Comparative and superlative differentials: experimental evidence from Czech

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Basic Contrasts

Modified Numerals

i) bare numerals

(1) This chocolate contains 25 grams of sugar.

Modified Numerals

ii) modified numerals

1. comparative modifiers (class A) (*more than*, *less than*, *over*, *?no more than*, ...)

(2) This chocolate contains more than 25 grams of sugar.

2. superlative modifiers (class B) (*at most*, *at least*, *minimally*, *maximally*, ...)

(3) This chocolate contains at most 25 grams of sugar.

extensive research: Büring 2008; Geurts and Nouwen 2007; Nouwen 2008; Nouwen 2010; Cummins and Katsos 2010; Kennedy 2015; Alexandropoulou et al. 2016

Modified Numerals and Existential Modals

Comparative modifiers can scope under or over existential modals.

(4) This bus can carry fewer than 45 people.

a. $\Diamond$ ¿ *fewer than 45* — true - coach bus: 55 people

b. *fewer than 45* ¿ $\Diamond$ — true - city bus: 30 people

Modified Numerals and Existential Modals

Superlative modifiers have to outscope existential modals.

- the contrast crucial for our experiment

(5) This bus can carry at most 45 people.

a. *$\Diamond$ ¿ *at most 45* — false - coach bus: 55 people

b. *at most 45* ¿ $\Diamond$ — true - city bus: 30 people

Geurts and Nouwen 2007; Blok 2019

Ignorance Implicatures

- another important contrast
- sometimes related to the Maxim of Quantity: logically weaker sentences can signal speaker's ignorance
- comparative modifiers without ignorance implicature

(6) This chocolate contains more than 25 g of sugar. no II

- superlative modifiers with ignorance implicature

(7) This chocolate contains at most 25 grams of sugar. II

Testing Czech no more than

Testing Czech no more than

Nouwen 2008 claims that *no more than* is a comparative modifier since:

- both scopes in the existential modal env.
- no ignorance implicature (and with scalar bounding reading)

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

Both properties are intuitively inappropriate for Czech *no more* ($\leftrightarrow$ motivation behind the experiments)

Differences between Czech and English no more

English *no* can act as an determiner:

(9) a. No man arrived.

b. Every/the man arrived.

Unlike Czech *no* in *ne víc* which seems to be a focus particle

(10) *#Ne/✓žádný muž nepřijel.*
no/any man arrived

Differences between Czech and English no more

Slavic focus particles (FP) have to (Jasinskaja 2012 a.o.):

- c-command their associated F-marked expression
- be adjacent to the F-marked constituent

Czech *no* behaves like all other FPs, as exemplified in (11) and (12) with a prototypical FP *pouze* ‘only’

(11) *Já se choval [seriózně]$_F$ *ne/pouze.*
I SE behaved seriously no/only.

(12) a. I behave only [seriously]$_F$.

b. I only behave [seriously]$_F$.

c. *Já *pouze/*ne jsem se choval [seriózně]$_F$.*
I *only/*no AUX SE behaved seriously

d. *Já jsem se choval pouze/ne [seriózně]$_F$.*
I AUX SE behaved only/no seriously

But the comparative morphology in Czech *no more* is present: *víc* is a comparative of *mnoho*, *než* is used in the comparatives

(13) a. *Petr měří ne víc než dva metry.*
Petr measures no more than two meters

b. *Petr je starší než Marie.*
Petr AUX older than Marie

Summary of *no more* vs. *ne víc* diffs:

- both are build on comparative base
- but *no* is a determiner while *ne* focus particle (constituent negation)
  - being focus particle Czech *no more* is close to focus sensitivity of *at most/at least*: Cohen and Krifka 2011; Coppock and Brochhagen 2013

Two Theories, Two Predictions

1. Nouwen 2008; Nouwen 2010: based on the morphology, *no more than* – comparative modifier
2. Kennedy 2015: the difference between comparative and superlative modifiers comes from the ordering (semantics) – strict (comparative) vs. non-strict (superlative)
   - comparative *fewer than 3*: $max < 3$ strict ord.
   - superlative *at most 3*: $max \leq 3$ non-strict ord.
   - *no more than*: can be treated as superlative modifier

Predictions

		$\Diamond >$ *no more than*	*no more than* $> \Diamond$
Predictions	NMC as CM	✓	✓
	NMC as SM	*	✓

Question Addressed by the Experiment

(14) If *no more than* is SM, it should sound odd in a context preferring $\Diamond >$ *no more than* interpretation.

Consequences:

- theoretical: support for one type of (modified) numerals theory;
- distinguishing two types of differentials:
  1. regular: *slightly less*
  2. morphologically comparative but semantically superlative (Czech *no more than*)

Experiment

Design

- joint work with Hana Krajíčková
- two experiments and two research questions:

(15) a. Does Czech *no more* behave more like a comparative or superlative modifier (in the modal environment)?

b. Does Czech *no more* behave like other differential quantifiers?

Further: exp 2 – it included all the conditions of exp 1

Design

- Czech native speakers
- Likert scale 1-5
- the appropriateness of one of the conditions in a context
- truth-value judgment task where a context described a situation strongly preferring the wide scope of the existential modal over the degree quantifiers

Design

- 16 items and 16 fillers,
- 98 subjects participated in the experiment (implemented on L-Rex), all of them passed fillers (uncontroversial TVJT)
- four conditions

Design

4 conditions:

1. standard comparative modifier (*méně než* ‘fewer than’): FEWER
2. standard superlative modifier (*nanejvýš* ‘at most’): AT-MOST
3. *no more* modifier (*ne víc než* ‘no more than’): NO-MORE
4. standard differential comparative modifier (*trochu méně než* ‘slightly less than’): SLIGHTLY-LESS

Design

- FEWER and AT-MOST tested the acceptability of modified numerals without differential
- SLIGHTLY-LESS, NO-MORE tested the presence of a differential (vague and zero degree differential)

Design

The design was 2x2 factorial:

- comparative vs. superlative modifier (CLASSA,CLASSB) x
- absence/presence of a differential (DIFFYES,DIFFNO)
- the main conditions:
  1. FEWER: [+CLASSA,-DIFF]
  2. AT-MOST [-CLASSA,-DIFF]
  3. NO-MORE [-CLASSA,+DIFF]
  4. SLIGHTY-LESS [+CLASSA,+DIFF]

contra Nouwen 2008

Example item

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

(16) *Toto balení může obsahovat*
this packaging can contain

a. FEWER
méně než
fewer than

b. AT-MOST
nanejvýš
at-most

Example item

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

(17) *Toto balení může obsahovat*
this packaging can contain

a. NO MORE
ne víc než
no more than

b. SLIGHTY LESS
trochu méně než 60 gramů cukru
slightly less than 60 grams of-sugar

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

Results

- mixed-effects linear model with subject and item intercept+slope random effects (R package LMERTEST)
- dependent variable was the subject's response
- 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):
- the model with independent variable conditions CLASSA/B vs. DIFFYES/NO and their interaction

Results

- negative main effect of CLASSB (SM) (t-value: -11.004, $p < 0.001$)
- positive effect of the absence of a differential (t-value: 3.946 $p < 0.001$)
- a negative interaction of CLASSB (SM) by DIFFNO (t-value: -3.129, $p = 0.002$)
    - AT-MOST was less acceptable than FEWER considering that both of them are without differentials

Results

- Tukey's pairwise comparison of the conditions: only AT-MOST and NO-MORE were statistically indistinguishable (t-value: -0.478, $p = 0.964$)
- all other pairs: differed significantly
- the boxplot representing means and SEs below

Boxplot

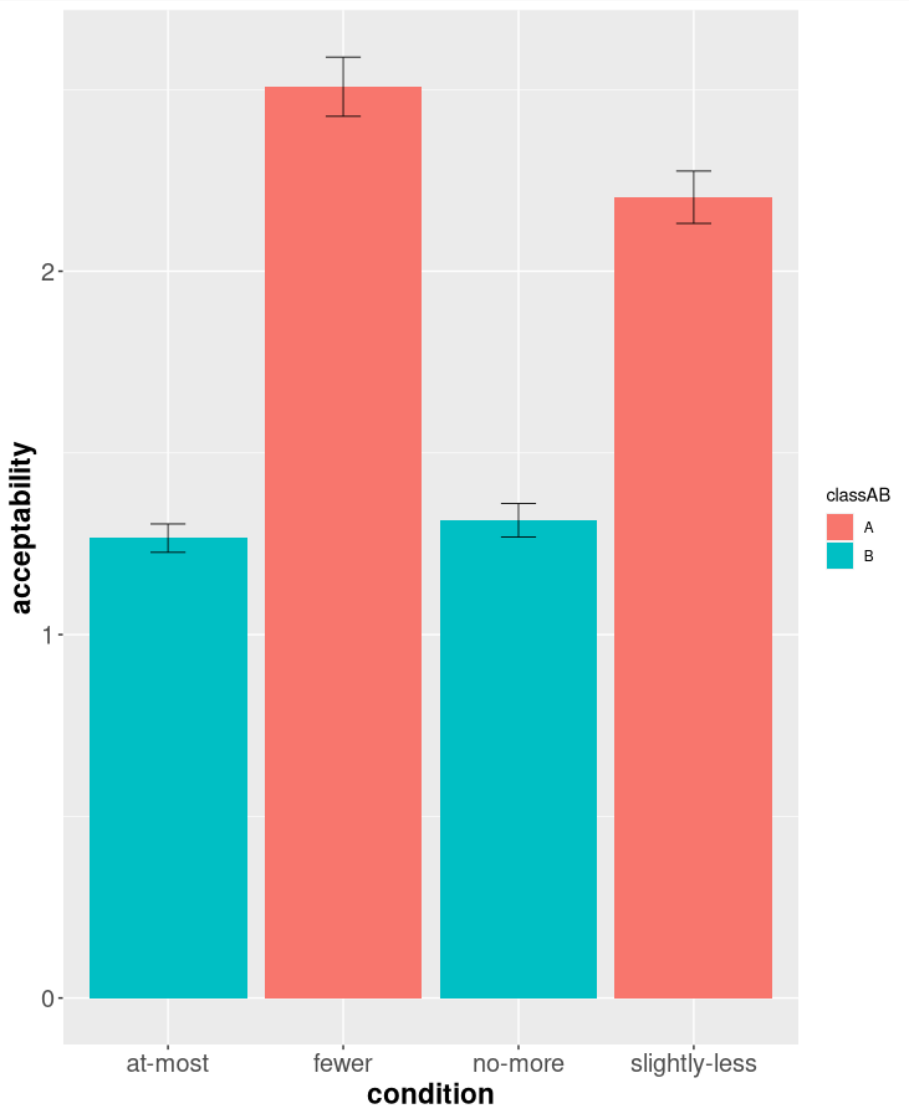

Figure 1: Boxplot of responses

Results

The experiment confirms:

- the scope behavior of Czech *no more* construction follows the pattern of superlative, not comparative modifiers
- $\leftrightarrow$ subjects rejected NO-MORE to the same extent as AT-LEAST
- the significant difference between NO-MORE and SLIGHTLY-LESS
- $\leftrightarrow$ *no more* is a superlative differential quantifier and *slightly less* as a comparative diff quant.

Results

Surprising result:

- low acceptability of all conditions: even the most default comparative modifier without a differential (cond FEWER) had μ=2.51 (SD: 1.61, SE: 0.04)
- possibly priming effect of the most frequent everyday contexts like (18), which strongly prefer the $max_d > \Diamond$ reading, just the opposite against the contexts described in our exp.

(18) *Tato elektrokoloběžka může jet méně než 25 km/h.*
this electric-scooter can run fewer than 25 km/h.

Analysis

Analysis

The scope behaviour of Czech NMC is of an superlative modifier profile

- generally: our exp confirms Kennedy 2015
- implementation: there is no positive difference in degree between the arguments of the comparative *more*
  1. following Nouwen 2008: analyze German/Dutch *nicht mehr/niet meer* as a negative differential expressing
  2. $[\![\text{nicht mehr } \alpha]\!] = \lambda P.\neg\exists d'[max_d(P(d)) = \alpha + d']$

Analysis

- the negative differential analysis is equivalent to the superlative at-issue semantics of *at most*
- in Kennedy's style of class A/class B analysis, we can classify Czech *no more* as a superlative modifier

(19) a. $\lambda P.\neg\exists d'[max_d(P(d)) = \alpha + d']$

b. $\approx \lambda P.max_d(P(d)) \leq \alpha$ (after Kennedy 2015)

Another approach

In Zhang and Ling 2021 interval arithmetic decompositional approach

- both *no more than 60* and *at most 60* denote upper bounded closed interval:

(20) a. no more/at most than 60 ... $(-\infty, 60]$

b. more then 60 ... $(-\infty, 60)$

Similar to the logic in Kennedy 2015: composition is semantically but not morphologically driven.

Analysis applied

The analysis correctly derives:

1. the wide scope of the class A modifiers NO MORE and AT-MOST: $max_d(\Diamond \text{contain}(\text{ChocBar}, d)) \leq 65g$
2. incompatible with Alex's continuation and predicts low acceptability of NO-MORE and AT-MOST

Analysis applied

The weak surface scope
$\Diamond[max_d(\text{contain}(\text{ChocBar}, d)) \leq 65g]$

allowed only for comparative modifiers

- explains the higher acceptability of FEWER and SLIGHTLY-LESS (whatever the reasons for obligatory wide scope of SM over existential modals are, see Blok 2019)

Consequences

1. morphology isn't always the right clue: Czech *no more* behaves as class B, despite its comparative morphology
2. the experiment brings support for the CM vs. SM theory presented by Kennedy 2015: the distinction between class A/B = the type of ordering relation (strict vs. non-strict) – **semantics**
   - Czech *no more* can be interpreted as $\neg$ (strict) $\rightarrow$ ordering entailments of non-strict ordering
   - regular differential quantifiers (SLIGHTLY-LESS) remain strictly ordered, thus class A

Cross-linguistic speculations

So far: three types of NMC-languages:

1. *no more* as class A, English type of NMC (bounding inferences and both scopes w.r.t. existential modals)
2. *no more* as class B, Czech type of NMC (only $max_d > \Diamond$, lack of bounding inferences: Dočekal 2017)
3. languages where NMC depending on its realization behaves as CM or as SM (Hungarian according to Balázs Surányi (p.c.))

Cross-linguistic speculations

The variation seems to be related to the morpho-syntactic status:

1. a focus particle/constituent negation in NMC (Czech) behaves as a superlative modifier
2. a negative quantifier (English) in NMC leads to the comparative modifier behaviour

Thank You for Your Attention!

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