The Semantics of Possessives

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Abstract

We investigate what possessives mean by examining a wide range of English examples, pre- and postnominal, quantified and non-quantified, to arrive at general, systematic truth conditions for them. In the process, we delineate a rich class of paradigmatic possessives having cross-linguistic interest, exploiting characteristic semantic properties. One is that all involve (implicit or explicit) quantification over possessed entities. Another is that this quantification always carries existential import, even when the quantifier over possessed entities itself doesn't. We show that this property, termed possessive existential import, is intimately related to the notion of narrowing (Barker 1995). Narrowing has implications for compositionally analyzing possessives' meaning. We apply the proposed semantics to the issue of definiteness of possessives, negation of possessives, partitives and prenominal possessives, postnominal possessives and complements of relational nouns, freedom of the possessive relation, and the semantic relationship between pre- and postnominal possessives.*

Keywords: possessive (prenominal and postnominal), compositional semantics, existential import, narrowing, definiteness, partitives, relational noun complements

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1 Introduction

Possessives constitute a rich class of expressions, whose morphology and syntax have been described for a wide range of languages (for example, Clark 1978; Laidig 1993; Luraghi 1990; McGregor 2009; Newman 1979; Sinor 1995; Song 1997; Taylor 1996). An impression of their variety in English is evident from these examples.

(1) a. {my/Mary's} {bicycles/books/hands/brothers}
b. (the) {bicycles/books/hands/brothers} of {mine/Mary's}
c. {several students'/each woman's} {bicycles/books/hands/brothers}
d. (the) {bicycles/books/hands/brothers} of {several students(')/each woman('s)}
e. {two/many} of {my/Mary's/several students'/each woman's} {bicycles/books/hands/brothers}
f. {two/many} {bicycles/books/hands/brothers} of {mine/Mary's/ several students(')/each woman('s)}

Moreover, possessive constructions can be iterated, yielding sentences such as[1]

(2) a. Mary's brothers' children are adorable.
b. One of John's ex-wives' previous husbands were millionaires. [cf. One of John's sisters' boyfriends were all millionaires.]
c. One of John's ex-wives' previous husbands was a millionaire.

While the syntactic productivity of possessive constructions is well-known, allowing a wide variety of DPs to serve as the possessor phrase, the study of their semantics has, with few exceptions, been restricted to a narrow slice of the full spectrum: mainly instances where the possessor DP is a proper noun (*Mary*) or pronoun (*me*), or a simple singular definite (*the table*), and where the possessed noun is in the singular.[2] And although there has been a fair amount of study of the semantic effects of varying the possessed noun, as in

(3) a. Mary's brother
b. John's portrait
c. my book
d. the table's leg
e. #the leg's table
f. God's love

and corresponding postnominal variants, other aspects of the possessive construction have not received a fraction of the same attention.

[1] If you worry that the DPs in 1e, 2b, and 2c are partitives and not possessives, see sect. 4.1. Concerning the double genitives in 1b, 1d, and 1f, see the final portions of sects. 2.1 and 4.2.

[2] The main exceptions are (Keenan & Stavi 1986) and (Barker 1995). Keenan and Stavi give truth conditions for a huge variety of possessive constructions, but without presenting compositional semantic rules. Barker proposes a systematic approach (for prenominal possessives with quantified possessor DPs) that differs in interesting ways from ours; see note 9.

There are two problems with such an approach. First, one risks attributing to possessives in general properties belonging just to a restricted subclass. Second, one may overlook properties that hold even of the restricted subclass, but are not easily visible from the narrower perspective. In this paper we start with the general case, and we will argue that this gives several added insights, including about the simple examples.

1.1 Approach

We present a systematic approach to the semantics of possessives, one that applies in particular to all the constructions exemplified in 1–3. If correct, it captures the essence of possessives' meaning, and shows that their meaning is largely independent of their morphosyntax. It also delineates in a novel way a class of paradigmatic possessive expressions. In our view, the essence of possessiveness is a specific kind of meaning expressed with a peculiar form, a certain combination of semantics and syntax. The fact that sometimes the same meanings can be expressed by other constructions doesn't necessarily make those other constructions possessive. Likewise, the fact that a syntactic device can be used to express possessives doesn't entail that all its uses are possessive. As a matter of fact, English is unusual in having two dedicated possessive constructions, one prenominal and one postnominal. This approach leads us to conclude (sect. 4) that the following things, for example, are not paradigmatic possessives, although all of them have at times been called possessives.

(4) a. subjects of gerundive complements and gerund(ive nominal(ization))s: *John's not remembering her name annoyed Mary.*
b. paraphrases of possessives, e.g. with *have*, *own*, or *belong to*: *Bicycles belonging to six students were stolen.*
c. relational noun complements: *Photographs of two people were on the mantel.*
d. so-called modifying possessives: *Most ill-fitting sailors' coats are quickly shed.*

Reasons for these judgments will emerge gradually in the paper. They lead to four characteristic features of paradigmatic possessive DPs, summarized at the end. We hope it will be amply clear by then that the class thus delineated is both natural and well worth linguists' attention.

1.2 Nomenclature

The following sentences illustrate the basic (and hopefully uncontroversial) terminology that will be used in the rest of the paper.

(5) a. <u>**Most teachers'** *cars*</u> are not luxury models
b. <u>Four *cats* **of Tom's**</u> wandered off last week
c. <u>**Mary's** *pets*</u> are undisciplined
d. <u>**The man's** *house*</u> is white.

Here is what we will call the various constituents.

(6) a. POSSESSIVE DET or PP: bold face in 5a–5d
b. POSSESSOR DP: bold face phrase except **'s** or **of**
c. POSSESSIVE DP: underlined phrase
d. POSSESSED NOUN or NOMINAL: italicized phrase

In addition, the POSSESSIVE RELATION is the relation indicated of possessors to possessions. We will use these terms throughout, as well as the verb 'possess', even for examples where (as is very often the case) the possessive relation has nothing to do with real possession or ownership.

1.3 Outline

Sections 2 – 4 spell out the meaning of possessives systematically in terms of truth conditions and lay out our analysis of the class of paradigmatic possessive DPs thus delineated. We suggest syntactic rules for generating possessive DPs as in examples 1, and formalize corresponding semantic rules yielding their meanings. An important observation—which appears to be new—is that paradigmatic possessives always involve QUANTIFICATION OVER POSSESSIONS: it can be universal, existential, or given by a generalized quantifier, but is always present. We also note that certain possessive look-alikes actually differ from paradigmatic possessives in important ways; in particular this holds for relational noun complements, even though in some cases it is tricky to distinguish them from postnominal possessives. We further show that, first impressions notwithstanding, the DPs in 1e are NOT partitive. There is a rich class of DPs of the form [Det of DP] which are possessive but not partitive. This observation also appears to be new.

Sections 5 – 7 are devoted to fine-tuning certain aspects of our analysis and highlighting important properties of paradigmatic possessives. Sect. 5 deals with the semantic behavior of negation in sentences containing possessives, with an application to the issue of possessives and presupposition. Sect. 6 presents a crucial feature of possessive DPs, which as far as we know is not discussed in the literature. POSSESSIVE EXISTENTIAL IMPORT (PEI) is the property that the omnipresent quantification over possessions invariably has existential import. This turns out to be a weaker form of the property of NARROWING introduced in (Barker 1995), that is, the property that a possessor DP of the form [Det N′] quantifies not over all individuals in the extension of N′ but only over those possessing something in the extension of the possessed noun. Barker held that all possessives narrow. We tend to agree, but counter-examples have been proposed. We show that, somewhat surprisingly, narrowing implies PEI, and that in many but not all cases, the converse implication holds as well. In sect. 7 we discuss the status of narrowing in those cases where it doesn't follow from PEI. In particular, we investigate what we call the uniformity/compositionality problem; essentially the problem of treating quantified and non-quantified possessor DPs alike while maintaining narrowing where it is found. The problem has interesting empirical as well as theoretical aspects that we discuss in some detail, although a few open questions remain.

Sections 8 and 9 apply the analysis to two disputes regarding possessives. Sect. 8 briefly discusses possessives and definiteness. Although it is sometimes claimed that all possessive DPs are definite, we point out that once you consider the full class of paradigmatic possessives, it becomes clear that most of them are not definite, and that we can use the systematic truth conditions to check which are and which aren't (semantically) definite. We use this to evaluate some generalizations in the literature concerning possessive DPs and definiteness, in particular the assertion that definiteness is INHERITED from the possessor DP.

A well-known feature of possessives it that the possessive relation is FREE. Careful formulation is important because freedom does not mean that no relations are ever excluded as possessive relations. But stated accurately, freedom seems to be a necessary characteristic of possessives, one that can be used to separate paradigmatic possessives from other constructions (sects. 4.2 and 4.3). Freedom also motivates our treatment of the possessive relation as a parameter in the semantics, to be set pragmatically. In sect. 9 we look at further implications of freedom, in particular to an issue discussed at length by Barbara Partee and others, namely, whether the possessed noun is by default to be treated as 2-place (relational) or 1-place.

We close, in section 10, with a succinct statement of our diagnostics for paradigmatic possessives.[3]

2 Truth conditions of possessives

As we have just said, paradigmatic possessives are QUANTIFYING—in the sense that they all involve QUANTIFICATION OVER POSSESSIONS. This quantification is sometimes IMPLICIT, in which case it is often either UNIVERSAL, as in

(7) a. Mary's dogs are penned up.
    b. Students must return their library books before the end of the term.

or EXISTENTIAL, as in

(8) a. When Mary's dogs escape, the neighbors catch and return them.
    b. No cars' tires were slashed last night.

[3]This paper elaborates the approach to possessives initiated in ch. 7 of (Peters & Westerståhl 2006), but doesn't assume familiarity with that work. The book chapter has extensive mathematical detail, such as an in-depth study of the monotonicity behavior of possessive Dets. Here we focus on the linguistic and conceptual aspects, and develop them significantly further. Many things are completely new, such as the crucial notion of possessive existential import (PEI), the inclusion of postnominal possessives, the discussion and application of the freedom of the possessive relation, and the use of diagnostic criteria to delineate the class of paradigmatic possessives.

The (very minimal) terminology and facts from generalized quantifier theory that we use in this paper will be introduced as we go along. For more details, the reader is referred to the book or to any of the available surveys or handbook chapters, such as (Glanzberg 2006) or (Keenan & Westerståhl 2011).

or ambiguous between the two.

(9) a. No student's library books were returned on time.
b. Three cars' tires had to be replaced.

But when it is EXPLICIT, almost any other quantifier may be used.

(10) a. Four of Tom's cats wandered off last week.
b. Most flights of those airlines(') were canceled due to strikes.

While each possessive DP in examples 7 might be regarded as referring to a particular group or set of possessions, examples 8–10 make it clear that many possessive DPs do not refer to any definite group or set of possessions whatsoever. What unifies all paradigmatic possessive DPs is that they quantify over possessed entities. Let us now examine their meaning more closely.

2.1 The quantificational force of possessive DPs

For convenience, we will use the symbol Q_2 schematically for the quantifier over possessions. When Q_2 is implicit, as 7–9, and in the meaning of simple prenominal possessive Dets like

(11) a. three children's
b. every student's
c. most professors'

(which have explicit quantification over possessors, here children, students, and professors), the implicit quantification over possessions is sometimes universal (Q_2 = *every*) and sometimes existential (Q_2 = *some*).[4] The most plausible interpretation of

(12) The teacher confiscated three children's paint sprayers.

has universal Q_2. There are three children who had paint sprayers and from whom the teacher confiscated EVERY paint sprayer the child had. By contrast, the most plausible reading of

(13) The teacher discovered three children's paint sprayers hidden in bushes near the school.

has existential Q_2. There are three children who had paint sprayers and for whom the teacher discovered at least SOME of the child's paint sprayers in the bushes. Thus the possessive DP *three children's paint sprayers* itself is ambiguous; it can be interpreted as quantifying either universally or existentially over paint sprayers belonging to three children, depending on the context in which it occurs. For implicitly quantified possessives, both possibilities—existential and

[4] The quantifiers *every* and *some* mentioned here are MEANINGS; see 36 in sect. 2.3. We use italics throughout to refer to such meanings. Context should disambiguate this use of italics from that for citing linguistic forms and examples.

alternatively universal quantification over possessed entities—are quite generally available, even if some cases are most naturally interpreted as expressing one rather than the other, or are only capable of expressing one.

Genuinely ambiguous sentences clearly exist, as in the already mentioned

(9a) No student's library books were returned on time.[5]

In a context that favors interpretating 9a as saying no student in question turned in all library books he had borrowed by their due date, it would be natural to continue with

(14) So every student who checked out library books had to pay at least one fine.

In a context that favors the existential interpretation of 9a (no student in question returned any library book in time), a natural continuation would instead be

(15) We need to find stronger inducements for students to return at least some library books on time.

Note that both readings of all simple prenominal possessives are readily paraphrasable with an explicit quantifier. For example, the most plausible interpretation of 12 is the same as the interpretation of the explicitly quantified 16.

(16)
a. The teacher confiscated {all/every one} of three children's paint sprayers.
b. The teacher confiscated all paint sprayers of three children('s).
c. The teacher confiscated the paint sprayers of three children('s).

Likewise, the most plausible interpretation of 13 is the same as of

(17)
a. The teacher discovered some of three children's paint sprayers hidden in bushes near the school.
b. The teacher discovered some paint sprayers of three children('s) hidden in bushes near the school.
c. The teacher discovered paint sprayers of three children('s) hidden in bushes near the school. [with existential interpretation of *paint sprayers*]

As soon as one considers postnominal possessive DPs, and expanded prenominal ones, as in these paraphrases, it is clear that an analysis involving the additional quantifier Q_2 to which we have drawn attention gives correct truth conditions. In such possessive DPs, the quantifier Q_2 is explicit. (We explain in detail why the expanded prenominal forms are not partitives in sect. 4.1.) A less obvious, but no less crucial point is that even simple basic prenominal possessive

[5] We thank Barbara Partee for pointing out the ambiguity of this example.

DPs have the additional quantifier Q_2 as part of their meaning although it is not explicit in their grammatical form. ALL paradigmatic possessives involve Q_2!

Postnominal possessives and the double genitive

We briefly digress to begin dealing with a question that will recur from time to time: Which postnominal prepositional phrases introduced by *of* are possessive? Many English speakers insist in cases like

(18) a. a desk of Mary's/hers
b. *a desk of Mary/her

that the postnominal possessor DP must have double genitive form: be suffixed with *'s* as well as preceded by *of*. The double genitive form is, when present, a reliable sign that the postnominal DP is a possessor phrase. Absence of *'s*, on the other hand, only sometimes indicates that a postnominal object of the preposition *of* is not a possessor DP. On the one hand, in the case of 19b its absence clearly results in a description of the portrait as depicting Picasso, whether or not it was owned by him (or is a self-portrait, etc.). Accordingly 19b is not possessive like 19a.

(19) a. a portrait of Picasso's/his
b. a portrait of Picasso/him

Similarly

(20) There are many living students of Aristotle but no living students of Aristotle's.

is understood as true because no one who currently studies Aristotle has any personal relationship such as having studied with him. On the other hand, *'s* is absent from

(21) a. a desk of the third U.S. President
b. the first steamship of the U.S. Navy
c. some customers of more than one airline

and many English speakers nevertheless accept these as postnominal possessive DPs. Some feel in fact that

(22) a. ?a desk of the third U.S. President's
b. ?the first steamship of the U.S. Navy's
c. ?some customers of more than one airline's

are of questionable grammaticality. For yet other cases, some English speakers would accept the same range of meanings for either form

(23) a. a brother of John's
b. a brother of John

and consider both forms possessive.

Such complexities make it challenging to distinguish postnominal possessive PPs from other postnominal modifiers and from complements of certain relational nouns. We argue in sect. 4.2 that the judgments described here are essentially correct; but for now we set the general question aside, and continue with the task of describing what possessive DPs mean. Nevertheless, a comment is in order about our use of (*'s*) in 1d,f, 10b, 16b,c, 17b,c, and later. It is not meant to assert that the presence of *'s* is grammatically acceptable, but instead to limit consideration to the possessive use of *of* in these sentences. This matters because *of*-phrases after nouns have other uses besides their possessive one.

2.2 Abstracting the meaning of possessives

It is a short step at this point to spell out explicitly what paradigmatic possessive DPs mean, and from there to abstract the meaning of the possessive morpheme itself: the determiner forming suffix *'s* in prenominal possessives and the preposition of_{poss} in postnominal possessives.

Possessives with explicitly quantified possessor DPs

Considering prenominal possessives first, observe that a sentence of the form

(24) Q_2 of Q_1 C's A are B

means that

(25) Q_1 C x that possess an A are s.t. Q_2 A that x possesses are B.

For instance, 26a has the truth conditions 26b.

(26)
a. All of three children's paint sprayers were confiscated by the teacher.
b. Three children, x, that possess a paint sprayer are such that all paint sprayers that x possesses were confiscated by the teacher.

As a logical form corresponding to 25, with R as the possessive relation, we use

(27) $Q_1x(Cx \wedge \exists y(Ay \wedge Rxy)\,, Q_2y(Ay \wedge Rxy\,, By))$

This is written in the standard notation of first-order logic with generalized quantifiers, where Q_1 and Q_2 are variable-binding operators just like $\exists$ and $\forall$, except that they bind a variable in two formulas rather than one; the general format is $Qx(\varphi(x)\,, \psi(x))$, with $\varphi(x)$ restricting the quantifier's domain and $\psi(x)$ being its scope.[6] Thus, the logical form for 26a is (with the obvious mnemonics)

[6] Other notations occur. For example, we could write

(i) $Q(\hat{x}[\varphi(x)])(\hat{x}[\psi(x)])$

(16c) $\underline{three}\, x(CHx \wedge \exists y(Sy \wedge Rxy)\,,\, \underline{all}\, y(Sy \wedge Rxy\,,\, CFTy))$

Also, as we've seen, sentences of the form

(28) Q_2 A of Q_1 C's are B

containing a postnominal possessive mean 25 (or equivalently 27) too. For instance, 29a has the truth conditions 29b and the logical form 29c.

(29)
a. Some boats of most technology billionaires(') are ostentatious.
b. Most tech billionaires, x, that possess a boat are such that some boats that x possesses are ostentatious.
c. $\underline{most}\, x(Tx \wedge \exists y(By \wedge Rxy)\,,\, \underline{some}\, y(By \wedge Rxy\,,\, Oy))$

Moreover, even sentences containing simple prenominal possessives seem to have the same sort of meaning. A sentence of the form

(30) Q_1 C's A are B

has the truth conditions 25 (or 27), the only difference from the preceding two cases being that 30 doesn't explicitly state what quantifier Q_2 is. For this case, Q_2 has to be determined pragmatically. For instance, the universal readings of 31a and 31c have the truth conditions 31b and 31d respectively.

(31)
a. Three children's paint sprayers were confiscated by the teacher.
b. Three children, x, that possess a paint sprayer are such that every paint sprayer that x possesses was confiscated by the teacher.
c. Every student's library books were returned late.
d. Every student, x, that possesses a library book is such that every library book that x possesses was returned late.

Note that replacing *every* by *the* in 31b and 31d would incorrectly require that each x had exactly one paint sprayer/library book. By the same token, the existential readings of 31c and 32a have the truth conditions 32c and 32b respectively.

(32)
a. Three children's paint sprayers were discovered by the teacher hidden in bushes near the school.
b. Three children, x, that possess a paint sprayer are such that some paint sprayer that x possesses was discovered by the teacher hidden in bushes near the school.

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as in (Barwise & Cooper 1981), or

(ii) $[Qx\colon \varphi(x)]\psi(x)$

as in (Higginbotham & May 1981). These both reflect the fact that the DP is a phrase, and that the Det can be interpreted as a function (from sets to DP interpretations), whereas 27 simply treats Det interpretations as binary relations (between sets). Syntactically, as well as semantically (see sect. 2.3), these are essentially notational variants.

c. Every student, x, that possesses a library book is such that some library book that x possesses was returned late.

Possessor DPs without explicit quantifiers

We must also spell out what possessive DPs mean when the possessor DP is not explicitly quantified—for example *John's cats*, *two of Mary's books*, and *firemen's children*—because sentences containing these do not have the form 30, 24, or 28. The answer can be approached in either of two ways. One is to provide a new meaning schema, different from 25, for these cases. The other is to describe how 25 can be used by choosing Q_1 and C suitably even if the possessor DP does not specify them explicitly. When the possessor DP is a proper noun or a bare plural, both approaches are feasible. The former approach interprets sentences of the form 33a as having the truth conditions 33b, and universal readings of sentences of the form 33c as meaning 33d.

(33) a. (Q_2 of) a's A are B
b. a possesses an A and Q_2 A that a possesses are B.
c. C's A are B
d. There is a C that possesses an A and every C x that possesses an A is s.t. Q_2 A that x possesses are B.

For instance,

(34) a. John's cats are mangy.
b. John possesses a cat and Q_2 cats that John possesses are mangy.
c. Firemen's children put up with a lot.
d. There is a fireman that possesses a child and every fireman, x, that possesses a child is such that Q_2 children that x possesses put up with a lot.

33d and 34d arise from the universal interpretation of the bare plural possessor DP. Bare plurals also have existential interpretations that may occur in possessives as well.

(35) a. Firemen are available.
b. There are firemen's children present (so watch your language).

It is clear for proper name and bare plural possessor DPs, however, that specifying their meaning does not require a new schema. We could just as well use 25 by construing sentences of the forms 33a and 33c as if they contained suitable Q_1 and C. All this requires is choosing Q_1 to be all_{ei} and C to be $\{a\}$ for proper names as in 33a, and similarly choosing Q_1 as all_{ei} for the universal interpretation of a bare plural, and as *some* for the existential interpretation, while choosing C in both cases to be the extension of the plural noun.[7] (Here

[7] A bare plural possessor DP, as in 34c, is only permitted in the simple prenominal possessive construction. **Two of firemen's children put up with a lot* is ungrammatical, as is **Two children of firemen's put up with a lot.* Furthermore,

all_{ei} is the universal quantifier with existential import; see the next subsection for definitions of these quantifiers.) In the interest of uniformity, whether or not the possessor is an explicitly quantified DP, we choose the latter approach (see also sect. 7.2).

2.3 Possessive truth conditions

As is already clear from our use of Q_1 and Q_2 above, generalized quantifiers play an important role in stating precise truth conditions for sentences with possessive DPs. We next explain how we think of generalized quantifiers in this paper and the notation used, and then proceed to formulate truth conditions for possessives, in terms of a higher-order operator called *Poss*.

Generalized quantifiers: definitions and terminology

In linguistic semantics, a generalized quantifier meaning is commonly thought of as a set of subsets of the universe, or as a function from such sets to truth values, and assigned the type $\langle\langle e,t\rangle,t\rangle$. We will call these UNARY QUANTIFIERS, and treat them as 1-place second-order relations—over a UNIVERSE M regarded as fixed in what follows. Unary quantifiers serve as the (extensional) interpretations of DPs. Similarly, BINARY QUANTIFIERS, which interpret (simple or complex) determiners, are 2-place relations between sets of individuals (type $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$).[8]

Thus, our notation for quantifier meanings is relational rather than functional, and we use set-theoretic terminology rather than lambdas. In the unary case, we write

$$Q(B)$$

(the unary relation Q holds of the argument B) to mean $B \in Q$. For binary quantifiers we always use the relational format

$$Q(A,B)$$

(the binary relation Q holds between the (set) arguments A and B). The corresponding functional version would be $Q(A)(B) = 1$ (the function Q, applied to the argument A, yields a function which, applied to the argument B, yields the truth value 1). The difference is mainly notational. Likewise, we write $\{a : \psi(a)\}$ (the set of a such that $\psi(a)$), where ψ is some formula with a free

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(i) Two firemen's children put up with a lot.

cannot mean that some or every fireman who has children has two who put up with a lot. It can only mean that two firemen who have children are such that all (or some) of their children put up with a lot, i.e. the meaning already given to it by 25 as a sentence of the form 30.

[8] A generalized quantifier is actually a GLOBAL object Q, assigning to each universe M a second-order relation Q_M over M. The global/local distinction plays no significant role in this paper, so keeping M fixed is a harmless simplification here. Global versions of the definitions and results to be stated here are given in (Peters & Westerståhl 2006), as well as justifications for using the local versions in the context of possessives.

variable, instead of $\lambda x\, \psi(x)$. The functional format is useful when semantic composition is taken to be function application, but compositional rules can be stated in set-theoretic notation too; see sect. 3.2.

Particular quantifiers can often be named by corresponding English words or phrases; we then use italics. Here are some common binary ones.

(36)
a. $\textit{every}\,(A, B) \Leftrightarrow A \subseteq B$
b. $\textit{all}_{\text{ei}}(A, B) \Leftrightarrow \emptyset \neq A \subseteq B$ (*all* with EXISTENTIAL IMPORT)
c. $\textit{no}(A, B) \Leftrightarrow A \cap B = \emptyset$
d. $\textit{some}(A, B) \Leftrightarrow A \cap B \neq \emptyset$
e. $\textit{at least four}\,(A, B) \Leftrightarrow |A \cap B| \geq 4$ ($|X|$ is the cardinality of X)
f. $\textit{the}_{\text{sg}}(A, B) \Leftrightarrow |A| = 1 \;\&\; A \subseteq B$
g. $\textit{the}_{\text{pl}}(A, B) \Leftrightarrow |A| > 1 \;\&\; A \subseteq B$
h. $\textit{the ten}(A, B) \Leftrightarrow |A| = 10 \;\&\; A \subseteq B$
i. $\textit{most}\,(A, B) \Leftrightarrow |A \cap B| > |A - B|$
j. $\textit{more than two-thirds of the}\,(A, B) \Leftrightarrow |A \cap B| > 2/3 \cdot |A|$

Recall that these quantifiers, like all Det interpretations, are CONSERVATIVE.

(CONSERV) $Q(A, B) \Leftrightarrow Q(A, A \cap B)$

This property will be crucial in sect. 6. Here are some unary quantifiers.

(37)
a. $\textit{something}\,(B) \Leftrightarrow B \neq \emptyset$ [the logician's $\exists$]
b. $\textit{everything}\,(B) \Leftrightarrow B = M$ [$\forall$; recall that M is the universe]
c. $\textit{at least three things}\,(B) \Leftrightarrow |B| \geq 3$
d. $\textit{most things}\,(B) \Leftrightarrow |B| > |M - B|$

Furthermore, we will treat proper nouns and bare plurals as unary quantifiers: for any individual a and any set C,

(38)
a. $I_a(B) \Leftrightarrow a \in B$ [the MONTAGOVIAN INDIVIDUAL I_a]
b. $C^{pl,u}(B) \Leftrightarrow \emptyset \neq C \subseteq B$ [universal: *Firemen are brave*]
c. $C^{pl,e}(B) \Leftrightarrow C \cap B \neq \emptyset$ [existential: *Firemen are present*]

Finally, DPs of the form [Det N′] can be interpreted as unary quantifiers obtained by FREEZING the first argument of $[\![\text{Det}]\!]$ to the set $[\![\text{N}']\!]$. In general, for any binary Q and any set A, define the unary Q^A by

(39) $Q^A(B) \Leftrightarrow Q(A, B)$

This notation will be used frequently. For example,

$$[\![\text{three cats}]\!] = [\![\text{three}]\!]^{[\![\text{cat}]\!]} = \{B\colon |[\![\text{cat}]\!] \cap B| = 3\}$$
$$[\![\text{no students}]\!] = [\![\text{no}]\!]^{[\![\text{student}]\!]} = \{B\colon [\![\text{student}]\!] \cap B = \emptyset\}$$

All of this concerns the semantic (model-theoretic) objects that interpret Dets and DPs. These objects are also used in the interpretation of logical forms, for which we employ the simple formalism of first-order logic with generalized quantifiers (see 27 in sect. 2.2). Logical forms are particularly useful for representing narrow vs. wide scope readings, as in the following example.

(40) a. Three critics reviewed at least two films.
b. $\underline{three}\, x(Cx\,, \underline{at\ least\ two}\, y(Fy\,, Rxy))$
c. $\underline{at\ least\ two}\, y(Fy\,, \underline{three}\, x(Cx\,, Rxy))$

The operation *Poss*

Now let us formalize, using the terminology and notation just introduced, the truth conditions of possessive constructions introduced in in sect. 2.2. To this end we introduce a higher-order operator *Poss*, which takes two binary quantifiers, Q_1 and Q_2, one set C, and one binary relation R as arguments, and yields a binary quantifier $Poss(Q_1, C, Q_2, R)$ as value. Recall the abstract schema 25 for possessives, repeated here.

(25) Q_1 C x that possess an A are s.t. Q_2 A that x possesses are B

or

(27) $Q_1 x(Cx \wedge \exists y(Ay \wedge Rxy)\,, Q_2 y(Ay \wedge Rxy\,, By))$

which we took to spell out the meaning of sentences containing any form of paradigmatic possessive DP: 24 (repeated here), 28, 30, 33a, or 33c.

(24) Q_2 of Q_1 C's A are B

The idea is for $Poss(Q_1, C, Q_2, R)$ to interpret the possessive determiner [Q_1 C*'s*] in 24 and the possessive prepositional phrase *of* [Q_1 C*'s*] in 28, with R as the possessive relation and Q_2 as the quantifier over possessions. Thus,

> $Poss(Q_1, C, Q_2, R)(A, B) \Leftrightarrow$ Q_1 C x that R an A are s.t. Q_2 A that x Rs are B.

We can express the right-hand side more concisely using the following notation. If a is any individual, let

$$R_a = \{b : R(a, b)\}$$

be the set of things possessed by a. Also, let

$$dom_A(R) = \{a : A \cap R_a \neq \emptyset\}$$

be the set of individuals possessing something in A. Schema 25 says that Q_1 holds between the set of possessors in C (those who possess something in A) and the set of individuals a such that Q_2 holds between the set of things in A that a possesses and B. In other words,

(41) $Poss(Q_1, C, Q_2, R)(A, B) \Leftrightarrow Q_1(C \cap dom_A(R), \{a : Q_2(A \cap R_a, B)\})$

Furthermore, the operator *Poss* itself can be seen as the meaning of the determiner forming possessive suffix *'s* and the possessive preposition of_{poss}. In the next section we sketch how it would fit into an analysis of the meaning of sentences with possessives.[9]

3 The possessive construction

The rules for generating paradigmatic possessive expressions in English are few but productive. We present syntactic and corresponding semantic rules in this section, focusing mainly on prenominal possessive DPs.

3.1 Syntax

Essentially two specific syntactic rules are needed. One—call it Poss_{smp} for 'simple'—forms a Det by attaching the possessive marker *'s* to a DP. All that matters to the semantic interpretation of these phrases is that almost any DP can be used (see sect. 7.2 for some exceptions), and that the result is a specifier of nominals in DPs.

(Poss_{smp}) Det $\rightarrow$ DP *'s*

We call a DP SIMPLE POSSESSIVE if it has the form [Det N′], where Det is formed using Poss_{smp}.

The other rule—call it Poss_{exp} for 'expanded'—is the one that makes quantification over possessions explicit; we can think of it as forming DPs of the form [Det of DP].

(Poss_{exp}) DP $\rightarrow$ Det *of* DP

There are constraints on this rule: roughly, the DP following *of* must be definite or simple possessive (and plural though not a bare plural), whereas Det must be neither definite nor simple possessive. In the literature, only the definiteness condition on DP is usually noted, but we will see that many simple possessive DPs are not definite, and give numerous examples showing that the construction is good in these cases too (sect. 4.1).

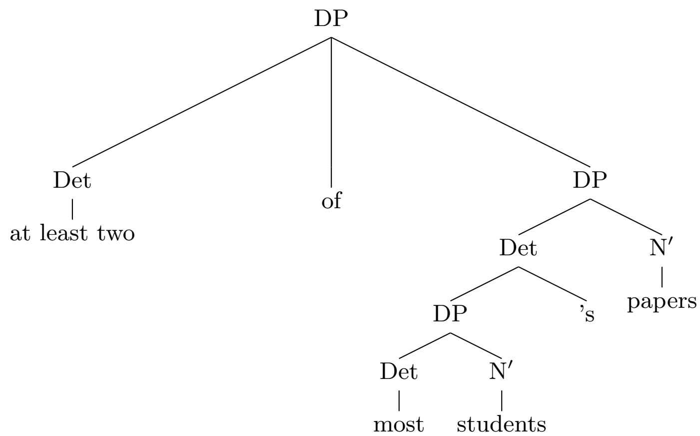
Here is a paradigmatic case.

(42) At least two of most students' papers got an A.

With Poss_{smp} and Poss_{exp} we get this structure for the possessive DP:

[9] The account in (Barker 1995) quantified over both possessors and possessions, but with a single quantifier that binds both variables simultaneously. For reasons too lengthy to explain here, this doesn't seem to give the desired range of truth conditions, whereas using two separate binary quantifiers leads straightforwardly to a perspicuous and empirically adequate analysis of the meaning of possessive DPs. Details of the problems confronting the single quantifier analysis can be found in URL.

(43)



Most students' papers is a simple possessive DP formed with Poss_{smp} and the usual rule

(DP_{qnt}) DP $\rightarrow$ Det N′

In that DP, the quantification over possessed entities is left unspecified, but it gets fixed to $Q_2 =$ *at least two* with the application of Poss_{exp}.

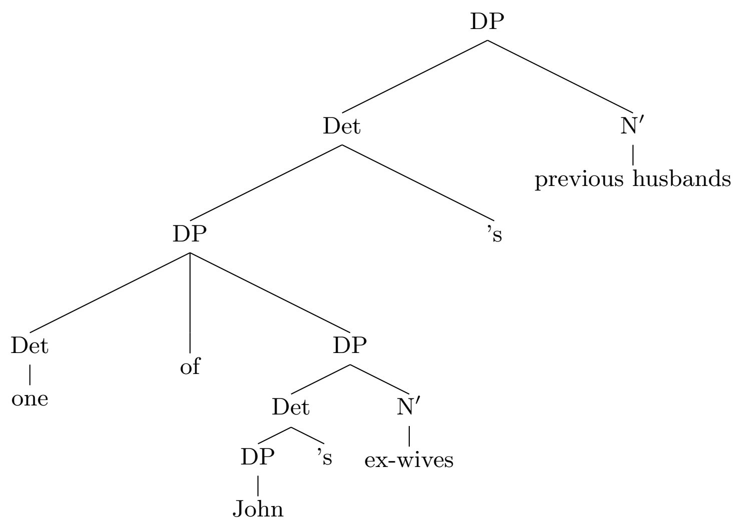
Together with DP_{qnt}, the rules Poss_{smp} and Poss_{exp} generate a rich class of prenominal possessive DPs. Here are some slightly more complex examples.

(44)
a. Several of John's books' pages are stained.
b. One of John's ex-wives' previous husbands were millionaires. [= 2b]
c. One of John's ex-wives' previous husbands was a millionaire. [= 2c]

It seems that 44a can be constructed in either of two ways according to whether *several* quantifies over books or over pages. In addition, there is the ambiguity concerning the remaining implicit quantification. Is it universal or existential? The latter ambiguity is not structural on our account, but the former is. In 44b and 44c, number agreement unambiguously goes with just one of the two structures: *one* quantifies over ex-wives in 44b, and over previous husbands in 44c.

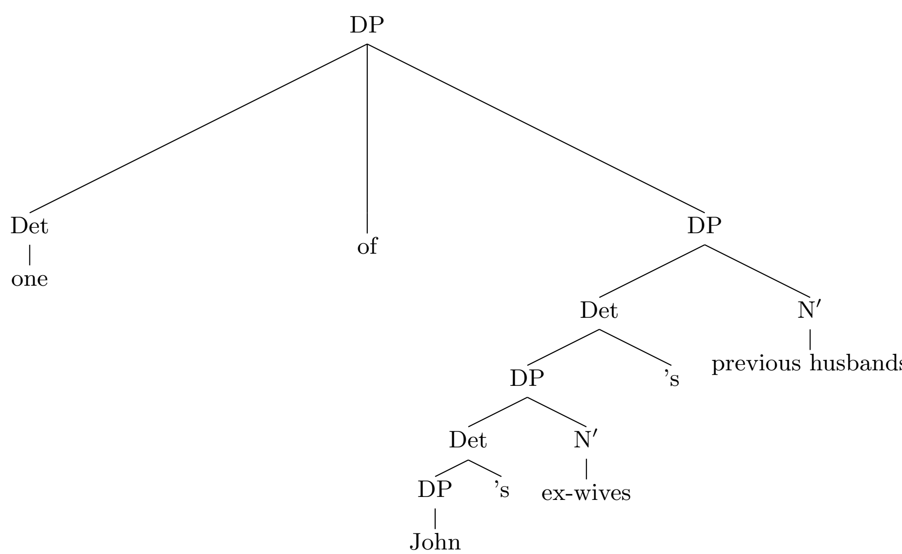
The form of the possessive DP in 44b (and in the first reading of 44a) is

(45)



whereas the form in 44c (and the second reading of 44a) is

(46)



Both contain the simple possessive DP *John’s ex-wives* within which the implicit Q_2 over ex-wives is not fixed. The derivation 45 fixes Q_2 to *one* using Poss_{exp}, yielding the unambiguous DP *one of John’s ex-wives*. Applying Poss_{smp} to this DP reintroduces the familiar possibilities. Is the implicit quantification over possessions (previous husbands) universal or existential? (In this case it is plausibly universal: all of that ex-wife’s previous husbands were millionaires.)

The derivation 46, on the other hand, iterates Poss_{smp} straightaway, combining *John’s ex-wives* with the possessive marker, and then combines that Det with the nominal *previous husbands* to form a more complicated but still simple possessive DP. Doing this introduces another quantifier Q_2', over previous husbands, so at this step there are in principle two different quantifiers to be specified. Application of Poss_{exp} makes explicit the interpretation of the quantifier Q_2'. The ambiguity regarding Q_2 is not structurally resolved in this case, but here the existential interpretation is pragmatically natural (rather than limit attention to men who were once married to each of John's ex-wives). Just one of the previous husbands in question is claimed to have been a millionaire.

Next consider the string

(47) *One of many of my friends works.

This shouldn't be derivable, and it isn't. *Many of my friends* is a well-formed possessive DP; but it is not simple or definite (as we shall see), and so Poss_{exp} cannot be applied. On the other hand, the following is fine.

(48) One of many of my friends' parents works.

Here both modes of quantification over possessed entities are explicitly fixed, and there is only one way to do this, so 48 unambiguously means that many of my friends are such that one of their parents works.

(49) $[_{\text{DP}}$ one of $[_{\text{DP}}$ $[_{\text{Det}}$ $[_{\text{DP}}$ many of my friends] '] parents]]

Specifically, even though *many of my friends* is not simple or definite, Poss_{smp} can be applied. This produces a possessive Det, which combined with a noun yields a simple possessive DP to which Poss_{exp} is applied. There is no way to get *one* to range over friends and *many* over parents; and there shouldn't be, since 48 cannot be used to say that one of my friends is such that many of his/her parents work.

3.2 Semantic correlates of Poss_{smp} and Poss_{exp}

As explained in sect. 2.3, the semantic correlate of the rule DP_{qnt} standardly freezes the first argument of $[\![\text{Det}]\!]$.

$$[\![\text{Det N}']\!] = [\![\text{Det}]\!]^{[\![\text{N}']\!]}$$

Now consider sentence 42, repeated here.

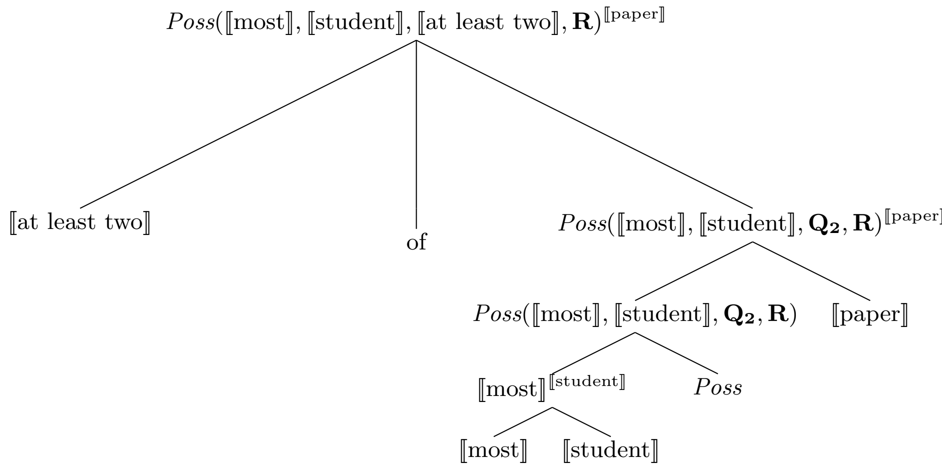
(42) At least two of most students' papers got an A.

Its subject DP has the structure 43, so the semantic correlate of Poss_{smp} combines $[\![\textit{most students}]\!]$, that is, a frozen quantifier $Q_1^C = [\![\text{most}]\!]^{[\![\text{student}]\!]}$, with $[\![\textit{'s}]\!] = \textit{Poss}$, to form

(50) $\textit{Poss}([\![\text{most}]\!], [\![\text{student}]\!], \mathbf{Q_2}, \mathbf{R})$

as the interpretation of the possessive Det *most students'*. Here the boldface $\mathbf{Q_2}, \mathbf{R}$ are parameters that still have to be set in the interpretation process. The first argument of the binary quantifier 50 is then frozen to $[\![\textit{paper}]\!]$, and finally the semantic correlate of Poss_{exp} fixes the quantifier over possessions (papers) to $[\![\textit{at least two}]\!]$. Thus, the following semantic tree corresponds to 43.

$(43)_{\text{sem}}$



This example demonstrates how the semantic correlates of DP_{ant}, Poss_{smp}, and Poss_{exp} interact in general.

The setting of the possessive relation inescapably involves pragmatics in addition to semantics (see sects. 4.2 and 9). In a plausible context of use, a possessive relation for 42 would be *wrote*, with the truth conditions ending up as follows.

(51) $\quad Poss([\![\text{most}]\!], [\![\text{student}]\!], [\![\text{at least two}]\!], \textit{wrote})^{[\![\text{paper}]\!]}([\![\text{got-an-A}]\!])$

Equivalently, these are the truth conditions, relative to a suitable model, of the following logical form.

(52) $\quad \underline{\textit{most}}\, x(Sx \wedge \exists y(Py \wedge Wxy)\,, \underline{\textit{at least two}}\, y(Py \wedge Wxy\,, GAy))$

3.3 Possessive DPs are quantificational units

We pause here to emphasize a fact built into to the meaning of possessives: a possessive DP is a QUANTIFICATIONAL UNIT. To see this, consider a sentence whose subject and direct object are possessive DPs, allowing the usual quantifier scope ambiguity.

(53) At most two of some professors' articles mention all of John's books.

The logical forms we use make the scopings explicit.

(54)
a. $\underline{\textit{some}}\, x(Px \wedge \exists y(Ay \wedge Rxy)\,, \underline{\textit{at most two}}\, y(Ay \wedge Rxy\,,$ $\exists z(Bz \wedge Rjz) \wedge \underline{\textit{all}}\, z(Bz \wedge Rjz\,, Myz)))$

b. $\exists z(Bz \wedge Rjz) \;\wedge\; \underline{\textit{all}}\, z(Bz \wedge Rjz\,, \underline{\textit{some}}\, x(Px \wedge \exists y(Ay \wedge Rxy)\,,$ $\underline{\textit{at most two}}\, y(Ay \wedge Rxy\,, Myz)))$

The thing to note is that these are the only possible scopings. The object DP *all of John's books* can have wide scope, but inside the subject DP, the quantifier Q_1 over possessors (*some*) always has wider scope than the quantifier Q_2 over possessions (*at most two*), AND no other quantifier can take scope between Q_1 and Q_2. Sentence 53 does not have the reading that some professor x is such that every book written by John is mentioned in two articles by x, where possibly different books are mentioned in different articles. A possessive DP can scope over, or be scoped over by, other quantifiers, but no external quantifier can scope inside it.

The explanation of this general fact (which holds for postnominal possessive DPs as well and for the same reason) is semantic: A possessive DP always has quantification (Q_2) over possessions, but the sets that Q_2 quantifies over depend on a possessor, which has to be identified first. Put differently, a quantified possessor DP ALWAYS has wider scope than the possessive relation.[10] The unitary meaning of possessives, which combines two quantifications in a particular configuration, is the main reason we propose to interpret *'s* and *of*$_{\text{poss}}$ as denoting the higher-order operation *Poss*, instead of it denoting just the possessive relation.

3.4 Postnominal possessive DPs

The syntactic structure of postnominal possessive DPs is no more remarkable than that just presented for prenominal ones. The uniform postnominal possessive morpheme, namely the preposition *of*$_{\text{poss}}$, combines with almost any DP (the possessor) into a possessive PP. This postnominal modifier combines with a preceding nominal (the possessed noun) to form a nominal phrase. The possessive DP is formed by combining a Det with that nominal phrase—or alternatively the latter becomes a bare plural DP. There is nothing special about the syntax, aside from quirkinesss about when the possessor DP is marked with *'s*. The thing that is special about postnominal possessive DPs is the semantic rules corresponding to some of these quite standard syntactic rules that generate them. The most striking examples arise from the fact that the bracketed nominal phrase in postnominal possessive DPs like

(55) a. some [customers of more than one airline]
b. several [boats of most technology billionaires]

do not denote a set; so a fortiori the preceding quantifier cannot combine with this nominal's meaning by the familiar semantic rule associated with DP_{qnt}. There is no set X of customers (or of any other things) to which the first argument of the binary quantifier *some* can be frozen so that

$$some^X = Poss([\![\text{more than one}]\!], [\![\text{airline}]\!], [\![\text{some}]\!], R)^{[\![\text{customer}]\!]}$$

[10]See (Bach & Partee 1981) for an analogous explanation of a similar scope and binding phenomenon concerning pronouns and quantified DPs (including possessive ones).

because 55a asserts for any given B that for two or more different airlines, a, $some^{[\![\text{customer}]\!]\cap R_a}$ holds of B. Intuitively, the reason why the bracketed nominals in 55 can't denote sets is ultimately that the quantifier to their left is scoped INSIDE the scope of a quantifier that is part of the nominal's meaning!

Nevertheless, the meaning of postnominal possessive DPs can still be assembled as compositionally from their parts as the meaning of prenominal possessive DPs is. Doing so just requires different rules than usual for interpreting the combination of possessed nominal with possessive prepositional phrase, and combining the resulting meaning with that of the possessive DP's initial Det. One could, for instance, interpret the possessed nominal plus possessive prepositional phrase like a simple prenominal possessive DP, and combine its meaning with that of the initial Det like the parts of an expanded prenominal possessive DP are combined. Since the semantic rules for interpreting postnominal possessive DPs do not seem to raise any fundamentally different questions than those for interpreting prenominal possessive DPs, other than the unusual correspondence of semantic types to syntactic categories, we do not present them in detail here.

3.5 The uniformity/compositionality problem

Repeated use of the semantic rules presented here gives exactly the desired readings of 42, 44, 48, and similar sentences with possessive DPs. There is, however, an issue concerning the rule corresponding to Poss_{smp} (the same issue arises in the postnominal case).

First, we formulated this rule for a quantified possessor DP, as in 42 (sect. 3.1). If this DP is not quantified, as in 44 and 48, it still contributes a unary quantifier Q, though not one of the form Q_1^C. To make that an input to *Poss*, we need to DECOMPOSE Q into Q_1 and C, as remarked in sect. 2.2. This can in fact always be done, but one has to choose the RIGHT decomposition. The alternative would be to use a separate semantic rule for the non-quantified possessor DP case.

Second, recall that compositionality requires that the meaning of a complex phrase, in this case a possessive Det, is determined by the meanings of its IMMEDIATE constituents, in this case a DP and *'s*. The meanings of these are Q_1^C and *Poss*, respectively. But again, applying the operator *Poss* requires access both to Q_1 and to C, and there is no way to uniquely recover these from Q_1^C.[11] Thus, the semantic rule formulated in this way requires access to the meanings of the IMMEDIATE CONSTITUENTS OF THE IMMEDIATE CONSTITUENTS. This is called SECOND-LEVEL compositionality in (Pagin & Westerståhl 2010), and it is weaker than full compositionality. (The semantic rule for Poss_{exp}, on the other hand, is fully compositional.)

[11] Decomposition of quantifiers is studied in (Westerståhl 2008), where it is shown that, under an additional assumption, C can always be recovered from Q_1^C, but never Q_1; there is always $Q_0 \neq Q_1$ such that $Q_1^C = Q_0^C$. Using this fact, one can construct counter-examples to the usual first-level compositionality of the semantic rule corresponding to Poss_{smp}.

These problems are two sides of the same coin. A uniform semantics for a possessive Det = [DP's] takes $[\![\text{DP}]\!]$ (and $[\![\text{'}s]\!]$) as inputs for building $[\![\text{Det}]\!]$. This is precisely what a compositional account requires, whereas, when DP has the form [Det N], use of *Poss* requires $[\![\text{Det}]\!]$ and $[\![\text{N}]\!]$ as inputs, that is, it requires decomposition of $[\![\text{DP}]\!]$. We will refer to this as the UNIFORMITY/COMPOSITIONALITY PROBLEM.

Is there an alternative semantic rule corresponding to Poss_{smp} that avoids the uniformity/compositionality problem? Interestingly, this question is closely connected to the issue of narrowing; we will discuss it at length in sect. 6.

4 The delineation of paradigmatic possessives

Having now proposed a form and meaning combination characteristic of possessive DPs, let us examine the implications for what are and are not possessives.

4.1 Expanded prenominal possessives and partitives

A question the reader may have wanted to raise for some time now is if the expanded prenominal possessive DPs, the ones of the form [Det of DP], aren't simply partitives? Our answer is: No. There is an important class of DPs of this form, not often discussed in the literature, which are possessive but not partitive. Consider DPs like the following.

(56) a. four of Tom's cats
b. most of six airlines' flights
c. all of three children's paint sprayers
d. some of most tech billionaires' boats
e. two of every student's books

which we have called expanded prenominal possessives. Many of them look superficially very like partitives, such as

(57) a. four of the cats
b. most of those flights
c. all of these paint sprayers
d. some of the five boats
e. two of these books

except that the DPs following *of* have a possessive Det in 56 where those in 57 have some form of definite or demonstrative article. Couldn't the full DPs in 56 be partitive, like those in 57?

Semantics of partitives vs. semantics of possessives

To answer this question, we start from the well-known PARTITIVE CONSTRAINT (Jackendoff 1977), according to which the DP after *of* must be DEFINITE. A useful survey of current notions of definiteness is Abbott (2010), ch. 9. Most of these incorporate some form of reference. Abbott also surveys suggested counter-examples to the definiteness constraint on partitives, noting that most of these actually do involve reference to pluralities or groups. This suffices for our point, which is the following: Expanded prenominal possessives are a different construction from the partitive. Their possessor DPs very often are not used to refer to individuals, or sets or groups of individuals. In fact, the meaning of such DPs cannot be derived along the lines of the usual semantics for partitives.

Consider the possessor DPs in 56. In a strict sense (made precise below), only 56a can be used to refer—and then only when the simple possessive DP *Tom's cats* is interpreted as quantifying over all cats belonging to Tom. The others cannot be treated as referring expressions, and yet the possessive DPs containing them have a perfectly clear meaning, indeed the one given to them by the rules for possessive DPs in sect. 3.

The case of 56a exemplifies the fact that sometimes both a partitive and a possessive analysis applies to a DP, and that in simple cases they result in the same truth conditions, as we will see presently. In more complex cases, the different analyses of the same DP can produce different truth conditions. This will be clear from a quick consideration of the possible interpretations of

(58) Two of the ten boys' books are missing.

Sentence 58 is THREE ways ambiguous. One interpretation says about two of the ten boys that each one's books are missing. This is generated by forming a possessive Det from the partitive DP *two of the ten boys*, in which *two* quantifies over boys. The implicit quantification over possessions (books of those two boys) could be *some* or *all*.

In addition, there are two readings where *two* instead quantifies over books. To distinguish them, ask how many books are missing: 2 or 20? The answer depends on whether the DP *two of the ten boys' books* is taken to be partitive or expanded possessive. If analyzed as a partitive, which requires treating *the ten boys' books* as a definite DP, that DP refers to the set of all books belonging to (one or more of) the ten boys, and then 58 says that *two* books in this set are missing. If *two of the ten boys' books* is analyzed as a possessive, on the other hand, 58 says that each of the ten boys is such that two of his books are missing, so twenty books in all could be missing.

This discussion shows that it is necessary to recognize expanded prenominal possessive DPs as a different construction than partitive DPs, with a different semantic interpretation rule. Considering the syntactic similarities, one could if desired take partitives of the form [Det of DP] to be generated by the same rule, Poss_{exp}, as expanded possessives (sect. 3.1); but the corresponding semantic rules are different. To spell out the semantic rule for partitives, we first need a more precise semantics for definites.

Formal semantics for definites

As above, we take semantic definiteness to amount essentially to referentiality. A precise version of this notion of definiteness was given in (Barwise & Cooper 1981) (called the INTERSECTION analysis in Abbott 2010), and we will use it here.[12]

Barwise and Cooper defined definiteness for determiners, but this extends immediately to DPs. Consider a DP denotation, that is, a unary quantifier Q. Q, as a set of subsets of the universe, is DEFINITE if it is either empty or generated by some non-empty set X—the GENERATOR of Q—in the sense that for all B,

$$B \in Q \;\Leftrightarrow\; X \subseteq B$$

In the latter case, the generator X is the intersection of the sets in Q: $X = \cap Q$. Next, a DP (and also the Det if the DP has the form [Det N′]) is SEMANTICALLY DEFINITE if $[\![\text{DP}]\!]$ is definite in this sense. Finally, for a definite DP, we say that the DP REFERS to the generator X when $[\![\text{DP}]\!]$ is non-empty.

For example (recall 38 and 36 in sect. 2.3),

(59) a. *Mary* refers to m (i.e. Mary), since I_m is generated by $\{m\}$ (PROVIDED $m \in M$).
b. *the ten boys* refers to the the salient set A of boys in M, since $(\textit{the ten})^A$ is generated by A (PROVIDED $|A| = 10$).
c. *Mary's books* refers to the set of books (A) that Mary has, more generally, to $A \cap R_m$, since (under the universal interpretation) $\textit{Mary's}^A$ is generated by $A \cap R_m$ (PROVIDED $A \cap R_m \neq \emptyset$).

But if the provisos in 59 are not satisfied, the quantifiers have no generators, and these semantically definite DPs do not refer at all. This is a precise and natural way to spell out of the idea of definiteness in terms of referentiality. And now it is easy to formulate the semantics for partitives.

Formal semantics for partitive DPs

Suppose partitive DPs of the form

(60) Det of DP

[12] Barwise and Cooper defined definiteness as referentiality in a framework that has ordinary individuals but does not model group/collective entities, and noted that it does not distinguish *both* from *the two* although only the latter can occupy the position after *of* in a partitive. Ladusaw (1982) showed that a framework which distinguishes a lattice of groups from a set of ordinary individuals permits a natural analysis of the difference in meaning: treat *both* as quantifying over individuals and *the two* as referring to a dyad, a group of two individuals. He proposed that each apparently quantified DP that appears after *of* in a partitive actually refers to a group, the one made up of the individuals in the set Barwise and Cooper say these definite DPs refer to. In this paper we sidestep the added complexity of introducing a lattice of groups. Everything we say about consequences of the definition for definiteness used here would remain true if Ladusaw's definition were adopted instead. The only change would be an ability to discriminate in partitives between *the two* and *both*.

as in 57 are generated by the same syntactic rule $\mathrm{Poss}_{\mathrm{exp}}$ as the possessive DPs in 56. The semantic rule for the partitive case applies when the DP in 60 is (a plural) definite.

(61) $[\![\text{Det of DP}]\!](B) \Leftrightarrow [\![\text{DP}]\!]$ has a generator and $[\![\text{Det}]\!](\cap[\![\text{DP}]\!], B)$

For example, the truth conditions for

(62) Two of the ten boys left.

are derived as follows. Assuming the salient set of boys has exactly ten elements, we saw that it is the generator of $[\![\textit{the ten boys}]\!]$. Then, according to 61, 62 is true iff $[\![\textit{two}]\!](\cap[\![\textit{the ten boys}]\!], [\![\textit{left}]\!])$ iff $[\![\textit{two}]\!]([\![\textit{boy}]\!], [\![\textit{left}]\!])$ iff $|[\![\text{boy}]\!] \cap [\![\text{left}]\!]| = 2$.

In general, then, two options exist for interpreting a phrase [Det of DP]. If $[\![\text{DP}]\!]$ has the form $\textit{Poss}(Q_1, C, \mathbf{Q_2}, \mathbf{R})^A$, where A is the extension of the possessed noun, then the possessive semantics applies, setting $\mathbf{Q_2}$ to $[\![\text{Det}]\!]$. If $[\![\text{DP}]\!]$ is definite, rule 61 for partitives applies.

If BOTH conditions are satisfied, both rules apply. In simple cases, they produce the same result. For example, consider

(63) Four of Tom's cats are grey.

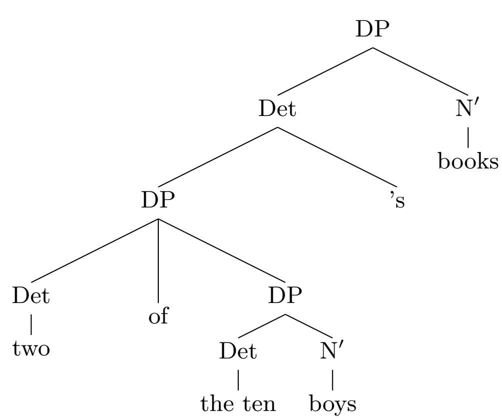
With the possessive rule (and with $[\![\textit{Tom}]\!] = I_t$ decomposed as $\textit{all}_{\mathrm{ei}}^{\{t\}}$; see sects. 2.2 and 7.2), one gets $\textit{Poss}(\textit{all}_{\mathrm{ei}}, \{t\}, [\![\textit{four}]\!], R)([\![\textit{cat}]\!], [\![\textit{grey}]\!])$, that is, $|[\![\text{cat}]\!] \cap R_t \cap [\![\text{grey}]\!]| = 4$ (the number of grey cats possessed by Tom is 4). And, provided Tom possesses at least one cat ($[\![\textit{cat}]\!] \cap R_t \neq \emptyset$; cf. 59c), this is exactly what results from the partitive rule 61, treating (the universal reading of) *Tom's cats* as a definite.

In more complex cases, the rules can give different (and correct!) results, as illustrated by the three readings of 58, repeated here.

(58) Two of the ten boys' books are missing.

The first reading uses the structure

(58a)



treating *two of the ten boys* as a partitive. Assuming $\cap[\![\textit{the ten boys}]\!] = [\![\textit{boy}]\!]$ (i.e. that $|[\![\textit{boy}]\!]| = 10$), $[\![\textit{two of the ten boys}]\!]$ is the unary quantifier Q defined in 61. To apply the semantic correlate of $\mathrm{Poss}_{\mathrm{smp}}$ to interpret the possessive determiner *two of the ten boys'*, we need to DECOMPOSE Q. This is immediate for partitives: in general, if $[\![\mathrm{DP}]\!]$'s generator is $X = \cap[\![\mathrm{DP}]\!]$, it follows from 61 that

$$[\![\text{Det of DP}]\!] = [\![\text{Det}]\!]^X$$

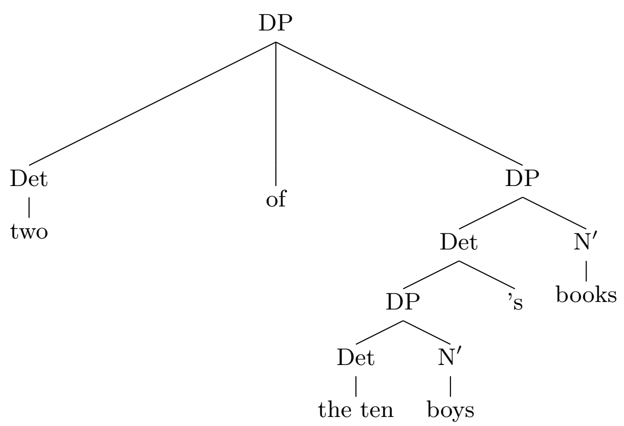
(notation as in 39, sect. 2.3). So $Q = [\![\textit{two}]\!]^{[\![\textit{boy}]\!]}$, and after applying *Poss* we eventually obtain the interpretation

(58′) $\quad Poss([\![\text{two}]\!], [\![\text{boy}]\!], \mathbf{Q_2}, \mathbf{R})^{[\![\text{book}]\!]}([\![\text{missing}]\!])$

(two boys are such that each one is missing Q_2 of his books, where Q_2 is *all* or *some*). Note that with this interpretation, it is not required that each of the ten boys possess books; only the two boys whose books are missing must do that. This seems correct.

The other two readings have *two* quantifying over books rather than boys; the structure is

(58b)



But they differ as to whether *two of the ten boys' books* is analyzed as an expanded prenominal possessive or as a partitive DP. In the former case, we end up with

(58″) $\quad Poss([\![\text{the ten}]\!], [\![\text{boy}]\!], [\![\text{two}]\!], \mathbf{R})^{[\![\text{book}]\!]}([\![\text{missing}]\!])$

(each of the ten boys is missing two of his books; a fortiori, he possesses at least two books). In the latter case, (the universal reading of) *the ten boys' books* is treated as a definite, and it is easy to see that its generator is $\bigcup_{a \in [\![\textit{boy}]\!]}([\![\textit{book}]\!] \cap R_a)$, the set of books possessed by one or more of the boys, PROVIDED it exists, that is, provided at least one of the exactly ten boys possesses books. Thus, using 61, we obtain the interpretation

(58‴) $[\![\text{two}]\!]\,(\bigcup_{a\in[\![boy]\!]}([\![book]\!]\cap \mathbf{R}_a), [\![\text{missing}]\!])$

(two books, out of the books possessed by one or more of the boys, are missing). Again, this does not require each boy to (individually or jointly) possess any books, only that taken together the boys possess at least two.

We can also write the truth conditions derived from 58 in our formal language.

(58′) $\underline{two}\,x(\underline{boy}\,x \wedge \exists z(\underline{book}\,z \wedge Rxz)\,, Q_2 y(\underline{book}\,y \wedge Rxy\,, \underline{missing}\,y))$

(58″) $\underline{the\ ten}\,x(\underline{boy}\,x \wedge \exists z(\underline{book}\,z \wedge Rxz)\,, \underline{two}\,y(\underline{book}\,y \wedge Rxy\,, \underline{missing}\,y))$

(58‴) $\underline{two}\,y(\underline{book}\,y \wedge \exists x(\underline{boy}\,x \wedge Rxy)\,, \underline{missing}\,y)$

Summing up this subsection, not only is the partitive construction different than the expanded possessive construction but, aided by a precise semantics for definites, we presented a clean theoretical analysis of partitives which together with the earlier analysis of possessives provides an empirically sound account of sentences with DPs of the form [Det of DP].

4.2 Which postnominal prepositional phrases with *of* are possessive?

Turning now to postnominal possessives, recall the observation at the end of sect. 2.1 that discerning which postnominal prepositional phrases with *of* are possessive can be complicated when the possessor DP lacks *'s*. It is nonetheless important to distinguish the possessive ones from other *of*-phrases because this preposition has numerous uses besides its possessive one, and conflating different uses can distort the analyses of multiple constructions. Besides nonpossessives like *a portrait of Picasso/him*, discussed earlier, a number of other cases are fairly easily recognizable as not being possessive (on their most likely interpretations).

(64)
a. the museum of trains
b. an archive of early photography
c. two bills of rights
d. every garden of many rose varieties
e. a salad of thirteen different vegetables

There are, however, plenty of cases for which it is tricky to determine whether they are possessive or not, or are ambiguous between a possessive interpretation and another one. Besides *a brother of John*, mentioned earlier, these include 65, among many others.

(65)
a. children of two mothers
b. the love of three oranges

Two characteristics possessives have that can be helpful in distinguishing them from other constructions were mentioned earlier. One is freedom of the possessive relation in the postnominal as well as the prenominal possessive construction. The fixedness of relation between the DP following *of* and the noun preceding it in 64 is a good indicator that these are not postnominal possessives. Another helpful characteristic of quantified possessor DPs is that they always have scope wide enough to include the possessive relation. This feature of possessives is neither accidental nor arbitrary. It is a consequence of the fact that in order for possessive DPs to quantify over sets of possessions, specifying possessors is a prerequisite for quantifying over each one's possessions. Thus mandatory scope of quantified possessors over the possessive relation is a corollary of the fact that paradigmatic possessives always quantify over possessions.

Observe that 65a has multiple interpretations. One refers to children with two mothers apiece, giving narrow scope to the quantified DP after *of*. On this reading the relation between mothers and children can only be the inverse of *child of*. For example, one mother might be a child's egg donor and the other its surrogate mother; or one a child's birth mother and the other its adoptive mother. There is, however, no flexibility in interpretation of their relationship to the child, who must be a child of both. An entirely different reading has mothers being designated to, for example, chaperone school children on a field trip, and requires no filial relationship between any chaperone and her assigned charges. To interpret the DP with this relation requires construing 65a with the possessive construction, which allows the possessive relation to be free for pragmatic interpretation. But the possessive construction of 65a requires *two mothers* to have scope over the chaperone relation. And this correctly predicts that the DP does not refer to doubly chaperoned children but rather to (some or all) charges of two chaperones. As we see, the two characteristics converge and indicate that the latter reading is possessive and the former is not (in fact, it is a relational noun with its complement DP).

Needless to say, a quantified complement of a relational noun can be interpreted with wide scope. Equally, when a possessed noun is relational, the possessive relation can be the inverse of the relation this noun expresses. These different ways of construing 65a lead to the same third interpretation of the DP, as denoting two mothers' children (in the most straightforward sense). Perhaps this fact is one reason why the two distinct constructions that 65a and numerous other examples like it have are so often conflated.

Now note that 65b does not seem to freely allow the oranges to stand in relations other than being loved, though it does permit wide as well as narrow scope of the quantification. This indicates that the DP cannot be construed as a postnominal possessive, a conclusion that meshes nicely with the fact that prenominal possessive #*three oranges' love* is anomalous. Deploying characteristics of paradigmatic possessives to sort genuine postnominal possessives out from other postnominal *of*-phrases as illustrated here can be a valuable tool in bringing order to discussions of not just possessives, but other constructions as well.

Freedom of the possessive relation

Freedom of the possessive relation is so useful in ascertaining which expressions of a particular form are possessive—e.g. that 65b and some uses of 65a are not, while other uses of 65a and *most books of undergraduate students* are—that it's worth a few more words here despite frequent mention of freedom in the literature on possessives.

Consider where a given possessive construction's possessive relation arises from. It may come in some way from a part of the sentence that contains the possessive DP, such as the possessed noun, the possessor DP, or even parts of the sentence that precede or follow the entire possessive DP. Several such candidates for the possessive relation can originate in linguistic parts of the sentence, even arise from a single part. The possessed noun *book*, for example, is intrinsically related to its author, its subject matter, and its own parts (chapters, leaves, etc.), among other things. The point of interest, however, is that despite the possibility for a possessive DP and the sentence containing it to offer candidates for the possessive relation, it is also possible for this relation to be taken as something entirely different than any of these semantically available candidates. *John's book*, for example, can be the book that John uses to prop open his door on hot days, or the one he was assigned to write a report on, or the one he named as his choice if stranded on a desert island, or any one of a plethora of other relations that have no intrinsic connection whatsoever to any part of the sentence *John's book is War and Peace.* These possessive relations arise from the context of use, not from any linguistic part of the sentence including the possessive DP.

Freedom of choice for the possessive relation is a hallmark of the possessive construction.

> FREEDOM: Every possessive DP can be used in a sentence S in a context where that DP's possessive relation is none of the options provided semantically by S but instead comes somehow from the context in which the sentence is used.

Freedom exists even for relational possessed nouns that may strongly favor interpreting the possessive relation as the inverse of the relation that the noun expresses. And freedom exists for postnominal possessive DPs as well as for prenominal ones. For instance,

(66) John's mothers are always wandering off.

can refer to mothers whom John is assigned to guide on an outing, and

(67) a. As a young lawyer, I was really learning to do cases from fathers of mine around the country.
b. Dozens of fossils of a graduate student's are missing.

can refer to fathers whom the lawyer represented in legal proceedings and to fossils that the student discovered or had been studying.

Note that freedom is not the claim that any relation whatsoever can serve as the possessive relation of a given possessive DP. Various authors have argued that certain linguistically available relations are barred (see e.g. Barker 1995, ch. 2, and references therein), and this is fully compatible with the way freedom is formulated here. We discuss this matter further in sect. 9.

Freedom in choosing the possessive relation is why the semantic interpretation rules that we have presented for possessives insert a relation parameter to be set pragmatically, rather than semantically specifying what possessive relation to use. Indeed, freedom implies that the latter cannot be done.

Semantics of relational noun complements

For good measure we spell out an explicit rule for semantic interpretation of one construction that postnominal possessives are sometimes conflated with: relational nouns with their complement DP. Of course, relational nouns govern many other prepositions besides *of*; and the others are not confused with postnominal possessives.

(68)
a. several donations to four good causes
b. many alliances with foreign nations
c. excessive reliance on numerous untrustworthy sources
d. three arguments against almost every plan
e. several photographs of two people

Semantically, a relational noun utilizes its complement DP to fill an argument role of the relation expressed by the noun. The semantic rule that accomplishes this is the following.[13]

(69) $[\![\mathrm{N_{rln}}\ \mathrm{P}\ \mathrm{DP}]\!] = \{a\colon a \in dom([\![\mathrm{N_{rln}}]\!])\ \&\ [\![\mathrm{DP}]\!](\{b\colon [\![\mathrm{N_{rln}}]\!](a,b)\})\}$

When the complement of the relational noun is a quantified DP, this quantification can generally take either narrow scope or wide scope with respect to the noun relation. For example, each donation mentioned in 68a could be to the benefit of four good causes, not necessarily the same four in the case of all donations; or there could be four causes each of which received several of the mentioned donations. Similarly, the photographs mentioned in 68e could each depict a pair of people, possibly different pairs in different photographs; or there could instead be two particular people each of whom is depicted by several mentioned photographs, perhaps some or all of these photographs depicting just one of these two people. Such quantifier scope ambiguities are commonplace in language, being permitted by familiar mechanisms for interpreting quantified DPs as taking a wider scope than their syntactic position itself indicates.

[13]The stipulation $a \in dom([\![\mathrm{N_{rln}}]\!])$ is needed in 69 because $[\![\mathrm{DP}]\!](\{b : [\![\mathrm{N_{rln}}]\!](a,b)\})$ does not always entail $a \in dom([\![\mathrm{N_{rln}}]\!])$. When a DP that does not is interpreted with narrow scope, only the additional stipulation guarantees, for example, that `an argument against no proposal` is an argument. There is no proposal that the number 2 is an argument against; but that fact does not make 2 an argument against no proposal.

4.3 Some possessive look-alikes

We have seen that partitive constructions and constructions with relational noun complements and certain postnominal modifiers need to be distinguished from possessive constructions. Here are some other kinds of phrases that may look like possessives but do not fall within the range of paradigmatic possessives.

Gerundive complements and nominalizations

(70)
a. My undergoing surgery for tattoo removal was a mistake.
b. He was baffled by {several students'/each woman's} refusal to budge.

Despite the striking identity of form between these and the ordinary possessives we have been analyzing, the *'s* in 70 can only express whatever thematic relation is determined for its subject by the verb from which the gerund or nominalization derives. This is in stark contrast with the widely recognized freedom of the possessive relation. Thus, suffixation of *'s* in gerundive complements and gerund(ive nominal(ization))s is a distinct use of this morphological device. Things that are putatively possessive as these subjects of gerunds and nominalizations are differ little from *for*-marked subjects of *for-to* complements, and thus are hardly at all like most other things that have been termed possessive.

Periphrastic possessives

By contrast, periphrastic possessives such as

(71)
a. Photographs that two people owned were on the mantel.
b. Many friends that John had let him down.
c. Three books belonging to Mary are lying on the sideboard.

may express a variety of different relationships between possessor and possessions. Indeed, each meaning they allow can be expressed by a corresponding paradigmatic possessive.

(72)
a. Two people's photographs were on the mantel.
b. Many friends of John's let him down.
c. Three of Mary's books are lying on the sideboard.

However, the so-called possessives in 71 are instances of general constructions containing certain transitive verbs, including *own*, *have*, *possess*, and *belong (to)*. These are differentiated from nonpossessive congeners simply by the circumstance of containing a verb that entails some general sense of possessing, not by anything particular to a construction that is specifically possessive. Although the meanings of periphrastic possessives are also expressible by ordinary possessives, the syntactic regularities of the different constructions are quite distinct, suggesting they should be kept clearly apart.

Modifying possessives

The suffix *'s* has been recognized as having a use different from its use in the possessives we have discussed so far, namely, to form MODIFYING POSSESSIVES (Quirk *et al.* 1985:327), also called CLASSIFYING or DESCRIPTIVE GENITIVES (Poutsma 1914, 1035,1138 and Halliday 1994; see also Munn 1995; Strauss 2004; Rosenbach 2003) such as *gardener's apron*, *busman's holiday*, etc. Here the possessor is not a DP (hence cannot be a proper name or pronoun) but is instead a common noun or nominal. And the possessive modifier is syntactically akin to an adjective rather than a determiner, so combines with the possessed nominal to form a nominal—which in turn must combine with a preceding determiner in order to form a DP, unless it is a bare plural. Thus, a sentence like 73 is ambiguous.

(73) Most sailors' coats are waterproof.

Most quantifies over sailors when the possessive phrase has the structure and meaning of a paradigmatic possessive, and over coats when it has the structure and meaning of a modifying possessive. For the latter, the phrase *sailors' coats* is understood as describing a certain sort of coat—coats for, or characteristically worn by, sailors—and this nominal phrase, comprising a modifier *sailors'* and head noun *coats*, is preceded by the determiner *most*, which quantifies as usual over the set denoted by the entire nominal phrase that follows it.

The difference can sometimes be structurally disambiguated as in

(74) a. This sailor's coat is bigger than that one.
b. This sailor's coat is bigger than that one's.

In 74a, *sailors' coat* can be understood as a nominal phrase, replaceable by the pro-form *one*, but *one* can never ne anaphoric to *sailor* in this sentence. By contrast, the same sequence of words is not a phrase in 74b; the only available antecedent for the pro-form is the nominal *sailor*, allowing *that one's* to be a paradigmatic possessive parallel to *this sailor's*.

The key difference is that if a sequence Q C *'s* A is constructed as a modifying possessive, Q quantifies over As that are appropriate for Cs, whereas if the same sequence of words is constructed as a paradigmatic possessive, then Q quantifies over Cs that possess an A.

4.4 Alternative forms for expressing possessives

To wrap up this section's discussions of where we think the boundaries lie of the two paradigmatic possessive constructions of English, let us say a bit more about what is found within those boundaries. While the prenominal and postnominal possessive constructions differ in syntactic structure, they are remarkably similar semantically. Not only do both always quantify over possessions, the prenominal construction can explicitly specify for this purpose any one of a wide range of quantifiers, as the postnominal construction must do (except when bare plural). In both constructions this quantifier has scope inside any quantification over possessors, although the constructional relationship between the two determiners in question might suggest otherwise. Both are free in the choice of possessive relation, as discussed in sect. 4.2. Both constructions permit virtually any noun to be the possessed noun, and likewise allow a very wide variety of DPs as the possessor phrase. While each construction has a few idiosyncrasies, almost any expression employing one construction has a counterpart utilizing the other, and usually counterparts differ little in meaning if at all. We present some of these correspondences here to illustrate their ubiquity, letting Q stand for a DP that expresses a unary quantifier. In general, the prenominal and postnominal possessive DPs in 75 are interchangeable, when Q_2 is any of *some*, *all*, *both*, *few*, *a few*, *several*, *enough*, *many*, *most*, or a cardinal number other than *one*.

(75) Q_2 of Q's As $\sim$ Q_2 As of Q's

For example,

(76) a. All of six boys' slingshots $\sim$ All slingshots of six boys(')
b. Several of Mary's photographs $\sim$ Several photographs of Mary's
c. Eight of most students' courses $\sim$ Eight courses of most students'
d. Few of that woman's books $\sim$ Few books of that woman('s)

Even when morphosyntactic quirks preclude quite so direct a correspondence of form, the correspondence holds once adjustments are made for the morphosyntactic peculiarities. Thus,

(77) a. two-thirds of Q's As $\sim$ two-thirds of the As of Q's
b. one of Q's As $\sim$ an A of Q's $\sim$ some A of Q's
c. each of Q's As $\sim$ each A of Q's
d. every one of Q's As $\sim$ every A of Q's
e. none of Q's As $\sim$ no A(s) of Q's

Another correspondence

(78) Q's As [universal interpretation] $\sim$ the As of Q's $\sim$ all/each/every one of Q's As

is of interest in connection with the common generalization that possessive DPs inherit their semantic definiteness from the possessor DP (see sect. 8).

However, the DPs

(79) a. Q's A [universal interpretation]
b. the A of Qs

with a singular possessed noun do not correspond quite as closely because 79b usually implies that the possession is unique whereas 79a need not. Thus *The tooth of Mary's hurts terribly* strongly suggests that Mary has only one tooth altogether, in contrast to 80a and other examples in 80.

(80) a. Mary's tooth hurts terribly.

b. My student will come see me this afternoon.
c. One assistant professor injured his leg.
d. Prince Edward was born at Henry VIII's palace.

In sum, English's prenominal and postnominal possessive constructions are very much like each other in extent and also in meaning; and both can be distinguished in principled ways from other constructions that superficially appear similar but are actually different, such as partitives or nonpossessive postnominal modifiers and complements.

5 Negating possessives

Let us return to predictions made by the analysis of possessives presented so far. In this section we explore the interaction of possessives with negation and its consequences for what possessives presuppose, if anything.

Since possessive constructions often involve two nested quantifiers (ALWAYS, if the possessor DP is always taken to denote a unary quantifier), there are several things the negation of a sentence containing a possessive construction could mean, depending on what scope the negation takes. Consider this sentence.

(81) Six people's dogs escaped from the kennel.

A reasonable interpretation in this case is existential: (exactly) six people were such that some of the dogs they had at the kennel escaped (but not necessarily all of those dogs). Then what does 82 mean?

(82) Six people's dogs didn't escape from the kennel.

Clearly, just applying negation to the whole sentence (or, equivalently, to *six*), yields a very far-fetched interpretation: the number of people who had one or more dogs at the kennel escape is different than six.[14] Rather, it is normally the existential quantifier that gets negated in 82: six people with dogs at the kennel were fortunate enough that none of their dogs escaped.

5.1 Outer, inner, and middle negation

We briefly point out the range of possible interpretations that negated sentences containing possessives can have, without attempting to specify exactly how these interpretations are generated. In general there are two ways to negate a quantified sentence, usually called OUTER negation and INNER negation (or POST-COMPLEMENT). These can be treated as Boolean operations applying to the quantifiers themselves; in the case of a binary CONSERV quantifier they are defined as follows.

(83) a. $\neg Q(A, B) \Leftrightarrow$ it is not the case that $Q(A, B)$

[14] Presumably, however, the right circumstances could favor that interpretation: *Six people's dogs didn't escape from the kennel—it was five people's dogs that escaped!*

b. $Q\neg(A, B) \Leftrightarrow Q(A, A - B)$

As an example of inner negation, the most plausible reading of the sentence

(84) At least two students didn't arrive late.

can be rendered either as

$$\textit{at least two}^{[\![\text{student}]\!]}([\![\text{student}]\!] - [\![\text{arrived-late}]\!])$$

or equivalently as

$$(\textit{at least two}\,\neg)^{[\![\text{student}]\!]}([\![\text{arrived-late}]\!])$$

The *Poss* operator (recall 41 in sect. 2.2) now gives a perspicuous way of applying inner and outer negations to the various quantifiers involved. It is easy to verify that the following equivalences hold.

(85) a. $\neg \textit{Poss}(Q_1, C, Q_2, R) = \textit{Poss}(\neg Q_1, C, Q_2, R)$
b. $\textit{Poss}(Q_1, C, Q_2, R)\neg = \textit{Poss}(Q_1, C, Q_2\neg, R)$
c. $\textit{Poss}(Q_1, C, Q_2, R) = \textit{Poss}(Q_1\neg, C, \neg Q_2, R)$

The first one, 85a, is responsible for the remark made earlier that negating the whole sentence 81 is the same as negating the quantifier *six*. Equivalence 85c says that facing negations cancel, which is reflected in the equivalence between 82 and

(86) All but six people's dogs escaped from the kennel.

Now notice further that the most natural way to read the negative sentence 82 is neither the outer nor the inner negation of the possessive determiner in 81: $\textit{Poss}(Q_1, C, Q_2, R)$. Rather, it is given by $\textit{Poss}(Q_1, C, \neg Q_2, R)$,

(87) $\underline{\textit{six}}\, x(Px \wedge \exists y(Dy \wedge Rxy)\,, \neg\, \underline{\textit{some}}\, y(Dy \wedge Rxy\,, Ey))$

(or equivalently, using 85c and $Q_1\neg\neg = Q_1$, by $\textit{Poss}(Q_1\neg, C, Q_2, R)$). We call this MIDDLE NEGATION and adopt the following notation:

(88) $\textit{Poss}\neg(Q_1, C, Q_2, R) \;=_{\text{def}}\; \textit{Poss}(Q_1, C, \neg Q_2, R)$

That middle negation sometimes is the natural one to employ doesn't mean it always is.

(89) Not everyone's needs can be satisfied with standard products.

This denies that everyone is such that (all) his/her needs can be satisfied with standard products, that is, it says someone has at least one need that cannot be so satisfied. Here we have outer negation, made available by the fact that the initial quantifier of the un-negated sentence, *every*, itself has an outer negation that is sometimes expressible as an English determiner phrase, *not every*.

As to inner negation, consider

(90) Mary's brothers didn't show up at the reception.

The positive statement *Mary's brothers showed up at the reception* says that each member of a certain non-empty set of brothers of Mary showed up at the reception, and the most likely interpretation of 90 is that every one of them failed to show up, in other words that none of them showed up.

(91) $\exists y B^{-1}my \wedge \underline{all}\, y(B^{-1}my\, , \neg\, Sy)$

(Note that the possessive relation is the inverse of B = *brother-of*.) This is inner negation. It would be rather strange to utter 90 knowing that some of her brothers showed up and others didn't. However, consider also the variant of 90 where the universal quantification is explicit.

(92) All of Mary's brothers didn't show up at the reception.

Many people find this perfectly consistent with some of her brothers showing up, so middle negation can be found here as in 82.

(93) $\exists y B^{-1}my \wedge \neg\, \underline{all}\, y(B^{-1}my\, , Sy)$

Thus, all three kinds of negation occur with possessives.[15]

5.2 Negation and presupposition

Both the inner and middle negation of *All of Mary's brothers showed up at the reception* share with the positive statement the entailment that Mary has brothers. The outer negation, on the other hand, does not; it would say that either she has no brothers or at least one of them didn't show up—an unlikely interpretation of 90 or 92. One might be tempted to assume that Mary's having brothers is a PRESUPPOSITION of any sentence, negated or not, containing *Mary's brothers*. But a presuppositional analysis cannot in general underlie the account of how possessives interact with negation; as the discussion of 81, repeated here,

(81) Six people's dogs escaped from the kennel.

clearly shows. While 81 can only be true if at least six people have dogs at the kennel, the latter is not presupposed by 81, as familiar tests for presupposition show. For instance, one can ask the question corresponding to 81, namely

[15] More is said on this subject in (Westerståhl 2011). We thank Stephen Read for pointing out that quantified possessives and negation were already studied in the Middle Ages by John Buridan. In our terminology, Buridan (ca. 1300–1358) considered $Poss(Q_1, C, Q_2, R)(A, B)$ when Q_1 and Q_2 are either *every* or *some*, and the verb phrase (denoting the set B) either is or isn't negated. He listed the eight logically distinct cases that can be obtained in this way, with examples like the following one.

(i) Some donkey of every man doesn't run.

(94) Did six people's dogs escape from the kennel?

without committing to the existence of six people who have dogs there. Similarly

(95) Every child's siblings are not always fun to be with.

does not require for its truth that every child have siblings. Sentence 95 is consistent with the existence of only children, whether it is construed with outer negation (some child has siblings that are sometimes not/are never fun to be with), or middle or inner negation (every child who has siblings sometimes/never has fun being with them). In the next section, we analyze in detail what existence requirements possessive DPs carry. Our aim here was simply to note that these existence requirements do not in general constitute presuppositions of possessives.

6 Possessive existential import (PEI)

This section highlights a universal property of possessive DPs, which we call POSSESSIVE EXISTENTIAL IMPORT (PEI): not only do possessive DPs always quantify over possessions, but this quantification always has existential import. PEI is built into the semantics we have given, but is somewhat hidden by the fact that the operation *Poss* enforces a still stronger property, namely NARROWING, discussed in (Barker 1995). Recall the definition of *Poss*, repeated here.

(41) $$\mathit{Poss}(Q_1, C, Q_2, R)(A, B) \Leftrightarrow Q_1(C \cap \mathit{dom}_A(R), \{a : Q_2(A \cap R_a, B)\})$$

Narrowing is the restriction of C to $\mathit{dom}_A(R)$. In other words, a quantified possessor DP quantifies only over those elements in C which possess something in A, not over all elements in C. For example, in

(96) Most hospitals' robot surgery equipment is less than four years old.

quantification is over hospitals with robot surgery equipment, not over hospitals in general.

We are sympathetic to Barker's claim that all possessive DPs have narrowing—that is why we have so far taken the meaning of *'s* and $\mathit{of}_{\text{poss}}$ to be given by *Poss*—but counter-examples have been suggested. On the other hand, we demonstrate that PEI holds universally of possessive DPs.

The structure of this section is as follows. We first show that the most obvious way to avoid the uniformity/compositionality problem, namely to simply drop '$\cap\, \mathit{dom}_A(R)$' from 41, drastically fails to give empirically correct truth conditions for numerous sentences with possessives, precisely because it does not guarantee PEI. We then observe that there is a way to enforce PEI universally without (always) requiring narrowing, by using an alternative operation Poss^w. Finally, we state the precise relations between PEI (using Poss^w) and narrowing (using *Poss*): Narrowing implies PEI, and the converse implication holds when the possessor DP is a proper name or is quantified with a symmetric quantifier.

6.1 A failed attempt

If we simply drop narrowing from 41, the right-hand side becomes

$$Q_1(C, \{a : Q_2(A \cap R_a, B)\})$$

that is,

$$Q_1x(Cx\,, Q_2y(Ay \wedge Rxy\,, By))$$

Recalling the definition 39 of freezing from sect. 2.3, this can equivalently be written

$$Q_1^C(\{a : Q_2(A \cap R_a, B)\})$$

Here Q_1^C is a unary quantifier, which is what would make this semantics uniform and compositional: we would define a ternary operator $Poss^*$ taking a unary quantifier Q, a binary quantifier Q_2, and a relation R as arguments.

(97) $Poss^*(Q, Q_2, R)(A, B) \Leftrightarrow Q(\{a : Q_2(A \cap R_a, B)\})$

$Poss^*$ applies to quantified and non-quantified possessive Dets or PPs alike. Problem solved? No. Semantic interpretation with $Poss^*$ instead of *Poss* gives incorrect truth conditions in many cases.

Suppose Mary has no sisters and wrote no term papers. Clearly, then, 98a is not true, and neither is 98b.

(98) a. Mary's sisters live in New York.
b. Mary's term papers got an A.

These sentences are naturally interpreted with $Q_2 = every$; but then they would be true if $Poss^*$ were used! That would interpret 98b as saying that either Mary wrote no term papers or she wrote term papers and they got an A. This is not what 98b means.

The observation just made is that the implicit quantifier in the possessive Det *Mary's* is universal quantification with existential import. But this phenomenon does not only concern universal quantification. The same holds for ALL quantifiers Q_2 over possessions: the sentences in 99 are just as false if Mary has no sisters, or never wrote a term paper, or didn't have any sons.

(99) a. At most one of Mary's sisters lives in New York.
b. Half or fewer of Mary's term papers got an A.
c. None of Mary's sons is male.

Similarly, since Einstein died of natural causes, 100 is not true.

(100) None of Einstein's assassins left prison alive.

To put it succinctly: the correct truth conditions for a sentence of the form

(101) Q_2 of Mary's *As* are B

are (expressed set-theoretically as well as logically)

(102) a. $A \cap R_m \neq \emptyset \; \& \; Q_2(A \cap R_m, B)$
b. $\exists y(Ay \wedge Rmy) \wedge Q_2 y(Ay \wedge Rmy\,, By)$

But what *Poss** gives is

(103) a. $Q_2(A \cap R_m, B)$
b. $Q_2 y(Ay \wedge Rmy\,, By)$

which is simply not right.[16]

The upshot is that one always has existential import when quantifying over possessions, requiring that the first argument of Q_2 is non-empty, even if Q_2 itself doesn't require that (e.g. *at most one*). This is PEI.

The role of PEI becomes even clearer when quantified possessor DPs are considered, as in 104.

(104) a. None of three students' Porsches are red.
b. No Porsches of three students' are red.

Each of these says, taking *three* to mean *exactly three*, that this many students who have Porsches are such that none of the Porsches they have are red.

(105) $\underline{\mathit{three}}\, x(Sx \wedge \exists y(Py \wedge Hxy)\,, \underline{\mathit{no}}\, y(Py \wedge Hxy\,, Ry))$

This is compatible with lots of students not having any Porsches at all (and, for that matter, with lots of students having one or more red Porsches).

However, applying *Poss**, with $Q = \mathit{three}^{[\![\text{student}]\!]}$ and $Q_2 = \mathit{no}$, to 104 would yield the following truth conditions.

$$\underline{\mathit{three}}\, x(Sx\,, \underline{\mathit{no}}\, y(Py \wedge Hxy\,, Ry))$$

That is, the number of students who have no red Porsches is exactly three, or, equivalently, all but three students have a red Porsche. Presumably, nobody thinks 104 means that.

Such examples can be multiplied; here are two more.

(106) a. Most Americans' second house is a vacation home.
b. Firemen's wives worry about their husbands.

Given the fact that most Americans don't own two or more houses, 106a would be TRIVIALLY TRUE if analyzed with *Poss**. Likewise 106b would be trivially true if no firemen were married. This is clearly wrong. Even if one feels that these sentences do not exhibit narrowing (in which case they would be false under the circumstances mentioned), they clearly are not trivially true.

[16] Here *Mary* is interpreted as the Montagovian individual I_m (see 38a, sect. 2.3), so we get

(i) $\mathit{Poss}^*(I_m, Q_2, R)(A, B) \Leftrightarrow I_m(\{a\colon Q_2(A \cap R_a, B)\}) \Leftrightarrow Q_2(A \cap R_m, B)$

6.2 PEI defined

The failed attempt at an alternative meaning for the possessive morphemes—motivated by concerns for uniformity and compositionality—had the positive effect of pointing the way toward a universal property of possessive DPs: PEI. Let us formulate it in a precise way.

A binary quantifier is standardly said to have EXISTENTIAL IMPORT iff

$$Q(A,B) \Rightarrow A \neq \emptyset$$

Thus, *most, at least five, exactly three, some but not all* have existential import, whereas *no, less than four, at most two-thirds of the* don't. If a quantifier doesn't have existential import, we can force it to, so to speak.

(107) $Q^+(A,B) \Leftrightarrow A \neq \emptyset \ \& \ Q(A,B)$

Q^+ always has existential import, and Q has existential import iff $Q = Q^+$. For example, $all^+ = all_{\mathrm{ei}}$, and $some^+ = some$. Now, POSSESSIVE existential import relates specifically to the interpretation of possessive DPs. It says the following.

(108) A possessive DP has POSSESSIVE EXISTENTIAL IMPORT (PEI) if the quantification over possessions is effected by Q_2^+. (So if the quantification is implicit and universal, it is effected by all_{ei}, and if it is explicitly given by a Det denoting Q_2, it is effected by Q_2^+.)

Our claim is that all possessive DPs have PEI. PEI is precisely what is missing from the analysis using $Poss^*$, which is why that gives the wrong result for DPs where Q_2 itself doesn't have existential import, as in 98, 99, 104, and 106.

6.3 $Poss^w$: implementing PEI

One can reinstate possessive existential import, without reinstating narrowing, by simply replacing Q_2 with Q_2^+ in the definition of $Poss^*$. The result is a higher-order operation that we call $Poss^w$ (w for 'wide'), defined as follows.

(109) $Poss^w(Q, Q_2, R)(A,B) \Leftrightarrow Q(\{a\colon A \cap R_a \neq \emptyset \ \& \ Q_2(A \cap R_a, B)\})$

That is, the truth conditions of Q_2 *of* Q*'s* A*s are* B now become

(110) Q x possess an A and are s.t. Q_2 A that x possesses are B

(111) $Qx(\exists y(Ay \wedge Rxy) \wedge Q_2 y(Ay \wedge Rxy \, , By))$

(cf. the schemas 25 and 27 in sect. 2.2). $Poss^w$ is an alternative to $Poss$ that can eliminate the uniformity/compositionality problem without having the obvious faults of $Poss^*$. The semantic operation corresponding to the rule $\mathrm{Poss}_{\mathrm{smp}}$—[Det → DP *'s*]—can simply combine $[\![\mathrm{DP}]\!] = Q$ and $[\![\textit{'s}]\!] = Poss^w$ to yield the parametric binary quantifier $Poss^w(Q, \mathbf{Q_2}, \mathbf{R}) = [\![\mathrm{Det}]\!]$. This is compositional, and the rule applies whether the DP is quantified or not. Moreover, $Poss^w$ gives correct truth conditions for sentences 98, 99, and 104 in sect. 6.1.

Problem solved this time? Only partially. The remaining problem with $Poss^w$ is that it gives up too much of narrowing. In many cases where narrowing is required, using $Poss^w$ gives empirically wrong truth conditions. For example, it will render 112 FALSE, due to the fact that most people in the world don't have grandchildren (they are too young for that).

(112) Most people's grandchildren love them.

This is plainly wrong. Sentence 112 doesn't quantify over all people; it says that a majority of people WITH GRANDCHILDREN are such that (all) their grandchildren love them. So 112 could very well be true. This is narrowing, and it is what one gets using *Poss*. Similarly, consider

(113) All but a few people's books are read only once.

Imagine a situation where half the people have no books, and very few of those who have books have even one that has been read more than once. In this situation, 113 is clearly true. But if we drop narrowing (while keeping PEI), 113 is predicted to be false, since a majority of the people either have no books or have at least one book that has been read more than once.

6.4 The relation between PEI and narrowing

Narrowing concerns quantification over POSSESSORS. PEI is about quantification over POSSESSIONS. How could these be related? The answer comes via conservativity, a universal property of all binary quantifiers that interpret Dets (see 36 in sect. 2.2), including those of the form $Poss(Q_1, C, Q_2, R)$ or $Poss^w(Q, Q_2, R)$. First, using CONSERV twice one sees that right-hand side in the definition 41 of *Poss* can equivalently be written as follows.[17]

$$Q_1(C \cap dom_A(R), \{a\colon A \cap R_a \neq \emptyset \;\&\; Q_2(A \cap R_a, B)\})$$

Comparing this with definition 109 of $Poss^w$ immediately implies that narrowing is as strong as PEI.

Observation 1: If a possessive DP has narrowing, it also has PEI.

Moreover, there is a partial converse to this result. The entailment from PEI to narrowing holds for possessives of several kinds that are discussed in the literature, such as *several students' bicycles*, *the manuscripts of some professor's*,

[17] The calculation with CONSERV has the form

$$\begin{aligned} Q_1(C \cap Y, Z) &\Leftrightarrow Q_1(C \cap Y, C \cap Y \cap Z) \\ &\Leftrightarrow Q_1(C \cap Y, Y \cap Z) \end{aligned}$$

with $Y = dom_A(R)$, noting that $a \in dom_A(R)$ iff $A \cap R_a \neq \emptyset$.

all of four visitors' keys. The reason is that in these cases, the quantifier Q_1 over possessors is SYMMETRIC.

$$Q_1(A,B) \;\Rightarrow\; Q_1(B,A)$$

For example, *some, no, at least six, several, between eight and twelve, an odd number of, finitely many* are symmetric. We have[18]

> **Observation 2:** If a quantified possessive DP has PEI, and the quantification over possessors is symmetric, then it also has narrowing.

This explains, for example, why $Poss^w$ gives the right result for 104: the quantifier *three* is symmetric. $Poss^w(Q, Q_2, R)$ also gives the right result in sentences 98 and 99. Indeed, when $Q = I_m$, the analysis with $Poss^w$ is equivalent to the one with *Poss*, provided I_m is decomposed as $all_{\mathrm{ei}}^{\{m\}}$.

(114) $\quad Poss^w(I_m, Q_2, R) = Poss(all_{\mathrm{ei}}, \{m\}, Q_2, R)$

Thus, narrowing is sometimes an automatic consequence of possessive existential import. A pretty wide variety of possessor DPs fall into this class, which includes not only proper names and pronouns but also possessors with symmetric quantifiers. It is no accident that $Poss^w$ gives the same, intuitively correct, truth conditions in these circumstances, since narrowing and PEI then amount to the same phenomenon.[19]

[18] To see this, we first note that for CONSERV Q_1, symmetry is equivalent to the condition

(i) $\quad Q_1(A,B) \Leftrightarrow Q_1(A\cap B, A\cap B)$

Then we calculate, with $Y = dom_A(R)$ and $Z = \{a\colon Q_2(A\cap R_a, B)\}$.

$$\begin{aligned} Q_1^C(\{a\colon A\cap R_a \neq \emptyset \;\&\; Q_2(A\cap R_a, B)\}) &\Leftrightarrow Q_1^C(Y\cap Z)\\ &\Leftrightarrow Q_1(C, Y\cap Z)\\ &\Leftrightarrow Q_1(C\cap Y\cap Z, C\cap Y\cap Z) \quad \text{(by (i))}\\ &\Leftrightarrow Q_1(C\cap Y, C\cap Y\cap Z) \quad \text{(again by (i))}\\ &\Leftrightarrow Q_1(C\cap Y, Z) \quad \text{(by C}\textsc{onserv}\text{)}\\ &\Leftrightarrow Poss(Q_1, C, Q_2, R)(A,B) \end{aligned}$$

[19] We note, however, a curious consequence of the fact that *Poss* enforces narrowing and $Poss^w$ doesn't: they behave differently with respect to negation. As we saw in sect. 5, *Poss* admits exactly three kinds of negation, all of which occur in English. With $Poss^w$, on the other hand, there would be four, since, as the reader may verify, in general $Poss^w(Q\neg, Q_2, R) \neq Poss^w(Q, \neg Q_2, R)$. That is, facing negations don't cancel; this holds even if Q is a frozen symmetric quantifier, like $[\![\text{three}]\!]^{\text{student}}$. We have not fully explored the implications of the existence of the fourth negation, but we note than the possessive existential import built into $Poss^w$ is lost with $Poss^w(Q\neg, Q_2, R)$ unless Q is monotone decreasing, as well as with $Poss^w(\neg Q, Q_2, R)$.

7 Narrowing

As for possessors that PEI does not automatically narrow, beginning with (Barker 1995) narrowing of non-symmetric quantifiers in possessor DPs has frequently been pointed out. These particular quantified possessors are where the phenomenon was first noticed because as we have just seen narrowing of proper names and symmetrically quantified possessors is not semantically distinguishable from PEI, which was tacitly assumed. Examples include

(115) a. Most planets' rings are made of ice.
 b. Not every school's linguistics program is as good as that one.

for which Barker observed that quantification is not over all planets (all schools), but over those planets that have rings (schools that have a linguistics program). Similarly, 96, 112, and 113, repeated here,

(96) Most hospitals' robot surgery equipment is less than four years old.

(112) Most people's grandchildren love them.

(113) All but a few people's books are read only once.

narrow the possessor quantifier's domain to the members that possess something in the denotation of the possessed noun, as is effected by *Poss* but not $Poss^w$. Likewise,

(116) a. American gun-owners' pistols are among their most treasured possessions.
 b. Every polynomial's positive roots are greater than zero.

can be true without every American gun-owner having a pistol and every polynomial having a positive root. Evidently a considerable variety of non-symmetrically quantified possessors narrow, including ones with *every*, *most*, and *all but a few*, as well as universally quantified bare plurals. As mentioned earlier, Barker proposed that narrowing is universal: all quantified possessor DPs narrow.

7.1 How universal is narrowing?

Although it is broadly accepted that narrowing occurs in many cases, as just illustrated, certain exceptions have been proposed to narrowing of non-symmetric quantifiers. Some speakers report that narrowing seems problematic when it cuts a large set down to a drastically smaller one.[20]

(117) a. Every US city's international airport was hit by a blizzard this winter.
 b. Most Americans' second house is a vacation home. [= 106a]
 c. Most people's third car is for their children.

[20]Sentences 117b, 117c, and 120b were suggested by Barbara Partee (*pc*).

Only a small minority of US cities have international airports, of Americans have a second house, of people have three or more cars. When discussion is not limited to those minorities, the sentences in 117 ring false to some people. (As already noted, the judgment of falsehood rests on PEI; without that property, all three sentences would be TRUE, given the facts just mentioned.) Lots of people readily accept

(118) Everyone's first kiss is the most memorable.

as a true statement. Some might balk to an extent at the claim that

(119) Everyone's first spaceflight is the most memorable.

although many may accept 119 as readily as 118.

Intuitions about cases like these seem to vary between speakers, or even for a single speaker from case to case. It is possible that pragmatic factors play a role in the reported intuitions. Are possessives capable by themselves of narrowing the domain of quantification, or do they require support from some other feature of surrounding discourse? Is the possessive's narrowing ability perhaps related to genericity of the possessor quantification? How much narrowing can a possessive accomplish?

It might be suggested that the requirement possessives trigger for existence of possessions is a presupposition, and that accommodation of this presupposition is the pragmatic mechanism that enforces narrowing (Beaver 2001, Barbara Partee, *pc*). We offer two comments. First, presupposition accommodation is a mechanism for inserting as an additional semantic requirement in one part of a sentence's meaning a presupposition of another part. This is what might enable accommodating the presupposition that possessions exist in the restriction on a possessor DP's quantifier to enforce narrowing by limiting the quantifier to range only over possessors that do have possessions. For the mechanism of accommodation to offer an account of complex facts like the ones we have discussed, it must be supplemented by subtle and sophisticated pragmatic considerations controlling when to accommodate the existence presupposition non-globally, and when not to. Secondly, we argued in sect. 5.2 that the requirement for possessions to exist is not a presupposition but rather an ordinary part of the truth conditions associated with possessives. If this is correct, then presupposition accommodation can have no role in explaining the presence of narrowing, or its absence.

The following examples address these concerns from a different direction.

(120) a. Firemen's wives worry about their husbands, and firemen's husbands worry about their wives.
b. Everyone's bike was parked in our driveway, and everyone's car was parked on the street.

Compare 120a with its first conjunct alone.

(121) Firemen's wives worry about their husbands. [= 106b]

Here it is natural to think narrowing is in force; otherwise 121 would entail that all firemen are married men, and there seems to be no such entailment. But some may feel that implication to be present in 120a, thus giving the whole sentence a ring of contradiction; and if narrowing is not in force, it IS a contradiction. Similarly, imagine a situation where some of the people in question came by car and the others by bike. Some speakers report they feel conflicting presuppositions in cases like 120b, which you may hear as claiming falsely that everyone came by bike AND by car.

On the other hand, you may not. If fluent speakers' judgments about such examples vary substantially, then determining the conditions under which non-symmetric quantifiers narrow the domain of possessors may require considerable empirical research—perhaps involving large-scale studies of natural usage, and controlled experiments measuring hearers' reactions. This will be needed to sort out the facts if people in general disagree about which such cases they feel do and do not narrow, or individuals have seemingly inconsistent intuitions about whether narrowing occurs (e.g. 121) or doesn't (120a).

However consistent or variable judgments are about narrowing of non-symmetric quantifiers of possessors, two important facts are clear. When non-symmetric quantifiers in possessor DPs are not narrowed, the possessive Det or PP gets its meaning via $Poss^w$. And when possessor DPs do narrow, *Poss* gives the possessive Det or PP its meaning from an appropriate decomposition of the possessor DP's meaning. The possibly unsettled question is just when to apply which of the two operations.

7.2 Narrowing and uniformity

As we saw in sect. 3.5, semantic interpretation with *Poss*, that is, with narrowing, needs to confront the uniformity/compositionality problem. It seems to us that retreating from first-level (ordinary) compositionality to second-level compositionality—the meaning of a complex phrase being determined by the meanings of its daughters AND ITS GRANDDAUGHTERS (along with the syntactic rule used)—is not a huge step. This property can still figure in an account of linguistic competence. The main question concerns uniformity.

Because $Poss^w$ applies to quantified and non-quantified possessor DPs alike, as long as all these phrases denote unary quantifiers, the following two sentences, for example, get their meaning in the same way.

(122) a. Mary's books were left on the table.
b. Some students' books were left on the table.

In the first case, you apply $Poss^w$ to the unary quantifier I_m, in the second case to the unary quantifier $some^{[\![\text{student}]\!]}$. But to interpret 122 using *Poss*, you must first DECOMPOSE I_m and $some^{[\![\text{student}]\!]}$, respectively. In the second case, a correct decomposition is immediate from the structure of the sentence, but not so in the first case. This is the sense in which interpretation using *Poss* is not uniform.

Two main issues are involved. The first is empirical: Which DPs can be used as possessor DPs in English possessives? The second is theoretical: How to best derive the meanings of possessive DPs, whatever possessor DP is used?

Which DPs can be possessor DPs?

We don't know the full answer to this question (and we have not found anything like an answer in the literature). But here are some candidates.

- DPs of the form [Det N′] (rule DP_{qnt}): Almost all DPs of this form can be possessor DPs (in pre- as well as postnominal possessive DPs), as we have seen in numerous examples in this paper. This includes cases where the Det is complex, e.g. possessive, as in *Mary's brothers* (cf. *Mary's brothers' friends tend to be noisy*).
- DPs of the form [Det of DP] (rule $Poss_{exp}$, sect. 3.1): Here the inner DP must be simple possessive or definite. The former case was exemplified in sentence 42 (*at least two of most students' term papers*, sect. 3.1), and the latter case in one reading of sentence 58 (*two of the ten boys*, sect. 4.1).

For reasons to become clear presently, we shall call these two kinds of possessor DPs SYNTACTICALLY DECOMPOSED. Among other possessor DPs we have

- Proper names, pronouns, and bare plurals (universal or existential): We have seen that these are fine as possessor DPs (e.g. 34 and 35, sect. 2.2).
- Some Boolean combinations of DPs.

As to Boolean combinations, conjunctions and disjunctions of proper names can be possessor DPs.

(123) a. John and Mary's term papers got an A.
b. Sue or Henry's grades are below average.

But intuitions seem to vary about sentences like the following, when the possessor DP is a coordinate structure.

(124) a. John, or Mary and Sue's grant applications were successful.
b. Some man or every woman's grant applications were successful.
c. John and some professor's grant applications were successful.
d. John and every professor's grant applications were successful.

There are other kinds of DPs about which one could ask if they can be possessor DPs or not, but we will not pursue this question further here. In the rest of this subsection, we focus on the second question: the best way to derive correct readings of the rich class of possessive DPs studied in this paper.

Of course, the most uniform strategy would be to use $Poss^w$ across the board. But we have already seen that this will not always give the empirically correct meaning for certain possessor DPs, specifically when they involve narrowing not forced by PEI (e.g. 121). Given that some amount of non-uniformity is inescapable, we ask the following questions related to the alternative of using *Poss*.

- Are decompositions unique when they exist?
- Can we always find a correct decomposition when needed?

We present some partial answers, and a hypothesis.

Non-uniqueness of decomposition

The answer to the question about the uniqueness of decomposition is an emphatic No. Consider again a simple possessive like

(125) Mary's cats are Siamese.

As discussed in sect. 6.1, 125 can be paraphrased as 126a, but not as 126b.

(126) a. Mary has at least one cat, and all her cats are Siamese.
b. Either Mary has no cats, or all her cats are Siamese.

But the unary quantifier I_m is decomposable in many different ways. For example, one can check that the following holds.

$$I_m = \mathit{all}_{\mathrm{ei}}^{\{m\}} = \mathit{every}^{\{m\}} = \mathit{the}_{\mathrm{sg}}^{\{m\}} = \mathit{some}^{\{m\}}$$

Choosing the decomposition $\mathit{every}^{\{m\}}$ and applying *Poss* results in 126b, which isn't a reading of 125. With all the other decompositions, 126a is obtained. In other words, to get correct truth conditions using *Poss*, one must decompose the possessor DP's meaning in the right way, or else lose the possessive existential import built into *Poss*.

That decomposition is never unique is an inescapable problem for any compositional semantics for possessives that implements narrowing. Even with a possessor DP like *every student* one gets wrong results if its meaning is incorrectly decomposed, that is, if the wrong Q_1 and C such that

(127) $\mathit{every}^{[\![\mathrm{student}]\!]} = Q_1^C$

are chosen. The problem here is Q_1, not C.[21] Equation 127 only guarantees that Q_1 behaves as expected on C, and says nothing about its behavior on the proper subset of C that narrowing may force one to consider. For example, suppose the number of (salient) students is ten, and that not all of them possess an A. Then,

$$\mathit{every}^{[\![\mathrm{student}]\!]} = \mathit{the\ ten}^{[\![\mathrm{student}]\!]}$$

[21] Indeed, Westerståhl (2008) shows that under a reasonable extra assumption, C is uniquely determined, and 127 implies $C = [\![\mathrm{student}]\!]$.

but analyzing *Every student's As are B* with $Poss(the\ ten, [\![\text{student}]\!], every, R)$ will make it false, whereas such a sentence could well be true. Narrowing *every student* has drastically different results than narrowing with *the ten students*. Of course, the meaning of *every* is very different from the meaning of *the ten*, but the point is that if we only have access to the unary quantifier $every^{[\![\text{student}]\!]}$, we don't have access to those meanings, and we cannot tell from the unary quantifier alone how to decompose it correctly.

In practice, this is never a problem with syntactically decomposed possessor DPs (in the sense defined above): the DP's structure then provides a correct decomposition as we presently explain in detail. (And if one is content with second-level compositionality, no decomposition is needed.) Likewise, it is not a problem for bare plurals, pronouns, or proper names. For a bare plural, let C be the extension of the plural noun, and let Q_1 be all_{ei} or *some*, depending on whether a universal or an existential reading of the possessor is used (see 38 in sect. 2.3). As to proper names, there do exist incorrect decompositions of I_m, as we just saw, but they are easily avoided: choose $C = \{m\}$ and $Q_1 = all_{\text{ei}}$.[22] The problem comes with Boolean compounds, even simple ones like *John or Mary*, or *John and Mary and Sue*.

There is both the empirical problem of how much narrowing a sentence like

(128) John and Mary and Sue's A are B

requires, and the theoretical problem of finding a corresponding decomposition. We may take syntax to provide the set $\{j, m, s\}$, but then one must choose Q_1 so that

(129) $I_j \wedge I_m \wedge I_s = Q_1^{\{j,m,s\}}$

AND 128 gets the desired truth conditions. $Q_1 = all_{\text{ei}}$ satisfies 129, but the analysis with *Poss* then only requires at least one of John, Mary, and Sue to possess some A. If we want 128 to entail that all three of them possess an A, we may choose $Q_1 =$ *the three*, for example. (This is the reading one gets without decomposition, using $Poss^w$.) If two of them suffice, take $Q_1 = the_{\text{pl}}$.

Similarly, consider

(130) John or Mary's term papers got an A.

Using $Poss^w$ with the quantifier $I_j \vee I_m$, 130 could be true (with $Q_2 = every$) even if John never wrote any term papers (as long as Mary did and all of her term papers got an A). Exactly the same truth conditions result if we decompose $I_j \vee I_m$ as $some^{\{j,m\}}$ and use *Poss*. But there seems to be another, perhaps more plausible interpretation: both John and Mary wrote term papers, and all term papers of one or both of them got an A. It turns out that this interpretation is obtainable using *Poss* with another decomposition: $I_j \vee I_m = Q_1^{\{j,m\}}$, where

[22] It is easy to see that if $I_m = Q_1^{\{m\}}$ and Q_1 has existential import, the correct reading exemplified by 126a above always results, whereas if Q_1 lacks existential import, one always gets the incorrect 126b. For proper names, there are just these two possibilities.

$$Q_1(A, B) \Leftrightarrow |A| = 2 \ \& \ (I_j \vee I_m)(A \cap B)$$

This interpretation cannot be obtained with $Poss^w$.

We don't know the answer to the empirical question of the amount of narrowing allowed with Boolean possessor DPs. But we have not found any example of any acceptable possessive DPs, Boolean or not, for which we could not discover a correct decomposition of the possessor DP. However, we also have not found a semantic rule that always makes the correct choice in the case of Boolean possessor DPs.

Does a correct decomposition always exist?

This is the question whether you always CAN narrow in cases when PEI doesn't entail the empirically required degree of narrowing. To address it, let us first state a precise definition of decomposability.

(131) A unary quantifier is DECOMPOSABLE if there is a CONSERV binary quantifier Q_1 and a set C such that $Q = Q_1^C$.

The requirement CONSERV is essential; without it every unary quantifier would be decomposable, but in a trivial and unhelpful way.

> **Claim:** Syntactically decomposed possessor DPs (in the defined sense) denote unary quantifiers with an obvious decomposition for which *Poss* yields correct truth conditions.

This is seen as follows. When the possessor DP has the form [Det N$'$], we let Q_1 = $[\![\text{Det}]\!]$ and $C = [\![\text{N}']\!]$; *Poss* was designed to give correct truth conditions, with narrowing, for this case. When it has the form [Det of DP], there are two subcases. First, if the latter DP is definite, and has a generator X, letting Q_1 = $[\![\text{Det}]\!]$ and $C = X$ is the correct choice; see the semantics for partitives in sect. 4.1. Second, if that DP is a simple possessive, it has the form [Det_1 N'_1], where Det_1 was formed by the rule Poss_{smp} (e.g. *several of John's books' pages*, see 44a in sect. 3.1). But then, it follows from the semantic rules corresponding to Poss_{smp} and Poss_{exp} specified in sect. 3.2 that if we let $Q_1 = [\![\text{Det}_1]\!]$ and C = $[\![\text{N}'_1]\!]$ (the role of Det is just to fix the interpretation of Q_2), we obtain the correct truth conditions.

This takes care of the Claim. As to DPs that are not syntactically decomposed, we have seen that proper names, pronouns, and bare plurals denote (correctly) decomposable quantifiers. Furthermore, Westerståhl (2008) proves the following model-theoretic fact.

(132) Boolean combinations (including inner negation) of decomposable quantifiers are decomposable.

This shows that decompositions of (the denotations of) Boolean compounds of proper names, or Boolean compounds of syntactically decomposed DPs, always EXIST; not that these decompositions are CORRECT in sentences with possessives. Nevertheless, we have found no counter-examples to the following

Hypothesis: Possessor DPs that are not syntactically decomposed denote unary quantifiers that are decomposable in such a way that *Poss* gives correct truth conditions. Moreover, DPs denoting non-decomposable quantifiers are not possessor DPs.

Since incorrect decompositions are plentiful, the first part of the hypothesis makes a substantive claim. Regarding the second part, there do exist DPs whose denotation is not of the form Q_1^C for ANY C or ANY CONSERV Q_1. But as far as we know, they cannot be possessor DPs. Here is an example. Define, for a given set D,

$$(\textit{only } D)(B) \Leftrightarrow \emptyset \neq B \subseteq D$$

These unary quantifiers plausibly occur with sentences like

(133) a. Only John left the party. ($D = \{\text{John}\}$)
b. Only firemen wear helmets.

It can be shown (Westerståhl 2008, Fact 4.12) that if D is non-empty, *only D* is not decomposable. So what about sentence 134?

(134) Only John's cats are allowed in the house.

Only can focus on the possessive Det *John's*, making 134 say that John's cats, and no one else's, are allowed in the house. Alternatively, *only* can focus on the possessive DP *John's cats*, making 134 say that nothing is allowed in the house except John's cats. In each case, the only decomposition required for interpreting the possessive Det is what is standard for proper names. But *only* cannot focus on *John*, as would be required to make *only John* the possessor DP. That would result in 134 meaning that John is the unique cat-owning person ALL (or SOME) of whose cats are allowed in the house, which is consistent with SOME cats of other cat-owners being allowed in the house (or in the existential reading, with ownerless cats being allowed). This is, to say the least, an unlikely interpretation of 134.

So these quantifiers in fact behave as the analysis and hypothesis in this paper predict. Note further that applying $Poss^w$ to *only John*, which could be done since $Poss^w$ does not require decomposition of the possessor DP's meaning, would yield exactly the dubious interpretation of 134.

How much of a virtue is it, then, that $Poss^w$ can uniformly interpret all possessive Dets and PPs regardless of the possessor DP's form? This capability is a virtue to the extent that the interpretation given is empirically correct, and obviously no further. For quantified possessor DPs with a non-symmetric quantifier, $Poss^w$ gives an interpretation that often fails to narrow sufficiently. Moreover, Boolean compounds may require narrowing not available with $Poss^w$. Thus the non-uniformity involved in decomposing possessor DP meanings correctly for application of *Poss* seems an inescapable cost of empirical correctness. A DP is plausibly unfit to be a possessor if its meaning cannot be decomposed. The open question about possessor DPs that are not syntactically decomposed is how to systematically choose a decomposition that leads via *Poss* to the empirically correct interpretation when the possessive narrows.

7.3 Open problem: anaphoric possessive pronouns

A very different problem posed by narrowing for uniformity/compositionality arises in connection with certain anaphoric uses of possessive pronouns. It has been noted in the literature (see Beaver & Geurts 2011) that the most natural interpretation of

(135) a. Most Germans wash their cars on Saturday.
b. Everybody loves their grandchildren.

narrows their quantifications to Germans with a car and people who have grandchildren. Instead of meaning

(136) a. $\underline{most}\, x(Gx\,, \exists y(Cy \wedge Rxy)\ \wedge \underline{all}\, y(Cy \wedge Rxy\,, Wxy))$
b. $\underline{every}\, x(Px\,, \exists y\, Hxy\ \wedge \underline{all}\, y(Hxy\,, Lxy))$

these sentences mean

(137) a. $\underline{most}\, x(Gx \wedge \exists y(Cy \wedge Rxy)\,, \underline{all}\, y(Cy \wedge Rxy\,, Wxy))$
b. $\underline{every}\, x(Px \wedge \exists y\, Hxy\,, \underline{all}\, y(Hxy\,, Lxy))$

How can a quantifier's domain be restricted by a possessive pronoun in its scope being anaphoric to it? This seems to defy compositionality. And the ability of pronouns in their antecedent's scope to restrict its domain is limited to possessive pronouns.

We do not know how anaphoric possessive pronouns with quantified antecedents force the narrowing of their antecedent. Beaver & Geurts (2011) discuss the proposal that this is accomplished by intermediate accommodation of an existence presupposition associated with the possessive pronoun. However, as we explained in sect. 7.1, we think that evidence indicates the existence requirement associated with possessives is not a presupposition. So a fortiori we are not convinced by an explanation of anaphoric possessive narrowing in terms of presupposition accommodation. We do believe a resolution of the problem awaits further work and therefore leave it here as an open question.

8 Possessives and definiteness

Having established PEI as a universal feature of possessive DPs, we look in this section at a different property, which in the literature is almost invariably discussed in connection with possessives: definiteness. We examine three main claims that have been made concerning concerning possessives and definiteness. In sect. 4.1 we already formulated a precise definition (Barwise and Cooper's) of semantic definiteness. This was in connection with the Partitive Constraint and the semantics for partitive DPs, distinguishing it from the semantics for expanded prenominal possessive DPs. Now we can use this definition, together with the semantics of possessives, to evaluate the three claims. In fact, we are able to explain precisely what is right, and what is wrong, about each claim.

8.1 Claims and counter-examples

The first claim is

(I) Possessive DPs (or Dets) are always definite.[23]

However, this view is only plausible if one restricts attention—as is often done—to possessive DPs whose possessor DP is a proper name or pronoun, or a definite article plus noun. As soon as one looks beyond this limited class, counter-examples to (I) abound, some which have been noted in the literature.

(138) a. a book of Paul's (Haspelmath 1999)
b. an old man's book (Woisetschlaeger 1983)
c. seven professors' manuscripts (Keenan & Stavi 1986)

Each of these can easily be placed in sentential contexts where none of the usual criteria of definiteness apply: uniqueness, familiarity, unacceptability in existential there sentences, etc. Also, there are what Barker calls POSSESSIVE WEAK DEFINITES, as in

(139) As you know, I never expected to be the parent of a hyperactive child. (Barker 2005)

Barker's worry here is that 139 is fine even if there are two parents in the discourse situation. Even more embarrassing for (I) is the fact that the embedded possessive PP can have wide scope (indeed it MUST have wider scope than *the parent* if the DP is possessive, as shown in sect. 4.2).

(140) If you want to reward the inventor of a new drug, build her a lab.

In the most plausible interpretation of 140, *the inventor of a new drug* does not refer to a definite individual, because *a new drug* has scope over *the inventor*.

In view of examples like these, revisions of (I) have been proposed, such as the following one.[24]

(II) Possessive DPs INHERIT their definiteness status from the possessor DP.

Let us call this the INHERITANCE CLAIM. Thus, *the tall man's lawyer* is definite because *the tall man* is, and *a tall man's lawyer* is indefinite because *a tall man* is.

However, it seems to us that even the Inheritance Claim is sometimes erroneous, namely, when the possessor DP is definite but quantification over possessions is EXISTENTIAL. For example, *Mary's cats* is definite in

[23]For example, Abbott's (2004) survey article on (in)definiteness reports: 'Possessive determiners . . . are almost universally considered to be definite'. (p. 123)

[24]From (Barker 2011); Barker attributes it to Jackendoff but says it is hard to find in published work.

(141) Mary's cats are mangy.

as the Inheritance Claim has it, but not in

(142) When Mary's cats escape, her neighbors usually catch them.

Under the most likely interpretation, no specific set or group of cats is referred to in 142, in contrast with the case of 141. Furthermore, possessive DPs with a proper noun possessor and implicit existential quantification over possessions can occur in existential there sentences.

(143) There are Amelias' toys in the kitchen.

Sentence 143 is a fairly natural way to assert the existence of (some of) Amelia's toys in the kitchen.

The Inheritance Claim recognizes that there are non-definite possessive DPs. Other ways to revise (I) have sought to preserve the idea that definiteness is always present, but in some weaker form. Notably, Barbara Partee and others have suggested what we may call the IMPLICIT DEFINITE ARTICLE CLAIM.[25]

(III) Even though a possessive DP need not itself be definite, it always contains an implicit definite article.

The status of (III) depends on precisely how 'contain' is spelled out.[26]

8.2 Semantic analysis

With these diverse claims and (counter-)examples as background, let us see what the analysis proposed here has to say about definiteness of possessive DPs. It is helpful to distinguish MORPHOSYNTACTIC from SEMANTIC definiteness. The former notion may not have a precise accepted definition but syntacticians tend to agree about morphosyntactic definiteness across languages. It is clear that the DP *the inventor of a new drug* in 140 is morphosyntactically definite. It

[25] See (Partee & Borschev 2003), fn. 6: '[T]he prenominal genitive in English seems to combine the "basic" genitive [which they take to be the postnominal form] with an implicit definite article'. Also Partee (*pc*): '[We believe] that there's a "the" in the interpretation here under the scope of the quantifier of the possessor—in effect, a version of "for most students x, the parents of x" ' (for the possessive DP *most students' parents*). Similarly, Vikner & Jensen (2002:201), while clearly stating that possessives need not be definite, claim that a possessor DP 'behaves as if it had an implicit definite article ... associated with [the possessed noun]'.

[26] There are other attempts in the literature to preserve a constant tie between possessives and definiteness. For example, Lyons (1999:23) and Huddleston & Pullum (2002) use semantic equivalences such as the ones between 138b and 138c and

(i) a. the book of an old man
b. the manuscripts of some professors

respectively, to this end. However, the DPs in (i) are only morphosyntactically definite, and there is no reason to expect syntactic properties to be preserved under semantic equivalence. Keenan & Stavi (1986:299–300), who do use a semantic notion of definiteness, suggest that possessive Dets are Boolean combinations of basic definite possessives. Even if this is true, we would take it to show rather that definiteness is not preserved under, say, disjunction.

is also clear that possessive DPs like the following are not morphosyntactically definite.

(144) a. no pupil's books
b. most professors' cars
c. at most two of every student's relatives
d. at least one of most people's cars

Turning to semantic definiteness, recall the discussion in sect. 4.1. A notion based in referentiality, and incorporating requirements for uniqueness and familiarity to some extent, seems to be the prevailing view on this subject, although proportions in the mixture remain controversial (see e.g. Kadmon 1987, Birner & Ward 1994, Roberts 2003, Barker 2005). Focusing on the semantic notion's foundation in reference, we presented Barwise and Cooper's formal definition of definiteness, noting that it captures this up to distinctions between groups and sets of individuals that are independent of the semantics this paper presents for possessives. Bringing the formal semantics together with the definition of definiteness, we can now say something precise about which possessives are definite.

(145) **Theorem:** If the quantification Q_1 over possessors is semantically definite, and if the quantification Q_2 over possessions is universal, then, for any C and R, $\mathit{Poss}(Q_1, C, Q_2, R)$ is semantically definite, as is the possessive Det that denotes it. But if either of these conditions fails, $\mathit{Poss}(Q_1, C, Q_2, R)$ is usually not semantically definite.[27]

So very many possessive DPs (most types, though not occurrences) are predicted not to be semantically definite. Indeed, all the counter-examples to Claim (I) in the preceding subsection are predicted by the theorem. As soon as you look beyond the limited space of possessive DPs with a definite possessor, finding definite possessive DPs will be the exception rather than the rule.

Furthermore, the theorem tells us what is right about the Inheritance Claim, as well as what is wrong. And it does not merely state the correct part—that semantic definiteness is indeed inherited from the possessor DP, PROVIDED quantification over possessions is universal—but it EXPLAINS why it holds (it follows precisely from the semantics of possessive DPs and definiteness). But when quantification over possessions is not universal, the possessive DP is usually not definite, and so definiteness is not inherited from the possessor DP, just as we saw in the examples 142 and 143.

What about the Implicit Definite Article Claim (III)? Let us express the informal idea behind it (see footnote 25) as follows. Sentences with possessive DPs, of the form

[27] The first claim can be PROVED, given the definition of *Poss* (41 in sect. 2.2) and definition of definiteness in sect. 4.1; a proof is given in (Peters & Westerståhl 2006), ch. 7.11.1. Looking at that proof, it also becomes clear that the somewhat loosely formulated second claim also holds.

(146) $(Q_2 \text{ of})\ Q_1\ C$'s A are B,

which we analyzed (sect. 2.2) as

(147) Q_1 C x that R an A are such that Q_2 As that x Rs are B,

can ALSO be paraphrased as follows.

(148) Q_1 C x that R an A are such that Q_2 *of the* As that x Rs are B

This paraphrase seems to reveal the 'hidden definite article'. But what does Q_2 *of the* mean? We have already encountered this quantifier, calling it Q_2^+ in sect. 6.2.

$$\begin{aligned} Q_2\ \textit{of the}\,(X,Y) &\Leftrightarrow X \neq \emptyset\ \&\ Q_2(X,Y) \\ &\Leftrightarrow Q_2^+(X,Y) \end{aligned}$$

Moreover, we noted (sects. 6.3–6.4) that, whether we analyze 146 with narrowing ($Poss$) or without it ($Poss^w$), possessive existential import (PEI) always holds, and is embodied precisely in the use of Q_2^+ (rather than Q_2) for quantification over possessions. PEI is the content of what some authors have regarded as an existence presupposition associated with the supposed definiteness of possessives, or somehow contained in them. Thus, a generous construal of the Implicit Definite Article Claim is in effect as the observation that PEI always holds for possessive DPs. This is the sole import of the definite article in the paraphrase 148. It does NOT follow, however, that a definite DP is somehow contained in possessive DPs. For although the definite phrase *the As that x Rs* is part of ONE paraphrase (viz. 148), the truth conditions are equally accurately paraphrased without any use of the definite article, as in 147.

9 Implications of freedom for semantic rules

As emphasized in sect. 4.2, freedom to choose as the possessive relation one that is not found in lexical entries of words in the possessive DP or other parts of the sentence containing it, but instead arises from the context of use, is characteristic of both the prenominal and the postnominal possessive constructions. We noted that freedom is consistent with certain linguistically available relations being barred. (Storto 2005) showed that postnominal possessive PPs differ somewhat from prenominal possessive Dets in what relations are barred.

(149) Yesterday John and Paul were attacked by two (different) groups of dogs;

a. ... unfortunately John's dogs were rabid.
b. #... unfortunately some dogs of John's were rabid.

The relation *attack*, made available by the context, cannot be chosen as the possessive relation of the postnominal PP in 149b even though it can in 149a. We do not agree with Storto's diagnosis of this interesting difference as suggesting that postnominal possessive DPs are generally indefinite (see sect. 8), although many, such as the one in 149b, are. We note that discourse-old relations clearly can hold between indefinites and other entities, for example in

(150) John ordered a sandwich; Mary, a salad.

Most significantly,

(149) c. #...unfortunately the three dogs of John's were rabid.

is just as resistant as 149b to allowing *attack* as the possessive relation, while

(149) d. unfortunately some of John's dogs were rabid.

happily allows it.[28] So we conclude that the difference these data illustrate between prenominal and postnominal possessives is attributable to the constructions themselves and not to any feature like the definiteness or indefiniteness of the possessive DPs.

9.1 Freedom and semantics

An immediate corollary of freedom, as pointed out in sect. 4.2, is that semantic rules cannot always assign the possessive relation, which is why it is treated as a parameter in this paper. Fully interpreting possessive DPs in effect involves answering three questions.

1. What choices for the possessive relation are available?
2. How is one selected?
3. What does the sentence containing the DP turn out to mean with this choice of possessive relation?

The literature contains considerable discussion of how options for the possessive relation arise semantically from constituents of sentences containing a possessive; (Vikner & Jensen 2002) is a particularly elaborate account. In contrast, little discussion has appeared of how free pragmatic options for the possessive relation arise from context. The first question's answer combines these two sets of options. Choosing among them in answer to the second question is a quintessentially pragmatic process, which seems to be almost entirely unstudied, important and interesting as it is. This paper does not address either of the first two questions. It is instead an attempt at a systematic answer to third question.

9.2 1-place vs. 2-place approaches

The semantics of possessives must describe how the possessive relation combines with the possessed noun to yield the correct meaning. In the literature, there

[28] Storto reports that a near equivalent of 149c is acceptable in Italian.

are essentially three kinds of semantic accounts (see Partee & Borschev 2003 for discussion). One approach takes the default case to be when the possessed noun is relational. It then needs to COERCE non-relational nouns to become relational in possessive contexts (see Jensen & Vikner 1994, Partee & Borschev 1998, and Vikner & Jensen 2002), so that, for example, $book(x)$ can become $book(x)$ & $wrote(y, x)$. Call this the 2-PLACE APPROACH.

Another route is the 1-PLACE APPROACH, where the possessions are always given by a noun denoting a set (see Hellan 1980); a story then has to be told about how that set is obtained in the case of relational nouns. MIXED APPROACHES (Partee 1997, Barker 1995, Partee & Borschev 2003) regard possessive DPs as ambiguous between the two forms.

9.3 Freedom favors a 1-place approach

The fact that all possessive DPs involve a possessive relation is not an argument in favor of the 2-place approach. First, that relation is NEVER the relation given by the relational noun; at most it can be derived from it (usually by taking its inverse). Second, even in those cases when a relational noun is available, freedom may result in the possessive relation being totally unconnected to that relation. Then the semantics clearly has to allow for the relational noun to be treated just as an ordinary noun.

The strongest argument for a 1-place approach is this. Relational or not, the possessed noun is still a noun. Ordinary determiners apply to relational and non-relational nouns alike. They denote ordinary binary quantifiers, not quantifiers relating a 2-place relation and a set. That is why we can COUNT admirers (of Mary), and QUANTIFY over mothers (of people). At the N′ level, a relational noun denotes a set. There are familiar mechanisms for interpreting certain expressions lexically standing for relations as sets. One is projection, by which the set of mothers is obtained as the domain of the *mother of* relation, and the interpretation of intransitive *eat* is obtained as the domain of the relation denoted by transitive *eat*. Another is anchoring, whereby one argument of the relation is fixed, as when *admirer* is interpreted as *admirer of Mary*, or intransitive *win* is interpreted as *win the America's Cup*. The need for these mechanisms is well-established, independently of the semantics of possessives.

Prenominal possessive Dets quite naturally express binary quantifiers, as shown throughout this paper. When the above mechanisms are combined with *Poss*, one obtains the correct meanings for the case when the possessive relation is the inverse of the relation expressed by a relational possessed noun, as well as for non-relational nouns.

The 2-place approach, on the other hand, needs to rely on an ad hoc mechanism, turning any noun into a relation, invented solely for the purpose of possessives. It may still seem that this approach has the upper hand in the case of relational nouns, for then it can take the inverse of that relation as the possessive relation, whereas the 1-place account always invokes context. But this advantage is illusory, precisely because of freedom. Context must be invoked regardless. In a particular context, *John's mother* may be a mother that he has been assigned somehow. Then, the 2-place account needs to do two things. First, it must find the correct possessive relation, which is not the inverse of *mother of*. Second, it must project *mother of* to the set of mothers; after all, it is mothers that are assigned to John, not, for example, their children. Thus, the 2-place account in any case needs the operations of projecting and anchoring, in addition to the operation of coercion. It is a more cumbersome way to achieve the same end result.

Much the same arguments apply to mixed approaches. You may think the presence of a relational noun points to one analysis (syntactically and semantically), and non-relational noun to another (as in Partee 1997). Or you may draw the line in a different way (as in Partee & Borschev 2003; see below). But the point remains that the relational noun case always has to be ready for a non-expected possessive relation, by freedom. Thus, at least in terms of economy of the semantic machinery needed (and also, we would argue, faithfulness to surface syntax), the 1-place approach has the advantage.

9.4 Two potential counter-arguments

Partee (1997) argues that approaches taking a free possessive relation parameter R as paradigmatic cannot account for the distribution of free vs. 'inherent' relations, as exemplified in the following contrastive pair.

(151) a. a portrait of John's
b. a portrait of John

The idea is that 151a admits the free interpretation, but 151b PRECLUDES it: only the inherent relation *depict* is available. This supports the claim that the two cases are syntactically as well as semantically distinct.

Actually, these facts perfectly fit the analysis in this paper; DP 151b is not a possessive, but a relational noun complement, and thus differs in syntactic structure and semantic interpretation (see sect. 4.2). Thus, once the distinction between possessive DPs and relational noun complements is properly drawn, the data actually support the free variable R approach.

While Partee (1997) used a mixed approach, Partee and Borschev later sided (for a while) with Jensen and Vikner (e.g. Vikner & Jensen 2002) in favor of a uniform 2-place account. A crucial argument they considered was a certain use of the modifier *former*. Consider

(152) Mary's former mansion was destroyed by fire.

Former seems syntactically to modify both 1-place and 2-place nouns in a rather uniform way: *former mansion*, *former husband*, etc. But 152 is ambiguous, since *former* can also semantically modify the possessive relation: say, from 'own' to 'formerly own'. Clearly, 152 can mean that something which is still a mansion but no longer owned by Mary was destroyed. A 1-place account with *former mansion* as a constituent of 152 will not readily get that reading. But, Partee and Borschev argue, if the noun is coerced into a relation, that coercion can take place at two places, either before or after *former* is applied to the noun, and the second alternative will produce the desired reading.

There is, however, problem with this: the suggested coercion mechanism doesn't actually give the correct reading either. Coercing $mansion(x)$ yields the relation $mansion(x)$ & $own(y,x)$; but if you apply *former* to that, there is no reason why only the second conjunct should be affected. Rather, one seems to obtain *former* $mansion(x)$ & *formerly* $own(y,x)$.

Partee and Borschev are aware that there is a problem as to how *former* applies to a conjunction; in fact, they say it could 'in principle target either part, depending on what was presupposed and what was focussed in the given context' (Partee & Borschev 2003, 23). But recall that the conjunction in this case is a theoretical construct, resulting from coercion. With actual conjunctions, it is more common for BOTH conjuncts to be affected. Consider

(153) Mary is a former actress and writer.

This means that once upon a time she was an actress AND a writer, not that she is still one but not the other. If Mary is in fact still an actress but no longer a writer, 153 is simply false, regardless of any presuppositions or focus the context may supply.[29] Thus, it appears to be mainly by stipulation that the suggested account of the second meaning of 152 would work. So this kind of example does not provide conclusive evidence against a 1-place approach.[30]

In conclusion, on closer inspection, none of these arguments offered against treating the possessive relation as a parameter to be set by context appears to be convincing.

10 Possessive diagnostics

We close with a summary of the criteria that have proved so valuable in this paper for identifying possessive DPs.

1. **Quantification over possessions.** That paradigmatic possessive DPs always involve quantification—implicit or explicit—over possessions has been a main theme, amply illustrated by examples throughout this paper. We used the symbol Q_2 for this quantifier, and we saw that, whether or not Q_2 itself has existential import, the possessive construction always endows quantification over the possessions with existential import. This is the property we call possessive existential import (PEI).

[29] Perhaps the conclusion from 152 should rather be that the syntax of *former* favors a structure placing it as it were outside the possessive. (Partee and Borschev hint at this possibility in footnote 28 of Partee & Borschev 2003.) Then it would no longer be a problem for the 1-place approach.

[30] Partee and Borschev put forward many other arguments, drawing on syntactic, semantic, and pragmatic features of language, in their endeavor to find the right treatment of possessives. Here we have focussed on expressive power—whether or not the proposed accounts generate the correct meanings—and on methodological economy.

2. **Primacy of possessors.** A quantified possessor DP NEVER has narrower scope than the possessive relation. This is a consequence of the semantic structure of possessive DPs, prenominal and postnominal alike. The sets that Q_2 quantifies over each depend on a possessor, so possessors need to be identified before quantification can occur over their possessions. Primacy of possessors is a key to distinguishing postnominal possessive DPs from other postnominal modifiers and complements of relational nouns.

3. **Inverse of noun relations.** When the possessed noun is relational AND the expressed relation helps pin down the possessive relation, this possessive relation is always the INVERSE of the relation expressed by the noun, never that relation itself. For example, the relation a person has to his parents is being parented by them, not being parent of them. This fact is a corollary of the first two: there is always quantification over possessions, and quantification over possessors always takes wider scope, which inverts the relation.

4. **Freedom.** That the possessive relation often is not inherent, but comes from the extra-linguistic context of utterance, is a well-known fact, often remarked on in the literature. We have seen that this characteristic freedom of the possessive relation—in the precise sense explained in sect. 4.2—is useful in distinguishing certain constructions that look like possessives from true possessives.

We have analyzed the meaning of possessive constructions as a binary quantifier defined in terms of the possessor's meaning, a possessive relation, which may but need not come from something in sentences containing the possessive construction, and an embedded quantification over possessions that the possessive meaning guarantees to have existential import. English pairs this semantic-pragmatic side of the possessive construction with two quite different morphosyntactic structures. This same meaning for possessives can interface equally well with still other morphosyntactic structures. A worthy hypothesis is that this meaning for possessives is universal across languages. Testing this hypothesis will be facilitated even when a given language's possessive construction is morphosyntactically similar to some different construction (such as partitives or relational noun complements, for English), or is radically different from any English morphosyntax, by virtue of the fact that the diagnostic criteria just enumerated depend only on the meaning of possessives, not their structure.

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