

Priming NPI Acceptability Judgments and the Bagel Problem

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Abstract

We report on a series of priming experiments on the acceptability of two types of Negative Polarity Items (NPIs) in two languages, namely, *any* in English and *libo*-NPIs in Russian. Our results show that (i) acceptability judgments of NPIs can be primed both in English and in Russian, and (ii) only unacceptability of the same type, i.e., unacceptability caused by an unlicensed NPI, triggers priming effects on the acceptability of NPIs. The results also indicate that (iii) priming effects for English *any* and Russian *libo*-NPIs are counter-directed: For *any*, an unlicensed instance has a positive priming effect, while for *libo*-NPIs an unlicensed instance has a negative priming effect. We attribute this contrast to the so-called ‘bagel’ distribution of *libo*-NPIs in Russian: Although licensed in all other contexts where weak NPIs are commonly licensed, *libo*-NPIs are hardly ever licensed by negation. We claim that this makes the crucial difference for priming effects triggered by unlicensed NPIs in English and Russian. That is, unacceptable primes trigger priming effects by evoking possible ways to ‘fix’ them, and different NPIs evoke different such ways, depending on their typical contexts of use, whereby exhibiting qualitatively different priming effects.

1 Introduction

The general idea behind *priming* is that if a preceding trial (a *prime*) affects one’s behavior in a following trial (a *target*), the two trials must have something in common. Typically priming studies involve comparing two or more types of primes (often including trivial primes, i.e., primes with no priming effects) with respect to the same target. The priming paradigm has been extensively employed to investigate various levels of linguistic representations from lexical semantics (e.g., D. E. Meyer and Schvaneveldt 1971; Neely 1976; Neely, Keefe, and Ross 1989; McNamara 2005; Neely 2012) to syntactic structure (e.g., Bock 1986; Ferreira and Bock 2006; Branigan 2007; Pickering and Ferreira 2008; Branigan and Pickering 2017) to quantifier scope (e.g., Raffray and Pickering 2010; Chemla and Bott 2015) to scalar implicatures (e.g., Bott and Chemla 2016; Rees and Bott 2018; M.-C. Meyer and Feiman 2021; Marty et al. 2024). However, it has rarely, if ever, been used in conjunction with an acceptability judgment task.

In this study, we report on a series of experiments that applied the priming paradigm to the acceptability judgments of NPIs. We tested two specific types of NPIs in two languages, *any* in English and *libo*-NPIs in Russian. The results show that acceptability judgments of NPIs can be primed both in English and in Russian, but only unacceptable primes trigger priming effects. We claim that this observation is harmonious with previous findings that large priming effects are only triggered by primes with ‘unexpected’ properties (e.g., Jaeger and Snider 2013; Marty et al. 2024). That is, since speakers normally do not encounter unlicensed, unacceptable NPIs in their daily lives, they trigger large priming effects. Importantly, we also observe that not all unacceptable primes trigger priming effects on acceptability judgments of NPIs, but only unacceptable primes that are unacceptable due to unlicensed NPIs do. This indicates that the priming paradigm can selectively tap into a representation or mechanism pertaining to NPI licensing. Moreover, we observe a curious crosslinguistic difference between the priming effects in English and Russian such that unlicensed *any* in English leads to a positive priming effect, but

unlicensed *libo*-NPIs in Russian leads to a negative priming effect. We attribute this contrast to the so-called ‘bagel’ distribution of *libo*-NPIs in Russian.

2 NPIs in English and Russian

2.1 English *any*

English *any* is seen as a prototypical NPI, more precisely a weak NPI, that is licensed by a variety of Downward Entailing (DE) operators (Fauconnier 1975; Ladusaw 1979 and much subsequent work), including clausemate negation, as well as by certain other non-monotonic operators (see below).

One complication that will be relevant for the present study is the fact that *any* has a Free Choice (FC) use (unlike other weak NPIs like *ever*), although the exact relationship between the NPI and FC uses of *any* is immaterial for our purposes (see, e.g., Giannakidou 2001; Dayal 2004; Menéndez-Benito 2010).

2.2 Russian *libo*-NPIs

Turning now to Russian, *libo*-NPIs, which are formed by suffixing *libo* onto a *wh*-word, exhibit an interesting distribution. *Wh-libo* is an NPI and as such needs a licenser, and it is in fact licensed in most typical contexts that license canonical weak NPIs including *any* in English such as the scope of *without* and the restrictor of a universal quantifier. This is illustrated by the contrast between (1-a-b) and (1-c), where the former, but not the latter, contain an NPI licenser (*každyj* ‘every’ and *bez* ‘without’).

- (1) a. *Každyj, kto gde-libo byval, znaet èto čuvstvo.*
 every who where-LIBO was knows this feeling
 ‘Everybody who has been anywhere knows this feeling.’
 b. *Ivan opozdal na urok bez kakoj-libo pričiny.*
 Ivan came.late on class without which-LIBO reason
 ‘Ivan came to class late without any reason.’ (Denić 2015)
 c. **Ivan opozdal na urok po kakoj-libo pričine.*
 Ivan came.late on class on which-LIBO reason
 Intended: ‘Ivan came to class late for some reason.’

In light of this, it is striking that *libo* NPIs are not licensed by clausemate negation, the most prototypical NPI licenser, as in (3).

- (2) **Ja ne videl kogo-libo.*
 I NEG saw who-LIBO
 Intended: ‘I didn’t see anybody.’

Explanations of this distributional ‘hole’ usually involve competition with another series of pronouns, *ni*-NPIs, which are strong NPIs that are canonically licensed by clausemate negation. In fact, the distributions of *libo* NPIs and *ni* NPIs are nearly complementary, as illustrated by (3) (although with some overlap; see Padučeva 2015; Padučeva 2016; Pisarenko 2023).

- (3) a. *Ja ne videl {ni-kogo / *kogo-libo}.*
 I NEG saw who-LIBO
 ‘I didn’t see anybody.’
 b. *Každyj, kto {*ni-gde / gde-libo} byval, znaet èto čuvstvo.*
 every who NI-where / where-LIBO was knows this feeling

‘Everybody who has been anywhere knows this feeling.’

For our purposes, details of theories of *libo* NPI’s ‘bagel’ distribution are immaterial. Importantly, *libo* is also licensed in non-negative contexts—such as deontic modals—where they exhibit non-NPI readings (for the discussion of these readings and the range of non-negative licensers, see Padučeva 2015 and Pisarenko 2023).

2.3 NPIs in non-monotonic environments

Apart from DE environments, weak NPIs can also appear in certain non-monotonic environments (Linebarger 1980; Linebarger 1987). Among such non-monotonic environments that license weak NPIs, we will focus on the scope of *exactly n* (Heim 1984; Rothschild 2006; Crnič 2014). Both English *any* and Russian *libo* NPIs are licensed in the scope of *exactly n*, as illustrated by (4) and (5).

- (4) Exactly two restaurants served any vegan dishes.
- (5) Rovno dva restorana dobavili v menju kakie-**libo** vegetarianskie bljuda.
 exactly two restaurants added in menu which-LIBO vegetarian dishes
 ‘Exactly two restaurants added any vegetarian dishes to their menu’

The acceptability judgments of NPIs in the scope of *exactly n* are not as crisp as those of NPIs in canonical DE environments, as previously experimentally shown by Alexandropoulou, Bylinina, and Nouwen 2020 for *any*. These intermediate judgments are advantageous for our purposes, as they are more likely to be affected by priming by more extreme judgments and may be affected in either direction. For this reason, our experiments use such sentences in target items.

3 Experiment 1: English

3.1 Methods

We collected acceptability judgments of 16 target sentences that contain *exactly n NP* in subject position and *any* in object position, as in (4). As weak NPIs are considered to be judged as more acceptable for smaller *n*’s (Heim 1984; Rothschild 2006; Crnič 2014), we used numerals between *two* and *eight*, each of which was used in two separate target items.

Each target sentence was preceded by two primes. There were six types of primes altogether, with *no* or *some* as the subject quantifier and one of the following as the object quantifier: (a) *any*, (b) bare plural, or (c) *many* + singular NP. The six types of primes are illustrated in (6) and (7).

- | | | | |
|-----|---|-----|---|
| (6) | a. No artists sold any paintings.
b. No artists sold paintings.
c. No artists sold many painting. | (7) | a. Some artists sold any paintings.
b. Some artists sold paintings.
c. Some artists sold many painting. |
|-----|---|-----|---|

Regardless of the subject quantifier, (b) is expected to be grammatical, and (c) is expected to be ungrammatical due to an irrelevant grammatical factor, namely, number mismatch between *many* and the noun. On the other hand, (a) should be sensitive to the subject quantifier such that it is acceptable with *no* and unacceptable with *some*.

We had a 2 (SUBJECT: Some vs. No) × 3 (OBJECT: Any vs. BarePlural vs. Many) factorial design, with both factors being between participants. This between-participant design was chosen to avoid potential spillover effects across primes, as a target trial could be influenced by priming trials occurring earlier in the experiment, rather than only by the two preceding prime trials. In addition to the six priming conditions, furthermore, we also prepared a baseline

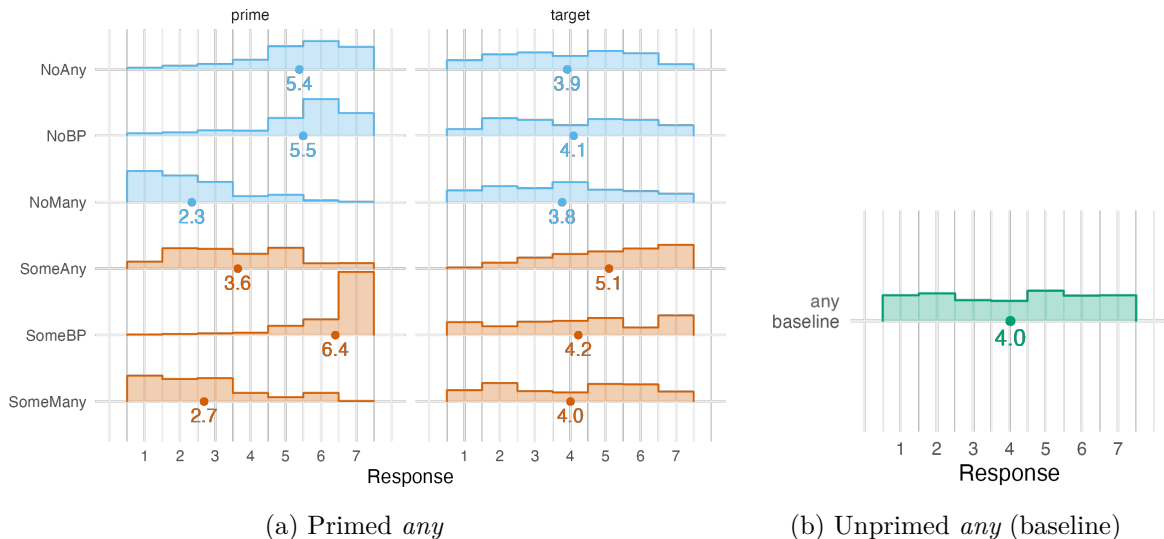


Figure 1: **Acceptability of English *any*.** (a) Ratings of primes and target items by condition in the priming experiment. (b) Ratings of target items outside of the priming context (baseline ratings).

condition, which was created by removing all the primes. The purpose of this condition was to collect baseline ratings for the target trials.

For the main six priming conditions, the 16 prime-prime-target triplets were interspersed by 72 filler items with varying acceptability. The order of stimulus presentation was randomized for each participant. Participants were randomly assigned to one of the six priming conditions. Each of them provided acceptability ratings of 120 sentences (16 prime-prime-target triplets = 48 items + 72 filler items) on a 7-point Likert scale (labelled ‘Completely ungrammatical’ and ‘Completely grammatical’ at endpoints), after reading instructions that were modelled after those used by Sprouse, Schütze, and Almeida 2013 and completing one practice item. The baseline condition was carried out in essentially the same way except that the participants saw no primes and half the filler items, so judged 48 sentences in total (16 targets + 36 filler items).

The experiment was designed on Gorilla. 90 participants were recruited on Prolific Academic (www.prolific.com). Each participant was compensated £3.00 for their participation and provided informed consent prior to participating. Two participants were excluded for low accuracy ($\leq 75\%$) on filler items, where accuracy was measured *post hoc*: Ratings outside 1.5 times the inter-quantile range from the median were considered wrong.

3.2 Results

The results are summarized in Figure 1. The acceptability judgments of primes (Figure 1a) are overall as expected. We fitted an ordinal mixed-effects regression model to the target data using the `ordinal` package (Christensen 2023) for R (R Core Team 2024). The model included two fixed effect variables, SUBJECT (Some vs. No) and OBJECT (Any vs. BarePlural vs. Many), each treatment-coded with Some and Any as reference levels, respectively. The model also had by-item variance on the intercept as the sole random effect (including any other random effect resulted in estimation error). The model reveals that target items following ungrammatical Some+Any primes were judged as more acceptable than those following grammatical No+Any primes ($\beta = -1.14, z = -7.24, p < 0.001$), and that target items following Some+Any primes were judged as more acceptable than those following the other two kinds of Some primes (BarePlural: $\beta = -0.83, z = 5.04, p < 0.001$; Many: $\beta = -1.04, z = -6.21, p < 0.001$). Baseline non-primed judgments (Figure 1b) confirm the direction of priming: Unlicensed *any* as a

prime drives amelioration in target acceptability (BarePlural: $\beta = -0.83, p < 0.001$; Many: $\beta = -1.04, p < 0.001$). In addition, significant positive interaction effects were observed (BarePlural: $\beta = 0.99, z = 4.24, p < 0.001$; Many: $\beta = 0.88, z = 3.89, p < 0.001$) that counteract the negative effect of SUBJECT and suggest that the acceptability of target items following the three types of No primes did not differ substantially from each other.

4 Experiment 2

4.1 Methods

Methods and procedure were the same as in Experiment 1. The main experiment is a priming study, followed by a baseline study where non-primed acceptability judgments were collected for the target items. The basis for the materials was translations of the English items used in Experiment 1 with *libo*-NPIs as objects in target items. Importantly, we changed the design of primes. There were 4 types of primes – each either had sentential negation (*ne* ‘not’) or did not have it (SUBJECT factor), and either contained *libo* or *ni* in object position (OBJECT factor). Example primes of each type are given below (items were shown to participants in Cyrillic):

- | | |
|---|---|
| <p>(8) Xudožniki ne prodali kakix-libo
 artists not sold which-LIBO
 kartin.
 paintings
 ‘No artists sold any paintings.’</p> | <p>(10) Xudožniki prodali kakix-libo
 artists sold which-LIBO
 kartin.
 paintings
 ‘Artists sold any paintings.’</p> |
| <p>(9) Xudožniki ne prodali nikakix
 artists not sold NI-which
 kartin.
 paintings
 ‘No artists sold any paintings.’</p> | <p>(11) Xudožniki prodali nikakix kartin.
 artists sold NI-which paintings
 ‘Artists sold any paintings.’</p> |

As in Experiment 1, SUBJECT and OBJECT were between-participant factors. Each participant was randomly assigned to one of the priming conditions in the main experiment and rated 120 sentences (16 prime-prime-target triplets + 72 fillers) on a 7-point Likert scale (labeled *Užasno zvučit po-russki, tak nikto ne govorit* ‘It sounds bad in Russian; no one speaks like that’ and *Xorošo zvučit po-russki, ja by sam(a) mog(la) tak skazat’* ‘It sounds good in Russian; I could say that myself’ at endpoints). In addition, there was a baseline condition that had no primes and half the fillers but was otherwise identical to the six priming conditions.

The experiment was designed using Gorilla. 68 native speakers of Russian were recruited via the Toloka platform. Each participant was compensated £3.00 for their participation and provided informed consent prior to participation. Five participants were excluded for low accuracy ($\leq 75\%$) on the filler items (same participant exclusion criterion as in Experiment 1).

4.2 Results

The obtained ratings are presented in Figure 2. As per Experiment 1, we fitted an ordinal mixed-effects regression model, with treatment-coded fixed effects: SUBJECT (absence of sentential negation (Pos) as reference level) and OBJECT (*libo* as reference level). The model revealed: (i) a difference in target acceptability between Pos+Libo and Pos+Ni prime conditions ($\beta = 2.10, z = 2.80, p < 0.01$), with the former receiving lower ratings overall; (ii) a difference in target acceptability between Pos+Libo and Neg+Libo primes ($\beta = 1.45, z = 1.99, p < 0.05$), with the former generally receiving lower ratings, and (iii) this difference being larger than the difference

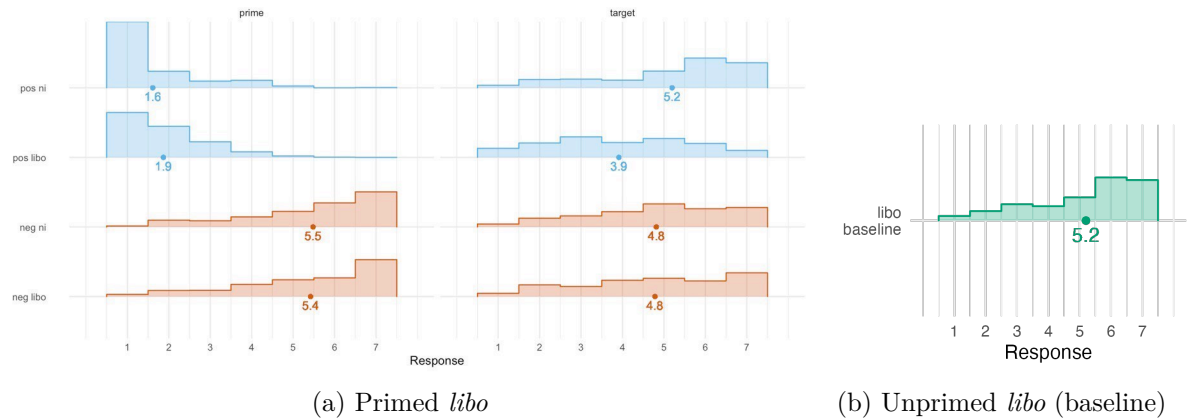


Figure 2: **Acceptability of Russian *libo*.** (a) Ratings of primes and target items by condition in the priming experiment. (b) Ratings of target items outside of the priming context (baseline ratings).

between Pos+Ni and Neg+Ni (significant interaction: $\beta = -2.06$, $z = -2.03$, $p < 0.05$). Given the non-primed baseline (Figure 2b), we conclude that the Pos+Libo prime (unlicensed *libo*) degrades the *libo* target.

5 General discussion

The results indicate that acceptability judgments of NPIs under *exactly n* can be primed, but only by unacceptable primes containing an unlicensed NPI. This selective nature of NPI priming gives credence to the existence of a mental representation dedicated to NPI licensing. Licensed NPIs don't show priming effects—we attribute this to the more general property of priming that only 'unexpected events' trigger priming effects (see Jaeger and Snider 2013; Waldon and Degen 2020; Marty et al. 2024).

Our results also indicate a contrast between English and Russian: unlicensed *any* triggers a positive priming effect, while unlicensed *libo* triggers a negative priming effect. We suggest that this difference arises from an interplay between the difference in their distributions and how acceptability judgments are primed. Specifically, for Experiment 1, we hypothesize that positive sentences containing unlicensed *any* evoked in participants' mind possible ways to make them grammatical, most plausibly, if not exclusively, by adding negation. Then upon encountering the following target item with *exactly n*, they are more likely to notice that it is another way of licensing the NPI *any*. Turning now to Experiment 2, we assume that priming effects arose in a similar manner, but crucially, *libo* does not have prototypical NPI uses under direct negation and as a result, salient ways of fixing ungrammatical primes involved other types of licensors. We hypothesize that one class of licensors that participants came up with was modals, in whose scope *wh-libo* receives a non-NPI reading. Then when judging acceptability of the following target item containing *exactly n*, licensing *wh-libo* as a non-NPI was still on the participant's mind and they were less likely to notice that *exactly n* is a possible licensor of its NPI use.

Note that English *any* also has a non-NPI use, namely a Free Choice use, under modals, but our explanation assumes that the most salient way that was evoked in Experiment 1 involved negation and other ways of licensing its NPI use. This assumption needs to be given independent evidence, and if true, a theoretical explanation, but we leave these questions for future research.

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References

- Alexandropoulou, Stavroula, Lisa Bylinina, and Rick Nouwen (2020). “Is there any licensing in non-DE contexts? An experimental study”. In: *Proceedings of Sinn und Bedeutung*. Vol. 24. 1, pp. 35–47.
- Bock, Kathryn (1986). “Syntactic persistence in language production”. In: *Cognitive psychology* 18.3, pp. 355–387.
- Bott, Lewis and Emmanuel Chemla (2016). “Shared and distinct mechanisms in deriving linguistic enrichment”. In: *Journal of Memory and Language* 91, pp. 117–140.
- Branigan, Holly (2007). “Syntactic priming”. In: *Language and Linguistics Compass* 1.1-2, pp. 1–16.
- Branigan, Holly and Martin J Pickering (2017). “An experimental approach to linguistic representation”. In: *Behavioral and Brain Sciences* 40, e282.
- Chemla, Emmanuel and Lewis Bott (2015). “Using structural priming to study scopal representations and operations”. In: *Linguistic Inquiry* 46.1, pp. 157–172.
- Christensen, Rune H. B. (2023). *ordinal—Regression Models for Ordinal Data*. R package version 2023.12-4.1. URL: <https://CRAN.R-project.org/package=ordinal>.
- Crnič, Luka (2014). “Against a dogma on NPI licensing”. In: *The art and craft of semantics: A festschrift for Irene Heim* 1, pp. 117–145.
- Dayal, Veneeta (2004). “The universal force of free choice”. In: *Linguistic variation yearbook* 4.1, pp. 5–40.
- Denić, Milica (2015). “Minimizing Scope Ambiguity Hypothesis”. Master’s Dissertation. Université Paris-Diderot – Paris 7.
- Fauconnier, Gilles (1975). “Polarity and the scale principle”. In: *Proceedings of the Chicago Linguistic Society*. Vol. 11, pp. 188–199.
- Ferreira, Victor S and Kathryn Bock (2006). “The functions of structural priming”. In: *Language and cognitive processes* 21.7-8, pp. 1011–1029.
- Giannakidou, Anastasia (2001). “The meaning of free choice”. In: *Linguistics and philosophy* 24.6, pp. 659–735.
- Heim, Irene (1984). “A Note on Negative Polarity and Downward Entailingness”. In: *Proceedings of NELS*.
- Jaeger, T Florian and Neal E Snider (2013). “Alignment as a consequence of expectation adaptation: Syntactic priming is affected by the prime’s prediction error given both prior and recent experience”. In: *Cognition* 127.1, pp. 57–83.
- Ladusaw, William A. (1979). “Polarity Sensitivity as Inherent Scope Relations”. Ph.D. Dissertation. University of Texas, Austin.
- Linebarger, Marcia Christine (1980). “The grammar of negative polarity”. PhD thesis. Massachusetts Institute of Technology.
- (1987). “Negative polarity and grammatical representation”. In: *Linguistics and philosophy*, pp. 325–387.
- Marty, Paul et al. (2024). “Implicature priming, salience, and context adaptation”. In: *Cognition* 244, p. 105667.
- McNamara, Timothy P (2005). *Semantic priming: Perspectives from memory and word recognition*. Psychology Press.
- Menéndez-Benito, Paula (2010). “On universal free choice items”. In: *Natural Language Semantics* 18, pp. 33–64.
- Meyer, David E and Roger W Schvaneveldt (1971). “Facilitation in recognizing pairs of words: evidence of a dependence between retrieval operations.” In: *Journal of experimental psychology* 90.2, p. 227.

- Meyer, Marie-Christine and Roman Feiman (2021). “Priming reveals similarities and differences between three purported cases of implicature: Some, number and free choice disjunctions”. In: *Journal of Memory and Language* 120, p. 104206.
- Neely, James H (1976). “Semantic priming and retrieval from lexical memory: Evidence for facilitatory and inhibitory processes”. In: *Memory & cognition* 4.5, pp. 648–654.
- (2012). “Semantic priming effects in visual word recognition: A selective review of current findings and theories”. In: *Basic processes in reading*, pp. 264–336.
- Neely, James H, Dennis E Keefe, and Kent L Ross (1989). “Semantic priming in the lexical decision task: roles of prospective prime-generated expectancies and retrospective semantic matching.” In: *Journal of Experimental Psychology: Learning, Memory, and Cognition* 15.6, p. 1003.
- Padučeva, E. V. (2015). “Snjataja utverditel’nost’ i neveridiktal’nost’ (na primere russkix mestoimenij otricatel’noj poljarnosti)/Suspended assertion and nonveridicality: the case of Russian Negative Polarity Items”. In: *Russian Linguistics*, pp. 129–162.
- (2016). “Mestoimenija tipa čto-nibud’ v otricatel’nom predložanii / Pronouns of the čto-nibud’ type in negative sentences”. In: *Voprosy jazykoznanija* 3, pp. 22–36.
- Pickering, Martin J and Victor S Ferreira (2008). “Structural priming: a critical review.” In: *Psychological bulletin* 134.3, p. 427.
- Pisarenko, Denis (2023). ““Bagel problem” v russkom jzyke: semantika mestoimenij serij -libo i -nibud’”. MA thesis. Higher School of Economics.
- R Core Team (2024). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria. URL: <https://www.R-project.org/>.
- Raffray, Claudine N and Martin J Pickering (2010). “How do people construct logical form during language comprehension?” In: *Psychological science* 21.8, pp. 1090–1097.
- Rees, Alice and Lewis Bott (2018). “The role of alternative salience in the derivation of scalar implicatures”. In: *Cognition* 176, pp. 1–14.
- Rothschild, Daniel (2006). *Definite descriptions and negative polarity*.
- Sprouse, Jon, Carson T Schütze, and Diogo Almeida (2013). “A comparison of informal and formal acceptability judgments using a random sample from Linguistic Inquiry 2001–2010”. In: *Lingua* 134, pp. 219–248.
- Waldon, Brandon and Judith Degen (2020). “Symmetric alternatives and semantic uncertainty modulate scalar inference.” In: *CogSci*.