Predictability affects the production of referring expressions across remention biases

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Current research has presented conflicting results as to whether referent predictability influences the choice of referring expression (e.g. *Mary* vs. *she*). Thus, for Implicit Causality (IC) verbs of STIM(ulus)-EXP(eriencer) and EXP(eriencer)-STIM(ulus) type (e.g., *fascinate* and *admire*), which display strong preferences for subsequent explanations about the stimulus argument (cf. [1])), [2] and [3] found no effect of IC on referring forms. From this, [4] have concluded that the production of referring forms is dissociated from the likelihood of remention as formalized in their Bayesian model. On the other hand, [5] found that Transfer of Possession (ToP) verbs, with a re-mention bias for goal arguments (e.g., indirect object of *sell* or subject of *buy*) do influence the choice of anaphoric form. Previous research has suggested that differences in argument structure, experimental design or utterance planning may have caused these discrepancies ([5]).
The present study shows for three different remention biases that they do affect the production of referring expressions, adding to the evidence that the proposed Bayesian dissociation of interpretation and production may be too strong. In three written production experiments employing a forced reference paradigm (e.g., [2]) IC, ToP and Implicit Consequentiality (I-CONS) biases were investigated in German, which has a slightly larger inventory of anaphoric forms than English. Moreover, our study focused on *coreference with object arguments* since a pilot study revealed that coreference to the subject was almost exclusively established with personal pronouns, showing no variability with regard to anaphoric forms.
Experiments 1a/b (N=42) compared IC-bias and ToP verbs. Exp. 1a tested IC items with NP1-biased STIM-EXP and NP2-biased EXP-STIM verbs and Exp. 1b tested 24 ToP items with subject vs. object goal bias as in [5]. It was also manipulated whether the referents were of the same or different gender, i.e. whether pronouns would be referentially ambiguous. Exp. 1a revealed clear form effects of gender ambiguity (GLMER: $\chi^2(1) = 23.1$) and an effect of IC verb type ($\chi^2(1) = 6.5$): Both in same-gender and different-gender conditions the likelihood to use a personal pronoun was higher in continuations congruent with IC-bias than in bias-incongruent continuations (Fig. 1). The same pattern of effects appeared for ToP verbs in Exp. 1b (Fig. 2): Both ambiguity ($\chi^2(1) = 14.4$) and verb type ($\chi^2(1) = 8.60$) contributed significantly to model fit.
Experiment 2 (N=60) replicated and extended the observed IC form effect. The two psych verb classes from Exp. 1a were tested together with NP2 biased AG(ent)-EVO(cator) verbs in a 3 (verb class) $\times 2$ (ambiguity) design. The experiment revealed a clear effect of gender ambiguity ($\chi^2(1) = 326.0$), see Fig. 3. In addition, IC-bias affected the rate of coreference with a proper name relative to the choice of pronouns: Bias-incongruent continuations after STIM-EXP verbs displayed more repeated names than bias-congruent productions after EXP-STIM and AG-EVO verbs. GLMER analyses confirmed a reliable main effect of verb type on the production of repeated names ($\chi^2(2) = 41.5$), which was significant both for the comparison of STIM-EXP and EXP-STIM ($\chi^2(1) = 27.8$) as well as between STIM-EXP and AG-EVO verbs ($\chi^2(1) = 33.0$).
Experiment 3 (N = 64) investigated form effects for IC and I-CONS biases of STIM-EXP and EXP-STIM verbs. IC and I-CONS biases have been shown to be reversed for these verb classes (e.g., [6]). This time, only same gender object focus conditions were tested – conditions not included in [2]. Exp. 3 revealed clear IC and I-CONS bias form effects in the expected directions (interaction: $\chi^2(1) = 102.3$), see Fig. 4. Follow-up analyses confirmed reliable IC- ($\chi^2(1) = 5.2$) as well as I-CONS-related congruency effects on the use of personal pronouns vs. more complex forms ($\chi^2(1) = 23.7$): more pronouns were used in congruent than in incongruent conditions.
In sum, the present experiments show that referential biases affect reference form production across remention biases and verb classes. This finding speaks against both proposals assuming a general dissociation between likelihood of mention and choice of referring expression ([4]) as well as proposals assuming an interaction with argument structure (as speculated in [5]).

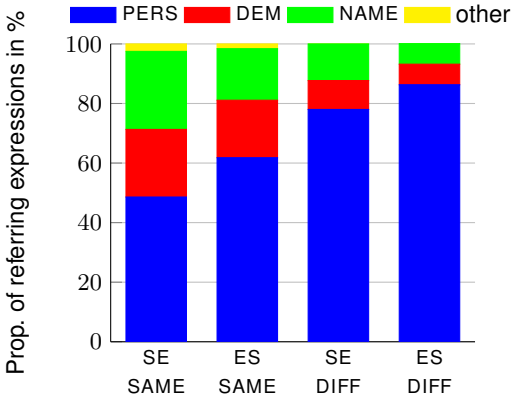

Fig. 1: Distribution of referring expressions (for object antecedents) in **Exp. 1a** depending on ANTECEDENT GENDER (same-gender vs. different-gender) and VERB TYPE (SE vs. ES).

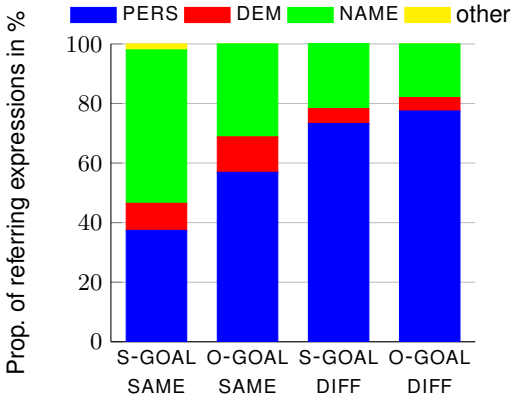

Fig. 2: Distribution of referring expressions (for object antecedents) in **Exp. 1b** depending on ANTECEDENT GENDER and VERB TYPE (subject goal vs. object goal)

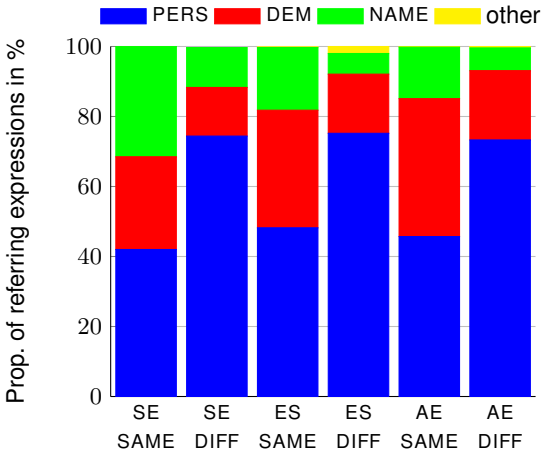

Fig. 3: Distribution of referring expressions (for object antecendents) in **Exp. 2** depending on ANTECEDENT GENDER and VERB TYPE (SE, ES, AE).

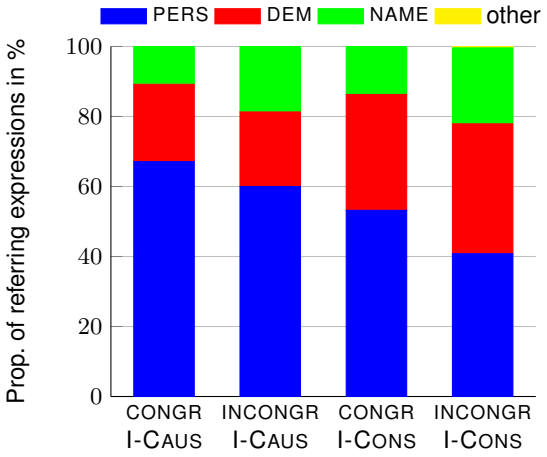

Fig. 4: Distribution of referring expressions (for object antecedents) in **Exp. 3** depending on BIAS TYPE (Implicit Causality vs. Implicit Consequentiality) and CONGRUENCY (bias-congruent vs. bias-incongruent).

Further abbreviations: PERS = *personal pronoun*, DEM = *demonstrative pronouns and d-pronouns*, NAME = *(repeated) proper name*, OTHER = *other referring expressions*; SE = *stimulus-experiencer*; ES = *experiencer-stimulus*, AE = *agent-evocator*; S-GOAL = *subject-goal*; O-GOAL = *object-goal*

Sample item, Exp. 1

Exp. 1a: Mary/Martin fascinated/admired Jane/John because ...

Exp. 1b: Mary/Martin sold a car to/bought a car from Jane/John and so ...

References

[1] Ferstl, E. C., A. Garnham & C. Manouilidou (2011): Implicit causality bias in English: A corpus of 300 verbs, Behavior Research Methods 43(1): 124-135. • **[2]** Fukumura, K. & R. van Gompel (2010): Choosing anaphoric expressions: Do people take into account likelihood of reference? Journal of Memory and Language 62(1): 52-66. • **[3]** Rohde, H. & A. Kehler (2014): Grammatical and information-structural influences on pronoun production. Language, Cognition and Neuroscience 29(8): 912-927. • **[4]** Kehler, A. & H. Rohde (2013): A probabilistic reconciliation of coherence-driven and centering-driven theories of pronoun interpretation. Theoretical Linguistics 39(1-2), 1-37. • **[5]** Rosa, E. C. & J.E. Arnold (2017): Predictability affects anaphoric form: Thematic roles can affect reference form selection. Journal of Memory and Language 94: 43-60. • **[6]** Crinean, M & A. Garnham (2006): Implicit causality, implicit consequentiality and semantic roles, Language and Cognitive Processes 21(5): 636-648.