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Experiments on Coreference in German and C-Command

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1 Introduction

This paper is part of a larger research program that seeks empirical evidence on the role the relation *c-command* plays in German syntax (see Webelhuth & Bader, 2021). The first part of the paper traces the theoretical developments that led to an increasing employment of *c-command* in the analysis of both English and German syntax. It is shown that in the 1980s and 1990s *c-command* became an important argument for syntactic constituency and in many cases even trumped the classical constituency tests of movement, pronominalization, and ellipsis, leading to substantive revisions of the sentence structures postulated for English and German. Against this background, the second part of the paper presents the results of two experiments that study the impact of *c-command* on coreference in German. This is done by comparing native speaker judgments on possible coreference in minimal pairs of sentences that only differ on whether a first nominal *c-commands* a second one or not.

2 Background: Syntactic Constituency

Grammatical theorizing in general and on German in particular has undergone important shifts within the past few decades. Traditional grammars typically focused on phonology and morphology and viewed syntax as the inflectional marking and the linearization of predicates, their arguments, and free adjuncts, where dependents and adjuncts were typically categorized by the grammatical functions of Latin grammar. Grammars of this kind in one way or the other contained a list of *Satzbaupläne* (sentence patterns) that made reference to the valence of the head predicate. Orthogonally, sentence structure was described in terms of so-called topological fields (prefield, left sentence bracket, middle field, right sentence bracket, final field), whose filling patterns were correlated with sentence types such as declarative main clause, dependent interrogative clause, etc. Syntactic phrase structure found scant explicit discussion. What were sometimes called “word groups” were recognized as the carriers of grammatical functions. Moreover, it was typically assumed that the left sentence bracket housing the finite verb in main clauses appears in second position and, consequently, that the words that jointly occur in the prefield form one grammatical unit.¹ Beyond this, phrase structure was not a prominent topic.

In the classificatory approach of structuralist linguistics, phrase structure received more attention and eventually even became the focus of linguistic theorizing in transformational grammar, where structure-changing rules like movement, ellipsis, and pronominalization were formulated in terms of syntactic constituents. Already early on, Chomsky explicitly argued that

* Please note that the first part of the paper contains footnotes because it was written by a linguist.

¹ The prefield test could not be subsumed under units that carry a grammatical function, since partial constituents, which lack a traditional grammatical function (e.g. a ditransitive verb with only one of its objects) can appear in the prefield. One work that did discuss constituency was Bech (1957). Bech analyzed the difference between coherently and incoherently combining verbs in terms of the formation of a verb cluster vs. the selection of a VP.

also the traditional grammatical functions of subject and object should be defined in terms of phrase-structural configurations, rather than being viewed as primitives. German grammarians working within generative grammar mostly followed these theoretical developments and postulated phrases like NPs and PPs on the basis of standard constituency tests. One phrase type that was controversially discussed in German linguistics in the 1980s was the VP (and to some extent the AP, where similar issues arise), with some authors arguing that the contrasts between English and German (freer phrase order, the topicalization of partial phrases) provide evidence against a finite VP constituent in German and others arguing that the contrasts between the two languages could be accounted for in terms of the existence of a scrambling rule that could rearrange constituents and extract them from the VP.²

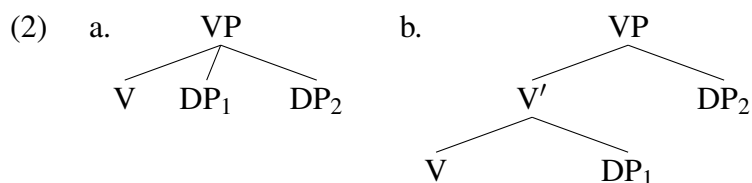
3 The Growing Importance of C-Command as Evidence for Syntactic Constituency

By the early 1990s, the discussions mentioned in the last section had abated, with most syntacticians working on German now making use of VP constituents. The discussion shifted to a different aspect of German phrase structure, namely the branching direction of phrases. In particular, the proper analysis of the right edge of verb phrases and sentences, as well as the status of extraposed constituents, became the focus of a theoretically and empirically interesting debate.

The German debate followed important developments in English syntax in the second half of the 1980s. Barss & Lasnik (1986) had investigated English double object constructions and had pointed out the existence of a number of asymmetries between the two objects, including interpretational asymmetries involving principles of the binding theory and quantificational binding. In particular, the first postverbal NP object can bind (into) the second one, whereas the reverse is impossible, as shown below:

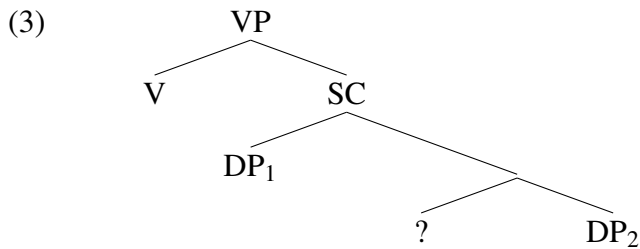
- (1) a. I showed [every friend of mine]_i his_i photograph.
b. *I showed its_i trainer [every lion]_i.

Barss & Lasnik discussed various analytical options of how to account for these asymmetries in terms of phrase structure and linear order, or a combination of the two. They pointed out that in both analyses below DP₂ c-commands DP₁, making it impossible to account for the asymmetries in terms of c-command alone:



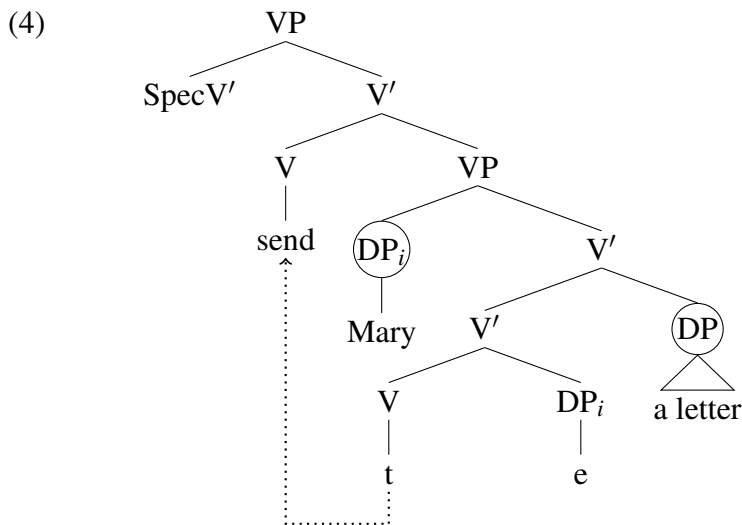
The authors end up defining the domain necessary for binding in terms of a combination of “c-command” and “precede”, even though this solution was in conflict with the view forcefully expressed in Reinhart (1976) and popular ever since that binding depends on c-command alone, without reference to linear order (setting aside relatively weak ordering preferences in discourse grammar). However, in a footnote, they discuss an analysis for the double object construction like the following, in which the first object asymmetrically c-commands the second one:

² See, among many others, Fanselow (1987), Haider (1982), and Webelhuth (1984).



They do not opt for this solution, writing that “[f]urther research is needed to determine whether it is appropriate to postulate such structures” (Barss & Lasnik, 1986: 351).

Larson (1988) took up Barss & Lasnik’s evidence for an asymmetric relationship between two co-argument objects in English and argued for the availability of systematically right-branching structures in English which are different from the structures that had previously been postulated.³ Larson fleshed out the schematic structure in (3) in the following manner:



(4) replaces the small clause constituent of (3) by a VP constituent headed by the ditransitive verb, which undergoes head movement to a higher “VP shell”. This gets the relative order of the verb and its complements right. At the point where the relative c-command relationship between the two complements (the circled nodes in (4)) becomes relevant for establishing, among others, binding potentials, the verb’s goal argument appears in the specifier of the lower VP and the patient argument in a position adjoined to the lower V’. Under the first-node-up definition of c-command, this entails that the first object asymmetrically c-commands the second one, as argued for in Barss & Lasnik (1986).

The other side of the coin is that these gains come at the expense of losing the correct predictions of the constituency tests involving movement, pronominalization, and ellipsis. The lower VP shell in (4) unambiguously fails all these “classical” tests.⁴

³ See Kayne (1994) and Pesetsky (1995) for other right-branching analyses of the English VP.

⁴ As Larson points out, however, coordination shows the reverse picture: unlike the traditional phrase structures for VPs, his structure (4) straightforwardly explains why the lower VP can be coordinated with another VP. This does not constitute a strong argument, however, as coordination is only a weak indicator of constituency. Under Larson’s structural assumptions, the coordination in the following sentence is predicted to be ungrammatical, contrary to fact, since the verb and its first object should not be able to form a constituent excluding the second object:

(i) The shop owner [loaned a book] and [sold a newspaper] to Mary.

The postulation of phrase structures like (4) thus entails a ranking of constituent tests: putative c-command-dependent phenomena are taken to be more important than the classical tests of movement, pronominalization, and ellipsis.⁵

4 C-Command and Branching Direction in German

It did not take long for the issue of binding asymmetries between co-argument objects to be brought up about German as well. The first lines of Haider (1992) read as follows:

There is a fact, easy to check and yet as puzzling as it is simple, that has not yet been fully appreciated: The VP-internal basic serialization patterns of non-verbal elements are cross-grammatically invariant. A particularly perspicuous case is the pattern of double object constructions with a directional PP. Both in OV- and in VO-languages the order is the one indicated in (5). Examples from two languages of each type are given under (6).⁶

(5) - IO - DO - PP -

- (6) a. daß sie jedem_i ein Paket an seine_i Privatadresse schicken werden (German)
 b. omdat ze iedereen_i een packje naar hem_i thuis zullen opsturen (Dutch)
 c. that they will send everybody_i a package to his_i home address
 d. at de forklarede hver deltager_i problemet på hans_i eget sprog (Danish)
 that they explained every participant the problem in his own language

Haider goes on to state:

Variable binding as illustrated in (6) and other **grammatical phenomena sensitive to c-command** point to the conclusion that the branching structure for OV- and VO-VPs must be the same. It is right-branching.⁷

Haider derives the suggested necessity of right-branching from a universal principle which he calls the *Branching Conjecture* whose effect he describes as follows:

The [Branching Conjecture] is a restriction on the branching of the main projection line with respect to the positioning of projected positions: They are projected on the left hand side of the projection line. **Thus any movement to the right is ruled out as well as basegenerated adjunction.**⁸

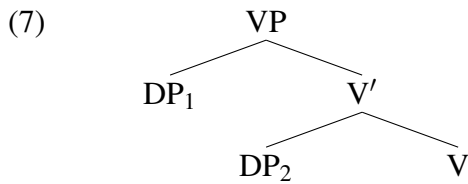
For SVO-languages like English and Danish, the Branching Conjecture enforces a right-branching tree geometry of the kind seen in (3) and (4), where the linearly first object asymmetrically c-commands the linearly second object. Where necessary, the relative surface order of the verb and its objects is achieved by head movement of the verb. As argued in the above-mentioned works of Barss, Lasnik, and Larson, this geometry accounts for the binding asymmetries between the two objects. For SOV-languages like German or Dutch, binary branching VP structures like the following are standardly assumed anyway and equally create the c-command asymmetry necessary to account for the data in (6):

⁵ Space limitations on the present paper prevent us from discussing in detail criticisms and rejoinders of the arguments in the main text. We can only give a few pointers to relevant literature and are aware that they are woefully incomplete. Jackendoff (1990) contains a systematic criticism of Larson's approach to double objects, to which Larson responded in Larson (1990). Barker (2012) and Bruening (2014) call into question the c-command analyses of quantificational binding and Principle C, respectively. We should also mention that starting with Reinhart (1983) there is a large literature arguing that Principle C effects can be derived from semantic and/or pragmatic principles and don't require any treatment in the syntax at all.

⁶ Throughout, we have adjusted the numbering of cited examples to the numbering of the present text.

⁷ Emphasis added and footnote omitted.

⁸ Emphasis added and footnote omitted.

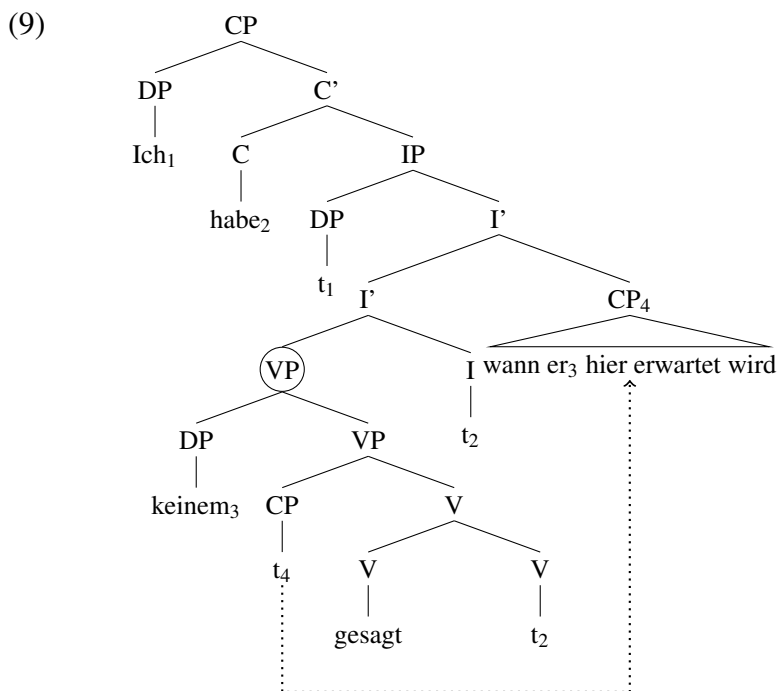


Haider's Branching Conjecture thus provides a uniform account of the binding data in SVO- and SOV-languages illustrated in (6). The right branching structure of the VP in both language types that is assumed to be universal leads to the first object asymmetrically c-commanding the second one.

However, as an invariant principle governing all phrase structures, the Branching Conjecture rules out a number of analyses that have traditionally been widely accepted among (German) syntacticians. A prominent case involves extraposition, as illustrated in (8):

- (8) *Ich habe keinem t_k gesagt, [CP wann er hier erwartet wird] $_k$.*
 I have nobody told when he here expected is
 'I told nobody when he is expected to be here.'

Under the traditional head-final analysis of the German VP, the CP to the right of the verb is assumed to be θ -marked in a position to the left of the verb. The structure in (8) then results from extraposition implemented as movement of the CP across the verb and adjunction to a higher projection, as shown below:⁹

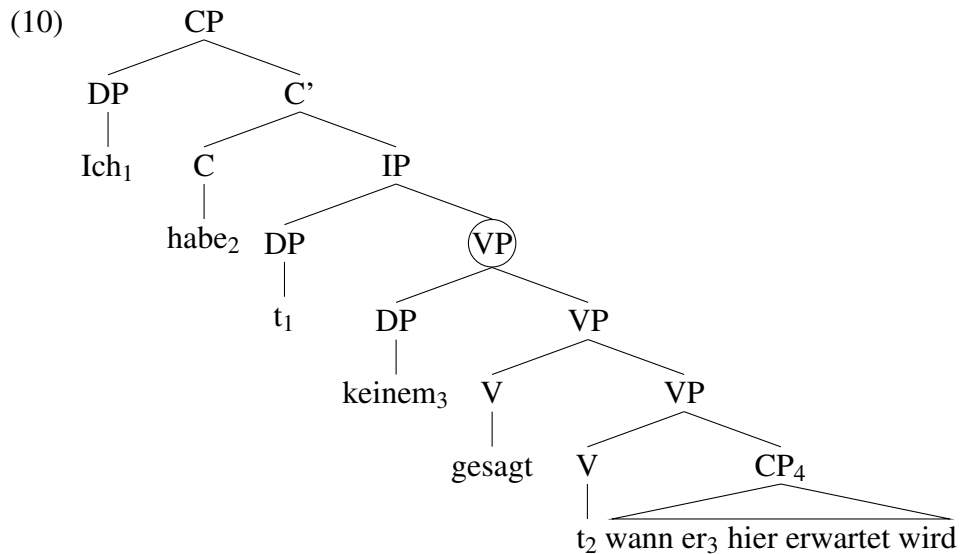


Clearly, the derivation and structure of this tree are forbidden by the Branching Conjecture, which rules out both rightward movement and rightward adjunction. As the correct analysis of

⁹ Under the assumption that finite verbs appear in a sentence-final I node in German (at some point of the derivation), the extraposed clause must be adjoined at least as high as I'. The evidence for this comes from the fact that extraposed clauses obligatorily follow all verbs, including the finite verb in the right sentence bracket:

- (i) dass ich bis jetzt keinem $_k$ gesagt *habe*, [wann er $_k$ hier erwartet wird].
 that I until now nobody told have when he here expected is
 (ii) *dass ich bis jetzt keinem $_k$ gesagt, [wann er $_k$ hier erwartet wird], *habe*.
 that I until now nobody told when he here expected is have

(8), Haider proposes the following strictly right-branching structure, which is in accord with the Branching Conjecture:



In this structure, the right-peripheral CP₄ is base-generated in what the author calls a “formal” complement position of the verb:¹⁰

This analysis changes the conception of “being extraposed”: it now means to be base-generated to the right of the rightmost verb position.

Besides the theoretical argument against (9) given above, Haider also presents an empirical argument against the high attachment analysis of the extraposed clause in (8). He points out that (9) creates the same binding-theoretic problem as the English tree (b) in (2) above: the quantified indirect object *keinem_i* does not c-command the extraposed clause in (9), because its c-command domain is upward-bounded by the circled VP-node and, hence does not c-command the pronoun *er_i* contained in that clause. This wrongly predicts that the quantifier should be unable to bind the pronoun, under the view held since Reinhart (1976) that quantificational binding presupposes surface c-command.¹¹

Büring & Hartmann (1997) defend the traditional structure in (9) by arguing that the rightward movement of CP₄ is A-bar movement and that this movement is undone by reconstruction before the binding principles apply. Since the trace of CP₄ is within the circled c-command domain of the quantified object in (9), binding of *er₃* by *keinem₃* is licensed under normal c-command.

Haider (1997: 116) counters the reconstruction argument by pointing out that if binding theory were to apply after reconstruction, it would be wrongly predicted that (11) should be as much a Principle C violation as (12) (both sentences are intended to mean “She did not tell him that she finds Max nice.”). In both cases, the subordinate CP has A-bar moved, to the left in (11) and to the right in (12). After reconstruction the structures should be indistinguishable, yet there is a clear contrast between the examples (the judgments are Haider’s):

¹⁰ Note that CP₄ appears as the right daughter of the lowest VP in (10). The Branching Constraint is stated in such a way that the lowest complement of the verb may be base-generated to its right.

¹¹ That quantificational binding requires c-command in German is claimed in Frey (1993), and Sternefeld (2006), among others. An empirical study of telescoping reported in Radó et al. (2019) found, however, that binding of pronouns by non-c-commanding quantifiers embedded in relative clauses is possible. Webelhuth (to appear) provides corpus evidence that pronominal binding is possible without c-command in German.

(11) [*CP Dass sie Max_i nett findet*]_j, *hat sie ihm_i nicht e_j gesagt.*
 that she Max nice considers has she him not said
 ‘She did not tell him that she finds Max nice.’

(12) **Sie hat ihm_i nicht e_j gesagt, [CP dass sie Max_i nett findet]*_j.
 she has him not said that she Max nice considers
 ‘She did not tell him that she finds Max nice.’

In addition, Haider (2010: 202) points out that in contrast to the argument clause in (12), R-expressions in extraposed adjunct and relative clauses do not trigger Principle C effects:¹²

(13) *Ich werde ihm_i nicht sagen, [wenn ich Karl_i sehe], [dass du Karl*_i suchst].*
 I shall him not tell when I Karl see that you Karl seek
 ‘I shall not tell him if I meet Karl that you are looking for Karl.’

In fact, the author demonstrates (Haider, 2010: 202) that Principle C also fails to apply in non-argument clauses which can be assumed to be in-situ:

(14) *Ich werde ihm_i, [wenn ich Karl_i sehe], sein Paket übergeben.*
 I shall him [if I Karl meet] his package hand-over
 ‘I will give his parcel to him when I see Karl.’

(15) *Man hat ihm_i, [obwohl / als Karl_i protestierte], den Zutritt verweigert.*
 they have him [although / when Karl protested] the admittance denied
 ‘They denied him the admittance although / when Karl protested.’

We add to this that there are also complement clauses where a pronoun in the middle field can naturally be interpreted as co-referential with a name in the extraposed clause:

(16) *Seine_i Eltern haben ihm_i immer noch nicht gesagt, [dass Karl_i adoptiert ist].*
 his parents have him still not said that Karl adopted is
 ‘His parents still have not told Karl that he was adopted.’

The experiments reported in this paper are part of a larger research effort that is designed to bring new evidence from German to bear on c-command-based arguments for sentence structure (see Weibelhuth & Bader, 2021 for arguments concerning extraposition). In the present paper, we deal with non-coreference effects. We present two acceptability experiments that were designed to measure non-coreference effects within clauses (Experiment 1) and across clause boundaries (Experiment 2). In the next section, we discuss prior experimental work on (non-)coreference to set the background for our own experiments.

5 Prior Experimental Work on Binding Theory

In the last twenty years, binding theory has been the subject of a growing body of experimental studies, addressing a variety of questions, ranging from the question of how grammar constrains coreference to questions concerning the on-line application of binding principles during first- and second-language processing (e.g., Gordon & Hendrick, 1997; Carminati et al., 2002; Harris & Bates, 2002; Sturt, 2003; Cunnings et al., 2014; Kush et al., 2015; Moulton & Han, 2018; Drummer & Felser, 2018; Patterson & Felser, 2019).

One of the earliest experimental studies testing whether binding theory correctly predicts participants’ coreference judgments is Gordon & Hendrick (1997). Gordon & Hendrick tested the acceptability of English sentences with co-referential names and pronouns in various structural configurations. Since our Experiment 1 is a replication of an experiment in Gordon & Hendrick (1997), we discuss this experiment in some more detail.

¹² For additional examples making this point, see Haider (1997: 149) and Wiltschko (1993: 28).

Table 1. Stimuli and results for Experiment 5 of Gordon & Hendrick (1997). The results show the mean ratings for each sentence on a scale from 1 (bad) – 6 (good)

C-c.	NP sequence	Question	No c-c.:	Who visited Lisa at college?
		C-c.:	Who did Lisa visit at college?	
No	Pronoun-pronoun	Her brother visited her at college.		5.19
No	Name-pronoun	Lisa's brother visited her at college.		5.25
No	Pronoun-name	Her brother visited Lisa at college.		3.36
No	Name-name	Lisa's brother visited Lisa at college.		3.91
Yes	Pronoun-pronoun	She visited her brother at college.		5.65
Yes	Name-pronoun	Lisa visited her brother at college.		5.43
Yes	Pronoun-name	She visited Lisa's brother at college.		2.63
Yes	Name-name	Lisa visited Lisa's brother at college.		3.18

The experiment solicited coreference judgments in eight configurations involving subjects and direct objects. In each case, one of these elements was a pronoun or a name acting as subject or object, and the other one a name or a pronoun acting as possessor within a complex subject or object DP. When the first element was the subject, it c-commanded the object and preceded it, when it was a possessor, there was linear precedence but no c-command. This experimental design made it possible to measure the effect of two factors on coreference judgments: (a) c-command vs. no c-command of the second element by the first one and (b) the noun types of the first and second elements in the four combinations pronoun-pronoun, name-pronoun, name-name, and pronoun-name. Together, this yielded eight different configurations. Respondents were asked to judge each sentence on a scale from 1 (bad) – 6 (good).

For further reference, we display the results obtained by Gordon & Hendrick (1997) in Table 1. Principle C has a clear effect, as expected from the theoretical literature on binding theory. When a name within the subject precedes but does not c-command a following name (as the direct object or its possessor), the judgment is 3.91. It drops to 3.18 when the first name makes up the whole subject which precedes and c-commands the second name. The same effect is found when the initial element is a pronoun (3.36 vs. 2.63). In addition to a Principle C effect, Gordon & Hendrick found three additional effects that do not follow from binding theory (but also do not contradict it). First, sentences that only differ with regard to the second element (pronoun or name) systematically show better judgments when the second element is a pronoun. These cases all get a judgment greater than 5, whereas the best sentence type with a name in second position only gets a judgment of 3.91. We refer to this effect as the *redundant name effect* in the following. Second, the *redundant name effect* is stronger in the Pronoun-Name configuration than in the Name-Name case (judgments of 3.36 vs. 3.91 in the no-command condition and 2.63 vs. 3.18 under c-command). We refer to this effect as the *linear order effect* in the following because this effect seems to be due to the unusual order of pronoun and name.¹³ Third, c-command also has an effect on sentences with a pronoun in second position. This *facilitating c-command effect* is the opposite of the Principle C effect

¹³ This is not to say that acceptability in general declines when a pronoun precedes its antecedent. A well-known case where this does not happen is provided by pronouns that are part of a preposed adverbial, for which highly acceptable pronoun-name sequences result, as shown among others by some of the other experiments of Gordon & Hendrick (1997).

– that is, acceptability is somewhat higher when the pronoun is c-commanded by the prior name or pronoun, with no significant difference between pronoun-pronoun and name-pronoun sentences.

In sum, Experiment 5 of Gordon & Hendrick (1997) confirms that violating Principle C of the binding theory leads to a strong reduction of acceptability. At the same time, the experiment yielded several effects that were not predicted by binding theory. As far as the effects revealed by Gordon & Hendrick's Experiment 5 are concerned, the grammar of German is similar to the grammar of English, so they should also occur in German. This prediction is tested in Experiment 1. A further aim of Experiment 1 was a methodological one. Gordon & Hendrick (1997) explicitly marked intended coreference in the stimuli presented to their participants whereas we do not. Should the results of Experiment 1 be similar to those of Gordon & Hendrick (1997), this would indicate that the computation of reference and coreference is an automatic process that works independently of explicit instructions. Based on the results of the first experiment, Experiment 2 investigates c-command relationships across clause boundaries.

6 Experiment 1

Experiment 1, which is a replication of Experiment 5 of Gordon & Hendrick (1997) for German, had two aims. The first aim concerns the effect of Principle C violations in German. Given the prior theoretical and experimental literature, violations of Principle C should drive acceptability down in German in similar ways as they do in English. How strongly Principle C violations affect acceptability, and how it relates to other factors governing the computation of coreference, is an open question however, which we address in Experiment 1.

The second aim of Experiment 1 was a methodological one. Gordon & Hendrick (1997) presented sentences with coreference made explicit by printing co-referential expressions in bold face and by explaining the concept of coreference in the instructions. In Experiment 1, in contrast, sentences were presented without any indication of coreference, and the instructions simply asked participants to judge sentences for their acceptability. The rationale for proceeding in this way was to make instructions as easy as possible, in particular by avoiding the inclusion of linguistic terms within the instruction. We expected that participants will nevertheless establish coreference relations because the computation of reference seems to be an automatic process triggered by the attempt to arrive at coherent sentence interpretations.

6.1 Predictions

As in Gordon & Hendrick's (1997) Experiment 5, each sentence contains two co-referential expressions, with the first one either c-commanding the second one or not. The two co-referential expressions are either subject or object, or they are embedded within the subject or object as a possessor of a complex NP [POSSESSOR [NOUN]]. The c-command relation between the two expressions is manipulated by varying the position of the complex NP. When the complex NP is the subject of the sentence, no c-command relation obtains between the two potentially co-referential items. When the complex NP is the object, c-command obtains. We next discuss the predictions that result from the work of Gordon & Hendrick (1997).

6.1.1 Predictions for No C-command Conditions (Complex Subject NP)

The example in (17) shows the conditions in which the subject is a complex NP and the object a simple NP.

- (17) *Context:*
Was Martin betrifft, habe ich Neuigkeiten.
'Concerning Martin, I have news.'

- a. *subject ±pro, object pronoun*

Sein/Martins Vater wird nächste Woche mit **ihm** segeln gehen.
 ‘His/Martin’s father will go sailing next week with him.’

- b. *subject ±pro, object name*

Sein/Martins Vater wird nächste Woche mit **Martin** segeln gehen.
 ‘His/Martin’s father will go sailing next week with Martin.’

The possessor within the complex subject NP as well as the object NP can be either a pronoun or a proper name. A possessor within the subject NP does not c-command the object, nor does the object c-command the subject-internal possessor. We therefore get the following predictions:

- Principle C effect: Due to the lack of a c-command relation, neither of the four possible combinations of name and pronoun contains a violation of Principle C, and acceptability should be equally high for all of them.
- Redundant name effect: Acceptability should be lower when the final NP, the object, is a name than when it is a pronoun.
- Linear order effect: Pronoun – name sentences should be less acceptable than all other sentences.

6.1.2 Predictions for C-command Conditions (Complex Object NP)

The examples in (18) show the conditions in which the subject is a simple NP and the object a complex NP.

(18) *Context:*

Was Martin betrifft, habe ich Neuigkeiten.
 ‘Concerning Martin, I have news.’

- a. *subject pronoun/name, object pronoun*

Er/Martin wird nächste Woche mit **seinem** Vater segeln gehen.
 ‘He/Martin will go sailing next week with his father.’

- b. *subject pronoun/name, object name*

***Er/Martin** wird nächste Woche mit **Martins** Vater segeln gehen.
 ‘He/Martin will go sailing next week with Martin’s father.’

Since in this case the sentence-initial proper name or pronoun is the subject NP, it c-commands the object. From this, the following predictions derive.

- Principle C effect: When the possessor within the object NP is a proper name, Principle C is violated. Given prior research on Principle C, this should lead to a drop in acceptability.
- Redundant name effect: Acceptability should be lower when the object is a name than when it is a pronoun.
- Linear order effect: Pronoun – name sentences should be less acceptable than all other sentences.

6.2 Method

6.2.1 Participants

Fifty-six students of an introductory course on English linguistics at the Goethe University Frankfurt participated in Experiment 1 during a regular class session. All participants had German as their native language.

Table 2. A complete experimental stimulus from Experiment 1

Context: Was Martin betrifft, habe ich Neuigkeiten. ‘Concerning Martin, I have news.’

No c-command (complex subject, simple object)

<i>Pronoun – pronoun</i> (<i>Subject [pronoun], object [pronoun]</i>)	Sein Vater wird nächste Woche mit ihm segeln gehen. ‘His father will go sailing next week with him.’
<i>Name – pronoun</i> (<i>Subject [name], object [pronoun]</i>)	Martins Vater wird nächste Woche mit ihm segeln gehen. ‘Martin’s father will go sailing next week with him.’
<i>Pronoun – name</i> (<i>Subject [pronoun], object [name]</i>)	Sein Vater wird nächste Woche mit Martin segeln gehen. ‘His father will go sailing next week with Martin.’
<i>Name – name</i> (<i>Subject [name], object [name]</i>)	Martins Vater wird nächste Woche mit Martin segeln gehen. ‘Martin’s father will go sailing next week with Martin.’

C-command (simple subject, complex object)

<i>Pronoun – pronoun</i> (<i>Subject [pronoun], object [pronoun]</i>)	Er wird nächste Woche mit seinem Vater segeln gehen. ‘He will go sailing next week with his father.’
<i>Name – pronoun</i> (<i>Subject [name], object [pronoun]</i>)	Martin wird nächste Woche mit seinem Vater segeln gehen. ‘Martin will go sailing next week with his father.’
<i>Pronoun – name</i> (<i>Subject [pronoun], object [name]</i>)	Er wird nächste Woche mit Martins Vater segeln gehen. ‘He will go sailing next week with Martin’s father.’
<i>Name – name</i> (<i>Subject [name], object [name]</i>)	Martin wird nächste Woche mit Martins Vater segeln gehen. ‘Martin will go sailing next week with Martin’s father.’

6.2.2 Materials

We constructed 32 experimental items for Experiment 1, with each item consisting of a context sentence followed by a target sentence. The target sentences appeared in eight conditions according to the factors *C-Command*, *Subject NP*, and *Object NP*. The context sentence was identical in all eight conditions. A complete experimental item is shown in Table 2. The factor *C-Command* varied whether the first referential expression c-commanded the second one or not. This was achieved by making either the subject NP or the object NP complex, where a simple NP consisted of just a pronoun or a proper name (e.g., *he/him* or *Martin*) and a complex NP consisted of a noun preceded by a possessive pronoun or a proper name (e.g., *his father* or *Martin’s father*). The factors *Subject NP* and *Object NP* contrasted NPs consisting of/containing a pronoun (e.g., *he/him* or *his father*) with NPs consisting of/containing a proper name (e.g., *Martin* or *Martin’s father*).

All context sentences started with the topic setting phrase *Was X betrifft* ‘As far as X is concerned’ followed by an unspecific statement like *there is news, I figured out something* or the like. All target sentences were simple main clauses with a finite auxiliary in verb-second position and the main verb in final position. The target sentences started with the subject and also contained one or two adverbial phrases and a prepositional object. While the target sentences investigated in Experiment 1 are structurally parallel to those of Experiment 5 of Gordon & Hendrick (1997), the context sentences were different. Our context was provided by a declarative clause, whereas the context was a question in Gordon & Hendrick’s Experiment 5. Gordon & Hendrick also ran a variant of Experiment 5 with no context at all. This experiment yielded results that were very similar to those of their Experiment 5.

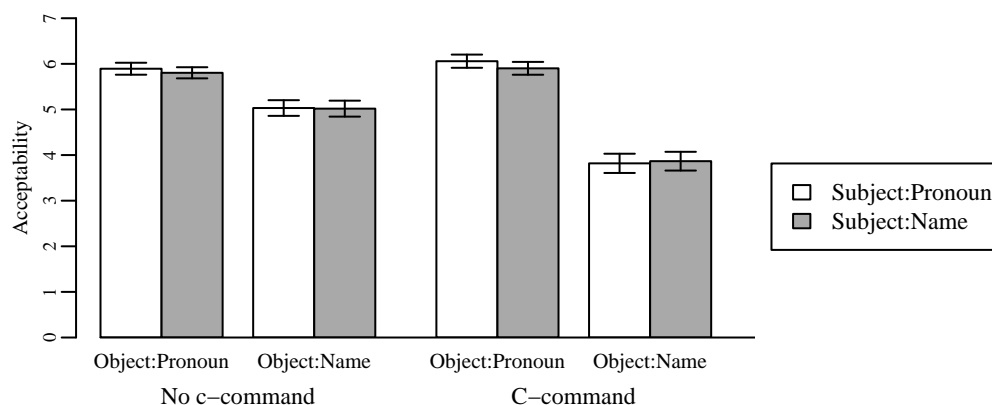


Figure 1. Mean ratings in Experiment 1; error bars show the standard error by participants

The 32 items were distributed across eight lists according to a Latin square design. Each list contained exactly one version of each sentence and an equal number of sentences in each condition. Each experimental list was combined with a list of 60 filler items that also consisted of two sentences. Part of the filler items were from an unrelated experiment. In the final lists, experimental items were always separated by at least one filler item.

6.2.3 Procedure

Eight questionnaires were constructed on the basis of the eight experimental lists. The experimental stimuli were randomized differently for each of the eight questionnaires. Participants completed the questionnaires as part of a regular class session. Participants rated the sentences on a scale from 1 (“completely unacceptable”) to 7 (“completely acceptable”). In contrast to Gordon & Hendrick (1997), intended coreference was not marked in our questionnaires. A short instruction on the first page of the questionnaire told participants that they should evaluate short texts, taking into account both the acceptability of individual sentences and the relationship between consecutive sentences. The concept of (co-)reference was not mentioned in the instructions in any way. Example sentences were not included in the instruction. Participants needed about 15–20 minutes to complete the questionnaire.

6.3 Results

All data presented in this paper were analyzed using the R statistics software (R Core Team, 2020). To test for significant effects, we analyzed the judgment data by means of ordinal mixed-effects models using the ordinal package (Christensen, 2019). We entered the experimental factors and all interactions between them as fixed effects into the model, using effect coding, that is, the intercept represents the unweighted grand mean and fixed effects compare factor levels to each other. In addition, we included random effects for items and subjects with maximal random slopes supported by the data, following the strategy proposed in Bates et al. (2015). Where necessary, simple contrasts were computed to compare mean values.

The results of Experiment 1 are shown in Figure 1. The corresponding ordinal mixed-effects model is shown in Table 3. As shown in this table, the main effects of the factors Subject NP and Object NP, the interaction between these two factors, and the interaction between C-Command and Object NP were all significant. All other effects were non-significant. In order to ease the discussion, Table 4 shows the mean acceptability values for the two significant two-way interactions.

Consider first the interaction between C-Command and Object NP. As revealed by Figure 1 and Table 4, sentences with a proper-name object were always judged as less acceptable than

Table 3. Ordinal mixed model fitted by maximum likelihood estimation for Experiment 1

	Estimate	Std. Error	z value	Pr(> t)
C-Command	-0.57980	0.15729	-3.69	< 0.001
Subject NP	-0.21266	0.12114	-1.76	< 0.1
Object NP	-2.31938	0.24348	-9.53	< 0.001
C-Command × Subject NP	-0.00632	0.18847	-0.03	n.s.
C-Command × Object NP	-1.73581	0.19777	-8.78	< 0.001
Subject NP × Object NP	0.52617	0.19194	2.74	< 0.01
C-Command × Subject NP × Object NP	0.14877	0.37643	0.40	n.s.

Table 4. Significant two-way interactions: Object NP × Complexity and Subject NP × Object NP

C-Command	Object NP		Subject NP	Object NP	
	pronoun	name		pronoun	name
no	5.85	5.03	pronoun	5.97	4.42
yes	5.98	3.84	name	5.85	4.44
Diff.	-0.13	1.19	Diff.	0.12	-0.02

sentences with a pronominal object, but the decrease in acceptability depends on the complexity of the subject. More precisely, sentences with a pronominal object (*him/his father*) received high ratings of about 5.9 on the 1–7 scale independently of whether the subject NP or the object NP was complex. When the object was non-pronominal (*Martin/Martin's father*), acceptability was reduced, but to different degrees depending on the position of the complex NP. When the subject was complex and the object was therefore not c-commanded by a co-referential NP, sentences with a proper name object received ratings that were about 0.8 lower than the ratings for sentences with a pronominal object. When the subject was non-complex and the antecedent therefore c-commanded the object, acceptability for sentences with a proper name object was about 2.1 units lower than for sentences with a pronominal object.

The second two-way interaction, the interaction between the factors Subject NP and Object NP, is more subtle. When the object was pronominal, sentences with pronominal subjects received slightly higher ratings than sentences with non-pronominal subject. In other words, pronoun-pronoun sequences were judged slightly better than name-pronoun sequences. When the object was non-pronominal, in contrast, there was basically no difference depending on whether the subject was pronominal or not. That is, pronoun-name and name-name sequences did not differ from each other.

6.4 Discussion

As discussed in Section 5, Experiment 5 of Gordon & Hendrick (1997) found a Principle C effect and three additional effects modulating the acceptability of sentences with intended coreference between a name and a pronoun. Experiment 1 replicates the Principle C effect and the redundant name effect. When a proper name followed its antecedent and was also c-commanded by it, resulting in a Principle C violation, acceptability was most strongly reduced. When a proper name followed a co-referential proper name or a pronoun without being c-commanded by its

co-referential NP, acceptability was also reduced, although not as strongly as in the case of a Principle C violation.

Two other effects found by Gordon & Hendrick were not replicated. First, we did not observe an effect of linear order in that pronoun–name sentences were not rated as less acceptable than name–name sentences. The absence of such an effect is possibly due to the fact that we used declarative context sentences, whereas the context sentences in Experiment 5 of Gordon & Hendrick (1997) were questions. This suggests a single speaker in our experiment but a speaker change in Gordon & Hendrick (1997) and, as pointed out in Gordon & Hendrick (1997), this speaker change brings the beginning of a new discourse segment with it. Starting a new discourse segment with a pronoun and then immediately returning to a name may be odd in terms of discourse grammar, therefore leading to some additional reduction in acceptability. A second effect found by Gordon & Hendrick (1997) that we did not replicate is the facilitating c-command effect on pronouns in name–pronoun and pronoun–pronoun sequences. For these sequences, no difference showed up depending on whether the second element was c-commanded by the first element or not. Why Gordon & Hendrick (1997) found such an effect whereas we did not must be left as an open question.

A further finding of Experiment 1 that was not present in Experiment 5 of Gordon & Hendrick (1997), was that pronoun–pronoun sentences were judged somewhat better than name–pronoun sentences. Given that all experimental items started with an introductory sentence containing a name (e.g., *Concerning Martin, I have news*), this means that repeating the name of the context sentence as subject of the target sentence was less acceptable than using a pronoun co-referential with the name. The lower acceptability of name–pronoun sequences can therefore be considered an instance of the repeated name penalty reported by Gordon et al. (1993). In Gordon et al. (1993), a repeated name penalty was observed for English texts when a name in subject position was co-referential with a name in the preceding clause, but only when the name in the first clause occurred in subject position, not when it occurred in object position. In our experimental materials, the first occurrence of the name was neither the subject nor the object of the initial sentence, but served the setting of a topic. This may be the reason why repeating the name had a very small effect, which still was significant however. For pronoun–name and name–name sequences, a repeated name penalty was not found. Since these are the conditions for which acceptability was already reduced for independent reasons, a small additional acceptability decrease due to repeating the name was probably not strong enough to be reflected in participants' ratings.

A final point to note is that although we found clear evidence that violating Principle C drives acceptability down, sentences violating Principle C still received mean acceptability values of about 3.8. On a scale from 1–7, this is very close to the scale's midpoint of 4. The corresponding value in Gordon & Hendrick (1997) was 2.9 on a scale from 1–6, which is somewhat further apart from the scale's midpoint of 3.5. When the 1–6 scale of Gordon & Hendrick is rescaled to a 1–7 scale, a value of 3.4 results, which is lower than the value obtained in Experiment 1, although the difference is small. Thus, the fact that coreference was not marked in our questionnaires and that the instructions asked for acceptability ratings without mentioning coreference or any related notion at all did not make a large difference in comparison with Gordon & Hendrick's Experiment 5, which explicitly asked for judgments of coreference. We therefore conclude that the sentences used in Experiment 1 triggered the automatic computation of coreference, so that participants' ratings reflect interpretations that are highly similar or even identical to interpretations based on explicit indications of coreference.¹⁴

¹⁴ One should also note that a sentence like *Peter met Peter's father* is not fully acceptable even when the two tokens of the name *Peter* refer to different individuals – after all, under this intended meaning the sentence would be ambiguous to an extent that makes it highly infelicitous.

In sum, there are two main conclusions to be drawn from Experiment 1. First, German is like English in that violating Principle C causes acceptability to decline, but also in that having a name as the second of two co-referential expressions reduces acceptability even in the absence of a c-command relation. Second, coreference can be investigated by simple acceptability ratings, that is, without explicit instructions and indications of coreference.

7 Experiment 2

In contrast to Experiment 1, which investigated the effect of Principle C on intra-clausal coreference, Experiment 2 investigates possible effects of Principle C across clause boundaries. As discussed in our review of c-command and branching direction in German, the attachment site of extraposed embedded clauses is a controversial issue. Since the attachment site is crucial for determining c-command between elements of the matrix clause and elements of the extraposed clause, the absence or presence of a Principle C violation can inform us about the phrase-structural position of different types of embedded clauses.

An uncontroversial violation of Principle C results when a proper name in a complement clause is co-referent with the subject of the main clause. Thus, sentence (19) should be substantially less acceptable with a possessive proper name than with a possessive pronoun within the embedded clause.

- (19) *Paul_i hat gesagt, dass Pauls_i/seine_i Freundin bald aus dem Urlaub zurückkehren wird.*
 Paul has said that Paul's/his girlfriend soon from the vacation return will
 'Paul said that Paul's/his girlfriend will soon come back from vacation.'

On the other hand, if coreference is intended to hold between two names and the two names appear in separate main clauses, no Principle C violation results for the simple reason that Principle C does not apply across independent clauses. Thus, binding theory does not predict any acceptability difference for (20) whether the possessive within the subject of the embedded clause is a proper name or a pronoun.

- (20) *Paul_i ist sehr glücklich. Pauls_i/Seine_i Freundin wird nämlich bald aus dem Urlaub zurückkehren.*
 Paul is very happy Paul's/his girlfriend will namely soon from the vacation
 zurückkehren.
 return
 'Paul is very happy. The reason is that Paul's/his girlfriend will soon come back from vacation.'

The two conditions considered so far serve as baseline when addressing the main question of Experiment 2: How do extraposed causal clauses introduced by the complementizer *weil* 'because' fare with regard to coreference? An example of the kind of causal clauses investigated in Experiment 2 is given in (21).

- (21) *Paul ist sehr glücklich, weil Pauls/seine Freundin bald aus dem Urlaub zurückkehren wird.*
 Paul is very happy because Paul's/his girlfriend soon from the vacation
 zurückkehren wird.
 return will
 'Paul is very happy because Paul's/his girlfriend will soon come back from vacation.'

As discussed above, the status of extraposed adverbial clauses with regard to binding theory is a controversial issue. According to Haider (2010), adverbial clauses are exempt from Principle C (see discussion of (13)), so acceptability should be equally high whether the subject NP of the *weil* clause contains the proper name *Paul* or the possessive pronoun *sein* ('his'). Thus, the acceptability of sentences as in (21) should be similar to the acceptability of sentences like (20) where the causal clause is a separate sentence. Of course, non-syntactic factors may

still cause a difference depending on whether the causal clause contains a proper name or a pronoun. In particular, the repeated name penalty discussed above may also show up here. Although this could affect embedded causal clauses as in (21) and independent causal clauses as in (20) in similar ways, it is also possible that repeating a name within a sentence or across sentence boundaries leads to penalties of different sizes. We therefore included sentences with two main clauses coordinated by the causal coordination *denn* ‘because’ as a further type of control sentences. An example is shown in (22).

(22) *Paul ist sehr glücklich, denn seine/Pauls Freundin wird bald aus dem Urlaub zurückkehren.*
 Paul is very happy because Paul’s/his friend will soon from the vacation return.

return

‘Paul is very happy because Paul’s/his girl friend will soon come back from vacation.’

Although (21) and (22) look almost identical and both have the same meaning, there is a crucial difference: the finite verb is in final position in the causal embedded clause in (21) but in verb-second position in the causal coordinated clause in (22). Due to the coordination structure, the first occurrence of *Paul* does not c-command the second one, and accordingly a Principle C violation is not predicted for (22). Thus, acceptability should be identical for sentences (21) and (22) if adverbial clauses are exempt from Principle C.

Even if adverbial clauses are not exempt from Principle C, it must be considered an open question whether extraposed causal clauses result in a Principle C violation or not. As discussed in Section 4, the prediction of a Principle C violation depends on the attachment site of the *weil* clause. Since the first occurrence of the name *Paul* is located in SpecCP, it c-commands \bar{C} and everything below \bar{C} . Thus, if a Principle C violation is observed this would provide evidence that the *weil* clause is adjoined below CP.

In sum, according to binding theory, Principle C is violated by a proper name possessor in *dass* ‘that’ clauses but neither in coordinated *denn* ‘because’ clauses nor in separate main clauses. The prediction of the binding theory for embedded *weil* ‘because’ clauses depends on specific assumptions about the phrase-structural position of adverbial clauses. Sentences with a possessive pronoun should be acceptable throughout and thus serve as base line.

7.1 Method

7.1.1 Participants

Fifty-six students from the same population as Experiment 1 participated in Experiment 2 using the same questionnaire-based sentence rating procedure. No participant had participated in Experiment 1.

7.1.2 Materials

For Experiment 2, we created 40 experimental items as illustrated in Table 5. Each item consisted of an introductory context sentence followed by a continuation consisting of two clauses which either formed a single sentence or two separate sentences. All continuations appeared in eight versions according to the three factors *Subject NP* (pronominal versus proper name possessor), *Embedding* (main-embedded versus main-main), and *Connectedness* (strongly connected versus weakly connected).

In contrast to Experiment 1, the context sentence did not introduce a referent taken up in the continuation. Half of the experimental items were introduced by the context sentence *Es gibt endlich mal wieder Neuigkeiten*. ‘Finally, there is news.’, the other half by the context sentence *Ich habe endlich mal wieder etwas Neues erfahren*. ‘Finally, I got some news.’ The

Table 5. A complete experimental stimulus from Experiment 2

Context:	Es gibt endlich mal wieder Neuigkeiten. ‘Finally, there is news.’
Target sentence(s)	
<i>Main clause – embedded clause</i>	
+Connected	Paul hat gesagt, dass seine/Pauls Freundin bald aus dem Urlaub zurückkehren wird. ‘Paul said, that his/Paul’s girlfriend will soon come back from vacation.’
–Connected	Paul ist sehr glücklich, weil seine/Pauls Freundin bald aus dem Urlaub zurückkehren wird. ‘Paul is very happy because his/Paul’s girlfriend will soon come back from vacation.’
<i>Main clause – main clause</i>	
+Connected	Paul ist sehr glücklich, denn seine/Pauls Freundin wird bald aus dem Urlaub zurückkehren. ‘Paul is very happy because his/Paul’s girlfriend will soon come back from vacation.’
–Connected	Paul ist sehr glücklich. Seine/Pauls Freundin wird nämlich bald aus dem Urlaub zurückkehren. ‘Paul is very happy. The reason is that his/Paul’s girlfriend will soon come back from vacation.’

main reason for including a context sentence was to have participants rate short texts instead of single sentences.

The continuation had either the form "main clause – embedded clause" (main-embedded) or "main clause – main clause" (main-main). In the condition main-embedded, the main clause either contained the verb *sagen* ‘say’ and the embedded clause was a complement clause introduced by *dass* ‘that’, or the main clause contained a predicative and the embedded clause was a causal clause introduced by *weil* ‘because’. The embedded clauses were identical across conditions with the exception of the complementizer (*dass* or *weil*). In the condition main-main, the two clauses were either two main clauses coordinated by the causal coordinator *denn* ‘because’ or two independent main clauses. A causal coherence relation was established between the main clauses by the discourse marker *nämlich* ‘lit. namely’. For lack of a better term, we will distinguish between the two subtypes of main-embedded and main-main items by the factor name *Connectedness*, with *dass* and *denn* items being strongly connected within their respective condition and *weil* and separate main clauses being weakly connected. In terms of lexical content, the second clause was identical across all four combinations of the factors Embedding and Connectedness. The first clause was also identical with the exception of the condition main-embedded/strongly connected (‘that’ clauses), which needed a verb selecting a complement clause.

7.1.3 Procedure

Eight questionnaires were constructed from the materials of Experiment 2, proceeding in the same way as for Experiment 1. The number of filler sentences was again 60. Participants filled out the questionnaire during a regular class session.

7.2 Results

Figure 2 shows the results of Experiment 2. The corresponding ordinal mixed-effects model is summarized in Table 6. As shown by Figure 2, sentences with a possessive pronoun within

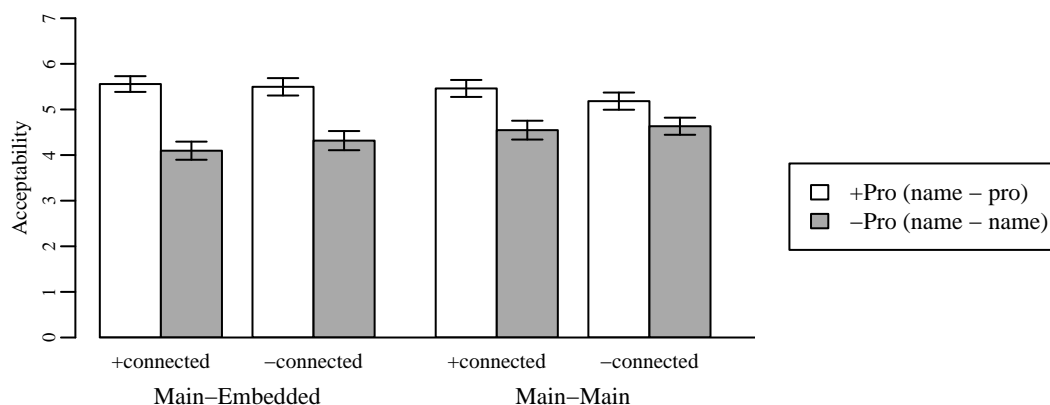


Figure 2. Mean ratings in Experiment 2; error bars show the standard error by participants

Table 6. Ordinal mixed model fitted by maximum likelihood estimation for Experiment 2

	Estimate	Std. Error	z value	Pr(> t)
Possessive	1.77892	0.29244	6.083	< 0.001
Embedding	0.07612	0.08086	0.941	n.s.
Connectedness	0.00411	0.08108	0.051	n.s.
Possessive × Embedding	-0.90280	0.16232	-5.562	< 0.001
Possessive × Connectedness	0.56034	0.16215	3.456	< 0.001
Embedding × Connectedness	0.33644	0.16189	2.078	< 0.05
Possessive × Embedding × Connectedness	0.30260	0.32368	0.935	n.s.

the subject NP of the second clause (name-pronoun sentences) were always rated better than sentences with a possessive proper name in place of the possessive pronoun (name-name sentences). Statistically, this is reflected in a significant main effect of the factor Possessive. As also revealed by Figure 2, the distance between name-pronoun sentences and name-name sentences decreases when going from left to right, that is, from embedded complement clauses to independent main clauses. Statistically, this decrease is reflected in all three two-way interactions being significant. In order to ease the discussion of the interactions, Table 7 shows the mean values corresponding to each two-way interaction.

Consider first the interaction between Possessive and Embedding. As can be seen in Figure 2 and Table 7, the difference between name-pronoun and name-name items is larger when the second clause is an embedded clause (diff. = 1.3) than when it is a main clause (diff. = 0.7). Second, the difference between name-pronoun and name-name sentences is larger for more tightly connected clauses (strongly connected; diff. = 1.2) than for less tightly connected clauses (weakly connected; diff. = 0.8). The final interaction is the one between Embedding and Connectedness. This interaction, which is barely visible in Figure 2, reflects the finding that the type of the second clause has a small effect in the case of strongly connected clauses (diff = -0.2) but no effect on weakly connected clauses (diff. = 0).

Table 7. Significant two-way interactions in Experiment 2: Object NP × Complexity and Subject NP × Object NP

	Embedding		Connectedness			Connectedness		
Possessive embedded	main		Possessive strong	weak		Embedding strong	weak	
pronoun	5.5	5.3	pronoun	5.5	5.3	embedded	4.8	4.9
name	4.2	4.6	name	4.3	4.5	main	5.0	4.9
Diff.	1.3	0.7	Diff.	1.2	0.8	Diff.	-0.2	0

The joint effect of the three interactions is that the difference between name-pronoun and name-name sequences increases when going from embedded complement clauses to independent main clauses, with the two types of causal clauses in between:

- ‘that’ clause (main-embedded, strongly connected): diff = 1.46
- embedded ‘because’ clause (main-embedded, weakly connected): diff = 1.18
- coordinated ‘because’ clause (main-main, strongly connected): diff = 0.92
- separate sentences (main-main, weakly connected): diff = 0.55

7.3 Discussion

As discussed in the introduction to Experiment 2, interpreting a name in a complement clause as co-referential with a name in the main clause results in a Principle C violation. This Principle C violation was clearly visible in the results of Experiment 2. With a mean rating of about 4, sentences violating Principle C received ratings similar to those for sentences violating Principle C in Experiment 1. When the names appear in two independent sentences, no Principle C violation results because Principle C does not apply across sentence boundaries. Nevertheless, Experiment 2 found a small decrease in acceptability for name-name sequences in comparison to name-pronoun sequences even when the second name occurred in a separate sentence. We surmise that this is another instance of the repeated name penalty found by Gordon et al. (1993) and also visible in Experiment 1.

The main question asked by Experiment 2 concerned the acceptability of co-referential names in causal clauses, which can either be embedded (*weil* clauses) or coordinated (*denn* clauses). The acceptability of embedded causal clauses (‘*weil* clauses’) was found to be in the mid of complement (*that* clauses) and coordinated causal clauses (*denn* clauses), which in turn were less acceptable than separate main clauses. Binding theory with its emphasis on c-command is compatible with these results if we assume that both types of embedded clauses are located below CP so that they are c-commanded from the first name in SpecCP. Embedded clauses would then cause a Principle C violation, whereas non-embedded clauses would not, in accordance with the significant factor of Embedding. However, it also clear that Principle C alone cannot explain the full result pattern. In particular, the significant factor of Connectedness defies a (straightforward) explanation in terms of c-command and Principle C. Our results do not suggest that adverbial clauses are exempt from Principle C, but it still seems to be the case that a principle C violation involving an adverbial clause is somewhat less severe than one involving a complement clause.

In Experiment 2, the first name was in SpecCP and thus in the position with the widest c-command domain. In order to narrow down the attachment site of extraposed clauses, we are currently preparing a follow up study in which the first name is in a lower position. In one

experiment, the first of two names will appear as object of the main clause, as illustrated in (23).

- (23) a. *Saskia hat Peter mitgeteilt, dass Peters Auto repariert werden muss.*
 Saskia has Peter told that Peter's car repaired be must
 'Saskia told Peter that Peter's car must be repaired.'
- b. *Saskia hat Peter abgeholt, weil Peters Auto repariert werden muss.*
 Saskia has Peter picked-up because Peter's car repaired be must
 'Saskia picked Peter up because Peter's car must be repaired.'

If sentences as in (23) are as acceptable as sentences without a Principle C violation, this would indicate that the embedded clauses are attached higher than VP. On the other hand, should we find clear evidence for a Principle C violation, we could conclude that the embedded clauses are attached very low. Of course, acceptability may differ between complement and *weil* clauses, indicating attachment sites of different heights.

8 General Discussion

This paper presented two experiments that have explored the role of c-command for the computation of coreference. According to binding theory, c-command plays a crucial role in this regard. In particular, Principle C of the binding theory states that a name cannot be co-referential with an expression by which it is c-commanded. In accordance with Principle C, all experimental conditions in which a name was c-commanded by a co-referential expression were of reduced acceptability. In this sense, the results of Experiment 1 and Experiment 2 are in accordance with Principle C.

From an explanatory point of view, in contrast, the results do not provide unanimous evidence for Principle C because we found a range of other effects that are not predicted by binding theory. This is not a principled problem for binding theory because it is well-known that acceptability judgments are governed not only by principles of grammar but by a variety of other factors as well (for an overview, see Schütze, 1996). The finding which is most relevant with regard to the status of Principle C is the redundant name effect found for English by Gordon & Hendrick (1997) and replicated in Experiment 1 for German. When the second of two co-referential expressions was a name, acceptability was reduced independently of whether the first expression c-commanded the second one or not, although the reduction was larger in the presence of a c-command relation. Thus, in contrast to fully acceptable sentences with a pronoun in second position, as in (24a), sentences with a name in second position are of reduced acceptability even when the name is not c-commanded by the first expression, as in (24b). When the name in second position is c-commanded by the first expression, as in (24c), acceptability is even lower. This holds for English and German alike.

- (24) a. Peter met his father on Tuesday/Peter's father met him on Tuesday.
 b. Peter's father met Peter on Tuesday.
 c. Peter met Peter's father on Tuesday.

According to binding theory, the sentences in (24a) and (24b) are grammatical whereas the sentence in (24c) is ungrammatical because it violates Principle C. Thus, from the perspective of binding theory, the difference between (24a) and (24b) is of a fundamentally different nature than the difference between (24b) and (24c): Whereas syntax-external factors are responsible for the reduced acceptability of (24b), the even more strongly reduced acceptability of (24c) is due to a syntax-internal Principle C violation. However, if the drop in acceptability seen for (24b) is caused by syntax-external factors, this could as well hold for the further drop in acceptability seen for (24c). Such syntax-external factors could still be of a linguistic nature, for example pragmatic principles as proposed in Harris & Bates (2002), but non-linguistic factors like processing complexity should also be taken into account (see, among others, Gordon &

Hendrick, 1998). We are not in a position to settle this issue because, as pointed out above, the research reported in this paper is just a small step toward a better understanding of the possible role of c-command for the acceptability of coreference (see Gordon & Hendrick, 1998, and Moulton & Han, 2018 for related research).

References

- Barker, C. (2012). Quantificational binding does not require c-command. *Linguistic Inquiry*, 43(4), 614–633.
- Barss, A., & Lasnik, H. (1986). A note on anaphora and double objects. *Linguistic Inquiry*, 17, 347–354.
- Bates, D., Kliegl, R., Vasishth, S., & Baayen, R. H. (2015). Parsimonious mixed models. *arXiv.org preprint – arXiv:1506.04967 [stat.ME]*.
- Bech, G. (1983 [1955/1957]). *Studien über das deutsche Verbum Infinitum*. 2., unveränderte Auflage, mit einem Vorwort von Catherine Fabricius-Hansen. Tübingen: Niemeyer.
- Bruening, B. (2014). Precede-and-command revisited. *Language*, 90(2), 342–388.
- Büring, D., & Hartmann, K. (1997). Doing the right thing. *The Linguistic Review*, 14(1), 1–41.
- Carminati, M. N., Frazier, L., & Rayner, K. (2002). Bound Variables and C-Command. *Journal of Semantics*, 19(1), 1–34.
- Christensen, R. H. B. (2019). ordinal—Regression Models for Ordinal Data. R package version 2019.4-25. <http://www.cran.r-project.org/package=ordinal/>.
- Cunnings, I., Patterson, C., & Felser, C. (2014). Variable binding and coreference in sentence comprehension: evidence from eye movements. *Journal of Memory and Language*, 71(1), 39–56.
- Drummer, J.-D., & Felser, C. (2018). Cataphoric pronoun resolution in native and non-native sentence comprehension. *Journal of Memory and Language*, 101, 97–113.
- Fanselow, G. (1987). *Konfiguralität. Untersuchungen zur Universalgrammatik am Beispiel des Deutschen*. Tübingen: Narr.
- Frey, W. (1993). *Syntaktische Bedingungen für die semantische Interpretation: Über Bindung, implizite Argumente und Skopus*. Berlin: Akademie-Verlag.
- Gordon, P. C., Grosz, B. J., & Gilliom, L. A. (1993). Pronouns, names, and the centering of attention in discourse. *Cognitive Science*, 17(3), 311–347.
- Gordon, P. C., & Hendrick, R. (1997). Intuitive knowledge of linguistic co-reference. *Cognition*, 62, 325–370.
- Gordon, P. C., & Hendrick, R. (1998). The representation and processing of coreference in discourse. *Cognitive Science*, 22, 389–424.
- Haider, H. (1982). Abhängigkeiten und Konfigurationen: Zur deutschen V-Projektion. *Groninger Arbeiten zur germanistischen Linguistik*, 21, 0–59.
- Haider, H. (1992). *Branching and Discharge*. Universität Stuttgart: Arbeitspapiere des Sonderforschungsbereichs 340 Nr. 23.
- Haider, H. (1997). Extraposition. In D. Beermann, D. LeBlanc & H. van Riemsdij (Eds.), *Rightward movement*, volume 17 (pp. 115–151). Amsterdam: John Benjamins.
- Haider, H. (2010). *The Syntax of German*. Cambridge: Cambridge University Press.
- Harris, C. L., & Bates, E. A. (2002). Clausal backgrounding and pronominal reference: A functionalist approach to c-command. *Language and Cognitive Processes*, 17(3), 237–269.

- Jackendoff, R. (1990). On Larson's treatment of the double object construction. *Linguistic Inquiry*, 21, 427–456.
- Kayne, R. (1994). *The Antisymmetry of Syntax*. Cambridge, MA: MIT Press.
- Kush, D., Lidz, J., & Phillips, C. (2015). Relation-sensitive retrieval: evidence from bound variable pronouns. *Journal of Memory and Language*, 82, 18–40.
- Larson, R. K. (1988). On the double object construction. *Linguistic Inquiry*, 19, 335–391.
- Larson, R. K. (1990). Double objects revisited: Reply to Jackendoff. *Linguistic Inquiry*, 21, 589–632.
- Moulton, K., & Han, C.-h. (2018). C-command vs. scope: An experimental assessment of bound-variable pronouns. *Language*, 94(1), 191–219.
- Patterson, C., & Felser, C. (2019). Delayed application of binding condition C during cataphoric pronoun resolution. *Journal of Psycholinguistic Research*, 48(2), 453–475.
- Pesetsky, D. (1995). *Zero Syntax: Experiencers and Cascades*. Cambridge, MA: MIT press.
- R Core Team (2020). *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing.
- Radó, J., Konietzko, A., & Sternefeld, W. (2019). Telescoping in relative clauses: Experimental evidence. In M. Krifka & M. Schenner (Eds.), *Reconstruction Effects in Relative Clauses* (pp. 405–426). Berlin/Boston: De Gruyter.
- Reinhart, T. (1976). *The Syntactic Domain of Anaphora*. Doctoral dissertation, MIT.
- Reinhart, T. (1983). *Anaphora and Semantic Interpretation*. London & Canberra: Croom Helm.
- Schütze, C. T. (1996). *The Empirical Base of Linguistics*. Chicago: Chicago University Press.
- Sternefeld, W. (2006). *Syntax. Eine morphologisch motivierte generative Beschreibung des Deutschen*. Band 2. Tübingen: Stauffenburg.
- Sturt, P. (2003). The time-course of the application of binding constraints in reference resolution. *Journal of Memory and Language*, 48, 542–562.
- Webelhuth, G. (1984). German is configurational. *The Linguistic Review*, 4, 203–246.
- Webelhuth, G. (to appear). C-command constraints in German: a corpus-based investigation. *Accepted for publication in Zeitschrift für Sprachwissenschaft*.
- Webelhuth, G., & Bader, M. (2021). Constraints on extraposition: No difference between relative and comparative clauses. *Linguistische Berichte*, 268, 413–453.
- Wiltschko, M. (1993). Extraposition in German. *Wiener Linguistische Gazette*, (48-50), 1–30.