FACULTY
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Polarity items: Theories and experiments

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Intro

Theoretical background

- talk about series of experiments targeting polarity phenomena
- theory $\longleftrightarrow$ experiments
- practical part: HOWTO for linking formal semantics/pragmatics with experiments

Unified theory of (N/P)PI and scalar particles

Krifka (1995):

- emphatic (strong) NPIs and PPIs are subject to the same probability-based presupposition (Emph.Assert)

(1) a. *Mary read ANY book.
b. Mary didn't read ANY book.

(2) a. *Mary doesn't have TONS of money.
b. Mary has TONS of money.

Krifka's spirit but Heim/Crnič formalization (Heim (1984), Crnič (2011), Crnič (2014))

- PI are alternative-introducing
- alternatives are integrated into truth-conditions via covert *even* (≈ Krifka's Emph.Assert)
- *even* is vacuous in truth-conditions
- but triggers a presupposition: Crnič (2014, ex.(4))

(3) even(C)(p,w) is defined only if $\forall q \in C : p \neq q \rightarrow p <_c q$. If defined, even(C)(p,w)=p(w).

(4) a. *Mary read ANY book.

b. even(C)(Mary read any book) is defined only if for all relevant $n > 1$: Mary read one book $<_c$ Mary read n books. (inconsistent)

- scope theory of *even*: scopes over negation
- ranking of likelihood respects entailment: $p \rightarrow q \ldots q \not<_c p$
- $[\![\textit{read 2 books}]\!] \rightarrow [\![\textit{read 1 book}]\!] \ldots$
  $[\![\textit{read 1 book}]\!] \not<_c [\![\textit{read 2 books}]\!]$

- prediction: weak elements (WE) become grammatical if a scale reversing operator intervenes between *even* and the WE

(5) a. Mary didn't read ANY book.

b. even(C)(Mary didn't read any book) is defined only if for all relevant $n > 1$: Mary didn't read one book $<_c$ Mary didn't read n books. (consistent)

- prejacent entails all the alternatives → is less likely than the alternatives

PPI

- assumption: monotonicity of degrees

(6) a. Mary has TONS of money.

b. even(C)(Mary has tons of money) is defined only if for all relevant *n* < *tons of money*: Mary has tons of money $<_c$ Mary has *n*-money. (consistent)

(7) a. #Mary doesn't have TONS of money.

b. even(C)(Mary doesn't have tons of money) is defined only if for all relevant *n* < *tons of money*: Mary doesn't have tons of money $<_c$ Mary doesn't have *n*-money. (inconsistent)

Scalar particles

- applies to scalar particles as well

(8) a. *Mary read even ONE book.
b. Mary didn't read even ONE book.

- the same explanation as for *ANY* (NPI)
- attractive for Czech data:

(9) a. *i* 'positive even' . . . scalar particle
b. *an-i* 'not even' . . . strong NPI

General overview

- polarity items, scalar particles + expressions introducing alternatives
- in positive polarity case: top/extreme value on scale
- expectation: PPI behaviour
- very different from the usual PPI approaches (Szabolcsi (2004) a.o.) focusing on *some*, . . .

(10) maximal amounts + alternatives $\longleftrightarrow$ PPI behaviour

- necessary ingredient: exhaustification (Krifka's Emph.Assert)
- tested in experiments

Why *even* should be PPI?

- Rullmann suggests positive polarity nature of *even*
- Rullmann (1997): (11) is interpreted only as (11-b)
- "weak element" reading

(11) They hired no linguist who had even read [$_F$ Syntactic Structures].

a. They hired no linguist who had even read [$_F$ Syntactic Structures]. SS very unlikely reading

b. They hired even [no linguist who had read [$_F$ Syntactic Structures]]. SS very likely reading

- similar observation for superlative-modified numerals: Mihoc and Davidson (2017), Cohen and Krifka (2014)

Experiment 1

Positive *even* in Czech

- joint work with Jakub Dotlačil and Iveta Šafratová
- truth value judgment task: 5-point Likert scale: 1-worst, 5-best
- 50 items in 2 parts: 18 items in part 1, 32 in part 2
- Latin-square design, IBEX farm
- selected condition from the first part of the experiment (only positive *even*):

(12) Brown rice can preserve essential vitamins but it has to be stored in the fridge, packed in hermetical dose and you have to consume it up to three days after cooking.

a. Rýže v ledničce vydrží **i** tři dny.
   ‘The rice in the fridge lasts even three days.’ (**top**)

b. Rýže v ledničce vydrží **i** dva dny.
   ‘The rice in the fridge lasts even two days.’ (**mid**)

c. Rýže v ledničce vydrží **i** jeden den. (**low**)
   ‘The rice in the fridge lasts even one day.’

- three conditions: **top**, **mid**, **low**
- ad hoc scales:

(13) x lasts 3 days → x lasts 2 days → x lasts 1 day

- other types of logical and contextual scales
- logical: buy 1 kg of sugar, buy 2 kg of sugar, buy 3 kg of sugar
- contextual: easy language to learn, medium, hard, …

Second part of the PPI-experiment

- 32 items in 5 conditions
- again scales (logical and contextual)
- subset of the conditions (3 of 5)

(14) Mother would be happy if her son would work for the police. The lowest rank is a sergeant, the highest is a general and somewhere in the middle is a colonel.

a. Syn nakonec vystudoval biochemii a nestal se **i** generálmajorem. (**neg-i**)
‘Son at the end studied biochemistry and didn’t become even general.’

b. Jestli se syn stane **i** generálmajorem, matka bude šťastná. (**ant-i**)
‘If son will become even general, his mother will be happy.’

c. Jestli se syn stane **i** rotným, matka bude šťastná.
‘If son will become even even sergeant, his mother will be happy.’ (**ant-i-bot**)

Descriptive statistics

```
> ddply(data_ppi, .(Condition), summarise, Means = mean(Answer, na.rm=TRUE))
  Condition    Means
1  Cond-Bot 2.994898
2  Cond-Top 3.663265
3       Low 2.326531
4       Mid 3.340136
5       Neg 1.780612
6       Top 4.040816
> ddply(data_ppi, .(Condition), summarise, Medians = median(Answer,na.rm=TRUE))
  Condition Medians
1  Cond-Bot       3
2  Cond-Top       4
3       Low       2
4       Mid       4
5       Neg       1
6       Top       5
>
```

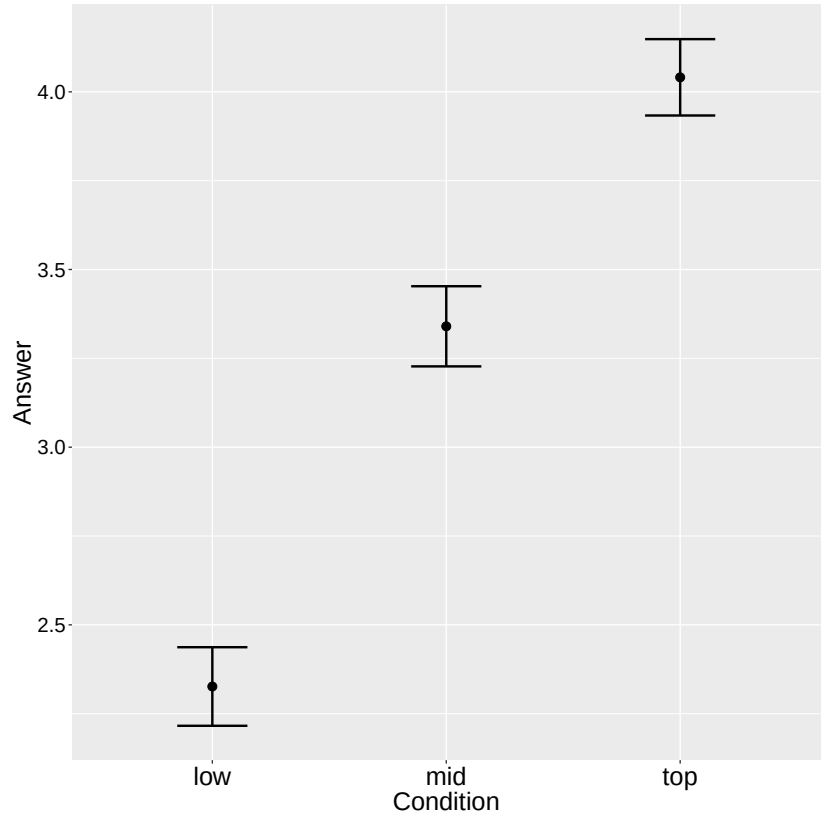

Figure 1: Error-bars, Experiment 1, part 1

Linear mixed model for part 1 I

```
> m1 <- lmer(as.numeric(Answer) ~ Condition + (1|Subj) + (1|Item), data=data_ppi_1)
> summary(m1)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: as.numeric(Answer) ~ Condition + (1 | Subj) + (1 | Item)
   Data: data_ppi_1

REML criterion at convergence: 1470.5

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.1454 -0.7445  0.1116  0.7417  2.2667

Random effects:
 Groups   Name        Variance Std.Dev.
 Subj     (Intercept) 0.1307   0.3615
 Item     (Intercept) 0.2161   0.4649
 Residual             1.4656   1.2106
Number of obs: 441, groups:  Subj, 49; Item, 9
```

```
Fixed effects:
             Estimate Std. Error       df t value Pr(>|t|)
(Intercept)    3.3500     0.1915  14.2807  17.491 4.80e-11 ***
Conditionlow  -1.0257     0.1415 382.4998  -7.246 2.38e-12 ***
Conditiontop   0.6831     0.1415 382.4998   4.826 2.02e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:
            (Intr) Cndtnl
Conditionlw -0.370
Conditiontp -0.370  0.500
>
```

- reference level condition: **mid** (releveled) – all fixed effects significant
- high preference for strong expressions associating with *i*
- middle: shrinking of the domain?

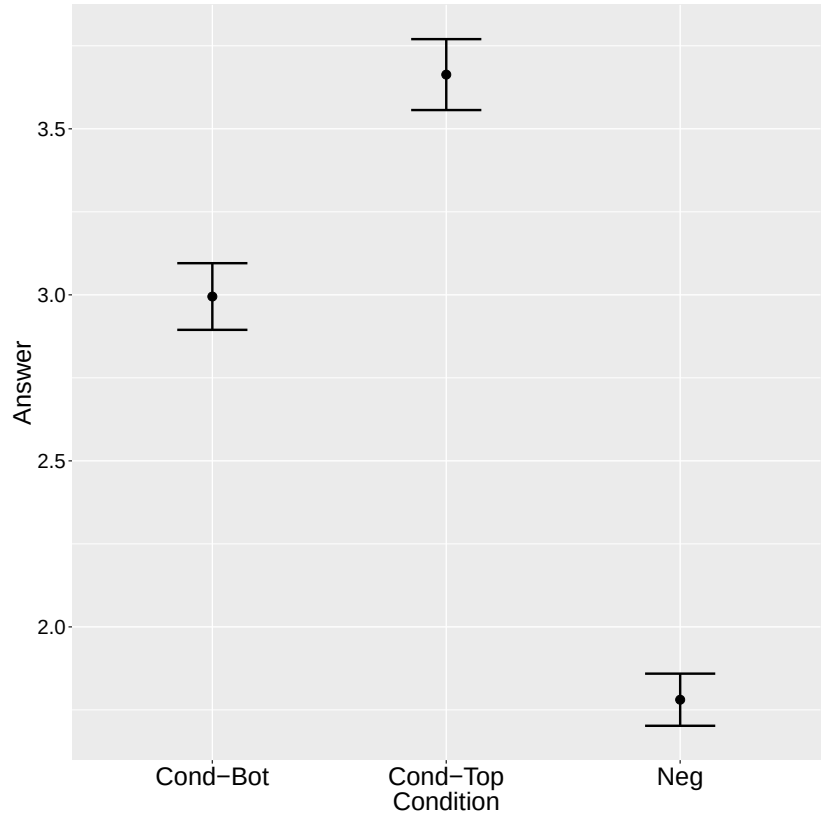

Figure 2: Error-bars, Experiment 1, part 2

Linear model for part 2 I

```
> m1 <- lmer(as.numeric(Answer) ~ Condition + (1|Subj) + (1|Item), data=data_ppi_2)
> summary(m1)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: as.numeric(Answer) ~ Condition + (1 | Subj) + (1 | Item)
   Data: data_ppi_2

REML criterion at convergence: 1982.9

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.2804 -0.6559 -0.0431  0.7140  3.4371

Random effects:
 Groups   Name        Variance Std.Dev.
 Subj     (Intercept) 0.22450  0.4738
 Item     (Intercept) 0.07654  0.2767
 Residual             1.50289  1.2259
Number of obs: 588, groups:  Subj, 49; Item, 32
```

```
Fixed effects:
                  Estimate Std. Error       df t value Pr(>|t|)
(Intercept)         3.0210     0.1234 112.5777  24.490  < 2e-16 ***
ConditionCond-Top   0.5883     0.1293 515.7070   4.551 6.66e-06 ***
ConditionNeg       -1.2590     0.1285 531.0764  -9.801  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:
            (Intr) CndC-T
CndtnCnd-Tp -0.521
ConditionNg -0.520  0.499
>
```

- reference level: **Cond-Bot**, the other two conditons are significantly different
- again *i* prefers to associate with strong elements but not so uncontroversially as in simple sentences

- surprising (correlates with **low** condition worst acceptability in part 1):
- Strawson-Downdward-Entailment (SDE)

(15) Even if John read ONE book, he will pass the exam.

a. even(C)(if John read one book . . .) is defined only if for all relevant $n > 1$: if John read one book . . . $<_c$ if John read n books . . . (consistent)

- expected ungrammaticality (plus change of the predicate!) but reported as acceptable: Crnič (2012)

(16) Even if John read ALL books, he will fail the exam.

a. even(C)(if John read all books . . .) is defined only if for all relevant $n <$ *all*: if John read all book . . . $<_c$ if John read n books . . . (inconsistent)

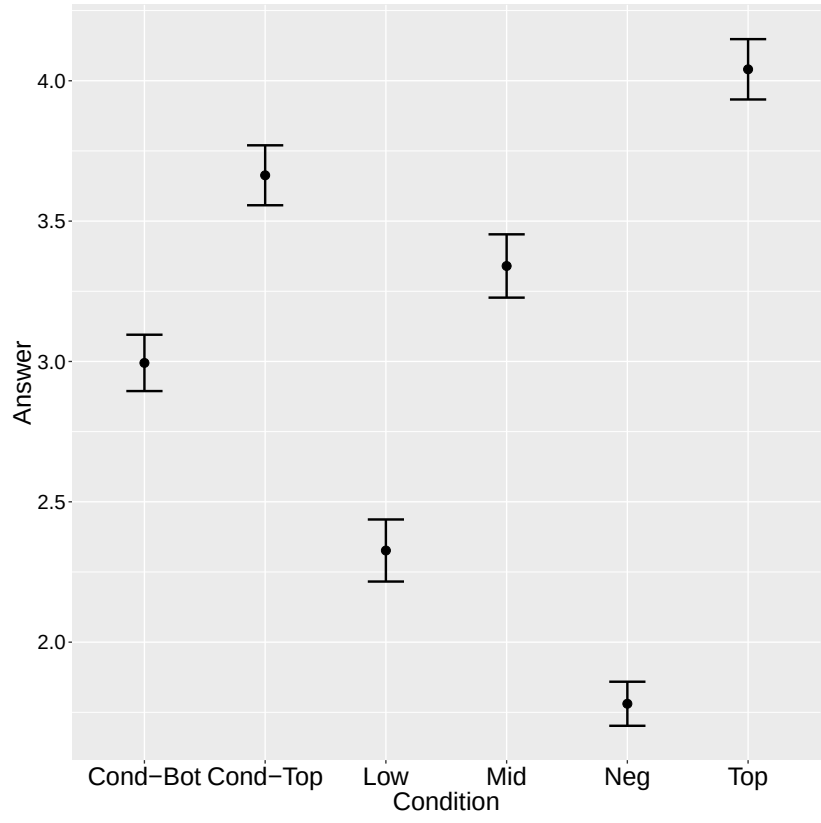

Figure 3: Error-bars, Experiment 1, all conditions

Summary

- *i* associates with strong elements even in the antecedent of conditional
- *i* can associate with weak elements in conditionals (less acceptable)
- *i* in negated sentences is ungrammatical

Summary

- reference level + ungrammatical

(17)

a.	✓ [… *i* + TOP …]	Top
b.	* ¬[… *i* …]	Neg

- decreasing acceptability:

(18)

a.	if [… *i* + TOP …]	Cond-Top
b.	[… *i* + MIDDLE …]	Mid
c.	[… *i* + BOTTOM …]	Cond-Bot
d.	[… *i* + LOW …]	Low

Interpretation

- *i*: Czech positive *even* with the un-likelihood presupposition
- explains: high acceptability of Top, low acceptability of Low
- ungrammaticality with Neg (different source: concurrence)
- PPI hypothesis predicts unobserved preference of the Cond-Bot over Cond-Bot

- explanation (after Crnič (2012)):
- Crnič observes expected *even*-association with weak elements (19) (in DE contexts $1 \rightarrow 2, \ldots$)
- but unexpected *even*-association with strong elements (20):
- problem: truth of *if John read some of the books he will fail the exam* $\rightarrow$ *If John read all of the books he will fail the exam*
- $\forall$ cannot be less likely than $\exists$

(19) Even if John read ONE book, he will pass the exam.

a. even(C)(if John read one book ...) is defined only if for all relevant $n > 1$: if John read one book ... $<_c$ if John read n-books ... (trivial)

(20) Even if John read ALL of the books, he will fail the exam.

a. even(C)(if John read all books ...) is defined only if John read all books ... $<_c$ if John read some books ... (incosistent)

Crnič's solution:

- exhaustification
- the alternatives are then (21-a) not (21-b)

(21) [even C_2] [if [exh C_0] [John read all$_F$ of the books] he will fail the exam]

a. {that if John read all of the books he will fail the exam, that if John read some but not all of the books he will fail the exam}

b. {that if John read all of the books he will fail the exam, that if John read some of the books he will fail the exam}

(22) exh(C)(p,w) = 1 iff p(w)=1 and $\forall q \in C[p \not\subseteq q \rightarrow q(w) = 0]$
all the alternatives not entailed by the prejacent are false

- applied to the experiment
- logically (and not even contextually) un-ordered/independent
- likelihood of logically independent alternatives is not constrained
- plausible: the higher rank son achieves, his mother will be more happy

(23) [even C_2] [if [exh C_0] [son becomes general$_F$] mother will be happy]

a. {that if son becomes general mother will be happy, that if son becomes mayor and not general mother will be happy, that if son becomes sergeant and not general mother will be happy}

- note: the environments (conditionals, restriction of plural definites and universal quantifiers) are Strawson-downward entailing:

(24) a. If son will become sergeant his mom will be happy.
≈ $\forall w \in Acc$[son becomes seregant in $w \rightarrow$ mom happy in w]

b. It is possible that son will become mayor or more.

c. {w: son become mayor or more in w} $\subseteq$ {w: son will become sergeant in w}

d. $\models$ If son will become general his mom will be happy.
≈ $\forall w \in Acc$[son becomes general in $w \rightarrow$ mom happy in w]

Conclusion

- *i* can have wide scope (PPI) and associate with strong elements
- PPI masked by the exhaustification

(25) Prediction: the environments where the exhaustification is blocked or weakened shouldn't allow association of *even* with strong elements.

Crnič (2012) (exhaustified (26-a) *read some but not all* would be non-contradictory):

(26) a. ?I doubt that John read some of the books but I also doubt that he read all of the books.
b. ?I even doubt that John read ALL of the books.

- contrast this with obligatory exhaustification (*read some but not all*):

(27) The students who read some of the books failed the exam but also the students who read all of the books did.

- to be tested
- plus: only in exhaustified cases a change of predicate should have an effect (*even ONE* vs. *ANY*)

Experiment 2

The experiment on swarms I

- swarm constructions (examples from Hoeksema (2009)):
- the construction expresses a high degree

(28) a. Termites are swarming in my kitchen. [A-Subject]
b. My kitchen is swarming with termites. [L-Subject]

- according to Hoeksema (2018) shows signs (corpus study) of PPI-hood
- shares "high degree" property with Krifka's *tons of money*

Czech data (one item from experiment 2)

Reference level

(29) Ta louka bzučela včelami.
the meadow swarmed.3SG bees.PL.INSTR
The meadow was swarming with bees.

(30) Na té louce bzučely včely.
on the meadow swarmed.3PL bees.PL.NOM
The bees swarmed on the meadow.

Degree

(31) Ta louka trochu bzučela včelami.
the meadow slightly swarmed.3SG bees.PL.INSTR

(32) Na té louce trochu bzučely včely.
on the meadow slightly swarmed.3PL bees.PL.NOM

Negation

(33) Ta louka nebzučela včelami.
the meadow neg-swarmed.3SG bees.PL.INSTR

(34) Na té louce nebzučely včely.
on the meadow neg-swarmed.3PL bees.PL.NOM

Rescuing

(35) Jestli to dnes na louce nebzučí
if it today on meadow neg-swarm.3SG
včelami, tak zítra bude.
bees.PL.INSTR, then ...

(36) Jestli dnes na louce nebzučí včely,
if today on meadow neg-swarm.3PL bees.PL.NOM,
tak zítra budou.
then ...

- joint work with Iveta Šafratová
- acceptability task: 5-point Likert scale: 1-worst, 5-best
- 4x2 conditions design
- 32 items (+32 fillers)
- Latin-square design, IBEX farm
- 50 subjects, all passed fillers

```
> ddply(data_part_1, .(Condition), summarise, Means = mean(Answer, na.rm=TRUE))
  Condition    Means
1  Deg-Inst 2.927083
2   Deg-Nom 3.541667
3  Neg-Inst 3.739583
4   Neg-Nom 4.239583
5  Ref-Inst 3.744792
6   Ref-Nom 4.619792
7 Resc-Inst 3.614583
8  Resc-Nom 4.078125


> ddply(data_part_1, .(Condition), summarise, Medians = median(Answer,na.rm=TRUE))
  Condition Medians
1  Deg-Inst       3
2   Deg-Nom       4
3  Neg-Inst       4
4   Neg-Nom       5
5  Ref-Inst       4
6   Ref-Nom       5
7 Resc-Inst       4
8  Resc-Nom       5
>
```

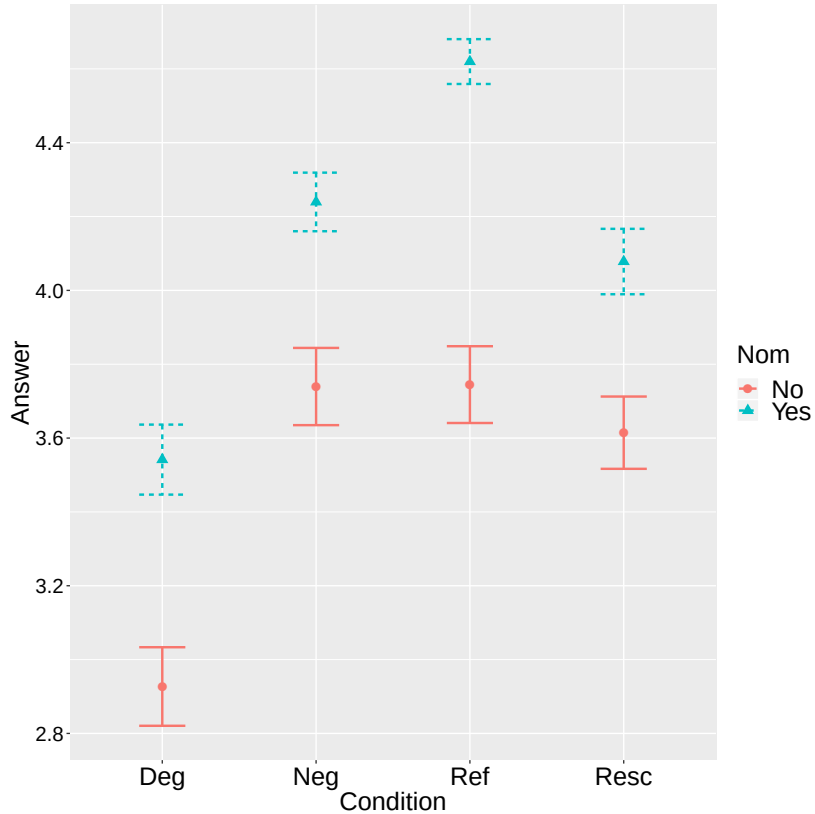

Figure 4: Error-bars, Experiment 2

Linear model for experiment 2 I

```
> summary(m1)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: as.numeric(Answer) ~ Condition * Nom + (1 | Subj) + (1 | Item)
   Data: data_part_1

REML criterion at convergence: 4917.1

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.5572 -0.5778  0.1593  0.7057  2.3157

Random effects:
 Groups   Name        Variance Std.Dev.
 Subj     (Intercept) 0.1993   0.4464
 Item     (Intercept) 0.1897   0.4356
 Residual             1.2932   1.1372
Number of obs: 1536, groups:  Subj, 46; Item, 32
```

```
Fixed effects:
                     Estimate Std. Error         df t value Pr(>|t|)
(Intercept)         3.733e+00  1.306e-01  1.383e+02  28.587  < 2e-16 ***
ConditionDeg-Inst  -8.175e-01  1.163e-01  1.453e+03  -7.030 3.16e-12 ***
ConditionDeg-Nom   -1.808e-01  1.164e-01  1.454e+03  -1.554  0.12034
ConditionNeg-Inst   6.586e-03  1.165e-01  1.454e+03   0.057  0.95491
ConditionNeg-Nom    5.242e-01  1.164e-01  1.454e+03   4.505 7.18e-06 ***
ConditionRef-Nom    9.123e-01  1.166e-01  1.455e+03   7.824 9.78e-15 ***
ConditionResc-Inst -1.158e-01  1.163e-01  1.453e+03  -0.996  0.31958
ConditionResc-Nom   3.551e-01  1.166e-01  1.455e+03   3.046  0.00236 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:
            (Intr) CndD-I CndD-N CndN-I CndN-N CndtnRf-N CndR-I
CndtnDg-Ins -0.445
CondtnDg-Nm -0.446  0.498
CndtnNg-Ins -0.446  0.501  0.498
CondtnNg-Nm -0.446  0.500  0.501  0.498
CondtnRf-Nm -0.447  0.499  0.502  0.502  0.500
CndtnRsc-In -0.445  0.498  0.500  0.501  0.498  0.501
CndtnRsc-Nm -0.447  0.501  0.500  0.502  0.502  0.503     0.499
fit warnings:
fixed-effect model matrix is rank deficient so dropping 8 columns / coefficients
```

Summary of experiment 2

- reference level condition: **Ref-Inst**
- against PPI-status: no significant difference against **Neg-Inst**
- rescuing doesn't work: **Resc-Inst** even worse
- the construction is sensitive to degrees: **Deg-Inst** significantly worse
- Nominative conditions are always better (default)
- degree construction with no real PPI behaviour (against Hoeksema (2009) and Morzycki (2012))

Another model

- some hint of PPI-hood: **Ref-Nom** and **Neg-Nom** are significantly different:

```
> data_part_1$Condition <- relevel(data_part_1$Condition, ref="Neg-Nom")
> m1a <- lmer(as.numeric(Answer) ~ Condition * Nom + (1|Subj) + (1|Item), data=data_part_1)
fixed-effect model matrix is rank deficient so dropping 8 columns / coefficients
> summary(m1a)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: as.numeric(Answer) ~ Condition * Nom + (1 | Subj) + (1 | Item)
   Data: data_part_1
...
Fixed effects:
                   Estimate Std. Error        df t value Pr(>|t|)
(Intercept)          4.2567     0.1306  138.2625  32.601  < 2e-16 ***
ConditionNeg-Inst   -0.5176     0.1166 1455.3944  -4.439 9.73e-06 ***
ConditionRef-Inst   -0.5242     0.1164 1453.7258  -4.505 7.18e-06 ***
ConditionDeg-Inst   -1.3417     0.1164 1453.7258 -11.531  < 2e-16 ***
ConditionDeg-Nom    -0.7050     0.1163 1453.2580  -6.063 1.71e-09 ***
ConditionRef-Nom     0.3881     0.1165 1454.4890   3.332 0.000883 ***
ConditionResc-Inst  -0.6399     0.1166 1455.3944  -5.488 4.78e-08 ***
ConditionResc-Nom   -0.1690     0.1163 1453.2580  -1.453 0.146332
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Linguistic interpretation

- PPI-status very improbable
- reasons:

1) Krifka/Crnič: PPI need emphatic/focus alternatives which are ordered logically (or by likelihood)
2) speakers distinguish between Nom/Instr but both seem to be extreme degree constructions (not ordered alternatives?)
3) the nature of *swarm*-alternatives is different (not focus?)

HOWTO: theories ⟷ experiments

Howto

1) Theory: very clear predictions
2) Design conditions: truth value judgment task vs. acceptability judgments, . . .
3) Make items
4) IBEX
5) Statistics: RStudio
6) Graphs!
7) Interpreting the results (confounds)

Conditions and items

```
Item 1

Byl krásný letní den a na louce u lesa rostly různé druhy květin. Barevné luční kvítí lákalo hmyz.

a) Ta louka bzučela včelami.
b) Na té louce bzučely včely.
c) Ta louka trochu bzučela včelami.
d) Na té louce trochu bzučely včely.
e) Ta louka nebzučela včelami.
f) Na té louce nebzučely včely.
g) Jestli to dnes na louce nebzučí včelami, tak zítra bude.
h) Jestli dnes na louce nebzučí včely, tak zítra budou.


Item 2

Rodiče navštívili svoji dceru, která je uvedla do obývacího pokoje, kde už měla připravené občerstvení.

a) Ten obývací pokoj voněl kávou.
b) V obývacím pokoji voněla káva.
c) Ten obývací pokoj voněl trochu kávou.
d) V obývacím pokoji voněla trochu káva.
e) Ten obývací pokoj nevoněl kávou, ale šípkovým čajem.
f) V tom obývacím pokoji nevoněla káva, ale šípkový čaj.
g) Jestli obývací pokoj nevoněl kávou, tak voněl šípkovým čajem.
h) Jestli v obývacím pokoji nevoněla káva, tak tam voněl šípkový čaj.
```

- how many: $\#(items) = \#(conditions)^2$: swarms: 4 conditions * 2 (Nom/Instr)=32
- fillers as many as items

IBEX-farm

- sequence of fillers and items
- smart random order (Latin-square design)
- JavaScript source code

```
[["first-item1-ref-inst", 1], aj, {s: {html: "<p>Ta louka bzučela včelami.</p>"}, leftComment: "(věta je nap
[["first-item1-ref-nom", 1], aj, {s: {html: "<p>Na té louce bzučely včely.</p>"}, leftComment: "(věta je nap
[["first-item1-ex-deg-inst", 1], aj, {s: {html: "<p>Ta louka trochu bzučela včelami.</p>"}, leftComment: "(v
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[["first-item1-resc-nom", 1], aj, {s: {html: "<p>Jestli dnes na louce nebzučí včely, tak zítra budou.</p>"},

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[["first-item2-ref-nom", 2], aj, {s: {html: "<p>V obývacím pokoji voněla káva.</p>"}, leftComment: "(věta je
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[["first-item2-neg-nom", 2], aj, {s: {html: "<p>V tom obývacím pokoji nevoněla káva, ale šípkový čaj.</p>"},
[["first-item2-resc-inst", 2], aj, {s: {html: "<p>Jestli obývací pokoj nevoněl kávou, tak voněl šípkovým čaj
[["first-item2-resc-nom", 2], aj, {s: {html: "<p>Jestli v obývacím pokoji nevoněla káva, tak tam voněl šípko
```

Results from IBEX

- csv example (cleaned)

Subj	ItemNo	Scenario	Answer	AnswerTimes	Item	Condition
subj01	349	filler1-good	5	15506	good	NA
subj01	358	filler10-bad	1	10116	bad	NA
subj01	359	filler11-good	1	7918	good	NA
subj01	360	filler12-bad	1	5319	bad	NA
subj01	361	filler13-good	5	23823	good	NA
subj01	362	filler14-bad	1	9507	bad	NA
subj01	363	filler15-good	5	11125	good	NA
subj01	364	filler16-bad	2	7410	bad	NA
subj01	365	filler17-good	4	22325	good	NA
subj01	366	filler18-bad	1	16110	bad	NA
subj01	350	filler2-bad	1	9637	bad	NA
subj01	351	filler3-good	5	9628	good	NA
subj01	352	filler4-bad	1	9684	bad	NA
subj01	353	filler5-good	5	10525	good	NA
subj01	354	filler6-bad	1	7552	bad	NA
subj01	355	filler7-good	5	5067	good	NA
subj01	356	filler8-bad	1	7843	bad	NA
subj01	357	filler9-good	5	6164	good	NA
subj01	13	first-item1-ant-i-bot	2	8907	item1	ant
subj01	78	first-item10-neg-ani	5	19489	item10	neg
subj01	87	first-item11-ant-ani	1	16479	item11	ant
subj01	96	first-item12-nr-ani	1	13871	item12	nr
subj01	105	first-item13-neg-ani-top	3	21275	item13	neg
subj01	114	first-item14-neg-i	1	17559	item14	neg
subj01	123	first-item15-ant-i	1	4021	item15	ant

Statistics

- RStudio
- great intro to statistics for linguists: Baayen (2008)
- R: graphs, additional libraries: plyr, dplyr, ggplot2, lme4, ...
- differential statistical methods:
  - corpus/frequencies: Fisher's test
  - standard experiments: mixed-models (fixed effects vs. random effects): lm (r-core), lme4, ordinal, ...
  - correlations (depending on results)

Linguistic Interpretation

Thanks!

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