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Pragmatic Licensing of Czech SuperStrong Negative Polarity Items: An Experimental Study[1]

Abstract

In this study, we report an experiment focusing on pragmatic factors (unlikelihood presupposition) in licensing of Czech superstrong negative polarity items.

Keywords

NPIs, scalar particles, alternatives, formal semantics, experimental linguistics

1. Introduction

In this study, we focus on the pragmatic and semantic properties of the Negative Polarity Item (NPI) *ani* in Czech + its associated expression. To frame our arguments, we begin with stating empirical properties of this expression. It seems that (as in many other languages) this expression lives a double life: as (i) either a scalar/additive particle; or (ii) a conjunction. One basic example showing the conjunctive usage of *ani* is in (1). In this case, *ani* works like English *nor* (modulo the negative concord difference between the two languages),

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requiring negation on the predicate and conjoining basically all types of constituents (but of the same type). Alongside the conjunction sub-type in (1), there is an additive usage of *ani* in (2), with the sentence implicating/presupposing that someone else (i.e., in addition to Petr) didn't come to the party as well and out of the blue doesn't bear any scalar presuppositions.

(1) neměl   otce   ani   matku
     NEG-have-3SG.M.PST   father-SG.M.ACC   nor   mother-SG.F.ACC
     'He had neither a father nor a mother.'

(2) na večírek   nepřišel   ani   Petr
     to party-SG.M.ACC   NEG-come-3SG.M.PST   even   Petr-SG.M.NOM
     'Even Petr didn't come to the party.'

In this article, we focus on the third type of *ani*, exemplified in (3), the scalar particle *ani* usually (as in the example) associated with expressions denoting minimal elements (the most frequent collocations of *ani* in Czech National Corpus (SYN2010) are *ani slovo* 'not even a word', *ani jeden* 'not even one', *ani trochu* 'not even a bit' and *ani jedenkrát* 'not even once'). The scalar *ani* usually requires clause-mate negation, but the nature of its licensing is semantic, not syntactic. For Polish syntactic and semantic constraints on similar NPIs see Błaszczak (2001); for Czech see Dočekal and Dotlačil (2016, 2018). In this article, we will report the pragmatic properties of scalar *ani* licensing (and will base our description mainly on experimental results). It is maybe possible to unify the second type of *ani* (additive) with its third type (scalar), but as this article is mainly a report on an experiment, we don't aspire to such a theoretical goal.[2]

(3) nezkazil   se   ani   jediný   výrobek
     NEG-go-rotten-3SG.M.PST   SE   even   one   product-SG.M.NOM
     'Not even single product got rotten.'

The structure of the article is the following: in Section 1.1 we introduce the theoretical tools we need; in section 2 we report the results of the experiment on Czech NPIs; Section 3 summarizes our findings.

1.1. Theoretical background

In this subsection, we introduce the framework we use. Our approach is a basically pragmatic theory of NPI licensing and stems from the seminal work of

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[2] List of Abbreviatons

3	third person	GEN	genitive	NEG	negation, negative
ACC	accusative	INF	infinitive	NOM	nominative
COMP	complementizer	INS	instrumental	PL	plural
F	feminine	M	masculine	PST	past
FUT	future	N	neuter	SG	singular

Krifka (1995). The pragmatic theory of NPI licensing is currently one of the standard approaches to polarity effects in natural language, although more traditional semantic theories (as Zwarts 1998) are still used too. We adopt the pragmatic stance since it allows us to deal with NPI licensing even in cases where the alternatives used for the computation are not logically related to the target sentence. As far as we are aware, such cases are hard to deal with purely semantic approaches to polarity effects.

The exact semantic properties of scalar *ani* follow from its polarity nature: *ani* is licensed in semantics and requires the strongest type of NPI environment, a so-called anti-morphic environment which licenses superstrong NPIs, (Krifka 1995; Zwarts 1998; Gajewski 2011). An operator O is anti-morphic if it meets the two following logical requirements:

1. it is anti-additive which means that O verifies the predicate-logic biconditional $O(P(x) \lor Q(x)) \equiv O(P(x)) \land O(Q(x))$ – the definition of anti-additive logical strength (Zwarts 1998: 222). Among the expressions of natural language, which are anti-additive, are sentential negation, negative quantifiers in non negative concord languages, and universal quantifiers. Universal quantifiers are anti-additive because the following predicate-logic equivalence holds:

$\forall x((P(x) \lor Q(x)) \to R(x)) \equiv (\forall x(P(x) \to R(x)) \land \forall x(Q(x) \to R(x)))$ – where

$\forall x(P(x) \to R(x))$ formalizes natural language universal quantifier in a subject position, the predicate $P(x)$ formalizes the restriction and $R(x)$ the nuclear scope, as usual. Another environment which is at least formally anti-additive is the material implication since the following propositional logic equivalence is valid: $((p \lor q) \to r) \equiv ((p \to r) \land (q \to r))$. But the material implication is not the most suitable formalization of natural language conditionals (as is well known, see von Fintel (1999) for a classic linguistic reflection), which is one of the reasons that Gajewski (2005: 62) classifies antecedents of conditionals as Strawson anti-additive, not simply anti-additive. Nevertheless, neither a universal quantifier nor an antecedent of a conditional seems to license *ani*. But to be sure about it, we tested the licensing of *ani* in the antecedent clauses of conditionals, and the experiment confirmed that *ani* isn't licensed there (see Section 2.1.2 for details). For these reasons, we classify *ani* as a superstrong NPI requiring an anti-morphic environment on top of the anti-additive logical property.

2. An operator is anti-morphic if (it is anti-additive plus) applied to a negation of some expression equivalent to a negation of the operator applied to the (non-negated) version of the expression: $O(\neg X) = \neg O(X)$. Classical verbal negation (interpreted as logical negation) is, of course, anti-morphic since $\neg(\neg X) = \neg\neg(X)$. This doesn't hold for a universal quantifier since $\neg\forall x[P(x) \to Q(x)]$. $\forall x[P(x) \to \neg Q(x)]$ which is the reason for a superstrong NPI *one bit* in (4) being licensed only by the verbal negation but not by the downward entailing

(and anti-additive) quantifier *every student* (example adapted from Zwarts 1998: 232).[3]

(4) a. John wasn't one bit happy about these facts.
     b. *Every student was one bit happy about these facts.

The superstrong nature of *ani* NPIs explains their ability to be licensed in the complements of negated Neg-raising verbs as opposed to non-Neg-raising verbs, see the contrast in (5a) vs. (5b), experimentally verified for Czech in Dočekal and Dotlačil (2016). Neg-raising predicates (unlike non-Neg-raisers as verbs of communication or causation) do share the "transfer of negation" property with anti-morphic environments: x ¬ *wants p* ceteris paribus implies that x *wants ¬ p* (see Gajewski 2007).[4]

(5) a. Petr   nechce,   aby   se   ztratila
        Petr-SG.M.NOM NEG-want-3SG.M COMP SE lost-3SG.F.FUT
        ani   jedna knížka   z   knihovny.
        even one   book-SG.F.NOM from library-SG.F.GEN
        'Petr doesn't want even one book from the library to be missing.'

     b. *Petr   neříkal,   že   se   ztratila
        Petr-SG.M.NOM NEG-say-3SG.M.PST that SE lost-3SG.F.FUT
        ani   jedna knížka   z   knihovny.
        even one book-SG.F.NOM from library-SG.F.GEN
        'Petr didn't say that even one book from the library got lost.'

Even if the semantic sensitivity of *ani* NPIs was established before, the exact nature of its pragmatic behaviour wasn't thoroughly tested, so we designed an experiment to check the pragmatic (likelihood) properties of *ani*. Now we will introduce the theoretical assumptions behind the experiment. We follow the line of the analysis presented in Krifka (1995), Lahiri (1998), and Crnič (2011). The theoretical ingredients we need are the following:

    i. NPIs are licensed both in semantics (in our case by anti-morphic operators) and pragmatics;

    ii. NPIs introduce alternatives which in case of strong and superstrong NPIs are integrated into the truth-conditions of their respective sentences (the prejacent) via covert pragmatic operator close in meaning to English *even*;

       – The core meaning contribution of the covert *even* is its unlikelihood presupposition, e.g., a sentence like *Petr laughs at even the most stupid jokes* (besides its at-issue meaning) has a likelihood presupposition

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[3] The literature on types of NPIs is alas not totally coherent: we use the label anti-morphicity in the same way as Krifka (1995) and Zwarts (1998). For a different approach to anti-additivity and anti-morphicity see Gajewski (2005) where anti-morphicity is defined via deMorgan equivalence, corresponding to what Krifka, Zwarts, and we call anti-additivity.

[4] But as one of the anonymous reviewers correctly points out, Gajewski classifies neg-raising as an anti-additive environment, not anti-morphic.

correlating unlikelihood of laughing at *x* with stupidity of *x* – the presupposition is triggered by overt *even*; the covert counterpart of *even* figures in the licensing of strong and superstrong NPIs.

– The likelihood is related to entailment: logically stronger propositions are less likely then logically weaker propositions.

Technical implementation: *even* takes two arguments: its prejacent *p* and a set of alternative propositions (to *p*), *q* (*q* being a product of classical Roothian alternative semantics); moreover we follow Crnič (2011) among others in allowing *even* to move in Logical Form. The formalization of the presupposition is in (6) after Crnič (2014, ex. (4)). It simply requires the prejacent to be less likely than all its focus alternatives.

(6) $\text{even}(C)(p,w)$ is defined only if $\forall q \in C: p \neq q \rightarrow p <_c q$.

Application to example (3): *even* either scopes below negation – (7a) or with a wider scope than negation – (7b), the alternatives for (7b) are the propositions in (7b'): generated by alternative cardinalities of the NP in (7b). (7a) is a possible scope for *even* but *even*'s likelihood presupposition wouldn't be satisfied. The alternatives for (7a) are in (7a'), the presupposition of *even* requires the alternatives to be less likely (and consequently logically stronger) than the prejacent but in this case, the entailment goes the other way round: from *q* to *p* and the prejacent cannot be less likely than the alternatives: the alternative $\exists x[\#(X)=2 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)]$ entails the prejacent $\exists x[\#(X)=1 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)]$, so the alternative is less likely than the prejacent and the presupposition of *even* is not satisfied. The situation changes when the covert *even* scopes over negation as in (7b): here the alternatives are in (7b') and since the rule of transposition of implication in logic equals the following two formula $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$, the negated alternative $(\neg\exists x[\#(X)=2 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)])$ and all other alternatives with higher cardinalities are implied by the prejacent $\neg\exists x[\#(X)=1 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)]$ in the same way the positive *p* entails *q*; and because of that the unlikelihood presupposition of *even* is satisfied. The presupposition treatment of *ani* + its associates then predicts likelihood/entailment sensitivity of *ani*, which is exactly what was tested in the experiment described further.

(7)   a. $\neg\exists x[\textit{even}[\#(X)=1 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)]]$
       b. $\textit{even}[\neg\exists x[\#(X)=1 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)]]$
       a'. $q=\{\exists x[\#(X)=2 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)], \exists x[\#(X)=3 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)], \dots\}$
       b'. $q=\{\neg\exists x[\#(X)=2 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)], \neg\exists x[\#(X)=3 \wedge \text{Product}(X) \wedge \text{GotRotten}(X)], \dots\}$

Another prediction of our approach then is that *ani* is (if it scopes over the negation) expected to associate with weak elements in most cases where the weak

elements (due to the lexical semantics of the verb) entail in a positive case the other alternatives. This fits nicely with the discussed collocations of *ani* (recall: expressions denoting bottom ends of cardinal scales or minimal speech contributions). On the other hand, if the lexical semantics of the predicate is such that the entailment is reversed, an association with strong elements is predicted to be possible. For such a case, consider a natural example in (8) where the predicate *stačit* 'be enough' reverses the logical entailment (against the predicate as *zkazit* 'get rotten' in (3), where the entailment – in the negated variant – goes from alternatives *n* to *n+1* inductively; in the case of predicates like *be enough* the entailment goes from *n* to *n-1* inductively). In example (8), if 100 million is not enough, then 100 million minus one Euro is also not enough but not the other way round. This explains why *ani* in (8) can associate with the high end of a scale without problems.

(8) ani   100 miliónů   eur   nebude   zájemcům
     even   100 million-PL.M.GEN euro   NEG-be-3SG.N applicant-PL.M.GEN
     z   Anglie   či Francie   stačit
     from   England-SG.F.GEN or France-SG.F.GEN be-enough-INF
     'Even 100 million euro will be not enough for applicants from England or France.'

We follow Crnič (2011) and Krifka (1995) in describing the polarity licensing in terms of likelihood. This pragmatic treatment of NPIs licensing is different from the purely semantic approach to NPIs as in Zwarts (1998). Our main reason for adopting the pragmatic theory of NPI licensing is its flexibility, allowing us to deal with cases of *ani* licensing in non-monotonic (non-entailing) contexts. Consider alternatives like *{John didn't become a priest, John didn't become a bishop, John didn't become a pope}*. The alternatives are logically independent but are sorted by likelihood and as we will discuss in detail in Section 2.1.2, Czech speakers strongly favor *ani* with the least likely alternatives (*a priest* in this context) even among such logically independent alternative propositions. We think that such subtle sensitivity is beyond the reach of purely semantic theories of NPI licensing.

2. Experiment

This section focuses on a relation between the likelihood and scopal properties of Czech *ani* 'NEG-even' and its NPI-behaviour as they were tested in the experiment. We experimentally tested *ani* in several environments so-called conditions; specifically, we tested (i) whether Czech *ani* behaves as a super-strong NPI; (ii) whether its occurrence depends on the likelihood presupposition; and (iii) whether there is a relation between the conditions and the covert *even* scopal properties.

    First, we introduce the design of the experiment and then the results we obtained. We can foreshadow already that the experiment confirmed that Czech

ani (i) behaves like a superstrong NPI and that (ii) it carries unlikelihood presupposition.

2.1. Method

2.1.1. Procedure and Participants

The experiment consisted of two parts, one immediately following the other. The experiment contained tested sentences as items, and controlled sentences as fillers. We used Latin square design in both experimental parts, which prevented any item appearing twice, i.e., each item occured only once in the whole experiment for each subject, whereas individual conditions cycled with the subjects. The order of items and fillers was presented to each participant randomly but in such a way that an item always alternated with a filler.

The experiment was run on Ibex and participants performed the experiment online (the web address of the experiment: spellout.net/ibexexps/iveta/october_2018/experiment.html). The experiment began with instructions, then practice items; after the practice, subjects judged real items and fillers.

The experiment was distributed by HUME Lab – the Experimental Humanities Laboratory at Masaryk University to the students enrolled in a course focused on experimental methods taught by HUME Lab. The students received course credit for their participation. 50 Czech native speakers participated in the experiment.

2.1.2. Materials

The experiment consisted of truth value judgment task: the experiment tested whether a sentence fits a given context, with the context preceding the target sentence. We used a 5-point Likert scale from 1 (*absolutně nepřijatelná věta* 'completely unacceptable sentence') to 5 (*věta je naprosto v pořádku* 'completely acceptable sentence'). The experiment consisted of two parts.

Part 1: there were 18 items and 18 fillers in the first part of the experiment in two sub-conditions: (i) items with *i* 'even', and (ii) items with *ani* 'not even'. The sample item including both sub-conditions is in (9).

(9) Context: Students received a list of recommended literature, consisting of six books, for an exam. However, passing the exam is not always influenced by the number of books studied.

a. Petr přečetl **i** šest knih, ale zkoušku neudělal.   TOP
   'Petr even read the six books, but he failed the exam.'

b. Petr nepřečetl **ani** šest knih a zkoušku udělal.   TOP
   'Petr didn't even read the six books, and he passed the exam.'

c. Petr přečetl **i** tři knihy, ale zkoušku neudělal.   MID
   'Petr even read three books, but he failed the exam.'

d. Petr nepřečetl **ani** tři knihy a zkoušku udělal.   MID
    'Petr didn't even read three books, and he passed the exam.'

e. Petr přečetl **i** jednu knihu, ale zkoušku neudělal.   LOW
    'Petr even read one book, but he failed the exam.'

f. Petr nepřečetl **ani** jednu knihu a zkoušku udělal.   LOW
    'Petr didn't even read one book, and he passed the exam.'

This is a typical type of condition where the theory predicts that *ani* should associate only with weak elements (the condition LOW) since the main predicate *přečíst* is downward monotonic: if Petr read *n* books, he read *n-1*, etc. In this study, we deal with the second sub-condition concerning *ani* because we explore NPI-behaviour of *ani*; for a related debate concerning the PPI behaviour of *i* see Dočekal and Šafratová (2019). For that reason, we limit our discussion (in the present paper) only to conditions with *ani* 'NEG-even', and leave the investigation of *i* 'even' aside. A sample glossed item restricted to the second sub-condition (negative *even*) is in (10).[5] All items were tested in three conditions:

1. TOP: top of the scale (10a)
2. MID: middle of the scale (10b)
3. LOW: low of the scale (10c)

(10) a. Petr   nepřečetl   **ani**   šest   knih
         Petr-SG.M.NOM   NEG-read-3SG.M.PST   even   six   book-PL.F.GEN
         a   zkoušku   udělal.
         and   exam-SG.F.ACC   pass-3SG.M.PST
         'Petr didn't even read the six books, and he passed the exam.'

    b. Petr   nepřečetl   **ani**   tři   knihy
        Petr-SG.M.NOM   NEG-read-3SG.M.PST   even   three   book-PL.F.ACC
        a   zkoušku   udělal.
        and   exam-SG.F.ACC   pass-3SG.M.PST
        'Petr didn't even read three books, and he passed the exam.'

    c. Petr   nepřečetl   **ani**   jednu   knihu
        Petr-SG.M.NOM   NEG-read-3SG.M.PST   even   one   book-SG.F.ACC
        a   zkoušku   udělal.
        and   exam-SG.F.ACC   pass-3SG.M.PST
        'Petr didn't even read one book, and he passed the exam.'

There is an ad hoc scale given by the context. The logical scale for the contextual alternatives is in (11-a): the stronger alternative always entails the weaker alternatives. Because of the contextual entailment, the likelihood is ordered as

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[5] The context used in the examples (9) and (10) remains the same.

in (11b): the stronger alternative is less likely than the weaker alternatives and the ranking or likelihood respects the entailment.

(11) a. x read 6 books → x read 5 books → … → x read 1 book
   b. x read 6 books $<_C$ x read 5 books $<_C$ …. $<_C$ x read 1 book

The alternative *x read 6 books* is the strongest one in the given context because it entails all alternatives, and at the same time, it is the least likely alternative because *x read 6 books* is less likely than other alternatives. The likelihood respects entailment in this case; therefore the strongest alternatives *x read 6 books* is also the least likely alternative.[6] We used other contextual and logical scale in the experiment too, as given by way of examples in (12).

(12) a. contextual scale: write a thesis → write two chapters → write notes
   b. logical scale: 3 visitors come → 2 visitors come → 1 visitor come

The theoretical framework predicts that NPI *ani* should associate with the most likely alternative in the positive scale (as in (11)), which becomes the least likely alternative when the proposition is negated as in the items of the experiment: recall that *x ¬ reads 1 book* entails all alternative propositions *x ¬ reads n books* and consequently is the least likely among the alternatives. Therefore, we expected that the condition LOW should be the most acceptable and we predict low acceptability of the condition MID and the condition TOP.

Part 2: there were 32 items and 32 fillers in this part in the same two sub-conditions as in the first part: (i) items with *i* 'even', and (ii) items with *ani* '(not) even'. The sample item including both sub-conditions is in (13).

(13) Context: The hierarchy of the Catholic Church consists of various ranks. The lowest rank is a priest, the highest rank is pope and somewhere in the middle is a bishop. The mother is deeply religious and wants her son to become a priest. However, the father strongly opposes her and wants their son to study mathematics.

   a. Syn se nakonec nestal **ani** knězem.   NEG-ANI
      'In the end, the son didn't become NEG-even a priest.'

   b. Syn se nakonec nestal **ani** papežem.   NEG-ANI-TOP
      'In the end, the son didn't become NEG-even the pope.'

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[6] The likelihood respects entailment, but if there is no entailment, the likelihood can be manipulated in any way.

In other words, the likelihood depends on the presence or the absence of entailment. If there is an entailment between alternatives, the likelihood is given by the entailment; however, if the entailment is missing, the likelihood between alternatives can be manipulated by the context. For instance, the proposition *Archaeologists will come to the party* is logically independent of the proposition *Linguists will come to the party*, i.e., neither one of them entails the other, but we can imagine that either *archaeologists* or *linguists* are a more likely group to come to the party. Therefore, if there is no entailment between these two propositions, we can manipulate a context and cause one proposition to be more likely than the other proposition.

c.   Jestli se syn stane **ani** knězem, otec bude mrzutý.   COND-ANI
     'If the son becomes neg-even a priest, his father will be annoyed.'

d.   Otec nechce, aby se jeho syn stal **ani** knězem.   NR-ANI
     'The father doesn't want his son to become NEG-even a priest.'

e.   Matka nechce, aby se její syn stal **i** papežem.   NR-I
     'The mother doesn't want her son to become even the pope.'

f.   Syn se nakonec nestal **i** papežem.   NEG-I
     'In the end, the son didn't become even the pope.'

g.   Jestli se syn stane **i** papežem, otec bude velmi naštvaný.   COND-I-TOP
     'If the son becomes even the pope, the father will be annoyed.'

h.   Jestli se syn stane **i** knězem, otec bude velmi naštvaný.   COND-I-BOT
     'If the son becomes even a priest, the father will be annoyed.'

We used logical and contextual scales in this part, as in the first part of the experiment. All items were tested in all conditions, but in the present study, we focus on a subset of conditions exploring *ani* 'NEG-even'. A discussion concerning the PPI *i* can be found in Dočekal and Šafratová (2019); a related investigation of *ani* and Neg-Raising is reported in Dočekal and Dotlačil (2016, 2018).

– NEG-ANI: *ani* in a simple negative sentence associating with the bottom of scale (14a)
– NEG-ANI-TOP: *ani* in a simple negative sentence associating with the bottom of scale (14b)
– COND-ANI: *ani* in the antecedent of the conditional associating with the bottom of scale (14c)

A sample glossed item restricted to these 3 conditions is the following:[7]

(14) a. Syn   se nakonec   nestal   **ani**
         son-SG.M.NOM SE in-the-end NEG-become-3SG.M.PST even
         knězem.
         priest-SG.M.INS
         'In the end, the son didn't become even a priest.'

     b. Syn   se nakonec   nestal   **ani**
         son-SG.M.NOM SE in-the-end NEG-become-3SG.M.PST even
         papežem.
         pope-SG.M.INS
         'In the end, the son didn't become even the pope.'

     c. Jestli se syn   stane   **ani**
         if   SE son-SG.M.NOM become-3.SG.M.FUT even
         knězem,   otec   bude   mrzutý.
         priest-SG.M.INS father-SG.M.NOM be-SG.M.FUT annoyed-3SG.M.NOM
         'If the son becomes even a priest, his father will be annoyed.'

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[7] The context remains the same for both examples (13) and (14).

The contextual scale of the alternatives given in the context is the following:

(15) a. x become the pope → x become a bishop → x become a priest
b. x become the pope $<_C$ x become a bishop $<_C$ x become a priest

The context is manipulated in such a way that the alternative *x become the pope* is the strongest one, and it entails *x become a bishop* and *x become a priest* because in most prototypical contexts. If somebody becomes the pope, he had to have become a bishop and a priest before. At the same time, the alternative *x become the pope* is the least likely alternative among other alternatives in the context. We again used mostly negated (or at least downward entailing/anti-additive conditions), so we expected that *ani* will associate with weak elements too since in DE contexts the weak associates become logically strongest and the least likely. Nevertheless, the alternatives are strictly logically independent (see our discussion at the end Section 1.1 above).

2.2. Results

We present here the statistical output of both parts of the experiment and the figures demonstrating the results. Responses were modeled using linear mixed-effects models (in R package *lmer*).

The fillers were non-controversially grammatical/acceptable (in their context), and we checked whether the average of each participant's responses to ungrammatical fillers was lower than the average of their responses to grammatical fillers. The difference was at least 1.5 on the Likert scale, which indicates that all the participants successfully passed the fillers; hence, we kept all the subjects in the subsequent analysis.

2.2.1. Part 1

To begin, we present results from the first part of the experiment. We constructed a mixed linear model, which tested whether subjects' answers can be predicted from a condition (fixed effect) and whether the conditions are statistically significantly different. The model had one predictor, i.e., the reference level condition: the condition MID and all fixed effects were significant (the model also included random effects for subjects and items). The model shows that the condition LOW was statistically significantly different from the reference level condition MID and the condition TOP statistically significantly differs from the reference level condition MID as well.[8]

The statistical output of the model is the following:

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[8] Three stars in the last column indicate the high statistical difference between the given condition and the reference level condition. The significance code is as follows: '***' 0.001; '**' 0.01; '*' 0.05; '.' 0.1; and no mark is 1.

Table 1. The statistical output: Part 1

Fixed effects:					
	Estimate Std.	**Error**	**df**	**t value**	**Pr(>|t|)**
(Intercept)	3.4901	0.2020	16.7490	17.274	4.17e-12***
Condition Low	0.7269	0.1445	382.5049	5.031	7.53e-07***
Condition Top	−0.7346	0.1445	382.5049	-5.084	5.79e-07***

Table 2. Correlation of Fixed Effects: Part 1

	(Intr)	Cndtnl
Condition Low	−0.358	
Condition Top	−0.358	0.500

Error-bars of the individual conditions of the first part of the experiment are shown in Figure 1.[9]

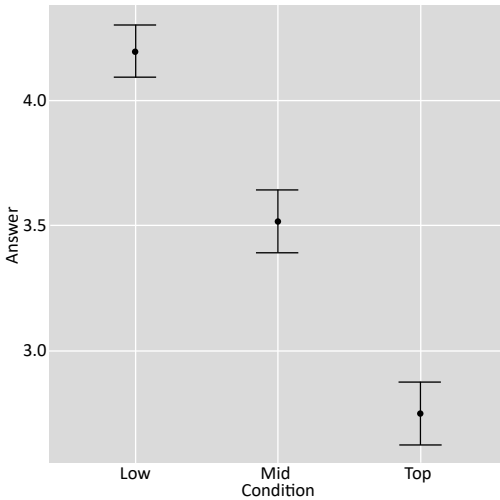

Figure 1. Results of Part 1

The statistical output and descriptive statistics show:

(i) the high preference for weak expressions associating with *ani;*

(ii) due to negation reversing the direction of the entailment and the likelihood, *ani* is a weak expression, but associates with the least likely alternative from the set of alternatives (the bottom of the scale: the condition LOW)

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[9] Error-bars don't show the real variation among participants, but rather the variation, which from the data, one would expect can occur if repeating the experiments. Namely, they show the expected variation among experiments.

whereas the association with the most likely alternative leads to strong un-acceptability (the top of the scale: the condition TOP);

(iii) in-between-acceptability for the MID condition is surprising: we assume that subjects used some rescue strategy as domain shrinking to satisfy the universal unlikelihood presupposition (we will discuss this point further bellow).

2.2.2. Part 2

We constructed the mixed linear model for the second part of the experiment too, as in the first part of the experiment. The model had one predictor – reference level condition: the condition NEG-TOP. And again, each condition statistically significantly differs from the reference level condition; specifically, the condition NEG was significantly different from the condition NEG-TOP and the condition COND-POS significantly differs from the condition NEG-TOP too (the model again included random effects for subjects and items): NEG was more acceptable (positive t value), COND-POS was considered worse.

The statistical output of the second part of the experiment is the following:

Table 3. The statistical output: Part 2

Fixed effects:					
	Estimate Std.	Error	df	t value	Pr(>|t|)
(Intercept)	2.2084	0.1275	96.5876	17.326	2e-16***
Condition CondPos	−0.5888	0.1377	532.7231	−4.275	2.26e-05***
Condition Neg	1.2854	0.1367	541.2981	9.404	2e-16***

Table 4. Correlation of Fixed Effects: Part 2

	(Intr)	Cndtnl
Condition CondPos	−0.536	
Condition Neg	−0.536	0.499

Error-bars of the individual conditions of the second part of the experiment are shown in Figure 2.
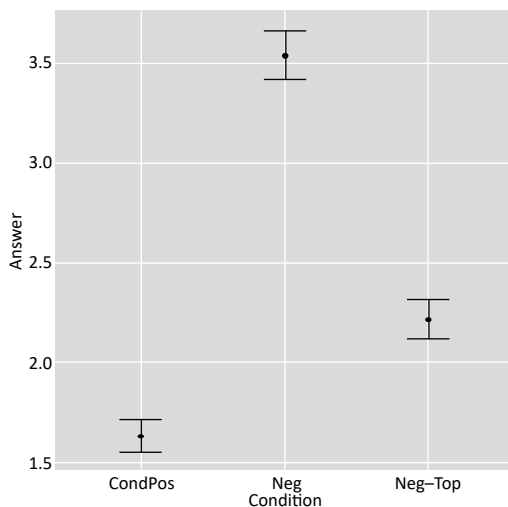
Figure 2. Results of Part 2

The statistical output and descriptive statistics show:

(i) *ani* prefers to associate with weak elements (the acceptability of the condition NEG was higher than the acceptability of the condition NEG-TOP) which confirms the results of the first part of the experimental;

(ii) *ani* is un-acceptable in the positive antecedent of the conditionals (the condition COND-POS), *ani* really needs the anti-morphic environment, DE/anti-additivity is not enough to license it.

2.2.3. Overall results

To summarize the first and the second part of the experiment, the descriptive statistics showing the means and medians of the individual conditions is the following:

Table 5. Means and medians of the individual conditions

	Condition	Means	Medians
1	CondPos	1.632653	1
2	Low	4.190476	5
3	Mid	3.517007	4
4	Neg	3.540816	5
5	Neg-Top	2.214286	2
6	Top	2.755102	3

Error-bars of the individual conditions of both experimental parts are shown in Figure 3.
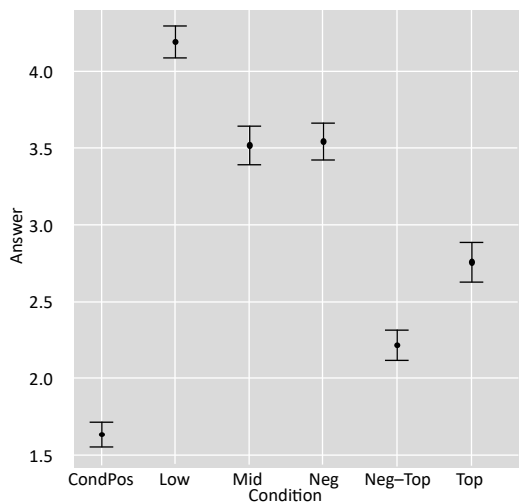
Figure 3. Overall results

The summary clearly shows the interplay of both semantic factors (required anti-morphic environment → low acceptability of COND-POS) and pragmatic factors: *ani* associates with weak elements on scales which due to the anti-morphic environment are interpreted as the least likely (theoretical explanation in the scope theory of *even*: *even* has wider scope than the negation and compares the prejacent with negated alternatives).

3. Summary

Let us summarize now: both the experimental findings and the way they fit into the assumed semantic-pragmatic theory of NPIs licensing. Let's begin with the clearest contrasts:

1. From the highest acceptability of LOW and low acceptability of TOP, it is clear that a purely semantic theory of *ani* NPIs cannot be right: both conditions tested the acceptability of *ani* NPIs in negated sentences but only in LOW condition, where *ani* associated with weak elements, did they fulfill the unlikelihood presupposition of the covert *even*. This shows that purely semantic concepts as anti-morphicity are not enough to explain *ani*'s behaviour. A similar conclusion can be drawn from even lower acceptability of NEG-TOP.

2. In our experiment we observed relatively high acceptability of Neg-Raising licensing of *ani* NPIs (the observed mean was 2.628, still better than NEG-ANI-TOP, e.g.) but because we discuss this issue elsewhere (Dočekal and Dotlačil 2016, 2018), we don't go into further details in the current article simply to save the space. In a nutshell, the Neg-Raising licensing confirms the semantic nature of *ani* licensing since it shows non-local dependency of the

NPI and its licensor, something that would be hard to explain in purely syntactic approaches to NPI licensing.

3. Relatively interesting is the 3.5 (mean) acceptability of MID: from the data we gathered in the experiment, we believe it can be hypothesized that some sort of domain shrinking strategy is the source of this (unexpectedly) high acceptability. Because otherwise the universal nature of *even* presupposition would be violated and another type of NPI theory would have to be accepted, we would like to blame an independent reason like pragmatic shrinking of the domain, as most of the experiment's results seem to be in accordance with the theory. Nevertheless, we plan to design a follow-up experiment to investigate this issue more thoroughly.

4. From the point of view of movement theory of *even*, it seems surprising that subjects were unable to associate high scalar items with *ani* (again the conditions TOP and NEG-TOP). Theoretically, this can be explained via the obligatory wide scope of *even* over negation. But why this should be the case, is to some extent unclear (the scope theory of *even* predicts that a schematic scope such as [¬[*even* … strong element]] should be acceptable despite its measured low acceptability rate.

To summarize the whole experiment, we can say that Czech *ani* NPIs behave like a relatively nice example of a superstrong class of NPIs: (i) they need anti-morphic environments (totally un-acceptable in purely Downward Entailing environments: COND-POS); (ii) their licensing is of a pragmatic nature too: only unlikelihood prejacents are good as their hosts.

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