Strategic pronoun use

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joint work with Oliver Bott and Torgrim Solstad

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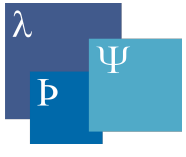
XPrag 2019

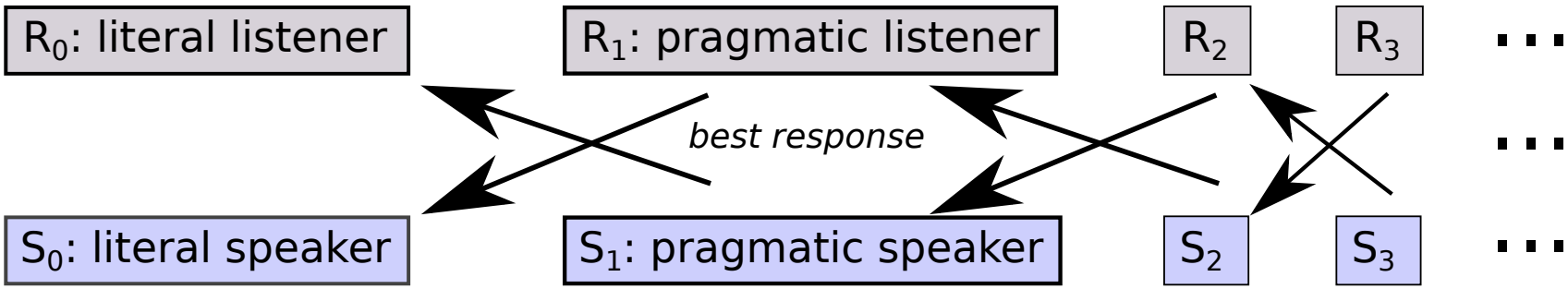
Edinburgh, June 20, 2019



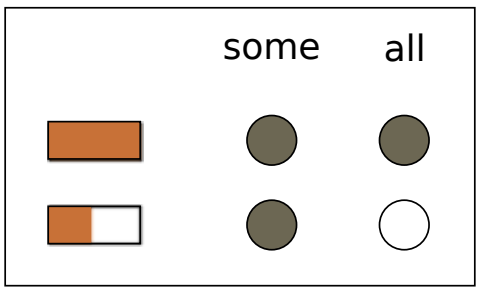
Leibniz-Zentrum
Allgemeine Sprachwissenschaft

special thanks to Oliver Bott and Torgrim Solstad

The Iterated Best Response (IBR) model of pragmatics

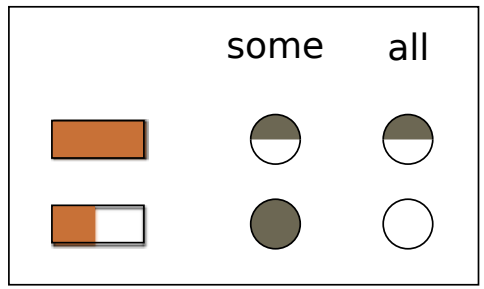


(Franke, 2009; Jäger, 2010; Franke, 2011; Jäger, 2012, 2013; Franke and Jäger, 2016)

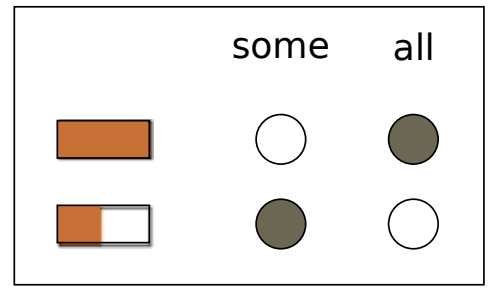


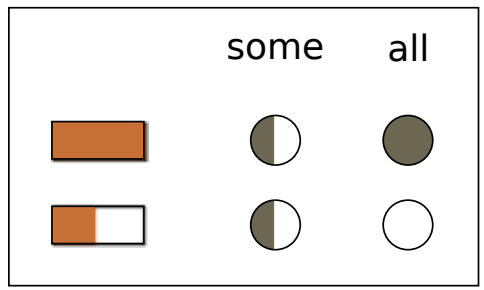
literal meaning

S_0

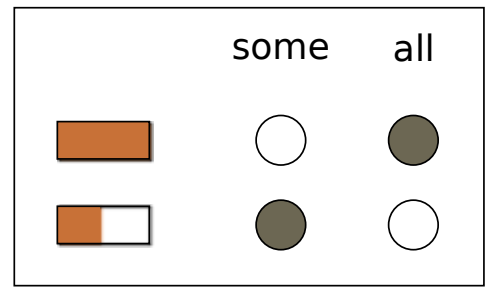


S_1





R_0



R_1

Remention biases: Implicit Causality

Expectations in discourse processing

- What kind of **discourse relation** is most likely to come next?
- Which referent(s) are most likely to be mentioned next?
- Which form of expression is used to communicate this reference?

(1) a. Peter impressed Mary. He is very clever. (**explanation**)
b. Peter impressed Mary **because** he is so clever.
c. Talking of Mary, she is entirely impressed by Linda **because** she/Linda is so clever.

Implicit causality bias (IC bias)

(2) a. **Peter** impressed Mary because **he** sang beautifully.

Implicit causality bias (IC bias)

(2) a. **Peter** impressed Mary because **he** sang beautifully.
b. Peter admired **Mary** because **she** sang beautifully.

Implicit causality bias (IC bias)

(2)
a. **Peter** impressed Mary because **he** sang beautifully.
b. Peter admired **Mary** because **she** sang beautifully.
c. Peter impressed **Mary**. That's why **she** started to write romantic poems.
d. **Peter** admired Mary. That's why **he** started to write romantic poems.

Implicit causality bias (IC bias)

(2)
a. **Peter** impressed Mary because **he** sang beautifully.
b. Peter admired **Mary** because **she** sang beautifully.
c. Peter impressed **Mary**. That's why **she** started to write romantic poems.
d. **Peter** admired Mary. That's why **he** started to write romantic poems.

A large number of psycholinguistic experiments show:

- Depending on the verb, participants prefer to produce/perceive an *explanation* associated with NP1 or NP2
- This preference is affected by the discourse relation: *result/consequence* relation shifts the bias

Implicit causality: The role of coherence relations

Kehler et al. (2008), see also Bott/Solstad (2014):

- IC verbs: explanation is the default
- coreference: explicitly marked = implicit explanations (continuations after a full stop without *because*)
- coreference varies with discourse relation

Coherence relation	Full stop P(CR) (%)	Full stop P(Subj|CR)	*because* prompt P(CR) (%)	*because* prompt P(Subj|CR)
Explanation	58	0.84	100	0.85
Result	22	0.10	—	—
Elaboration	10	0.61	—	—

Table [illegible] Probabilities from Experiment 3 (IC-NP1 verbs)

Coherence Relation	Full stop P(CR) (%)	Full stop P(Subj|CR)	*because* prompt P(CR) (%)	*because* prompt P(Subj|CR)
Explanation	62	0.13	100	0.10
Result	15	0.03	—	—
Elaboration	14	0.46	—	—

Table [illegible] Probabilities from Experiment 3 (IC-NP2 verbs)

Coherence Relation	Full stop P(CR) (%)	Full stop P(Subj|CR)	*because* prompt P(CR) (%)	*because* prompt P(Subj|CR)
Explanation	24	0.57	100	0.56
Elaboration	[illegible]	0.58	—	—
Result	22	0.24	—	—
Violated Expectation	13	0.40	—	—
Occasion	9	0.53	—	—

Table 7 Probabilities from Experiment 3 (non-IC verbs)

Implicit causality: Online processing

A growing number of online studies show early 'focussing' effects:

- Eyetracking during reading and self-paced reading (Koornneef/van Berkum 2006, Featherstone/Sturt 2010): IC congruency effect right at the pronoun
- Eyetracking in the visual world paradigm (Pykkönen/Järvikivi 2010, Cozijn et al. 2011): Referential expectation even before *because*
- Event-related potentials (Otten et al. 2008): P600 effect right at IC-bias incongruent pronouns
- Implicit learning paradigm (Rohde/Horton 2014): IC verbs raise expectations for explanation relations

▷ IC bias sentences give rise to expectations about an upcoming explanation re-mentioning a particular referent

- Sexus ambiguity, no forced referent conditions

(3)
a. John infuriated Bill.
b. John scolded Bill.
c. John chatted with Bill.

- Only effects of position/grammatical function

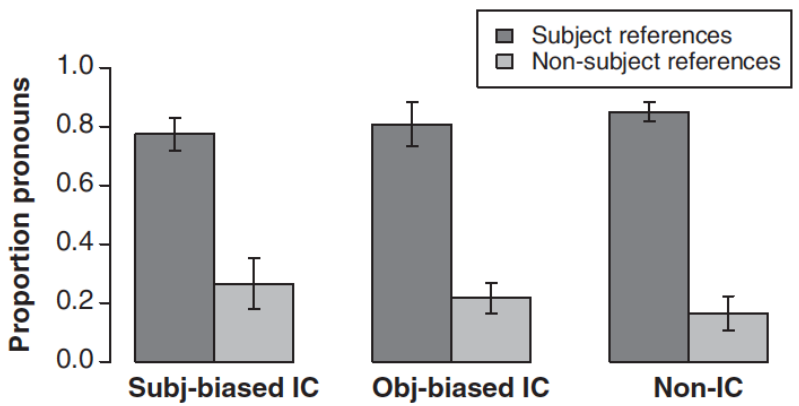


Figure 2. Rate of pronominalisation, by verb bias and referent position (subject vs. non-subject).

Implicit causality: Dissociation between reference and anaphoric form?

Forced referent continuation paradigm, Fukumura/van Gompel (2010):

(4)
a. **John** impressed Mary because...
b. **John** impressed Mary because...
c. John admired **Mary** because...
d. John admired **Mary** because...

- Dependent variable: Anaphoric form (pronoun, proper name, definite description)
- Forced corefence: 1) subject vs. object, 2) IC-bias congruent vs. incongruent
- Influence of grammatical function, more pronouns for subject than object coreference
- **No effect of IC bias**

Implicit causality: Dissociation between reference and form?

Kehler/Rohde (2013, 2014) propose Bayesian analysis assuming a fundamental dissociation between production and comprehension:

$$p(\textit{referent}|\textit{pronoun}) = \frac{p(\textit{pronoun}|\textit{referent}) * p(\textit{referent})}{p(\textit{pronoun})}$$

- $p(\textit{pronoun}|\textit{referent})$ relates to a production problem: *Should I – the speaker – choose a pronoun to refer to this referent?*
- The prior $p(\textit{referent})$ relates to a comprehension problem: *How likely is it that a certain referent is re-mentioned?*
- Dissociation
  - IC-bias is among the factors influencing $p(\textit{referent})$
  - IC-bias is not among the factors influencing $p(\textit{pronoun}|\textit{referent})$, but subjecthood, or rather topichood are

▷ No "cascading" from higher levels to anaphoric form?

Implicit causality and anticipatory processing

- Early focussing effects provide evidence for anticipation at the discourse level
- However, the exact form of these effects seems to be at odds with the generative models assumed in the prediction literature
  - ✓ Discourse expectation of an explanation
  - ✓ Referential expectation
  - ✗ Predicted anaphoric form – bias-congruent pronoun

Implicit causality accounts

- Observations: For a number of verbs, IC bias is strongly correlated with verb class
- IC bias is related to argument structure
  - Stimulus-Experiencer (e.g. *impress*), Experiencer-Stimulus (e.g. *admire*)
  - Agent-Evocator (e.g. *thank*)
- Brown & Fish 1983, Au (1986), Rudolph & Försterling (1997), Ferstl et al. (2011), Hartshorne & Snedeker (2013), ...

Main claim (Bott/Solstad 2014; under review)

IC verbs trigger specific kinds of explanations associated with one of the two participants

(5) a. Bias-congruent
John admired **Sarah** because . . . **she** sang beautifully.
b. Bias-incongruent
John admired **Sarah** because . . . he was very impressed by **her** performance.

- IC bias may be observed when a *because* clause/an explanation can specify a semantic entity associated with (only) one of the participants
- Bias: Epi-phenomenon of explanation preferences
- We need to look beyond pronouns

Implicit Causality ingredients

- IC bias is dependent on
  - "Slots" providing causal elaboration possibilities in *NP1 verb-ed NP2*
  - Semantic properties of *because* (clauses)
- Consequently, we need a suitable theory of verb semantics and a typology of explanations (as introduced by *because*)
- Upshot: Rooted in verb semantics, our theory allows for systematic manipulation of the IC bias.

✓ Discourse expectation of an explanation

✓ Referential expectation

✗ Predicted anaphoric form – bias-congruent pronoun

- Other verb classes display remention biases.

Transfer-of-possession predicates

Anna gave Angie a bouquet. Then . . . she threw it away.

Anna got a bouquet from Angie. Then . . . she put it away.

For transfer-of-possession predicates, the recipient/goal argument is referred to preferably. ⇒ in particular for result relations

Stevenson et al. 1994, Arnold 2001, Rosa & Arnold 2017

(6) a. [Michael] handed a cookbook to Mary/John.

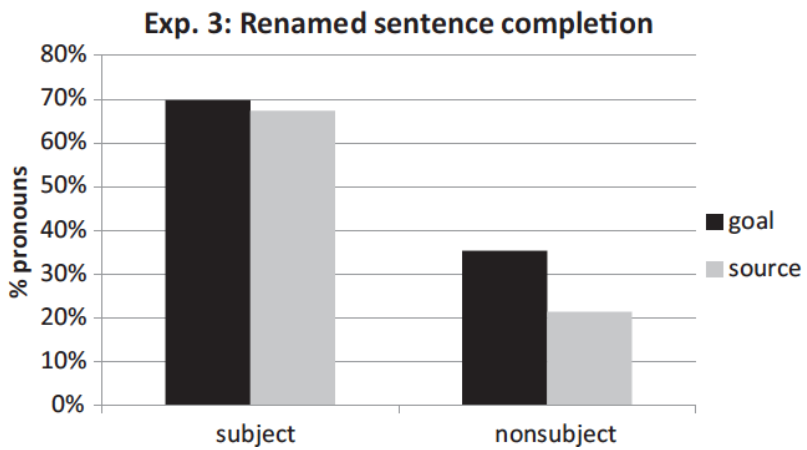
b. Michael handed a cookbook [to Mary/John].

c. [Michael] took a cookbook from Mary/John.

d. Michael took a cookbook [from Mary/John].

Table 7
Experiment 3 results: Rate of pronoun production by condition.

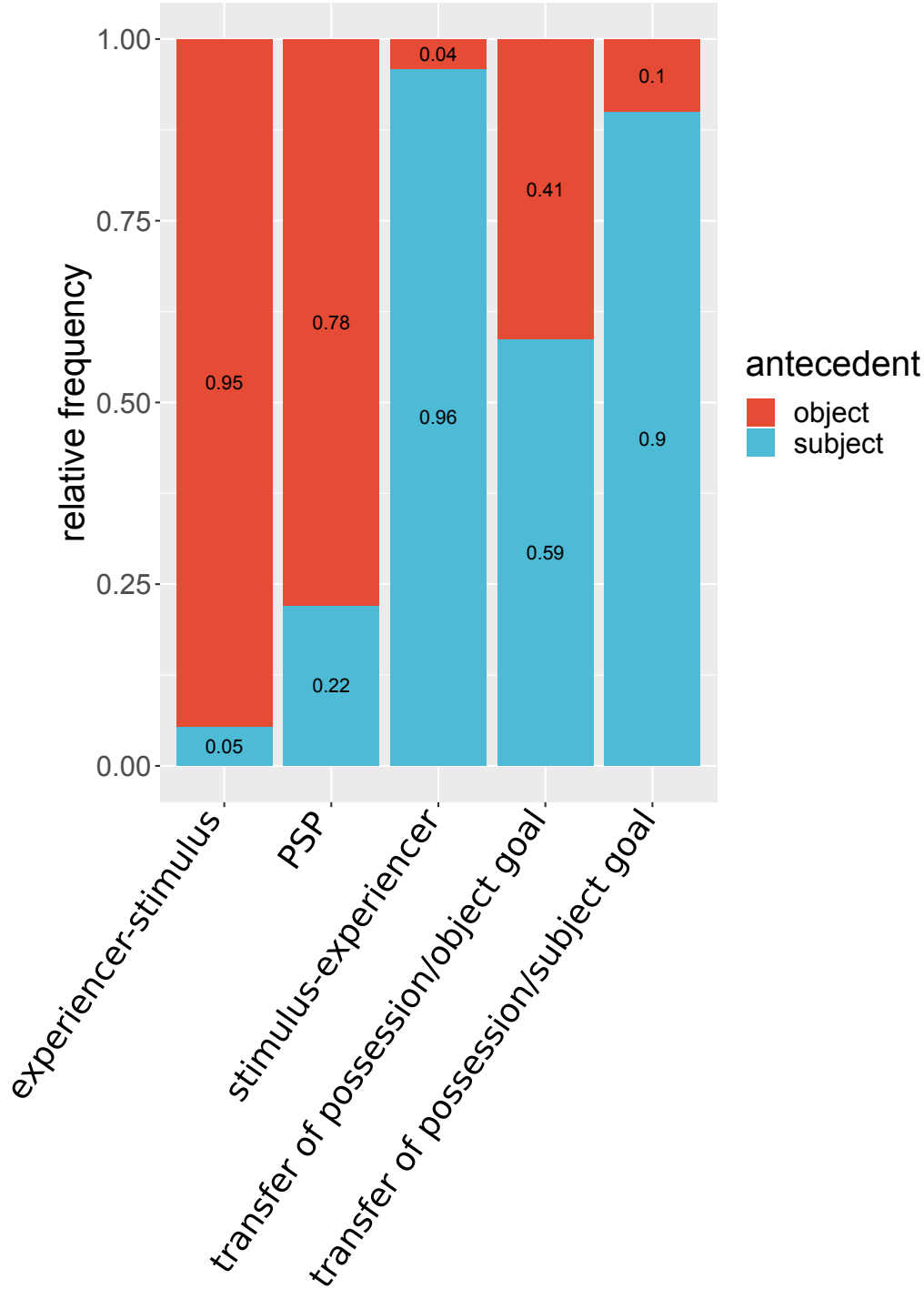
		Goal (%)	Source (%)
Different-gender	Subject	71	71
	Nonsubject	38	33
Same-gender	Subject	68	64
	Nonsubject	33	10



Experimental study, part I – Pretest

- 60 Implicit Causality verbs:
  - 20 stimulus-experiencer verbs (*impress*)
  - 20 experiencer-stimulus verbs (*admire*)
  - 20 agent-evocator verbs (*praise*)
- 48 Transfer-of-possession verbs $\rightarrow$ subject-goal, 24 object-goal
- same gender ("ambiguous") vs. different gender ("unambiguous")
- participants: 24 native speakers of German

(18)
a. Janina/Paul faszinierte Sonja/Peter ganz und gar, weil...
'Janina/Paul fascinated Sonja/Peter altogether, because...'
b. Adele/Felix achtete Katrin/Mark in hohem Maß, weil...
'Adele/Felix respected Katrin/Mark to high degree, because...'
c. Käthe/Franz verkaufte Lisa/Max einen Fernseher. Danach...
'Käthe/Franz sold Lisa/Max a TV set. Then...'
d. Käthe/Franz kaufte von Lisa/Max einen Fernseher. Danach...
'Käthe/Franz bought from Lisa/Max a TV set. Then...'
e. Jule/Ansgar lobte Lea/Justus ganz besonders, weil...
'Jule/Ansgar praised Lea/Justus extraordinarily, because...

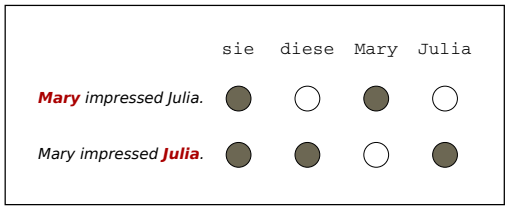

1.00
0.75
0.50
0.25
0.00
relative frequency
0.95
0.05
0.78
0.22
0.04
0.96
0.41
0.59
0.1
0.9
experiencer-stimulus
PSP
stimulus-experiencer
transfer of possession/object goal
transfer of possession/subject goal
antecedent
object
subject

Consequences for IBR

- experimental paradigm allows to manipulate the *prior probability* of different meanings while everything else remains constant
- German has rich system of expressions for anaphoric relations

(19)
a. Ich konnte nicht schlafen. Dieser Hund / Fido / *dieser / *jener / *der / *er hielt mich wach.
'I could not sleep. This dog / Fido / *PROX-DEM / *DIST-DEM / *D-PRO / *he kept me awake.'
b. Ich grüßte meinen neuen Nachbarn. Dieser / jener / der / er / war gestern eingezogen.
'I welcomed my new neighbor. PROX-DEM/ DIST-DEM / D-PRO / he had moved in yesterday.'
c. Peter grüßte Lisa. ?Dieser / ?jener / ?der / er war gestern eingezogen.
'Peter greeted Lisa. ?PROX-DEM / ?DIST-DEM / ?D-PRON / he had moved in yesterday.'

stimulus-experiencer verbs/ambiguous

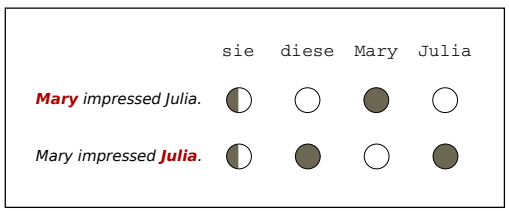


literal meaning

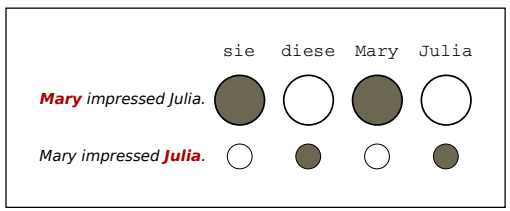
S_0

S_1

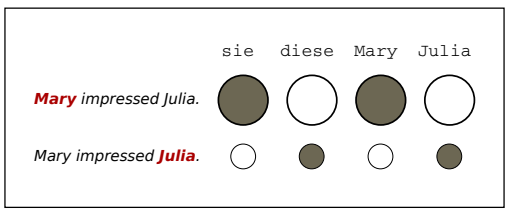
S_2



R_0

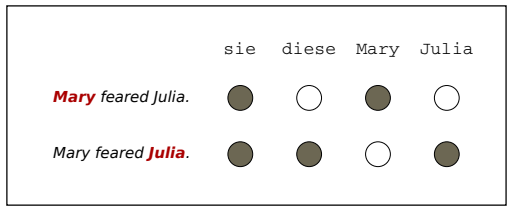


R_1

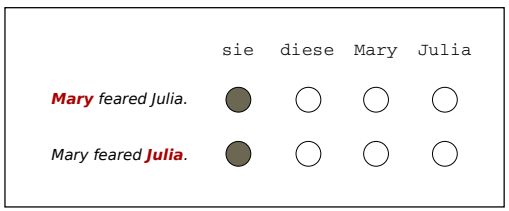


R_2

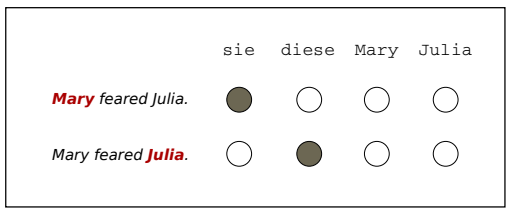
experiencer-stimulus verbs/ambiguous



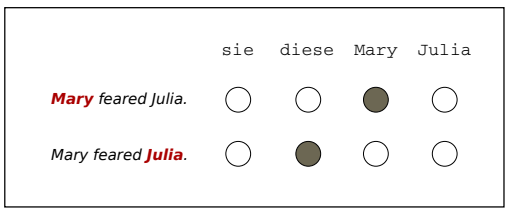
literal meaning



S_0



S_1



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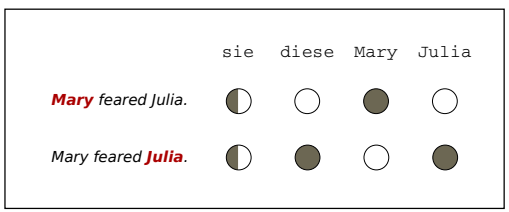

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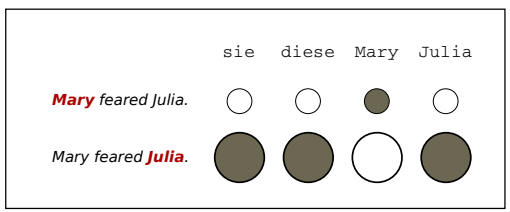
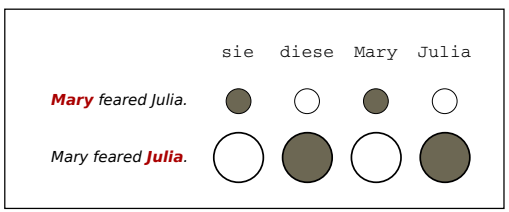
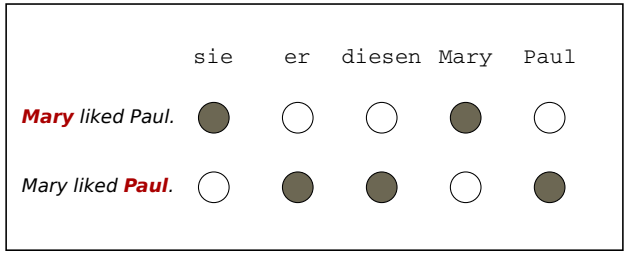


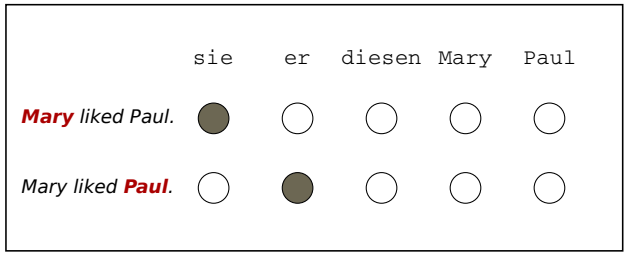
R_1



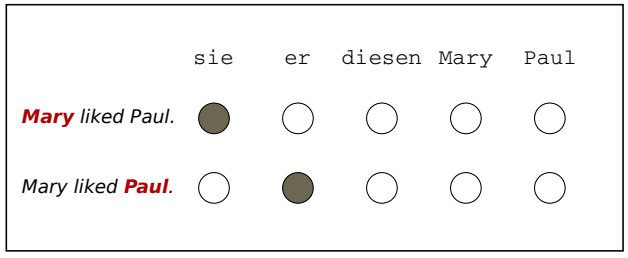
R_2



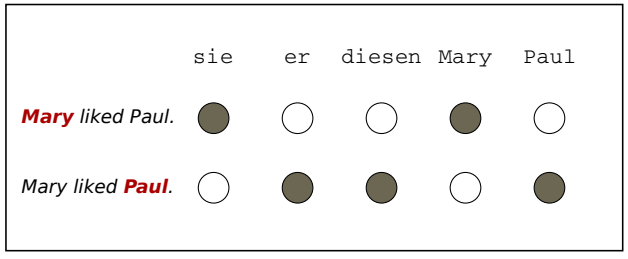
literal meaning



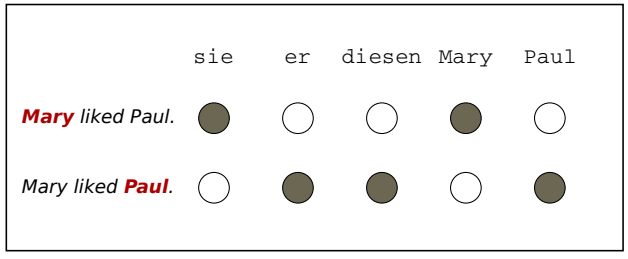
S_0



S_1



R_0



R_1

Predictions

- unambiguous: only personal pronouns
- stimulus-experiencer, ambiguous:
  - subject reference $\Rightarrow$ personal pronoun
  - object reference $\Rightarrow$ demonstrative
- experiencer-stimulus, ambiguous:
  - object reference $\Rightarrow$ demonstrative
  - subject reference:
    - $S_1, S_3, \ldots$: personal pronoun
    - $S_2, S_4, \ldots$: proper noun

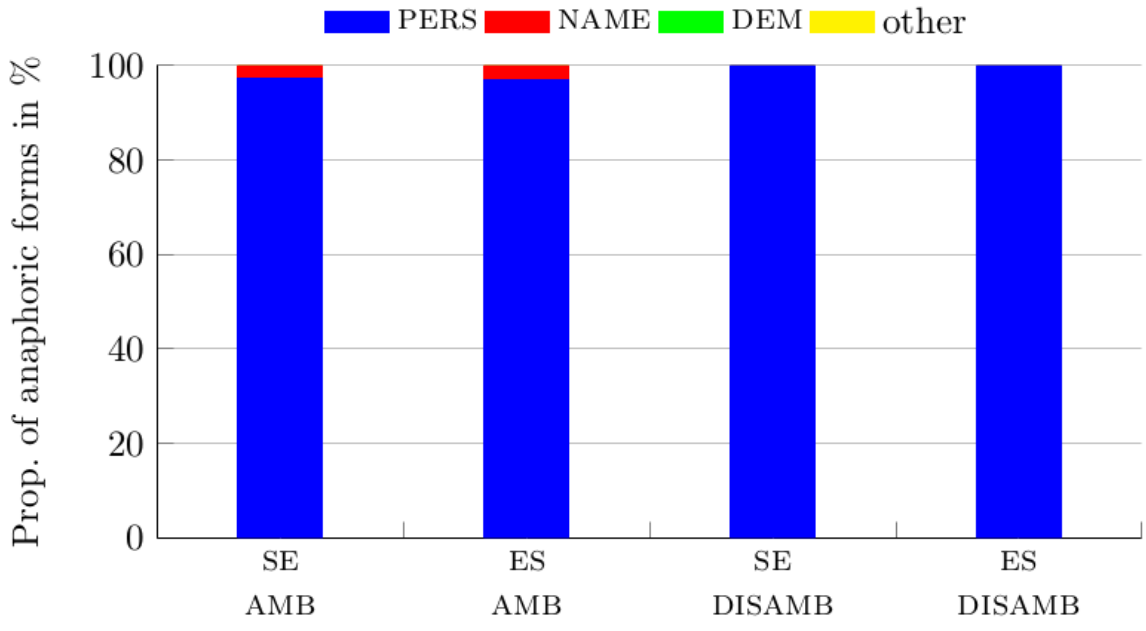
Experimental study, part II

- similar setup as before but **forced referent continuation**
- one name in the context sentence is highlighed and participants are instructed to refer back to that person
- in total, 1,280 continuations were elicited

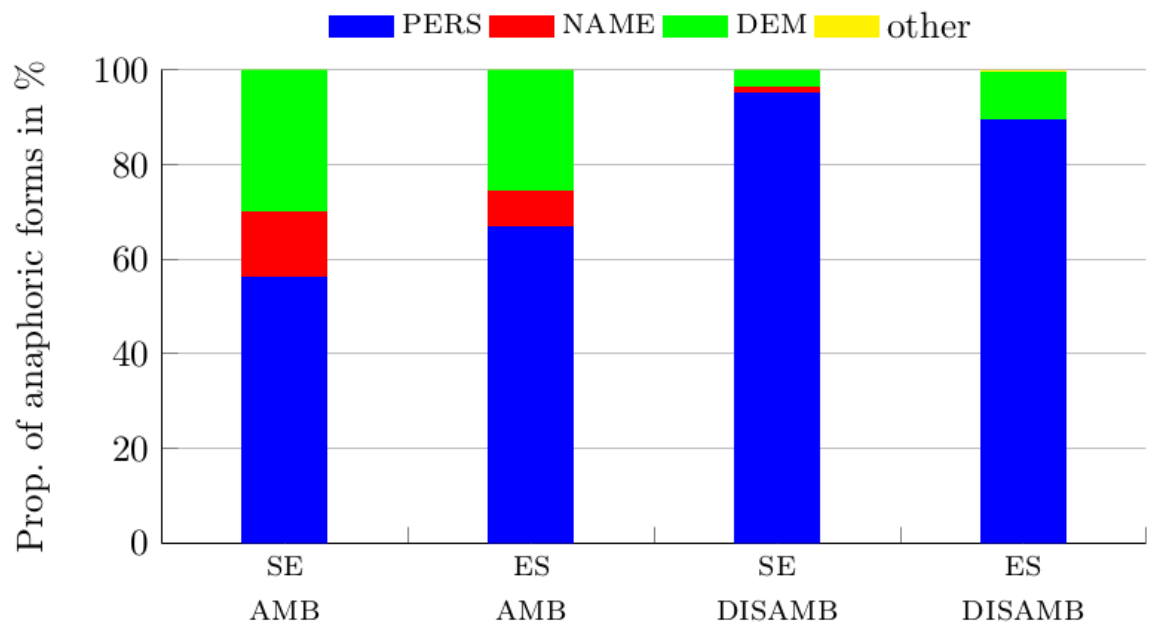
(20) a. Jonas entzückte **Rüdiger** ganz außergewöhnlich, weil...
'Jonas enchanted **Rüdiger** extraordinarily because...'
b. *...jener etwas Nettes gesagt hatte.*
'DIST-DEM had said something nice'

(21) a. Carla verabscheute **Marlene** schon seit Wochen, weil...
'Carla despised **Marlene** since weeks because...'
b. *...jene nur Lügen über ihre Mitmenschen verbreitete.*
'DIST-DEM only spread lies about her fellow humans.

(22) a. **Anke** hasste Madeleine bis aufs Blut, weil...
'**Anke** hated Madeleine fiercly because...
b. *...Anke eifersüchtig war.*
'...Anke was jealous.'



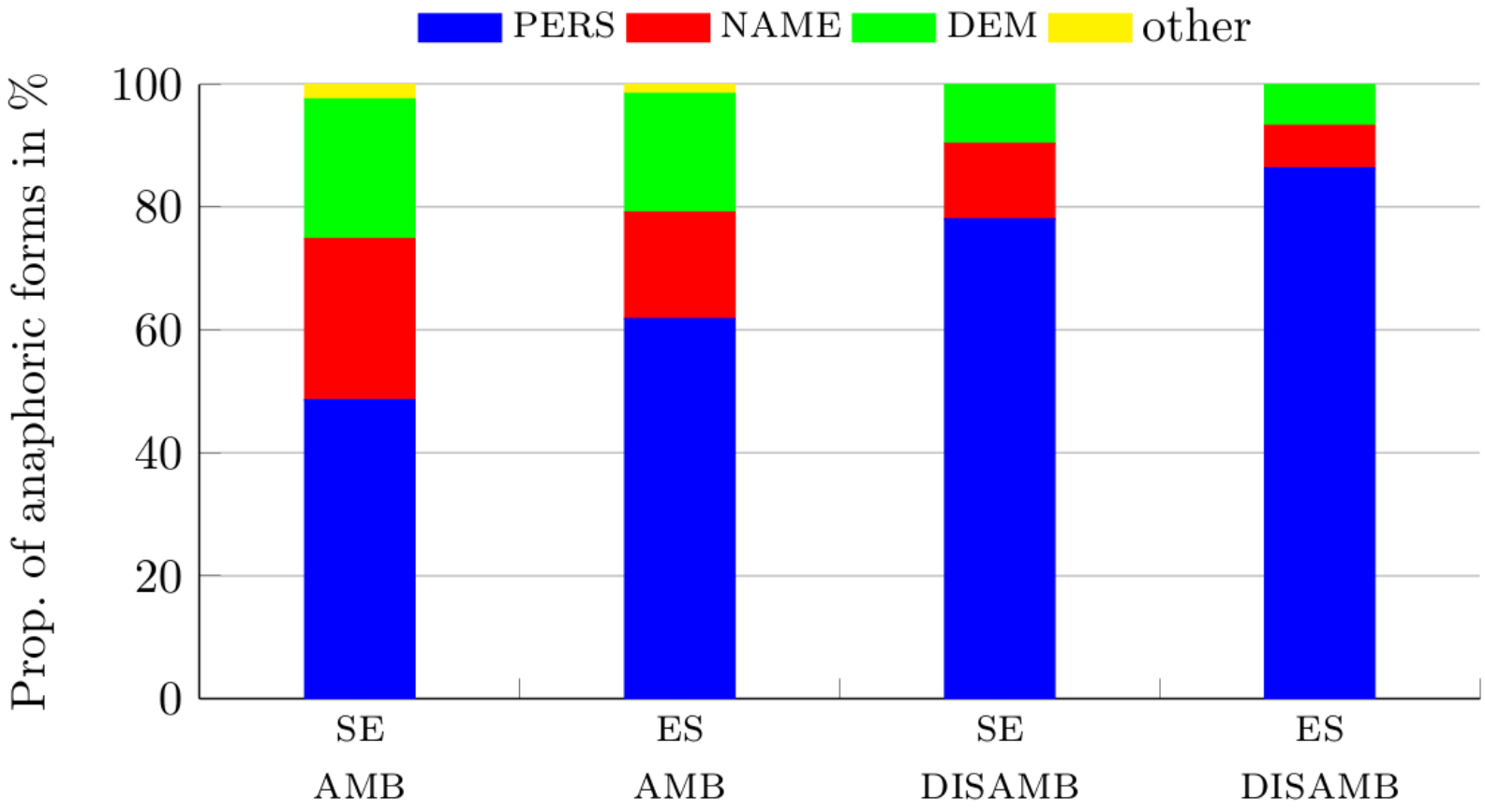
(a) Subject focus conditions



(b) Object focus conditions

Experiment 2

- only testing the object focus condition
- within-participant comparison
- 42 participants
- 1,393 continuations analyzed

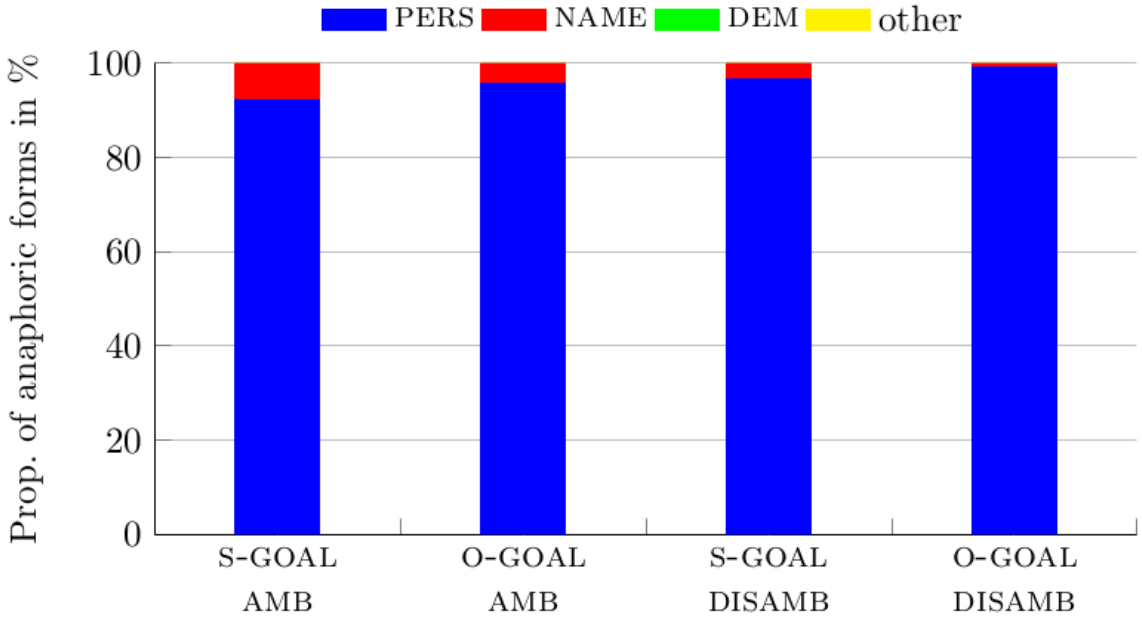

PERS
NAME
DEM
other
Prop. of anaphoric forms in %
100
80
60
40
20
0
SE AMB
ES AMB
SE DISAMB
ES DISAMB

	β	*se*	*Wald's z*	*p*
foc*amb*verb+(1|p)+(1|i)				
INTERCEPT	1.22	0.41	2.944	**
AMB	3.27	1.11	5.05	***
FOC	3.27	1.11	2.96	**
VERB	-.50	.33	-1.50	
FOC × AMB	-.22	.95	-0.23	
FOC × VERB	1.71	.82	2.08	*
AMB × VERB	1.33	0.57	2.32	*
FOC × AMB × VERB	-1.47	1.57	-0.93	
subject foc.: amb*verb+(1|p)+(1|i)				
INTERCEPT	4.96	1.22	4.07	***
AMB	1.84	0.91	2.03	*
VERB	1.30	0.86	1.51	
AMB × VERB	-0.25	1.53	-0.16	
object foc.: amb*verb+(1|p)+(1|i)				
INTERCEPT	1.2	0.42	2.85	**
AMB	1.96	.39	5.08	***
VERB	-.52	.34	-1.54	
AMB × VERB	1.35	.58	2.34	*
object foc., unamb.: verb+(1|p)+(1|i)				
INTERCEPT	3.10	.61	5.07	***
VERB	.93	0.58	1.59	
object foc., amb.: verb+(1|p)+(1|i)				
INTERCEPT	1.34	.46	2.89	**
VERB	-.60	0.36	-1.68	

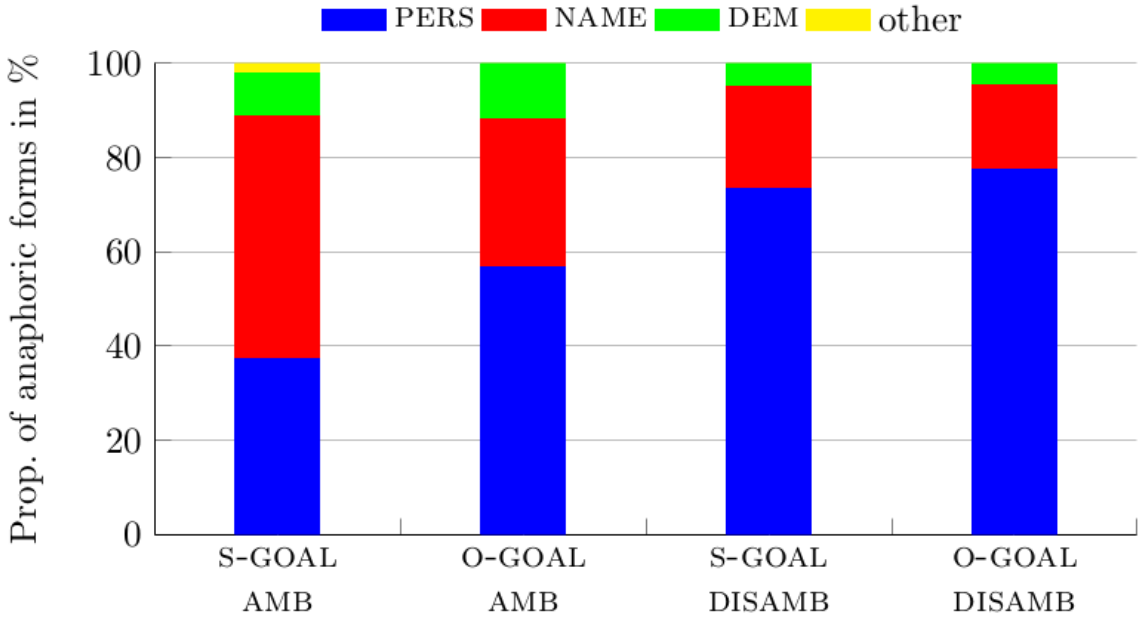
Table 2: Logit mixed-effects model analyses on the rate of personal pronouns computed for Exp. 1 with model equations in R-syntax. The global analysis was computed on the complete data set, the other analyses analyzed the specifiied subsets of the data. Abbreviations: * = '$p < .05$', ** = '$p < .01$', *** = '$p < .001$'; AMB = *ambiguity*, FOC = *focus*, VERB = *verb type*, p = *participant*, i = *item*.

Experiment 3

- transfer-of-possession verbs, subject-goal vs. object-goal (cf. Kehler, 2008; Rosa and Arnold, 2017)
- run together with previous experiments; same participants and procedure
- 1,008 continuations elicited
- only 21% chose explanation continuation and were used for further analysis



(a) Subject focus conditions

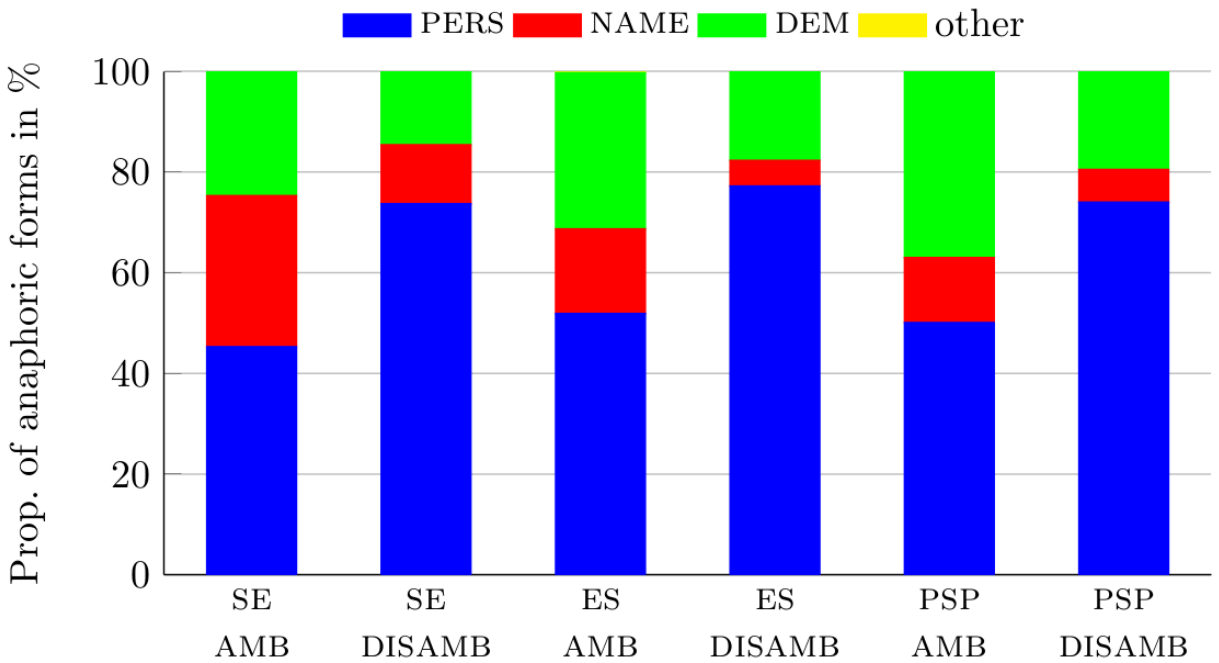


(b) Object focus conditions

	β	*se*	*Wald's z*	*p*
amb*verb+(1+verb|p)+(1|i)				
INTERCEPT	0.71	0.56	1.27	
AMB	1.98	0.50	4.02	***
VERB	-1.21	0.51	-2.39	*
AMB × VERB	-0.18	0.61	-0.30	

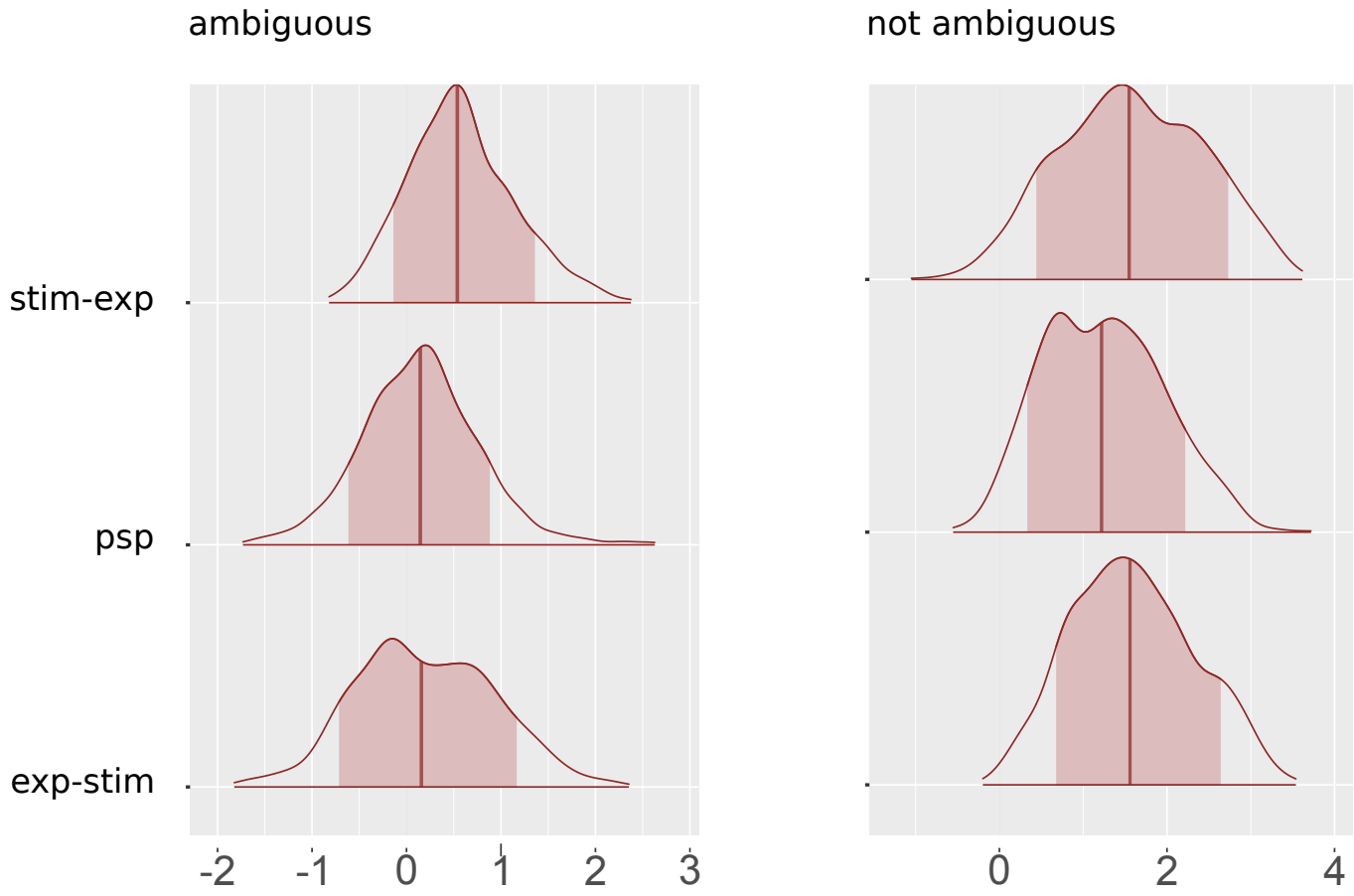
Table 4: Logit mixed-effects model analysis on the rate of personal pronouns computed for the object focus conditions in Exp. 3. Please note that models with a more elaborate random effects structure failed to converge. Abbreviations: * = '$p < .05$', ** = '$p < .01$', *** = '$p < .001$'; AMB = *ambiguity*, VERB = *verb type*, p = *participant*, i = *item*.

- only testing the object focus condition
- 60 new participants, 3,600 continuations

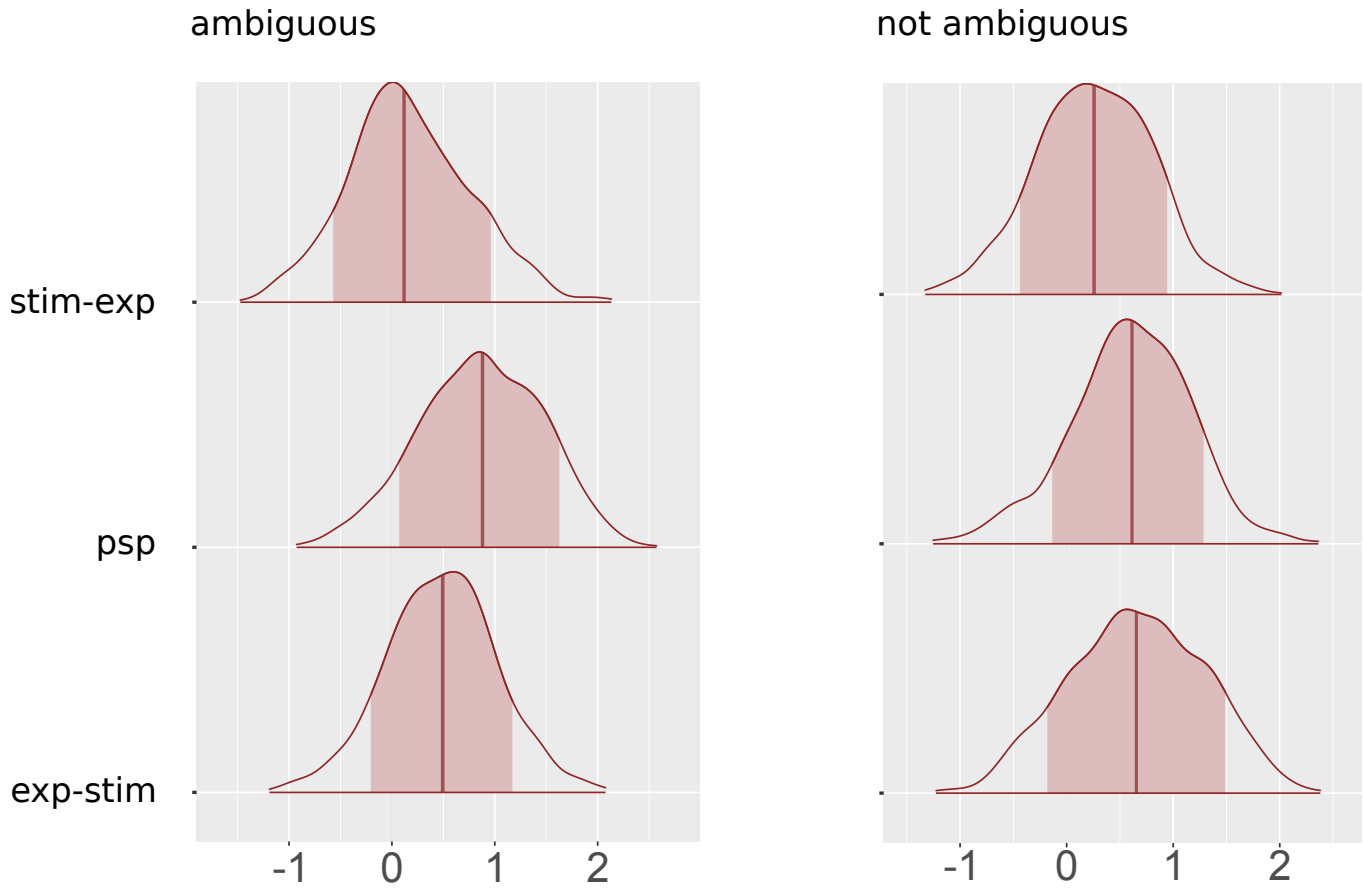


Evaluation: Bayesian mixed-effects multinomial logistic regression with interaction

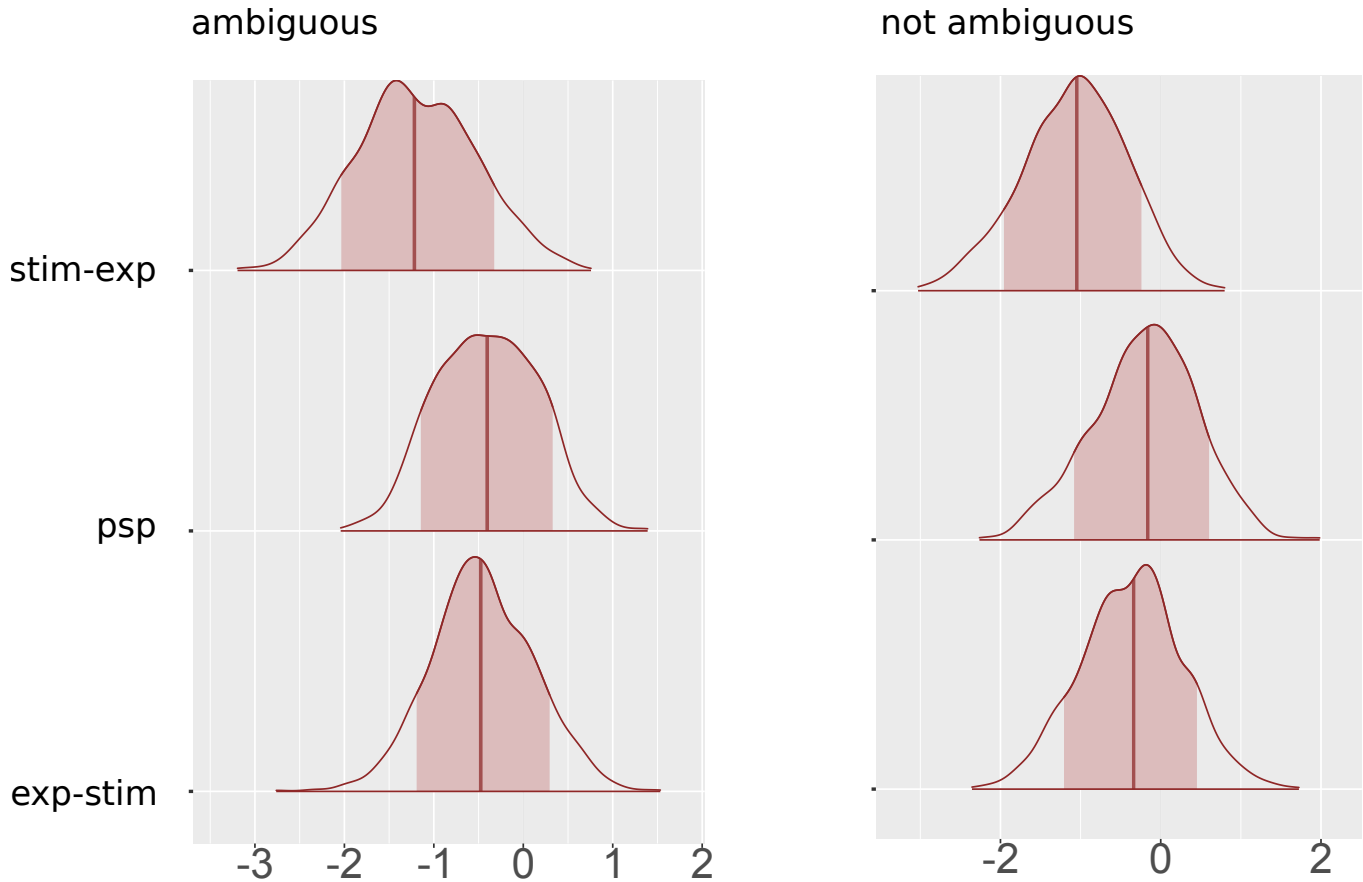
personal pronouns



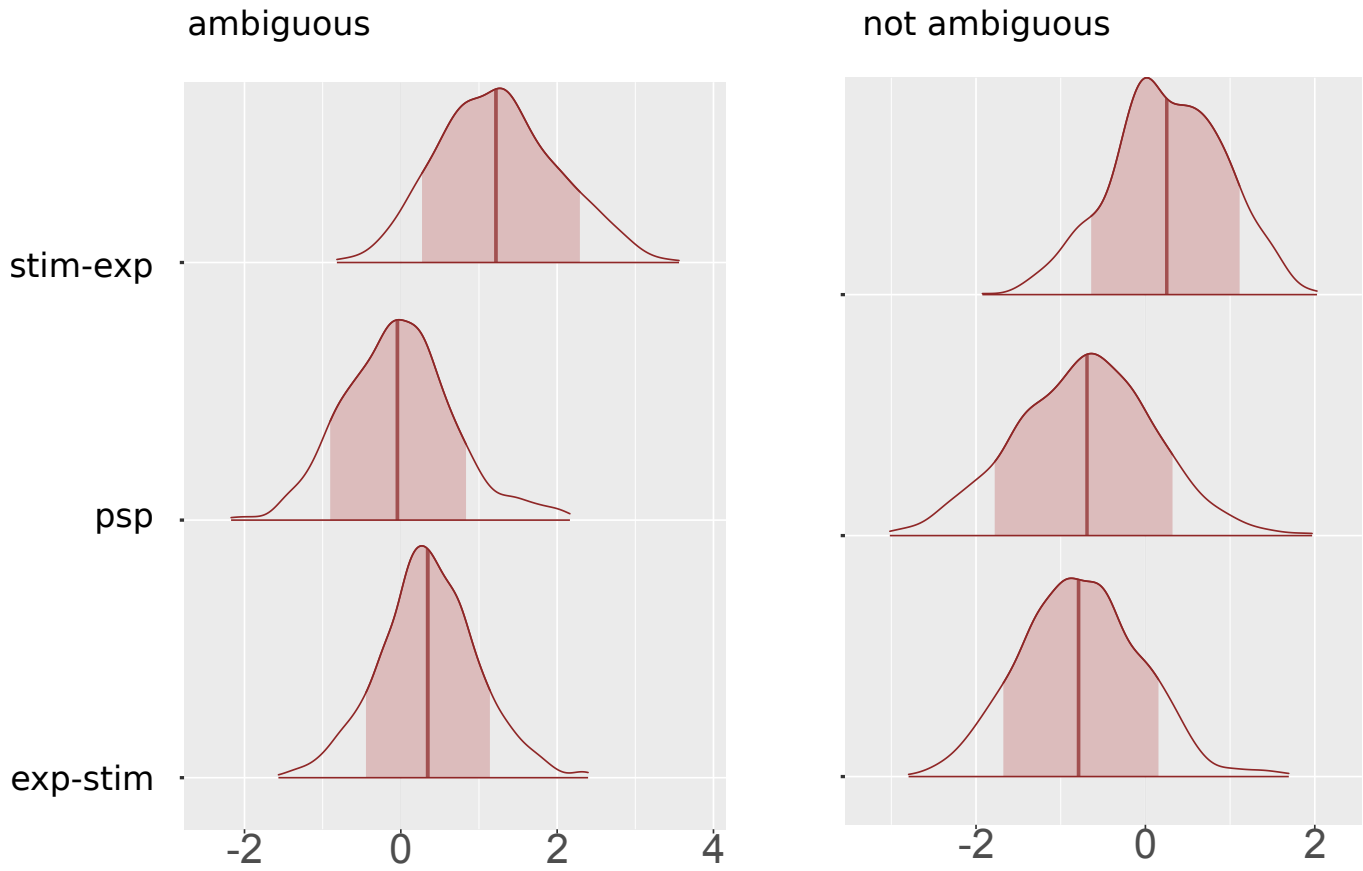
prox-demonstrative pronouns



prox-demonstrative pronouns



proper nouns



Evaluation: Frequentist mixed-effects logistic regression with interaction

	β	se	$Wald's\ z$	p
amb*verb+(1+|p)+(1|i)				
INTERCEPT	0.28	0.33	0.86	
AMB	1.82	0.19	9.4	***
VERB (contrast: SE vs. ES)	0.04	0.19	0.19	
VERB (contrast: SE vs. PSP)	-0.12	0.20	-0.59	
AMB × VERB (contrast: SE vs. ES)	0.044	0.25	0.17	
AMB × VERB (contrast: SE vs. PSP)	-0.10	0.25	-0.39	

Conclusion

Important aspects for experimental design

- Forced referent (vs. Rohde & Kehler)
- Sexus ambiguity/Audience design (vs. Fukumura & van Gompel)
- Experiment 2: Implicit causality and transfer-of-possession verbs in a within subjects design (vs. everybody)
- Tested for German: Richer inventory of anaphoric form

- unexpectedly weak effect of continuation bias on choice of referring expression
- clear effect of ambiguity: personal pronouns are preferred unless they lead to (local) ambiguity
- consistent with IBR-prediction $R_0 \leftarrow S_1 \leftarrow R_2 \leftarrow S_3 \cdots$
- inconsistent with IBR-prediction $S_0 \leftarrow R_1 \leftarrow S_2 \leftarrow R_3 \cdots$
- future work: quantitative modeling via RSA model

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