Chapter 2

N-words and NPIs: Between syntax, semantics, and experiments

Mojmír Dočekal
Masaryk University in Brno

In this paper I experimentally approach the following question: do strict negative concord languages like Czech employ two strategies (syntactic and semantic) to encode negative dependency between a verb and its argument(s) or not? And the answer is: beside the default syntactic strategy (n-words), there is a class of negative dependent expressions which are licensed by semantic rules.

Keywords: n-words, negative polarity items, experiments, neg-raising, Czech

1 Introduction

In this article I focus on a problem of dividing negative dependent expressions into two classes: (i) N-WORDS like Czech *nikdo* 'nobody' or Romanian *nimeni* 'nobody' (glossed as N-PERSON) in (1a); (ii) NEGATIVE POLARITY ITEMS (NPIs) like Czech *sebemenší šance* 'slightest chance ' or Romanian *vreun* 'any' in (1b). Despite the long research traditions on both types of expressions (for NPIs see Heim 1984; Ladusaw 1992; Kadmon & Landman 1993; Krifka 1995; Giannakidou 1997; Lahiri 1998; Gajewski 2011; Chierchia 2013; Crnič 2014 among many others; for n-words see Laka 1990; Zeijlstra 2004; 2008 among others) there is still no consensus on the relationship between the two classes of items.[1]

[1]Both n-words and NPIs are generally grammatical in sentences with a negated verb. There are of course language-specific differences, e.g. English NPI *any* usually cannot appear in subject position, Romanian *vreun* 'any' in (1b) behaves similarly but many languages allow NPIs to freely occur in subject position – Błaszczak (2001) lists Hindi, Korean, Japanese among many other languages where NPIs are licensed in any position of a sentence with a negated verb. Slavic languages discussed in detail further belong to the set of languages allowing NPIs in subject position, too.

Mojmír Dočekal. 2020. N-words and NPIs: Between syntax, semantics, and experiments. In Franc Marušič, Petra Mišmaš & Rok Žaucer (eds.), *Advances in formal Slavic linguistics 2017*, 15–49. Berlin: Language Science Press. DOI:10.5281/zenodo.3764845

(1) a. Nimeni nu a venit.
n-person not has come
'Nobody came.'

b. * Vreun student nu a venit.
npi student not has come
Intended: 'No student did not come.'

(Romanian; Fălăuș & Nicolae 2016: 586, 591)

Nevertheless, it seems to be settled that the division between n-words and NPIs correlates with the division between syntactic licensing and semantic licensing along the following lines:

1) n-words are syntactically negative dependent expressions;[2]

2) negative polarity items are semantically negative dependent expressions.

Some languages lexicalise the difference between NPIs and n-words, as shown in the example (1) but sometimes the distinction manifests itself only via stress (and usually consequently) focus marking. An example of the second strategy is in (2) from Giannakidou & Zeijlstra (2017) where the non-focused expression *kanenan* 'anybody' is (according to standard criteria) an NPI while the focused expression KANENAN 'n-person' behaves as a n-word.

(2) a. Dhen idhe kanenan o Janis.
not saw npi.person the John
'John didn't see anybody.'

b. Dhen idhe KANENAN o Janis.
not saw n-person the John
'John didn't see anybody at all.'

(Greek; Giannakidou & Zeijlstra 2017: 17)

[2]This classification is of course very schematic and it can be a bit problematic to apply it to a set of typologically diverse languages. Consider e.g. Romance languages where it seems to be possible to use n-words in questions and in context without overt verbal negation (cases of indirect negative verbs like *doubt* a.o.). Romance languages (and generally all non-strict negative concord languages) allow moreover preverbal n-words in affirmative sentences (as a rule in non-strict negative concord languages, preverbal n-words require positive verb, unless the speaker wants to convey a double negation reading: see Laka (1990) for many examples and further details). But even if the cross-linguistic scenery of n-words is more nuanced than the distinction n-words=syntax, NPIs=semantics suggests, the classification is generally correct and can be applied even to Romance (and generally non-strict negative concord languages), once our syntactic toolbox is supplemented with phonologically null operators which license n-words (see Zeijlstra 2004 a.o. for such a theory) – the licensing of such operators is of course highly constrained (see again Zeijlstra 2004 and Zeijlstra 2008 for details).

Next to the classification of n-words as being basically licensed in syntax (either via agreement or some other standard syntactic process) and NPIs as semantically dependent expressions (occurring only in environments with specific monotonicity properties) there is also an agreed-upon criterion of teasing apart the two classes, one of its recent formalizations can be found in Giannakidou & Zeijlstra (2017) – see (3), their example (16).[3] The criterion is partially meaning based and partially relies on context felicity of n-words. Its working will be exemplified in the following sections.

(3) X qualifies as an n-word iff:
  a. X can be used with structures with sentential negation or other X with meaning equivalent to one ¬; and
  b. X provides a negative fragment answer.

In this article I discuss mainly experimental evidence from Czech which allows us to answer a research question: do languages like Czech (where the evidence to differentiate between n-words and NPIs is very limited) distinguish between n-words and NPIs (particularly the class of NPIs called strong NPIs)? Why is Czech (and generally strict negative concord languages) a good data source for finding differences between strong NPIs and n-words? Because even if the introduced distinction between syntactically licensed n-words and semantically licensed NPIs is supported by many researchers today (Zwarts 1998; Zeijlstra 2004 and Gajewski 2011 among others), there are very influential theories which subsume n-words under NPIs (Ladusaw 1992) or observe close relationship of the two classes (Laka 1990): in such theories the distinction between syntactic licensing (n-words) and semantic licensing (NPIs) of course disappears. The question of nature (if any … depending on the theory) of the distinction between n-words and NPIs is theoretically still open and empirically is especially vexing in strict negative concord languages because there the environment where a speaker can get positive evidence about the distinction between n-words and NPIs boils down to neg-raising contexts. This is the reason of centrality of neg-raising for NPI debate – see further §2 and §3.1.

To foreshadow the experiments discussed in much bigger detail later, let us consider the following set of Czech sentences (items from one of the experi-

[3] Beside n-words and their cross-linguistic variation with respect to the strictness of negative concord, there is also a variation in NPIs: while generally NPIs are bad as negative fragment answers, one particular subtype of them, minimizers provide felicitous fragment answers, see Giannakidou (1998) and Błaszczak (2001) for further details. Thanks to an anonymous reviewer for pressing these points about n-words and NPIs licensing variation.

ments): if asked about grammaticality of such sentences, Czech native speakers would consider (4a) ungrammatical, (4b) perfectly acceptable, (4c) good and (4d) and (4e) bad to some extent. Such graded judgments of sentences containing (what I will argue further to be) strong NPIs, in concreto graded acceptability of strong NPIs depending on the presence of negation and/or the type of embedding verb and some other factors was the original motivation for running the series of experiments resulting in the current article. It is important to notice that there is variation among speakers, variation caused by lexical items used in the tested sentences, etc. This naturally calls for an experimental verification because relying on a researcher's intuitions in such cases can lead to totally conflicting claims: e.g. Bošković & Gajewski (2011) state non-existence of neg-raising in Slavic languages, while Dočekal & Dotlačil (2016a) defend limited existence of neg-raising in Czech. The experimental data and their careful analysis – in the light of current formal semantic theories – allow me to avoid such contradicting claims and eventually isolate the relevant factors behind NPI licensing and an interaction of the licensing with other syntax-semantics phenomena as neg-raising, etc.[4]

(4) a. * Zmizela ani jedna knížka.
Lost not.even one book
'A single book is missing.'

b. Nezmizela ani jedna knížka.
NEG.lost not.even one book
'Not a single book is missing.'

c. Náš nový knihovník nechce, aby zmizela ani jedna knížka.
our new librarian NEG.wants COMP lost not.even one book
'Our new librarian doesn't want even one book to be missing.'

d. Náš nový knihovník si nepředstavuje, že zmizela ani jedna knížka.
our new librarian SE NEG.imagine COMP lost not.even one book
'Our new librarian doesn't imagine that even one book is missing.'

e. Náš nový knihovník neslyšel, že zmizela ani jedna
our new librarian NEG.heard COMP lost not.even one

[4] Thanks to an anonymous reviewer for raising importance of this general background question to me.

knížka.
book
'Our new librarian didn't hear that even one book was missing.'

The article is organized as follows: in the first, more theoretically based part (§2) I will illustrate the empirical criteria distinguishing n-words and NPIs, then I will tease apart so called weak NPIs from strong NPIs and lastly I will introduce the basic observations about Czech and negative dependent expression. §3.1, §3.2, and §3.3 will be more of the experimental linguistic character, they are heavily based on the joint work with Jakub Dotlačil (partially reported in Dočekal & Dotlačil 2016a,b; 2017). In concreto, I will report the experimental evidence for distinguishing n-words from NPIs stemming from three classes of phenomena: (i) neg-Raising contexts; (ii) fragment answers; (iii) likelihood manipulated contexts. The nature of this article is more overview-like, the details about statistics, design of the experiments, etc. can be found in Dočekal & Dotlačil (2016a,b; 2017); Dočekal & Šafratová (2018).

2 NPIs vs. n-words: Theory

2.1 N-words

Let us start with introducing some important pieces of linguistic knowledge concerning n-words, the expressions which are generally taken as syntactically dependent on negation and which are different both from negative quantifiers on the one hand and from NPIs on the other hand.

N-words crucially differ from Germanic negative quantifiers as the following contrast in (5) shows: English verbal negation and a negative quantifier in (5a) yield only a double negation reading while the word for word translation of (5a) into Czech with the n-word *nikoho* 'anybody' and verbal negation in (5b) is interpretable only with one negation scoping wide over the whole sentence as is clear from the predicate logic formalization. Generally, n-words are syntactically dependent expressions which occur only in languages where some form of negative concord is attested.

(5) a. John didn't see nobody. (English)
$\neg\exists x[\textsc{person}(x) \wedge \neg\textsc{see}(\textsc{John}, x)]$

b. John nikoho neviděl.
John nobody NEG.saw
'John didn't see anybody.' (Czech)
$\neg\exists x[\textsc{person}(x) \wedge \textsc{see}(\textsc{John}, x)]$

The distinction between n-words and NPIs already mentioned in the criterion in 3 is illustrated in (6): (6b) illustrates the unavailability of NPIs as fragment answers versus the perfect acceptability of n-words in the same context in (6d) – the Czech translation of the (6a) – (6b) mini-dialogue.

(6) *NPIs ≠ n-words:*
   a. Whom did you talk to?
   b. * Anybody. / Nobody.
   c. S kým jsi mluvil?
      with whom AUX spoke?
      'With whom did you speak?'
   d. S nikým.
      with nobody
      'With nobody.'

There are at least two influential theories of n-words: the first one treats n-words as non-negative indefinites (predicate of type $\langle e, t \rangle$) which are required to be in the scope of clause-mate negation (so called roofing requirement from Ladusaw (1992), see Giannakidou (1997) for an historical overview). The second type of theory compares n-words to agreement markers which nicely explains their locality requirements, basically their need to be licensed syntactically by clause-mate negation. The second type of approach is developed in Zeijlstra (2004) and Zeijlstra (2008). In this article I will follow the syntactic agreement approach even if nothing hinges too much on the particular framework as far as it constrains the distribution of n-words to clauses with overt verbal negation. This locality constraint is one of the usually mentioned contrasts between n-words and NPIs since unlike NPIs which just need to be in a scope of negative element, n-words need a local negation as the following contrast from Giannakidou & Zeijlstra (2017) shows.

(7) Dhen prodhosa mistika [pu eksethesan [kanenan /*KANENAN]].
    not betrayed.1SG secrets that exposed.3PL anybody N-BODY
    'I didn't reveal secrets that exposed anybody.'
    (Greek; Giannakidou & Zeijlstra 2017: 18)

It should be noted that the locality requirement of n-words varies across languages but for n-words in Slavic languages the locality requirement is very strict as observed already by Progovac (1993). So unlike in Spanish, Italian or Greek where the licensing of n-words sometimes (especially in case of subjunctive embedding) can span from a negation on the root verb to n-words in embedded clauses, such licensing is ungrammatical in Slavic languages, see the following examples from Czech.

(8) a. * Petr neřekl, že nikdo přišel.
Petr NEG.said that N-BODY came
Intended: 'Petr didn't say that anybody came.'

b. Petr řekl, že nikdo nepřišel.
Petr said that N-BODY NEG.came
'Peter said that nobody came.'

c. * Petr nechce, aby tu nikdo byl.
Petr NEG.wants COMP.SBJV here N-BODY were
Intended: 'Petr doesn't want anybody to be here.'

d. Petr chce, aby tu nikdo nebyl.
Petr wants COMP.SBJV here N-BODY NEG.were
'Peter wants nobody to be here.'

2.2 NPIs

A prototypical example of an NPI is the English expression *any* – see the seminal work of Kadmon & Landman (1993) (and there for older references). If an NPI occurs in a sentence without negation it results in an ungrammatical sentence – (9). If it occurs in a negated sentence like in (10), the only interpretation is a scope of *any* under negation: (10a) vs. the unavailable interpretation in (10b). In English a quantifier *few students* (which shares with negation the relevant property of downward entailingness – discussed shortly) licenses NPIs in the object: (11).

(9) * Peter visited anyone.

(10) Petr didn't visit anyone.

a. Available: $\neg\exists x[\textsc{person}(x) \wedge \textsc{visit}(\textsc{Peter}, x)]$

b. Unavailable: $\exists x[\textsc{person}(x) \wedge \neg\textsc{visit}(\textsc{Peter}, x)]$

(11) Few students visited anyone.

Next, negation is not the only expression licensing NPIs which (at least in the case of so called weak NPIs) sets NPIs apart from n-words which are licensed only by negation. Compare the following Czech paradigm in (12) where the

NPI/minimizer *sebemenší šance* 'slightest chance' contrasts with the adjectival n-word *žádnou* (glossed as N-ADJ). The NPI licensing expression in (12a) is the quantifier *málo studentů* 'few students'. The negation and other NPI licensing expressions share the property of reversing the direction of entailment in their argument. Notice how negation reverses entailment in Table 1: logical conjunction entails logical disjunction in a positive case but negated logical disjunction entails negated logical conjunction – notice the tautological status of both formulas in Table 1. Because of the entailment reversion property of NPI licensors their essential quality is called downward entailing (DE) and is generally accepted by scholars as the most probable common denominator of NPI environments (since Ladusaw 1992 at least).[5]

(12) a. Málo studentů mělo sebemenší šanci složit tu zkoušku.
few students had slightest chance to.pass the exam
'Few students had the slightest chance to pass the exam.'

b. # Málo studentů mělo žádnou šanci složit tu zkoušku.
few students had N-ADJ chance to.pass the exam
Intended: 'Few students had any chance to pass the exam.'

Table 1: Entailment properties of conjunction and disjunction

p	q	$(p \wedge q) \rightarrow (p \vee q)$	$\neg(p \vee q) \rightarrow \neg(p \wedge q)$
1	1	1	1
0	1	1	1
1	0	1	1
0	0	1	1

In natural language the reasoning of monotonicity is frequently applied in relation to sets, subsets and supersets. Notice the predicate logic implications in

[5] I will discuss in more detail the distinction between weak and strong NPIs. In the literature there are various attempts to reclassify the landscape of NPIs, one of them Rullmann 1996, following the work of Krifka 1995 and further elaborated in Lahiri 1998 points out that there is a special class of NPIs – in Rullmann's terms *even*-NPIs (*ook maar*-series in Dutch) which seem to be an indefinite incorporated with the semantics of the scalar focus particle *even*. *Even*-NPIs are inherently scalar and interact with focus. Czech *ani*-NPIs have precisely the characteristics of *even*-NPIs as I will discuss later. In this respect they belong to the same class (*even*-NPIs) as stressed English *any* and the *ook maar*-series in Dutch. Thanks to an anonymous reviewer for pointing out the importance of this cross-linguistic comparison.

(13) which corresponds to the patterns from the propositional calculus. If there is some x in the intersection of P and Q denotation then necessarily there is an x in P and Q union (13a). And if there is no x in P and Q union, then there cannot be any x in their intersection (13b). So in a affirmative sentence (in predicate logic non-negated formula) the entailment goes from an subset (intersection) to a superset (union) while in a negated sentence, the entailment is reversed and proceeds from a superset (union) to its subset (intersection). A natural language example is in (14): the denotation of NP *red wine* is a subset of the NP *wine* denotation and in an affirmative sentence (14a) the entailment is from a subset to a superset, not vice versa: (14b). In a negated sentence the entailment reverses: (14c).

(13) a. $\exists x[P(x) \wedge Q(x)] \rightarrow \exists x[P(x) \vee Q(x)]$
 b. $\neg\exists x[P(x) \vee Q(x)] \rightarrow \neg\exists x[P(x) \wedge Q(x)]$

(14) red wine → wine
 a. John likes red wine. → John likes wine.
 b. John likes wine. ↛ John likes red wine.
 c. John does not like wine. → John does not like red wine.

The general condition stating that NPIs occur in downward entailing (DE) environments can be stated like (15), from (von Fintel 1999: 100).[6]

(15) Fauconnier–Ladusaw's Licensing Condition: An NPI is only grammatical if it is in the scope of an α such that $[\![\alpha]\!]$ is DE.

The downward monotonic and upward monotonic reasoning in case of quantifiers works like this: upward monotonic quantifiers allow reasoning from subsets to supersets while downward monotonic quantifiers from supersets to subsets: (16). Natural language examples of upward, downward and non-monotonic quantification are presented in (17).

(16) a. DET A is upward entailing iff for any B, C $(B \subseteq C)$ DET $A\,B \Rightarrow$ DET $A\,C$

[6] The licensing condition has to be understood as necessary, not sufficient: there are cases of intervention in NPIs licensing (see Linebarger 1987 for an early treatment and Homer 2008 for a more recent approach), then cases of NPIs being unacceptable even in simple negative sentences (see Uribe-Echevarria 1994 and Błaszczak 2001). But as none of the experiments reported further addresses such type of data, for the purposes of this paper I stick to (15), as a working definition of NPI licensing.

b. $\text{DET}\,A$ is downward entailing iff for any B, C $(B \subseteq C)$
$\text{DET}\,A\,C \Rightarrow \text{DET}\,A\,B$

c. if not upward or downward monotonic → non-monotonic

(17) Upward/Downward entailing and non-monotonic determiners:

a. *some:* Some toys are blue ⇒ Some toys are colored

b. *few:* Few toys are colored ⇒ Few toys are blue

c. *exactly n:* Exactly three toys are blue ⇎ Exactly three toys are colored

It is important to notice that monotonicity properties belong to a position in a sentence and they are computed compositionally: so a position in a sentence can be upward entailing even if it occurs in the scope of a downward entailing quantifier. In (18) the object position is in the scope of two DE quantifiers and consequently is upward monotonic, as the validity of the entailment pattern shows.[7]

(18) a. [↓ At most three detectives arrested ↓[fewer than four ↑[criminals]]]

b. →[↓ At most three detectives arrested ↓[fewer than four ↑[humans]]]

2.3 Weak and strong NPIs

There is a class of NPIs, so called WEAK NPIs with prototypical English examples like *any* or *ever*. Weak NPIs occur in all downward entailing environments as illustrated in (19).

(19) a. Bill didn't ever say anything.

b. No student ever said anything.

c. Few students ever said anything.

d. At most 5 students ever said anything.

e. * Between 5 and 10 students ever said anything.

f. * {Some/all/most} students ever said anything.

The second class of NPIs instantiated by English expressions like *in weeks*, additive *either*, and punctual *until* are so called STRONG NPIs and as the name suggests,

[7]Early discussion of this compositionality which can lead to flip-flop effects in NPIs licensing can be found in Baker (1970), a recent study incorporating some experimental findings is Geurts & van Der Slik (2005).

they occur only in a subset of environments where weak NPIs are grammatical as illustrated in (20).[8]

(20) a. Bill didn't leave until his birthday.
b. No student left until his birthday.
c. * Few students left until their birthdays.
d. * At most 5 students left until their birthdays.
e. * Between 5 and 10 students left until their birthdays.
f. * {Some/most/all} students left until their birthdays.

The logical property which licensors of strong NPIs share (negation and *no* in (20)) is a strengthened form of entailment reversal and usually is named anti-additivity.[9] In using anti-additivity as the necessary condition for strong NPI acceptability I follow seminal work of Zwarts (1998). There is a popular alternative explanation of strong NPIs and their behavior in Gajewski (2011) which describes their stricter distribution via downward entailing properties but checked both in at-issue meaning and in the presupposition/implicature part of the meaning. I will stick to the classic theory of anti-additivity here: the definition is in (21). (22) illustrates the anti-aditivity (the quantifier *no* is anti-additive since negation is always anti-additive as is clear from deMorgan's law: $\neg(p \vee q) \leftrightarrow (\neg p \wedge \neg q)$). But DE quantifiers like *few students* in (23) are not anti-additive – imagine a scenario

[8] The interaction of strong NPIs and locality is a vast topic but notice the following pattern from Romoli (2013: 317):

(i) a. John doesn't think that Mary will arrive until tomorrow.
b. * John isn't certain that Mary will arrive until tomorrow.

As the pattern shows, licensing of strong NPIs is always possible in case of negated neg-raising predicates like *think* but results in ungrammaticality in cases of negated non-neg-raisers as the predicate like *be certain*.

[9] The full hierarchy of negative strength is the following one: anti-morphicity > anti-additivity > downward entailing (anti-morphicity defined after Krifka 1995: an operator O is anti-morphic iff: $O(\neg X) = \neg O(X)$; negation is anti-morphic unlike English negative quantifier *no* as can be seen from the following equivalence and non-equivalence *John wasn't happy = It's not the case that John was happy* vs. *No student wasn't happy ≠ It's not the case that no student was happy*). Being the strongest negative expression (like verbal negation) entails being classified as anti-additive and downward entailing automatically. Strong NPIs are usually taken to be licensed by operators of at least anti-additive strength – see the grammaticality of (20b). In Slavic languages (strict negative concord) it is not that easy to tease apart anti-additivity and anti-morphicity of negative NPs headed by *no* but it seems that strong NPIs in Slavic require at least anti-additive licensors as well.

with 10 students, three of them drinking and three of them smoking, then $\vee$ part of (23) is false while $\wedge$ part of (23) is true.[10]

(21) Anti-additive function: $F(x \vee y) \leftrightarrow F(x) \wedge F(y)$

(22) No student smokes or drinks $\leftrightarrow$ No student smokes and no student drinks.

(23) Few students smoke or drink $\nleftrightarrow$ Few students smoke and few students drink

2.4 NPIs vs. n-words

Returning now to the broader question of distinguishing between NPIs (negative dependent expressions licensed in semantics via notions like monotonicity and/or anti-additivity) and n-words (negative dependent expressions licensed in syntax via agreement), it is acknowledged that such a distinction corresponds nicely with a well established modularity architecture of a grammar where usually we distinguish between different forms of well-formedness such as syntactic or semantic, corresponding to well-formedness which is located in different modules of grammar. But the picture is not so clear when we consider recent theories of NPI licensing where the logical properties correlate with syntactic acceptability of NPIs. In concreto: if ungrammaticality of NPIs in upward entailing environments is due to lack of the right monotonicity properties in them, then we are in fact linking the domains of semantics with syntax. And in some theories (Heim 1984; Crnič 2014) of NPIs licensing where the licensing of NPIs is postulated via presupposition the linking goes even further: between the licensing in pragmatics with syntactic acceptability. Recent theories of NPIs (Chierchia 2013) and strong NPIs (Gajewski 2011) seem to point in the same direction.

Before we move to the experimental part of the article, let us have an outlook of Czech data scrutinized in much more detail in the series of experiments I will report. In Czech there are two candidates both at first sight reasonable for the NPI

[10]Corresponding to the full scale of negative strength – see the previous footnote – some researchers like Krifka (1995) and Van der Wouden (2002) distinguish weak (licensed in downward entailing contexts), strong (licensed in anti-additive contexts) and super-strong NPIs (licensed in anti-morphic contexts). Due to the strict negative concord properties of Slavic languages (discussed in the previous footnote too) I will stick to the basic dichotomy: weak/strong NPIs where strong NPIs would subsume the strong and the super-strong NPIs from the more nuanced classifications. Thanks to an anonymous reviewer for pointing out the importance of this issue.

or n-word status: *ani (jeden)* 'not even (one)' and *žádný* 'N-ADJ'. As the following example demonstrates, both require clause-mate negation in basic cases, so both can be thought of as either n-words or strong NPIs (the embedded clauses of communicative verbs can be shown to be non-anti-additive: details to follow).

(24) a. Petr neviděl {ani jednoho / žádného} studenta.
Petr NEG.saw even one N-ADJ student
'Petr didn't see any student.'

b. {*Ani jeden / *žádný} student přišel.
even one N-ADJ student came
'Not even one/any student came.'

c. Petr neslyšel, že {*ani jeden / *žádný} student přišel.
Petr NEG.heard that even one N-ADJ student came
'Petr didn't hear that even one/any student came.'

So it is well conceivable that four logical possibilities of classifying *ani jeden* 'not even one' and *žádný* 'N-ADJ' are reasonable. Czech tradition like Havránek et al. (1960) can be interpreted as Table 2 suggests, so basically treating both types of expressions as syntactically dependent on negation.

Table 2: Czech traditional grammar on *ani* vs. *žádný*

item/profile	NPIs	n-words
ani jeden	✗	✓
žádný	✗	✓

And as it is clear from the previous discussion, the division between n-words and strong NPIs is subtle – the only other clause-mate environment (next to negation) which passes the test of anti-additivity are prepositions like English *without* (compare the equivalence of: *John left the pub without paying and saying good bye* ↔ *John left the pub without paying or John left the pub without saying good bye*). So it is reasonable to ask a research question like (25). Neg-concord languages like Czech (and generally all Slavic languages) do employ negative dependency on negation via n-words, so is there a reason for a language to maintain a set of expressions which does nearly the same job but is licensed in semantics? In the rest of the article I will argue for the positive answer to the question: the experimental evidence clearly shows that *ani (jeden)* 'not even (one)' expressions pattern like strong NPIs, not like n-words, while *žádný* 'N-ADJ' are n-words.

(25) Research question: do strict neg-concord languages even allow grammaticalization of strong NPIs?

3 Experimental evidence

In the three following sections I will discuss the experimental evidence which allows us to tease apart n-words from NPIs. First in §3.1 I will report evidence coming from the behavior of NPIs in neg-raising constructions: NEG-RAISING (NR) is a primarily interpretational phenomenon where a negation of verbs like *think, believe* or *want* is most saliently understood as scoping over their embedded verb (*I don't want to leave* ≈ *I want not to leave*, compared with a lack of such interpretation in case of non-NR predicates: *I don't say I will leave* ≉ *I am saying that I will not leave*). In §3.2 the evidence for distinguishing between n-words and NPIs will come from their different acceptability as fragmentary answers to questions. And in §3.3, the two classes will be shown to behave differently with respect to their entailment and likelihood properties.

3.1 Neg-raising

Because NPIs are licensed in the semantic part of the grammar engine, they are (ceteris paribus) expected to be able to be licensed at long distance. N-words as syntactically dependent on negation have to obey strict locality conditions unlike NPIs. And even more importantly, if the licensing of NPIs happens in semantics, their licensing should be sensitive to properties of their embedding verbs, in case of NR-predicates, NPIs should appear in the embedded clauses of NR-predicates but are predicted to be unacceptable in the embedded clauses of non-NR predicates (verbs of communication or causation). If we construe such long distance licensing, the expected pattern should look like the one in Table 3: n-words cannot be licensed across a clausal boundary, while NPIs can be licensed from their embedding clause. Nevertheless in case of NR-predicates, we expect a sharp difference between predicates like *want* or *believe* and non-NR predicates like *hear, say,* or *force*.

The experimental results which bear on this issue are summarized in more detail in Dočekal & Dotlačil (2016a). Let us call this experiment Experiment 1. Experiment 1 consisted of 5 conditions demonstrated in (26), one of the items of the experiment. The experiment tested acceptability of sentences containing NPIs and focused on neg-raising.

Table 3: n-words vs. NPIs in Neg-raising and non-NR contexts

environment/status	NPIs	n-words
NR embedded	✓	✗
non-NR embedded	✗	✗

(26) a. Ztratila se ani jedna ovce.
Lost SE not.even one sheep
'A single sheep is missing.'

b. Neztratila se ani jedna ovce.
NEG.lost SE not.even one sheep
'Not a single sheep is missing.'

c. Nový bača v Tatrách nechce, aby se ztratila ani jedna ovce.
new shepherd in Tatras NEG.wants COMP SE lost not.even one sheep.
'The new shepherd in Tatras doesn't want even one sheep to be missing.'

d. Nový bača v Tatrách si nemyslí, že se ztratila ani jedna ovce.
new shepherd in Tatras SE NEG.think COMP SE lost not.even one sheep
'The new shepherd in Tatras doesn't think that even one sheep is missing.'

e. Nový bača v Tatrách neříká, že se ztratila ani jedna ovce.
new shepherd in Tatras NEG.say COMP SE lost not.even one sheep
'The new shepherd in Tatras doesn't say that even one sheep is missing.'

The sentences represent 5 environments listed below:

(A) an affirmative sentence

(B) a negative sentence

(C) a clause embedded under negated NR predicates of intention and judgement/obligation (e.g. *want, advise*)

(D) a clause embedded under negated NR predicates of opinion (*believe*)

(E) non-NR predicates

Experiment 1 tested only NPIs: *ani jeden* was one two NPIs in it, the second one *až do* 'until' + time expression is not important for this article, n-words were not tested. The descriptive statistics of Experiment 1 is visualized in Figure 1: the x-axis represents the 5 conditions and the y-axis represents the 5-point Likert scale (1 = the least acceptable, 5 = the most acceptable). The boxplots summarize the acceptability in the usual manner. As is evident from the graph, Condition A was the least acceptable, Condition B most accepted, all other conditions somewhere in the interval between the two extremes. The most important difference for this article is the one between the conditions C and D and E where E represents non-NR predicates and was perceived as less acceptable by native speakers. This seems to be result of unlicensed NPI in the embedded clauses of non-NR predicates. I discuss the design of Experiment 1 in more detail here because the following two experiments (viz §3.2 and §3.3) have an analogical design and statistical modeling. When describing the following two experiments, I will be less eloquent.

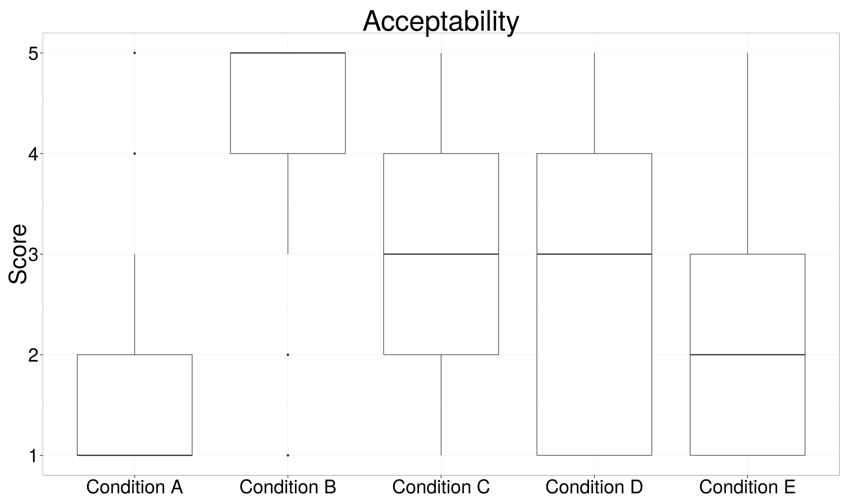

Figure 1: Results of Experiment 1

The results of the experiment can be theoretically explained in the scalar approach to NR (Horn 1973; Romoli 2012; 2013). In the scalar theory of neg-raising NR predicates (beside the assertion – (27a)) contribute the excluded middle (EM) implicature to the semantic composition (27b). And finally the alternatives generated by the implicature are exhaustified by EXH – (28).

(27) a. $[\![\text{NR}]\!] = \lambda p \lambda x. \Box_x [p]$

b. $\text{ALT}([\![\text{NR}]\!]) = \{\lambda p \lambda x. \Box_x [p], \lambda p \lambda x. [\Box_x [p] \vee \Box_x [\neg p]]\}$

(28) $\text{EXH}(\text{ALT}(p))(p)(w) = p(w) \wedge \forall q \in \text{EXCL}(p, \text{ALT}(p))[\neg q(w)]$

I will illustrate the mechanics of the scalar theory of NR on an example item from Experiment 1: (29). Formula in (30a) shows the alternatives generated by the excluded middle implicature from (27b): it is the negated at-issue meaning ($\neg\text{WANT}_s[p]$) and the excluded middle part ($\neg(\text{WANT}_s[p] \vee \text{WANT}_s[\neg p])$). The excluded middle in this case formalizes the involvement of the subject *s*: he either wants the proposition *p*, or he wants the negation of *p* but he cannot be uninterested with respect to *p*. The excluded middle for other classes of NR-predicates has an analogous meaning: opinionatedness for *know*/*believe*, clear intentions for *plan*, etc. Compare the lack of such an excluded middle meaning in predicates of communication: a speaker can say *p* or neg *p* but he can be silent about *p* as well. (30b) then shows the exhaustification of the alternatives: the at-issue meaning remains the same but the excluded alternative is negated – the usual strenghtening of the sentence meaning via negating its alternatives. The at-issue meaning and double negated excluded middle alternative then (via deductive reasoning) yield the semantic low scope of negation in the embedded proposition. So, as a consequence of exhaustification of the NR predicate and its excluded middle implicature, the negation is of the NR predicate is interpreted as having low scope (semantically).

(29) 'A new shepherd in Tatra mountains doesn't want even one sheep to be missing.'

$\neg\text{WANT}_s[p]$

(30) a. $\text{ALT}(\neg\text{WANT}_s[p]) = \{\neg\text{WANT}_s[p], \neg(\text{WANT}_s[p] \vee \text{WANT}_s[\neg p])\}$

b. $\text{EXH}(\neg\text{WANT}_s[p]) = \neg\text{WANT}_s[p] \wedge \neg\neg(\text{WANT}_s[p] \vee \text{WANT}_s[\neg p]) \models \text{WANT}_s[\neg p]$

Let us recall that strong NPIs are licensed by anti-additive functions: functions which obey deMorgan's laws which naturally is true for negation: a natural language example is presented in (31a) and (31b) where the entailment is bidirectional and in propositional logic in (31c) and (31d) where the same meaning equivalence holds.

(31)
a. It didn't rain and it didn't snow.
b. It didn't rain or snow.
c. $\neg p \wedge \neg q$
d. $\neg[p \vee q]$

In the case of NR predicates like *want* in (32) the embedded clause qualifies as an anti-additive environment due to the NR-transfer of negation: (32a) is equivalent to (32b) – both require p and q being false in all possible worlds – see Table 4 with an example of two possible worlds. In such a model both logical formulas in (32c) and (32d) are true.

(32)
a. Susan does not want to sleep and she does not want to dance.
b. Susan does not want to sleep or dance.
c. $\Box\neg p \wedge \Box\neg q \leftrightarrow$
d. $\Box\neg(p \vee q)$

Table 4: A fragment of possible worlds for (32)

world/proposition	p	q
w_1	0	0
w_2	0	0

But consider an example of non-NR predicates like *say* in (33a) and (33b). (33b) does not follow from (33a) since non-NR predicates if negated allow only the high scope of negation interpretation: (34a) – and such an interpretation is the following: it requires there to be at least some possible worlds where the propositions p and q are false. But (34a) is stronger: it requires both propositions p and q to be false in all possible worlds. (34a) would be true in a valuation of propositions across possible worlds in Table 5 but (34b) would be false in such a model. In other words: non-NR predicates do not create anti-additive environment in their embedded clauses. And since strong NPIs need anti-additivity, they are unlicensed in the embedded clauses of non-NR predicates.

(33) a. Susan didn't say that she will sleep and she didn't say that she will dance.
b. Susan didn't say that she will sleep or dance.

(34) a. $\neg\Box p \wedge \neg\Box q$ (true in the table)
b. $\neg\Box[p \vee q]$ (false in the table)

Table 5: A fragment of possible worlds for (33a)/(33b)

world/proposition	p	q
w_1	0	1
w_2	1	0

Returning now to the initial predictions: Experiment 1 confirmed the NPI status of *ani (jeden)* – if *ani (jeden)* were an n-word, the contrast between NR predicates (*ani (jeden)* licensed) and non-NR predicates (*ani jeden* not acceptable) would be unexplained since syntactic licensing should not be sensitive to semantic distinctions between anti-additive and non-anti-additive environments. So we can conclude this section with a first clear experimental confirmation of classifying *ani (jeden)* as a strong NPI. Moreover it was established that anti-additivity is a necessary condition for licensing the strong NPI *ani (jeden)*. Experiment 1 itself did not establish contrast between strong NPIs (*ani (jeden)*) and n-words but its results would be unexpected if *ani (jeden)* were not a strong NPI. Experiment 1 did not test intuitions for *žádný*, the reason for that is the following one: *žádný* is perceived by native Czech native speakers to be grammatical only if it appears in a sentence with local negation (26b) type of sentences. So unlike in case of *ani (jeden)* where the judgments are much more graded, there is no need to experimentally establish the acceptability of *žádný*.

Table 6: N-words vs. NPIs in Neg-raising environments

environment/status	NPIs	n-words
NR embedded	✓	✗
non-NR embedded	✗	✗

3.2 Fragment answers

Another distinction mentioned already in criterion 3 is the distinction between n-words and NPIs with respect to their ability to be fragmentary answers to questions. Roughly, n-words are good fragmentary answers, while NPIs are generally not acceptable as fragmentary answers. Similarly to the situation in NR contexts reported in the last section, the acceptability of *ani (jeden)* as a fragmentary answer seems to be more varied than in case of n-words which are always good as fragment answers. I pre-experimentally noticed that especially in cases where the question supplies more context, the NPIs seem more acceptable, following the pattern in (35). The fragment answers were tested in two expriments; first in Experiment 2 the fragment answers were tested against minimal context questions.

(35) a. Kdo byl dneska večer na náměstí?
who was today evening on square?
'Who was today in the evening on the square?'

b. ? Ani jeden člověk.
NPI one human
'Not even one man.'

c. Kdo tu dneska byl?
who here today was
'Who was here today?'

d. ??? Ani jeden člověk.
NPI one human
'Not even one man.'

In Experiment 2 (details can be found in Dočekal & Dotlačil 2017), there was a negative interaction of *ani* and ellipsis in non-negative questions like (36). In other words, as expected n-words were judged by speakers as better fragmentary answers than NPIs. The statistical outcome is visualized in Figure 2 – the relevant condition is ELLIPSIS and blue bar for n-words, red for NPIs.

(36) Kdo odešel z hospody?
who left from pub?
'Who left the pub?'

a. Žádný student.
N-ADJ student
'No student.'

b. ?? Ani jeden student.
NPI one student
'Not even one student.'

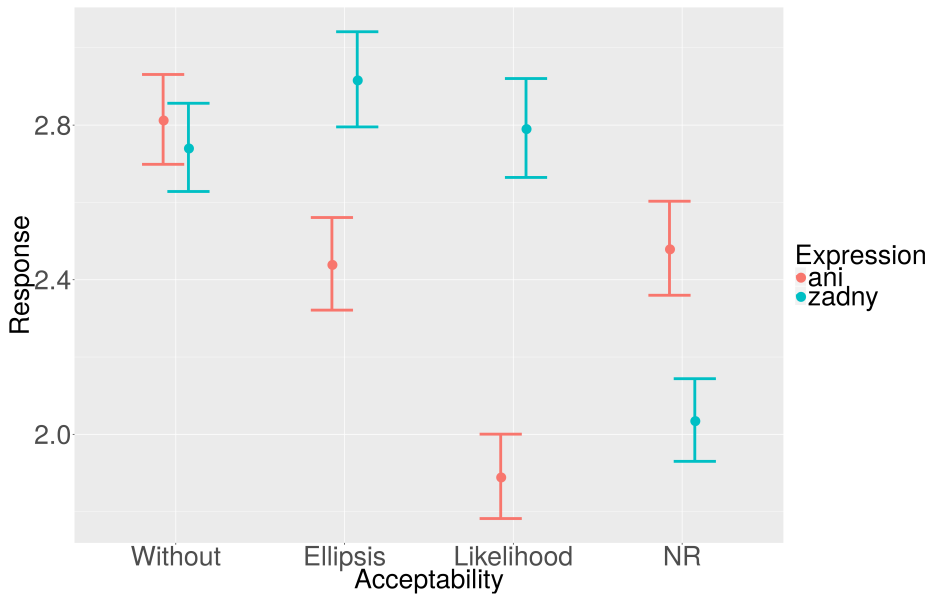

Figure 2: Results of Experiment 2

The theoretical explanation of this known difference is usually provided via a possible reconstruction of n-words and unavailability of reconstruction for NPIs. Because NPIs are usually not able to reconstruct under a possible licensor in their scope (De Swart 1998) like in the following example where NPI *any* student in the cleft cannot reconstruct to its base object position under the quantifier *no professor* which would license it.[11]

(37) *It is any student that no professor likes.

We further elaborated the fragment answer distinction in Experiment 3 (details can be found in Dočekal & Dotlačil 2017) where we provided more contextual

[11] Again the ban on NPI reconstruction can be side-stepped with a carefully constructed example as the following sentence from Uribe-Echevarria (1994: p.17) shows: *A doctor who knew anything about acupuncture was not available*. It seems though that in such cases it is the whole subject NP (containing the NPI) reconstruction which saves grammaticality of NPI and this type of construction seems to be highly restricted. Nevertheless thanks to an anonymous reviewer for pointing this out.

informations like in the example item (38). In this experiment the correlation disappeared: see Figure 3 – conditions FragNPI vs. FragNword with no difference in acceptability.

(38) Koho vyhodil profesor Palný včera ze zkoušky?
whom fired prof Palný yesterday from exam?
'Who was fired by prof Palný during yesterday's exam?'

a. Žádného studenta.
N-ADJ student
'No student.'

b. Ani jednoho studenta.
NPI one student
'Not even one student.'

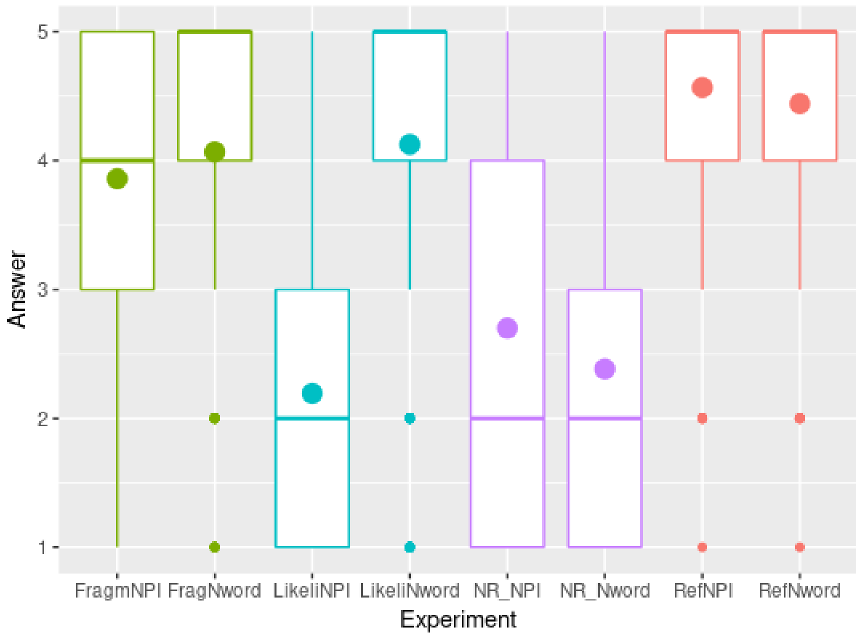

Figure 3: Results of Experiment 3

The ability of n-words to appear as fragmentary answers is usually taken as the standard distinction of n-words against NPIs. But in a recent paper Fălăuș & Nicolae (2016) observe a strikingly related phenomen: the authors claim (based on data from many strict neg-concord languages) that in strict neg-concord languages n-word answers to negative questions can have (surprisingly) a Double Negation (DN) reading. This observation goes against the n-words vs. NPIs criterion as it falsifies the meaning part of it: n-words and (reconstructed) negation yield only one semantic negation. I checked Fălăuș & Nicolae's (2016) claims with 10 native speakers of Czech and they seem to be valid – see example (39): there seems to be even a preference (8/10) for the DN reading – (39a) but the negative concord reading (39b) is considered to be possible (for 2 out of 10 speakers).

(39) Kdo nepřečetl žádný článek?
who neg.read N-ADJ article
'Who didn't read any article?'

a. Nikdo.
Nobody. (None of us read a single one.) NC (2/10):
$\neg\exists x, y[\textsc{person}(x) \wedge \textsc{article}(y) \wedge \textsc{read}(x, y)]$
$\equiv \forall x[\textsc{person}(x) \rightarrow \neg\exists y[\textsc{article}(y) \wedge \textsc{read}(x, y)]]$

b. Nikdo.
Nobody. (Each of us read an article) DN (8/10):
$\neg\exists x[\textsc{person}(x) \wedge \textsc{article}(y) \wedge \neg\textsc{read}(x, y)]$
$\equiv \forall x[\textsc{person}(x) \rightarrow \exists y[\textsc{article}(y) \wedge \textsc{read}(x, y)]]$

Fălăuș & Nicolae (2016) solve the availability of DN reading of n-words via postulating another (focus-related) position for covert negation (CN): in the left periphery of a clause as in the tree in Figure 4. The position is according to Fălăuș & Nicolae (2016) licensed via n-word movement to the left peripheral position above TP. A negation in the left periphery is a second negation in a sentence, next to the reconstructed negation from the question (surface negation, SN). So the first negation in (39b) is the interpretation of covert negation, the second one of the verbal negation. If we follow Fălăuș & Nicolae (2016), we can explain the puzzling disappearance of contrast between n-words and NPIs (Experiment 3) as a consequence of the covert negation – if such a negation appears in a clause, the NPIs are licensed because they do not need to reconstruct under the scope of verbal negation and then the contrast between n-words and NPIs disappears. There are many questions raised by postulating such covert negation, especially with respect to possible over-generation – at the end n-words in strict negative concord languages cannot appear in sentences without negation but postulating covert negation leaves this robust observation unexplained. Fălăuș & Nicolae (2016) try to resolve such problems by restricting the covert negation only to controllable set of cases, all somehow related to focus movement of n-words to

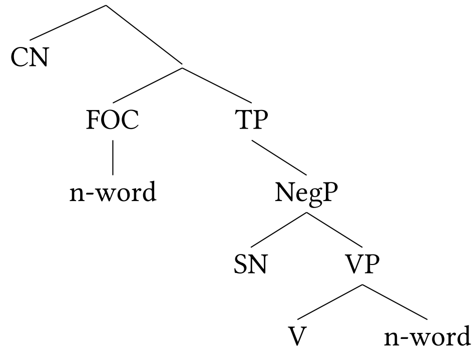

Figure 4: Covert negation, syntax

the left periphery. I tried to verify their claims and conducted a small survey again with the same 10 speakers of Czech and it seems that Fălăuș & Nicolae's general idea is confirmed with an interesting twist. Let us start with a basic case – (40) is interpreted only with NC reading as is visible from the ranking in (40a) and (40b) – a double negation reading is simply non-existent.

(40) Nikdo ničemu nevěří.
N-PERSON N-THING NEG.believes
'Nobody believes anything.'
   a. NC: $\forall x[\textsc{person}(x) \rightarrow \neg\exists y[\textsc{entity}(y) \wedge \textsc{believe}(x, y)]]$
   b. * DN: $\forall x[\textsc{person}(x) \rightarrow \exists y[\textsc{entity}(y) \wedge \textsc{believe}(x, y)]]$

But in case of information structure manipulation like in (41), which is even an affirmative sentence, the double negation reading surprisingly emerges. A similar pattern is observed in (42). The sentences moreover seem to have the double negation reading only. This confirms Fălăuș & Nicolae's hypothesis about focus position of the CN: example (40), where there is no object movement to the left periphery (unlike in (41) and (42)), has only the expected NC reading. In this article it is not possible to explore more details of this interesting appearance of double negation reading in a negative concord language like Czech but more importantly: it seems to be reasonable to postulate another position for negation in the left periphery of a clause, such a position (because it is somehow licensed via focus) can then blur the picture of the fragmentary answer criterion and the fluctuation of acceptability of NPIs as fragmentary answers observed in Experiment 3 is no longer a mystery, context manipulation can lead to a focus related CN licensing of even strong NPIs as fragment answers.

(41) V nic nikdo nevěří.
in N-THING N-PERSON believes
'Nobody believes in anything.'
a. * NC (0/10): $\forall x[\textsc{person}(x) \rightarrow \neg\exists y[\textsc{entity}(y) \wedge \textsc{believe}(x, y)]]$
b. DN (10/10): $\forall x[\textsc{person}(x) \rightarrow \exists y[\textsc{entity}(y) \wedge \textsc{believe}(x, y)]]$

(42) Nic při té zkoušce nikdo nenapsal.
N-THING at the exam N-PERSON NEG.wrote
'Nobody wrote anything during the exam.'
a. * NC (0/10): $\forall x[\textsc{person}(x) \rightarrow \neg\exists y[\textsc{entity}(y) \wedge \textsc{write}(x, y)]]$
b. DN (10/10): $\forall x[\textsc{person}(x) \rightarrow \exists y[\textsc{entity}(y) \wedge \textsc{write}(x, y)]]$

Summary of this section: there seems to be some evidence for classifying *ani* as an NPI and *žádný* as an n-word which stems from the fragment answer experiments. When the results diverge from the expected dichotomy, there seems to be a reasonable explanation via postulation of a second covert negation in the sentence.

3.3 Likelihood scenarios

The last environment discussed in this article concerns the semantic properties of sentences where n-words vs. NPIs occur. The straightforward predictions are the following:

1) n-words (licensed in syntax) should not be sensitive to logical properties of their environment (they require just sentential/verbal negation)

2) NPIs are licensed in semantics and by definition are dependent on semantic properties like DE, anti-additivity, etc.

I will pursue the line of distinguishing NPIs from n-words via the NPI sensitivity to monotonicity and likelihood. And I will base my reasoning on a very influential theory of NPI licensing, the so called simple *even* hypothesis of NPI licensing (Heim 1984; Krifka 1995; Crnič 2014 – I will call the theory Heim/Crnič theory further). The theory describes NPIs using the following three ingredients:

- NPIs associate with covert *even* – the formalization can be via a formal [*even*] feature carried by the NPIs, etc.

- NPIs (like focused element) generate sets of possible alternatives;

- covert *even* associates with the alternatives and generates presupposition of its prejacent being the least probable member of the set of alternatives (entailing all the alternatives) – in case of association with *even* (some authors suggest different covert licensors of NPIs too);

The immediate predictions of the Heim/Crnič theory is that NPIs should be sensitive to probability and entailing properties. The first and the second one are logically related: a proposition p cannot be more likely than a proposition q, if p entails q: intuitive illustration – p being *Rambo killed 100 enemies*, q being *Rambo killed 99 enemies*, p entails q and p is less likely than q; q does not entail p and is more likely than q – see Crnič (2011) for details of relating entailing and likelihood. The theoretical intricacies away, the prediction that NPIs should be sensitive to logical properties like entailing or probability while n-word not is uncontroversial, see Table 7 for a visualization of these predictions.

Table 7: N-words vs. NPIs in probability manipulated environments

property/item	entailment/probability
n-words	✗
NPIs	✓

And exactly this prediction was tested in Experiment 2 and Experiment 3. In both we found a strong correlation of *ani* and probability. As a side note: a corpus survey (the biggest national Czech corpus, Křen et al. (2015)) confirms the likelihood sensitivity of *ani* – a prototypical example in (43) shows that *ani* usually associates with weak scalar items (*ani jeden* is the second most frequent collocation, the first one another minimizer *ani slovo* 'not a single word'). which via scalar reasoning entails all other scalar alternatives ($\neg\exists X[\textsc{customer}(X) \wedge \#X = 1 \wedge \textsc{enter}(X)] \rightarrow \neg\exists X[\textsc{customer}(X) \wedge \#X > 1 \wedge \textsc{enter}(X)]$). And due to this entailment the sentence with *ani* and a weak element associated with *ani* is the least probable (entailing all other alternatives).

(43) tento nyní úspěšný podnikatel [...] v prvním měsíci neměl [ani
this now succesfull businessman in first month NEG.had NPI
jednoho zákazníka]
one customer
'This currently succesfull businessman did not have even one customer in the first month.'

In Experiment 2 the acceptability of *ani* with strong scalar items was tested – example item in (44) where the scale of catholic hierarchy is most probably $\langle priest, bishop, cardinal \rangle$ – *cardinal* being high scalar item in any case. The scale entails contextual (not proper formal logical) entailment due to the facts of world we know the following implicational hierarchy: $\exists x[\textsc{become cardinal}(x) \rightarrow \textsc{become bishop}(x) \rightarrow \textsc{become priest}(x)]$ and its reversal as invalid: $\exists x [\textsc{become priest}(x) \nrightarrow \textsc{become bishop}(x) \nrightarrow \textsc{become cardinal}(x)]$. To acquire the grade of cardinal entails acquiring (ceteris paribus) acquiring all lower ranks of catholic hierarchy but not the other way round. The scalar item *cardinal* is the strongest (in the ad hoc scale), it entails all other items in the scale and is consequently least likely (which fits the natural intuitions). If *ani* prefers weak scalar items, it should be degraded with strong items, while n-words (as they are not picky about semantic environments) should be more acceptable.

(44) [...] nestal se {ani / žádným} kardinálem
NEG.became SE NPI N-ADJ cardinal
'He didn't become even a cardinal.'

And we found out that people overall preferred *žádný* (n-word) with strong scalar items. The reason is that n-words do not have semantic requirements unlike NPIs: *ani* prefers weak scalar items. The statistical results of Experiment 2 are in Figure 2, the pertinent condition LIKELIHOOD: *ani* (red) had mean acceptability very much below the n-word's mean acceptability (blue) (around 2.8 for n-words).

Experiment 3 was partially an elaboration of Experiment 2 – while Experiment 2 used an acceptability task, in Experiment 3 the truth value judgment task was used in case of testing likelihood properties of *ani*. An example item is in (45). Again it was tested how much worse is the acceptability of strong scalar items with *ani*. In this scenario the scale is ⟨PhD, MA, BA⟩: here the scale is contextually based on the likelihood of passing the exam (if the scale were based simply on academic hierarchy, as in the acceptability testing in (44), it would be ⟨PhD, MA, BA⟩ but in (45) the scale is reversed as passing the exam is prototypically negatively correlated with the academic rank). The scale is (due to the context) again based on contextual entailment: $\forall x[\mathrm{BA}(x) \rightarrow \textsc{pass}(x)] \rightarrow [\forall x[\mathrm{MA}(x) \rightarrow \textsc{pass}(x)] \rightarrow \forall x[\mathrm{PhD}(x) \rightarrow \textsc{pass}(x)]]$. Therefore *ani* associates again with the strongest scalar item (in the positive version of a tested sentence entailing all its scalar alternatives). And as the statistical summary in Figure 3 shows (the relevant condition LIKELI_NPI s. LIKELI_NWORD – blue color), speakers again preferred n-words to *ani* NPIs. This again follows from *ani*'s semantic requirements (it associates with weak items which in negative contexts become least likely among alternative scalar items) vs. n-words which do not have any semantic sensitivity and are therefore more acceptable than *ani*.

(45) Scenario: prof. Novák yesterday examined an easy course which BA, MA and PhD students attend. PhD students pass the exam always, MA in most cases but BA only rarely. Včerejší zkoušku u prof. Nováka
yesterday exam at prof. Novák
nesložili {ani / žádní} bakaláři.
NEG.passed NPI N-ADJ BA-students
'No bachelors passed the yesterday's exam by prof. Novák.'

Empirically both experiments strongly support the classification of *ani* as an NPI which associates with weak scalar items and *žádný* as an n-word licensed in the syntax (and consequently without any particular semantic sensitivity).

Table 8: *Ani* vs. *žádný* in probability manipulated environments

property/item	probability/entailment
žádný	✗
ani	✓

The theoretical explanation of *ani* being an NPI which obligatorily selects weak scalar items can be the following. The first thing to note is that the facts observed in the experiments are only a piece of a bigger pattern where *ani* competes in some environments with another scalar particle *i* 'even'. In a recent experiment (Dočekal & Šafratová 2018) it was confirmed that *i* obligatorily selects strong scalar items, while *ani* weak items. Illustrated on a data pattern close to the catholic hierarchy from Experiment 2 Czech native speakers are prone to the following judgments (where * should be understood as total unacceptability in experiments, ?? as in-between-acceptability and ✓ as nearly total acceptability – statistic noise away – but of course only in case the judgments are related to the set up scale, catholic hierarchy in (46).

(46) a. *Upward entailing contexts:*
i. Petr se nakonec stal {✓i kardinálem / ??i knězem}.
Petr SE at-end became even cardinal even priest
'Petr in the end became { even a cardinal / even a priest }.'

ii. Petr se nakonec stal {*ani kardinálem / *ani
Petr SE at-the-end became not.even cardinal not.even
knězem}.
priest.
'Petr in the end didn't become even a cardinal.'

b. *Downward entailing, non anti-additive contexts:*

i. Jestli se Petr stal {✓i kardinálem / ??i knězem}, tak...
If SE Petr became even cardinal even priest then
'If Peter became even a cardinal, then ...'

ii. Jestli se Petr stal *ani kardinálem, tak ...
If SE Petr became not.even cardinal, then
'If Peter didn't become even a cardinal, then ...'

c. *Downward entailing, anti-additive contexts:*

i. Petr se nakonec nestal {*i kardinálem / *i
Petr SE at-the-end NEG.become even cardinal even
knězem}.
priest
'Petr didn't become even a cardinal at the end.'

ii. Petr se nakonec nestal {??ani kardinálem /
Petr SE at-the-end NEG.become not.even cardinal
✓ani knězem}.
not.even priest
'Petr didn't become even a cardinal at the end.'

The pattern we observe is the following: *i* in upward entailing contexts and downward entailing contexts prefers strong elements on a scale but it is unacceptable with weak or strong scalar items in anti-additive contexts; *ani* prefers weak scalar items in anti-additive contexts but it is unacceptable in upward entailing contexts with both weak and strong scalar items (and in simple DE contexts). Such a pattern is explainable (following the logic of argumentation in Crnič 2011) as *i* and *ani* spelling out the following features:

(47) a. *i* ... [EVEN]

b. *ani* ... [EVEN,AA]

The feature [EVEN] requires the association with covert *even* defined below in (48) following Crnič (2014) among many others. The feature [AA] requires the item to occur in an anti-additive environment. The items form a scale in (49) and compete for insertion via the usual Maximize presupposition principle which requires the speaker to make her contribution presupposing as much as possible (for the original formulation see Heim 1991).

(48) $[\![\text{even}]\!]^{w}(C)(p)$ is defined only if $\forall q \in C[q \neq p \rightarrow q >_{\textsc{likely}} p]$

(49) $\langle i, ani \rangle$

The observed distribution of *i*/*ani* and their strong/weak association is explainable as follows:

1. Upward entailing environments: *i* is licit but only with strong scalar items as then the *even* presupposition is satisfied, *ani* cannot be inserted as UE environments clash with *ani* [AA] feature.

2. Downward entailing environments: *i* is licit with *even* scoping below the DE operator: [→ [[even C] antecedent … *i* …] consequent], *ani* cannot be used due to the [AA] feature requirement.

3. Anti-additive environments: *i* cannot be inserted because Maximize Presupposition dictates the insertion of the most specific item (*ani* in this case), *ani* associates with weak scalar items: the scope [even C] [¬ …*ani* …].

4. The association of *i*/*ani* with 'wrong' scalar items is perceived as bad (??) but not totally ungrammatical – weak scalar item for *i* in upward entailing contexts and strong scalar items for *ani* in anti-additive environments.

The last point seems to point to the existence of possible reversed scoping: [even C][→ [antecedent …*i* …] consequent] for *i* and [¬ [even C] …*ani* …] for *ani* which would explain their allowed (even if not preferred) 'crossed' association. But as it was confirmed by Experiment 2 and Experiment 3 *ani* associates with weak items, while *i* with strong scalar items (see Dočekal & Šafratová 2018 for details) by default. This default scope exchange of *i*/*ani* which happens exactly in anti-additive contexts (*i* prefers strong elements, *ani* weak elements but only in the scope of negation – negation being the anti-additive licensor in 99%) reveals their unified semantics where the flip-flop is a consequence of entailment/likelihood reversal caused by the negation. The only difference between *i* and *ani* is the formal feature [AA] which formalizes the morphological incorporation of negation into *ani*. It would be possible to encode the scope differences via different features ([SOLO] of Crnič 2011 for the weak elements) but such a move would miss the nice competition pattern which emerged from the data: namely *i* is in principle expected in anti-additive environments but cannot be inserted as a consequence of *ani* being more specific ([even,aa]).

Summary of this section: *ani (jeden)* ‘not even (one)’ behaves like a strong NPI – this behavior was confirmed by Experiment 2 and Experiment 3 where association with strong scalar items was sanctioned (against relatively acceptable n-words modifying strong scalar items). Furthermore, *ani* competes with *i* – the former prefers strong scalar items which was experimentally confirmed too. The association with weak scalar items and competition with *i* would be unexpected if *ani* were n-word.

3.4 Summary

Let us end this article by answering the question asked at the beginning: do n-words and strong NPIs co-exist in natural language? And if yes (in some languages like English they do co-exist for sure), does this distinction hold even in strict neg-concord languages where the boundary between strong NPIs and n-words is even more subtle? The experiments, their results and their theoretical interpretation described in this article bring very strong support of the existence of both classes of negatively dependent expressions even in a strict neg-concord language like Czech. This result allows us to maintain the standard assumptions concerning n-words (they are licensed syntactically) and NPIs (they are licensed in semantics/pragmatics). More importantly, the data patterns of Czech NPIs seem to strongly favor the NPI theories which base their licensing on concepts like anti-additivity and likelihood (Zwarts 1998 in the first case, Heim 1984 and Crnič 2014 in the second). Another issue touched in this article is unreliability of our intuitions: it seems that distinguishing between n-words and strong NPIs has to be based on such subtle data which can only be obtained by experimental methods. The subtlety of judgments can explain differing stances on this distinction in the previous literature where such opposing views as: n-words are a subclass of NPIs (Ladusaw 1992, Fălăuș & Nicolae 2016 a.o.) versus n-words are a separate class (Zeijlstra 2008 and Giannakidou & Zeijlstra 2017 a.o.) were maintained. There is another pertinent question raised by the data: do all speakers agree with respect to the distinction between n-words and strong NPIs? And if no, is there a real dialectal variation or at least some correlation? The results of the experiments in fact bear direct evidence on this fascinating question but the space of this article is alas filled completely.

Abbreviations

N-PERSON	n-word for persons	SG	singular number
N-THING	n-word for things	COMP	complementizer
NEG	negation	AUX	auxiliary verb
NPI	negative polarity item	N-ADJ	n-word for properties
SBJV	subjunctive	AA	anti-additive
DE	downward entailing	SE	reflexive clitic
PL	plural number	NR	Neg-raising

Acknowledgements

I would like to thank two anonymous reviewers, the editors of the volume, the audience at the FDSL 12.5 conference, especially Julie Goncharov and Lanko Marušič, as well as Jakub Dotlačil, Iveta Šafratová, Anamaria Fălăuş and Hedde Zeijlstra. All errors are, of course, my own. I gratefully acknowledge that the research was supported by a Czech Science Foundation (GAČR) grant to the Department of Linguistics and Baltic Languages at the Masaryk University in Brno (GA17-16111S).

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