Equatives and two theories of negative concord

experimental evidence from Czech

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Intro

- talk about expressions depending on the polarity
- evidence: Czech (strict negative concord language)
- data gathered from many experiments: long and extensive collaborative work with Jakub Dotlačil, Iveta Šafratová, Tereza Slunská, Martin Juřen and many other linguists in Brno and around
- add to experimental research on NPIs: [5, 13, 1] a.o.
- more specifically: [11, 27] and their experimental work on cross-linguistic variation in NPI licensing (following [6])
- empirically, the talk is about Czech strong NPIs and neg-words
- *ani jeden* 'even one' vs. *žádný* 'no' (neg-word)
- in the majority of contexts: interchangeable – (1)

(1) Petr nepotkal {ani jednoho/žádného} studenta.
Petr neg-met strong NPI/neg-word student
'Petr didn't meet even one/any student.'

- strong NPIs (theoretical framework: [14]) but with the unlikelihood presupposition (English *ANY*: [19], Hindi *ek bhii*: [22], English *even one*: [10])
- *ani*: the unlikelihood presupposition of English *even* but limited to strong NPI contexts
- strongest (unlikely) prejacent: entailing all the alternatives

(2) FC Barcelona nedala {ani jeden/#ani deset} gól/ů.
FC Barcelona neg-gave even one/#even ten goal(s)
'FC Barcelona didn't score even one/#ten goal(s).'

Czech neg-words

- similar to Italian neg-words (*niente*, e.g.: [21]) but as in all Slavic languages (strict negative-concord: [30]) in majority of contexts require verbal negation (in the same clause)

(3) a. Petr nedal žádný gól.
Petr neg-scored neg-word goal
'Petr didn't score any goal.'
b. Nikdo {nepřišel/#přišel}.
neg-word neg-came/came
'Nobody came.'
c. *Petr neřekl, že nikdo přišel.
Petr neg-said that neg-word came

- the most influential analysis of neg-words: syntactic approach ([30] a.o.)
- in strict negative concord languages, all neg-words (and the verbal) negation carry [uNeg] and are checked against [iNeg] (covert) operator with the semantics of ¬
- part of the talk: experimental support for an alternative, semantic theory of neg-words ([23, 20])
- equatives: one of the contexts where strong NPIs and neg-words distribution diverge
- Czech equatives don't license strong & weak NPIs (like German and many other non-English NPIs: see [18]) but license neg-words
- surprising against English and standard theories of equatives [28, 2] a.o.
- one of the environments where the contrast is most robust but still there's a variation: some speakers treat *ani* as neg-word

(4) Petr je tak vysoký jako {#ani jeden/žádný} jiný student.
Petr is so tall how strong NPI/neg-word other student.

(5) Paris is as quiet as ever.

Negative quantifiers, NPIs, neg-words and variation

- connected to the recent work on English NPIs vs. negative quantifiers and its variation
- [29, 3]: NPIs replace negative quantifiers in some (lower, e.g.) syntactic domains
  - historical and social factors are real but weaker than grammatical
- similarly: [4]: the variable negative concord in Québec French

- experimental work: search for factors (grammatical and social as well)
- plus explaining the puzzling equative pattern

The empirical and theoretical questions

(6) Question 1: How to explain the unpredicted acceptability of Czech neg-words in equatives (and NPIs unavailability)?

   a. Especially considering the monotonic properties of equatives.

- experimental data give us precise enough clues

(7) Question2:
   a. How can we explain microvariation by grammatical (semantic) factors?
   b. Is part of the variation caused by social factors?

Experiment

- the experiment was run online on the L-Rex platform
- mostly students of MUNI (Brno) and UK (Prague)
- 105 participants, 82 passed the fillers and were included in the stats
- each questionnaire: 64 items, 48 randomized lists
- 3 demographic-related questions:
  - age
  - region
  - daily reading time (books, etc.)

Two parts of the experiment:

1. acceptability judgment task (no context)
2. acceptability judgment task against probability/scalarity manipulated context

- both parts: participants judged the acceptability of sentences on a 1 to 7-point Likert scale (1 the worst, 7 the best)
- both parts: all conditions were crossed with two conditions:
  - neg-words
  - strong NPIs

Experiment: part 1 (example item)

(8) a. V království nezůstal {žádný/ani jeden} zloděj.
in kingdom neg-ramained neg-word/NPI thief
'No thief remained in the kingdom.'

b. Král nechce, aby v království zůstal {žádný/ani jeden} zloděj.
King neg-wants that in kingdom remained neg-word/NPI thief
'The king doesn't want any thief to remain in the kingdom.'

c. Zloděj ze souostroví Qwghlm je tak šikovný jako {žádný/ani jeden} zloděj.
thief from archipelago Qwghlm is so clever how neg-word/NPI thief

'The thief from the Qwghlm archipelago is as clever as no other thief.'

- first part: 3x2 design

Experiment: part 2

- in this part, the two classes of negative dependent expressions were tested against a manipulated context
- the context was created to fix a scale (probability, noteworthiness, …)
- both neg-words and strong NPIs were tested with tops and bottoms of the contextual scale
  - 2x2 design
  - neg-words/strong NPIs vs. top-of-the scale/bottom of the scale

(9) Kontext: Šikovný trpaslík ze vsi najde v těchhle dolech za den 1, 2 někdy i 3 diamanty.
Context: A clever dwarf from the village will find 1, 2 or 3 diamonds in these mines per day.

a. Jeden šikovný trpaslík ze vsi nenašel včera v dolech {žádný/ani 1} diamant.
one clever dwarf from village neg-found yesterday in mines neg-word/NPI 1 diamond
'One clever dwarf from the village didn't find even one diamond in the mines yesterday.'

b. Jeden šikovný trpaslík ze vsi nenašel včera v dolech {žádné/ani} 3 diamanty.
one clever dwarf from village neg-found yesterday in mines neg-word/NPI 3 diamonds
'One clever dwarf from the village didn't find even three diamonds in the mines yesterday.'

Results

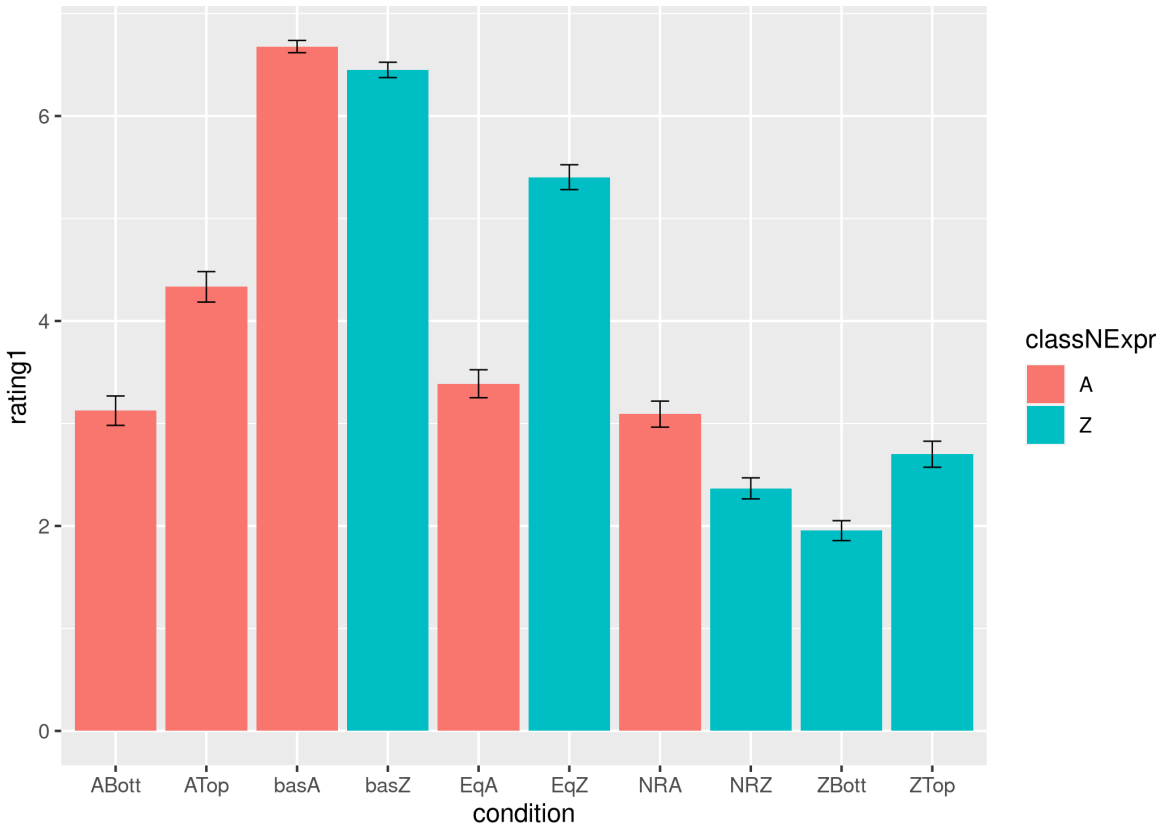

Figure 1: Graph of acceptance (+error bars)

Hierarchical models

(bottom of the scale probability, top in Appendix)

- mixed hierachical models with random effects for subjects and items (full structure: slope and intercept)
- Cumulative Link Mixed Model: R package `ordinal` (Christensen [7])
- multiple hierarchical regression with interaction (3x2 and 2x2)

Demographic factors

- negative concord can vary depending on social factors (Montréal French: Burnett, Tremblay, and Blondeau [4] but also: Burnett, Koopman, and Tagliamonte [3])
  - age, education level
- in the experiment, the subjects were asked for:
  - region
  - age
  - daily reading time (books, newspapers, …)

Summary of demographic factors:

- no interaction between neg-words or strong NPIs with either of the 3 factors
- no main effect
- the variation effects discussed later are not social (the same results: after z-transformation of age)

1. main effects: all conditions were degraded against the baseline
2. **interaction effects**:

- the strong positive effect of neg-words by equatives
- non-significant effect of neg-words by NegRaising (but see next exps and variation)
- significantly strong negative effect of neg-words by probability

(the same results: Bayesian model – Appendix)

```
Cumulative Link Mixed Model fitted with the Laplace approximation
formula: as.factor(rating1) ~ condition * classNExpr + (1 + condition |
  participant) + (1 + condition | item)
  data:    items_with_probability_bott

Coefficients:
                          Estimate Std. Error z value Pr(>|z|)
conditionEq               -5.31772    0.46257 -11.496  < 2e-16 ***
conditionNR               -5.62684    0.44530 -12.636  < 2e-16 ***
conditionProb             -5.62179    0.51548 -10.906  < 2e-16 ***
classNExprZ               -0.88195    0.26981  -3.269  0.00108 **
conditionEq:classNExprZ    3.16921    0.32897   9.634  < 2e-16 ***
conditionNR:classNExprZ    0.06224    0.31883   0.195  0.84523
conditionProb:classNExprZ -0.71610    0.33130  -2.161  0.03066 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1```
```

Summary

1. neg-words are (unlike strong NPIs) accepted in the standard of equatives

- unexplainable in the syntactic theory of neg-words
- NPI unacceptability is surprising but probably results from cross-linguistic differences in equatives

2. NegRaising predicates are better licensors for strong NPIs (the effect was not significant in this experiment but see exp. evidence below)

3. in probability/scale manipulated contexts, strong NPIs are preferred

- again problematic for the syntactic theory of neg-words

Intriguing correlations between conditions (per speaker).

Correlations

- all speakers agreed on their high acceptance of baseline
- but some rated *ani* high in equatives, those who accept it in NegRaising: strong NPI
- similar observations in previous experiments: baselines universally accepted but divergent acceptability in non-baseline conditions
- speakers who accept *ani* in equatives treat it as neg-word
- technically:
  - z-transformation of (by subject) acceptance of conditions
  - checking the correlation of such z-transformed ratings
  - Pearson's product-moment correlation: $t = -5.93$, p-value < 0.001
- this is a continuation of Dočekal and Dotlačil [12]: correlation between probability and NegRasing (for *ani* but not for neg-words): see experiments below
- but crucially, no correlations against the baseline: slide after the next slide

Distribution and correlations summary

	Bas	Prob (unlik.)	Eq	NR	Fragm.	Without
strong NPIs	✓	✓	*	✓*	*	✓
neg-words	✓	*	✓	*	✓*	✓

	Eq … NR	Prob. … NR	Fragm. … NR	Eq … Bas
strong NPIs	neg. corr.	neg. corr.	neg. corr.	*
neg-words	*	*	*	*

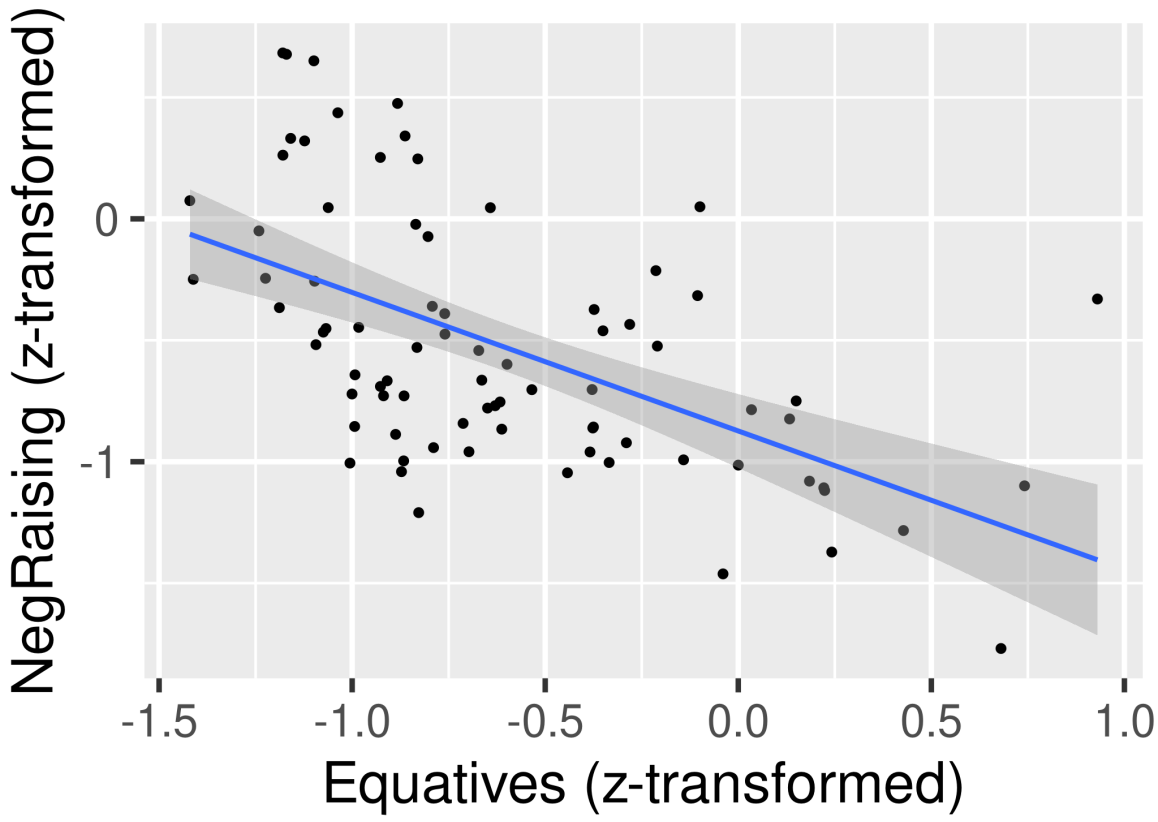

Figure 2: Correlations between NegRaising and Equatives

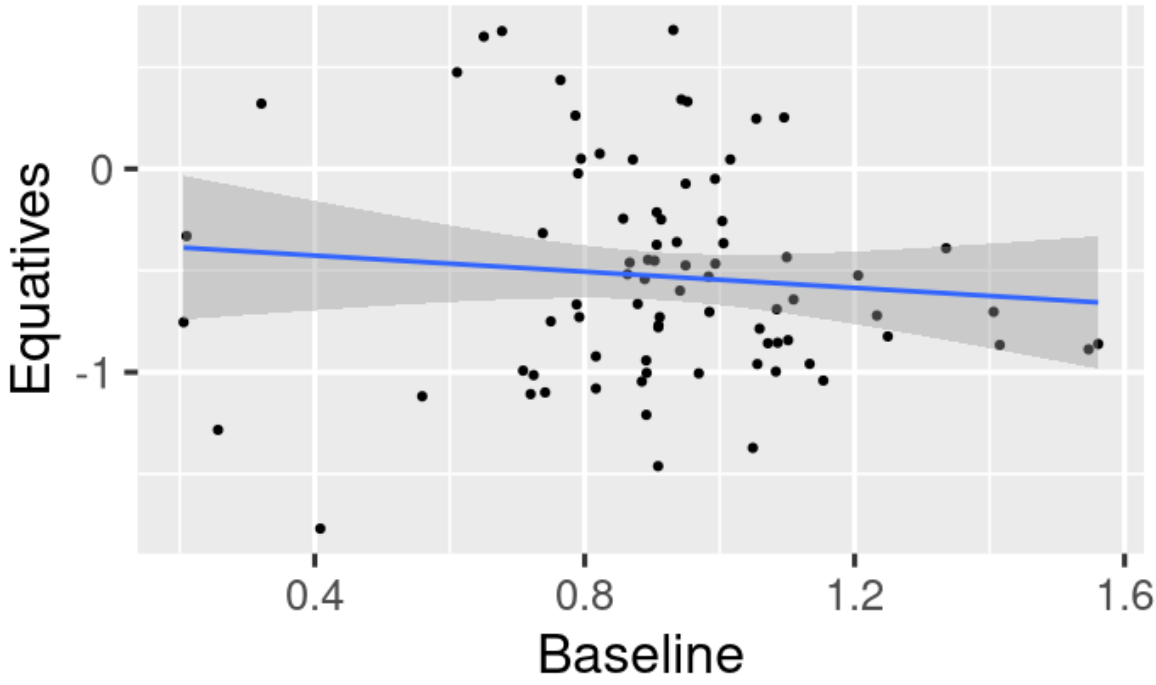

Figure 3: Correlations between Equatives and Baseline

Theoretical consequences

Assumptions: licensing of (strong) NPIs

- general framework: mixture of *even*-theory of NPIs licensing ([19, 22, 10] a.o.) and Gajewski's formalization of strong NPIs [14]
- licensing NPIs (after Gajewski [14]): strong NPIs are licensed in downward-entailing (DE) environments
- DE both in Truth-Conditions (TC) but also in the non-at-issue meaning

(10) An NPI is licensed in the environment γ
$[_\alpha exh [_\beta \ldots [_\gamma$ NPI $] \ldots]]$:
a. the environment γ is DE in β — weak NPIs
b. the environment γ is DE in α — strong NPIs

- the exhaustifier for strong NPIs as English *even one*: covert *even*
- the standard analysis for scalar strong NPIs Crnič [8] and for scalar reading of focus particles Panizza and Sudo [24]
- overt but also covert *even* has scalar (11-a) and additive (11-b) presupposition:
- the presuppositions after Panizza and Sudo [24] (the additive sometimes suspended):

(11) a. Even Pope_F danced.
b. Even one_F cat will make Pope happy.

(12) 'Even ϕ' presupposes:
a. that ϕ is relatively unlikely to be true among $\text{Alt}(\phi)$; and
b. that there is $\psi \in \text{Alt}(\phi)$ that is not entailed by ϕ and is true.

(for monotonic scales, likelihood translates into entailment (after [9]))

Baseline from the experiment

- *ani* strong NPIs associate with covert *even* (scope: propositional level)
- it reqires DE both in TC and non-at-issue
- plus the scalar presupposition of covert *even* exhaustifier
- the exhaustified focus alternatives: other cardinality predicates (after [22, 9] a.o.)
- the entailment between numerals is reversed by negation: $\neg(\llbracket$ one cat $\rrbracket \ldots) \vDash \neg(\llbracket$two cats$\rrbracket \ldots)$

(13) Ani one thief neg-remained in the kingdom.

a. $[_\alpha$ (*even*) $[_\beta \neg [_\gamma$ ani one thief remained in the kingdom $]]\ ]$
(i) TC (in β) DE: ✓
(ii) non-at-issue (in α) DE: ✓

(iii) scalar presupposition of (even): $\rightarrow \neg$(two thieves remained), $\neg$(three thieves remained), ...: ✓
(iv) additive presupposition: $\neg$(two thieves remained) $\vee$ $\neg$(three thieves remained), ...: ✓

Other conditions from the experiment

Likelihood

- the explanation is the same as for the baseline: the scope (*even*) $>$ $\neg$ $>$ ... one ...
- the general preference of strong NPIs over neg-words follows from the semantic theory of neg-words – bellow

Neg-Raising

- in many previous experiments (three at least): Neg-Raising was better accepted with strong NPIs (but the effect was never strong)
  - one possibility: the variation – speakers who treat *ani* as a neg-word blur the line
- standard theories of Neg-Raising: [15] or [26]
  - the scope of negation (via the excluded middle inference) on the embedded predicate
- at the embedded level: covert (*even*) $>$ $\neg$ $>$ [... one ...]
- neg-words: the locality constraints – see below

Neg-words

- semantic/pragmatic theory of neg-words and negative concord
- Ovalle and Guerzoni [23] and modern reformulation in Kuhn [20]
- TC: indefinite description
- non-at-issue: empty reference

(14) a. $[\![\text{neg-word}]\!]=\lambda P.\exists x[SORT(x) \wedge P(x)]$ TC
b. $[\![\text{neg-word}]\!]=\neg\exists x[SORT(x) \wedge P(x)]$ non-at-issue
(i) after Kuhn [20]: $\wedge\mathbf{0_x}$ ...postsupposition (highest scope)

Locality, etc.

- Kuhn [20]: many improvements of Ovalle and Guerzoni [23]
- discourse referents (presupposed to be empty) are delimited by the previous context
  - more specific concerning the presupposition of emptiness
- neg-words are analyzed via split scope around licensor (prototypically negation)
  - the split scope is achieved via quantifier raising
  - the locality constraints on neg-word licensing ≈ QR in the particular language and construction

Explaining the baseline

(15) neg-word thief neg-remained in the kingdom.

a. $[\neg[\exists x[\mathbf{thief}(x) \wedge \mathbf{remained}(x)]\ ]] \wedge \mathbf{0_x}$

- TC and the postsupposition are compatible
- in positive sentences, the $\mathbf{0_x}$ postsupposition leads to ungrammaticality:

(16) neg-word thief remained in the kingdom.

a. $[\exists x[\mathbf{thief}(x) \wedge \mathbf{remained}(x)]\ ] \wedge \mathbf{0_x}$ $\bot$

- this also nicely explains the acceptability of neg-words with *bez* 'without' (no morphological negation)

Other conditions from the experiment

Probability

- both in top and bottom contexts, strong NPIs were preferred
- the contexts were (nearly always) set up with positive inference
- the positive inference goes against $\mathbf{0_x}$ presupposition of neg-words
  - it can also explain the surprisingly high acceptability of strong NPIs even in top scalar contexts
  - another factor: different scales (numerical in last experiment, ad-hoc in previous) → future experimental work

Neg-Raising

- previous experimental work: mostly evidence for decreased acceptability of neg-words (against strong NPIs) in NR
- Kuhn's QR approach: explains the neg-words decreased acceptability
- in the last experiment: the contrast is blurred
- one possibility: to remove subjects treating *ani* as a neg-word from the stats
- unlike with equatives, the environment seems to be nearly as acceptable for neg-words as for strong NPIs

Equatives

- Slavic equatives are different from English equatives, and their morpho-syntax is very similar to correlatives
  - Slavic equatives are built on the correlative syntax
  - and following [17]: correlatives are bad licensors of NPIs
- another experiment in preparation: weak NPIs are penalized in Czech equatives (but acceptable in comparatives)
  - Slavic equatives are probably not even DE (as was observed for German: [18, 25])
- neg-words are acceptable but verbal negation not (as in German: [25])

(17) Petr je tak chytrý jak nikdo jiný/*Marie ne.
Petr is so smart how neg-word else/Mary not

Equatives II

- syntactic and semantic ingredients (pseudoCzech in (18))
- non-standard: $max \rightarrow max_{inf}$ (otherwise max would lead to $\perp$): [25]

(18) This thief is so clever how neg-word other thief.

a. [so [so$_1$ no other thief t_1 clever]]$_2$ [This thief is t_2 clever]

b. $[\![so]\!]$ … picks up the degree denoted by the standard clause

c. $[\![$ how$_1$ neg-word other thief clever is $]\!]$

(i) nobody other than the thief is d-clever — neg-word presupposition

(ii) the thief is d-clever — implicature of *other*

(19) a. $[\![$ as $]\!] = \lambda S \lambda C.max(C) \geq max(S)$

b. $S' \subseteq S : max(C) \geq max(S) \rightarrow max(C) \geq max(S')$ — English DE *as*

Equatives III

Motivation of the ingredients:

- max_{inf}: the equative in Czech has exactly the same building blocks (*tak* 'so' … *jak* 'how') as correlative constructions
- *other*: the anaphor similar to reciprocal anaphors
  - it identifies the dref
  - it is also used in the exceptive phrases from which the presupposition comes: *Nobody other than John neg-came* presupposes that John came (as the only exception)
- neg-word presupposition ranges over the dref picked up by the reciprocal

Summary 1

- Czech neg-words and strong NPIs
- existential TC core: $\lambda P.\exists x[NP(x) \wedge P(x)]$

	TC	non-at-issue meaning
neg-words	existential	$\mathbf{0_x}$
strong NPIs	existential	scalar presupposition association with (even)

Summary 1

- that explains (with some other more or less standard assumptions) the patterns of the experiment(s) plus:

(20) How to explain the unpredicted acceptability of neg-words in equatives (and NPIs unavailability)?

(21) The non-standard max_{inf} accounts for the surprising neg-words acceptability.

a. decisive evidence for the semantic theory of neg-words

b. non-monotonic environment: NPIs are predicted to be out

- neg-words in equatives: no standard theory of equatives with interpreted ¬ ([uNeg]) in the standard
- the answer to Question 2:

(22) Question2:
a. How can we explain microvariation by grammatical (semantic) factors?
b. Is part of the variation caused by social factors?

(23) The speaker variation is explainable as shifting from the scalar to the emptiness of the DR presupposition (in case of *ani jeden* 'even one').
a. Social factors don't seem to play a role in this shift.

- the experimental data support the semantic theory of neg-words: higher acceptability of strong NPIs in the probability manipulated contexts: unpredicted, many other environments (fragmentary answers preference for neg-words and also *without* type of P)

Open questions

- proper investigation of locality constraints
  - NegRaising: the concurrence sometimes vanishes (Maximize Presupposition of [16]?)
- both scopes of covert *even* in probability contexts (exp1) or just one (exp2 & exp3), or the difference comes from different scales?
- cross-linguistic variation in the neg-words locality: at least in some Romance languages, neg-words are licensed in *before*-clauses and under *doubt*-type of predicates
  - some suggestions in [20]

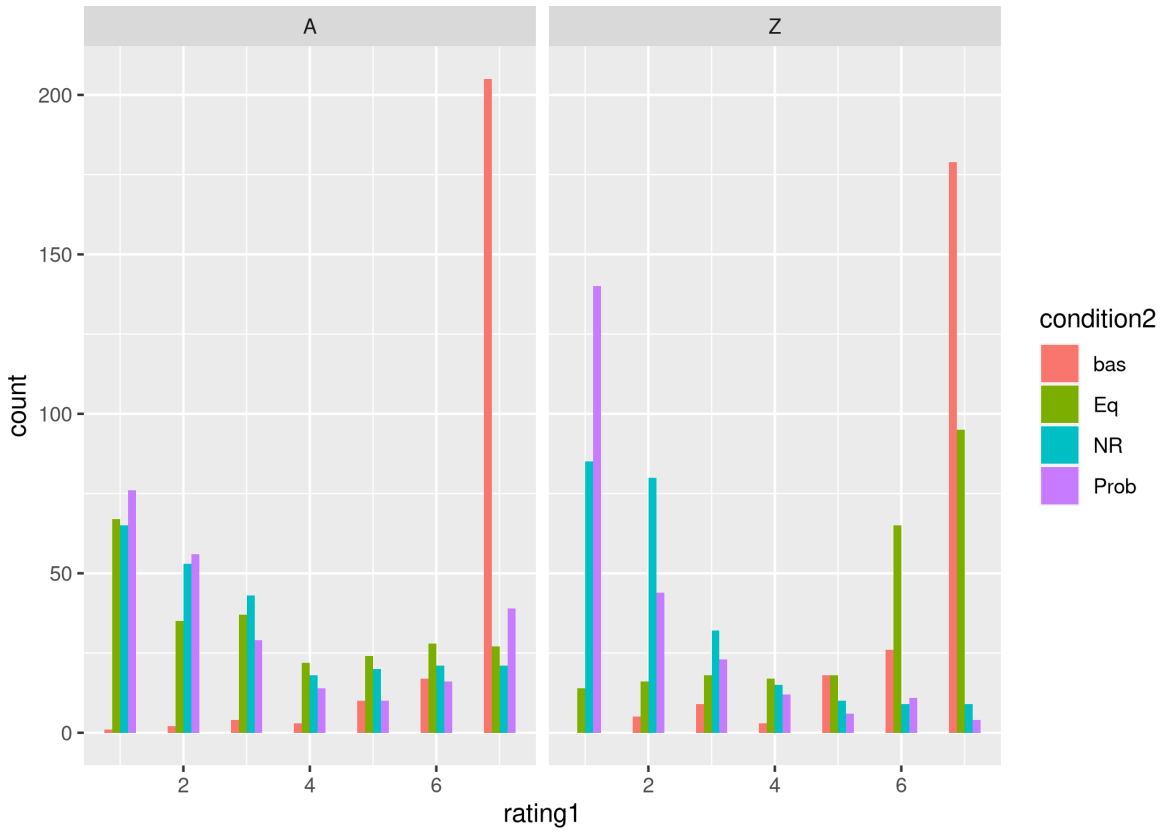

Figure 4: Histogram: probabilities Bottom of the scale

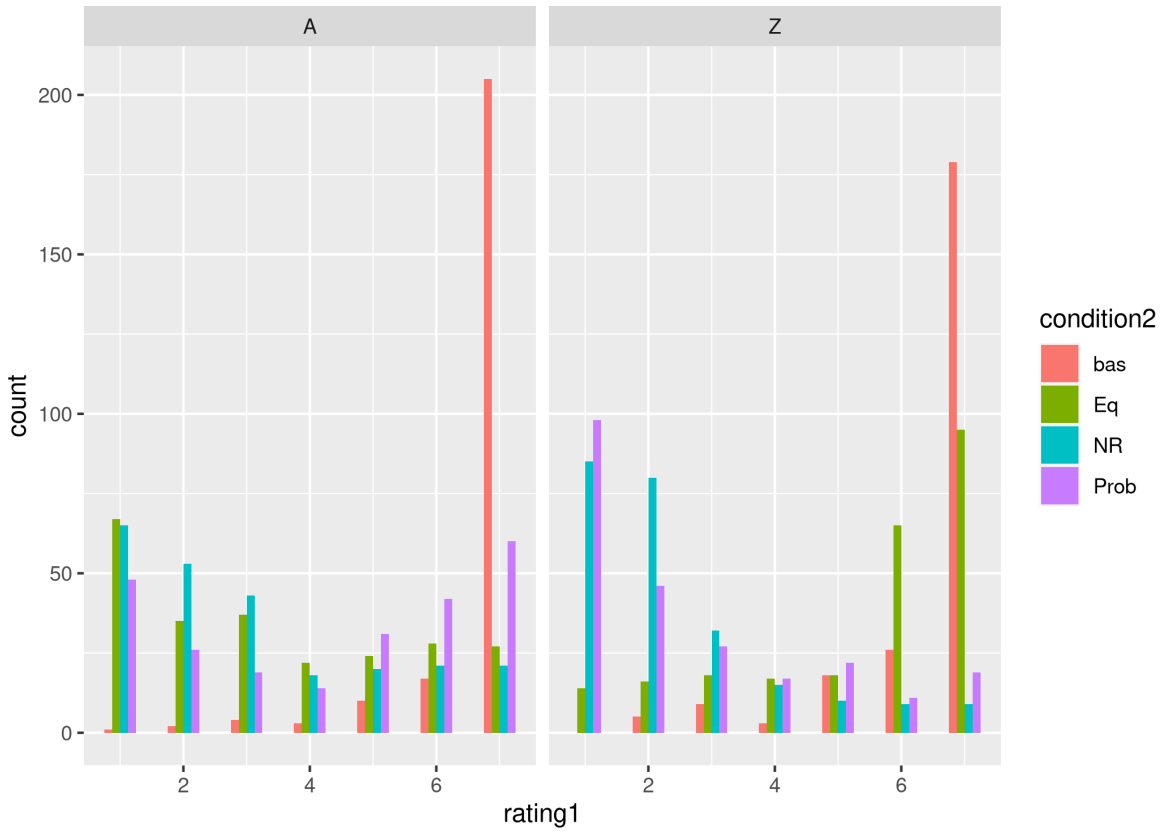

Figure 5: Histogram: probabilities Top of the scale

Appendix

Histograms

Demographic factors II

1. region:

- all regions of the Czech Republic aggregated to Bohemia vs. Moravia:
- 67% of subjects were from Bohemia, 33% from Moravia
- no significant main or interaction effect was found

2. age:

- range: 19 to 71 years, mean: 25.6, median: 23
- only significant interaction effect: younger people (under 27) rated probability condition slightly better (t-value: 2.02, $p < 0.05$)

Demographic factors III

3. reading time

- a proxy for education bias
- reading time of books and other media: 0 to 10 hours
- mean: 1.43, median: 1 hour
- only one significant interaction: subjects with reading time > 1 hour rated NR-condition better (t-value 2.05, $p < 0.05$)

More models

- Bayesian model for experiment 1: next slide
- confidence intervals agree with p-values from the cumulative mixed model

- mixed linear model for the top of the scale (probability)

```
Cumulative Link Mixed Model fitted with the Laplace approximation

formula: as.factor(rating1) ~ condition * classNExpr + (1 + condition |
    participant) + (1 + condition | item)
data:    items_with_probability_top

Coefficients:
                        Estimate Std. Error z value Pr(>|z|)
conditionEq              -5.41517    0.46741 -11.585  < 2e-16 ***
```

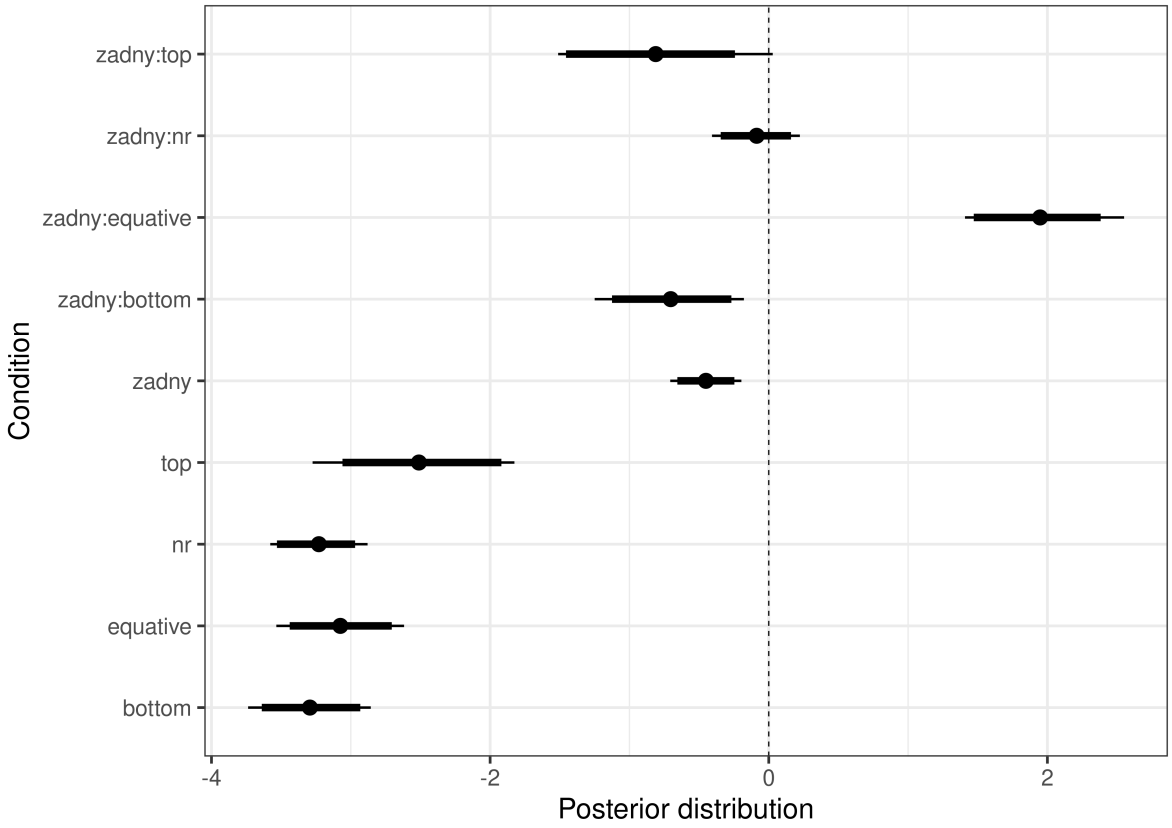

Figure 6: Bayesian model

```
conditionNR               -5.72051    0.44478 -12.861  < 2e-16 ***
conditionProb             -4.59856    0.56993  -8.069  7.1e-16 ***
classNExprZ               -0.88066    0.27140  -3.245 0.001175 **
conditionEq:classNExprZ    3.21934    0.33077   9.733  < 2e-16 ***
conditionNR:classNExprZ    0.05194    0.32027   0.162 0.871180
conditionProb:classNExprZ -1.16830    0.32806  -3.561 0.000369 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

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