

Structural Priming of Comprehension Affects Parsing in Temporarily Ambiguous Sentences but Not Otherwise



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Summary

Two experiments examined the on-line processing effects of structural priming in comprehension using the self-paced reading task. In Experiment 1, structural facilitation was found in temporarily ambiguous sentences but not in unambiguous sentences. Experiment 2 used modified target sentences with no ambiguity. The structural priming effect disappeared in Experiment 2. The results suggest that structural priming of on-line processing is only possible for ambiguous sentences.

Structural priming

Structural priming is an influence of a recently processed sentence structure on the processing of subsequent sentences. It is known to influence production quite robustly (e.g. Bock, 1986). Effects on comprehension appear to be more fragile.

Some existing studies that found structural priming in comprehension:

- Branigan, Pickering, and McLean (2005): categorical effects on the interpretation of ambiguous sentences.
- Scheepers and Crocker (2004): anticipatory eye movements.
- Arai, van Gompel, and Scheepers (2007): anticipatory eye movements (only in sentences with repeated verbs).
- Traxler (2008): reading times, also Traxler and Tooley (2008).

Only the studies by Traxler et al. showed effects of structural priming on on-line processing. Both used ambiguous sentences as stimuli. It is not known if the processing of unambiguous sentences can be primed as well. Nor is it known if effects on predictive processing lead to reading time facilitation.

Goals

Test structural priming of on-line processing in ambiguous and unambiguous structures, using structures shown previously to prime structural anticipations.

Questions

- Does repetition of syntactic structures facilitate sentence processing, as measured by the self-paced reading task?
- Are there differences in the susceptibility to structural priming between ambiguous and unambiguous sentences?

Experiment 1

Two types of target sentences were used. OVS sentences began with a case-ambiguous noun disambiguated as accusative by the postverbal unambiguous nominative noun (cf. Scheepers & Crocker, 2004). The OVS order is marked in Czech, but not ungrammatical. OVS targets were preceded by unambiguous sentences with the OVS structure (matching primes) or SVO structure (non-matching primes).

Sentences with datives were unambiguous. The same verb was used in the prime and target sentence, in order to replicate conditions under which Arai et al. (2007) found priming effects on structural anticipations.

Experiment 1 stimuli

OVS (ambiguous target)

Matching prime
Skrytou cestu najde kapitán. / (Hidden path)_{acc} finds the captain_{nom}.
Non-matching prime
Starý kapitán najde cestu. / (The old captain)_{nom} finds the path_{acc}.
Target
Štěně postrčí unavený osel u vrat. /
A puppy_{Ambig} pokes the tired donkey_{Nom} at the gate.

Dative (unambiguous target)

Matching prime
Dědeček daroval hračku vnukovi. / Granddad gave toy_{acc} grandson_{dat}.
Non-matching prime
Dědeček daroval vnukovi hračku. / Granddad gave grandson_{dat} toy_{acc}.
Target
Básník daroval kabelku manželce důležitého nakladatele. /
Poet gave purse_{acc} wife_{dat} important publisher_{gen}.

Participants and procedure

Total of 39 native speakers participated in a word-by-word self-paced reading task. Each trial comprised four masked sentences: the prime, the target, and two fillers. Sentences were followed by a comprehension question.

Analysis

The primary analyses compared total reading times for the region of interest (italicized in the example). Post-hoc analyses were performed for individual words. Mixed-model analysis was used with persons and target sentences as random effects, and condition and trial number as fixed effects. The significance levels were calculated empirically (cf. Baayen, Davidson, & Bates, 2008).

Results

Total mean reading times and the means for individual words:

	Total	Word no.				
		3	4	5	6	
OVS						
matched	2906	629	638	445	1133	
non-matched	3031	651	659	455	1161	
effect	**125	22	21	10	28	
Dative						
matched	2900	574	598	619	1053	
non-matched	2830	555	583	592	1002	
effect	-70	-19	15	-27	-51	

The only significant fixed effect of condition was observed for the total reading times in the OVS sentences. The region of interest was read faster in the matching condition compared to the non-matching condition ($t = 2.54$, $p = 0.028$). No significant differences were observed for individual words, but the total times for words 3 and 4 in the OVS sentences were faster in the matching condition ($t = 2.88$, uncorrected $p = 0.008$).

No significant effects were observed for the target sentences with datives.

Discussion

- Only ambiguous sentences showed evidence of priming.
- Was this because of the ambiguity, or because of general difficulty? The OVS sentences appeared more difficult than the sentences with datives.
- Perhaps priming only occurs in sentences that are hard to read?

Experiment 2

The target sentences were modified so that the OVS sentences were unambiguous, and the sentences with datives were more difficult to process. In OVS sentences, the initial noun was substituted for one in unambiguous accusative form. In sentences with datives, the position of the recipient and the direct object NP was exchanged. This moved the “heavy” dative NP to a sentence-internal position and a single-word accusative NP to the sentence end.

If priming occurred in the modified sentences, it would suggest that difficulty rather than ambiguity makes sentences susceptible to priming.

Experiment 2 stimuli

OVS

Matching prime
Skrytou cestu najde kapitán. / (Hidden path)_{acc} finds the captain_{nom}.
Non-matching prime
Starý kapitán najde cestu. / (The old captain)_{nom} finds the path_{acc}.
Target
Lišku postrčí unavený osel u vrat. /
A fox_{Acc} pokes the tired donkey_{Nom} at the gate.

Dative

Matching prime
Dědeček daroval hračku vnukovi. / Granddad gave toy_{acc} grandson_{dat}.
Non-matching prime
Dědeček daroval vnukovi hračku. / Granddad gave grandson_{dat} toy_{acc}.
Target
Básník daroval manželce důležitého nakladatele kabelku. /
Poet gave (to the wife)_{dat} (of an important publisher)_{gen} (a purse)_{acc}.

Participants, procedure, analysis

Total of 46 native speakers participated. The format of the task was the same as in Experiment 1, as were the analytic procedures. In OVS sentences, the primary observed variable was the reading time for the sentence-initial noun. In sentences with datives, the region of interest was the same as in Experiment 1, i.e. the sequence from first structural difference to the sentence end.

Results

Mean reading times are reprinted in the table. For comparison with Experiment 1, mean times for all words in OVS targets are reported.

	Word no.					
	1	2	3	4	5	6
OVS						
matched	664	554	610	553	432	1138
non-matched	706	571	631	557	436	1114
effect	42	17	21	4	4	-24
Dative						
	Total	Word no.				
		3	4	5	6	
matched	3062	585	620	574	1186	
non-matched	3027	572	588	566	1222	
effect	-35	-13	-32	-8	36	

The analyses revealed no significant effects of experimental condition in either type of sentences. In OVS sentences, this was the case for individual words as well as for the total reading time for the whole sentence, and for the total reading time for the OV sequence (initial two words).

Conclusions

The results indicate that structural ambiguity may be an important factor determining susceptibility of sentences to structural priming.

- Unambiguous sentences did not undergo priming, even though the verb was repeated.
 - Previously, priming effect in English sentences with datives was shown for predictive processing (Arai et al., 2007).
 - Present results suggest that predictive processing effects may not lead to reading facilitation.
- Structural priming occurred in garden-path OVS sentences even in the absence of verb repetition.
 - Effect disappeared when the ambiguity was removed.
 - No previous reports found structural priming of comprehension in unambiguous sentences (except for anticipations).
- Perhaps priming of on-line parsing only occurs in ambiguous sentences.

Possible implications

Evidence for the revision stage?

If replicated, the distinction between ambiguous and unambiguous sentences could support the two-stage accounts of parsing.

- It looks like priming facilitates revisions but not first-pass parsing.
- If the distinction proves to be robust, it would support the existence of two separate processing stages, each susceptible to different influences.

Further research

A single experiment with two factors, priming and ambiguity, would provide much stronger evidence for the suggested claims: it could test the interaction of the two factors. Such an experiment needs a structure where a minimal change of the target sentence disambiguates it. An ongoing experiment uses sentences with dative/accusative ambiguities for this.

References

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