

Illusions of principle C reconstruction in ATB movement*

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1. Introduction

Across-the-board (ATB) movement forms an exception to the Coordinate Structure Constraint: Extraction from a coordinate structure is grammatical if the extractee is related to a gap in each conjunct. The exact relation between the extractee and each gap is controversial, however (for an overview, see de Vries 2017). Approaches either posit that material is extracted from only one of the conjuncts with ellipsis, operator movement or PF-deletion in the other (Salzmann 2012, Munn 1994, An 2007, Ha 2008); or that there is extraction from all conjuncts via parallel extraction (Williams 1978, Hein and Murphy 2020) or due to multidominance (Citko 2005); or that ATB is derived via sideward movement (Nunes 2001, Hornstein and Nunes 2002). There exist reports of principle C reconstruction targeting only the initial conjunct (Citko 2005, Salzmann 2012 contra Nissenbaum 2000). If this observation is correct, it would suggest that there is no element in the non-initial conjunct triggering a principle C violation. Verifying these data is of interest for at least for two reasons: First, because there is syntactic material matching the antecedent's properties in the non-initial conjunct in all approaches, therefore predicting no difference between conjuncts (vehicle change under ellipsis causing a principle B violation, pace Salzmann 2012, Ha 2008; the complete lack of syntactic material being unlikely due to morphosyntactic effects, see Georgi et al. to appear contra Larson 2013, 2014). Second, because there is reason to mistrust the validity of existing data given the persistent debate on the reconstruction of nominal PP modifiers for principle C (see Szarvas under review for a comparative evaluation). The following three experiments assess the pattern of principle C reconstruction in German ATB dependencies via coreference judgments.

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2. Testing principle C reconstruction in ATB movement experimentally

All experiments draw from the method and setup by Salzmänn et al. (2023) used in simple wh-dependencies and adapt it to ATB, with various modifications from experiment to experiment. All of them have the same 2x2 Latin Square design varying the factors GRAMFUNC (grammatical function of the extracted phrase, object or subject), and POSITION (of the conjunct containing the matching pronoun, initial or non-initial). Under subject extraction, the R-expression will never end up in the c-command domain of the object pronoun, whereas there should be a reconstruction effect under object extraction and a subject pronoun. A significant interaction between GRAMFUNC and POSITION would indicate that there is a reconstruction effect, and that it is uneven across conjuncts. A significant main effect of GRAMFUNC would indicate reconstruction to both gaps. A significant main effect of POSITION would indicate the involvement of linear factors, i.e. that the position of the pronoun determines the coreference pattern regardless of the pronoun c-commanding the base position of the extractee. All participants were native speakers of German raised with their native language only, recruited via Prolific, and provided monetary compensation upon completion of the experiment. Statistical modeling was carried out in R (R Core Team 2024) using generalized linear mixed effects models for binary data from the package *lme4* (Bates et al. 2015). The maximal model was fitted for all three data sets, including the interaction of the fixed effects and random intercepts and slopes by item and participant (Barr et al. 2013). The random effects structure was simplified in experiments 1 and 3.¹

2.1 Experiment 1: The maximal

In the first experiment, the original study's setup was modified such that each sentence was presented with a context introducing the referents.² In each trial, participants were presented with two yes-no questions: whether the pronoun could refer to the matrix referent (which should always be highly accessible) and whether it could refer to the embedded referent (which should yield a principle C effect in object conditions if there is reconstruction). There were 12 target sentences and 48 distractors including attention checks. 277 participants remained after exclusions (analyzing 831 observations per condition).

(1) a. Object, initial conjunct

Ich habe Helen gefragt, welchen Witz über Ute [sie ___ mitgehört] und
 I have Helen asked which joke about Ute she ___ overheard and
 [Mats ___ erfunden hat.]
 Mats ___ made.up has

¹In experiment 1 due to a perfect negative correlation of random effects for GRAMFUNC by item, and in experiment 3 because a likelihood ratio test using the *anova* function in R favored a simpler model.

²Context sentences mentioned all of the referents as a group (in the order in which they appeared, i.e. *Helen, Ute and Mats*) and a joint activity or a habit they shared that connected them to the events in the respective target sentence.

Illusions of Principle C Reconstruction in ATB Movement

'I asked Helen which joke about Ute she overheard and Mats made up.'

Can this sentence be understood such that...

... *Helen overheard a joke?*

yes no

... *Ute overheard a joke?*

yes no

b. **Subject, initial conjunct**

Ich habe Helen gefragt, welcher Witz über Ute [**sie** irritiert] und [

I have Helen asked which joke about Ute her irritated and

Mats amüsiert hat.]

Mats amused has

'I asked Helen which joke about Ute irritated her and amused Mats.'

Can this sentence be understood such that...

... *a joke irritated Helen?*

yes no

... *a joke irritated Ute?*

yes no

c. **Object, non-initial conjunct**

Ich habe Helen gefragt, welchen Witz über Ute [Mats erfunden] und [**sie**

I have Helen asked which joke about Ute Mats made.up and she

mitgehört hat].

overheard has

'I asked Helen which joke about Ute Mats made up and she overheard.'

Can this sentence be understood such that...

... *Helen overheard a joke?*

yes no

... *Ute overheard a joke?*

yes no

d. **Subject, non-initial conjunct**

Ich habe Helen gefragt, welcher Witz über Ute [Mats amüsiert] und [

I have Helen asked which joke about Ute Mats amused and

sie irritiert hat.]

her irritated has

'I asked Helen which joke about Ute amused Mats and irritated her.'

Can this sentence be understood such that...

... *a joke irritated Helen?*

yes no

... *a joke irritated Ute?*

yes no

Figure 1 illustrates inter-speaker variability in the direction and size of the effect of GRAM-FUNC. Data analysis revealed a significant main effect of GRAMFUNC and POSITION as well as a significant interaction between the two. That is, while the pronoun c-commanding the R-expression's base position is estimated to have an effect on coreference in both conjuncts (main effect of GRAMFUNC), the effect is particularly pronounced in the initial conjunct (interaction). The relevance of distance, whether it is structural or linear, is further shown by the significant main effect of POSITION, meaning that the model estimates that there is generally a decrease of coreference rate in the initial conjunct compared to the non-initial conjunct regardless of the factor GRAMFUNC. Notice that the coreference rates

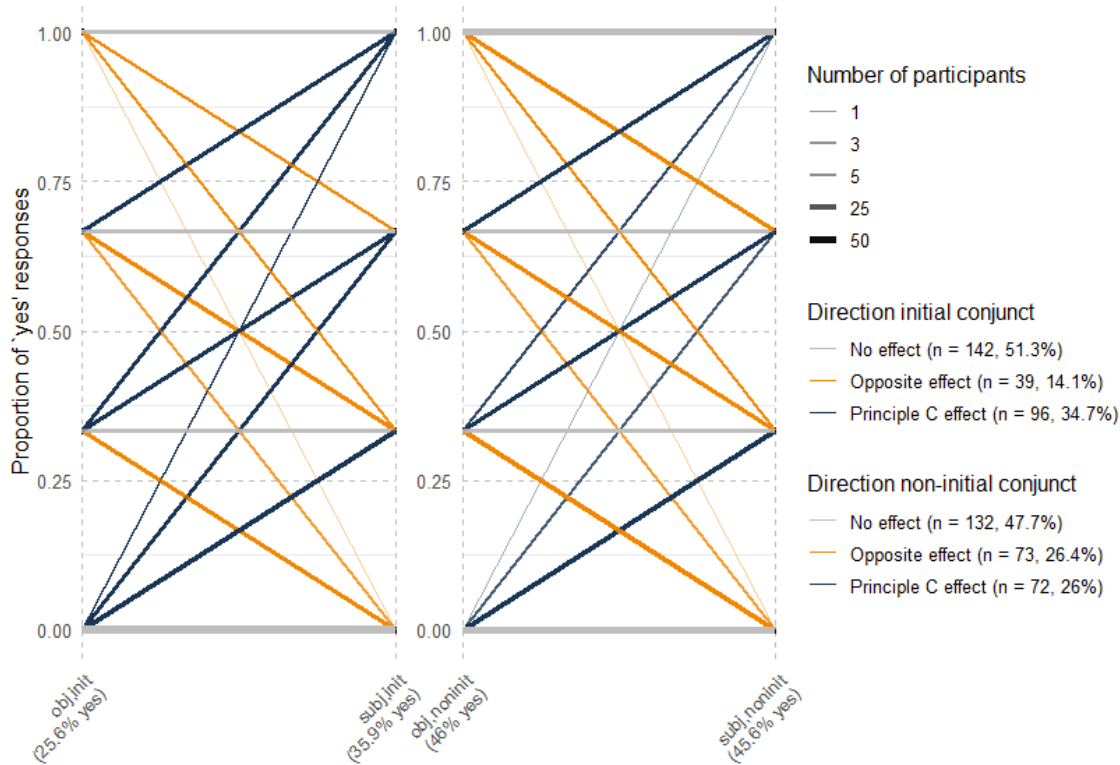


Figure 1: Individuals' ($n = 277$) overall proportions of responses indicating coreference with the embedded referent in experiment 1 by condition. Y-axis indicates proportion (0-1 by 0.33 based on 3 observations per participant per condition), lines connect individual participants' proportions in the object and subject conditions of the initial (l) and non-initial conjunct (r), respectively. Color indicates the direction of the effect (blue: subject > object, orange = subject < object, gray = subject = object), thickness and opacity indicate the number of participants. X-axis indicate overall percentage of yes responses in condition.

are very low in the subject condition where no syntactic violation is in sight, indicating the involvement of factors beyond principle C reconstruction in giving rise to the pattern.

2.2 Experiment 2: Simplified task

The second experiment eliminated the confound of using variable verbs between conditions by contrasting the pattern *which joke about Ute she found irritating* (object extraction) with *which joke about Ute irritated her* (subject extraction). Upon suspicion that task complexity could be responsible for surprisingly low embedded referent responses in the subject condition, participants were only presented with one question per trial assessing the possibility of coreference with the embedded referent for target items. Distractor items ensured that trials about the matrix and embedded referent were counterbalanced. This study fea-

Illusions of Principle C Reconstruction in ATB Movement

tured 24 targets, 32 pseudofillers (targets in a study reported in Szarvas under review) and 12 fillers. Data from 150 participants (900 observations per condition) were analyzed.

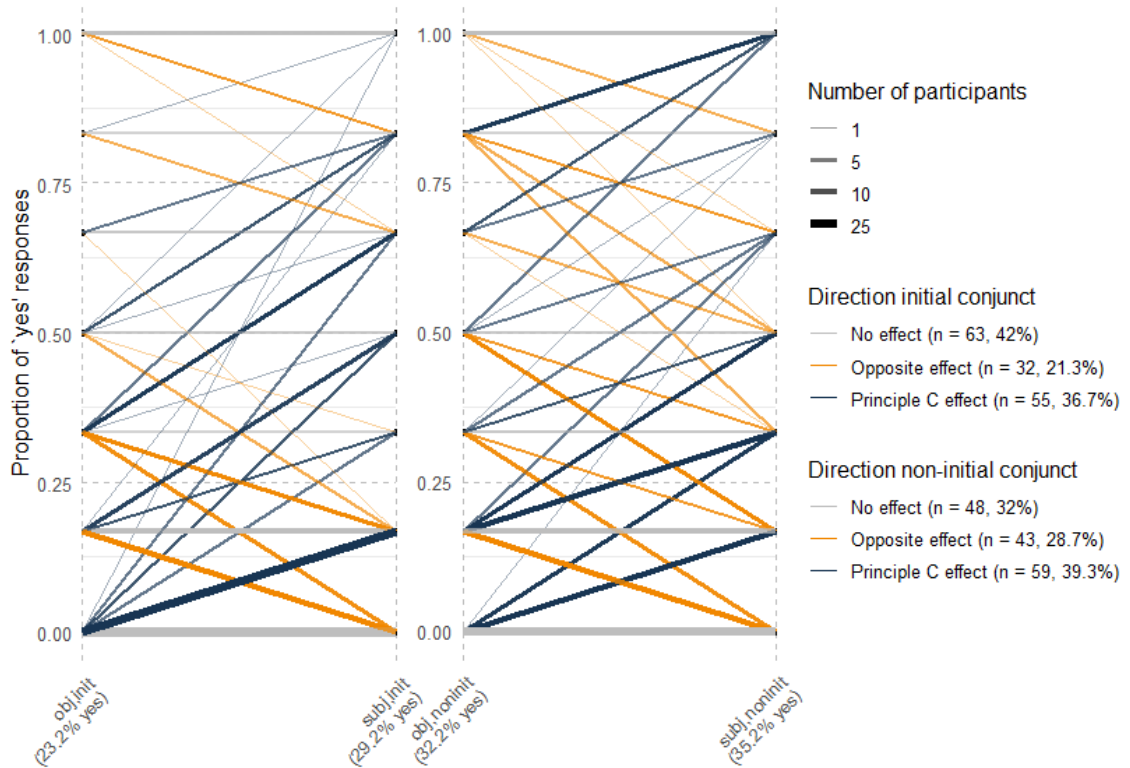


Figure 2: Individuals' (n = 150) overall proportions of responses indicating coreference with the embedded referent in experiment 2 by condition. Y-axis indicates proportion (0-1 by 0.167 based on 6 observations per participant per condition), lines connect individual participants' proportions in the object and subject condition of the initial (l) and non-initial conjunct (r), respectively. Color indicates the direction of the effect (blue: subject > object, orange = subject < object, gray = subject = object), thickness and opacity indicate the number of participants. X-axis indicate overall percentage of yes responses in condition.

Figure 2 illustrates inter-speaker variability in the direction and size of the effect of GRAMFUNC. Data analysis revealed a significant main effect of GRAMFUNC and POSITION without a significant interaction. That is, the pronoun c-commanding the base position of the R-expression is estimated to have an effect on coreference regardless of the position of the pronoun, and the position of the pronoun is estimated to have an effect on coreference regardless of the underlying c-command relations. These results indicate that the pattern is the same across conjuncts, notwithstanding that coreference is, again, lower in the initial conjunct overall regardless of GRAMFUNC. Notice that the task intended to increase the contrast between the conditions and instead further depressed coreference rates. Participants' comments show that this was caused by the task: trials inquiring about the embedded referent caused irritation due to the overwhelming prominence of the matrix referent.

2.3 Experiment 3: The minimal

The third experiment eliminated two crucial components of the item structure: There was no embedding sentence and thus also no context because there was no competing referent. These modifications were made upon suspicion that the presence of the matrix referent was too prominent, keeping participants from considering the embedded referent reading at all. Participants saw interrogative sentences (modified materials from experiment 2). The task was also altered so that participants had to respond to the prompt *What is this about?*, offering the reading coreferent with the embedded referent (*a joke that irritated Ute*) and an unnamed referent (*a joke that irritated someone else*) as response options. While the maximum response proportion was 100% per reading in experiments 1 and 2, in experiment 3, the proportion of responses indicating one reading depended on the proportion of respon-

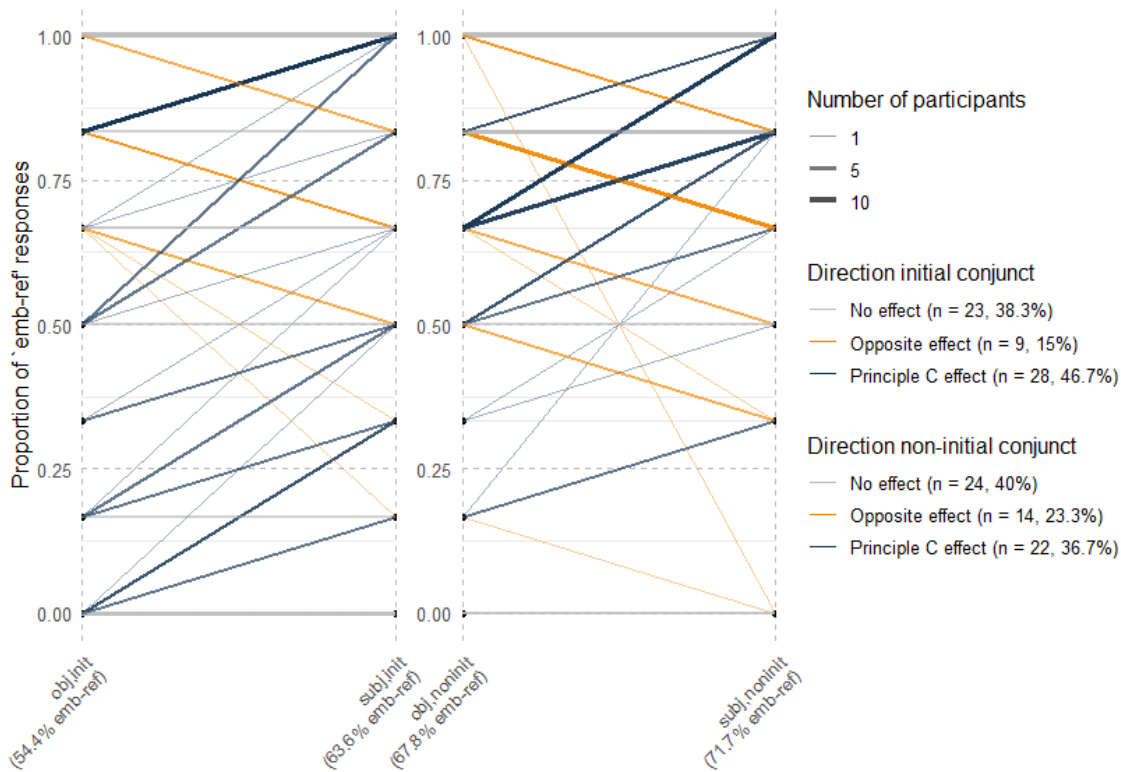


Figure 3: Individuals' ($n = 60$) overall proportions of responses indicating coreference with the embedded referent in experiment 3 by condition. Y-axis indicates proportion (0-1 by 0.167 based on 6 observations per participant per condition), lines connect individual participants' proportions in the object and subject conditions of the the initial (l) and non-initial conjunct (r), respectively. Color indicates the direction of the effect (blue: subject > object, orange = subject < object, gray = subject = object), thickness and opacity indicate the number of participants. X-axis indicate overall percentage of yes responses in condition.

Illusions of Principle C Reconstruction in ATB Movement

ses indicating the other reading. If there is no preference, proportions of 50% for each reading are expected. Again, there were 24 targets, 32 pseudofillers (cf. Szarvas under review). Data from 60 participants (360 observations per condition) were analyzed. Figure 3 illustrates inter-speaker variability in the direction and size of the effect of GRAMFUNC. Data analysis revealed a significant main effect of GRAMFUNC, indicating that there seems to be an effect of principle C reconstruction regardless of the position of the pronoun. That is, while the difference between the initial and the non-initial gap is not significant, the difference between subject and object extraction is significant in both conjuncts. Overall, coreference rates drastically increased compared to the two prior experiments, with participants picking the coreferent reading in the forced choice task above chance level. This is surprising considering that the two response options were dependent on one another given the change of task in this experiment to a single forced choice task between two possible readings. It illustrates that participants are highly biased to resolve pronominal reference with whatever morphosyntactically matching referent is available.

3. Discussion

The overall coreference rates obtained across conditions show the same pattern across experiments, see Table 1. The conditions can be ranked as follows (in increasing order of coreference chosen in across experiments, with a minor deviation of 0.4 in experiment 1): *object, initial* > *subject, initial* > *object, non-initial* > *subject, non-initial*. The data from

	<i>obj, init</i>	<i>subj, init</i>	<i>obj, noninit</i>	<i>subj, noninit</i>
Experiment 1	25.6%	35.9%	46%	45.6%
Experiment 2	23.2%	29.2%	32.2%	35.2%
Experiment 3	54.4%	63.6%	67.8%	71.7%

Table 1: Overall proportions of responses indicating coreference between pronoun and R-expression in PP modifier of wh-phrase in experiments 1-3.

the three experiments suggest the following: (i) The principle C reconstruction diagnostic using PP modifiers as in the previous literature on ATB movement does not support the conclusion that reconstruction only targets the initial conjunct. The fact that the interaction between GRAMFUNC and POSITION is significant in only one of the experiments (in addition to significant main effects of both) speaks against an underlying syntactic asymmetry between the conjuncts. (ii) Depending on the task and the experimental condition, the size of the participant group showing no effect at all or an effect in the opposite direction, i.e. an increase of coreference under object extraction compared to subject extraction, varies between 53.3 and 74%, indicating that the experiment is measuring something other than principle C reconstruction. (iii) The differences across experiments illustrate how sensitive coreference resolution is to the presence of context, a competing referent, and the phrasing of the experimental task. The findings are consistent with previous studies suggesting that the reconstruction of PP modifiers is compromised, although there is no unanimous explanation as to how this variability should be modeled (a comprehensive overview is given

in Szarvas under review). I conclude that the asymmetrical pattern observed with PP modifiers is a superficial phenomenon, with the increased distance between the R-expression and the pronoun in non-initial conditions being a more likely cause than syntactic structure. The evidence from this series of experiments is not conclusive regarding theories of ATB movement, it merely highlights that principle C reconstruction, at least of PP modifiers, is a poor choice to study underlying syntactic relations. The first takeaway from the experiments is the importance of including baselines to check whether the test is valid. Here, this was achieved by contrasting subject and object extraction, thereby manipulating whether pronoun c-commanded the base position of the R-expression, while keeping linear order constant. Such a comparison revealed that the position of the pronoun can have a significant effect regardless of underlying c-command relations. Previous reports in the literature only compared structures corresponding to the conditions *obj, initial* and *obj, non-initial*. The second takeaway is that in future research using principle C reconstruction as a tool to learn about complex dependencies, we need to overcome the issue posed by the compromised reconstruction properties of PP modifiers. The categories of adjuncts and arguments and their reconstruction have been subject to controversy for decades (and remain to be, see recent experimental work by Adger et al. 2017, Bruening and Al Khalaf 2019, Stockwell et al. 2021, 2022, Salzmann et al. 2023 and references therein). Possible alternatives include predicates (Heycock 1995, Adger et al. 2017, though they do not allow for controlled baselines) and verbal gerunds with small clause complements (Moulton 2009:51).³

- (2)
- a. Whose painting John_i nude does he_i resent ___ and Mary appreciate ___?
 - b. Whose painting John_i nude does Mary appreciate ___ and he_i resent ___?
 - c. Whose painting John_i nude ___ shocked him_i and ___ delighted Mary?
 - d. Whose painting John_i nude ___ delighted Mary and ___ shocked him_i?

The idea is that the accusative-marked argument of the gerund (*John*) cannot escape reconstruction via Late Merger (Lebeaux 1991) or Neglect (Sportiche 2016), forcing it to be interpreted in the c-command domain of the pronoun in (2a) if principle C reconstruction is asymmetric Citko (2005), Salzmann (2012), and in both (2a) and (2b) if it is symmetric Nissenbaum (2000).⁴ There should be no violation of principle C under reconstruction in (2c) and (2d), since the extracted phrase containing the R-expression is a subject and should therefore never end up in the c-command domain of the pronoun. Citko (2005) hypothesizes that the variability of reconstruction phenomena in ATB movement is caused not by some mysterious property of ATB movement, but due to the varying properties of reconstruction types themselves. It is quite likely that the compromised reconstruction status of PPs modifying NPs is responsible for the asymmetry. If examples like (2a-2b) could be shown to contrast with (2c-2d), there would be no need for theories to account for a difference between the two conjuncts of an ATB dependency. I leave this endeavour open for future research. To conclude, the type of data cited in the literature claiming principle C reconstruction of PP modifiers to be a window to the underlying syntax of ATB proved to be

³All conditions should ideally use the same verb, but animacy restrictions make this impossible.

⁴And argued by Munn (1994), who, however, only shows the symmetry of strong crossover effects.

inconclusive upon experimental scrutiny. While there seems to be an asymmetry between the two conjuncts, it also surfaces in the absence of a configuration where the pronoun c-commands the R-expression. The experiments reflect the weakening of the effect observed in simple wh-dependencies with both increased structural and linear distance (Adger et al. 2017, Salzmann et al. 2023, Stockwell et al. 2021). They further show that the acceptance of coreferent readings can get boosted in complex dependencies (compared to simple wh-dependencies tested with the same task, see Szarvas under review), indicating a bias to resolve pronominal reference (Gordon and Hendrick 1998). Future research targeting principle C reconstruction could focus on predicates and gerunds; while for ATB, the use of less controversial reconstruction phenomena, such as variable binding or crossover effects, may be more promising.

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