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RESEARCH

An experimental investigation of the binding options of demonstrative pronouns in German

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This paper discusses data from two self-paced reading experiments as well as an acceptability rating study that shed light on the binding behaviour of demonstrative pronouns as opposed to personal pronouns. Participants read (Experiments 1 & 2) or rated (Experiment 3) single sentences that contained either a demonstrative pronoun (DPro) or a personal pronoun (PPro). Sentences contained a determiner phrase (DP) that functioned as the grammatical subject and a DP that functioned as the direct, indirect or prepositional object. The pronoun was either contained in the direct object DP or a prepositional object DP. In half of the sentences, pronouns could only be interpreted as bound by the subject DP. In the other half of sentences, they could only be interpreted as bound by the object DP. Results from Experiment 1 reveal similar reading times for DPros and PPros when they were bound by the object DP, and significantly longer reading times for DPros than PPros when they were bound by the subject DP. Experiment 2 replicated the DPro effect from Experiment 1 with materials where potential subject and object binders were quantifiers. Finally, Experiment 3 shows that also in the context of quantifier binding DPros are not generally dispreferred. Sentences with a DPro were only rated as less acceptable than sentences with a PPro when the potential binder was the subject. Taken together, our data provide evidence that DPros can be bound as long as their binders are not grammatical subjects.

Keywords: demonstrative pronouns; binding; grammatical subjects; prominence

1 Introduction

The co-referential behavior of German demonstrative pronouns (DPros) of the *der/die/das* paradigm has received considerable attention in the literature, including empirical and corpus investigations (Bosch, Rozario & Zhao 2003; Bosch & Umbach 2006; Bosch, Katz & Umbach 2007; Kaiser & Trueswell 2008; Schumacher, Backhaus & Dangl 2015; Järvikivi, Van Gompel & Hyönä 2016; Schumacher, Dangl & Uzun 2016; Schumacher, Roberts & Järvikivi 2017). Much less is known about the interpretation of DPros in binding configurations, i.e. in configurations where the DPro is c-commanded by its antecedent (see Reinhart 1983; Heim 1998; Reinhart 2006). Notable exceptions are Wiltschko (1998), Hinterwimmer (2015), and Patel-Grosz and Grosz (2017). Wiltschko (1998) suggested that DPros, unlike personal pronouns (PPros) of the *er/sie/es* paradigm, cannot be bound at all. This assumption was based on examples such as those in (1). In contrast and based on examples like the one in (2), Hinterwimmer (2015) proposed that DPros can in principle be bound, but that grammatical subjects do not seem to fall under the set of potential binders.

(1) a. *[Jeder Mann]$_i$ glaubt, dass der$_i$ klug ist.
[every man]$_i$ believes that he.DPRO$_i$ smart is
'Every man believes that he is smart.'

b. [Jeder Mann]$_i$ glaubt, dass er$_i$ klug ist.
[every man]$_i$ believes that he.PPRO$_i$ smart is
'Every man believes that he is smart.'

c. *Peter$_i$ glaubt, dass der$_i$ klug ist.
Peter$_i$ believes that he.DPRO$_i$ smart is
'Peter believes that he is smart.'

d. Peter$_i$ glaubt, dass er$_i$ klug ist.
Peter$_i$ believes that he.PPRO$_i$ smart is
'Peter believes that he is smart.'

(2) Peter$_i$ glaubt von [jedem Kollegen]$_j$, dass der$_j$ klüger ist als er$_i$.
Peter$_i$ believes of [every colleague]$_j$ that he.DPRO$_j$ smarter is than he.PPRO$_i$
'Peter believes of every colleague that he is smarter than him.'

Another approach to the binding options of DPros is provided by Patel-Grosz and Grosz (2017). The authors agree with Hinterwimmer (2015) that DPros can be bound but, unlike Hinterwimmer, assume that DPros can only be used when there is some goal of the speaker that could not be achieved by the use of a PPro. The idea is that DPros are structurally more complex than PPros and therefore more marked. Consequently, the use of a DPro should be pragmatically licensed. One such licenser could be ambiguity avoidance. Indeed, ambiguity avoidance seems relevant for the binding configurations displayed in (2), where two potential binders are available.

In this paper, we empirically addressed the various claims made by Wiltschko's (1998) account and Hinterwimmer's (2015) account. However, our data will also have implications for the ambiguity avoidance account of Patel-Grosz and Grosz (2017). We conducted two self-paced reading experiments, in which readers read single sentences containing a subject and a direct, indirect, or prepositional object determiner phrase (DP). We also conducted an acceptability rating study with very similar materials as the self-paced reading experiments. Examples are provided in (3).

(3) a. Frau Meyer kocht Herrn Brunn dessen liebstes Essen, weil er
Mrs. Meyer cooks Mr. Brunn his favorite dish, because he
sich das gewünscht hatte.
REFL it wished had
'Mrs. Meyer cooks Mr. Brunn's favorite dish for him, because he asked for it.'

b. Frau Meyer kocht Herrn Brunn sein liebstes Essen, weil er
Mrs. Meyer cooks Mr. Brunn his favorite dish, because he
sich das gewünscht hatte.
REFL it wished had
'Mrs. Meyer cooks Mr. Brunn's favorite dish for him, because he asked for it.'

c. Herr Brunn kocht Frau Meyer dessen liebstes Essen, weil er
Mr. Brunn cooks Mrs. Meyer his favorite dish, because he
sich das gewünscht hatte.
REFL it wished had
'Mr. Brunn cooks his favorite dish for Mrs. Meyer, because he asked for it.'

d. Herr Brunn kocht Frau Meyer sein liebstes Essen, weil er
Mr. Brunn cooks Mrs. Meyer his favorite dish, because he
sich das gewünscht hatte.
REFL it wished had
'Mr. Brunn cooks his favorite dish for Mrs. Meyer, because he asked for it.'

Both phrases preceded a possessive pronoun contained in a DP (*dessen/sein liebstes Essen*). The containing DP always functioned as a direct or prepositional object. Importantly, the gender of the two antecedent DPs only allowed the pronoun to be interpreted as bound by the preceding subject ((3c) and (3d)) or object DP ((3a) and (3b)). The three experiments presented here, then, directly tested the claim that DPros cannot be bound (Wiltschko 1998) and, in case they can be bound, whether they avoid grammatical subjects as binders (Hinterwimmer 2015).

1.1 Previous research on demonstrative pronouns

1.1.1 Co-reference

Based on comprehensive corpus and empirical data, Bosch et al. (2003; see also Bosch et al. 2007) suggested that DPros avoid referents of DPs as antecedents that function as the grammatical subject of the immediately preceding sentence (see also Kaiser 2011a). In contrast, PPros do not show such an anti-subject bias and, on the contrary, even display a general preference for subject referents as antecedents. Similar contrasts have been observed for other languages with personal pronouns and demonstrative pronouns, such as Finnish, Dutch, and Romance languages, which have null pronouns in addition to overt pronouns (see Kaiser & Trueswell 2008; Mayol & Clark 2010; Kaiser 2010; 2011b; 2013).

However, judging from data such as the ones presented in (4), Bosch and Umbach (2006) argued that DPros do not necessarily avoid referents of grammatical subjects, but rather discourse topics. That is, the DPro in (4a) can only refer to the referent of the grammatical subject of the preceding sentence, *Peter*, and not the referent of the indirect object, *Karl*. According to Bosch and Umbach (2006), this is due to the fact that *Karl* has been established as the discourse topic: The first sentence poses a question about *Karl* and the two subsequent sentences address this question. With respect to PPros, Bosch and Umbach (2006) propose that these pronouns have a (weak) preference for discourse topics, which is attested by the observation that the PPro in (4b) is typically interpreted as referring to *Karl*, although it could also, at least in principle, refer to *Peter*.

(4) a. Woher Karl_i das weiß? Peter_j hat es ihm$_i$ gesagt. $\text{Der}_{*i/j}$ war
where.from Karl_i that knows? Peter_j has it him$_i$ told he.$\text{DPRO}_{*i/j}$ was
gerade hier.
just here
'How does Karl know? Peter told him. He has just been here.'

b. Woher Karl_i das weiß? Peter_j hat es ihm$_i$ gesagt. $\text{Er}_{i/j}$ war
where.from Karl_i that knows? Peter_j has it him$_i$ told he.$\text{PPRO}_{i/j}$ was
gerade hier.
just here
'How does Karl know? Peter told him. He has just been here.'

Now, Bosch and Umbach (2006) can account for contrasts that have been taken as evidence for subject avoidance in previous research by assuming that grammatical subjects are, by default, discourse topics. In other words, what seems to be (strong) subject avoidance in the case of DPros and (weak) subject preference in the case of PPros might in fact be an artifact of the observation that grammatical subjects are often also the discourse topic (but see Schumacher et al. 2017).

Extending Bosch et al.'s work, Schumacher et al. (2016) conducted three experiments comparing the German PPro *er* with the German DPro *der*. In Experiment 1, a forced choice antecedent selection task, sentences either contained an accusative verb (*to rescue*) or a dative experiencer verb (*to attract attention*). Furthermore, the two potential antecedents of the pronoun appeared in canonical (SVO) or non-canonical word order (OVS).

For accusative verbs, Schumacher and colleagues found a bias for PPros to refer to the nominative marked agent antecedent and a bias for DPros to refer to the accusative marked patient antecedent, and this data pattern was independent of word order. For dative experiencer verbs and for canonical word order, PPros were mostly interpreted to refer to the dative marked agent/experiencer antecedent and DPros to refer to the nominative marked patient antecedent. For non-canonical word order, no interpretation bias was found for PPros or DPros. The authors concluded that multiple prominence cues negotiate during pronoun interpretation, with thematic role presumably being a stronger predictor than grammatical role (see also Schumacher et al. 2015 for evidence from event-related potentials).

1.1.2 Binding: Wiltschko (1998)

While the co-referential use of DPros has been targeted in theoretical and empirical investigations, there has been relatively little systematic research on the binding behavior of DPros, in particular in the empirical domain. Wiltschko (1998) proposed that DPros are referential expressions that correspond to definite DPs consisting of an overtly realized determiner and an empty NP introducing a free predicate variable. Consequently, these pronouns cannot be bound by c-commanding DPs without violating Principle C of Binding Theory (Chomsky 1986) and not be interpreted as bound variables either. The idea is that DPros can only pick up contextually given individuals or be interpreted as donkey pronouns (see Wiltschko 1998 for details), where donkey pronouns are pronouns that behave as if they were bound by indefinite DPs that do not have scope over them due to their containment in a syntactic island or different sentence (see Geach 1962; Heim 1990; Elbourne 2005 and the references therein). For PPros, in contrast, Wiltschko (1998) assumes that they lack a DP-layer entirely and are just projections of agreement features. As such they introduce variables which can either receive a value from the context or be bound by a c-commanding DP. Evidence for Wiltschko's claim comes from sentences such as those in (5a–d) (reproduced from (1) above) and (5e–h), for which the use of DPros is infelicitous (at least in the absence of a contextually salient male individual, which the DPro could refer to).

(5) a. *[Jeder Mann] glaubt, dass der klug ist.
[every man] believes that he.DPRO smart is
'Every man believes that he is smart.'

b. [Jeder Mann] glaubt, dass er klug ist.
[every man] believes that he.PPRO smart is
'Every man believes that he is smart.'

c. *Peter glaubt, dass der klug ist.
Peter believes that he.DPRO smart is
'Peter believes that he is smart.'

d. Peter glaubt, dass er klug ist.
Peter believes that he.PPRO smart is
'Peter believes that he is smart.'

e. *[Jeder Mann]$_i$ glaubt, dass dessen$_i$ Klugheit die seiner Kollegen
[every man]$_i$ believes that his.DPRO$_{i,}$ smartness that his.GEN colleagues
bei weitem übersteigt.
by far surpasses
'Every man believes that his smartness surpasses that of his colleagues by far.'

f. [Jeder Mann]$_i$ glaubt, dass seine$_i$ Klugheit die seiner Kollegen
[every man]$_i$ believes that his.PPRO$_i$ smartness that his.GEN colleagues
bei weitem übersteigt.
by far surpasses
'Every man believes that his smartness surpasses that of his colleagues by far.'

g. *Peter$_i$ glaubt, dass dessen$_i$ Klugheit die seiner Kollegen bei
Peter$_i$ believes that his.DPRO$_{i,}$ smartness that his.GEN colleagues by
weitem übersteigt.
far surpasses
'Peter believes that his smartness surpasses that of his colleagues by far.'

h. Peter$_i$ glaubt, dass seine$_i$ Klugheit die seiner Kollegen bei
Peter$_i$ believes that his.PPRO$_i$ smartness that his.GEN colleagues by
weitem übersteigt.
far surpasses
'Peter believes that his smartness surpasses that of his colleagues by far.'

Note that while Wiltschko does not discuss the contrasts between DPros and PPros in their co-referential behavior, her analysis could easily be extended in a way that it can account for these contrasts as well. One could, for example, assume that being assigned as value to a free individual variable is a process that is preferably applied to contextually maximally prominent individuals. The more indirect process of making a DPro co-referential with an individual via assigning a suitable value to the predicate variable, in contrast, could be assumed to preferably apply to less prominent individuals.

1.1.3 Binding: Hinterwimmer (2015)

Hinterwimmer (2015) questions the core arguments presented by Wiltschko (1998) and argues, on the basis of examples like those in (6a–b), that DPros can in principle be bound by DPs c-commanding them either on the surface or at LF, i.e. after Quantifier Raising has applied.

(6) a. Peter$_i$ glaubt von [jedem Kollegen]$_j$, dass der$_j$ klüger ist als er$_i$.
Peter$_i$ believes of [every colleague]$_j$ that he.DPRO$_j$ smarter is than he.PPRO$_i$
'Peter believes of every colleague that he is smarter than him.'

b. Peter stellte [jedem Studenten]$_j$ mindestens eine Frage, die der$_j$
Peter$_i$ asked [every student]$_j$ at.least one question that he.DPRO$_j$
nicht beantworten konnte.
not answer could.
'Peter asked every student at least one question that he could not answer.'

Hinterwimmer (2015) proposes that both DPros and PPros are DPs that consist of a(n) (phonetically differently realized) overt determiner and an empty NP introducing a free predicate variable, which follows Elbourne's (2005) analysis of PPros. Setting aside the case of donkey pronouns, which are irrelevant for the discussions in the present paper, the free predicate variable can be resolved in two ways: First, to the property of being identical to a contextually provided individual, which results in a co-referential interpretation. Second, to the property of being identical to (the value of) a variable that is bound by a c-commanding DP. Note that when the binding DP is a referential DP such as a proper name or definite description, the resulting interpretation is indistinguishable from a co-referential interpretation. Nevertheless, following Reinhart (1983; 2006) and Heim (1998), Hinterwimmer (2015) assumes that whenever binding is possible, it is

preferred over co-valuation when the two resulting interpretations are equivalent, where co-valuation is a process in which two terms are assigned the same value accidentally, i.e. without being co-indexed.

The critical argument for the assumption that there is a real difference between bound and co-referential interpretations even in cases where the putative binder is a referential DP comes from the following observation (see Reinhart 1983; Heim 1998 and Reinhart 2006 for detailed discussion and additional references): A sentence such as (7), in both the version with VP-ellipsis and the version without VP-ellipsis, allows for a strict as well as a sloppy reading. On the sloppy reading, *Paul* is said to adore his own (i.e. *Paul's*) cat, while on the strict reading *Paul* is said to adore *Mike's* cat. The strict reading comes about via co-valuation: The pronoun receives the contextually salient individual *Mike* as value. The sloppy reading, in contrast, comes about via binding: The variable introduced by the pronoun is co-indexed with and thus bound by a lambda-operator, turning the VP *adore*(*s*) *his cat* into a predicate. That predicate is then applied to the individual denoted by the subject DP, *Mike*. In cases such as (7), where co-valuation makes available a reading that could not be achieved via binding, co-valuation is licit. In cases where binding is an option and where there is no difference between a bound and a co-referential interpretation, binding is assumed to be preferred over co-valuation.

(7) Mike adores his cat, and Paul [does]/[adores his cat], too.

When the DP on whose interpretation the pronoun depends is a quantifier (e.g., (6a)), binding is the only option to begin with. As in cases in which the binder is a referential DP, it comes about via a lambda-operator binding the variable introduced by the pronoun. Because of the higher semantic type, however, the resulting predicate is not applied to the binding DP. Rather, it is the other way round: The quantifier is applied to the predicate, resulting in a bound variable interpretation of the pronoun.

On Hinterwimmer's (2015) account, neither PPros nor DPros are expected to give rise to Principle C effects, unlike DPs with an overt NP (cf. Schlenker 2005). The crucial difference between DPros and PPros is rather that DPros, by virtue of being the marked pronoun variant in German, signal to the reader/hearer that the default process of identifying a potential antecedent or binder does not apply.

Technically, this is implemented in the following way: DPros, in contrast to PPros, come with a lexical presupposition which prevents the predicate variable introduced by the empty NP from being resolved in a way that makes it dependent on the (currently) most prominent DP. The idea is that the default process of identifying a potential antecedent or binder would pick out the most prominent one. Importantly, the lexical presupposition that prevents this process is the "frozen" effect of a general principle: Formal markedness corresponds to a non-default interpretation. Crucially, what counts as the (currently) most prominent DP differs in binding and non-binding configurations. Binding configurations are defined in structural terms: A (potential) binder has to be contained in the same sentence as its bindee, and the former needs to c-command the latter either on the surface or, at the latest, at LF (see discussions in Barker 2012 for evidence that binding does not require surface c-command, but only linear precedence in combination with scope, contra Reinhart 1983; Heim 1998; Reinhart 2006). We would therefore expect that prominence is defined in structural terms as well. Non-binding configurations, in contrast, are cases in which the pronoun is neither c-commanded on the surface nor at LF by the DP on which its interpretation depends. That is because that DP is either contained in a separate sentence or in a syntactic island from which it cannot be moved out at LF.

Now, grammatical subjects are the syntactically most prominent DPs within their sentences (for example, in terms of operations such as controlling implicit arguments or reflexive binding being readily available to them, but not to other DPs). Consequently, the lexical presupposition of DPros precludes the predicate variable from being resolved to the following predicate: the property of being identical to (the value of) a variable bound by the respective grammatical subject. In that vein, the contrast between the DPro and PPro variants in (5) is simply due to DPros avoiding grammatical subjects as binders. In (6a) and (6b), in contrast, an interpretation on which the DPro is bound by the respective prepositional or indirect object is unproblematic. That is, the free predicate variable can be resolved to the property of being identical to the value of a variable bound by the respective DP.

Turning to non-binding configurations, we first note that prominence in these contexts is defined in terms of discourse properties, with discourse topics (Bosch & Umbach 2006; or agents, see Schumacher 2016) being maximally prominent (but see, e.g.: Grosz, Joshi & Weinstein 1995 for the claim that structural factors such as subjecthood play an important role in the interpretation of cross-sentential pronouns). In the absence of a potential binder, the lexical presupposition of DPros thus precludes them from referring to antecedents that function as discourse topics. In other words, the free predicate variable may not be resolved to the property of being identical with the individual functioning as the current discourse topic.

Concerning the co-referential behavior of DPros, the analysis of Hinterwimmer (2015) thus makes exactly the same predictions as the analysis provided by Bosch and Umbach (2006). Although Hinterwimmer (2015) does not provide an explicit discussion of languages other than German, his reasoning generalizes to any language that has marked and unmarked pronouns, as long as prominence in terms of topicality and subjecthood makes clear whether to use the unmarked pronoun. Consequently, the null hypothesis would be that marked pronouns in other languages come with the same presupposition as the one assumed for DPros in German, as this presupposition is assumed to be the "frozen" effect of the general principle mentioned above: Formal markedness corresponds to a non-default interpretation.

1.1.4. Binding: Patel-Grosz and Grosz (2017)

Patel-Grosz and Grosz (to appear) agree with Hinterwimmer (2015) that DPros can in principle be bound. Their analysis, however, differs from Hinterwimmer (2015) in that the authors do not assume DPros to come with a lexical presupposition which prevents them from being bound by/co-referring to the (currently) most prominent DP. Instead, Patel-Grosz and Grosz assume that the contrast between PPros and DPros emerges as the artifact that DPros are structurally more complex than PPros. That is, both types of pronouns are analyzed as DPs with an overt determiner and a covert NP (as in Hinterwimmer 2015). However, DPros, unlike PPros, contain an additional functional layer above the D-layer and it is this additional layer that is ultimately responsible for the different phonetic realizations.[1] Patel-Grosz and Grosz (2017) follow Schlenker (2005) in assuming that the pragmatic economy principle *Minimize restrictors!* is in effect. This principle basically precludes items with more (complex) structure to be used (a) whenever there is a structurally less complex alternative available and (b) when using the less complex

[1] It also has an interpretative effect that is discussed at length in Patel-Grosz and Grosz (2017), which is, however, irrelevant for our purposes in this paper: They assume the combination of the D-layer and the functional layer above the D-layer to correspond to Schwarz's (2009) strong definite article, which enforces an anaphoric or bound interpretation.

alternative does not lead to a difference in interpretation. Whenever there is a pragmatic benefit, though, using the more complex variant is felicitous. Consequently, DPros should only be used when there is some benefit that could not be achieved by using a PPro. Since *Minimize restrictors!* is a general pragmatic principle, it should hold for the marked pronoun variants in other languages as well, as Patel-Grosz and Grosz also state in their paper.

1.2 Overview of experiments and predictions

We conducted two self-paced reading experiments as well as an acceptability rating study, which allowed us to explicitly test the predictions made by Wiltschko (1998), on the one hand, and Hinterwimmer (2015), on the other. While our data will also speak to the ambiguity avoidance hypothesis put forward by Patel-Grosz and Grosz (2017), this aspect will only be discussed in some more detail in the General Discussion. In Experiment 1, we used single sentences (see (8) and (9)) that consisted of a clause containing a non-pronominal DP functioning as the grammatical subject (e.g., *Frau Meyer* in (8)) and a clause functioning as the direct, indirect, or prepositional object (e.g., *Herrn Brunn* in (8)). Furthermore, the possessive version of either the masculine singular DPro ((8a) and (9a)) or PPro ((8b) and (9b)) was always contained in a DP functioning as the direct object or in a prepositional object DP (*dessen/sein liebstes Essen* in (8a) and (8b)). The two non-pronominal DPs always preceded the DP containing the possessive pronoun, and the subject DP always preceded the other non-pronominal DP.

Moreover, since the two non-pronominal DPs were always contained in the same clause as the DP containing the possessive pronoun, both non-pronominal DPs always appeared in a (potential) binding configuration with the possessive pronoun (following Barker 2012). That the configurations are binding configurations can be seen by the existence of sloppy readings (see the discussion in Section 1.1.3 above) for the two variants of the second clause in (10): The sentence in (10) can easily be interpreted as meaning that Mrs. Meyer cooks Mr. Brunn his favorite dish, while Mrs. Schwarz cooks Mr. Ried his favorite dish.

(8) a. Frau Meyer kocht Herrn Brunn dessen liebstes Essen, weil er
Mrs. Meyer cooks Mr. Brunn his favorite dish because he
sich das gewünscht hatte.
REFL it wished had.
'Mrs. Meyer cooks Mr. Brunn's favorite dish for him, because he had asked for it.'

b. Frau Meyer kocht Herrn Brunn sein liebstes Essen, weil er
Mrs. Meyer cooks Mr. Brunn his favorite dish because he
sich das gewünscht hatte.
REFL it wished had
'Mrs. Meyer cooks Mr. Brunn's favorite dish for him, because he had asked for it.'

(9) a. Fräulein Schäfer verlässt ihren Verlobten an dessen dreißigsten Geburtstag,
Ms. Schäfer leaves her fiancé on his thirtieth birthday
weil sie es einfach nicht mehr ausgehalten hat.
because she it simply not anymore stand has
'Ms. Schäfer leaves her fiancé on his thirtieth birthday because she simply could not stand it anymore.'

b. Fräulein Schäfer verlässt ihren Verlobten an seinem dreißigsten Geburtstag,
Ms. Schäfer leaves her fiancé on his thirtieth birthday
weil sie es einfach nicht mehr ausgehalten hat.
because she it simply not anymore stand has
'Ms. Schäfer leaves her fiancé on his thirtieth birthday because she simply could not stand it anymore.'

(10) Frau Meyer kocht Herrn Brunn sein liebstes Essen und Frau Schwarz
Mrs. Meyer cooks Mr. Brunn his favorite dish and Mrs. Schwarz
Herrn Ried.
Mr.DAT Ried
'Mrs. Meyer cooks Mr. Brunn's favorite dish for him, and Mrs. Schwarz Mr. Ried's.'

Additionally, as shown by the contrasts in (11) and (12), the configurations exemplified in (8) and (9), respectively, give rise to Principle C effects. In principle, this could be taken as evidence that the second non-pronominal DP in (8) and (9) always c-commands the DP containing the respective pronoun, and therefore the pronoun itself, already on the surface. However, some caution is called for: The PPro in (13a) is contained in a prepositional phrase (PP) and should thus not c-command anything outside that PP, at least under the standard definition of c-command. Nevertheless, the contrast between (13a) and (13b) is as strong as the one between (11a) and (11b), and (12a) and (12b), respectively. The evidence is therefore inconclusive with respect to surface c-command.

(11) a. *Frau Meyer kocht ihm$_i$ Ottos$_i$ liebstes Essen, weil er sich das
Mrs. Meyer cooks him$_i$ Otto$_i$'s favorite dish because he REFL it
gewünscht hatte.
wished had
*'Mrs. Meyer cooks him$_i$ Otto$_i$'s favorite dish, because he had asked for it.'

b. Frau Meyer kocht seinem$_i$ Neffen Ottos$_i$ liebstes Essen, weil er sich
Mrs. Meyer cooks his$_i$ nephew Otto$_i$'s favorite dish, because he REFL
das gewünscht hatte.
it asked for had
'Mrs. Meyer cooks his$_i$ nephew Otto$_i$'s favorite dish, because he had asked for it.'

(12) a. *Fräulein Schäfer verlässt ihn$_i$ an Ottos$_i$ dreißigstem Geburtstag, weil sie
Ms. Schäfer leaves him$_i$ on Otto$_i$'s thirtieth birthday because she
es einfach nicht mehr ausgehalten hat.
it simply not anymore stand has
*'Ms. Schäfer leaves him$_i$ on Otto$_i$'s thirtieth birthday because she simply could not stand it anymore.'

b. Fräulein Schäfer verlässt seinen$_i$ Neffen an Ottos$_i$ dreißigstem Geburtstag,
Ms. Schäfer leaves his nephew on Otto$_i$'s thirtieth birthday
weil sie es einfach nicht mehr ausgehalten hat.
because she it simply not anymore stand has
'Ms. Schäfer leaves his$_i$ nephew on Otto$_i$'s thirtieth birthday because she simply could not stand it anymore.'

(13) a. *Frau Kerner fährt mit ihm$_i$ zu Ottos$_i$ neuer Vernissage, weil man
Mrs. Kerner drives with him$_i$ to Otto$_i$'s new exhibition because one
da nur mit dem Auto hinkommt.
there only by the.DAT car gets.there
*'Mrs. Kerner drives with him$_i$ to Otto$_i$'s new exhibition because one only gets there by car.'

b. Frau Kerner fährt mit seinem$_i$ Neffen zu Ottos$_i$ neuer Vernissage, weil
Mrs. Kerner drives with his$_i$ nephew to Otto$_i$'s new exhibition because
man da nur mit dem Auto hinkommt.
one there only by the.DAT car gets.there
'Mrs. Kerner drives with his$_i$ nephew to Otto$_i$'s new exhibition because one only gets there by car.'

As already pointed out above, all test sentences in Experiment 1 presented two full DPs both of which preceded the DP containing the respective pronoun. Critically, one DP was marked for male gender via a corresponding determiner or choice of proper name. The other DP was marked for feminine gender and did therefore not serve as potential binder. Thus, in all materials, the pronoun, by virtue of being marked for male gender, could only be interpreted as bound by the DP referring to the male referent or quantifying over male referents, thereby avoiding any ambiguity. For example, in (8a) and (8b), both *dessen liebstes Essen* (DPro version) and *sein liebstes Essen* (PPro version) can only be bound by *Herrn Brunn*.

We constructed two versions of each test sentence. In one version, the masculine DP was the grammatical subject and the feminine DP the indirect, direct, or prepositional object, with both DPs occurring in canonical position. In the other version, the grammatical function and the order of the DPs were reversed: The masculine DP was the indirect, direct, or prepositional object and the feminine DP the subject. As already said, pronouns (DPros and PPros) were always contained in the DP functioning as the direct object or in a DP functioning as a prepositional object. The materials of Experiments 2 and 3 were very similar to the materials of Experiment 1. However, unlike for Experiment 1, sentences in Experiments 2 and 3 used non-pronominal binder DPs that were always quantificational (e.g., *jedem Mann* instead of *Herrn Brunn* in (8a) and (8b)), which increases the probability of bound readings. While Experiments 1 and 2 used self-paced reading, Experiment 3 elicited acceptability judgments.

We predicted that, if DPros cannot be bound (Wiltschko 1998), we should find a reading slow-down for DPros and/or subsequent words (i.e. at the point readers encounter, interpret, and integrate the pronoun, e.g., *dessen liebstes Essen* in (8a)) compared to their PPro counterparts (*sein liebstes Essen* in (8b)). Importantly, this reading time difference should obtain regardless of whether readers try to interpret the DPro as bound by the preceding subject or object DP. In contrast, if DPros only avoid grammatical subjects as binders (Hinterwimmer 2015), we expect significantly longer reading times for DPros than PPros when the pronoun agrees in gender marking with the DP functioning as the grammatical subject. Similar reading times on DPro and PPro regions should obtain when the pronoun agrees in gender marking with the DP that functions as indirect, direct, or prepositional objects.

The comparison between DPros and PPros also allowed us to test whether potential reading time differences are due to differences in distance between pronoun and object (short distance) and pronoun and subject (long distance). If more distal referents generally lead to longer reading times associated with DPro and PPro encounter we should

find slower readings for subject agreement versions than object agreement version of sentences, and this difference should be independent of pronoun type.

Note that longer reading times for sentences with DPros that agree in gender marking with the DP functioning as the grammatical subject as opposed to the other three conditions (which would be compatible with Hinterwimmer 2015 and incompatible with Wiltschko 1998) would not show directly that DPros cannot be bound by subjects. Strictly speaking, such differences in reading times would only show that it is more difficult to interpret DPros as bound by subjects than objects. In the absence of a similar effect with PPros, however, we would take them as strongly suggesting that an account along the lines of Hinterwimmer (2015) is on the right track.

In sum, in Experiment 1, we compared reading times for sentences with the DPro *dessen* with reading times of sentences with the PPro *seinen*. Both non-pronominal DPs were always referential, i.e. we used proper names or definite descriptions. In Experiment 2, we only tested DPros. In this experiment, the DP that agreed in gender marking with the DPro was quantificational, while the other DP was referential (cf. (6a) and (6b) above). The purpose of that manipulation was to test whether DPros cannot only be bound in principle, but are indeed capable of receiving bound variable interpretations (recall that if the binder is a referential DP, a bound reading is equivalent to a co-referential one). In Experiment 3, using offline acceptability judgments, we extended the findings from Experiments 1 and 2 to the use of quantificational DPs in both DPro and PPro contexts.

2 The experiments

2.1 Experiment 1

In Experiment 1, we manipulated the gender of the subject and the non-pronominal indirect, direct, or prepositional object DP while introducing a DPro or PPro shortly after encounter of the non-pronominal object DP. In line with Hinterwimmer (2015), we predicted a general tendency of readers to interpret the DPro as bound by the object DP rather than the subject DP of the sentence. This should result in faster reading times of DPros and subsequent words when the object was masculine compared to when it was feminine.

2.1.1 Method

2.1.1.1 Participants

56 students from the University of Cologne participated in this experiment for course credit or monetary compensation (EUR 4). All participants were native speakers of German and reported normal or corrected-to-normal vision.

2.1.1.2 Materials

We constructed a total of 20 experimental sentences, such as the one presented in (14). All sentences are provided in the Online Supplement. They introduced two human referents. Referents were introduced with a proper name (e.g., *Mr. Brunn*) or with a definite DP (e.g., *the artist*). One referent was male (masculine gender) and the other one female (feminine gender). In each sentence, one referent was the subject and the other the direct, indirect, or prepositional object. Importantly, experimental materials were constructed in a way that referents could be reversed without any further changes to the materials. Sentences therefore either appeared in a male subject/female object condition (male subject condition, (14c) and (14d)) or in a female subject/male object condition (male object condition, (14a) and (14b)). Reversing subjects and objects lead to a total of 40 experimental sentences, half of which were male subject versions and half of which were male object versions.

(14) a. Frau Meyer kocht Herrn Brunn **dessen liebstes Essen, weil er**
Mrs. Meyer cooks Mr. Brunn his favorite dish because he
sich das gewünscht hatte.
REFL it asked for had
'Mrs. Meyer cooks Mr. Brunn his favorite dish, because he had asked for it.'

b. Frau Meyer kocht Herrn Brunn **sein liebstes Essen, weil er**
Mrs. Meyer cooks Mr. Brunn his favorite dish because he
sich das gewünscht hatte.
REFL it asked for had
'Mrs. Meyer cooks Mr. Brunn his favorite dish, because he had asked for it.'

c. Herr Brunn kocht Frau Meyer **dessen liebstes Essen, weil er**
Mr. Brunn cooks Mrs. Meyer his favorite dish because he
sich das gewünscht hatte.
REFL it asked for had
'Mr. Brunn cooks Mrs. Meyer his favorite dish, because he had asked for it.'

d. Herr Brunn kocht Frau Meyer **sein liebstes Essen, weil er**
Mr. Brunn cooks Mrs. Meyer his favorite dish because he
sich das gewünscht hatte.
REFL it asked for had
'Mr. Brunn cooks Mrs. Meyer his favorite dish, because he had asked for it.'

All experimental sentences contained the DPro *dessen* (*his*), the possessive version of the masculine German DPro *der*, or the PPro *seinen* (*his*). Thus, we constructed four versions of each test sentence by crossing pronoun type (DPro vs. PPro) and grammatical role (male object vs. male subject). Note that we only included masculine forms of pronouns because feminine forms are ambiguous between a singular female and a plural interpretation. In all experimental sentences, the pronoun occurred shortly after the second, i.e. the direct, indirect, or prepositional object referent. Although sentences were somewhat heterogeneous, using various syntactic structures, in all but one experimental sentence was the pronoun followed by an adjective which, in turn, was followed by a noun. This was done to provide readers with structurally easy continuations after pronoun encounter.

Crucially, the morphological marking of the DPro and PPro only allowed their interpretation as bound by the referent marked for masculine gender, regardless of whether the referent was the subject or object. For example, in (14), *dessen/sein* can only be interpreted as bound by *Herr Brunn*. In all experimental sentences, our region of interest started with the pronoun (DPro or PPro) and spanned over the subsequent four words (highlighted in bold in (14) for illustration). Most importantly for our comparisons of male object and male subject conditions, regions of interest were exactly the same across conditions.

In a pilot study with 24 participants and 20 experimental sentences, we found that DPro regions were read significantly more slowly when the potential binder appeared in subject position (i.e. in the male subject condition) than when it appeared in object position (i.e. in the male object condition). However, because this study did not include personal pronouns as comparison, its data are not illuminating as to whether demonstrative pronouns might just always be the marked variant in binding configurations or whether the observed reading time difference resulted from a genuine non-subject bias of DPros. A more complete description of the pilot experiment and the results can be accessed in the Online Supplement.

We also constructed 60 filler sentences, of which 20 items were used as distractors to disguise the experimental manipulation. The first part of these sentences contained a

homonym while the second part disambiguated the homonym towards its less frequent meaning. Debriefing after the experiment confirmed that participants thought that the experiment was about the lexical ambiguity associated with the homonyms. Remaining fillers were single sentences with no obvious semantic or syntactic anomaly. All filler materials resembled experimental sentences in length and structure.

All materials were distributed across four presentation lists. Experimental sentences were divided into ten male subject and ten male object versions for each of the two pronoun types. All sentences that appeared in the male subject condition in two lists appeared in male object condition in the other two lists, and likewise for pronoun type. Finally, to make sure that participants carefully read our stimuli, 20 of the filler sentences were followed by a *yes-no* comprehension question.

2.1.1.3 Procedure

Materials were presented on an Intel Core i3 PC (4GB, ASUS 21.5″ monitor) using the Open Sesame software (Mathôt, Schreij & Theeuwes 2012) on Ubuntu (version 13.04). All trials began with sequences of underscores, representing the sentence that participants were about to read. Each sequence represented a word and each underscore within a sequence represented a letter. Participants read the first word of a sentence by pressing the space bar. Each subsequent press of the space bar triggered the presentation of the next word while letters of the preceding word were again replaced by underscores. Thus, participants read all sentences word by word and at their own reading pace. After participants had read the last word of a sentence and pressed the space bar again, they either encountered the word *Weiter?* 'Continue?' or they encountered a comprehension question which was either true, requiring a yes-response or false, requiring a no-response. Button presses in response to the question triggered presentation of the subsequent sentence with a delay of 1s.

Prior to the main experiment, participants received four practice sentences to familiarize themselves with the task. Feedback was provided during the practice session but not during the main experiment.

2.1.2 Results

Overall accuracy for comprehension questions was 94%. Mean reading times and standard errors for each word region (words 1–5) are provided in Table 1. Reading times and confidence intervals are also plotted in Figure 1. Effect sizes of comparisons were calculated using Cohen's *d* and are provided in Table 1. Prior to statistical analysis, reading times faster than 200 ms and slower than 2000 ms were excluded from further analysis (0.1% of the data). All other reading times were log-transformed individually for each word region (words 1–5) using Box-Cox power transformations.

Linear mixed effects regression models were used for each word region individually to test for differences between male object and male subject conditions for the two pronoun types. While reading times were included as dependent measure, pronoun type (DPro or PPro) and grammatical role (male object or male subject), and their interaction, were included as independent variables. We also included random intercepts and random slopes for pronoun type and grammatical role, both for participants and items. We started with the most complex random effects structure and reduced the complexity of the slopes by successively reducing the random effects structure until the model converged. For words 1, 4, and 5, models converged with the most complex random effects structure. For word 2, the final model only included main effects and no interaction, while, for word 3, only the interaction in the by-items slopes was removed.

Table 1: Mean reading times and standard errors for Experiment 1.

Pronoun type		Word 1	Word 2	Word 3	Word 4	Word 5
DPro	Example	*dessen*	*liebstes*	*Essen*	*weil*	*er*
		his$_{DPRO}$	*favorite*	*dish*	*because*	*he*
	Male object	411 (8)	454 (10)	527 (15)	448 (10)	387 (6)
	Male subject	404 (7)	480 (12)	580 (20)	454 (10)	399 (8)
	Difference	– 7	26	53	6	12
	d	0.07	0.16	0.26	0.22	0.07
PPro	Example	*sein*	*liebstes*	*Essen*	*weil*	*er*
		his$_{PPRO}$	*favorite*	*dish*	*because*	*he*
	Male object	400 (7)	456 (10)	525 (15)	441 (9)	388 (7)
	Male subject	409 (9)	444 (10)	512 (17)	446 (10)	401 (8)
	Difference	9	– 12	– 13	5	13
	d	0.08	0.11	0.09	0.01	0.12

Note: Words 1–5 = Word regions of interest; Male object = female subject referent, male object referent (male object condition); Male subject = male subject referent, female object referent (male subject condition); DPro = demonstrative pronoun; PPro = personal pronoun; Difference = subject reading – object reading; Standard errors in parentheses; *d* = Cohen's *d*.

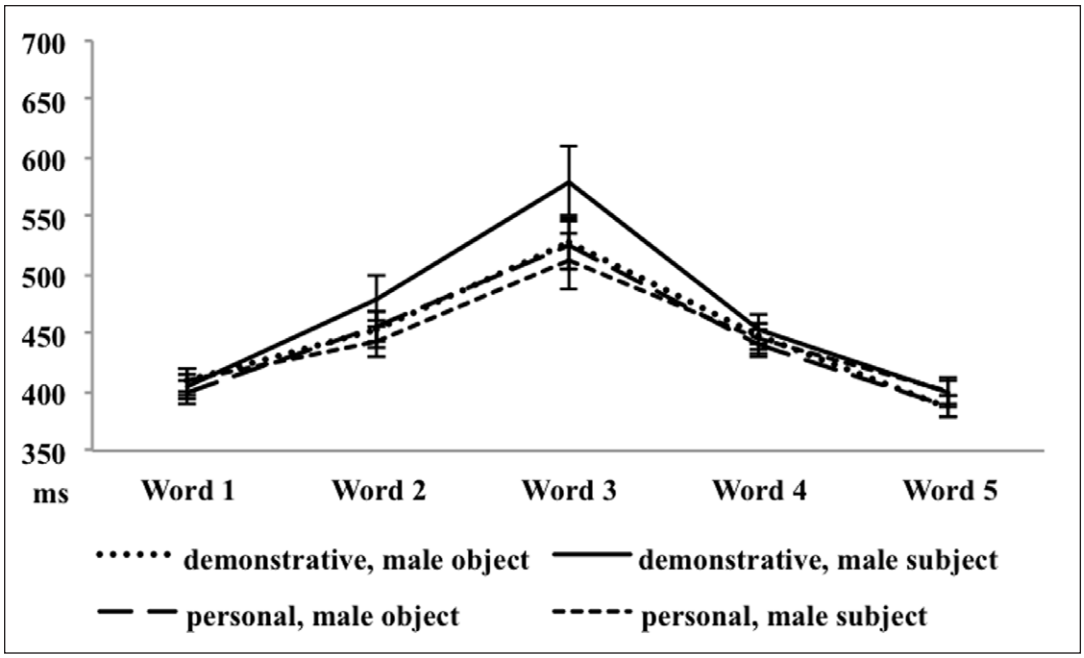

Figure 1: Mean reading times in milliseconds and 95% confidence intervals of word regions in Experiment 1. Demonstrative = demonstrative pronoun; Personal = personal pronoun; Male object = female subject referent, male object referent (male object condition); Male subject = male subject referent, female object referent (male subject condition).

Grammatical role and pronoun type were centered prior to analysis and *p*-values calculated on the assumption that our models' intercepts are normally distributed. For each word region, we fitted an individual model.

For first, fourth, and fifth words of our regions of interest, we failed to find any reliable reading time differences between conditions, $ts < 0.9$, $ps > 3$. However, for the second word region, the male object condition was read faster than the male subject condition, but only when the sentence included a DPro, leading to a Grammatical role × Pronoun

type interaction β = 12.75e-04, SE = 5.57e-04, t = 2.29, p = .022. The same was true for the third word region, β = 5.63e-04, SE = 2.85e-04, t = 1.97, p = .049. To ensure that the observed reading time differences generalized to both prepositional and non-prepositional object versions of test sentences, we reran the models for the second and third word, while including object type (prepositional object or non-prepositional object) as a co-variant. Log-likelihood ratio testing revealed no improvement of model fit for the second, $\chi^2(1) = 0.96$, p = .327, or the third word, $\chi^2(1) = 0.03$, p = .862.

2.1.3 Discussion

The reading time data of Experiment 1 show that, first, the male object condition with a DPro was read faster than the male subject condition with a DPro and, second, that the male object condition with a DPro was read as fast as the male object condition with a PPro. These data speak against the claim that DPros can generally not be bound. If this were the case, the male object variants of sentences should have led to longer reading times in pronoun regions when the sentence included a DPro than when it included a PPro. This is not what we observed. A more straightforward explanation of the observed data pattern is provided by Hinterwimmer (2015): DPros avoid grammatical subjects as binders (see also Bosch & Umbach 2006; Kaiser 2010).

We should point out here that one might argue that participants adopted a relative clause interpretation for the male object DPro condition, as *dessen* matches in form with the genitive form of the German relative pronoun. If this were correct, the male subject DPro sentences were read more slowly because readers were surprised with a male relative pronoun used for a female marked head noun. We think that this alternative interpretation of the data is highly unlikely, though. First, in 12 out of 20 experimental sentences the pronoun was embedded in a prepositional phrase, thereby blocking a relative clause reading. Second, relative clauses require the use of a comma, which was never present in our items. Third, if readers had adopted a relative clause reading, we should have observed a strong reading slow-down for the male object DPro condition at the point the relative clause reading turned out to be false. We should then have observed a reading slow-down for male object DPros in the later spillover region, which is not what we found (cf. Figure 1).

2.2 Experiment 2

In Experiment 2, we used the same design as in Experiment 1. However, unlike for the materials in Experiment 1, in Experiment 2, we only included DPros and the male DP was always a quantificational DP headed by *jeder* 'every' (e.g., *every accountant*). This was done to ensure that DPros cannot only be bound in general, but that they are indeed capable of receiving a bound variable interpretation, contra Wiltschko (1998) (recall that in cases where the binder is a referential DP, bound readings are equivalent to co-referential ones).

2.2.1 Method

2.2.1.1 Participants

24 students from the University of Cologne participated in this experiment for course credit or monetary compensation (EUR 4). All participants were native speakers of German and reported normal or corrected-to-normal vision. No participant participated in Experiment 1.

2.2.1.2 Materials

We constructed 24 experimental sentences. Each sentence again contained exactly one masculine marked and one feminine marked full DP (e.g., *accountant* and *Mrs. Bauer*). While the general structure of sentences was identical to the items of Experiment 1,

the masculine marked DP was always a quantificational DP headed by *jeder*, such as in *every/each accountant*. An example is provided in (15). All sentences can be found in the Online Supplement.

(15) a. Frau Bauer bringt jedem Buchhalter **dessen neue Daten, die schon**
Mrs. Bauer brings every accountant his new data which already
lange fällig waren.
long overdue were
'Mrs. Bauer brings every accountant his new data, which have been overdue for a while.'

b. Jeder Buchhalter bringt Frau Bauer **dessen neue Daten, die schon**
every accountant brings Mrs. Bauer his new data which already
lange fällig waren.
long overdue were
'Every accountant brings Mrs. Bauer his new data, which have been overdue for a while.'

Like for Experiment 1, we were again interested in potential reading time differences between the male object and male subject condition for regions of interest, starting with the pronoun (see words in bold in (15)). Filler and distractor sentences were the same as for Experiment 1 and all items were counterbalanced across two presentation lists, such that participants saw 12 sentences in each of the two conditions without encountering any sentence twice. Comprehension questions were presented for 40 filler sentences.

2.2.1.3 Procedure

The procedure was the same as for Experiment 1.

2.2.2 Results

Accuracy of comprehension questions was 97%. Reading times were elicited and analyzed individually for five regions of interest, comparing the male object with the male subject condition. Mean reading times and standard errors for each word region (word 1–5) are presented in Table 2 and plotted in Figure 2. Effect sizes of comparisons, which are provided in Table 2, were again calculated using Cohen's *d*. Prior to statistical analyses, reading times faster than 200 ms and slower than 2000 ms were identified as outliers and therefore excluded (1% of the data). The remaining reading times were log-transformed for each word of interest individually using Box-Cox power transformations.

We again fitted mixed effects models for each word of interest individually, using the same fitting procedure as described for Experiment 1. The independent variable was grammatical role (male object or male subject), and was centered. Random intercepts and random slopes were included for participants and items. Final models for all words only included the main effect of grammatical role in the by-participants and by-items random slopes.

Results for Experiment 2 replicated those of Experiment 1. We failed to find statistically reliable reading time differences between male object and male subject condition for the first, second, and fifth word, $ts < 1.5$, $ps > .2$. However, we found a reliable difference for the third, $\beta = 2.71\text{e-}03$, $SE = 1.28\text{e-}03$, $t = 2.11$, $p = .035$, and a marginal difference for the fourth word of interest, $\beta = 7.69\text{e-}05$, $SE = 4.05\text{e-}05$, $t = 1.90$, $p = .058$. To investigate whether the observed data pattern generalized to both prepositional and non-prepositional object versions, we again compared the final regression models with models that additionally included object type (prepositional vs. non-prepositional) as predictor using log-likelihood ratio tests. No improvement of model fit obtained for word three, $\chi^2(1) = 0.63$, $p = .478$, or word four, $\chi^2(1) = 1.27$, $p = .260$.

Table 2: Mean reading times and standard Errors for Experiment 2.

	Word 1	Word 2	Word 3	Word 4	Word 5
Example	**dessen**	**neue**	**Daten**	**die**	**schon**
	his$_{DPRO}$	**new**	**data**	**that**	**already**
Male object	452 (8)	491 (12)	592 (17)	483 (10)	436 (7)
Male subject	450 (9)	515 (13)	627 (18)	510 (11)	452 (9)
Difference	–2	24	35	27	16
d	0.07	0.18	0.14	0.05	0.05

Note: Words 1–5 = Word regions of interest; Male object = female subject referent, male object referent (male object condition); Male subject = male subject referent, female object referent (male subject condition); Difference = subject reading – object reading; Standard errors in parentheses; *d* = Cohen's *d*.

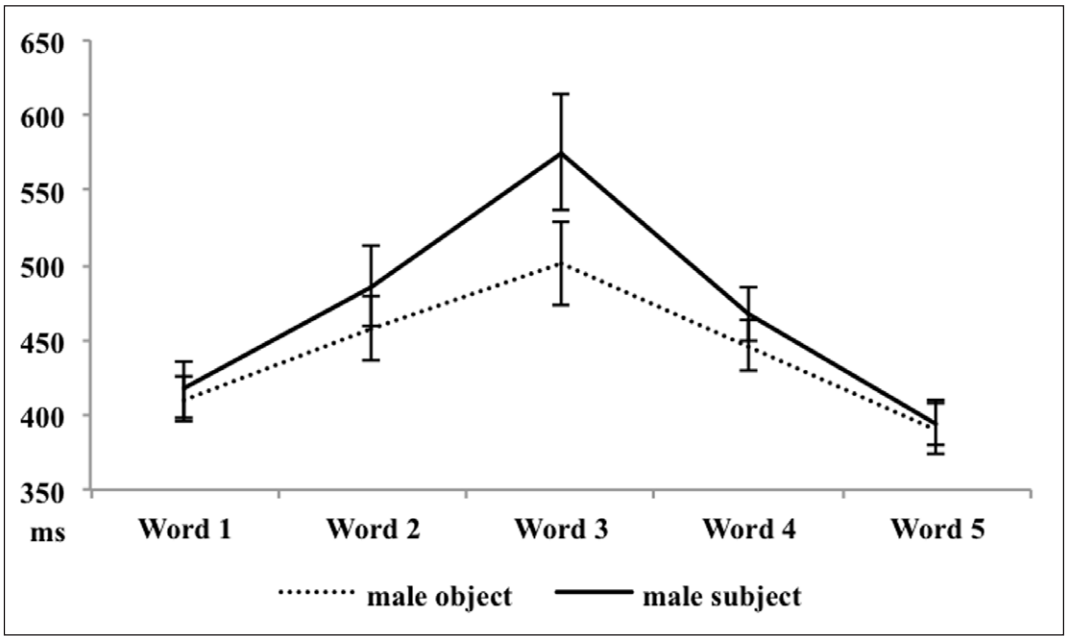

Figure 2: Mean reading times in milliseconds and 95% confidence intervals of word regions in Experiment 2. Male object = female subject referent, male object referent (male object condition); Male subject = male subject referent, female object referent (male subject condition).

2.2.3 Discussion

The close resemblance of the reading time differences between the DPro conditions in Experiment 1 and Experiment 2 are difficult to entertain within a framework that generally disallows DPros from receiving a bound variable interpretation (Wiltschko 1998). However, our data are fully in line with the proposal that DPros can be interpreted as bound variables as long as the (potential) binder is not the grammatical subject of the respective sentence (Hinterwimmer 2015).

Before we continue, there is an important point to address: Reading times were overall longer in Experiment 2 than Experiment 1. Considering that only the test materials of Experiment 2 unambiguously forced bound readings, one might argue that, relative to PPros, DPros are still marked variants, at least when they trigger bound readings. In other words, although the data from Experiment 2 provide evidence that, in binding configurations, DPros can more easily be bound by a preceding object than a preceding subject quantifier, they might still be poorer candidates, in both binding contexts, than their PPro counterparts. To test for this possibility, we conducted an offline rating study including DPros and PPros in quantification contexts.

If the longer reading times observed in Experiment 2 were due to the fact that bound readings of DPros are generally less acceptable than their (potentially) co-referential interpretations, the test sentences of Experiment 2, which included DPros, should be less acceptable than when these sentences include a PPro, which is arguably not marked. If, on the other hand, the longer reading times in Experiment 2 were simply due to the fact that we recruited overall slower readers in the second than the first experiment, the experimental sentences of Experiment 2 should be rated as similarly acceptable when they involve object binding irrespective of whether they include a DPro or a PPro.

2.3 Experiment 3

In Experiment 3, we tested the experimental sentences of Experiment 2, with the only difference that test sentences were presented in both a DPro and a PPro condition.

2.3.1 Method

2.3.1.1 Participants

Sixty-four participants took part in Experiment 3. Participants were recruited over Prolific and self-reported that their native language was German. They received 2.00 pounds for their participation in the experiment.

2.3.1.2 Materials

We used the same 24 experimental sentences that we used in Experiment 2. However, in Experiment 3, we also tested these sentences in a PPro condition. That is, experimental sentences either included a DPro, like in Experiment 2, or they included a PPro. This led to the creation of four experimental conditions: DPro – male object, DPro – male subject, PPro – male object, and PPro – male subject.

Experimental sentences were distributed across four presentation lists. Each list contained six DPro sentences with a male subject and a female object referent, six sentences with a DPro and a female subject and a male object, six sentences with a PPro and a male subject and a female object, and six DPro sentences with a female subject and a male object. The four lists also included 32 filler sentences, 16 of which were fully acceptable and 16 of which made little to no sense.

2.3.1.3 Procedure

Materials were constructed and presented using Qualtrics. All sentences were presented on a single page together with seven blank stars. Participants were asked to judge how acceptable they thought a presented sentence was. They were instructed to assign many, i.e. up to seven stars when they judged a sentence to make good sense, and few, i.e. up to zero stars when they thought that the presented sentence made little or no sense. To ensure that participants understood their task and to provide a measure of "making sense," three practice sentences were provided at the beginning of the experiment, along with some narrative explaining why the presented sentence made sense, made moderate sense, or made no sense at all.

2.3.2 Results

Sentences with male objects were rated as overall more acceptable than sentences with male subjects, in both the DPro and the PPro conditions. More interestingly, though, sentences with a DPro and a male subject were rated as much less acceptable than their PPro counterparts. Sentences with a DPro and a male subject received a mean acceptability score of 4.23 ($SE = 0.10$). Corresponding sentences with a PPro received a mean acceptability score of 4.88 ($SE = 0.09$). Sentences with a masculine marked object received a

mean acceptability score of 5.51 ($SE = 0.08$) when the sentence contained a DPro, and a mean acceptability score of 5.38 ($SE = 0.09$) when it contained a PPro.

To test for statistical reliability, we fitted a linear mixed effects model with grammatical role (male object or male subject) and pronoun type (DPro or PPro) as well as their interaction as predictors and acceptability scores as dependent variable. The model included random intercepts and random slopes for participants and items. Random slopes converged with the Grammatical role × Pronoun type interaction. The output of the model reveals a significant Grammatical role × Pronoun type interaction, $\beta = -0.78$, $SE = 0.20$, $t = -3.84$, $p < .001$. This statistically confirms the observation that there was a much larger difference in acceptability between DPro and PPro versions when the pronoun was bound by the subject quantifier than when it was bound by the object quantifier.

Results of Experiment 3, then, are a nice extension of the reading time data of Experiment 1 and suggest that reading times in Experiment 2 were not overall longer because bound versions of DPros were generally less acceptable than potentially co-referential versions, which were tested in Experiment 1. Indeed, we elicited very similar acceptability scores for DPros and PPros when the pronoun could be bound by the object quantifier, which is not compatible with the view that bound readings of DPros are generally dispreferred. Instead, DPros only seem to be dispreferred when the only available binder is a subject DP, which is fully compatible with our reading time data from Experiments 1 and 2.

Before turning to the General Discussion, we would like to point out a potential shortcoming of the data tested in Experiments 2 and 3.[2] As shown by Roberts (1989) and on the basis of examples like the one in (16), quantificational DPs headed by *every* and *each* allow telescoping. That is, under specific conditions, quantificational DPs seem to bind pronouns that they clearly do not c-command, neither at the surface nor at LF. In contrast to this, downward entailing quantifiers do not allow telescoping.

(16) Roberts (1989: 717)
Each degree candidate walked up to the stage. He took his diploma from the Dean and returned to his seat.

Because we only used sentences with quantificational DPs headed by *jeder* 'every' in Experiments 2 and 3, we cannot rule out the possibility that the object quantifiers in our test materials do not enter into standard binding configurations with the DPros, and that telescoping might therefore be involved. In addition, the variant of the DPro version of our test sentence in (15a) given in (17a), in which the universally quantified DP is replaced by a negative DP, is judged as slightly degraded by some informants and does not sound entirely natural to us either. Note that the variants in (17b) and (17c), where the respective quantificational DP does not have an overt NP as its complement, seem completely unacceptable. In contrast, the variants with the PPros in (18) all seem felicitous.

(17) a. (??)Frau Bauer bringt keinem Buchhalter dessen neue Daten.
Mrs. Bauer brings no accountant his new data
'Mrs. Bauer brings no accountant his new data.'

b. *Frau Bauer bringt keinem dessen neue Daten.
Mrs. Bauer brings nobody his new data
'Mrs. Bauer brings nobody his new data.'

[2] We are grateful to an anonymous reviewer for making us aware of this.

c. *Frau Bauer bringt jedem dessen neue Daten.
Mrs. Bauer brings everyone his new data
'Mrs. Bauer brings everyone his new data.'

(18) a. Frau Bauer bringt keinem Buchhalter seine neuen Daten.
Mrs. Bauer brings no accountant his new data
'Mrs. Bauer brings no accountant his new data.'

b. Frau Bauer bringt keinem seine neuen Daten.
Mrs. Bauer brings nobody his new data
'Mrs. Bauer brings nobody his new data.'

c. Frau Bauer bringt jedem seine neuen Daten.
Mrs. Bauer brings everyone his new data
'Mrs. Bauer brings everyone his new data.'

While we do not have an ultimate explanation for the unacceptability of (17b) and (17c) and the intuition that (17a) is somewhat degraded, albeit not unacceptable, we consider it unlikely that telescoping can explain these contrasts. First, the contrast in acceptability between (17a), on the one hand, and (17b) and (17c), on the other, is not expected if telescoping were involved: Replacing the universally quantified DP in (16) by a negative DP, as shown in (19), does not only make telescoping more difficult; it makes telescoping completely unavailable.

(19) No degree candidate walked to the stage. #He took his diploma from the Dean and returned to his seat.

Second, whatever the correct account of telescoping is, it seems to be a rather complicated process that is only available under very specific and still poorly understood discourse conditions involving factors such as narrative continuity (see the brief discussion in Roberts 1989). It does not seem to be an all-purpose repair mechanism that applies whenever standard variable binding fails. Finally, we are not aware that telescoping has ever been proposed for cases in which standard binding is possible, i.e. cases in which the quantifier c-commands the pronoun on the surface already or precedes it on the surface and can easily take scope over it at LF (which, recall, are the conditions which we, following Barker 2012, consider to be decisive for binding configurations).

Of course, the discussed contrasts between (17), on the one hand, and the sentences in (18), on the other, need to be accounted for. For now, we do not have a conclusive explanation. Intuitively, what seems to be relevant is the availability of a specific set of individuals as the domain of quantification for a quantifier that is to bind a DPro. This is further suggested by the observation that (20), which also contains a negative quantifier, sounds entirely natural:

(20) Maria hat mit keinem ihrer Studenten *über* dessen Seminararbeit gesprochen.
Maria has with none her.GEN students about his termpaper talked
'Maria talked to none of her students about his term paper.'

Needless to say, that the above-discussed contrasts do not follow from anything said in Hinterwimmer (2015) (or any of the other discussions on DPros). However, with the data at hand, we do not see the putative existence of the discussed restriction as a reason to reject the idea that DPros can be bound by quantificational DPs c-commanding them on the surface or at LF at the latest.

3 General discussion

In this paper, we investigated participants' reading behavior and acceptability ratings for sentences in which DPros can receive a bound reading. We presented data from two self-paced reading experiments and an acceptability rating study, which, as they stand, are fully compatible with the claim that DPros can be bound by referential as well as quantificational DPs, as long as the respective DP does not function as the grammatical subject (Hinterwimmer 2015). Our data are difficult to explain within a framework that generally disallows DPros from being bound (Wiltschko 1998). In Experiment 1, we found that reading times of DPros and immediately subsequent words were very similar to those of PPros and immediately subsequent words in parallel sentences, provided that the potential binder was not the grammatical subject. When the pronoun could only be bound by a DP functioning as the grammatical subject, the DPro versions of sentences led to significantly longer reading times than the corresponding PPro versions. The observation that DPros avoid grammatical subjects as binders was replicated in Experiments 2 and 3, where the potential binders of the pronouns were quantificational DPs. Reading times were significantly longer and acceptability ratings significantly lower when the potential binder was the subject than when it was a direct, indirect, or prepositional object.

Taken together, our results fit nicely with the proposal in Hinterwimmer (2015) that DPros are prohibited from being bound by the most prominent DP. On this account, because syntactic prominence is decisive in (potential) binding configurations, and because grammatical subjects are the syntactically most prominent DP within the respective clause, DPros are prohibited from being bound by grammatical subjects.

Note that our data from Experiment 1, directly comparing DPros and PPros, are also difficult to explain with ambiguity avoidance (Patel-Grosz and Grosz 2017). If DPros are indeed marked pronouns that are predominantly used to avoid ambiguity in binding configurations, we should have found longer reading times for sentences where the DPro was bound by the object than for sentences where the DPro was replaced by a PPro (see Arnold & Griffin 2007 for a discussion of the relationship between choice of referential form and ambiguity avoidance). This would have been expected because by virtue of using one masculine marked and one feminine marked antecedent in our test sentences, no ambiguity was ever present in our materials. We should point out, though, that our results do not ultimately rule out the claims in Patel-Grosz and Grosz (2017). Indeed, there might be a pragmatic benefit associated with the male object condition including a DPro that Patel-Grosz and Grosz (2017) did not consider.[3] At least in the absence of an alternative explanation of our results in terms of pragmatic benefits, then, our results nevertheless provide preliminary evidence against the analysis of Patel-Grosz & Grosz (2017).

We should point out that all data obtained in the present study are based on the use of the possessive form of the demonstrative pronoun contained in direct or prepositional object DPs. Of course, there is a large literature on reference management that shows that subject and object position do not behave the same in referent tracking (e.g., Crawley & Stevenson 1990; Gernsbacher 1990; Gordon, Grosz & Gilliom 1993; Stevenson, Crawley &

[3] An anonymous reviewer suggested that the relevant pragmatic effect might be the signaling of a topic shift away from the respective subject referent to the referent of the DPro (cf. Diessel 1999). While this is conceivable for the test items in Experiment 1, where the DPros are bound by referential DPs, it is difficult to entertain for Experiment 2, where the referent of the respective DPro varies with the individuals quantified over by the object DP. It can thus by definition not be the topic of the following sentence. As we have seen in Section 2.2, however, the results concerning the difference in reading times between subject and object conditions were replicated in Experiment 2. An entirely different pragmatic effect would then have to be invoked for these cases.

Kleinman 1994; Arnold 1999; Arnold & Wasow 2000). In fact, Schumacher et al. (2015) have recently shown that personal pronouns and demonstrative pronouns behave differently depending on the syntactic position that they appear in. Clearly, more research is needed to disentangle type of pronoun and syntactic position.

In recent work, Hinterwimmer and Bosch (2016; 2017) have argued that DPros do not really avoid discourse topics as antecedents, but that they are rather anti-logophoric pronouns which avoid individuals functioning as perspectival centers as antecedents. Intuitively, an individual is a perspectival center with respect to a proposition if that proposition is understood as the content of a thought of that individual or describes an event or state in a way that is compatible with the doxastic state of that individual at the time at which he or she perceives it. Importantly, Hinterwimmer and Bosch (2016; 2017) assume discourse topics to be perspectival centers by default, (i.e. in the absence of a speaker or narrator making her own perspective salient), thus accounting for the impression that DPros avoid discourse topics. The authors show, however, that when the two notions come apart, DPros can easily be understood as picking up individuals functioning as discourse topics.

As further noted by Hinterwimmer and Bosch (2016; 2017), the assumption that DPros are anti-logophoric pronouns can also account for the contrast between (5) and (6), since the subjects in (5) are the perspectival centers with respect to the propositions denoted by the embedded clauses containing the DPros, while this is not true for the prepositional object in (6a) and the indirect object in (6b). Whether this analysis can also be extended to account for the contrasts discussed in the present paper is not clear, though there is no independent evidence that the individuals denoted or quantified over by the DPs functioning as grammatical subjects in our test sentences are necessarily perspectival centers with respect to the sentences containing them, while the ones denoted or quantified over by the DPs functioning as indirect objects are not. We thus leave it as a topic for future research whether subject avoidance in binding configurations needs to be retained as an independent constraint in addition to anti-logophoricity or whether it can ultimately be derived from (or at least be related to) it.

Additional Files

The additional file for this article can be found as follows:

- **Online Supplement.** Test sentences used in Experiments 1 and 2 along with their English translations, and a short description of the pilot study. DOI: https://doi.org/10.5334/gjgl.150.s1

Abbreviations

DAT = dative, DPRO = demonstrative pronoun, GEN = genitive, PPRO = personal pronoun, REFL = reflexive pronoun.

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Competing Interests

The authors have no competing interests to declare.

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