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).

EXAMLE ITEM

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

Locally coherent:

. . . . einer der Spitzel enttarnte Informanten . . . .
Exposure of singular informants.

Not locally coherent:

. . . . einiger der Spitzel enttarnte Informanten . . . .
Exposure of plural informants.

Grammatical/Ungrammatical:

. . . . mit raffinierten Tricks warnte(n).
With subtle tricks warned.

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

RESULTS

Grammaticity judgments

<table>
<thead>
<tr>
<th>Condition</th>
<th>Proportion correct</th>
<th>[95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammatical</td>
<td>0.91 [0.87, 0.94]</td>
<td></td>
</tr>
<tr>
<td>Not locally coherent</td>
<td>0.90 [0.86, 0.94]</td>
<td></td>
</tr>
<tr>
<td>Ungrammatical</td>
<td>0.84 [0.80, 0.89]</td>
<td></td>
</tr>
<tr>
<td>Not locally coherent</td>
<td>0.87 [0.83, 0.91]</td>
<td></td>
</tr>
</tbody>
</table>

No evidence of grammaticity illusions due to local coherence.

Longer FPRTs in subject (Δ = 35 ms, CrI: [−1 ms, 70 ms]) and object region (Δ = 57 ms, CrI: [19 ms, 94 ms]) for locally coherent conditions.

Interaction between local coherence and grammaticality in final region: Shorter FPRTs (Δ = 66 ms, CrI: [−102 ms, −29 ms]) and TRTs (Δ = −112 ms, CrI: [−162 ms, −74 ms]) due to local coherence in grammatical sentences, longer TRTs due to local coherence in ungrammatical sentences (Δ = 83 ms, CrI: [28 ms, 137 ms]).

No evidence of targeted regressions apart from rereading of subject NP in ungrammatical conditions (Δ = 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 parafocal preview: Effect is strongest on einer/einenige, “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?

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 NPs) 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).

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REFERENCES

Christianson et al. 2010; Q J Exp Psychol 70(7), 1380–1405.
Konieczny et al. 2009; Psycholinguist 1, 135–139.
Levy et al. 2009; PNAS 106(50), 21086–21090.