Grammatical and demographic factors in linguistics

experimental evidence from Czech equatives

Mojmír Dočekal

11-05-2023

Innsbruck

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: Chemla, Homer, and Rothschild (2011),J. Gajewski (2016),Alexandropoulou, Bylinina, and Nouwen (2020) a.o.
- more specifically: Djärv, Zehr, and Schwarz (2018),Schwarz, Djärv, and Zehr (2020) and their experimental work on cross-linguistic variation in NPI licensing (following Chierchia (2019))

Negative polarity items vs. neg-words

- Negative polarity items (English *any*) require negation or such operators which share with negation the downward entailing property

(1) a. John doesn't like cats.
b. $\rightarrow$ John doesn't like black cats.
c. John doesn't like **any** cats.

(2) a. If you like cats buy this book.
b. $\rightarrow$ If you like black cats buy this book.
c. If you like **any cats** buy this book.

Neg-words

- expressions like Italian *nessuno* requiring negation on verb

(3) A John non piace nessuno.
John doesn't like anybody.

- in Slavic languages (like in Romance languages) negative pronouns roughly corresponding to *anybody*, *anything*, *anywhere*, ...

Czech neg-words

- similar to Italian neg-words (*niente*, e.g.: Ladusaw (1992)) but as in all Slavic languages (strict negative-concord: Zeijlstra (2004)) in majority of contexts require verbal negation (in the same clause)

(4) 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

- 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 – (5)

(5) 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: Jon R. Gajewski (2011)) but with the unlikelihood presupposition (English *ANY*: Krifka (1995), Hindi *ek bhii*: Lahiri (1998), English *even one*: Crnič (2014b))

- *ani*: the unlikelihood presupposition of English *even* but limited to strong NPI contexts
- strongest (unlikely) prejacent: entailing all the alternatives

(6) 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).'

- the most influential analysis of neg-words: syntactic approach (Zeijlstra (2004) 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 $\neg$
- part of the talk: experimental support for an alternative, semantic theory of neg-words (Ovalle and Guerzoni (2004),Kuhn (2022))

- 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 Krifka (1992)) but license neg-words
- surprising against English and standard theories of equatives Stechow (1984),Beck (2019) 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

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

(8) Paris is as quiet as ever.

Bigger picture

- English NPIs vs. negative quantifiers
- previous studies (typology, functional linguistics – Tottie (1991) a.o.): the newer NPIs replace the older negative quantifiers
- Burnett, Koopman, and Tagliamonte (2018): NPIs replace negative quantifiers in some (lower, e.g.) syntactic domains
    - historical and social factors are real but weaker than grammatical

(9) a. I know nothing. negative quant.
b. I don't know anything. NPI

- similarly: Burnett, Tremblay, and Blondeau (2015): the variable negative concord in Québec French
- is not only explainable by social factors (age, education): against older sociolinguistic work

- this talk: is also about the variation
    - for a diachronic glimpse: Appendix
- similar to Burnett, Tremblay, and Blondeau (2015): the distinction between neg-words and strong NPIs is robust and well testable
    - nothing like a historical replacement of the older strong NPIs by newer neg-words
- but there is a change in process: some speakers use strong NPIs as neg-words
- experimental work: search for factors (grammatical and social as well)
- plus explaining the puzzling equative pattern

The empirical and theoretical questions

1. empirical:

(10) Question1:

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

2. more theoretical: how to reconcile degree theories (equatives, ...) with the theories of NPIs licensing

(11) Question 2: 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

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.)

L-Rex link

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

- 3 environments:

1. baseline
2. Neg-words and strong NPIs in the (positive) embedded clauses of negated Neg-Raising predicates
3. both types of expressions in the standard part of the equative

- first part: 3x2 design

Example item from Part 1

(12) 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}
King neg-wants that in kingdom remained neg-word/NPI thief
zloděj.

'The king doesn't want any thief to remain in the kingdom.'

c. Zloděj ze souostroví Qwghlm je tak šikovný jako {žádný/ani
thief from archipelago Qwghlm is so clever how neg-word/NPI
jeden} zloděj.
thief
'The thief from the Qwghlm archipelago is as clever as no other thief.'

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

(13) 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
one clever dwarf from village neg-found yesterday in mines
{žádný/ani 1} diamant.
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
one clever dwarf from village neg-found yesterday in mines
{žádné/ani} 3 diamanty.
neg-word/NPI 3 diamonds
'One clever dwarf from the village didn't find even three diamonds in the mines yesterday.'

Results

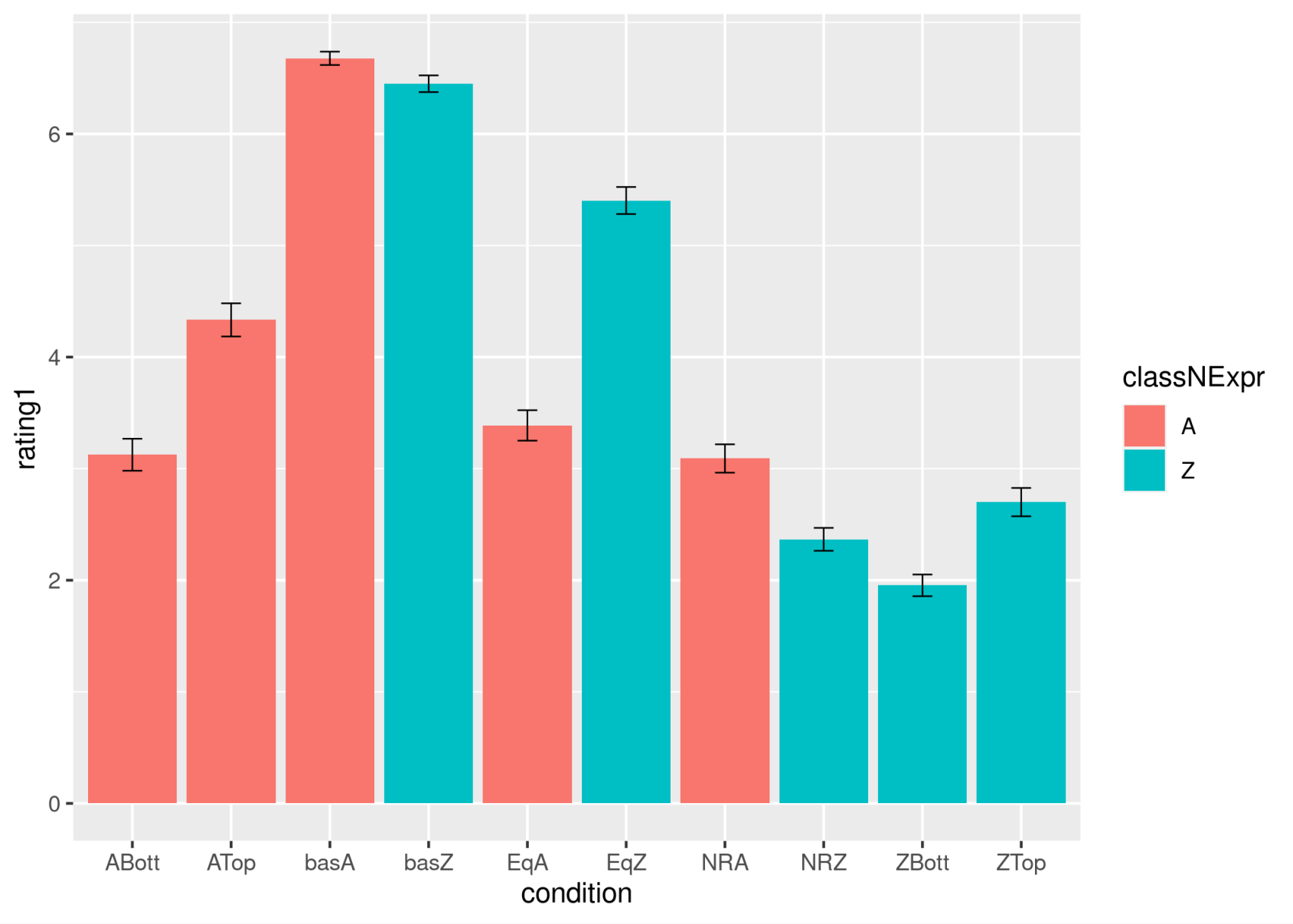


Figure 1: Graph of acceptance (+error bars)

Part 1

- in this talk I focus on the first part
- zoom of the descriptives statistics on the next slide

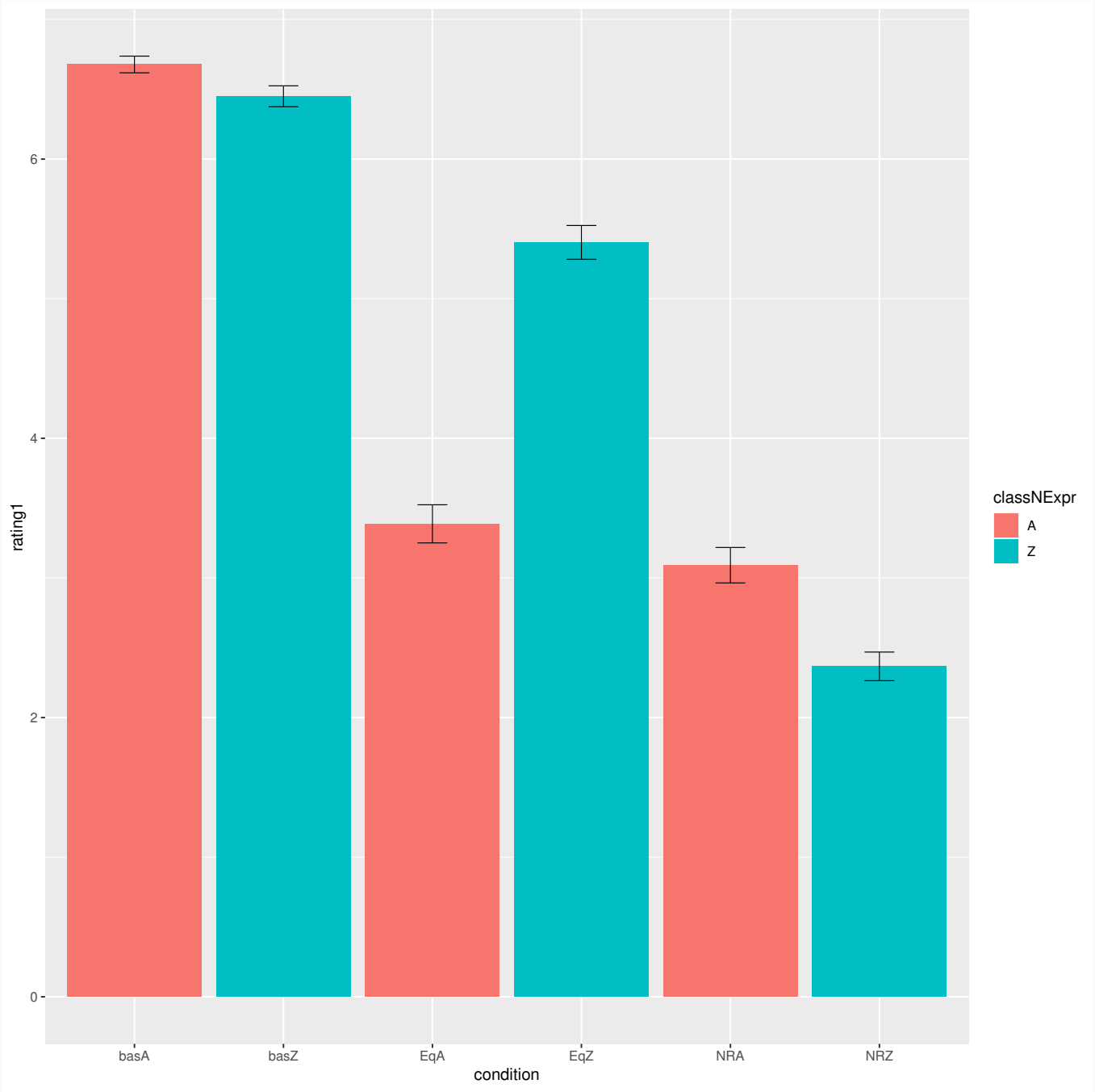


Figure 2: Graph of acceptance (+error bars)

Bayesian models

- Bayesian hierarchical random-effects model with default priors was fit using the R package RSTANARM Goodrich et al. (2022)
- the dependent variable was the subject's response
- the independent variables were:
    - (i) environment (BAS, EQ, NR)
    - (ii) type of the polarity-dependent expression (A, Z)
    - and their interaction
- the reference level was BAS, A
- the model included random effects for both subject and item intercepts

Demographic factors

- negative concord can vary depending on social factors (Montréal French: Burnett, Tremblay, and Blondeau (2015) but also: Burnett, Koopman, and Tagliamonte (2018))
    - age, education level
- in the experiment, the subjects were asked for:
    - region
    - age
    - daily reading time (books, newspapers, ...)

Demographic factors

- three Bayesian generalized mixed linear models were fitted to detect any demographic factors inhibiting or prohibiting the acceptability
- important since previous work (see Burnett, Tremblay, and Blondeau (2015) and Burnett, Koopman, and Tagliamonte (2018) a.o.) revealed that both grammatical and demographic factors are at play when negative polarity variation is linguistically studied
- the pool of subjects was rather homogeneous, consisting mainly of university students

Age

- ranged from 19 to 71, with a median 23, mean 25.59, and sd 9.47
- age was first z-transformed and then plugged in as the third interaction variable in the Bayesian model (next to the two conditions, Z and BAS/NR/EQ environment)
- the acceptability overall wasn't affected by age at all (main effect of AGE: $\hat{\mu} = 0.01$, $\text{CI} = [-0.25, 0.28]$, ROPE: 58.00% for the $[-0.10, 0.10]$ interval)
- no significant interaction with any single or pair of conditions
- the lowest ROPE was 30.55 % for the three-way interaction between EQ:Z:AGE
    - all other interactions had an even bigger portion in ROPE

Region

- more varied than AGE where the data points from the first to the third quantile were in the range 21 to 25
- I didn't control for the specificity of the values entered into the form, the answers ranged from city-specific to region-specific
- I aggregated all the answers into discrete factor with two levels: MORAVIAN, NONMORAVIAN 67 % of subjects entered as their region NONMORAVIAN, the remaining 33 % identified themselves as being from Moravia

Region

- main effect of the region wasn't significant ($\hat{\mu} = 0.33$, $\text{CI} = [-0.18, 0.88]$, ROPE: 14.79% for the $[-0.10, 0.10]$ interval)
- some anecdotal evidence coming from interactions
- a slight tendency for higher acceptance of Neg-Raising in the non-Moravian part of the Czech Republic (the interaction NR:Moravian: $\hat{\mu} = -0.61$, $\text{CI} = [-1.28, 0.04]$, ROPE: 3.89% for the $[-0.10, 0.10]$ interval)
- linguistic Neg-Raising isogloss between Czech dialects?

Reading time

- the factor was used to get information about education or education aspirations.
- the answers (converted to hours) ranged from 0 to 10 hours, with 1 hour as the median, 1.43 hours as the mean, and the range of first and third quantiles being 1 hour and 2 hours, respectively
- similarly to AGE, data points are centered around the mean with a small standard deviation, 1.26, and few outliers
- as in the case of AGE, I recoded the continuous variable as a factor READINGTIME with two levels: OVER1HOUR,UNDER1HOUR dividing the sample according to the median value of reading time
- the result was two nearly proportional halves: 52 % of subjects claimed that their daily reading time is under 60 minutes, and the remaining 48 % entered that they read more than one hour

Reading time

- the main effect of READINGTIME is nonsignificant ($\hat{\mu} = -0.13$, $\mathrm{CI} = [-0.63, 0.39]$, ROPE: 28.89% for the $[-0.10, 0.10]$ interval)
- similarly to REGION, there was one weakly significant interaction: subjects claiming to read more than average (over 60 minutes daily) are more accepting Neg-Raising constructions (NR:OVER1HOUR interaction: $\hat{\mu} = 0.66$, $\mathrm{CI} = [0.04, 1.27]$, ROPE: 1.24% for the $[-0.10, 0.10]$ interval)

Summary of demographic factors:

- the design of the experiment and three demographic questions didn't reveal any important information concerning the demography-related variation in polarity constructions of Czech speakers
- two weak effects can be interpreted as clues about region and education-level variation concerning Neg-Raising
- there seems to be nothing significant in the variation of *ani* vs. *žádný* in the studied constructions. - whatever speaker variation (in the usage of *ani*) we will discuss further, it seems not to be derivable from age, region, or education level (unlike in the previous work like Burnett, Tremblay, and Blondeau (2015),Burnett, Koopman, and Tagliamonte (2018))

Grammatical factors

(reminder)

- Bayesian hierarchical random-effects model with default priors was fit using the R package RSTANARM Goodrich et al. (2022)
- the dependent variable was the subject's response
- the independent variables were:
    - (i) environment (BAS, EQ, NR)
    - (ii) type of the polarity-dependent expression (A, Z)
    - and their interaction
- the reference level was BAS, A
- the model included random effects for both subject and item intercepts

A. baseline was very well accepted ($\mathrm{Intercept} = 6.67$, 95 % C(redibility) I(nterval)$= [6.38, 6.95]$) - there is no distinction between neg-words and strong NPIs in it and sine qua non, both expressions are acceptable to the same extent (posterior main effect in the form of median and 95 % CI: $\hat{\mu} = -0.20$, $\mathrm{CI} = [-0.47, 0.08]$)

B. neg-words were much better accepted in equatives than strong NPIs (the positive interaction of EQ by Z: $\hat{\mu} = 2.18$, $\mathrm{CI} = [1.81, 2.58]$)

C. strong NPIs were preferred in Neg-Raising (the negative interaction of NR by Z: $\hat{\mu} = -0.53$, $\mathrm{CI} = [-0.91, -0.14]$)

- the results are also supported by the results of R(egion) O(f) P(ractical) E(quivalence), ROPE:
- only z is not credible, since it is 23 % in ROPE
- for all medians, confidence intervals, and ROPE percents, see TABLE
    - all percents of ROPE are computed for the interval $[-0.10, 0.10]$
    - posterior samples are also visually represented by the graph in FIGURE

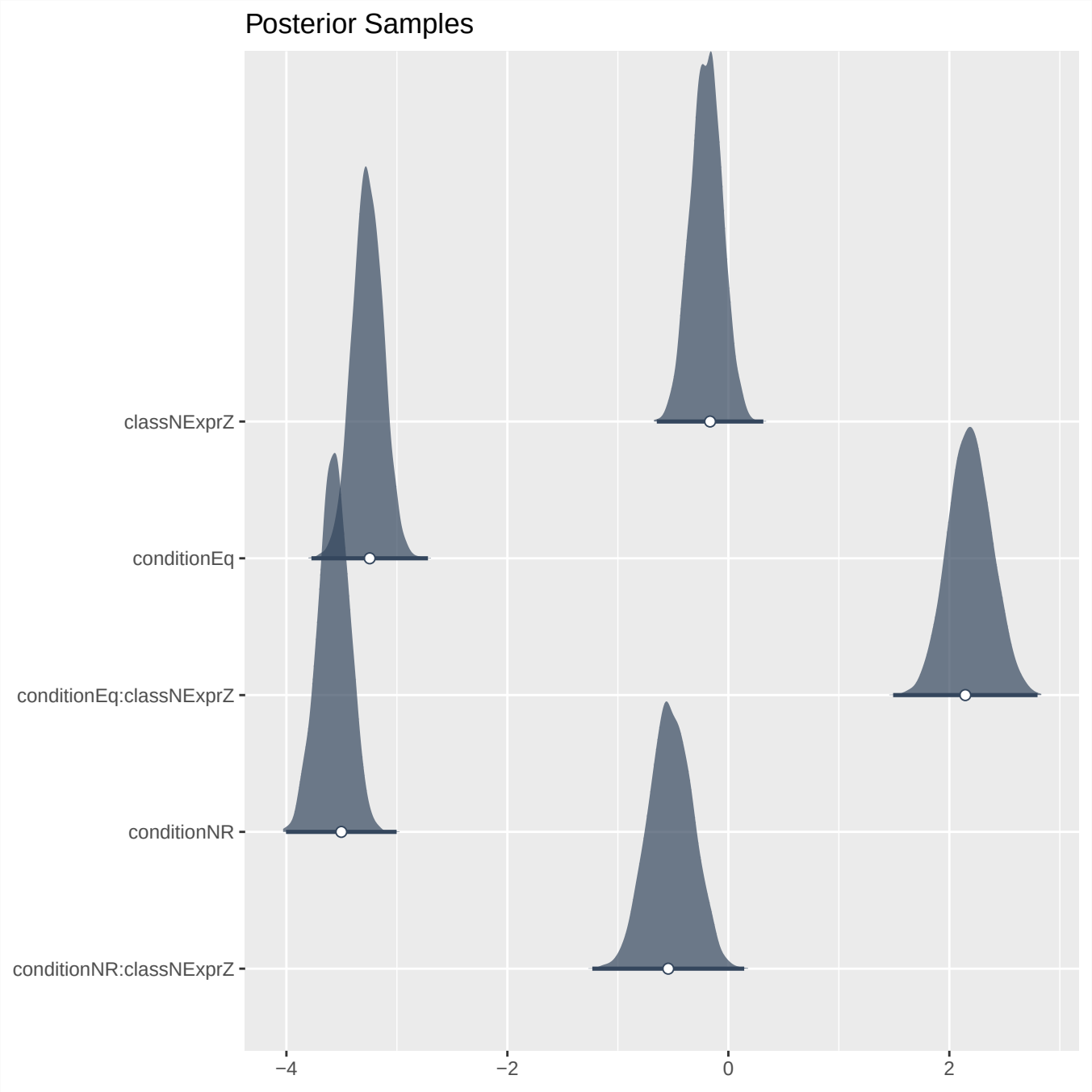


Figure 3: Graph of posterior samples

1. main effects: all conditions were degraded against the baseline
2. **interaction effects**:
   - the strong positive effect of neg-words by equatives
   - weak negative interaction effect of neg-words by NegRaising
   - strong NPIs and neg-words not distinguishable in the baseline

Summary of Posterior Distribution

Parameter	Median	95% CI	pd	ROPE	% in ROPE	Rhat	ESS
(Intercept)	6.67	[6.38, 6.95]	100%	[-0.10, 0.10]	0%	1.002	1905.00
conditionEq	-3.27	[-3.53, -3.00]	100%	[-0.10, 0.10]	0%	1.000	3381.00
conditionNR	-3.57	[-3.86, -3.30]	100%	[-0.10, 0.10]	0%	1.000	3320.00
classNExprZ	-0.20	[-0.47, 0.08]	92.30%	[-0.10, 0.10]	23.08%	1.001	2936.00
conditionEq:classNExprZ	2.18	[1.81, 2.58]	100%	[-0.10, 0.10]	0%	1.002	2954.00
conditionNR:classNExprZ	-0.53	[-0.91, -0.14]	99.67%	[-0.10, 0.10]	0%	1.001	3027.00

How much variation is explained by the model?

- Bayesian models are not easily evaluated by the usual Multiple R or R-squared metrics
- which represent how much variation in the dependend variable is explained by the model
- but frequentist model with the same parameters reports:

Multiple R-squared: 0.5074, Adjusted R-squared: 0.5057

- see report

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
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
- but different group of speakers rated *ani* high in NR (tables in the Appendix)
- of the top ten speakers that rated *ani* high in equatives, only 1 rated *ani* high in NR
- similar observations in previous experiments: baselines universally accepted but divergent acceptability in non-baseline conditions

Correlations II

- speakers who accept *ani* in equatives treat it as neg-word
- probably the result of the limited positive evidence to distinguish them: NegRaising, equatives, probability contexts
- technically: there was no variation (or correlation with other conditions) with baseline – uniform acceptability
- 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

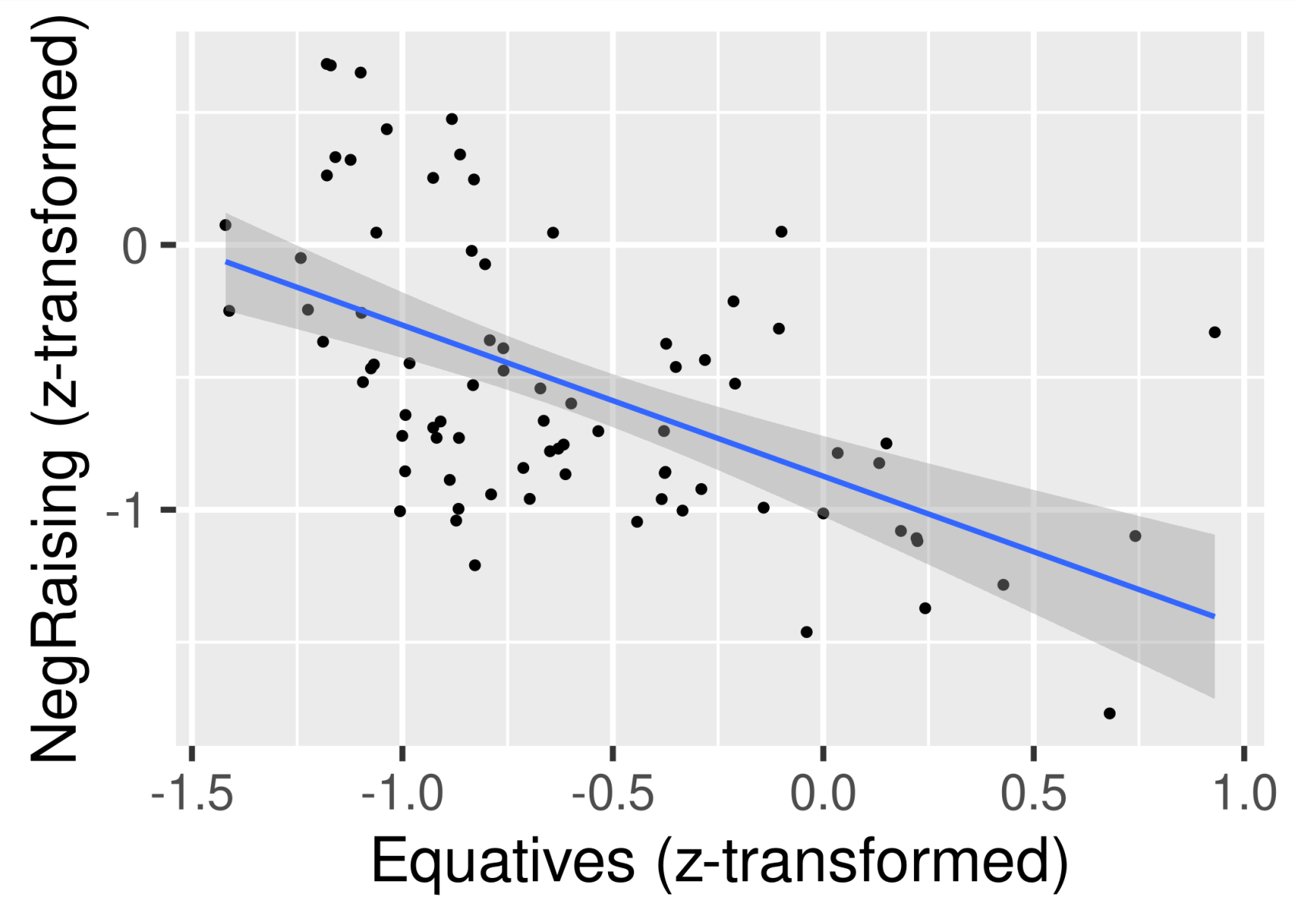


Figure 4: Correlations between NegRaising and Equatives

- there are:

1. subjects who accept *ani* with equatives but reject it with NegRaisers
2. subjects who accept *ani* with NegRaisers but reject it with equatives

The two sets don't intersect.

- this is a continuation of Dočekal and Dotlačil (2017): correlation between probability and NegRasing (for *ani* but not for neg-words): see experiments below
- but crucially, no correlations against the baseline: next slide
- Pearson's product-moment correlation: t = -0.84, p-value = 0.41

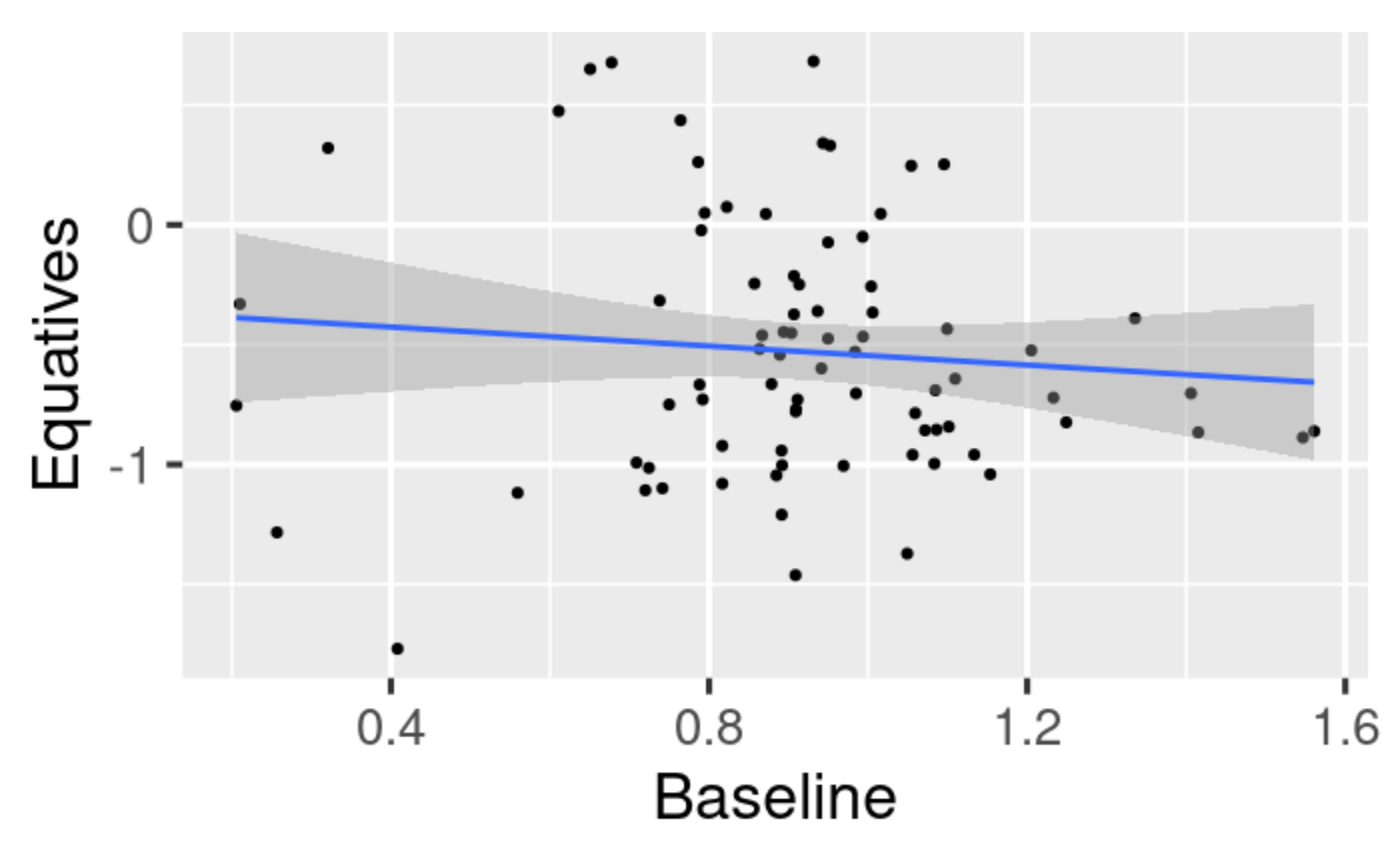


Figure 5: Correlations between Equatives and Baseline

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	*	*	*	*

Theoretical consequences

- general picture: both standard theories can explain the BAS and NR
- but only newer, alternative theory of negative concord can say something reasonable about neg-words acceptability in EQ
- and the semantic theory can give handle on speaker variation
- skip to slide 60

Assumptions: licensing of (strong) NPIs

- general framework: mixture of *even*-theory of NPIs licensing (Krifka (1995),Lahiri (1998),Crnič (2014b) a.o.) and Gajewski's formalization of strong NPIs Jon R. Gajewski (2011)
- licensing NPIs (after Jon R. Gajewski (2011)): strong NPIs are licensed in downward-entailing (DE) environments
- DE both in Truth-Conditions (TC) but also in the non-at-issue meaning

(14) 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 (2014a) and for scalar reading of focus particles Panizza and Sudo (2020)
- overt but also covert *even* has scalar (15-a) and additive (15-b) presupposition:
- the presuppositions after Panizza and Sudo (2020) (the additive sometimes suspended):

(15) a. Even Pope$_F$ danced.
b. Even one$_F$ cat will make Pope happy.

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

(for monotonic scales, likelihood translates into entailment (after Crnič (2011)}))

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 Lahiri (1998),Crnič (2011) a.o.)

- the entailment between numerals is reversed by negation: $\neg(\llbracket$ one cat $\rrbracket \ldots) \models \neg(\llbracket$two cats$\rrbracket \ldots)$

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

a. $[_{\alpha}$ $(even)$ $[_{\beta}$ ¬$[_{\gamma}$ ani one thief remained in the kingdom]]]

(i) TC (in β) DE: ✓

(ii) non-at-issue (in α) DE: ✓

(iii) scalar presupposition of (even): $\rightarrow$ ¬(two thieves remained), ¬(three thieves remained), ...: ✓

(iv) additive presupposition: ¬(two thieves remained) $\vee$ ¬(three thieves remained), ...: ✓

Other conditions from the experiment

Likelihood

- for BOTTOM: the explanation is the same as for the baseline
- the scope ($even$) > ¬ > ... one ...
- the general preference of strong NPIs over neg-words follows from the semantic theory of neg-words
    - core idea: neg-words presuppose emptiness of their discourse referent extension
- all the items were (nearly always) constructed in such a way that there was a positive inference (some diamonds were found, etc.:)

Neg-Raising

- in many previous experiments (three at least): Neg-Raising was better accepted with strong NPIs
- but the effect was never strong; in the last two the effect disappeared
- one possibility: the variation – speakers who treat *ani* as a neg-word blur the line
- standard theories of Neg-Raising: Jon Robert Gajewski (2007) or Romoli (2013)
- 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
- Equatives: more in the neg-words section

Neg-words

- semantic/pragmatic theory of neg-words and negative concord
- Ovalle and Guerzoni (2004) and modern reformulation in Kuhn (2022)
- TC: indefinite description
- non-at-issue: empty reference

(18) 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 (2022): $\wedge\mathbf{0_x}$ ...postsupposition (highest scope)

Locality, etc.

- Kuhn (2022): many improvements of Ovalle and Guerzoni (2004)
- 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 $\approx$ QR in the particular language and construction

Explaining the baseline

(19) 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:

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

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

- 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 $\mathbf{O_x}$ 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) $\longrightarrow$ 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 Jacobson (1995): 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: Krifka (1992),Penka (2016))
- neg-words are acceptable but verbal negation not (as in German: Penka (2016))

(21) 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 (22))
- non-standard: $max \rightarrow max_{inf}$ (otherwise max would lead to $\perp$): Penka (2016)

(22) 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*

(23) 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)

- that explains (with some other more or less standard assumptions) the patterns of the experiment(s)
- the answer to Question 1 :

(24) Question1:

a. How can we explain microvariation by grammatical (semantic) factors?

b. Is part of the variation caused by social factors?

(25) 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
- obvious problems for the syntactic approach:
    - neg-words in equatives: no standard theory of equatives with interpreted ¬ ([uNeg]) in the standard
    - higher acceptability of strong NPIs in the probability manipulated contexts: unpredicted
    - non-stipulative explanation for fragmentary answers preference for neg-words and also *without* type of P

Summary 2

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

(27) 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

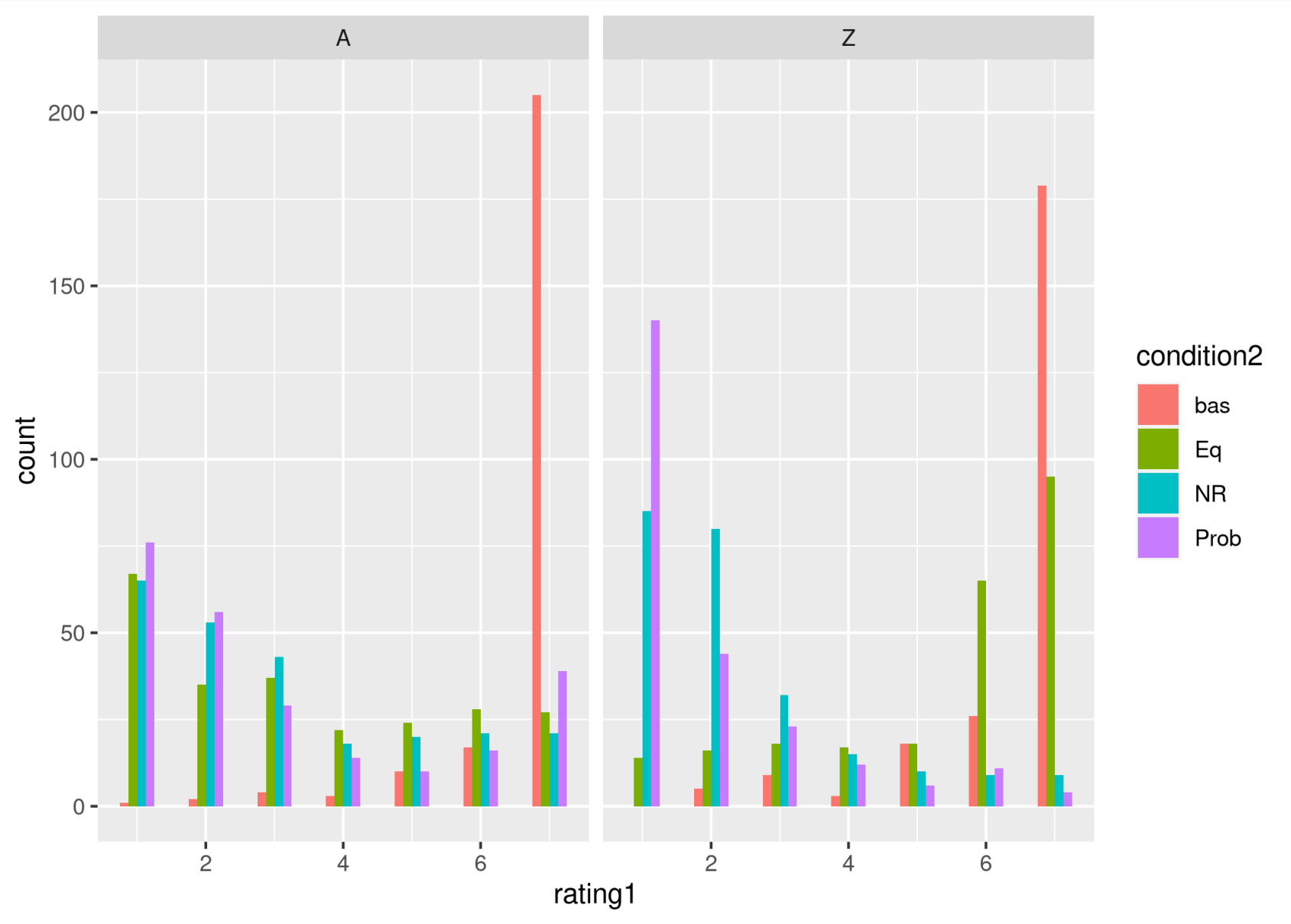
- prediction: minimizers (and other non-monotonic tolerating) NPIs should be ok ... intuitively correct

Thanks!

Open questions

- proper investigation of locality constraints
    - NegRaising: the concurrence sometimes vanishes (Maximize Presupposition of Heim (1991)?)
- 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 Kuhn (2022)

Histograms


A
Z
count
200
150
100
50
0
2
4
6
rating1
condition2
bas
Eq
NR
Prob

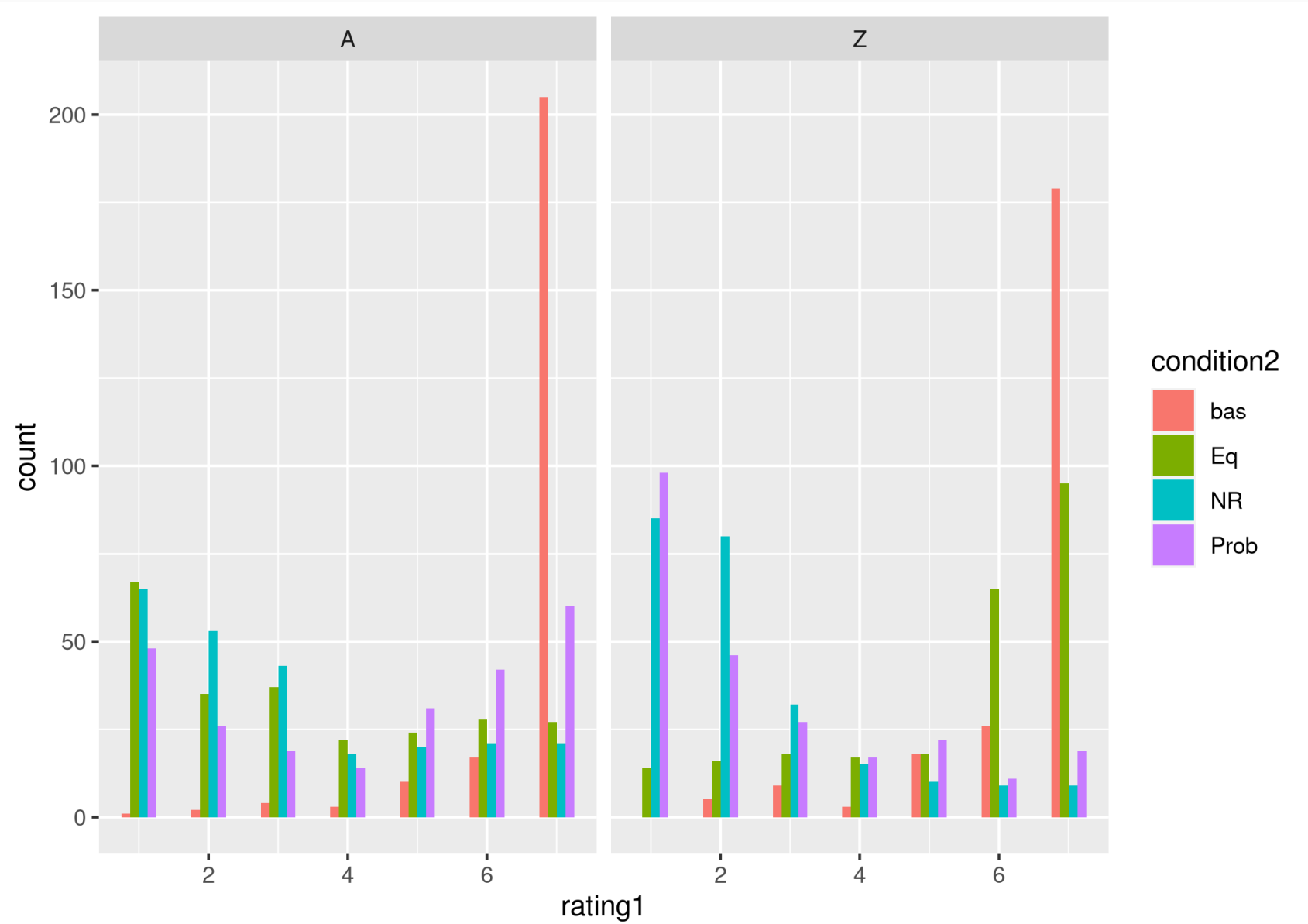


Figure 7: Histogram: probabilities Top of the scale

Items

- the predicates in baseline and NegRaising conditions were the same
- with equatives, this wasn't possible to realize, but the sentences were constructed as close to the meaning of baseline and NegRaising as possible
- and the standard of equatives was always the same neg-word NP/strong NPI as in the baseline and NegRaising conditions

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

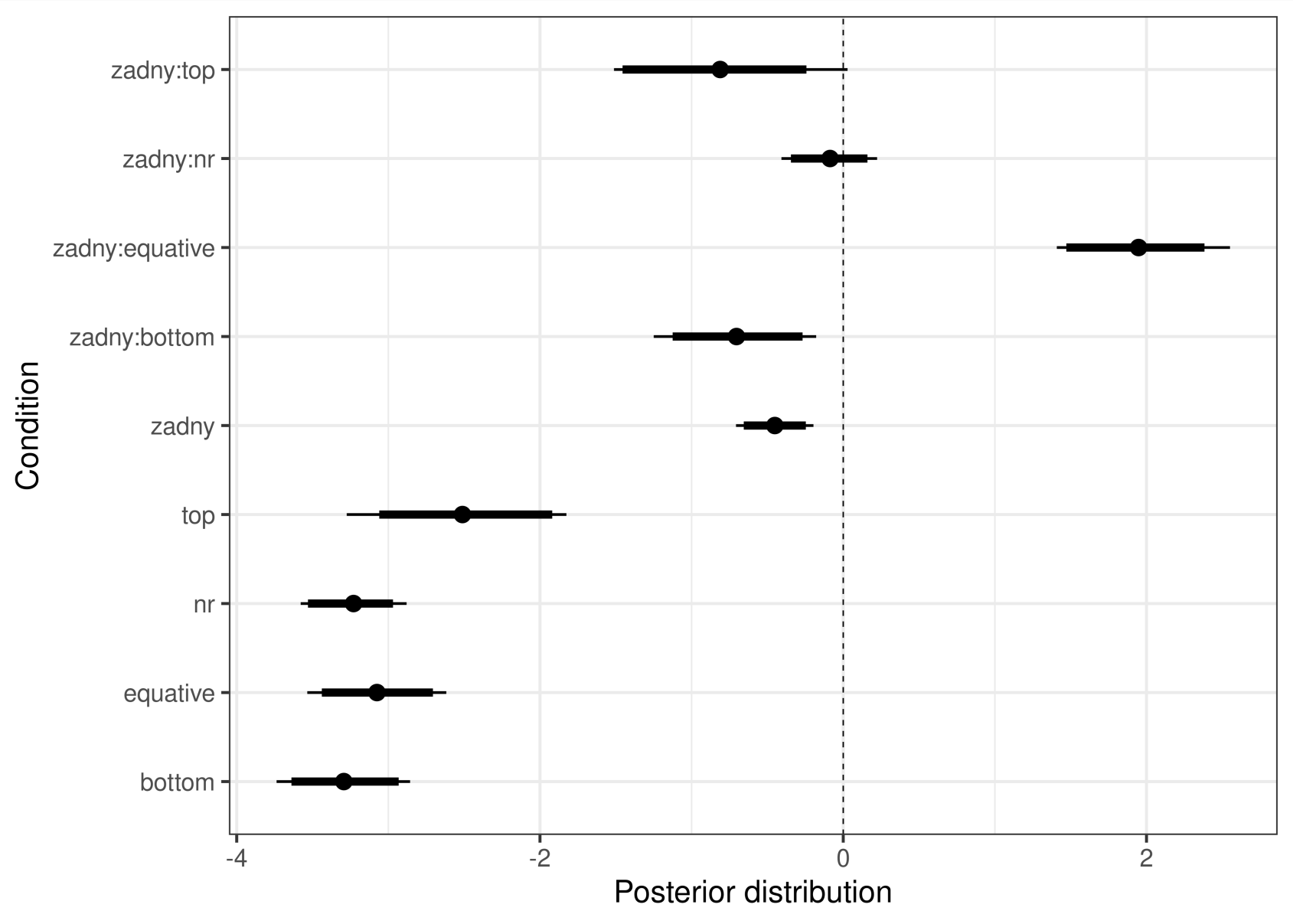


Figure 8: Bayesian model

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

- the last experiment: surprisingly high acceptability of strong NPIs in the top of the scale contexts
- in previous experiments, we tested top of the scale, and neg-words were better accepted
- one possible explanation: the nature of the scale:
    - the last experiment: just numerical scales, the two before social hierarchies, not numerical scales
- future experiment: probabilities and different scales

Strong negative effect of neg-words

- not as strong as the conditions
- unclear reason
- but it is not frequency:
- Czech National Corpus Křen et al. (2015) search for *ani* plus numeral, noun, pronoun, preposition
- the same for *žádný* and the same categories: (28)
- their frequency is nearly the same

(28) a. [ani ...]: 73 917 hits

b. [žádný ...]: 66 912

- possible syntactic factor: first query into Křen et al. (2015)
- asymmetry between *ani* and *žádný* in terms of their scope preferences
- *žádný* preferentially scopes in VP
- Burnett, Koopman, and Tagliamonte (2018): the distinction between negative indefinites and NPIs (hard constraint in Scandinavian, soft constraint in English)
    - handle for: neg-words do have syntactic component, NPIs not
- 3 out of 4 conditions in the experiment: strong NPI/neg-word in subject

(29) a. žádný 'no':
    (i) 11 580 in Subj, 19 445 in Obj
  b. ani 'even'
    (i) 8 661 in Subj, 8 562 in Obj

The correlation table (subjects)

Historical note (Czech)

- diachronic linguists (Bauer, Lamprecht, and Šlosar (1986),Holub and Kopečný (1952)): at least some neg-words are newer than strong NPIs:
- neg-words (because appearing in negative clauses frequently) acquired the modern *no* meaning
- strong NPIs are older

Old Czech data

- strong NPIs are older than neg-words: *ani jeden hrad neg-V* from 14$^{\text{th}}$ century

(30) Dám tobě zemi žádnú.
give.1SG to-you land wanted
'I will give you the wanted land.' old Czech

(31) Nedám ti žádnou zemi.
give.1SG to-you no land
'I will give you no land.' modern Czech

##

Ex-

per-

i-

ment

(33) ELLIPSIS

a. A: Koho vyhodil professor Palný včera ze zkoušky?
A: whom failed professor Palny yesterday from exam
‘Who was failed by professor Palny during yesterday’s exam?’

b. B: (POLARITY-ITEM) studenta.
B: POLARITY-ITEM student
‘Not any /Not even one student.’

(34) NR

a. A: Co je nového na katedrových zkouškách?
A: what is new at department exams
‘What happened new during the department exams?’

b. Profesor Palný nechce, abychom vyhodili (POLARITY-ITEM)
professor Palny neg-wants COMP fail POLARITY-ITEM
studenta
student
‘Professor Palny doesn’t want any/even one student to fail.’

(35) LIKELIHOOD

a. Yesterday, Professor Novák ran exams of a fairly easy lecture, which is attended by bachelors, masters and doctoral students. Doctoral students always pass the exam, masters usually do, bachelors rather don't.'

b. Včerejší zkoušku u prof. Nováka nesložili
yesterday exam by professor Novak neg-passed
(POLARITY-ITEM) bakaláři.
POLARITY-ITEM bachelors
'Any/even bachelors didn't pass professor Novak's exam yesterday.'

- notice: the likelihood of context is reversed – *ani* is expected to fare worse

- the experiment was a 4x2 design
- the descriptive summary follows
- the main effects are all significantly negative against the baseline

1. in LIKELIHOOD strong positive interaction effect by *žádný*: t-value = 8.32

2. no significant interaction effect of ELLIPSIS by the expression: the context seems to meliorate the difference between strong NPIs and neg-words

3. the interaction between NR and the expression is nearly significant

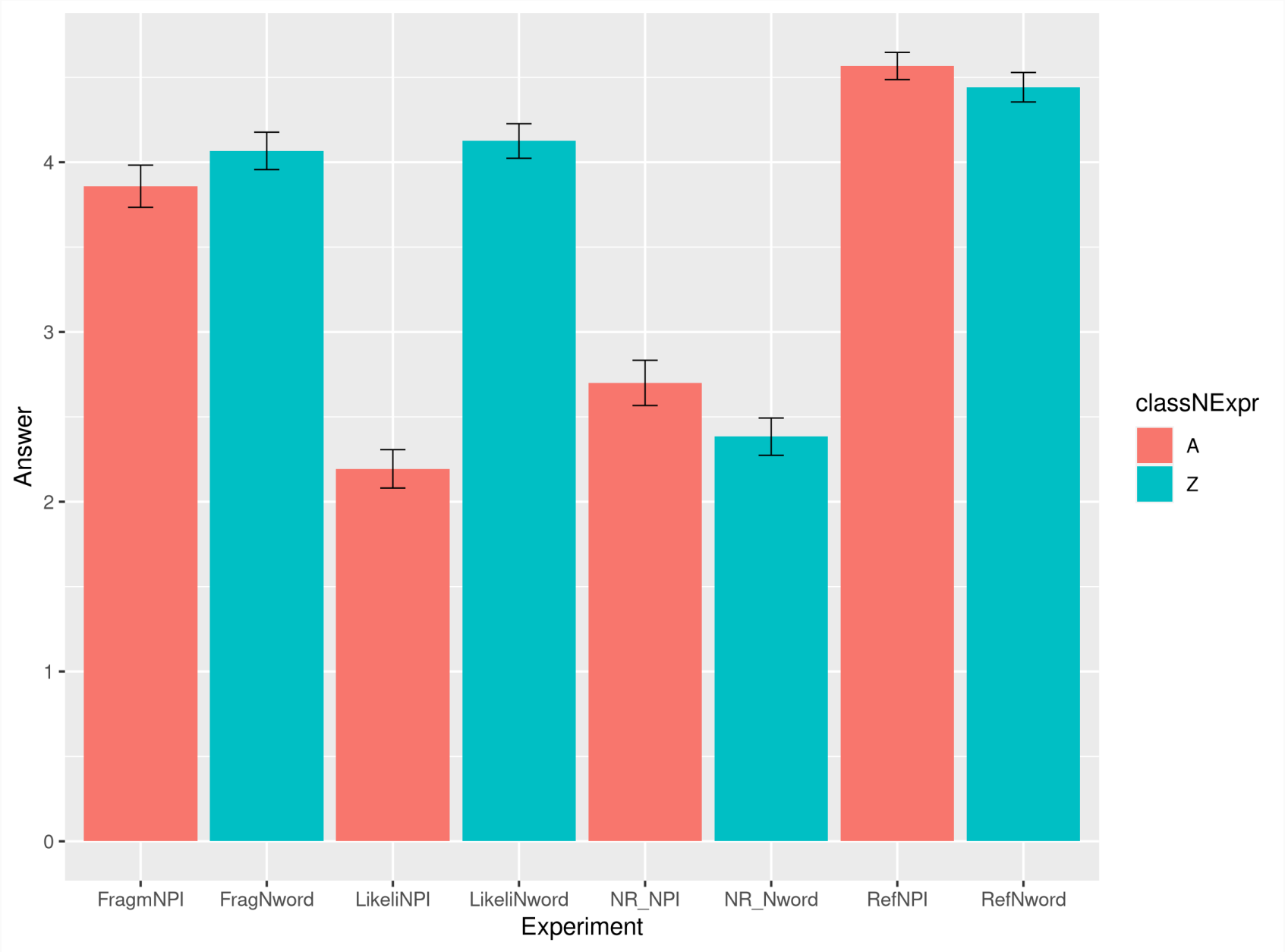


Figure 9: Graph of acceptance (+error bars) Experiment 2

Correlations in Experiment 2

- again, the correlation between the type of expression and its acceptability in tested environments was searched

1. strong and highly significant negative correlation between LIKELIHOOD and NR: t-value = -3.2 p=$.003$

- see the figure on the next slide; again z-transformation

2. significant correlation between ELLIPSIS and NR-responses with *ani*: t-value = -2.1, p = $.04$

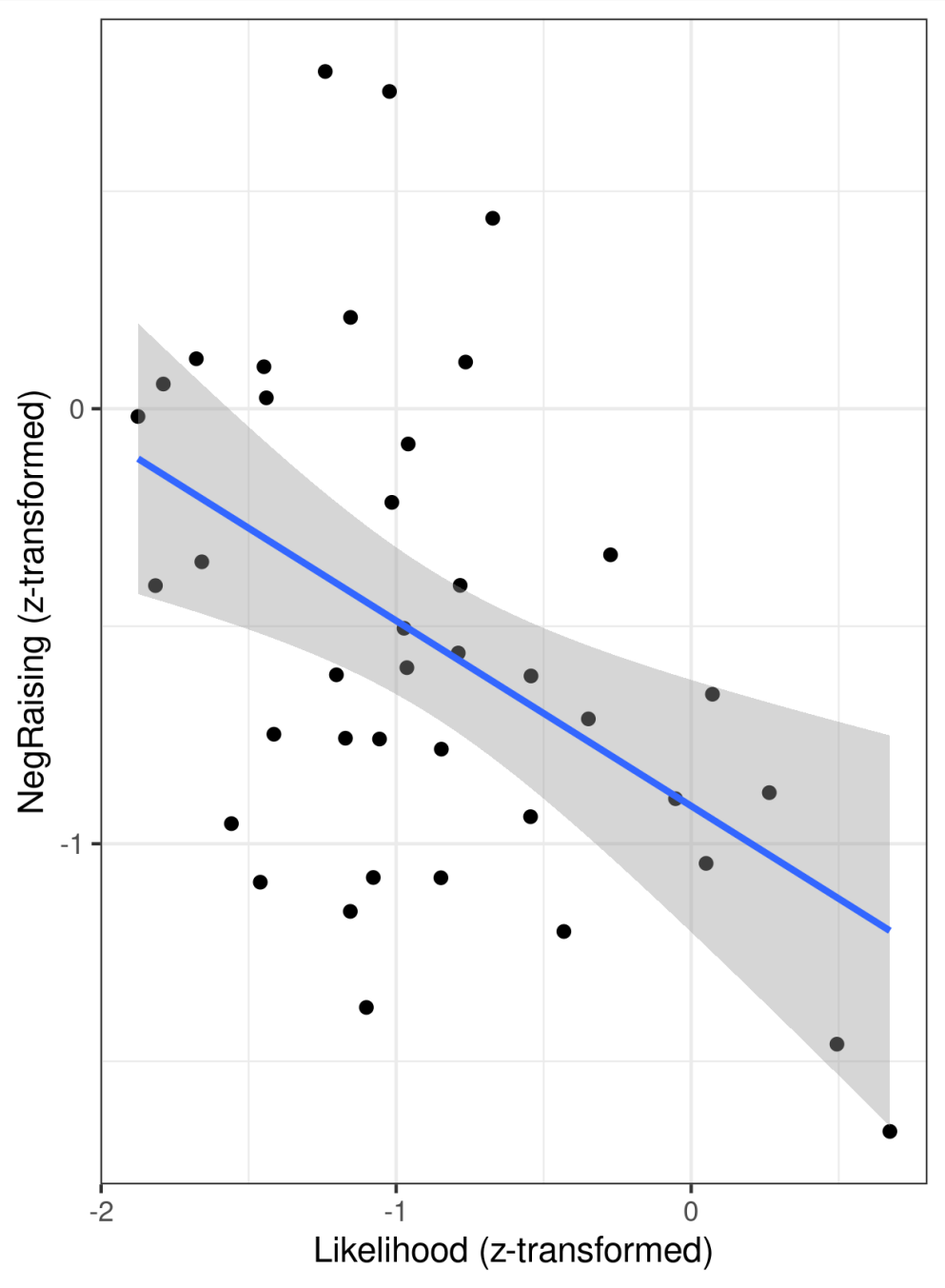


Figure 10: Correlation between LIKELIHOOD and NR (ani) Experiment 2

As for the correlations between *žádný* and ELLIPSIS/NR or LIKELIHOOD/NR

- the expectation is to find no correlation
- and indeed: all models: p > $.1$
  - LIKELIHOOD and NR with respect to *žádný*: negative but not significant (t = -1.6, p = 0.11) unlike for ani
  - see the figure on the next slide

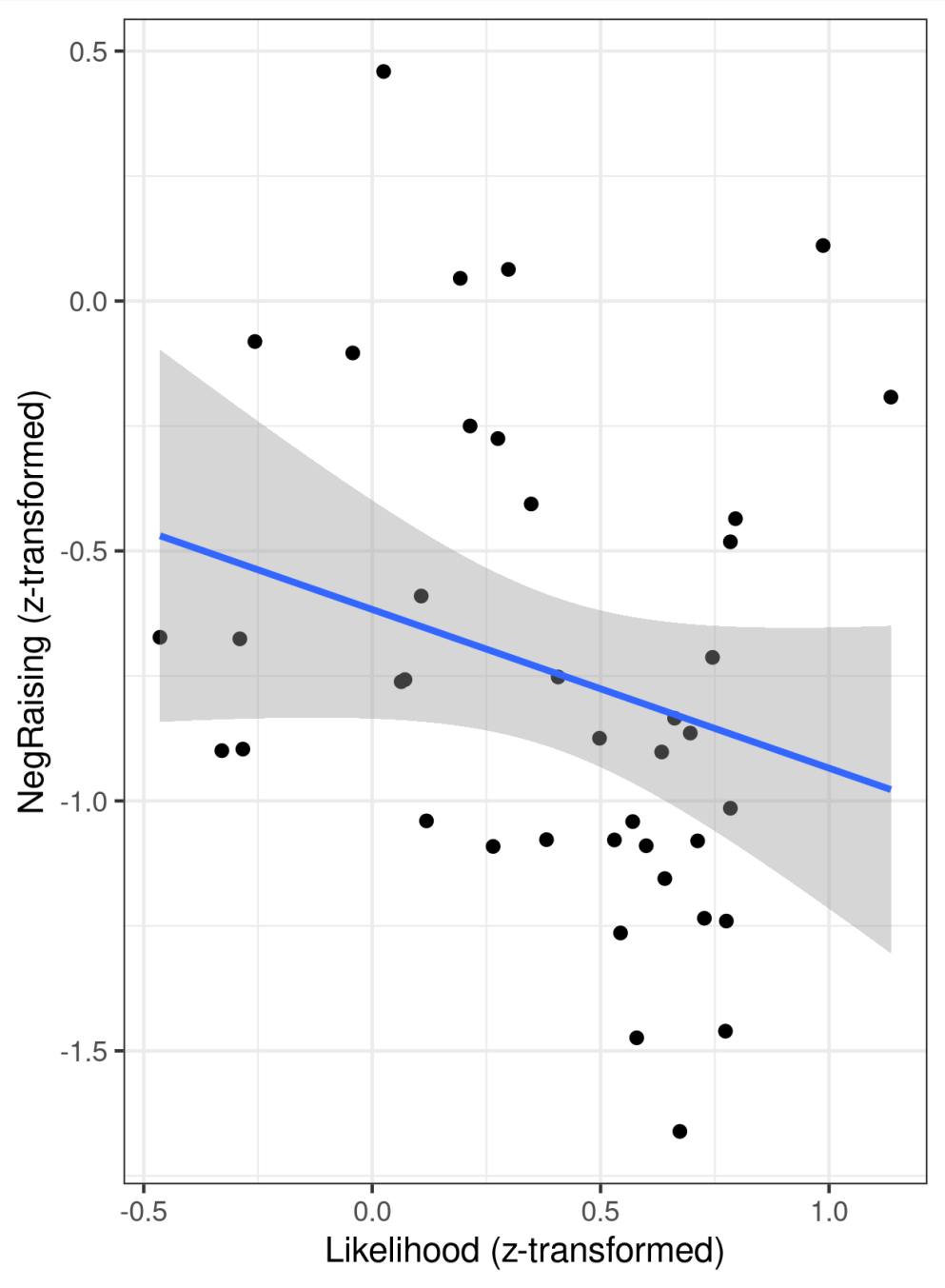


Figure 11: Correlation between LIKELIHOOD and NR (žádný) Experiment 2

Experiment 3

- very similar design as experiment 2 (previous version)
- five conditions against crossed with the polarity-item: 5x2:
- 25 items, 25 fillers

1. NR
2. ELLIPSIS
3. WITHOUT
4. LIKELIHOOD
5. IDIOM

- 55 participants, one excluded for a bad score in fillers
- mostly students of MUNI in Brno
- examples of WITHOUT and LIKELIHOOD:
- the error bar graph in Figure 10

(36) WITHOUT

a. Prodal mu dvě šachové sady bez (POLARITY-ITEM) krále.
sold him two chess sets without POLARITY-ITEM king
‘He sold him two chess sets without any/even one king’

- notice: Czech *bez* doesn’t bear any morphological negation

(37) LIKELIHOOD

a. Ten kněz byl cílevědomý, ale neschopný, takže se
The priest was purposeful but incompetent therefore SE
nestal (POLARITY-ITEM) kardinálem.
NEG-became POLARITY-ITEM cardinal
'The priest was purposeful but incompetent; therefore, he didn't become any/even cardinal.'

- notice: as in experiment 2, the context likelihood goes against the *even* presupposition of *ani*

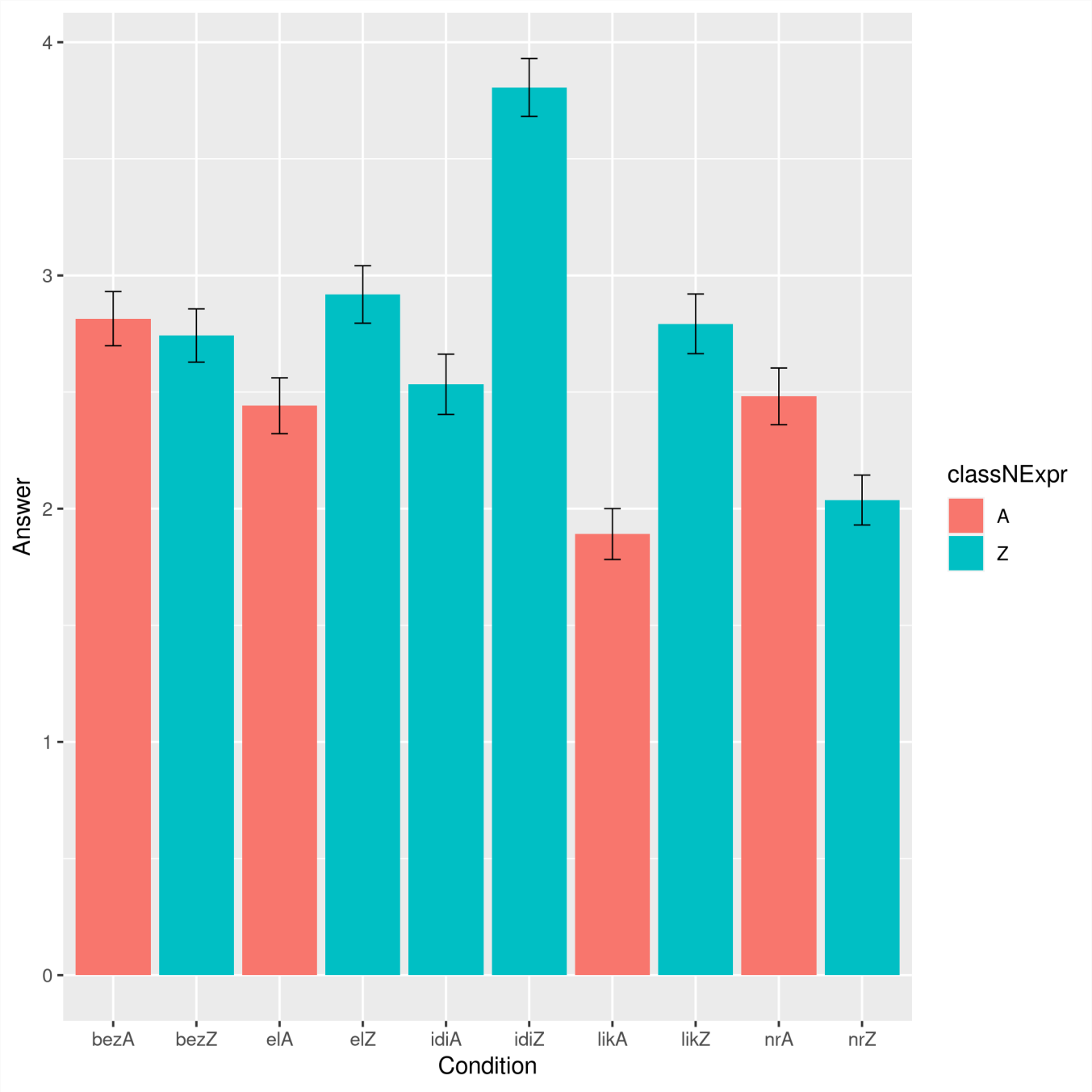


Figure 12: Graph of acceptance (+error bars) Experiment 3

- again mixed-models
- WITHOUT: baseline – both polarity items were indistinguishable in the baseline
- three important interaction effects:

1. *ani* was considered worse in ELLIPSIS: t = -2.61, p $< .01$
2. *ani* was worse in LIKELIHOOD: t = -4.73, p $< .001$
3. *ani* was better in NR: t = 2.41, p $< .05$ (similar findings as in older experimental work focused on NegRaising: Dočekal and Dotlačil (2016a),Dočekal and Dotlačil (2016b))

- the baseline shows that both polarity items can appear in sentences without verbal negation
- the positive interaction of *ani* by ELLIPSIS: expected for NPIs
- in both experiment 2 and experiment 3 *ani* was tested in LIKELIHOOD with a bad probability/noteworthiness profile for it
    - but the scales were ranks (nouns), not numerical
    - in both experiments, *ani* was judged as worse in LIKELIHOOD than *žádný*

The correlation in experiment 3 and summary

- again, the negative correlation between *ani* acceptability in NR and its acceptability in LIKELIHOOD was found
- t=-3.0, p < 0.005

- in all three experiments, the following negative correlations for *ani* were found:

1. the acceptability in EQUATIVES and *ani* acceptability in NR (experiment 1)
2. the acceptability in LIKELIHOOD and *ani* acceptability in NR (experiment 2 & 3)
3. the acceptability in ELLIPSIS and *ani* acceptability in NR (experiment 2)

References

Alexandropoulou, Stavroula, Lisa Bylinina, and Rick Nouwen. 2020. “Is There *Any* Licensing in Non-DE Contexts? An Experimental Study.” In *Proceedings of Sinn Und Bedeutung*, edited by M. Franke et al., 24:35–47. 1.

Bauer, J., A. Lamprecht, and D. Šlosar. 1986. *Historická Mluvnice Češtiny*. SPN.

Beck, Sigrid. 2019. “13 Comparison Constructions.” *Semantics-Lexical Structures and Adjectives*, 415.

Burnett, Heather, Hilda Koopman, and Sali A Tagliamonte. 2018. “Structural Explanations in Syntactic Variation: The Evolution of English Negative and Polarity Indefinites.” *Language Variation and Change* 30 (1): 83–107.

Burnett, Heather, Mireille Tremblay, and Hélène Blondeau. 2015. “The Variable Grammar of Negative Concord in Montréal French.” *University of Pennsylvania Working Papers in Linguistics* 21 (2): 3.

Chemla, Emmanuel, Vincent Homer, and Daniel Rothschild. 2011. “Modularity and Intuitions in Formal Semantics: The Case of Polarity Items.” *Linguistics and Philosophy* 34 (6): 537–70.