On reconstruction in German ATB-movement and the optimization of experimental designs

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This paper reports on an experimental study of principle C reconstruction in German ATB-movement. The results indicate that the previously reported asymmetry between the two conjuncts is due to distance between the referent and the pronoun. The findings suggest that principle C reconstruction is not suitable to probe into underlying syntactic structures, while prompting a discussion about experimental designs for coreference tasks. I hypothesize that binding phenomena in ATB-dependencies show different patterns due to their own nature, not some inherent trait of ATB-movement.

1. Introduction

In across-the-board (ATB) constructions, a single filler ('what') is related to multiple gaps in a coordinate structure ('does John like and Mary hate').

(1) [What] does John like ____ and Mary hate ____?

Approaches differ with respect to how each of the gaps is created. While they make clear predictions about (a-)symmetries between the conjuncts, the evidence is delicate and mostly based on individual judgments. Syncretism has been argued to ameliorate case mismatches (Dyła 1984; Franks 1995; Citko 2005; te Velde 2005), yet experimental evidence is argued to support this only for Polish (Rothert 2022), not for German (Hartmann et al. 2016). In English, variable binding, idioms and strong crossover are reported to behave symmetrically, but principle A and C as well as weak crossover induce violations only in the initial gap (Citko 2005; Salzmann 2012). Experimental evidence for English has challenged the claim that reconstruction for principle C is asymmetric (Bruening & Al Khalaf 2017), stressing the need to test the predictions of existing theories systematically to better understand and evaluate the evidence. In this paper, the focus is on principle C reconstruction in German ATB-dependencies. I will show that principle C reconstruction in German ATB-movement appears to display a weak asymmetry as reported

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for English, arguing that this is not due to the syntactic structure of ATB-movement, but the lack of robustness found in principle C reconstruction generally. I will conclude that principle C reconstruction is not a reliable test for the underlying structure of ATB-movement and that the differences between binding phenomena in ATB-movement arise from their own nature, rather than some eclectic properties of ATB-movement (as proposed for right node raising by Barros & Vicente 2011). The paper is structured as follows: section 2 provides some theoretical background on principle C reconstruction and ATB-movement. Section 3 presents the current experiment. Section 4 discusses previous reports on the properties of ATB-movement and how these should be viewed in light of the current experimental findings, as well as discussing the direction of future research on this matter. Section 5 concludes.

2. Background

2.1. Binding principle C reconstruction

Binding principle C states that a referring expression (R-expression) must be free (Chomsky 1981). For an R-expression to be bound, it needs to be c-commanded by the binder. Principle C rules out this binding relation resulting in disjoint reference between the R-expression and the c-commanding pronoun in (2).

(2) *He$_i$ says that Poirot$_i$ is leaving. (Haegeman 1994:226)

Coreference and binding are often treated as separate phenomena based on the observation that coreference does not require c-command, but binding does (Reinhart 1983a,b). Coreference can be specified in a discourse model and is available to R-expressions in addition to binding. This observation goes back to strict and sloppy readings in ellipsis, where sloppy readings arise due to binding and strict readings due to coreference (Sag 1976; Reinhart 1983b; Heim & Kratzer 1998). Nevertheless, some approaches maintain that coreference should too be regulated by the binding principles (Heim 2007; Bruening 2021).

(3) Gina called her mother. The teacher did, too.
   a. *sloppy reading:* 'The teacher called the teacher's mother.'
   b. *strict reading:* 'The teacher called Gina's mother.'

Coreference and binding possibilities in Ā-movement dependencies, such as wh-movement or topicalization, are sensitive to reconstruction. The displaced syntactic element is interpreted in a position it has occupied in an earlier cycle of the derivation, either an intermediate landing site or its base position. It is maintained that constituents reconstruct to their base positions for the evaluation of binding principle C, meaning that the constituents must obey the condition in their base positions, but can violate it in intermediate ones (Nissenbaum 2000; Sportiche 2017).

(4) a. *I wonder [whose picture of a successful athlete$_i$] he$_i$ reminded Bill that you saw ____.
   b. I wonder [whose comments about him$_i$] no one$_i$ reported ____.
(Sportiche 2017:16)

The observation that the pronoun cannot be bound by in (4-a) but can be bound in (4-b) indicates

that the wh-extracted object reconstructs to the internal argument position of the verb. While it is clear that the head noun reconstructs in such dependencies, it is highly debated how its complements behave. While the general consensus is that adjuncts do not reconstruct, researchers are divided with respect to whether arguments do, as reported in (5).

(5) a. *Which investigation of Nixon$_i$ did he$_i$ resent ____?
b. Which investigation near Nixon$_i$'s house did he$_i$ resent ____?

(Safir 1999:589)

The claim is as follows: in (5-a), the PP *of Nixon* reconstructs to the base position alongside the noun and yields a principle C violation, disallowing coreference with the pronoun and making the reading intended in (5-a) unacceptable. In (5-b), the PP *near Nixon's house* does not reconstruct to the base position, therefore no violation obtains and coreference between *Nixon* and the pronoun is possible. Under this view, there is a syntactic distinction between arguments and adjuncts of nouns (van Riemsdijk & Williams 1981; Freidin 1986; Barss 1988; Lebeaux 1988; Chomsky 1995; Sauerland 1998; Takahashi & Hulsey 2009). Other researchers have argued that (5-a) is acceptable as well, proposing that neither arguments nor adjuncts of the head noun reconstruct (Bianchi 1995; Lasnik 1998; Safir 1999; Kuno 2004; Henderson 2007). Both positions need to explain why (in some or all cases) only part of the complex NP is interpreted in the base position. The most prominent proposal explaining this phenomenon is adjunct or Wholesale Late Merger, where the complement is merged countercyclically (Lebeaux 1988, 1991; Takahashi & Hulsey 2009). More recently, it has been proposed that a syntactic mechanism achieving the observed results should be available by default, making it possible to interpretively ignore up to all occurrences of an interpretable syntactic object but one (Sportiche 2016, 2019). The question then remains whether this operation is exclusively available for adjuncts or all complements of a noun.

Experimental work on English led to mixed conclusions about the argument-adjunct asymmetry. Adger et al. (2017); Bruening & Al Khalaf (2019) conclude that neither arguments nor adjuncts reconstruct, while Stockwell et al. (2021, 2022) argue that principle C reconstruction is stable. All authors found that increasing the length of the dependency boosted coreference. It is to be noted that the conflicting claims may result from distinct designs, item complexity and item structure, but also from how individual researchers interpret the results. Because coreference and disjoint reference do not usually manifest in clear floor or ceiling effects, researchers often have to work with arbitrary thresholds when determining whether an effect is strong enough, especially when comparing surface principle C violations to underlying ones. The experimental study on German principle C reconstruction by Salzmann et al. (2023) attempted to tackle some of the non-syntactic and design-related issues. In the experiments reported therein, each item was accompanied by two forced choice tasks inquiring about the co-reference possibility with the R-expression in the displaced NP (called embedded referent in the following) or the R-expression in the matrix clause (called the matrix referent), respectively. Participants were explicitly asked about the possibility of coreference and were instructed to consider each reading carefully.

(6) Lisa erzählt, welche Geschichte über Hannah sie ____ ärgerlich
Lisa.NOM tell-3SG which story.ACC about Hannah.ACC she.NOM upsetting

fand.
find.PST.3SG
'Lisa tells (us) which story about Hannah she found upsetting.'
Can the sentence be understood such that...

a. ...Lisa found a story upsetting? yes/no (matrix referent)
b. ...Hannah found a story upsetting? yes/no (embedded referent)

Contrary to all previous studies in English, subject and object extraction was also contrasted in comparison to moved and unmoved conditions.

(7) Lisa erzählt, welche Geschichte über Hannah ____ sie verärgert
Lisa.NOM tell-3SG which story.NOM about Hannah.ACC she.ACC upset-3SG
hat.
have-3SG
'Lisa tells (us) which story about Hannah upset her.'

Participants indicated that coreference with the embedded referent, i.e. *Hannah*, was possible in 35.9% of the observations for items like (6), where reconstruction of the extracted phrase should yield a principle C violation. The coreference rate remained the same when the PP modifier was an adjunct. For items like (7), where reconstruction does not yield a violation, participants indicated the possibility of coreference in 50.8% of the observations, with a slight increase of 0.8% when the PP was an adjunct. The authors conclude that principle C is a soft constraint under reconstruction in German for both arguments and adjuncts.

In (6), the extracted constituent *welche Geschichte über Hannah* 'which story about Hannah' is the object of the verb in the embedded clause, while in (7), it is its subject. Studies comparing moved vs. unmoved conditions, i.e. surface vs. underlying principle C violations, predict a null effect under reconstruction, which is difficult to interpret. Confounds make it unlikely that an underlying principle C violation will elicit the same response as a surface violation. Contrasting subject vs. object extraction, however, allows for more straightforward predictions where a difference between the two conditions would indicate successful reconstruction. While the surface order of constituents is the same, the principle C violation only obtains in object conditions and should only occur under reconstruction. Subjects should show no such effects and always allow for coreference.

Before moving on to how this experimental design was adapted for studying the reconstruction pattern in ATB-movement, the following section outlines existing proposals to ATB-movement and discusses the reconstruction data reported in the previous literature.

2.2. Across-the-Board movement

Across-the-Board (ATB) constructions constitute a notable exception to the one-to-one mapping found across syntactic dependencies. In standard syntactic movement, a filler occupies a single position on the surface, i.e. the position at which it is pronounced, originating from a single base position where it leaves a gap. By this definition, every gap is related to exactly one filler. In ATB-constructions, on the other hand, a single filler appears to be related to more than one

gap.[1]

(8) [What] does John like ____ and Mary hate ____?

What serves as the direct object of one verb in each conjunct, a relation that cannot be created by a simple implementation of wh-movement. One strand of approaches to ATB-movement maintains that there is an instance of the filler moving from each gap, having to explain why only one filler is pronounced. Qualifying explanations are that the additional instance of the filler is deleted at Phonological Form (Wilder 1994; Biskup 2018), that the two instances fuse together over the course of the derivation (Ross 1967; Williams 1978; Hein & Murphy 2020), or that the structure is multidominant, meaning that there is only one instance of the filler, but it is dominated by multiple nodes at the same time, occupying multiple distinct positions at once (Williams 1978; Citko 2005; Bachrach & Katzir 2009). These approaches will be called symmetric in the following because they assume that sub-extraction targets all existing conjuncts symmetrically.

The second strand of approaches argues that there is only one instance of the filler in the derivation that is extracted from either one of the conjuncts, having to explain why there are multiple gaps. Proposals include empty operator movement (Munn 1992, 1993, 2001; Franks 1995; Bošković & Franks 2000) or *pro* (Zhang 2010) in the non-initial conjunct, while ellipsis has been proposed to target either the non-initial (Salzmann 2012) or the initial conjunct (Ha 2008). These approaches will be called asymmetric, for they postulate that material is extracted asymmetrically from only one of the conjuncts.

There is a third type of approach that is neither symmetric nor asymmetric, strictly speaking. A special type of movement is proposed where the two conjuncts are built in two independent work spaces, and the extracted constituent is only base-generated in the non-initial one, moving to the matrix CP through the initial conjunct (Nunes 2001). In a sense, this kind of sideward movement in ATB-constructions treats the initial gap site as an intermediate landing position. Notice that sideward movement gives up the assumption that the landing site needs to c-command the launch site of movement.

All of the approaches make straightforward predictions, and particularly clear ones for reconstruction, which should directly reveal the positions that were occupied by the extracted constituent over the course of the derivation. The puzzling observation is, however, that different types of interpretive tests are reported to yield different reconstruction patterns in ATB-movement. All following examples are taken from Citko (2005), but see also Salzmann (2012). Principle C violations are reported if the pronoun c-commands the initial gap, but not if it c-commands the non-initial gap, taken to indicate that material is only extracted from the initial conjunct. Under symmetric reconstruction to both gaps, the reading in (9-b) where *John* and *he* refer to the same individual would also be ruled out.

(9) a. *Which picture of John_i did he_i like ____ and Mary dislike ____?
b. Which picture of John_i did Mary like ____ and he_i dislike ____?

[1] ATB-dependencies can in principle involve infinitely many conjuncts. For the sake of conciseness, this paper only includes descriptions and examples of constructions with two conjuncts, but all concepts equally apply to dependencies with more conjuncts. In asymmetric approaches, no matter how complex the coordination, there is only one conjunct targeted by proper Ā-movement.

(Citko 2005:494)

Note that the validity of the principle C test rests on the assumption that PP arguments of nouns fully reconstruct. Strong crossover effects as in (10) obtain regardless of which conjunct the pronoun is in, meaning that the extracted material seems to cross over the pronoun in both cases.

(10) a. *Whose$_i$ mother did we talk to and he$_i$ never visit?
b. *Whose$_i$ mother did he$_i$ never visit and we talk to?

Variable binding likewise behaves symmetrically. The pronoun *his* in (11-a) is bound by *every Italian* in the first conjunct and *every Frenchman* in the second, yielding a strict reading. Ungrammaticality arises if there is no suitable binder in one of the conjuncts, as in (11-b) and (11-c), meaning that the extracted material must reconstruct into both conjuncts.

(11) a. Which picture of his mother did every Italian like and every Frenchman dislike?
b. *Which picture of his mother did every Italian like and Mary dislike?
c. *Which picture of his mother did Mary dislike and every Italian like?

Idiom interpretation (12) and scope reconstruction (13) is also possible in both of the conjuncts.

(12) a. Which picture did John take and Bill pose for?
b. Which picture did John pose for and Bill take?

(13) a. How many books did every student like and every professor dislike?
b. Seven books. (*how many* > *&* > *every*)
c. Student A liked seven books and Prof. B disliked two books; Student C liked nine books and Prof. D disliked four books. (*&* > *every* > *how many*)
d. Every student liked seven books and every professor disliked three books. (*&* > *how many* > *every*)

The different effects found with different types of binding in ATB-movement are puzzling, but note that experimental evidence for English has been argued to indicate symmetrical reconstruction for principle C after all (Bruening & Al Khalaf 2017). There is reason to assume that the introspective data reports may not be systematic enough to pinpoint the source of the observed patterns. The aim is to broaden the empirical coverage not only by providing more experimental data, but also data from different languages to assess potential cross-linguistic variability.

3. Experimental investigation

3.1. Method

To test if and how ATB-movement reconstructs for principle C in German, a coreference judgment experiment was designed. In each trial participants saw a sentence with three referents and a pronoun. The pronoun matched the features of the matrix and the embedded referent, yielding a principle C violation under reconstruction. Participants were given two forced choice tasks per item, asking about the possibility of coreference with either of the matching referents. Participants saw each item in only one out of the four conditions. Metalinguistic terms were

avoided by repeating the sentence with the intended reading (Salzmann et al. 2023). The task was untimed. Participants were instructed to read the sentences carefully, but to make decisions based on their first impression.

3.2. Participants

A total of 300 participants with mean age 31.2 (sd = 9.92) were recruited over Prolific. Participants were native speakers of German located in Germany with a monolingual upbringing and no language related disorders. The data from 33 participants were excluded from the analysis based on failed attention checks. All participants who successfully completed the study received monetary compensation, regardless of whether their data were used in the analysis or not.

3.3. Materials

The experiment only tested displaced nouns with PP arguments based on reports about a weak adjunct-argument asymmetry in German (Salzmann et al. 2023). Sentences involved a referent in the matrix clause ('I asked Julian…'), a displaced wh-phrase with a PP argument containing another referent ('… which idea of Arthur's…'), followed by the coordinate structure with two conjuncts, one of them containing a pronoun matching both referents ('… he explained…'), and the other a mismatched referent ('… and Iris misunderstood.'). The experiment manipulated two factors with two levels each: PHRASE, denoting the grammatical function of the displaced constituent with levels 'object' and 'subject', and POSITION denoting which conjunct the matching pronoun is in with levels 'initial' vs. 'non-initial'. The factors were fully crossed, yielding a 2x2 design, i.e. four conditions in total. Participants saw 12 target items, each appearing in only one of the four conditions, and 48 distractors. An example of a target item is given in (14).

(14) Ich habe Julian gefragt, [welche Idee von Arthur]…
I have-1SG Julian.ACC ask.PST which.NOM/ACC idea of Arthur.DAT
'I asked Julian which idea of Arthur's…

a. *object, initial*
er ____ erläutert und Iris ____ missverstanden hat.
he.NOM explain.PST and Iris.NOM misunderstand.PST have-3SG
…he explained and Iris misunderstood.'

b. *object, non-initial*
Iris ____ missverstanden und er ____ erläutert hat.
Iris.NOM misunderstand.PST and he.NOM explain.PST have-3SG
…Iris misunderstood and he explained.'

c. *subject, initial*
____ ihn angespornt und ____ Iris geschockt hat.
he.ACC motivate.PST and Iris.ACC shock.PST have-3SG
…motivated him and shocked Iris.'

d. *subject, non-initial*

____ Iris geschockt und ____ ihn angespornt hat.
Iris.ACC shock.PST and he.ACC motivate.PST have-3SG
. . . shocked Iris and motivated him.'

The logic of the design is as follows: reconstruction of the extracted constituent to the gap c-commanded by the pronoun should rule out coreference between the pronoun and the referent in the reconstructing phrase, i.e. *Arthur* in the examples above. The research question at hand is whether this effect occurs in both conjuncts, as predicted by symmetric extraction approaches, or only one of them, as predicted by asymmetric approaches. Each sentence was accompanied by a neutral context introducing the referents to avoid making either of them more prominent than the other. Making the referent in the matrix clause the direct object of *fragen* 'to ask' was a conscious choice to avoid prominence effects associated with subjects and topics (Cowles et al. 2007; Kaiser 2011), trying to minimize the factors distracting from the embedded referent.

3.4. Procedure

The experiment was set up through the platform L-Rex (Starschenko & Wierzba 2024). The sentences were displayed simultaneously with the context, the latter in italics. The two questions were shown below the sentence with the answer options 'yes', indicating coreference, and 'no', indicating disjoint reference. The first block included two training items in non-randomized order, showing sentences with two referents matching the pronoun, in one case allowing for coreference with both and in one case allowing for coreference with only one of them. The second block contained target items and fillers in pseudo-randomized order, such that two items from the same set of materials were never shown consecutively. The order in which the questions were presented was randomized. (15) illustrates how each trial was set up.

(15) Context:
Julian, Arthur und Iris arbeiten gemeinsam an einer Seminararbeit in Philosophie, wobei viele Unklarheiten entstehen.
'Julian, Arthur and Iris are doing coursework for their philosophy class together, during which a lot of confusion arises.'

Target:
Ich habe Julian gefragt, welche Idee von Arthur er erläutert und Iris missverstanden hat.
'I asked Julian which idea of Arthur's he explained and Iris misunderstood.'

Questions:
Kann der Satz so verstanden werden, dass Julian eine Idee erläutert hat? ☐ *ja* ☐ *nein*
'Can the sentence be understood such that Julian explained an idea?' ☐ yes ☐ no
Kann der Satz so verstanden werden, dass Arthur eine Idee erläutert hat? ☐ *ja* ☐ *nein*
'Can the sentence be understood such that Arthur explained an idea?' ☐ yes ☐ no

3.5. Predictions

In the following, the term 'coreference rate' indicates the proportion of yes-responses to the forced choice task asking about coreference with the embedded referent. For object conditions, there are three distinct reconstructions patterns predicted by the theories of ATB-movement. A symmetric approach where the displaced element is base-generated in and extracted from both conjuncts predicts no difference between the gaps, as shown in Figure 1 below.[2] The constituent should reconstruct symmetrically and a violation should obtain symmetrically as well. Again, disjoint reference was not expected to manifest in coreference rates close to 0% due to non-syntactic factors, but below chance level. No additional significant effects were expected since the position of the pronoun should be irrelevant.

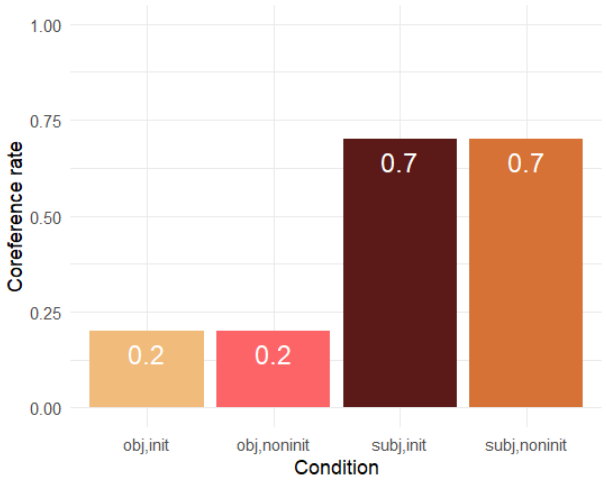

Figure 1. Predicted coreference rates if ATB-movement is symmetric, targeting all conjuncts.

In asymmetric approaches where the shared element only moves from the initial gap and is eliminated by some other operation in the non-initial gap, reconstruction should only target the initial gap, as shown in Figure 2. An empty operator or *pro* should circumvent a principle C violation and therefore, these approaches predict disjoint reference only in the condition 'object, initial'. In an ellipsis approach, the aforementioned asymmetric reconstruction pattern is predicted due to vehicle change under ellipsis, avoiding a principle C violation (Fiengo & May 1994). Here, a significant interaction between PHRASE and POSITION is expected.
The asymmetric approach where ellipsis targets the initial gap as well as sideward movement predicts that reconstruction should only target the non-initial gap. As visualized in Figure 3, coreference should be allowed in the condition 'object, initial' but not in 'object, non-initial'. Although the extracted element moves through the initial gap in sideward movement, based on the observation that principle C is only evaluated in base positions but not intermediate ones, the prediction is asymmetric (cf. Nissenbaum 2000; Sportiche 2017). Again, a significant interaction between PHRASE and POSITION is expected.

It is further to be noted that proximity effects may play a role. There are two conceivable ways in which they could impact coreference under reconstruction. First, the relative surface po-

[2] Figures 1,2 and 3 are dummy plots that do not depict previously observed or simulated data. The coreference rates are estimates based on the reports by Citko (2005); Salzmann (2012) and the experiment by Salzmann et al. (2023).

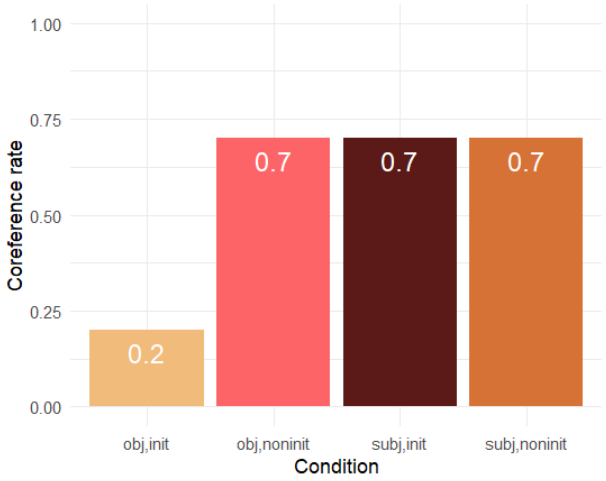

Figure 2. Predicted coreference rates if ATB-movement is asymmetric, targeting only the initial conjunct.

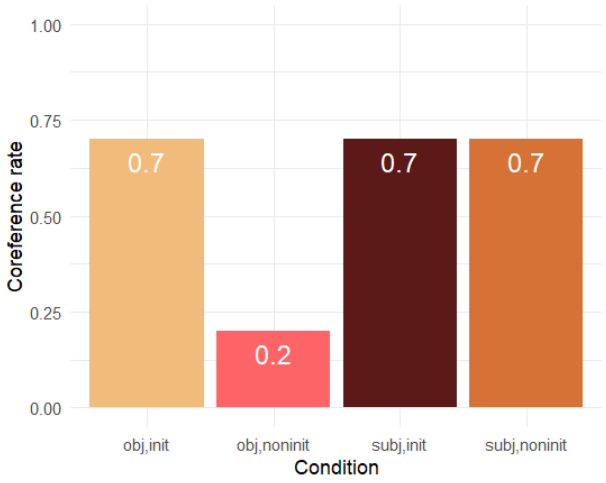

Figure 3. Predicted coreference rates in object conditions if ATB-movement is asymmetric, targeting only the non-initial conjunct.

sition of the referent and the pronoun could influence coreference, regardless of reconstruction. Authors diverge with respect to their hypotheses and findings. While for English, increasing linear and structural distance between the referent and the pronoun is argued to facilitate coreference equally (Adger et al. 2017; Bruening & Al Khalaf 2019), the opposite has been argued for based on recency effects (Salzmann et al. 2023). If it is recency that plays a role, decreasing the distance between the embedded referent and the pronoun should facilitate coreference. Second, it needs to be considered that in multi-gap-dependencies, the robustness of reconstruction could be affected by the distance between the filler and the gap. This could favor the initial gap due to proximity, which in turn would predict less coreference in the condition 'object, initial' than in the 'object, non-initial'. If the relative surface position plays a role, there should be a significant main effect of position. The proportion of responses will help determine whether the effect of proximity is positive or negative.

Notice that subject conditions are predicted to be constant with respect to allowing coreference with the embedded referent in the vast majority of cases. This is due to the lack of a principle C violating c-command configuration both in the underlying as well as the surface structure – the pronoun never c-commands the wh-phrase and its PP modifier. The value in collecting responses for these conditions lies in their ability to identify whether the experiment is valid, i.e. whether responses are actually guided by underlying c-command relations. If so, there should be no difference between the two subject conditions, and they should both elicit high coreference rates.

3.6. Results

Data from n = 277 participants was analysed.[3] Participants' attention and whether they understood the task was assessed through inspecting coreference rates with the matrix referent, i.e. one of the questions in target trials, as a sanity check. Failure to indicate coreference with the matrix referent in 25% of cases or more led to exclusion. This was taken to indicate that participants either responded based on preferences rather than possibilities, or that they did not complete the task responsibly. Figure 4 shows that in the overwhelming majority of cases and across conditions, the remaining participants correctly indicated that coreference between the pronoun and the matrix referent was widely possible, though not at ceiling.

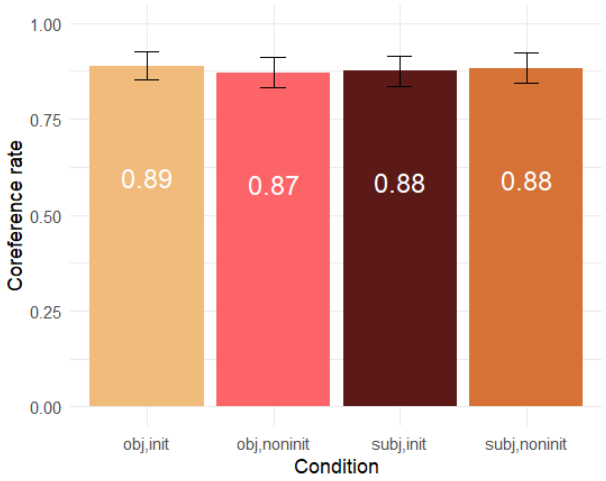

Figure 4. Observed coreference rates for the matrix referent across conditions. Error bars indicate standard error.

Concerning the research question about reconstruction in ATB-movement, coreference rates with the embedded referent are shown in Figure 5. In particular, the hypothesis that coreference should always be allowed in subject conditions is not borne out. Not only is the proportion below chance level in subject conditions, but crucially, coreference rates differ by 10% based on which conjunct the pronoun is in. Turning to object conditions, responses deviate from all possible predictions. Again, there is a clear difference between the condition testing reconstruction to the initial vs. the non-initial gap, but the contrasts are weaker than expected based on the

[3] The materials, analysis script and data can be viewed at https://osf.io/hf27s/ under *Experiment 1*.

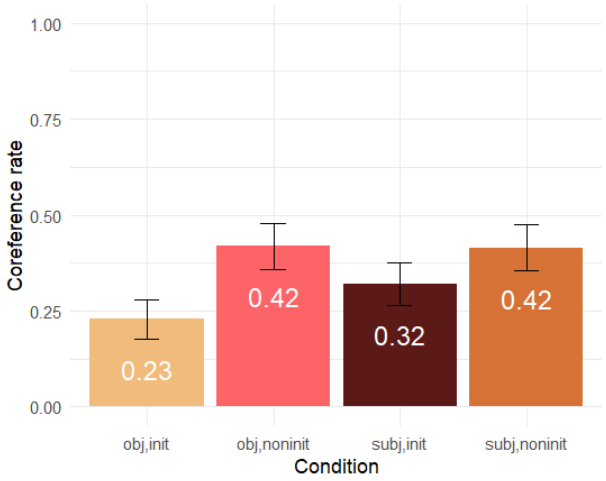

Figure 5. Observed coreference rates for the embedded referent across conditions. Error bars indicate standard error.

syntactic predictions. Participants found that coreference was possible more frequently when the pronoun was in the non-initial conjunct than in the initial one, but the proportions do not indicate a clear tendency towards coreference being ruled in or out by a syntactic constraint. The significant interaction between PHRASE and POSITION reveals that the contrast between subject and object extraction conditions only holds if the pronoun is in the initial conjunct. In the non-initial conjunct, this contrast vanishes completely.

The data was analyzed in R (R Core Team 2021) using a generalized linear mixed effects model through the function *glmer* with the family *binomial* (logit link) and the optimizer *bobyqa* (Bates et al. 2015). Modelling was carried out only for the task about the embedded referent due to the lack of theoretical value in hypothesizing about coreference with the matrix referent. A conservative α-level of 0.05 was defined. The model included fixed effects for both factors, PHRASE and POSITION, the interaction of the two, and a random effects structure with varying intercepts and slopes for both participants and items.

(16) rating $\sim$ phrase * pos + (1 + phrase + pos | item) + (1 + phrase + pos | participant)

The model estimates are reported in Table 1. Because the model had problems estimating random slopes and intercepts by item due to insufficient data, two more models were fitted. One of them attempted to address the issue by dropping the correlation between the random intercepts and slopes by item, the other one omitted the random effects structure by item altogether. Nevertheless, a likelihood ratio test revealed that the model reported in (16) has the lowest AIC out of the three and a significant p-value. The reported estimates are on the log-scale and factors are treatment contrast coded (levels 'initial' and 'subj' treated as the base, coded 0).

The model estimates a statistically significant main effect of PHRASE, i.e. subject vs. object extraction. It likewise estimates that the interaction between the factors PHRASE and POSITION is significant, and so is the main effect of POSITION. These significance estimates match the predictions of an asymmetric derivation of ATB-movement, however, the main effect of POSITION indicates that the surface configuration also plays a role.

GLMM	Estimate (SE)
(Intercept)	1.00^{***} (0.15)
phrase	0.73^{***} (0.19)
pos	-0.65^{***} (0.17)
phrase:pos	-0.77^{***} (0.19)
AIC	3157.94
Num. obs.	3048
Num. groups: participant	254
Num. groups: item	12
Var: participant (Intercept)	3.57
Var: participant phrase	0.06
Var: participant pos	1.05
Var: item (Intercept)	0.00
Var: item phrase	0.21
Var: item pos	0.06

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 1. Estimates of the generalized linear mixed effects model given in (16).

3.7. Discussion

The asymmetry in coreference rates between the initial and the non-initial conjunct across the factor levels of PHRASE likely results from relative surface order. There appears to be a proximity effect, though unclear if due to linear or structural proximity. It seems, in line with findings by Adger et al. (2017), that increasing the distance between the referent and the pronoun boosts coreference. The pattern is thus not a recency effect whereby the most recently mentioned referent relative to the pronoun is favored, since this wrongly predicts that coreference rates should increase in 'initial' conditions. Rather, we observe that increasing the distance has a positive effect, potentially because it allows the referent to *decay* in memory before a pronoun refers back to it. The interference of a mismatched referent in non-initial conditions may also make coreference more felicitous. Thus, the asymmetrical pattern reported for principle C reconstruction in ATB-movement could merely be a positive effect of distance rather than an indicator of the presence or absence of the displaced constituent in the underlying representation.

4. General discussion

The experimental findings indicate that the principle C reconstruction test in ATB-movement is inconclusive. The reason for this is, on the one hand, the weakness of the contrast between responses in the conditions 'object, initial' and 'subject, initial', and on the other hand, the presence of a contrast between the conditions 'subject, initial' and 'subject, non-initial'. The data suggest that the observed effect, though showing the same tendency as reported in the literature for English, is not due to asymmetric reconstruction to the initial gap and a corresponding syntactic derivation where extraction only targets the initial conjunct. Rather, it is the distance between the pronoun and the embedded referent that appears to cause this asymmetry based

on the presence of the effect in subject conditions where the offending c-command configuration is never obtained. The current findings are in line with the conclusions by Bruening & Al Khalaf (2017) from an experiment on reconstruction in English ATB-movement. The authors compared principle C effects in ATB-movement and Right Node Raising (RNR). The design compared surface violations of principle C in RNR to underlying ones under reconstruction in ATB, assuming that RNR does not *bleed* principle C (Levine 1985). Coreference rates in the RNR conditions were found to be around 5% and thus 20-25% lower than in ATB conditions. The authors conclude that the reported asymmetry is not real. For English, the contrast between the initial and non-initial gap is reported to be lower than found for German in the current experiment, suggesting that there may be cross-linguistic variability. Note, however, that comparing surface vs. reconstructed violations of principle C can be inconclusive due to the inherent instability of reconstruction, as addressed by the authors in more recent work (Bruening & Al Khalaf 2019).

Whether the proximity effects are due to linear or structural distance cannot be answered based on the ATB data – the linear order of the conjuncts always corresponds to their hierarchical order. However, the same paradigm could be adapted to parasitic gaps in German to tease apart the difference. Parasitic gaps are sharing constructions in which the licensing gap is in the matrix clause and the parasitic gap is in an adjunct clause, among other options. While the adjunct clause is more deeply embedded, it can be linearized in two different ways in German, allowing for the free manipulation of the surface order.

(17) a. Welches Gerücht über Arthur hat Iris ____
which rumour.NOM/ACC about Arthur.ACC have-3SG Iris.NOM
geglaubt ohne ihm *pg* zu erzählen?
believe.PST without he.DAT to tell.INF
'Which rumour about Arthur did Iris believe without telling him?'

b. Welches Gerücht über Arthur hat Iris, ohne
which rumour.NOM/ACC about Arthur.ACC have-3SG Iris.NOM without
ihm *pg* zu erzählen, ____ geglaubt?
he.DAT to tell.INF believe.PST
'Which rumour about Arthur did Iris, without telling him, believe?'

Although promising, some confounds make this test difficult to carry out experimentally. Because the relevant adjunct clauses in German do not introduce new subjects, instead of the subject-object contrast, one would have to switch to indirect vs. direct objects. This gives rise to new problems, such as gapless readings where the (di-)transitive verb in the adjunct clause is interpreted as intransitive. Further, the c-command relation between indirect and direct objects in German is debated (Grewendorf 1988; Featherston & Sternefeld 2003; Twiner & Lee-Schoenfeld 2019). An acceptability judgment experiment on German further found high inter-speaker variability for both aforementioned versions of parasitic gap constructions, finding them to be judged as marginal at best when the adjunct clause was extraposed (Szarvas to appear).

Moreover, it remains to be explored whether the presence of the matrix referent and the complexity of the experimental task have a depressing effect on coreference rates, particularly in the subject condition. To address this, the same experiment will be piloted twice with slight changes. In one pilot, the context, matrix referent and phrasing of the task will remain the same.

However, participants will only have to respond to one task in each trial. In target items, participants will always be asked about coreference possibilities with the embedded referent. Fillers will be used for counterbalancing, i.e. the respective trials will only inquire about the possibility of coreference with the matrix subject. In the other pilot, the matrix referent, embedding sentence and context will all be omitted. Participants will be given a general context applicable to all sentences and asked whether the pronoun refers to the embedded referent or 'someone else' (cf. Stockwell et al. 2021, 2022). Both of these pilots will include the experimental items tested by Salzmann et al. (2023) as pseudo-fillers, assessing how these factors influence not only ATB-dependencies but also regular wh-extraction. Lexical variability across conditions will also be eliminated by using psych verbs, contrasting the pattern 'X boreed Y' with 'Y found X boreful', X being the displaced constituent containing the embedded referent and Y the pronoun, instead of using distinct verbs (Salzmann et al. 2023). The prediction is that removing the matrix referent or merely the question about it from the experimental items should boost coreference at least in subject conditions. If the boost is observed across conditions again, this will further support the view that the pattern is not a result of a c-command-based principle C violation.

The anonymous reviewer points out that coreference rates are well below chance across all conditions, and they wonder whether any conclusions can be derived from interpretations that are unequivocally perceived as ungrammatical. I fully agree with this concern, though I think it remains an open issue whether the readings are indeed perceived as ungrammatical in this experiment. One step towards clarity may be to collect acceptability judgments either alongside the forced-choice task or integrating a Likert scale into the task (Stockwell et al. 2021, 2022).

Finally, given these current findings on ATB- as well as prior ones on regular wh-movement, there is a very simple preliminary explanation for why reconstruction patterns in ATB-movement seem to differ across phenomena. As noted in section 3, most types of binding show a symmetric reconstruction pattern, with principle C being one of the noteworthy exceptions seemingly only targeting the initial gap (Citko 2005; Salzmann 2012). The present data, in line with Bruening & Al Khalaf (2017), are taken to indicate that the alleged principle C effect in ATB-movement is not an effect of reconstruction. I hypothesize that this is due to the instability of principle C reconstruction in and of itself. On the one hand, it has long been noted that coreference or the lack thereof does not require c-command whereas binding does (Reinhart 1983a,b). On the other hand, even if we follow the idea that binding principles are responsible for regulating coreference as well (Chomsky 1981; Heim 2007; Bruening 2021), both prior as well as current findings support the view that PP arguments do not reconstruct alongside the head noun, as claimed by many (Bianchi 1995; Lasnik 1998; Safir 1999; Kuno 2004; Henderson 2007), rendering the principle C reconstruction test useless. The innovation of the current experiment is that the subject conditions serve as a sanity check, showing that surface order plays a crucial role in determining coreference patterns in ATB-dependencies. Given that proper binding, such as variable binding, is only possible under c-command, it should behave differently from principle C in ATB-dependencies and could supply the necessary evidence to determine whether extraction affects all conjuncts equally. The next step is thus to test the introspective judgments from the literature experimentally for other types of binding as well.

5. Conclusion

The presented experiment shows that the principle C reconstruction test in German is insufficient to make any claims about the underlying structure of ATB-movement. At the same time, it suggests that the asymmetry reported in English based on introspective judgments may be a more general proximity effect, in line with conclusions reached for English based on a different experimental design. The experiment provides evidence for the aforementioned claim by showing that coreference possibilities are affected by the alleged principle C violation even in cases where the offending c-command relation does not hold on the surface nor underlying level. This kind of comparison is entirely novel for ATB-movement. The data further suggest, together with previous studies on reconstruction in simple wh-dependencies, that the results of the principle C reconstruction test could be impacted by the experimental design, such as the availability of alternative referents and their prominence. To assess the relevance of these influences, I have proposed two further pilot studies. Future studies on ATB-movement should focus on types of binding that are reported to behave symmetrically to test these claims. Based on the data currently available, I hypothesize that the conflicting evidence is a result of conflicting requirements of different binding phenomena rather than the derivation of ATB-movement itself.

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Abbreviations

1SG	first person singular	INF	infinitive
3SG	third person singular	NOM	nominative
ACC	accusative	PST	past
DAT	dative		

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