Symmetric but non-complementary: Gradient paradigmatic opposition in binding

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Abstract This paper relies on experimental data on the interpretation of Estonian proforms to argue for an overhaul of Binding Theory. First, we show that classical binding principles are unable to capture the distribution of nonreflexive proforms, which must be locally free in finite clauses but may be bound in embedded infinitives. Second, we provide evidence that possessives exhibit a symmetrical distribution: while the proportion of local antecedents for possessive reflexives varies depending on the syntactic context, it matches the proportion of nonlocal antecedents for antireflexives. This is strong evidence for the existence of substantial grammatical constraints on binding of a gradient nature. Third, we propose a 2×2 typology of systems of binding constraints, which can be symmetric or asymmetric and categorical or gradient. We provide empirical evidence that all four types are attested.

Keywords Binding Theory · reflexive · possessive · experimental · Estonian

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1 Introduction: possessives and binding theory

Reflexive proforms are anaphoric expressions with an affinity towards local antecedents: for instance, *herself* in (1a) needs to be bound by the subject of the embedded clause. They contrast with what we call antireflexive proforms, which have the opposite affinity: witness the binding potential of *her* in (1b).[1]

[1]Generative literature since Chomsky (1981) uses anaphor as a cover term for reflexives and reciprocals, and pronominal for what we call antireflexives, a reassignment of traditional grammatical labels leading to much confusion. As we will have nothing to say on reciprocals in this paper, we adopt from Heine (2005); González et al. (2020) the term antireflexive as a name for those proforms with binding properties opposite to those of reflexives.

(1) a. Mary$_i$ was surprised that Eva$_j$ was blaming herself$_{*i/j/*k}$ for the accident.
b. Mary$_i$ was surprised that Eva$_j$ was blaming her$_{i/*j/k}$ for the accident.

Classical binding theory (Chomsky 1981) regulates the distribution of reflexives and antireflexives through the separate but complementary principles A and B: reflexives must be bound by a commanding expression in their binding domains, while antireflexives can't. An appropriate definition of binding domains that captures the whole distribution of each proform is thus a crucial ingredient of the theory. For English, the relevant binding domain for reflexives is taken to be what Büring (2005) calls the SUBJECT DOMAIN, i.e. the smallest constituent containing the reflexive and either a subject or a possessive. This makes the correct predictions about the binding of *herself* in the following examples, where the binding domain is indicated in square brackets.

(2) a. [Jane$_i$ washes herself$_i$].
b. [Jane$_i$ saw a picture of herself$_i$].
c. [Jane$_i$'s picture of herself$_i$] is beautiful.

One of the main challenges facing classical binding theory is to account for situations of noncomplementarity in the distribution of reflexives and antireflexives.[2] Standard accounts (Chomsky 1981; Kuno 1987; Hestvik 1991) rely on the idea that different proforms have qualitatively different binding domains. In particular, English antireflexives rely on the COARGUMENT DOMAIN, the smallest constituent containing the head assigning a semantic role to the proform and its arguments. As the coargument domain is, in some configurations, smaller than the subject domain, this correctly predicts an overlap between the distribution of English reflexives and antireflexives. This is the case in example (3), where *around* assigns a semantic role to its object but does not have a subject.

[2]Other challenges not discussed in this paper include what we call neutral proforms, i.e. proforms that can be either free or bound (Zribi-Hertz 1995), exempt reflexives (Pollard & Sag 1992), long-distance reflexives (Dalrymple 1993), logophors (Reuland 2001) as well as non-subject oriented forms such as Norwegian *ham selv* (Hellan 1980; 1988; Jakubowicz 1984).

(3) [$_{SD}$ John$_i$ looked [$_{CD}$ around himself$_i$/him$_i$]]

In this paper, we focus on *possessive* reflexives and antireflexives, which raise important challenges for classical binding theory. Estonian is an example of a language with such types of proforms. In simple clauses, they exhibit the expected complementary distribution: reflexive *oma* must be bound by the local subject, while adnominal genitive pronouns such as the first-person singular *minu* and second-person singular *sinu*, as antireflexives, can't (Erelt et al. 1993; Metslang 2013), as we can see in (4).[3]

(4) a. *Ma loe-n oma raamatut.*
1SG.NOM read-1SG REFL.POSS book.PART
'I read my book.'
b. *Ma loe-n sinu raamatut.*
1SG.NOM read-1SG 2SG.GEN book.PART
'I read your book.'
c. **Ma loe-n minu raamatut.*
1SG.NOM read-1SG 1SG.GEN book.PART

In infinitive complement clauses, both reflexives and antireflexives may be bound by either the implicit embedded subject or the subject of the embedding clause.

(5) a. *Ma$_i$ luba-n sind$_j$ PRO$_j$ oma$_{i/j}$*
1SG.NOM authorize-1SG 2SG.PART REFL.POSS
kredikaarti kasuta-da.
credit_card.PART use-INF
'I give you permission to use my/your credit card.'
b. *Ma$_i$ luba-n sind$_j$ PRO$_j$ minu$_i$*
1SG.NOM authorize-1SG 2SG.PART 1SG.GEN

[3]Some authors (Reuland 2011; Despić 2015) call *reflexive possessive* any possessive that is required to be bound, whether or not they contrast with an antireflexive. This leads to lumping together Estonian *oma*, which in most contexts is in complementary distribution with genitive proforms, and e.g. Mandarin Chinese *ziji-de*, which can always be replaced by the binding-agnostic possessive *ta-de*. We adopt a narrower usage, and will qualify a possessive as reflexive only when it contrasts with an antireflexice counterpart.

kredikaarti *kasuta-da.*
credit_card.PART use-INF
'I give you permission to use my credit card.'

c. *Ma*$_i$ *luba-n* *sind*$_j$ *PRO*$_j$ *sinu*$_j$
1SG.NOM authorize-1SG 2SG.PART 2SG.GEN
kredikaarti *kasuta-da.*
credit_card.PART use-INF
'I give you permission to use your credit card.'

The data so far is consistent with postulating that reflexive *oma* must be bound in the TENSE DOMAIN, as has been proposed for its Norwegian counterpart (Hellan 1988). However, there is no possible specification of a binding domain that will account for the distribution of antireflexives in both (4) and (5): the antireflexive can be bound by the local subject in an infinitive complement clause, but not in a finite clause.[4] The classical formulation of binding principles, which are supposed to be valid across constructions, cannot capture this distribution. In the next section we further argue that, in situations like (5) where there is no categorical constraint on the use of a reflexive or antireflexive, there are still gradient preferences going in the direction of the binding principles.

2 Symmetric binding

This section describes the results of two experiments and analyses their results. These experiments document the interpretation of the Estonian reflexive and antireflexive possessives in contexts other than prototypical simple finite clauses. We propose a post hoc analysis, as the experiments were run with a different purpose. In both cases, participants read sentences and then answered a question eliciting the referent of the possessive form, with two semantically and morphologically plausible choices. We refer the reader to Lesage & Bonami (2021) and Lesage (2022b) respectively for a full description of experimental designs.

[4]The same pattern is found in other languages with reflexive possessives, including Czech (Lesage 2022a), Danish (Lundquist 2014) and Swedish (Tingsell 2007).

2.1 Experiment 1: Binding in embedded infinitives

Seventy-six native speakers of Estonian recruited on social media took part in the first experiment. They were asked to first read a sentence or a pair of sentences, and then fill a gap in second sentence rephrasing the sentence they had read (see 1). The experiment contained twenty-four items and thirty-six fillers. The experiment had six conditions. Three ways of expressing the possessor were possible: reflexive, antireflexive, or no overt expression. There were also two syntactic contexts: the proform was either in an independent clause preceded by another clause containing a possible antecedent (6a), or in an embedded infinitive clause where the main clause contained a possible antecedent (6b). Conditions with unexpressed possessors are irrelevant to the present argument, and will thus be omitted. Sample materials are shown in Table 1.

(6) a. ***Paul*** *on kõik läbi mõel-nud.* ***Katrin*** *jätab oma/tema dokumend-id registratuuri.*
Paul.NOM be.3SG.PRS all through think-PPAST Katrin leave3SG.PRS POSS document-PL.NOM reception.ILL
'Paul made arrangements. Katrin will leave his/her documents at the reception.'

b. ***Paul*** *lase-b* ***Katrini-l*** *oma/tema dokumendi-d registratuuri jät-ta.*
Paul.NOM let-3SG.PRS Katrin-ADE POSS document-PL.NOM reception.ILL leave-INF
'Paul allowed Katrin to leave his/her documents at the reception.'

We expect reflexives and antireflexives to be in complementary distribution in simple clauses, as we have seen in (4): the reflexive must be interpreted as having the local subject (*Katrin*) as an antecedent and the antireflexive cannot be given this interpretation. In the experimental configuration, the only available antecedent for the antireflexive is the subject of the sentence preceding the sentence containing the possessive form (*Paul*). In nonfinite clauses, we expect the distribution of possessives not to be complementary, as we have seen in examples (5). More precisely, we hypothesize that the reflexive still has a preference for the local subject (*Katrin*), and the antireflexive has a preference for the non-local subject (*Paul*).

Clause type	Proform	Example
Independent	Reflexive	*Paul on kõik läbi mõelnud. Katrin jätab oma dokumendid registratuuri.*
	Antirefl.	*Paul on kõik läbi mõelnud. Katrin jätab tema dokumendid registratuuri.* 'Paul made arrangements. Katrin will leave his/her documents at the reception.'
Infinitive	Reflexive	*Paul laseb Katrinil oma dokumendid registratuuri jätta.*
	Antirefl.	*Paul laseb Katrinil tema dokumendid registratuuri jätta.* 'Paul allowed Katrin to leave his/her documents at the reception.'
Sentence to fill		_____ *dokumendid jäetakse registratuuri.* 'Someone left _____'s documents at the reception.'

Table 1 Materials for experiment 1

Experimental results shown in Figure 1 confirm our assumptions. In simple clauses, reflexives and antireflexives are in complementary distribution. In infinitive complement clauses, the distribution is not complementary, but the proportion of local antecedents is still higher for reflexives than for antireflexives.[5] A generalized linear mixed model [6] trained only on possessives in infinitive clauses confirmed the statistical significance of the effect. Note that, as Figure 1 makes clear, most participants exhibit variation in their responses for infinitive clauses. Hence the effect is not driven by different subpopulations having different categorical preferences. Although this is not shown in the figure, we likewise observe that most items do not give rise to uniform responses across participants.

[5] A similar experiment on Czech gives rise to the same pattern (Lesage 2022a).

[6] This model had participants' answer as the dependent variable. Fixed effects were the clause type, the possessive proform, as well as their interactions. Random intercepts were included for participant and item.

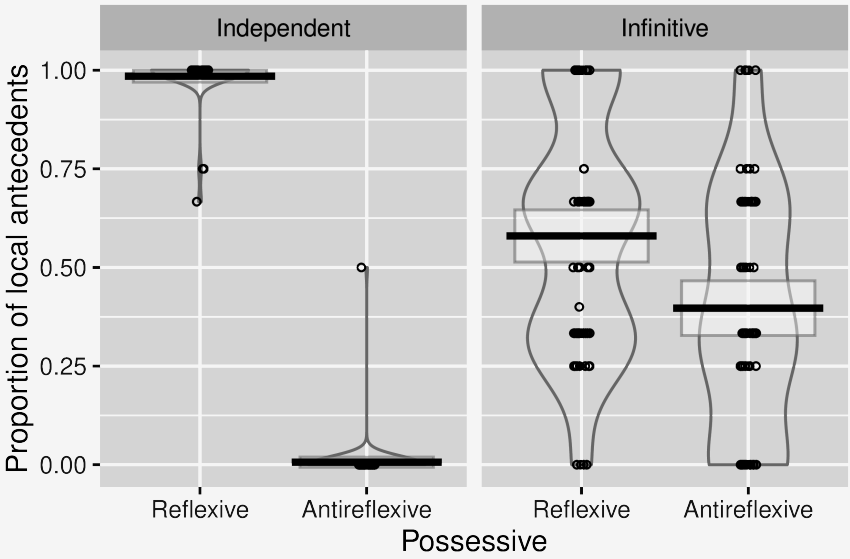

Figure 1 Main results of experiment 1. The horizontal line is the global mean, with the box around it specifying the 95% confidence intervals assuming a normal sampling distribution. Individual points indicate by-participant averages.

2.2 Experiment 2: Binding with non-canonical argument structure constructions

The second experiment focused on binding in a noncanonical argument structure construction, where a nominative argument realizes the stimulus and an allative argument realizes the the experiencer (7). This construction is of particular interest in terms of binding, as both arguments can bind either a reflexive or antireflexive possessive.[7]

(7) ***Katrin*** *meeldi-s* ***Pauli-le*** *[oma/tema õnnetuse-ks].*
Katrin.NOM appeal-3SG.PST Paul-ALL POSS misfortune-TR
'Paul loved Katrin for his/her great misfortune.'

[7]There are other non-canonical constructions in Estonian in which the possessive's binding is atypical (i.e. the reflexive possessive is bound by the oblique argument), but in those constructions the reflexive possessive cannot be bound by the subject and the antireflexive possessive cannot be bound by the oblique argument (Lesage 2022b). They are not relevant for our point.

This unusual behavior is certainly linked to the fact that this construction leads to an unusual mix of properties for the two arguments. Although the nominative argument is clearly the syntactic subject (it is the agreement trigger, the raised argument in a raising construction, and the deleted argument in impersonal constructions), the allative has some properties associated with subjecthood in canonical constructions: it codes the most agentive semantic role, and is most often realized in preverbal position (88% of the time in Metslang's (2013) study), a position associated with topicality in Estonian and otherwise generally occupied by subjects.

In the experiment, we compared this construction to two different baselines: sentences with a transitive verb and an allative argument expressing a beneficiary (8a), and sentences with a transitive psych verb, with a nominative argument expressing the experiencer and a partitive expressing the stimulus (8b). Note that the first baseline is parallel to the construction of interest in terms of the morphosyntactic case of the potential binders, while the second is parallel in terms of semantic roles.

(8) a. ***Paul*** *laena-s* ***Jaani-le*** *ülikonna [oma/tema*
Paul.NOM lend-3SG.PST Jaan-ALL suit POSS
õe *pulma-de* *jaoks].*
sister.GEN wedding-PL.GEN for
'Paul lent a suit to Jaan for his sister's wedding.'

b. ***Katrin*** *põlga-s* ***Pauli*** *[oma/tema sotsiaalse*
Katrin.NOM despise-3SG.PST Paul.PART POSS social.GEN
päritolu *tõttu].*
origine.GEN because
'Katrin despised Paul because of his/her social class.'

In addition to the construction type, we manipulated word order. In Estonian, word order is free but correlates strongly with information structure (Tael 1988), with the preverbal constituent normally constituting a topic. Thus word order preferences could be shifted in the non-canonical argument structure condition of interest, where the oblique argument is a natural candidate for topicality. [8]

[8]Note that the postverbal subject is even more unusual in canonical constructions that the preverbal suject in a non-canonical construction.

ARG-ST	Order	Example
NOM agent, ALL beneficiary (BenAll)	SX	*Paul laenas Jaanile ülikonna oma/tema õe pulmade jaoks.*
	XS	*Jaanile laenas Paul ülikonna oma/tema õe pulmade jaoks.*
		'Paul lent a suit to Jaan for his sister's wedding.'
Question		*Kelle õe pulmadest on juttu?*
		Whose marriage is it about?
NOM experiencer, NOM stimulus (ExpNom)	SX	*Katrin põlgas Pauli oma/tema sotsiaalse päritolu tõttu.*
	XS	*Pauli põlgas Katrin oma/tema sotsiaalse päritolu tõttu.*
		'Katrin despised Paul because of his/her social class.'
Question		*Kelle sotsiaalse päritolust on juttu?*
		Whose social condition is in question?
PART stimulus, ALL experiencer (ExpAll)	SX	*Katrin meeldis Paulile oma/tema õnnetuseks.*
	XS	*Paulile meeldis Katrin oma/tema õnnetuseks.*
		'Paul loved Katrin for her/his great misfortune.'
Question		*Kelle õnnetusest on juttu?*
		Whose misfortune are we talking about?

Table 2 Materials for experiment 2

Each item sentence in the experiment contained a possessive embedded in an oblique dependent of the verb, indicated by brackets in (7) and (8). Two arguments, indicated in boldface, are potential binders for the possessive. For each construction, type of possessive (reflexive vs. antireflexive) and word order (preverbal vs. postverbal subject) were manipulated. Sample materials are shown in Table 2.

Our assumptions were the following.

- Reflexives and antireflexives are in strict complementary distribution in canonical constructions (BenAll and ExpNom) regardless of word order.
- Reflexives and antireflexives are not in complementary distribution in non-canonical constructions (ExpAll). In this type of construction, word order plays a role: the reflexive favors a preverbal antecedent while the antireflexive favors a postverbal antecedent.

Ninety-five native speakers of Estonian recruited on social media took part in a second experiment that focused on simple finite clauses. They were asked to read a sentence and to answer a question about the sentence they had read. This experiment contained twenty-four experimental items and twenty-five fillers.[9]

As the descriptive statistics in Figure 2 illustrate, part of our assumptions are confirmed. We found a nearly complementary distribution in conditions where both the argument structure construction and the word order are canonical. If either argument structure or word order departs from the canon, the categorical distinction becomes a mere tendency. No difference of behavior between the two types of possessives is found when the sentence is noncanonical in both dimensions. A generalized mixed effects model confirmed the significance of the effect.[10]

Note that the proportions of local subject antecedent in canonical configurations are more extreme in the first experiment than in the second one. It does not seem to us that this difference is attributable (only) to the type

[9] As explained above, we take the nominative argument to be the subject in the non-canonical construction.

[10] The model we used had participants' answer as a dependent variable. Fixed effects were the construction type, the possessive proform, the word order as well as their interactions. Random intercepts were included for participant and item.

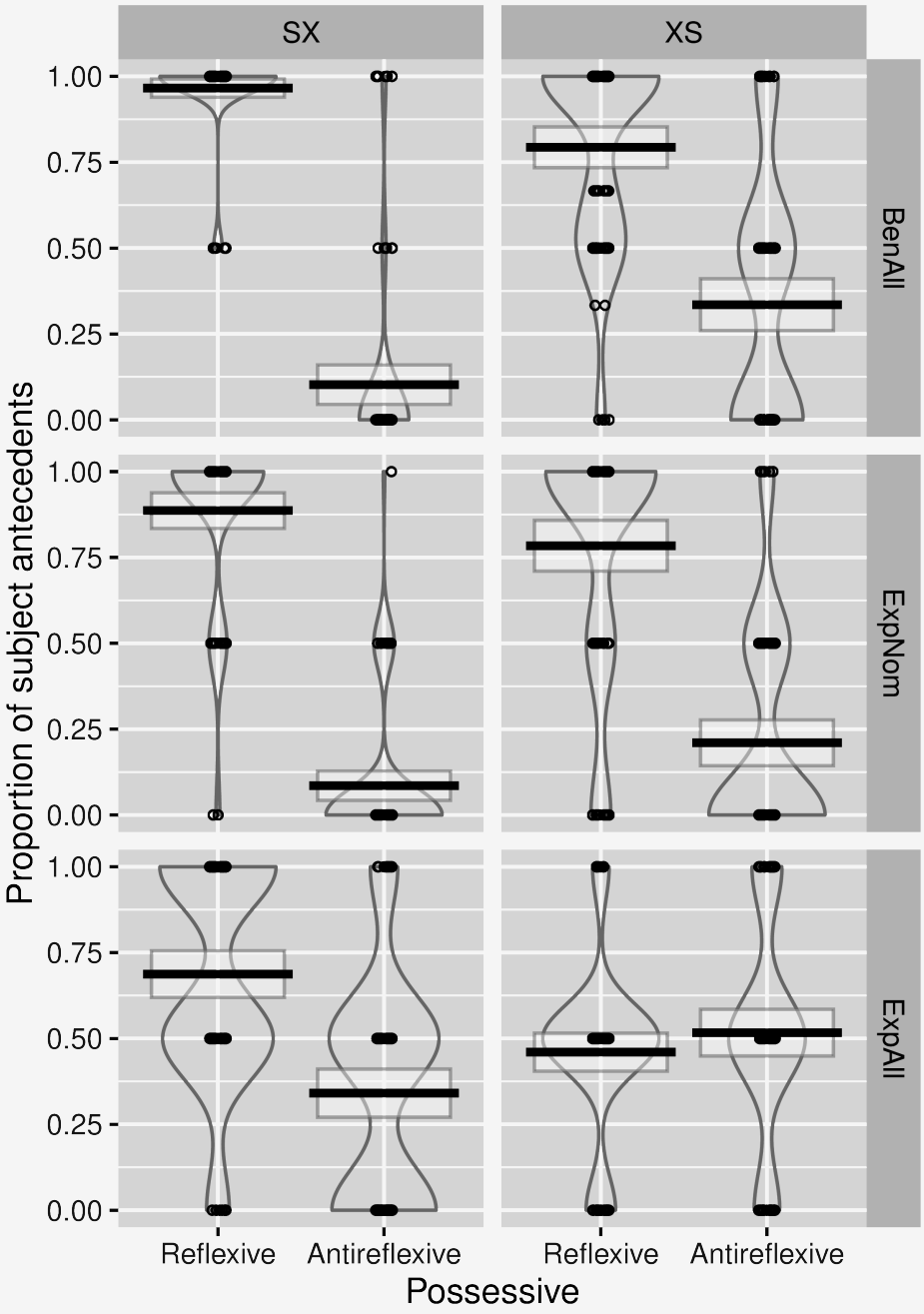

Figure 2 Main results of experiment 2.

of constructions under scrutiny, but rather we think that the nature of the experimental task (answering an open question with a freeform response in experiment 1 and selecting an answer in a list in experiment 2) could lead to this difference.

2.3 Gradient paradigmatic opposition

The experimental results above lead to two striking generalizations. First, while the binding preferences of reflexives and antireflexives do not always lead to a complementary distribution, they are always symmetric: the proportion of choice of one antecedent for the reflexive matches the proportion of choice of the other for the antireflexive. The pattern in the results of experiment 1 or 2 could be the result of chance, but the fact that this pattern is repeated in different constructions of Estonian suggests that it is likely not accidental. In fact, a third experiment on Czech reflexive possessives found the same pattern again (Lesage 2022b). Second, the strength of these preferences varies with the typicality of the syntactic configuration: preferences are maximal in simple finite clauses with a canonical word order and in canonical argument structure constructions; they are weaker for less typical clause types (nonfinite), argument structure constructions, or word orders; these preferences are even unperceivable if the configuration is atypical in more than one dimension.

We take it that these observations must be handled by binding theory, since the same constraints that are categorical and attributed to binding theory in some contexts apply in a gradient manner in other contexts. Our argument is similar to that of Bresnan & Dingare & Manning (2001), who point out a categorical vs. gradient effect of the person hierarchy in passive constructions in Lummi and English. Moreover, as noted above, classical binding theory fails to account for even the categorical aspects of the distribution of antireflexive possessives (see Section 1); hence it needs to be amended anyway, independently of the gradient effects documented above.

To account for the data presented thus far, we appeal to the logic of paradigmatic opposition. We start from the many studies (Bouchard 1983; Yadurajan 1987; Burzio 1996; 1998; Kiparsky 2002; Rooryck & Vanden Wyngaerd 2011) arguing that the symmetric behavior of reflexive and antireflexive expressions should be accounted for with a single mechanism, rather than two independent principles. To this end they posit that the distribution

of antireflexives is due to a blocking effect attributable to the ELSEWHERE PRINCIPLE familiar from phonology and morphology (Kiparsky 1973; Anderson 1992): antireflexive forms are used where reflexives forms are not available.

As elegant as it is, this formulation cannot deal with the present data, as it is crucially dependent on reflexives and antireflexives being not only paradigmatically opposed but in complementary distribution. Instead, we submit that an adequate account of binding constraints for Estonian possessives requires replacing binding principles with four ingredients:

(9) a. A characterization of the BINDING DOMAIN for each reflexive proform. In any sentence, we call REFLEXIVE BINDING TARGETS (RBTs) all commanding referential expressions within the binding domain.
b. A statement of the strength of reflexive binding preferences in different syntactic configurations.
c. A paradigmatic pairing of each (collection of) reflexive proforms with matching antireflexive proforms.
d. The SYMMETRIC BINDING PRINCIPLE (SBP), stating that:
In any syntactic configuration, reflexives and antireflexives display symmetric preferences for the binding of RBTs.

The SBP is readily interpreted in probabilistic terms. In a situation where there is a single RBT *e* that is a reflexive binding target, as with Estonian *oma*, given some sentence frame with a slot containing a proform, the probability of choosing *e* as an antecedent if the proform is reflexive is the complement of the probability of choosing *e* if the proform is antireflexive:

(10) $P(e|\text{reflexive}) = 1 - P(e|\text{antireflexive})$

In our two experiments, the experimental items provide two reflexive binding targets *e* and *e′* inside the sentence. In the absence of a context, participants are unlikely to consider an extra-sentential antecedent. Hence most of the probability mass will be assigned to the two intra-sentential candidate antecedents. This then leads to the symmetric distribution:

(11) $P(e|\text{refl.}) = 1 - P(e|\text{antirefl.}) \approx P(e'|\text{antirefl.}) = 1 - P(e'|\text{refl.})$

Together these four ingredients provide a general account of gradient binding preferences in the Estonian data. Note that the theory as developed so far accommodates the challenging observations on binding domains for antireflexive possessives discussed in Section 1. Antireflexives do not have a binding domain per se, but have binding preferences matching those of the corresponding reflexive. Hence the behavior of antireflexive possessives follows from that of reflexives: in (4), there is a single reflexive binding target, and hence no possibility for an antireflexive to be bound; in (5), there are two reflexive binding targets splitting the probability mass, hence we correctly predict that antireflexives should be bindable by either.

Finally, while it is designed to account for gradient binding preferences, the theory also encompasses as a special case familiar classical binding theory effects, where the distribution between reflexive and antireflexive is complementary and the reflexive has only one possible antecedent. Consider the case of French object reflexive *se*, which takes the local subject as antecedent in all contexts (unlike what happens in Estonian, English, and many other languages), and antireflexive *le*, which never does. In such a situation, the Symmetric Binding Principle makes exactly the same predictions as Rooryck & Vanden Wyngaerd's account: if $P(e|\text{reflexive}) = 1$, then $P(e|\text{antireflexive}) = 0$.

(12) a. *Paul*$_i$ *se*$_{i/*j}$ *lave.*
Paul REFL wash.PRS.3SG
'Paul washes.'

b. *Paul*$_i$ *le*$_{*i/j}$ *lave.*
Paul 3SG.M wash.PRS.3SG
'Paul washes him.'

c. *Paul*$_i$ *demande à Pierre*$_j$ *de se*$_{j/*i}$ *présenter.*
Paul ask.PRS.3SG to Pierre REFL introduce.INF
'Paul asks Pierre to introduce himself.'

d. *Paul*$_i$ *demande à Pierre*$_j$ *de le*$_{i/*j}$ *présenter.*
Paul ask.PRS.3SG to Pierre 3SG.M introduce.INF
'Paul asks Pierre to introduce him.'

3 Toward a typology of binding constraints

3.1 Not all binding is symmetric

In the last section we argued that a principle of symmetric binding captures both the gradient binding properties of Estonian possessives and the categorical distribution of some reflexive/antireflexive pairs. Importantly though, not all reflexive/antireflexive pairs conform to the principle in all contexts. As a case in point, English reflexives and antireflexives do obey the principle in direct object position, but not when the pronoun occurs in the last of a series of complements, as in (13) (see Pollard & Sag 1992: 266 or Van Valin & LaPolla 1997: 398; for a semantic explanation, see Jackendoff 1972). Here the antireflexive can't refer to the subject, hence $P(\mathit{John}|\mathit{him}) = 0$, but the reflexive has two possible binders. As a consequence, $P(\mathit{John}|\mathit{himself}) < 1$.

(13) John_i talks to Peter_j about $\text{himself}_{i/j/*k}$/$\text{him}_{k/*i/*j}$.

Likewise, pronouns in adjuncts do not conform to symmetric binding, as we already saw in (3). This time, the subject is the only possible antecedent for the reflexive, so that $P(\mathit{John}|\mathit{himself}) = 1$, but the antireflexive is not barred from taking the subject as an antecedent, so that $P(\mathit{John}|\mathit{him}) > 0$.

These cases clearly indicate that, while symmetric binding needs to be recognized as one type of binding constraint configuration, it does not account for the distribution of all reflexive/antireflexive pairs, and, in fact, fails to account for well-known cases correctly covered by classical binding theory.

3.2 Laying out a typology of binding constraints

At this point, we have witnessed pairs of proforms having three types of distributions. In the first type, exemplified by French *se* and *le*, reflexive and antireflexive are in full complementary distribution. In the second type, exemplified by Estonian possessives, the two proforms satisfy symmetric binding, with the rate of reference to RBTs not lower than 50%, depending on the construction. In the third type, exemplified by English *him* and *himself*, binding constraints are categorical but not symmetric. As a consequence, the two proforms are in complementary distribution in some contexts, but in others one of the two forms has a more constrained distribution than the other.

	Categorical	Gradient
symmetric	French *le* and *se*	Estonian possessives
asymmetric	English *him* and *himself*	?

Table 3 Four configurations of binding constraints for pairs of proforms. 'Categorical' means that at least one of the two proforms under consideration either must or can't be bound by the local subject in some syntactic context.

As Table 3 illustrates, comparison on the three types of systems suggests that two dimensions have to be taken into account to describe the distribution of a pair of proforms: the symmetry of constraints (symmetric for French object pronouns and Estonian possessives, assymetric for English pronouns), and the strength of the constraints (gradient in Estonian, categorical in French and English). This leaves an empty slot for a system that is neither categorical nor symmetric. In the next section we provide evidence that Estonian non-possessive pronouns fill that slot.

3.3 Experiment 3: Gradient asymmetric binding

We ran a third experiment about the interpretation of non-possessive pronouns in simple finite clauses and infinitive complement clauses. We decided to investigate this situation on the basis of informally collected speaker judgements. According to these, we have the expected complementary distribution in simple finite clauses: in (14), reflexive *endast* needs to be bound by the local subject, while antireflexive *temast* can't. On the other hand, in infinitive complement clauses, judgements are different: in (15), reflexive *endast* can readily be bound either by the local subject (*Paul*) or the matrix subject (*Katrin*), but speakers disagree on whether the local subject can bind antireflexive *temast*. This leads us to expect to find nonsymmetric binding constraints in infinitive complement clauses.

(14) a. ***Katrin***$_i$ *avalda-s oma arvamus-t.* ***Paul***$_j$
Katrin.NOM open-3SG.PST REFL.POSS opinion-PART Paul.NOM
rääki-s enda-st$_{*i/j}$ *liiga palju.*
talk-3SG-PST REFL-ELA too much
'Katrin gave her opinion. Paul talked too much about himself.'

b. ***Katrin***$_i$ *avalda-s oma arvamus-t.* ***Paul***$_j$
Katrin.NOM open-3SG.PST REFL.POSS opinion-PART Paul.NOM
rääki-s tema-st$_{i/*j}$ *liiga palju.*
talk-3SG-PST 3SG-ELA too much
'Katrin gave her opinion. Paul talked too much about her.'

(15) a. ***Katrin***$_i$ *soovita-b* ***Pauli-l***$_j$ *töövestluse*
Katrin.NOM advice-3SG.PRS Paul-ADE job.interview.GEN
jooksul mitte liiga palju enda-st$_{i/j}$ *rääki-da.*
during NEG too much REFL-ELA talk-INF2
'Katrin advises Paul not to talk too much about her/himself during the job interview.'

b. ***Katrin***$_i$ *soovita-b* ***Pauli-l***$_j$ *töövestluse*
Katrin.NOM advice-3SG.PRS Paul-ADE job.interview.GEN
jooksul mitte liiga palju tema-st$_{i/??j}$ *rääki-da.*
during NEG too much 3SG-ELA talk-INF2
'Katrin advises Paul not to talk too much about her/??himself during the job interview.'

Sixty native speakers of Estonian recruited on Prolific[11] (mean age: 26,5 years, median age: 25) took part in this third experiment. They were paid 4€ and the experiment lasted 20 minutes on average. We manipulated two variables: the finiteness of the embedded clause (finite vs. infinitive) and the type of proform (reflexive vs. antireflexive). The experiment had four conditions, shown in Table 4. The experiment contained 20 experimental items and 43 fillers. The fillers consisted of pairs of sentences. The second sentence contained a proform referring to one element mentioned in the previous sentence. In some sentences, there were two semantically and morphologically possible antecedents for the proform (as exemplified in (16a)). For some other fillers, the proform in the second sentence had only one semantically possible antecedent (as exemplified in (16b)). The experiment started with three training items to allow participants to get used to the task. The sentence was followed by a question eliciting the referent of the proform. As in experiment 1, participants had to write the answer in a freeform text box.

[11] prolific.co

Clause type	Proform	Example
Independent	Reflexive	*Katrin avaldas oma arvamust. Paul rääkis endast liiga palju.*
	Antirefl.	*Katrin avaldas oma arvamust. Paul rääkis temast liiga palju.* 'Katrin gave her opinion. Paul talked too much about her/himself.'
Infinitive	Reflexive	*Katrin soovitab Paulil töövestluse jooksul mitte liiga palju endast rääkida.*
	Antirefl.	*Katrin soovitab Paulil töövestluse jooksul mitte liiga palju temast rääkida.* 'Katrin advises Paul not to talk too much about her/himself during the job interview.'
Question		*Kellest räägitakse/räägiti?* 'Who is being talked about?'

Table 4 Materials for experiment ”

(16) a. ***Andrus*** *peit-is* ***Jaani****.* *To-l* *aja-l*
Andrus.NOM hide-3SG.PST Jaan.GEN this-ADE time-ADE
ol-i ***ta*** *sõdur.*
be-3SG.PST 3SG.NOM soldier
'Andrus hid Jaan. At this time, he was soldier.'

b. *Ma* *võt-s-in* *looma-de* *varjupaiga-st* ***kassi****,*
1SG.NOM take-PST-1SG animal-GEN.PL shelter-ELA cat.GEN
mitte ***koera****.* ***Tema*** *eest tule-b* *hoolitse-da.*
NEG dog.PART 3SG.GEN of need-3SG.PRS take_care-INF
'I took from an animal shelter a cat, not a dog. It needs to take care of it.'

Figure 3 confirms informal judgements. In simple finite clauses, reflexives and antireflexives are roughly in complementary distribution in simple clauses, although the reflexive was interpreted as free in a nontrivial number of cases (5%).[12] In infinitive complement clauses, the proportion of local

[12]Surprisingly, this proportion is higher than what we found for reflexive possessive in experiment 1 (see Figure 1). This is unexpected, as binding constraints on non-possessives

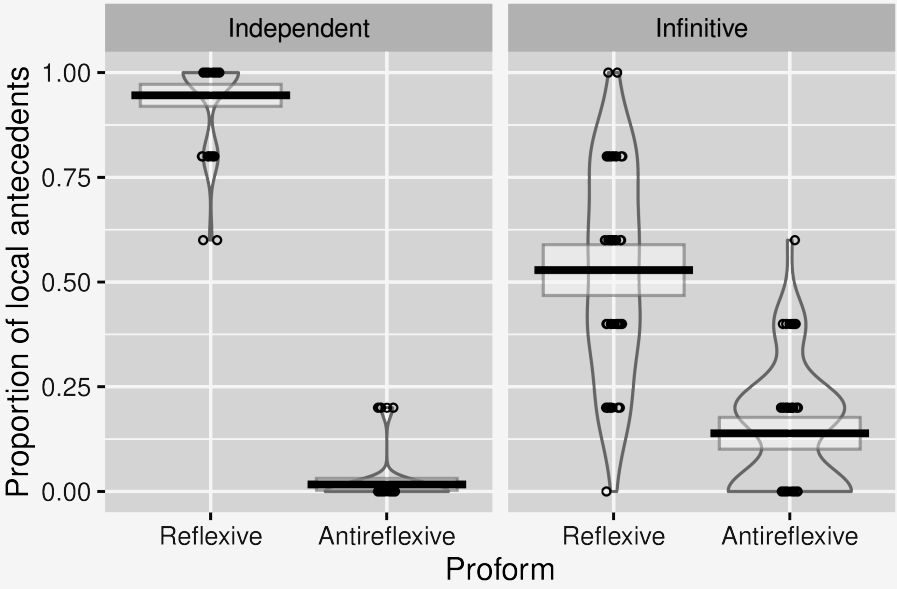

Figure 3 Main results of Experiment 3.

antecedents is higher for reflexives than for antireflexives, as it was for possessives in Experiment 1. However the distribution is not symmetric: only 51% of reflexives are bound by the local subject, whereas 86% of antireflexives are bound by the matrix subject.

We have thus provided clear empirical evidence that binding constraints can be asymmetric and gradient at the same time, filling the last slot of the typology in Table 3.

4 Conclusion

In this paper, we first showed that classical binding theory fails to describe the use of some proforms. More precisely, principle B does not capture the distribution of antireflexives in infinitive complement clauses in Estonian.

We then showed that Estonian possessives are subject to gradient constraints in some contexts. Our observations here contrast with previous work on the role of non-categorical preferences in binding. For example,

are generally stricter than those on possessives. Be that as it may, this does not affect the point at hand.

Keller (2000) observes gradient effects of factors orthogonal to those that classical binding theory focuses on (lexical semantics and definiteness). We on the other hand document gradient effects of the locality of the syntactic relationship between proform and binder, the bread and butter of binding theory.

We furthermore showed that, although the strength of binding constraints on Estonian possessives vary across constructions, they always exhibit symmetric binding: reflexive and antireflexive possessives exhibit complementary binding preferences. We sketched a version of binding theory encompassing a probabilistic symmetric binding principle, and accounting for all three observations.

Finally, we outlined a typology of systems of pairs of proforms on the basis of the kinds of binding constraints they fulfill: these can be symmetric or asymmetric, categorical or gradient. Classical binding theory focuses on categorical constraint alone, and reduces the symmetric/asymmetric distinction to whether the reflexive and antireflexive have the same binding domain. We provided empirical evidence from Estonian that the two kinds of systems of gradient binding constraints are attested, which calls for an overhaul of binding theory.

The present study opens up at least two avenues for future research. First, we need to better understand the interplay between gradient binding constraints in production and comprehension. Because of its categorical nature, classical binding theory is agnostic to production and comprehension: the same constraints are readily interpreted as dictating what form can be used to express the intended coreference, and which antecedents are available for a given form. As soon as we recognize gradient constraints, agnosticism is not warranted anymore: $P(form|meaning)$ need not be the same as $P(meaning|form)$. Production studies parallel to the comprehension experiments reported in this paper would be needed to find out whether production binding constraints match their comprehension counterparts. The corpus study reported in Lesage & Bonami (2019) suggests that they don't: that study found that speakers seldom use an antireflexive bound by an allative experiencer, while the second experiment in the present paper found that the corresponding interpretation was more common.

Second, the relative strength of binding constraints warrants a more detailed look. Experiments 1 and 2 suggested that the more ordinary the

syntactic context is, the stronger binding constraints are: simple finite clauses lead to stronger constraints than embedded infinitives; canonical transitive constructions lead to stronger constraints than noncanonical constructions with mixed subject properties; and default SX word order leads to stronger constraints than marked XS order. These binding preferences may be a consequence of the familiarity of speakers with different construction types: in the same way as more familiar items, like canonical simple clauses, lead to sharper acceptability judgements (Divjak 2017), more familiar syntactic configurations lead to stronger preferences for binding.

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