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Mojmír Dočekal

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ABSTRACT

This article discusses differing interpretations of constituent negation in Czech and English. It empirically focuses on negated comparatives containing numerals as exemplified in the title. The English negated comparative has exact semantics (sentence like “No more than 30 people showed up” is true in a situation where exactly 30 people showed up), unlike its Czech translation (sentence like “Ukázalo se ne více než 30 lidí” would be true in any situation where the cardinality of people who showed up lies in the interval from 0 to 30), hence I call the Czech interpretation of comparatives containing numerals interval. This seems to be a fact about Czech constituent negation as testified by a corpus study reported in the article. I explain the cross-linguistic difference in the constituent negation in the following manner: the Czech constituent negation is semantically interpreted as denial, it is not exhaustified pragmatically, consequently the interval reading results; English negated comparatives are interpreted through pragmatic strengthening, consequently they receive the exact semantics.

KEYWORDS

Formal Semantics; Negation; Modified Numerals; Denial; Exhaustification.

1. Foreword

I am very happy to dedicate this article to Petr Karlík on the occasion of his birthday. I am proud to be his student, PhD graduate, colleague and friend. I am sure Petr's linguistic influence is greater than what I am able even to enumerate here but let me focus on one aspect which is particularly important for me: his role as a founder of Czech formal linguistic tradition. It is fair to say that 20 years ago there was nothing like a generative grammar or formal semantics in the Czech Republic: no publications, no summer schools, no real cooperation with formal

linguistics in the world. And without Petr, his encouragements, support, enthusiasm and influence, it would be the same today: Markéta, Pavel or me would not be working in Brno, there would be no Egg summer schools in Brno, no FDSL/CFG/Kognice conferences in Brno, no papers, no talks in generative/semantic conferences whatever. Louise McNally once told me in Barcelona that she knows what it means to be in a linguistic dessert. Thanks to Petr, students and teachers of linguistics in Brno do not know such experience anymore.

2. Data and a problem

2.1 Introduction to the problem

The goal of this article is to develop a formal semantic account of some peculiar types of Czech constituent negation. The most discussed type of the construction which I will focus on, is exemplified in (1). Descriptively speaking, it is a constituent negation of comparative (containing numerals), which is adjoined to an NP. I will try to stay away from some very complicated issues concerning the syntactic and semantic nature of the comparative itself, because the main problem I will investigate is the interpretation of the cardinality denotation of the numeral and its interaction with the constituent negation. The intuitive interpretation of (1) is close to the paraphrase ‘At most/maximally two people testified truthfully’. The sentence (1) comes from the SYN2010 corpus – the biggest and most representative corpus of contemporary Czech – and the context of the sentence confirms the proposed intuitive meaning. The goal of this article is to derive the intuitive meaning of (1) in a compositional way and compare the derivation to a different meaning that this type of constructions/sentences yield in English. In general terms, this article belongs to the comparative formal semantics of natural language.

- (1) *Ne více než dva lidé vypovídali pravdivě.*
‘No more than two people testified truthfully.’

For Czech native speakers, the intuitive meaning is straightforwardly compositional: if the meaning of the comparative in (1) is the mathematical relation $>$, the meaning of the numeral is the number 2 and the meaning of the negation is the reversal of the mathematical relation, then the meaning of the Czech [no more than two people] is ‘ ≤ 2 people’, which then interacts with the meaning of the VP in a totally compositional manner. And if we would describe just Czech (or generally, as we will see, Slavic) data, the article could end here. But the meaning of (1) described intuitively in this paragraph, is surprising from the cross-linguistic perspective, as we will discuss now.

From the perspective of Slavic speakers, it is surprising that speakers of Germanic languages interpret similar constructions in a very different way. Linguistic reflection of this can be found in a recent article by NOUWEN (2008), where examples like (2) are discussed at length. Nouwen claims that the most salient interpretation of negated comparatives with numerically modified NPs is upper bounded, which means that the intuitive interpretation of (2) is exact (not an interval as in Czech) and close to the paraphrase ‘Exactly 30 people showed up’. There is a pragmatic implicature on top of the exact interpretation which suggests that the number of people is surprisingly lower than expected, the implicature seems not to interact with the whole semantic composition nevertheless. NOUWEN (2008) observes that such a reading is both intuitively and theoretically surprising because following the same compositional steps as we did for (1), we would expect the interval reading for (2) too: something close to a paraphrase ‘At most/maximally 30 people showed up’, which is exactly the reading that the Czech translation of (2) gets.

(2) *No more than 30 people showed up.*

The intuitive semantic composition discussed above is exactly mirrored by standard assumptions about the meaning of parts and their composition in (2): the meaning of a phrase *more than α P* is formalized as a quantifier over 2 arguments: number α (denotation of the numeral) and property *P* (denotation of the NP). For instance, the predicative usage (simpler to treat than (2)) in (3) would be composed step-by-step in the following way: (3a) is the set of sets with cardinalities > 3 (meaning of *more than three*), (3a) has to rise for type reasons as the clausal subject is of type $\langle e \rangle$, but the comparative needs a property (*P*): (3b) where the trace after movement is λ -bound and the λ -abstraction creates the needed property of the $\langle e, t \rangle$ type. (3c) is the result of functional application of the raised comparative to the property resulting from the λ -abstraction. (3c) represents the intuitive meaning of (3): maximal number of guests was more than 3.

(3) *The number of guests was more than three.*

- a. $[\lambda\alpha\lambda P.\max_d(P(d))>\alpha](3)$
- b. $[\lambda P.\max_d(P(d))>3](\lambda n[\text{the number of guests was } n])$
- c. $\max_d(\lambda d.\text{the number of guests was } d) > 3$

Adding negation (in the form of a negative determiner) is not expected to change anything in the composition and in the result, of course with the exception of reversing the relation from $>$ to \leq . So the theoretically expected reading of (4) is (4a), an interval reading, but as already mentioned, English negated comparatives are interpreted not as an interval but as the exact cardinality (exactly 3 for (4)). The

exact-interpretation is the most salient interpretation of (4) and it is formalized in (4b).

- (4) *The number of guests was no more than three.*
 $\max_d(\lambda d. \text{the number of guests was } d) \leq 3$
 $\max_d(\lambda d. \text{the number of guests was } d) = 3$

In examples like (5), where the negated comparative numeral is used in an argument position, the same unexpected exact-meaning appears again. The composition is similar to (4), but for type reasons (the distinction between predicate and argument position) we have to insert HACKL'S (2000) counting quantifier *m*-many, with the semantics $\lambda A \lambda B. \exists x[\#x=m \wedge A(x) \wedge B(x)]$, where the cardinality ($\#x$) comes from the numeral, the denotation of *A* is the meaning of its NP argument, and the denotation of *B* is the meaning of the VP argument. (2), repeated below as (5), has the truth conditions in (5a) (the interval semantics) which again is strengthened in English to the equality reading formalized in (5b) – exactly the same unpredicted reading as in (4).¹

1 The distinction between predicate and argument usage of the comparative (which probably holds for other relations – beyond comparative – between cardinality of a set and a set) can be illustrated in the following example: while (i) – a predicate usage of a comparative numeral – is grammatical, in (ii), the same comparative numeral leads to ungrammaticality if we add an NP to it. However, in (iii), the same comparative numeral plus NP is grammatical in the argument position. The reason for this is that the comparative numeral needs only one property-type argument (fulfilled in (i)), but in (ii) there are two property denoting phrases (NP part of the comparative and the set resulting from QR of the comparative numeral). (iii) is grammatical as Hackl's counting quantifier supplies two argument slots (a theoretical reflection of the change of the grammatical role from a predicate to an argument). The same contrast can be observed with numerical NPs: (iv) numerical NP in predicate position allows just one property argument, (v) is grammatical as the phrase appears in subject argument position, because again Hackl's counting quantifier needs two property arguments.

- (i) *Návštěvníků té výstavy bylo víc než deset.*
 visitors_{GEN} that_{GEN} exhibition_{GEN} was more than ten
 'The visitors of the exhibition were more than ten.'
- (ii) **Návštěvníků té výstavy bylo více než deset studentů.*
 visitors_{GEN} that_{GEN} exhibition_{GEN} was more than ten students_{GEN}
 'The visitors of the exhibition were more than ten students.'
- (iii) *Více než deset studentů bylo návštěvníky té výstavy.*
 more than ten students_{GEN} was visitors_{INS} that_{GEN} exhibition_{GEN}
 'More than ten students were visitors of the exhibition.'
- (iv) *Návštěvníků té výstavy bylo deset /*deset studentů.*
 visitors_{GEN} that_{GEN} exhibition_{GEN} was ten / ten students_{GEN}
 'The visitors of the exhibition were ten/*ten students.'
- (v) *Deset studentů bylo návštěvníky té výstavy.*
 ten students_{GEN} was visitors_{INS} that_{GEN} exhibition_{GEN}
 'Ten students were visitors of the exhibition.'

- (5) *No more than 30 people showed up.*
- a. $\max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) \leq 30$
 - b. $\max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) = 30$

Generally, the problem can be formulated in this way: English numerical comparatives negated with *no* have surprisingly strengthened equative reading while the same construction in Czech yields just the theoretically and intuitively expected interval reading. Nouwen's theoretical explanation of the English data pattern is the following: he assumes that non-strict comparison (relations such as \leq , \geq which correspond to English negated comparatives like *no more than* or *no less than*) yields sensible implicatures which are then exhausted through the usual pragmatic strengthening (via negation of logically stronger alternatives/implicatures of the asserted sentence). The strengthening proceeds analogically to the textbook example like (6) which has a truth-conditional/at-issue meaning in (6a) (the truth conditions would be true even in a scenario where all students came). But (6) yields even a scalar implicature derived from Horn's scale $\langle \text{some}, \text{all} \rangle$ which is logically stronger (at least for non-empty $P: \forall x P(x) \models \exists x P(x)$) and as such is negated (because of Grice's Maxim of Quantity) – (6b). The strengthened meaning of (6) is (6c). And according to Nouwen, (7) has the truth-conditions/at-issue meaning in (7a) but it has scalar implicature in (7b) which is (because 29 is under negation logically stronger than 30) negated, consequently the strengthened truth-conditions in (7c) explain the equative reading of negated English comparatives.

- (6) *Some students came.*
- a. at-issue meaning: $\exists x[\text{student}(x) \wedge \text{came}(x)]$
 - b. negation of SI: $\neg \forall x[\text{student}(x) \rightarrow \text{came}(x)]$
 - c. $\exists x[\text{student}(x) \wedge \text{came}(x)] \wedge \neg \forall x[\text{student}(x) \rightarrow \text{came}(x)]$
- (7)
- a. at issue: $\max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) \leq 30$
 - b. SI: $\neg \max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) \leq 29$
 - c. $\max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) = 30$

Nouwen further claims that the non-strict comparison differs from the strict comparison (relations like $>$, $<$ denoted by English comparatives *more than*, *less than*) which (as was discussed in the literature before in KRIFKA 1999, SCHULZ – VAN ROOIJ 2006, FOX – HACKL 2006) do not lead to the pragmatic strengthening/meaning enrichment. And Nouwen follows the consensus in current formal semantics: strict comparison does not produce sensible scalar implicatures, particularly he builds on Fox and Hackl's *Universal Density of Measurement Hypothesis* which for strict comparison predicts that the computation of implicatures crashes in an in-

finitive loop. This theoretically explains why un-modified numeral comparatives like (8) never strengthen its meaning, otherwise (contrary to intuitions in any natural language) (8) would be true iff exactly 31 people came.

(8) *More than 30 people came.*

a. at issue: $\max_d(\lambda y \exists x[\#x=y \wedge \text{people}(x) \wedge \text{came}(x)]) > 30$

b. no SI

2.2 More data and the summary of the puzzle

As was shown above, Slavic constituent negation in comparatives is interpreted (as expected) as an interval combining with a property (denoted by a noun), whereas in English, the same construction yields the equative reading. The equative reading is surprising because modified numerals usually do not strengthen their meaning via negation of logically stronger alternatives, but if Nouwen is right, exactly the process of pragmatic strengthening is the reason behind the English equality readings in negated comparatives.

To check my intuitions, I conducted a small corpus research: I extracted all occurrences of negated comparative constructions from SYN2010 (the most representative corpus of contemporary Czech). The corpus contained around 200 instances of the *no more than* or *no less than* type, one of the most frequent examples is, e.g., a negation of a time denoting comparative like *ne více než dvě hodiny* ‘no more than two hours’. The outcome is that all of the occurrences of the construction have the interval reading I already discussed (I checked the context of the sentences to see whether it approves the interval reading or not). Next I checked the translation of (1) into Polish, Bulgarian and Russian with native speakers of these languages and all of them again confirmed that the most salient reading they get is the interval one. So it seems safe to claim that negated comparative numerals do have interval semantics in Czech and it is highly probable that this empirical generalization holds for the whole Slavic languages family as well.

The finding of the interpretational distinction between English and Czech is surprising from Nouwen’s perspective as his mechanism of obtaining the equality reading is supposed to be language universal. But before we will move to the explanation of the difference, let us look at more data which bring evidence for the generality of the difference.

3. Equality readings and modal contexts

Nouwen points out that examples like (9a) and (9b) yield the equality readings as well: the ingredients are structurally similar again – comparative negated by *no* but this time it is not numerals (what is compared) but a degree to which some

property holds: (9a) is true iff the size of Holland equates to a very big city, (9b) is true, iff the extent to which a whale is a fish equates the extent to which a horse is a fish.

- (9) a. *Holland is no more than a very big city.*
b. *A whale is no more a fish than a horse.*

Czech translation of (9a) is (10) which has just the interval reading again: (10) would be true, iff Holland's size is smaller or equal to a size of a very big city.

- (10) *Holandsko je ne víc než jedno velké město.*
'Holland is no more than a very big city.'

Nevertheless Czech is able to express the equality reading as well: we just have to use the ordinary prefixal verbal negation (on a lexical verb or on an auxiliary, depending on tense, mood, ...) like in (11a) or in (11b) – the first sentence equates the size of Holland to a big city and the second sentence is true iff exactly 2 people testified truthfully. So unlike the constituent negation, Czech verbal negation has the equality reading as its primary meaning ((11a)/(11b) could be used with the interval meaning as well but it is not the most salient interpretation).

- (11) a. *Holandsko není víc než jedno velké město.*
'Holland is not more than a very big city.'
b. *Pravdivě nevyprávěli víc než 2 lidé.*
'More than two people did not testify truthfully.'

And very interestingly: Nouwen claims that English *not* in examples like (12a) have exactly the interval reading we observed in Czech. In other words: (12b) claims that the emperor remained at Rome exactly three months, but (12a) is true, iff the emperor remained there less than three months. Nouwen claims that *not* in the cases like (12a) is used as a denial of the strict comparison and because of that it does not yield the strengthened equality reading.

- (12) a. *The victorious emperor remained at Rome not more than three months.*
'< 3 months'
b. *The victorious emperor remained at Rome no more than three months.*
'= 3 months'

The same difference as between English and Czech or within Czech between constituent negation (interval reading) and verbal negation (equality reading) is observable in modal contexts. First, let us look at English: the most salient reading of (13) is (13a), where the maximality operator outscopes the existential modal, consequently 20 pages is limit, papers with 21 and more pages would be rejected in the situation described by (13). But (13a) is still not the equality reading, the equality reading is rendered in (13b) and it is the right formalization for the most salient interpretation of (13), as the incoherence of the continuation of (13) with something like *#In fact, the page limit is 15 pages* indicates (note that if the reading of (13) would be (13a), such continuation would be predicted to be acceptable). The sentence also has a weak reading (13c), which can be used in a scenario where someone thinks that Cody's paper is too short and it should be longer, but someone other answers him: *You're wrong, Cody's paper IS allowed to have no more than 20 pages* indicating that the existential modal outscopes the maximality operator, and such a reading would true even in a situation where the article would be allowed to be more than 20 pages long.

(13) *Cody's paper is allowed to have no more than 20 pages.*

- a. $\max_d(\diamond [\text{Cody's paper has } d\text{-many pages}]) \leq 20pp$
- b. $\max_d(\diamond [\text{Cody's paper has } d\text{-many pages}]) = 20pp$
- c. $\diamond[\max_d(\text{Cody's paper has } d\text{-many pages}) \leq 20pp]$

And again, in modal contexts, Czech constituent negation behaves like English *not* and has only the interval, non-exhaustified meaning, see (14), where the continuation which shrinks the limit of coffee drinking down is perfectly acceptable. The intuition is formalized with (14a) where the non-strict comparison is not strengthened to the equality. But again, Czech verbal negation allows the equality reading as (15) shows: here the continuation with change of the coffee limit is at least questionable, more probably incoherent. This is the reason for the strengthened equality formalization in (15a).

(14) *Kvůli vysokému tlaku má Karel dovoleno vypít ne víc jak 3 kávy, ve skutečnosti je limit na den 2 kávy.*

'Due to hypertension Karel is allowed to drink no more than 3 coffees, in fact his day limit is 2 coffees.'

- a. $\max_d(\diamond [\text{Karel can drink } d\text{-many coffees}]) \leq 3$

- (15) *Kvůli vysokému tlaku nemá Karel dovoleno vypít víc jak 3 kávy, ??? ve skutečnosti je limit na den 2 kávy.*
 ‘Due to hypertension Karel isn’t allowed to drink more than 3 coffees, ??? in fact his day limit is 2 coffees.’
- a. $\text{max}_d(\diamond [\text{Karel can drink } d\text{-many coffees}]) = 3$

4. An empirical generalization

Let’s summarize the empirical findings: it seems that English *no* in comparatives leads to the exhaustification, unlike *not* which (probably due to its denial nature) has just the interval (\leq) reading. In Czech, the readings are disambiguated with pre-verbal *ne-* which has as its most salient reading the exhaustified reading, while constituent negation *ne* does not lead to exhaustification. Table 1 summarizes the observations. We can speculate that the divide is dictated by the markedness: as we will discuss later, denial has to be marked (prosodically or by other means) and at least in Czech, the constituent negation is more marked than the preverbal negation.

Tab. 1. Default interpretation

	exhaustification	denial (no exhaustification)
English	<i>no</i>	<i>not</i>
Czech	<i>ne-</i> (verbal)	<i>ne</i> (constituent)

Nevertheless it is important to say that Table 1 summarizes just the most salient readings. (16a) shows an English sentence which for extra-linguistic reasons has primary the interval reading even though the determiner *no* is used. And similarly (16b) shows a Czech sentence which again for pragmatic reasons is clearly ambiguous: the non-strengthened interval reading is probably the more salient one, even though the verbal negation is used. For Czech, we can assume that the interval reading comes from the constituent negation interpretation of the verbal negation which is always at least possible.

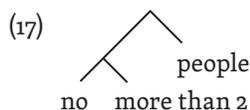
- (16) a. *According to EU law, passenger cars are allowed to be 2.50 m wide, but no wider.*
 b. *Letos jsme nepřijali víc jak 500 studentů.*
 ‘This year we did not accept more than 500 students.’
- (i) $\text{max}_d(\text{we accepted } d\text{-many students}) = 500$
 (ii) $\text{max}_d(\text{we accepted } d\text{-many students}) \leq 500$

5. A Solution

To deal with the data summarized at the end of the last section, I will propose a solution which will explain the denial (non-exhaustified) interpretation of Czech constituent negation. In an intuitive way: I assume that in Czech constituent negation of phrases like \neg [more than two people], the scope of negation is just over the [more than two] part of the whole constituent. This will lead to the right truth conditions via the denial interpretation of negation (see GEURTS 1998). To motivate such a scope I will present some empirical evidence.

5.1 Syntactic evidence²

To propose that Czech (and most probably generally Slavic) constituent negation (in the discussed constructions) scopes only over the *more than two* part would mean syntactically that the constituent structure would be $[\neg$ [no more than two] people] (more graphically in (17)). Such a proposal is non-standard, as default scoping of NP modifiers is expected to be [no [more than [two [people]]]]. Nevertheless, let us assume that the low scope of negation is possible (and at least syntactically it is perfectly reasonable to have such a scope even if the low scope is expected to be just one of two adjunction possibilities for the negation, the other one would be the standard scope).



Moreover there are some linguists who work with structures close to my proposal. One of the current proposals in the literature is CORVER – ZWARTS' (2006) idea of prepositional numerals. Let us consider one of their examples – (18) which they claim to have a syntactical bracketing in (18a), in other words: similarly to my proposal, Corver and Zwarts claim that a preposition and a numeral form a constituent excluding the noun. Their motivations for such a structure of complex numerals are partially syntactic and partially semantic. The semantical proposal derives the need for non-standard bracketing from the compositionality: Corver and Zwarts assume that prepositions do have the same vector space semantics in numeral domain as they have in the spatial domain. From this perspective the preposition *above* in (18) maps a number (100) to an interval (metaphorically going up from 100) in one-dimensional number line, namely to a partially closed interval $[100, \infty]$ which is pragmatically bounded. Semantically the preposition

² I would like to thank Pavel Caha for discussion of the syntactic details investigated in this section.

first combines with the numeral [P Num] and the resulting interval feeds the cardinality meaning slot of the noun [[P Num] Noun] – reminiscent of Krifka’s object unit – of the noun denotation – see (18b).

- (18) *There are over a hundred students.*
- syntax: There are [_{DP} [_{PP} over a hundred] students].
 - semantics: $\exists x[\text{students}(x) \wedge \#x \in \text{above}(100)]$

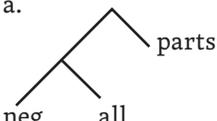
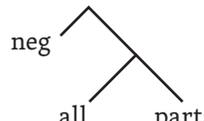
If we follow Corver and Zwarts’ reasoning, the composition of (17) would be the following: first the comparative combines with the numeral to denote an interval $(2, \infty]$, with syntactic structure [more than two]. Then the negation applies and results in an interval $[0, 2]$; syntactically $[\neg \text{ [more than two]}]$. Finally, the interval is used in the count noun *people* cardinality denotation resulting in the right truth conditions $\exists x[\text{people}(x) \wedge \#x \leq 2 \wedge \text{testified_truthfully}(x)]$. Such reasoning is theoretically without problems but we have to search for some empirical evidence which would support it. This will be done in the following section.

5.2 The evidence for the low scope of negation

I was able to find two types of empirical data which speak for the low scope of constituent negation. The first type comes from the difference in the licensing and the lack of the licensing of Czech Free Choice Items (FCIs). Czech contains a series of *wh*-items with the suffix *-koli(v)*, which corresponds to some extent the English FCI usage of *any* (for a detailed comparison see DOČEKAL – STRACHOŇOVÁ 2014). Czech FCIs are (as expected) licensed by universal quantifiers – see (19), a natural example from SYN2010. But a minimal change of the example (20), where we add the constituent negation on top of the universal quantifier, leads to ungrammaticality. The ungrammaticality is unexpected because the negation of a universal quantifier is still downward entailing. To see that, consider the validity of a reasoning from *Not all students came* to *Not all students came early*. We can hypothesize that this follows from a low scope of the constituent negation, namely $[\neg \forall][\text{parts}]$ – see (21), where the negation’s low scope is interpreted as a denial and leads to an existential interpretation (\exists). The existential quantifier is not downward entailing, so the ungrammaticality of (20) is expected.

- (19) *Přitažlivé je i luxusní provedení všech částí, kterých se jakkoli dotýkáte.*
appealing is also luxurious execution all parts, which CL.REFL however touch
‘Appealing is also the luxurious execution of all parts which you touch in any manner.’

(20) **Přitažlivé je i luxusní provedení NE všech částí, kterých se jakkoliv dotýkáte.*

- (21) a.  b.* 

Alas even if we can use such evidence, the result is inconclusive because there is another explanation of the facts. Namely, as pointed out already by LINEBARGER (1987) and recently by the influential CHERCHIA (2013), a.o., the universal quantifier sandwiched between negation and NPI/FCI gives raise to intervention effects in the NPI/FCI licensing. Such effects are attested in Czech as well, consider the minimal pair in (22a) and (22b) where the universal quantifier unlike the existential one destroys the strict NPI licensing (strict NPI: *ani jednu známku* ‘not even one grade’).

- (22) a. *Petr nedal některým studentům ani jednu známku.*
‘Petr gave some students not even one grade.’
b. **Petr nedal všem studentům ani jednu známku*
‘Petr gave all students not even one grade.’

The second piece of evidence comes from some case patterns. Czech cardinal numerals from the interval [1,4] do not assign genitive, but act as syntactic adjectives, agreeing with the case of the head noun; see (23a). Czech nouns assign genitive as seen in (23b). But if the constituent structure I propose is right, numerals [1,4] embedded under a comparative are expected to act as nouns, because the sister of the noun is not only the numeral but the whole [more than Num] constituent. And as a noun-like constituent, we expect the case on its noun complement to be adnominal, namely genitive. And this expectation is fulfilled, see (23c) where the noun appears in the genitive instead of the accusative. This nice syntactic pattern provides another evidence for the proposed constituent structure. Let us summarize: there is semantic and syntactic evidence for the low scope of negation and constituency of the string [more than two], even if the evidence is not water-proof.

- (23) a. *Přečetl jsem dvě knihy.*
read_{1sg} AUX_{1sg} two_{ACC} books_{ACC}
‘I read two books.’

- b. *Kniha [mého přítele]*
 book my_{GEN} friend_{GEN}
 ‘my friend’s book’
- c. *Knih jsem přečetl [víc než dvě].*
 books_{GEN} AUX_{1sg} read_{1sg} more than two_{ACC}
 ‘As for books, I read more than two.’

6. The semantics of denial

Let us recap: natural languages allow a negation to signal the speech act of denial by various markers, negation is of course the most common. For English, as already mentioned, *not* in (12) repeated below as (24) is interpreted as a denial marker (and let us recall: without exhausted interpretation). I follow Geurts’ approach (see especially GEURTS 1998) to denial where the negation (in our case: *not* in English, constituent negation in Czech) is a regular negation but the denied expression is both used and mentioned. So unlike in Horn’s approach (see HORN 1989) to the phenomenon where it is claimed that metalinguistic negation is a different type of negation than regular truth-reversing operation, in Geurts’ approach the denial interpretation has its source in a shifted interpretation of the denied expression, not in the reinterpretation of the negation. See (25a) and (25b) from GEURTS (1998): the denial is not metalinguistic in a sense that a speaker called a name spelled *poLICE* (instead of *POlice*), the denial negates both the form and the denotation – the speaker called an institution and he spelled its name in a particular way.

- (24) a. *The victorious emperor remained at Rome not more than three months.*
 ‘< 3 months’
- b. *The victorious emperor remained at Rome no more than three months.*
 ‘= 3 months’
- (25) a. *He didn’t call the *PO*lice, he called the *poLICE*.*
- b. He didn’t call the <official body whose name is pronounced ‘*PO*lice’>, he called the <official body whose name is pronounced ‘*poLICE*’>.

For Czech constituent negation, let us assume that in the case of the negated comparative, the negation is interpreted as a form denial and its (low) scope delimits the string being used, mentioned and then denied. For the example (1), I assume (in Geurts’ notation) that some formal representation close to (26) is right. The degree property is both used, mentioned and finally denied. The constituent negation is used as a marked form of negation to indicate that the constituent in its

scope is being reinterpreted from its pure denotation to the ordered pair <denotation, form>.

(26) \neg [<the degree properties of two and more expressed by Czech ‘more than two’> people testified truthfully]

The form denial is then predicted to be immune to standard scalar implicatures as the alternatives are computed on the base of the ordered pair <denotation, form>, not on the basis of the regular meaning (and then on logically stronger/weaker alternatives). And that is the reason, why we obtain the interval (= non-exhaustified) reading for Czech constituent negation. Let us look at the semantical step-by-step derivation in (27). First: based on the arguments in the last section, let us assume that the negation scopes low to signal the denied expression and the whole constituent is part of the argumental NP phrase: (27a). The basic semantics of the negated constituent is (27b) – the degree property which would be true of any set (P) with the cardinality bigger than two (27b). Because it appears in an argument position, for type reasons, it has to combine with Hackl’s counting quantifier in (27c) and again raise for type reasons (it has to combine with a property) to the left periphery of the clause; its trace is interpreted via λ -binding which turns the clause into the appropriate property type (27d). Then the constituent marked for denial (27e) is denied: (27f). Note that the reversed relation is non-strict (\leq) but there are no sensible scalar implicatures as the alternative calculations ranged over denotation/form, not over pure denotation. So final truth-conditions are in (27g), no strengthening happens and the observed interval interpretation is explained.

- (27) a. [[no] [more than two]] in argument position:
 b. \llbracket more than two $\rrbracket = \lambda P. \max_d(P(d)) > 2$
 c. \llbracket m-many $\rrbracket = \lambda A \lambda B. \exists x [\#x = m \wedge A(x) \wedge B(x)]$
 d. \llbracket [[no] [more than two]] $\rrbracket [\lambda n$ [n-many people testified truthfully]]
 e. denial: \llbracket [<the degree properties of two and more expressed by Czech ‘more than two’>] $\rrbracket [\lambda n$ [n-many people testified truthfully]]
 f. $[\lambda P. \max_d(P(d)) \leq 2$ [λn [n-many people testified truthfully]]]
 g. $\max_d(\lambda y \exists x [\#x = y \wedge \text{people}(x) \wedge \text{truthful_witness}(x)]) \leq 2$

7. Summary

In this article, I discussed two ways of negating comparative numerical NPs: (i) regular negation (verbal negation in Czech, determiner *no* negation in English)

which following NOUWEN (2008) leads to strengthened equality interpretation; (ii) denial negation (constituent negation in Czech, constituent *not* negation in English) which is not exhausted and yields interval interpretation.

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