

The role of different linguistic and discourse-level factors in the processing of causal relations

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The ability to comprehend causal relationships is a cornerstone of discourse processing, enabling readers to integrate fragmented textual information into coherent mental representations. This study on Russian examines the combined influence of linguistic markers (connectives, e.g. *potomu čto* 'because', *poetomu* 'therefore' vs. their absence) and punctuation (commas vs. periods) on the processing of causal relations. Furthermore, it explores the interaction of logical directionality (cause-to-effect vs. effect-to-cause) with these textual markers. While prior studies have demonstrated the facilitative local role of connectives in reading [1, 2], evidence regarding their global and comprehension-level influence remains inconsistent [3, 4]. A possible reason for these contradictions may be the isolated investigation of connectives without accounting for other discourse and textual markers. Addressing this gap, we adopt a holistic approach that examines the integration of discourse, lexical, and punctuational markers in discourse processing.

We ran two experiments: a self-paced reading task (SPRT) with 72 native Russian participants and an eye-tracking study with 48 participants. Both studies employed a within-subject factorial design, explained in Table 1. By keeping the target discourse unit (DU) identical across all six conditions, we controlled for lower-level phenomena and isolated the influence of preceding discourse properties and markers. Statistical analysis used mixed-effects linear regressions (all data have been log-transformed prior to the analysis).

Exp. 1 revealed that connectives facilitated the processing of the subsequent word in both groups of comparisons (Tables 2, 3). Interaction analyses showed significant differences between conditions: only 'therefore' ($\beta=0.043$, $p<0.05$), but not 'because' sped up processing. Additionally, when a period preceded the DU, connectives played a greater role in establishing connections, with their effects extending beyond the first word to the second ($\beta=0.038$, $p<0.05$).

Exp. 2 confirmed the local facilitative effect of connectives on discourse processing, evidenced by reduced total reading time (TRT), first pass (FP), and regression path duration (RPD) (Tables 4, 5). Eye-tracking also revealed global effects of connectives, as their presence accelerated reading of the entire DU and reduced RPD from its final word (Tables 6-9). However, these global effects were absent when a period preceded the DU, highlighting differences in discourse processing. Logistic regression analysis showed that participants skipped significantly more words in conditions with connectives, indicating a more fluent reading mode. Exp. 2 replicated reading time patterns from Exp. 1 across conditions, confirming the reliability of the effects (see Figures 1 & 2). The preceding period condition was the only exception, which we attribute to possible regressions during eye-tracking,

This study advances psycholinguistic models of discourse processing by demonstrating how textual markers and the logical structure of the discourse jointly influence the integration of causal relationships in naturalistic reading environments. While replicating previous findings, our experiments also revealed broader, more global effects of connectives on discourse processing. Connectives serve as processing cues that guide readers toward the correct interpretation of new fragments. Our evidence suggests that their impact extends beyond the initial integration of the DU, continuing until the DU is fully incorporated into the existing discourse representation. Additionally, we showed that discourse features and punctuation markers, although less impactful on their own, interact with connectives to modulate their facilitative effects. These findings highlight the necessity of considering multiple factors in discourse processing research and caution against overlooking other linguistic and structural cues when investigating connectives.

References. [1] Canestrelli, A., Mak, W., & Sanders, T. (2013). Causal connectives in discourse processing: How differences in subjectivity are reflected in eye movements. *Language and*

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Table 1. Experimental conditions in Exp. 1 and 2.

No	Logical directionality (LD)	Punctuation	Connective (Con)	Text
1	Effect	,	Yes	CS. ... , <u>therefore</u> DU.
2	Effect	,	No	CS. ... , DU.
3	Cause	– (only ,)	Yes	CS. ... , <u>because</u> DU.
4	Cause	– (only ,)	No	CS. ... , DU.
5	– (only Effect)	.	Yes	CS. <u>Therefore</u> DU.
6	– (only Effect)	.	No	CS. DU.

Note: CS – contextual sentence; DU – target discourse unit. Comparisons were performed between conditions 1-2-3-4 (1st comparison group) and 1-2-5-6 (2nd comparison group).

Table 2. Exp.1: LMER 1st word RT, 1st grp.

Predictor	β	SE	t	p
Con	-0.023	0.010	-2.226	0.026
LD	-0.019	0.010	-1.828	0.067

Table 3. Exp.1: LMER 1st word RT 2nd grp.

Predictor	β	SE	t	p
Con	-0.054	0.010	-5.158	< 0.001
Punct	-0.014	0.010	-1.340	0.180

Table 4. Exp.2: LMER 2nd word TRT 1st grp.

Predictor	β	SE	t	p
Con	-0.090	0.026	-3.47	< 0.001
LD	-0.042	0.026	-1.59	> 0.05

Table 5. Exp.2: LMER 2nd word TRT 2nd grp.

Predictor	β	SE	t	p
Con	-0.070	0.026	-2.65	< 0.001
Punct	0.028	0.026	1.09	> 0.05

Table 6. Exp.2: LMER Full DU TRT 1st grp.

Predictor	β	SE	t	p
Con	-0.114	0.02	-5.63	< 0.001
LD	-0.022	0.02	-1.12	> 0.05

Table 7. Exp.2: LMER Full DU TRT 2nd grp.

Predictor	β	SE	t	p
Con	-0.07	0.02	-3.57	< 0.001
Punct	0.01	0.02	0.54	> 0.05

Table 8. Exp.2: LMER last word RPD 1st grp.

Predictor	β	SE	t	p
Con	-0.145	0.06	-2.48	< 0.05
LD	0.005	0.06	0.09	> 0.05

Table 9. Exp.2: LMER last word RPD 2nd grp.

Predictor	β	SE	t	p
Con	-0.099	0.06	-3.57	0.078
Punct	0.053	0.05	0.54	> 0.05

Figure 1. Exp.2: log-TTR across conditions.

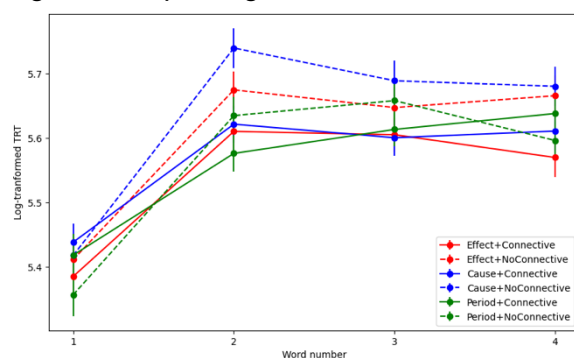


Figure 2. Exp.1: log-RT across conditions.

