

Upper bounded and un-bounded ‘no more’

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Abstract: Constituent negation (CN) is commonly thought to be a subtype of natural language negation which does not exhibit substantial differences from the more frequent verbal negation. In this paper, I argue that at least Czech CN is different. I argue that its semantics targets both at-issue meaning and focus alternatives. The evidence will come from differences in interpretations between English and Czech with respect to negated comparatives adjoined to NPs (like *no more than two people*) and from many other types of negated constituents. I argue that the cross-linguistic variation can be explained if Slavic CN is treated as a focus-oriented particle, unlike English *no* which targets scalar alternatives.

Keywords: constituent negation; scalar implicatures; focus alternatives; comparative; Slavic

1. Data and problem

1.1. Introduction to the problem

The goal of this article is to develop a formal semantic account of Czech constituent negation. To accomplish this task, I will discuss the most frequent sub-types of constituents modified by a constituent negation. One crucial sub-type of a phrase modified by constituent negation (CN) 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 avoid highly complicated issues concerning the syntactic and semantic nature of the comparative itself since the main problem I will investigate is the interpretation of the cardinality denotation of the numeral and its interaction with the constituent negation and its semantics. An intuitive interpretation of (1) is close to a paraphrase ‘At most/maximally two people testified truthfully’. The sentence (1) comes from the SYN2010 corpus – the largest and most representative corpus of contemporary Czech – and the context of the sentence confirms the proposed intuitive meaning. The goal of my article is to derive the intuitive meaning of (1) in a compositional way and to compare the derivation to a different meaning which this type of construction/sentence yields in English.

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

For Czech native speakers the intuitive meaning appears to be straightforwardly compositional, i.e., if the meaning of the comparative in (1) comprises the mathematical relation $>$, whereas the meaning of the numeral is essentially the number 2 and the meaning of the negation employs the reversal of the mathematical relation, then the meaning of Czech [no more than two people] is ‘ ≤ 2 people’ which then interacts with the meaning of the VP in an entirely compositional manner. And if we were to account merely for the Czech (or generally, as we’ll see, Slavic) data, the article could end here. However, the meaning of (1), described intuitively in this paragraph, turns out to be surprising from the cross-linguistic perspective, as we’ll discuss immediately.

For Slavic speakers it is startling that speakers of Germanic languages interpret similar constructions in a very different way. A linguistic reflection of this phenomenon can be found in a recent article Nouwen (2008), where examples such as (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 reading as in Czech) and close to a paraphrase ‘Exactly 30 people showed up’.¹ 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 English (2) as well, i.e., something close to a paraphrase ‘At most/maximally 30 people showed up’ which is exactly the reading the Czech equivalent of (2) gets.

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

The intuitive semantic composition discussed above is accurately mirrored by standard assumptions concerning 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, namely a number α (a denotation of the numeral) and a property *P* (a denotation of the NP). For instance, the predicative usage (simpler to treat than (2)) in (3) would be composed

¹ There is a pragmatic implicature on top of the exact interpretation which suggest that the number of people is surprisingly lower than expected; nevertheless the implicature seems not to interact with the whole semantic composition, so I will ignore this implicature further.

step-by-step in the following way: (3a) constitutes the set of sets with cardinalities > 3 (the meaning of *more than three*), (3a) has to raise for semantic 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 required 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. Thus, (3c) represents the intuitive meaning of (3), i.e., the 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 form of a negative determiner) is not expected to change anything in the composition as well as in the final result, of course with the exception of reversing the relation from $>$ to \leq . Hence, the expected reading of (4) is (4a), i.e., the interval reading, but as already mentioned, English negated comparatives do not get an interval but rather an exact cardinality interpretation (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.
- a. $max_d(\lambda d.\text{the number of guests was } d) \leq 3$
 - b. $max_d(\lambda d.\text{the number of guests was } d) = 3$

In an example such as (5) where the negated comparative numeral is used in argument position the same unexpected exact meaning appears again. The composition is similar to (4) but due to the semantic type reasons (the distinction between the predicate and argument position) it is necessary to insert Hackl's counting quantifier m -many with the semantics $\lambda A \lambda B. \exists x [\#x = m \wedge A(x) \wedge B(x)]$. The cardinality ($\#x$) comes from the numeral, whereas 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). In English it is further strengthened to the equality reading represented in (5b) which is exactly the same unpredicted reading as in (4).

- (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. $\max_d(\lambda y \exists x[\#x = y \wedge \text{people}(x) \wedge \text{showed_up}(x)]) = 30$

In general, the problem can be formulated in the following way. English numerical comparative negated with *no* has surprisingly strengthened the equative reading while the same construction in Czech yields just the theoretically and intuitively expected interval reading. Nouwen's theoretical explanation of the English pattern is as follows. He assumes that non-strict comparison, i.e., 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 by means of the usual pragmatic strengthening, i.e., via negation of logically stronger alternatives/implicatures of the asserted sentence. According to Nouwen, (2) does have the truth-conditions/at-issue meaning in (6a) but, in addition, it also has a scalar implicature in (6b) which is negated, because under negation 29 is logically stronger than 30. Consequently, the strengthened truth-conditions in (6c) explain the equative reading of negated English comparatives.

- (6) 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, i.e., relations such as $>$, $<$ denoted by English comparatives *more than*, *less than*, which (as was discussed in the literature before – Krifka 1999; Schulz & van Rooij 2006; Fox & Hackl 2007, etc.) do not lead to the pragmatic strengthening/meaning enrichment. Furthermore, Nouwen follows the consensus in current formal semantics: strict comparison does not produce sensible scalar implicatures. In particular, he builds on Fox and Hackl's Universal Density of Measurement hypothesis which for strict comparison predicts that the computation of implicatures crashes into an infinitive loop. This theoretically explains why un-modified numeral comparatives such as (7) never strengthen their meaning, otherwise (contrary to intuitions in any natural language) (7) would be true iff exactly 31 people came.

- (7) 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

1.2. More data and the summary of the puzzle

As demonstrated 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 equality reading. The equality reading is surprising because modified numerals usually do not strengthen their meaning via negation of logically stronger alternatives, but if Nouwen is right, the process of pragmatic strengthening is exactly the reason behind the English equality readings in negated comparatives.

In order to verify my intuitions, I conducted a small corpus study. I extracted all occurrences of negated comparative constructions from SYN2010 which is the most representative corpus of contemporary Czech. The corpus sample contained approximately 200 instances of the *no more than* or *no less than* type and one of the most frequent examples is, e.g., negation of a time denoting comparative such as *ne více než dvě hodiny* 'no more than two hours'. I have checked the context of the sentences to see whether it approves the interval reading or not and the outcome is that all of the occurrences of the construction have the interval reading I have already discussed. Next, I have consulted 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.² Therefore, 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 entire Slavic language family as well.

² The Bulgarian, Polish and Russian translations of (1) can be seen in (i)–(iii) respectively (thanks to Zornica Cvetkova, Anton Poludněv and Marcin Wągiel for the native speaker data and judgments):

- (i) Ne poveche ot dvama du'si otgovoracha pravilno.
 no more than two.GEN people.GEN.PL testified truthfully
 'No more than two people testified truthfully.'
- (ii) Nie więcej niż dwóch ludzi zeznawało prawdę.
 no more than two people testified truth
 'No more than two people testified truthfully.'
- (iii) Ne bolee chem dva cheloveka svidetel'stvoval-i/-o pravdivo.
 no more than two.NOM human.GEN.SG testified truthfully.
 'No more than two people testified truthfully'

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

Equality readings

Nouwen points out that examples such as (8a) and (8b) yield the equality readings as well. Again, the ingredients are structurally similar, i.e., the comparative negated by *no*, but this time what is compared is not numerals, but rather a degree to which a property holds. For instance, (8a) is true iff the size of Holland equates to a very big city, (8b) is true, iff the extent to which a whale is a fish equates the extent to which a horse is a fish.

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

The Czech translation of (8a) is (9) which again has the interval reading only, i.e., (9) would be true, iff Holland's size is smaller or equal to a size of a very big city.

- (9) 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 by means of the ordinary prefixal verbal negation (on the lexical verb or on the auxiliary, depending on tense, mood, etc.), as demonstrated in (10a) or in (10b). The first sentence equates the size of Holland to one big city and the second sentence is true iff exactly 2 people testified truthfully. Thus, unlike constituent negation Czech verbal negation has the equality reading as its primary meaning.³

- (10) 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.'

³ (10a)/(10b) could be used with the interval meaning as well but it is not the most salient interpretation.

Interestingly, Nouwen claims that English *not* in examples such as (11a) does have the interval reading we observe in Czech. In other words, (11b) states that the emperor remained at Rome for exactly three months, whereas (11a) is true, iff the emperor remained there for less than three months. Nouwen claims that *not* in cases like (11a) is used as a denial of the strict comparison and because of that it does not yield the strengthened equality reading.

- (11) 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'

1.3. Empirical generalization

Let us summarize the empirical findings. It seems that English *no* in comparatives leads to exhaustification, unlike *not* which (probably due to its denial nature) has just the interval (\leq) reading. In Czech the readings are disambiguated with either the pre-verbal *ne-* whose most salient reading is the exhaustified one, whereas the constituent negation *ne* does not lead to exhaustification. Table 1 summarizes the observations. We can speculate that the distinction is due to markedness since, as we will discuss later, denial has to be marked (prosodically or by other means) in English. And as for Czech, while verbal prefixal negation seems to lead to the exhaustified meaning, this is not true for Czech constituent negation. Nonetheless, as I will argue further, in Czech it is not denial what causes the non-exhaustified interval reading.

Table 1: Default interpretation

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

Nevertheless, it is important to note that Table 1 summarizes only the most salient readings. (12a) introduces an English sentence which for extralinguistic reasons has the primary interval reading even though the determiner *no* is used. Similarly, (12b) demonstrates a Czech sentence which for pragmatic reasons is clearly ambiguous. The non-strengthened interval reading in (12b-i) is presumably more salient than the equality reading in

(12b-i) even though the verbal negation is used. For Czech we can assume that the interval reading in cases like this comes from the constituent negation interpretation of the verbal negation which is always at least possible.

- (12) 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. $\max_d(\text{we accepted } d\text{-many students}) = 500$
 ii. $\max_d(\text{we accepted } d\text{-many students}) \leq 500$

2. Solution

My solution to the discussed differences in interpretations between Czech and English constituent negation (CN) will be developed beginning with the following section 2.1 where I summarize the data pointing at the focus particle behaviour of Czech CN. Next, in section 2.2, I will propose a semantic formalization of Czech CN which reflects its focus sensitive nature. In the following section 2.4 the developed semantics will be applied to most types of phrases modified by Czech CN to test the accuracy of the proposed formalization. Finally, in section 2.5 we will return to the original puzzle concerning the difference between the interpretations of negated comparatives with numerically modified NPs in Czech and English.

2.1. Syntactical behaviour of Czech CN

It is well known (see Jasinskaja 2016, among others) that Slavic focus particles (FP) have to c-command their associated F-marked expression – see (13) – and unlike English FPs they normally have to be adjacent to the F-marked constituent – see (14). In this regard, CN behaves like all other FPs, as exemplified in (13) and (14) with a prototypical FP *pouze* ‘only’.

- (13) Já se choval [seriózně]_F *ne/pouze.
 I SE behaved seriously not/only.
 (14) a. I behave only [seriously]_F.
 b. I only behave [seriously]_F.
 c. Já *pouze/*ne jsem se choval [seriózně]_F.
 d. Já jsem se choval pouze/ne [seriózně]_F.

However, in some environments, namely if the F-marked constituent is an NP embedded in another NP ([NP [NP]_F]) or if the F-marked NP is embedded in an PP ([P [NP]_F]), Czech FPs allow for non-adjacency and in most cases they even sound distinctly odd if they are adjacent to their F-marked expression, see the contrast in (15) and (16). In this respect, Czech CN behaves like a prototypical Czech FP *pouze* 'only'. Generally, Czech FPs (including CN) are in this respect reminiscent of German FPs such as *sogar* or *nur* (for the original observations concerning German facts see Buring & Hartmann 2001 and Reis 2005).

- (15) a. Pozval jsem pouze/ne [majitele [pivovarů]_F].
invited-I AUX only/not owners breweries-GEN
- b. Pozval jsem [majitele *pouze/ne [pivovarů]_F].
invited-I AUX only/not owners breweries-GEN
- (16) a. Došli jsme pouze/ne [k [mostu]_F].
came-we AUX only/not to bridge
- b. Došli jsme [k *pouze/ne [mostu]_F].
came-we AUX to only/not bridge

Based on these observations I will further assume that Czech CN is a focus particle associated with an F-marked expression. If we look at the intuitive semantics of Czech CN, exemplified in (17a), it seems it would be best to paraphrase it in English via the use of a negated cleft as in (17b). In other words, indicating a further formalization, Czech CN seems to negate the truth-conditions of its clause, i.e., the ordinary semantic value in Rooth's terms (see Rooth 1992), but at the same time it presupposes that at least one of the alternatives to its clause (where alternatives are computed from the point of view regarding focus) has to be true. For instance, (17a–b) is true if the speaker did not invite the owners of breweries, but the owners of something other than breweries, e.g., candy stores, coffeehouses, etc., instead.

- (17) a. Pozval jsem ne majitele [pivovarů]_F.
invited-I AUX not owners breweries-GEN
'I invited not the owners of breweries.'
- b. ≈It were not the owners of breweries, whom I invited.

Notice that Czech verbal negation is different from CN since it allows for the association with an F-marked expression at distance, as in (18a), and it even allows for an F-marked expression to c-command the negated

verb, i.e., it exhibits the opposite behaviour to FPs/CN. As for the non-adjacency in (17), it is a standard pattern in case of verbal negation, unlike its exceptional behaviour with CNs/FPs.⁴

- (18) a. Petr včera neprozradil Karlovi [to tajemství]_F.
 Petr yesterday neg-revealed to-Karel the secret.
- b. [To tajemství]_F Petr včera Karlovi neprozradil.
 the secret Petr yesterday to-Karel neg-revealed.

2.2. Formalization

In this section, I will formalize the intuition discussed above. Building on the semantics for FPs proposed in Buring & Hartmann (2001), let us assume that Czech CN combines with a set denoting expression, e.g., set of entities, set of sets etc. It negates the set meaning, i.e., the complement of the original set, which formalizes the truth-conditional effect at the ordinary semantic level. Moreover, Czech CN asserts (or, alternatively, presupposes) that at least one of the sortally suitable focus alternatives to the negated F-marked expression fulfills the predicate/rest of the sentence meaning. The proposed formalization is in (19). As we will further see, the flexible type in (19), i.e., $\langle \alpha, t \rangle$, is exactly what we observe in various types of constituents modified by CN.⁵

⁴ It would be great to elaborate more on the relation between the verbal negation and the CN with respect to their information structure effects. I further acknowledge that there is a long inspirational tradition in Czech linguistic which focuses on the information structure effects of the Czech verbal negation (as e.g., Hajičová 1984). But as far as I can tell, the Czech tradition is really more devoted to the verbal negation, sidestepping partially the CN and its informational structure effects. The argumentational strategy of this article is just the opposite. So, as usually, for the lack of space, I have to postpone a more inclusive and comparative treatment of both verbal negation and CN for a future work.

⁵ In my formalizations I rely on the alternative semantics for focus which in the standard approach to the interpretation of focus stems from Rooth 1985 and Rooth 1992. In the alternative semantics approach, the meaning of the sentence is computed from the ordinary meaning (truth-conditions – I signal them with the usual double brackets, e.g., $\llbracket A \rrbracket$) and from the computation of the focus alternatives (signaled with the superscripted f , e.g., $\llbracket A \rrbracket^f$). Czech information structure is traditionally described by variety of authors building on the Prague school model of information, for a recent summary see Hajičová et al. (2013). An comparison of the alternative semantics with Prague school model (even if theoretically interesting) lies far away beyond the scope of my paper but I assume that my formalizations are at least in principle translatable into the Prague school model.

- (19) If A is of type $\langle \alpha, t \rangle$, *ne* A is of type $\langle \alpha, t \rangle$ too, and $\llbracket \textit{ne } A \rrbracket$ is the set of all B such that B does not have the property $\llbracket A \rrbracket$, i.e., $B \notin \llbracket A \rrbracket$, but it has some property (P) that is an alternative to A , i.e., in $\llbracket A \rrbracket^f / \text{ALT}(A)$.

Let me now illustrate how (19) works on a simple example where CN associates with a predicate F-marked NP as in (20).⁶ The formalization of (20) is given in (21a). The constituent *office_seeker*(x) which corresponds to the A (of type $\langle e, t \rangle$) from (19) gets negated (the complement set to office seekers) and one of the alternatives (again of type $\langle e, t \rangle$), probably of social roles, professions etc., is supplied directly by the linguistic context in (20), namely the property of being a Christian. The complete truth-conditions of (20) would then be as in (21b), i.e., the speaker attempts to be a member of the set of Christians and not a member of the set of office seekers.

- (20) Snažím se být křesťanem, ne hledačem funkcí.
 want-I SE BE Christian not seeker office-GEN
 'I want to be a Christian, not an office seeker.'
- (21) a. $\llbracket \textit{not office_seeker} \rrbracket = \lambda x[\neg \textit{office_seeker}(x) \wedge \exists P[P \in \text{ALT}(\textit{office_seeker}) \wedge P(x)]]$
 b. $\textit{try}(I, Q) \wedge Q = \lambda x[\neg \textit{office_seeker}(x) \wedge \exists P[P \in \text{ALT}(\textit{office_seeker}) \wedge P(x) \wedge P = \textit{christian}]]$

2.3. Corpus verification

In this section, I will briefly demonstrate how corpus data support my analysis of Czech CN as FP with semantics in (19). I have selected 300 random sentences containing Czech CN from the largest current synchronic corpus SYN2010 (100 millions tokens) and classified the sentences according to (mostly) syntactic types of F-marked expressions negated by CN. Figure 1 and Table 2 offer an overview of the data. The most frequent contexts are various degree/measure phrases (examples such as Nouwen's fall into this category), then various PPs somewhat similar to example (16), then whole CPs, and finally NPs like in example (20). It is evident already from this

⁶ As one of the two anonymous reviewers correctly remarks it is not immediately clear whether syntactically example (20) is a case of constituent or sentential negation. I agree with the remark, though what is crucial is that (20) is not a case of verbal negation and it does not semantically behave as the Czech verbal negation. Moreover (20) provides a nice illustrative example for the semantic composition before the cases where (uncontroversially) CN in more complex semantic environments will be dealt with.

classification that CN of NPs, which is the most discussed type of Slavic CN in the literature, is far from being the most frequent and most interesting representative of CN in the empirically attested sample. In the rest of this section I will quickly go through the various types from Table 2 and demonstrate that the proposed semantics can be applied seamlessly to contexts giving raise to the intuitively appropriate truth conditions.

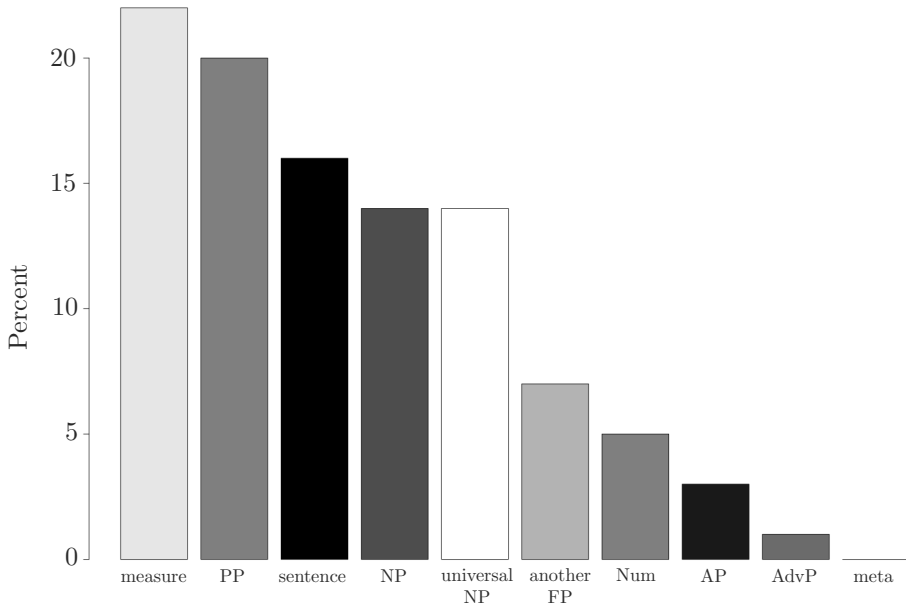


Figure 1: Occurrences of types

Table 2: Occurrences of types

Type	Percent	Type	Percent
measure	22	another FP	7
PP	20	Num	5
sentence	16	AP	3
NP	14	AdvP	1
universal NP	14	meta	0

2.4. The most important types of F-marked constituents modified by CN

The most frequent type of construction from the corpus inquiry is the CN of a degree/measure phrase exemplified by (22). In (22), the measure word *dost* 'enough' is part of AdvP which is itself part of conjoined AdvP in predicative position. In this type of construction, I generally assume that locative adverbs such as *blízko* 'close' are predicates of events (of type $\langle v, t \rangle$), whereas measure words such as *dost* 'enough' are their modifiers (hence, of type $\langle \langle v, t \rangle, \langle v, t \rangle \rangle$). The formal semantics for (22) is then (23), i.e., a set of events which are not close enough, where the subject of the sentence *mrak* 'cloud' is the theme of the event. The value for the variable P is supplied by the context as *vábne* 'temptingly'.

- (22) Mrak byl vábivě blízko, ale ne dost blízko.
 cloud was temptingly close but not enough close
 'The cloud was temptingly close but not close enough.'

$$(23) \llbracket \text{not enough close} \rrbracket = \lambda e[\neg \text{enough}(\text{close}(e)) \wedge \exists P[P \in \text{ALT}_{\text{enough}}] \wedge P(\text{close}(e))]$$

The second most frequent type of a constituent negated by CN are PPs. The most common instantiation of this type are locative PPs as in (24). I assume the predicate semantics of the whole PP, i.e., *in some dump* is a set of entities being in a dump (of course inner semantic composition of the PP is most probably much more interesting and complicated – see Corver & Zwarts 2006 – but for our purposes what is essential is the resulting meaning of the PP). CN *not in some dump* has the same semantic type $\langle e, t \rangle$. The composition with the VP then proceeds via Predicate Modification. It would be possible to propose here the event-modifier type for the PP, analogous to the measure case in (22), but nothing would change the overall composition, hence, I stick to the basic type $\langle e, t \rangle$. The meaning of (24) formalized in (25) is the set of entities located not in a dump but in some other place (again, contextually supplied by the linguistic context as *tady* 'here').

- (24) Ať radši umřou tady a ne v nějakém zapadákově.
 let better die-they here and not in some dump
 'Let them die here and not in some dump.'

$$(25) \llbracket \text{not in some dump} \rrbracket = \lambda x[\neg \text{in_dump}(x) \wedge \exists P[P \in \text{ALT}(\text{in_dump})] \wedge P(x)]$$

The third most frequent type of construction modified by CN are whole CP, as exemplified in (26). What seems to be going on in this type of

cases is that the CN in fact targets just one sub-constituent of the whole CP. In this example (as well as in majority of other CPs modified by CN), it targets the modal (or in another cases the auxiliary, phase etc.) verb. Thus, the accurate paraphrase of (26) would be: ‘I do not desire to be a nursing father but I will have to be/... one’. In other words: the CN is focus associated at distance with the modal verb and the speaker presupposes some alternative propositional attitude towards the proposition. Since modal verbs are quantifiers over propositions (of type $\langle\langle s, t \rangle, t \rangle$), the semantics for (26) is (27), i.e., a set of such propositions which are not in the modality of *want* with respect to the speaker but in some alternative propositional modality. The proposition *p* in (26)/(27) is the set of all possible worlds, where the speaker is a nursing father.

- (26) Ne že bych toužil být kojícím otcem.
 not that would-I desire BE nursing father
 ‘Not that I desire to be a nursing father.’

$$(27) \lambda p[\neg want(I, p) \wedge \exists P[P \in ALT(want) \wedge P(p)]]$$

Another construction which can be seen with CN quite often is the negation of universal quantifier as in (28). I assume the standard type of the universal quantifier, i.e., a set of sets of entities ($\langle\langle e, t \rangle, t \rangle$), and its force is universal as in the case of modal verb in (26) (a universal quantifier over propositions). In the case of (28), there is only one alternative to \forall , namely \exists , and the accurate paraphrase of (28) is as follows: ‘There are some Praguers who are satisfied with leatherette seats but it is not the case for all Praguers.’ Formally, the meaning of (28) is (29), i.e., it is a set of sets but not the set of sets containing the set of Praguers (the meaning of \forall), but the set of sets having an intersection with the set of Praguers (the formal meaning of \exists) which intersects with the set of people who are satisfied with leatherette seats.

- (28) Ne všem Pražanům ale koženkové sedačky vyhovují.
 not all Praguers but leatherette seats fit
 ‘Leatherette seats fit not all Praguers.’

$$(29) \llbracket not\ all \rrbracket = \lambda Q[\neg all(Q) \wedge \exists P[P \in ALT(all) \wedge P(Q)]]$$

The last type of construction which I formalize in detail concerns focus particles on top of PPs. Focus particles are themselves modified with CN as in the prototypical example (30). In general, the meaning of *only PP* (for locative PPs, the most frequent subtype of this construction) is a set

of entities located in the PP and not existing in another location (again, I assume the basic $\langle e, t \rangle$ type for the PP), see (31a). The meaning of *not only PP* is then the set of all entities located either in the PP or being in another location (part of the entities occur in the PP, the rest of the entities occur in another location) as represented in (31c), a more legible though logically equivalent version of (31b). In other words, CN cancels the exclusivity part of the meaning of *pouze* 'only' from (30).

- (30) K narušení symetrie dojde všude v jediném okamžiku,
 to violation symmetry-GEN occur everywhere in single moment
 ne pouze v částech vesmíru uvnitř bublin.
 not only in parts universe-GEN inside bubbles
 'The violation of symmetry occurs everywhere in a single moment, not only in parts
 of the universe inside bubbles.'

- (31) a. $\llbracket \textit{only PP} \rrbracket = \lambda x [PP(x) \wedge \forall P [P \in \textit{ALT}(PP) \rightarrow P = PP]]$
 b. $\llbracket \textit{not only PP} \rrbracket = \lambda x [PP(x) \wedge \neg \forall P [P \in \textit{ALT}(PP) \rightarrow P = PP]]$
 c. $\llbracket \textit{not only PP} \rrbracket = \lambda x [PP(x) \wedge \exists P [P \in \textit{ALT}(PP) \wedge \neg (P = PP)]]$

Another types of constructions which can be found in the corpus, i.e., CN of NumP, APs, AdvPs, and the denial subtype of CN, are also very interesting, but for space reasons I have to skip APs and AdvPs (their semantics is basically predicative, so their composition is very similar to PP modifiers such as (24) and I will focus just on two of the above mentioned constructions, namely on NumPs and the denial interpretation of CN – both of them have their own subsection, i.e., sections 2.5 and 2.6 respectively. Generally, the aim of this section was to demonstrate that the proposed semantics for CN really captures all the three types of CN found in Czech which goes far beyond what is usually discussed with respect to CN in the literature. Moreover, the semantics nicely captures one frequent feature of CN regarding that in most cases the CN is accompanied by a positive specification of the degree/set/... which fulfills the main predicate instead of the negated degree/set/... negated by CN. The formalization codes this via the existence closure of P variable which ranges over the alternatives of negated constituents. It is reasonable to hypothesise that such a variable needs to have its value set by the context, i.e., the positive analogon to the negated constituent.

2.5. The FP solution for CN of comparative NumPs

Let us repeat the example which we have started with as (32). We have observed in the beginning that unlike English, Czech allows for and even prefers the interval reading for such sentences. Now we are ready to explain this difference in the interpretation between Czech and English. For (32), the ordinary semantic value is (32a) – the numeral moves due to semantic type requirements – which is the interval reading. However, on top of that CN requires at least one alternative of the focus marked phrase (*více* ‘more’ in this sentence) to be true. Nevertheless, we will see that the focus alternative computation in (32b) will not cancel the literal interval reading in (32a). I assume that comparative in numeral phrases is interpreted as a set of sets ($\langle\langle e, t \rangle, t \rangle$), specifically such sets whose cardinality is specified by the number word of the NumP. In this case, if the P were to be interpreted as the equality alternative to the F-marked $>$ operator ($P = \{=\}$), the meaning of the comparative would be a set of sets with cardinality equaling exactly 2, e.g., one such a set can look like $\{\{a, b\}, \{1, 2\}, \{3, 4\}, \dots\}$. On the other hand, in the case of P being interpreted as less or equally alternative to $>$ ($P = \{\leq\}$), the meaning of the comparative would be a set of sets with cardinalities 2, 1, or 0, e.g., one such a possible set can look like $\{\{a, b\}, \{1, 2\}, \{3, 4\}, \{a\}, \{b\}, \{\emptyset\}\}$. There are two reasonable candidates for the alternatives to $>$, i.e., the mentioned $=$ and \leq relations. The existential closure in the CN meaning in (32b) does not distinguish between them – it requires one of them to be satisfied though we do not know which one. This correctly predicts a slight uncertainty of Czech speakers about the interpretation of (32) since although many speakers agree with my intuitions concerning the interval reading as being the most salient, some of them allow for the equality reading as well (though all of them agree that it is not the preferred reading). Nonetheless, what is crucial is that unlike in English, the strengthening to the sole equality reading (which would mean that the majority of speakers allow only for the equality reading) in Czech does not happen.

(32) Ne [vícе než dva]_F lidé vypovídali pravdivě.

no more than two people testified truthfully

‘No more than two people testified truthfully.’

a. $\neg \max_d (\lambda y \exists x [\#x = y \wedge \text{people}(x) \wedge \text{truthful_witness}(x)]) > 2$

b. $\lambda Q [\neg \text{more_than_two}(Q) \wedge \exists P [P \in \text{ALT}(\text{more_than_two}) \wedge P(Q)]]$

The difference between Czech and English, thus, comes from the fact that unlike English *no*, Czech CN is a focus particle. According to Nouwen

(2008), the equality reading in English arises through implicature calculation. For Nouwen, *no more than two* in English yields implicatures based on the non-strict comparison \leq ordering (0, 1, 2 in this case) which are strengthened via common negation of logically stronger implicatures (0, 1 in this case) – under negation, scales reverse and 0 and 1 become logically stronger than 2, as was discussed for another example already in section 1.1. For details see Nouwen (2008), but the core distinction between English and Czech seems to be clear. Though in both languages the negated comparative gives raise to alternatives, in each language they behave differently. In English, they act as classical scalar implicatures (and, thus, they are strengthened to the equality reading), whereas in Czech, where CN works with the focus alternatives, in the case of comparative it is not able to distinguish between the two possible relations (= and \leq) – the fact which is formalized as the existential closure of the alternatives in (32b). From this it follows that Czech negated comparative cannot be strengthened and we observe the interval reading.

2.6. The denial interpretation of CN

In the corpus, I have also found one example of CN interpreted as metalinguistic negation (or denial, to use the terminology of Geurts 1998), see (33). The example is different from the other discussed cases since the negation seems to target both the form and the interpretation. An accurate paraphrase of (33) would be as follows: Eliot does not call Kipling's work "poetry" (it is not true for Eliot that Kipling wrote poetry and Eliot does not want to call it poetry). Therefore, I agree with Geurts (1998) that the denial interpretation is not just negation of the form, but rather it is negation of the meaning as well, i.e., it operates both on the use and mention dimension. But still (33) is different from the previous types of CN discussed in this article in that it really is a negation of the form unlike all previous cases where the negation was operating on the meaning dimension only.

- (33) Eliot nazývá Kiplingovo metrické dílo "verši", ne "poezif".
 Eliot calls Kipling's versical work verses not poetry
 'Eliot calls Kipling's versical work "verses", not "poetry".'

The denial interpretation of English *not* is also mentioned by Nouwen (2008) when he discusses examples such as (34), observed already by Jepsersen, as was discussed already in section 1.2. As Nouwen explains,

(34a) does not have the exact meaning (contrary to (34b)), so it seems that English *not* (unlike *no*) does have the interval reading we have observed in Czech examples such as (1). Nouwen (2008) blames the lack of exhausted/equality reading in cases like (34a) on the denial interpretation of *not*. He claims that *not* in such constructions is interpreted as denial and, consequently, the meaning of a whole is not strengthened because there are no scalar implicatures which would be exhausted (at most there are alternatives in the form/mention dimension).

- (34) a. The victorious emperor remained at Rome not more than three months.
 b. The victorious emperor remained at Rome no more than three months.

I think Nouwen's solution works well for English where *not* in examples such as (34) is more marked than *no* and thus more readily interpreted as denial (the more marked expression of negation is a signal that negation can or should be interpreted as denial since a denial interpretation usually requires special signals such as intonation etc.). However, it would be inadequate for Czech examples of CN with the exception of clear denial cases like (33). In Czech examples of CN there is no signal of formal markedness similar to (34a) (in contrast to (34b)). Therefore, it seems that although both languages allow for the interval reading with CN, they both arrive at them via different strategies, i.e., English through the denial interpretation of *not*, whereas Czech through the computation of focus alternatives.

3. Summary

This article has discussed CN in Czech and in some cases it has contrasted its behaviour with English negation of the non-verbal type signaled with *no/not*. There were two perspectives pursued. The first one was broad, aiming at the descriptively adequate formal semantics for all cases of Czech CN. I consider the goal for finding the right semantics for Czech CN reached since we have arrived at a satisfactory formalization which explains the semantic behaviour of various sub-types of CN. The second perspective was more narrow: I compared Czech and English negated comparative numerals and demonstrated how their different interpretations follow from the proposed semantics for CN and particularly from the fact that Czech CN operates on focus alternatives of the F-marked phrase (unlike English *no*). At the end, we considered an alternative explanation of the interval/exact difference between Czech and English, namely the

denial explanation of Nouwen (2008) and we discarded it as empirically in-adequate at least for Czech CN.

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