

Comparative and superlative differentials: experimental evidence from Czech

Mojmír Dočekal & Hana Krajičková

Masaryk university

Background. Previous research on modified numerals established some widely accepted contrasts between comparative modifiers (CM) and superlative modifiers (SM) (see [2, 4, 8, 6, 9] a.o.), such as: (i) CM don't but SM do give raise to obligatory ignorance implicatures; (ii) CM can scope over or under existential modals (EM) but SM have to outscope them. A *no more than Num* construction (NMC), where negation and comparison are combined like in English (1a) from [7], is then claimed to allow both scopes w.r.t. EM ([7]:(1a)) and to have scalar bounding inference (50 for (1b)). NMC is then subsumed under the umbrella of differential quantifiers in the class CM (as *slightly less* in (1c)). Such claims seem to be supported by the comparative morphology of NMC. We bring new experimental evidence (from Czech) against such claims, showing that (unlike in English): (i) NMC can be interpreted with wider scope than EM; (ii) NMC can behave unlike other differential CM. The result of our experiment shows there are two kinds of differential quantifiers: comparative ((1c) and English (1a)) and superlative (Czech NMC as in (2a.c.)).

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

b. *No fewer than fifty people showed up.*

c. *John is slightly less tall than Mary.*

Experiment. We designed two experiments to target two research questions: (i) whether Czech NMC would behave more like CM or SM (in the modal environment); (ii) whether Czech *no more* behaves like other differential quantifiers. In both experiments, Czech native speakers judged (Likert scale 1-5) the appropriateness of one of the conditions in a context (we discuss exp 2: it included all the conditions of exp 1). The experiment followed an observation ([4, 1] a.o.) that CM allow both wide and narrow scope w.r.t. an existential modal reading but SM have to out-scope the existential modals (split-scope). The experiment was a truth-value judgment task where a context described a situation strongly preferring the wide scope of the existential modal over the degree quantifiers. There were 16 items and 16 fillers, 98 subjects participated in the experiment (implemented on L-Rex), and all of them passed fillers (uncontroversial TVJT). There were four conditions: i) CM: FEWER, (2a.a.); ii) SM: AT-MOST, (2a.b.); iii) *no more* modifier: NO-MORE, (2a.c.) and iv) differential *slightly less* modifier, (2a.d.) – SLIGHTLY-LESS. The conditions FEWER and AT-MOST tested the acceptability of modified numerals without differential; the conditions SLIGHTLY-LESS, NO-MORE tested the presence of a differential (zero degree differential in the case of NO-MORE). All conditions were used as a test of the particular modifier possible narrow scope w.r.t. the existential modal. [7] predicts NO-MORE to be the CM as SLIGHTLY-LESS. The design was 2x2 factorial: CM or SM (CLASSA, CLASSB) x absence/presence of a differential (DIFFYES, DIFFNO). An example item from the experiment is in (2).

(2) Context: Alex is reading the following sentence on a chocolate bar packaging:

a. *Toto balení může obsahovat {a. méně než/ b. nanejvýš/ c. ne víc než/ d. trochu méně než} 60 gramů cukru.*

than 60 gram.GEN.SG sugar.GEN.SG

'This packaging can contain {a. at most/b. fewer than/c. no more than/d. slightly less than}'

60 grams of sugar.’
 Alex says: ‘So, in this chocolate bar there can be sometimes even 65 grams of sugar.’

Results. We analyzed the data in a mixed-effects linear model with subject and item intercept+slope random effects (R package LMERTEST). The dependent variable was the subject’s response. We constructed several models, and the one that describes data the best (the less fitting models included models with main effects only and models where *no more* was treated as a CM) used as independent variable conditions and their interaction. We found a negative main effect of CLASSB (SM) (t-value: -11.004, $p < 0.001$) and a positive effect of the absence of a differential (t-value: 3.946 $p < 0.001$). The model also reports a negative interaction of CLASSB (SM) by DIFFNO (t-value: -3.129, $p = 0.002$). Tukey’s pairwise comparison of the conditions reveals that only AT-MOST and NO-MORE were statistically non-significantly different (t-value: -0.478, $p = 0.964$). All other pairs of conditions differed significantly. The boxplot representing means and SEs is presented in Fig. 1. The experiment thus confirms that the scope behavior of Czech *no more* construction follows the pattern of SM, not the CM, since subjects accepted NO-MORE to the same extent as AT-LEAST. Next, the stats confirm the difference between NO-MORE and SLIGHTLY-LESS which can be explained by classifying *no more* as an SM differential quantifier and *slightly less* as a CM. The surprising result of this exp is the overall low acceptability of all conditions; even the most default CM without a differential (cond FEWER) had $\mu=2.51$ (SD: 1.61, SE: 0.04). We hypothesize that this results from the priming effect of the most frequent everyday contexts, which strongly prefer the $max_d > \diamond$ reading, just the opposite against the contexts described in our exp.

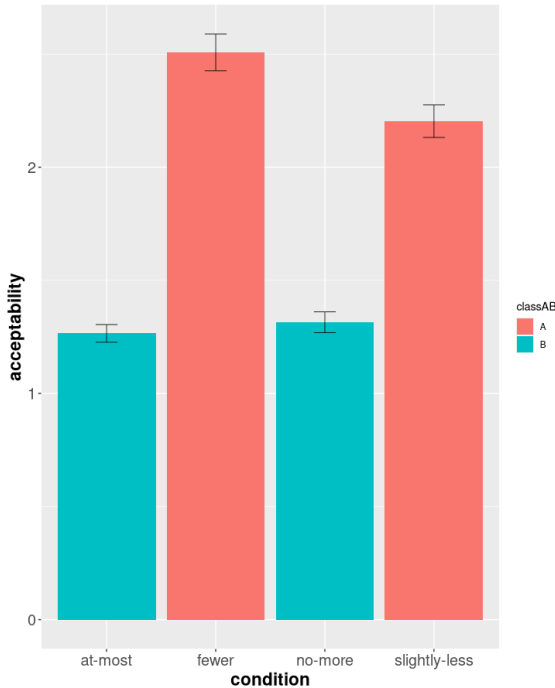


Fig. 1: Boxplot of responses

Analysis. The scope behaviour of Czech NMC is of an SM profile. Thus we follow original [7] suggestion to analyze German/Dutch *nicht mehr/niet meer* as a negative differential expressing that there is no positive difference in degree between the arguments of the comparative *more*: $\llbracket \text{nicht mehr } \alpha \rrbracket = \lambda P. \neg \exists d' [\text{max}_d(P(d)) = \alpha + d']$. And since the negative differential analysis is equivalent to the SM at-issue semantics of *at most*: $\lambda P. \text{max}_d(P(d)) \leq \alpha$ (after [5]), such approach applied to Czech experimental data correctly derives the similar scope behaviour of NMC and SM. The wide scope of the NMC/SM modifiers NO MORE and AT-MOST (2b,c) then is $\text{max}_d(\diamond \text{contain}(\text{ChocBar}, d)) \leq 65g$, which is incompatible with Alex’s continuation and predicts low acceptability of NO-MORE and AT-MOST in the experiment. The weak surface scope ($\diamond [\text{max}_d(\text{contain}(\text{ChocBar}, d)) \leq 65g]$) which allows ‘more than’ reading is allowed only for CM and explains the higher acceptability of FEWER and SLIGHTLY-LESS (whatever the reasons for obligatory wide scope of SM over existential modals are, see [1]).

The scope behaviour of Czech NMC then shows that semantically NMC behaves as SM, despite its comparative morphology. Secondly, the experiment brings support for the CM vs. SM

theory presented by [5] where the distinction boils down to the type of ordering relation (strict vs. non-strict). NMC can, at least in languages like Czech, be interpreted as \neg (strict) resulting in ordering entailments of non-strict ordering. Regular differential quantifiers (SLIGHTLY-LESS) remain strictly ordered, thus CM. Finally, cross-linguistically we found three types of NMC-languages: i) NMC as CM, English type of NMC (bounding inferences and both scopes w.r.t. existential modals), ii) NMC as SM, Czech type of NMC (only $max_d > \diamond$, lack of bounding inferences: [3]); iii) languages where NMC depending on its realization behaves as CM or as SM (Hungarian according to Balázs Surányi (p.c.)). The variation is related to the morpho-syntactic status, a constituent negation in NMC (Czech) behaves as SM; a negative quantifier (English) in NMC leads to CM. Our experiment clearly shows that treating uniformly all NMC as CM is cross-linguistically untenable and the distinction between CM and SM isn't purely morphological: Czech NMC contains both comparative marker and comparative standard marker but unlike regular CM differentials, Czech NMC acts as a superlative numeral modifier.

References: [1] D. Blok. *Scope Oddity*. PhD Thesis, LOT, 2019. [2] D. Büring. The least at least can do. In *Proceedings of WCCFL*, volume 26, pages 114–120. Citeseer, 2008. [3] M. Dočekal. Upper bounded and un-bounded 'no more'. *ALA*, 64(2):213–231, 2017. [4] B. Geurts and R. Nouwen. 'At least' et al.: the semantics of scalar modifiers. *Language*, pages 533–559, 2007. [5] C. Kennedy. A "de-Fregean" semantics (and neo-Gricean pragmatics) for modified and unmodified numerals. *Semantics and Pragmatics*, 8:10–1, 2015. [6] C. Mayr. Implicatures of modified numerals. *From grammar to meaning*, pages 139–171, 2013. [7] R. Nouwen. Upper-bounded no more: the exhaustive interpretation of non-strict comparison. *NLS*, 16(4):271–295, 2008. [8] R. Nouwen. Modified numerals: the epistemic effect. *Epistemic Indefinites*, pages 244–266, 2015. [9] B. Schwarz. Consistency preservation in quantity implicature: The case of at least. *S&P*, 9:1–1, 2016.