Can local coherence effects lead to illusions of grammaticality?

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Introduction

- Consider the sentence in (1):

(1) The coach smiled at **the player tossed a frisbee**.

- The substring **the player tossed a frisbee** is **locally coherent**: It could be parsed as a main clause, but global grammatical constraints should prohibit this analysis
- Local coherence has been found to interfere with parsing, leading to longer reading times (Tabor, Galantucci & Richardson, 2004) and temporary misinterpretations (Konieczny et al., 2009)
- Local coherence effects are expected if parsing is **self-organized**: Words are allowed to combine freely without central grammatical supervision until a globally optimal solution is found (e.g. Tabor & Hutchins, 2004; Smith, 2018)

> **Open question**: What if there is no globally optimal parse, that is, what if the sentence is ungrammatical?

- Self-organization would predict that a locally coherent parse may be able to outcompete an ungrammatical global parse
- Prediction: **Illusions of grammaticality** should result

Experimental design

- 2×2 design with factors local coherence (locally coherent vs not locally coherent), grammaticality (grammatical vs ungrammatical); 75 subjects, 32 items
- Eye tracking during reading, end-of-sentence binary grammaticality judgments
- Manipulation similar to Konieczny et al. (2009); Paape & Vasishth (2016)

EXAMPLE ITEM

Diamonds indicate region of interest boundaries

Man erfuhr später, ◇ dass ◇ ...
One learned later that

Locally coherent

... einer der Spitzel ◇ enttarnte Informanten ◇
[one of.the snitches]$_S$ [exposed informants]$_O$
[one of.the snitches]$_S$ exposed(.sg)$_V$ informants$_O$

Not locally coherent

... einige der Spitzel ◇ enttarnte Informanten ◇
some of.the snitches exposed(.sg) informants

Grammatical/Ungrammatical

... mit raffinierten Tricks ◇ warnte(n).
with subtle ploys warned(-pl)

- Locally coherent SVO parse is ungrammatical in the presence of *dass*, 'that', which embeds verb-final subordinate clauses

Predictions (Preregistration: https://osf.io/ersxn)

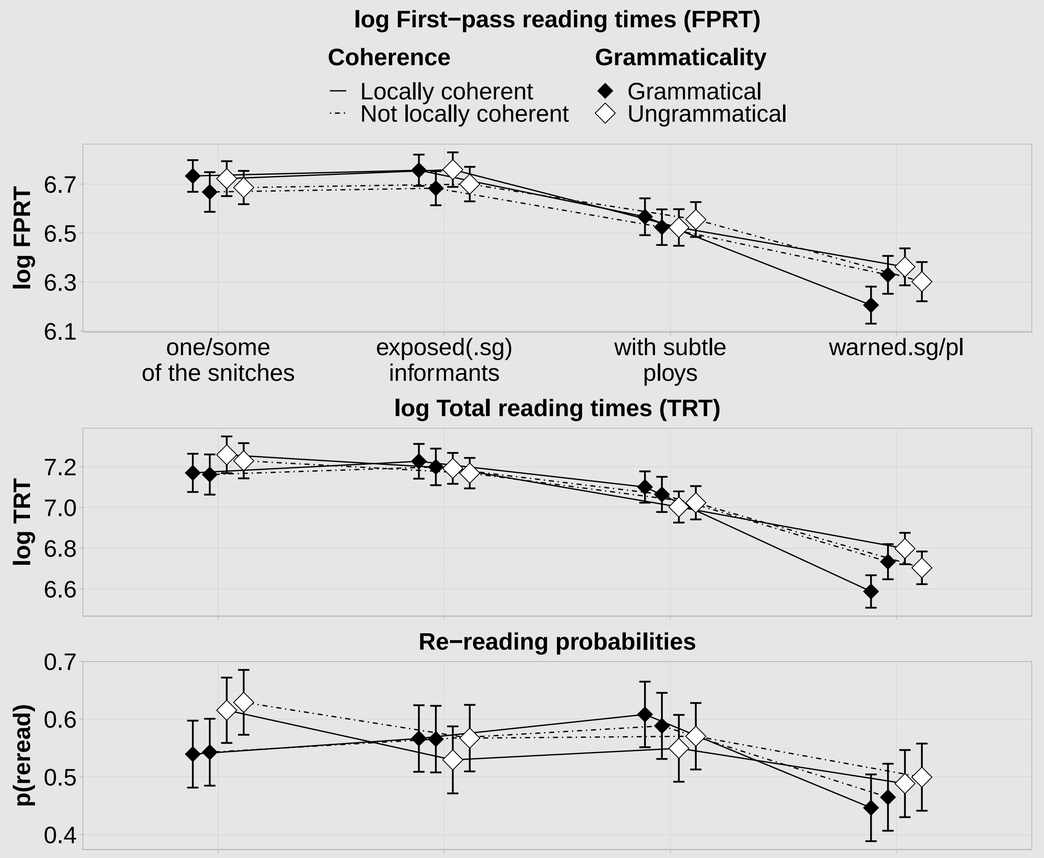
- Processing difficulty (longer reading times, regressions) expected at *exposed informants* in locally coherent conditions due to competition between local (verb+object) and global (adjective-modified NP) analyses
- Illusions of grammaticality (incorrect positive grammaticality judgments) expected if the locally coherent analysis outcompetes the global analysis in ungrammatical sentences
- Regressions to locally coherent material expected if readers attempt selective reanalysis (Frazier & Rayner, 1982) or become uncertain about previous input (Levy et al., 2009)

Results

Grammaticality judgments

Grammaticality	Local coherence	p(correct)
grammatical	non-coherent	**0.91** [0.87, 0.94]
grammatical	coherent	**0.90** [0.86, 0.94]
ungrammatical	non-coherent	**0.84** [0.80, 0.89]
ungrammatical	coherent	**0.87** [0.83, 0.91]

- No evidence of grammaticality illusions due to local coherence



- Longer FPRTs in subject ($\widehat{\Delta} = \mathbf{35}$ ms, CrI: [$-\mathbf{1}$ ms, **70** ms]) and object region ($\widehat{\Delta} = \mathbf{57}$ ms, CrI: [**19** ms, **94** ms]) for locally coherent conditions
- Interaction between local coherence and grammaticality in final region: Shorter FPRTs ($\widehat{\Delta} = -\mathbf{66}$ ms, CrI: [$-\mathbf{102}$ ms, $-\mathbf{29}$ ms]) and TRTs ($\widehat{\Delta} = -\mathbf{112}$ ms, CrI: [$-\mathbf{162}$ ms, $-\mathbf{74}$ ms]) due to local coherence in grammatical sentences, longer TRTs due to local coherence in ungrammatical sentences ($\widehat{\Delta} = \mathbf{83}$ ms, CrI: [**28** ms, **137** ms])
- No evidence of targeted regressions apart from rereading of subject NP in ungrammatical conditions ($\widehat{\Delta} = \mathbf{0.12}$, CrI: [**0.07**, **0.17**])

Discussion

- Effect of local coherence on FPRTs adds to existing evidence, matches previous eye tracking results (Levy et al. 2009; Christianson et al. 2016; Müller & Konieczny, 2019)
  - Effect in "early" measure may suggest role of low- rather than high-level linguistic information (e.g. n-grams)
  - Effect in subject region likely not due to parafoveal preview: Effect is strongest on *einer/einige*, "one/some", not reliable in word-by-word analysis
- Absence of grammaticality illusions means no evidence that the local analysis can outcompete even malformed global analyses (in German subordinate clauses)
- No evidence that local coherence leads to targeted regressions
  - For English LC structures, Levy et al. (2009) and Christianson et al. (2016) found evidence of targeted regression patterns – difference in the difficulty of the sentences or possibly task effect?
- Interaction in final region suggests effect of LC on wrap-up processes, though interpretation is unclear – possibly suppression of lingering LC parse?

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