptation

Between Subjects Conclusions:

- NP/Z "adaptation" not modulated by frequency
  - Neither between-subjects NP/Z comparison is sig.
- Sig. critical ORC interaction
  - Partial replication of Wells et al. (2009)
  - But comparison to within-subjects complicates a syntactic adaptation account

Sentence Completion Results



Dative Continuations*

		β(SE)	p
Dat PPs Only	*Intercept*	1.06 (0.07)	<.0001
	Pre/Post	0.18 (0.09)	0.07
Any VP-attached PP**	*Intercept*	1.27 (0.07)	<.0001
	Pre/Post	0.29 (0.09)	<.001

*Experiment 1 only
** Non-dative PPs (e.g. locatives) are also primed by PO datives (Bock & Loebell, 1990)

ORC Continuations

	β(SE)	p
Intercept	-4.85 (1.18)	<.0001
Pre/Post	1.79 (0.62)	<.005

NP/Z Continuations

	β(SE)	p
Intercept	-0.97	<.0001
Pre/Post	**-0.26**	<.05
Comma	-0.04	>.05
Interaction	0.25	>.05

- Both ORCs and PO datives show sig. increased production after eyetracking
  - The experiments can 'prime' in principle
- Production priming effect is reversed for NP/Zs
  - Intransitives become slightly rarer in post-test
- Reversed effect for Zs could indicate that NP/Z adaptation is not related to production priming

Conclusions

- Comprehenders adapt to the overall difficulty of a context, rather than to a specific syntactic structure
  - Order effects were mediated by difficulty of a construction
  - but not frequency
- What 'adaptation' there is, is primarily due to re-reading
  - More consistent with modulating depth of interpretation than predictive syntactic parsing

References

Fine, Jaeger, Farmer, Qian. (2013).*PloS one*; Tooley & Traxler.(2018).*JML*; Wells, Christiansen, Race, Acheson & MacDonald. (2009).*Cognitive Psychology*; Levy. (2008). *Cognition*; Stack, James, Watson. (2018). *Mem & Cognition*; Bock & Loebell. (1990). *Cognition*;

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