SEMANTICS OF POSSESSIVE DETERMINERS

STANLEY PETERS
DAG WESTERSTÅHL

Linguistics Department, Stanford University
Department of Philosophy, Göteborg University
peters csli.stanford.edu, dag.westerstahl phil.gu.se

Abstract

We give a uniform account of a wide range of possessive determiners, including simple (John's), quantified (few doctors'), and partitive (each of most students'), focusing on certain (frequently neglected) features of their semantics. One is the *mode of quantification* over the 'possessed' objects: often universal, but other modes are allowed too. Another is what Barker 1995 calls *narrowing*: we agree that it belongs to the semantics of possessives but note that it appears to lead to certain methodological problems. A third is the *role of definiteness* for possessives: we compare our account to the 'definiteness account' common in the literature, and in particular discuss the definiteness of partitives. Fourth, we study the *monotonicity behavior* of possessives.

1. Background

A (generalized) *quantifier of type* $\langle 1, 1\rangle$ (of type $\langle 1\rangle$) is a mapping Q that with each universe M associates a binary (unary) relation Q_M between subsets of M. Determiners typically denote type $\langle 1, 1\rangle$ quantifiers, including the possessive determiners studied here, and noun phrases denote type $\langle 1\rangle$ quantifiers. Determiner denotations characteristically have the following properties:

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

(EXT) for $A, B \subseteq M \subseteq M'$, $Q_M(A, B) \Leftrightarrow Q_{M'}(A, B)$

EXT applies to quantifiers of any type; in particular, many NP denotations are EXT, such as those of proper names (if John = j, $(I_j)_M(B) \Leftrightarrow j \in B$), bare plurals (if C is the set of firemen, $(C^{\mathrm{pl}})_M(B) \Leftrightarrow \emptyset \neq C \subseteq B$), and type $\langle 1\rangle$ quantifiers Q^A got by *freezing* the restriction argument of an EXT type $\langle 1, 1\rangle$ quantifier Q as a set A:

(1) $(Q^A)_M(B) \Leftrightarrow Q_{M\cup A}(A, B)$

We focus on prenominal (also known as Saxon) genitives, which can be construed as determiners. *Basic possessives* like

(2) John's, no doctors', at least five teachers', most children's

and taken to be formed by a rule

(poss) Det ⟶ NP 's

subject to certain (light) restrictions on the NP.[1] *Complex possessives*, as in

(3) few of John's, all but five of Mary's, each of most students'

are taken to be formed by

(plex) Det ⟶ Det of Det

where the second Det is a basic possessive.[2] (plex) applies to other Dets too (see below), though under heavy restrictions on the Dets. A main task is to provide correct and uniform truth conditions for sentences with basic and complex possessives.

2. Universal Readings and Others

(4) John's bikes were stolen.

usually means that each of John's bikes was stolen: a *universal* reading, i.e., with universal quantification over the 'possessed' objects. But other modes of quantification are used as well; in

(5) At most two cars' tires were slashed.

the mode is existential: at most two cars are such that *some* of their tires were slashed. (With 7 cars, the universal reading would, unreasonably, allow up to 23 slashed tires.) This indicates that the mode is given by an implicit quantifier parameter (Q_2) in basic possessives, whereas Q_2 is explicitly specified in complex possessives:

(6) Several of John's CDs were stolen.

(7) Three of each country's athletes carried a banner.

3. Narrowing

Consider

(8) a. Most people's grandchildren hate them.
b. Most people's grandchildren love them.

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[1] We also account for possessives where a numeric expression is inserted, as in "several of John's ten", but omit them from this discussion for simplicity.

[2] An alternative is to use a rule

(part) NP ⟶ Det of NP

Keenan and Stavi 1986 argue at length that (plex) is preferable. In our treatment, both rules have their advantages and drawbacks, but not much hinges on which one we choose.

Presumably, (8a) is false and (8b) true. Most people in the world (being too young) don't have grandchildren, but this fact is clearly irrelevant to the truth value of (8a,b), since in both cases quantification is *narrowed* to people with grandchildren. Otherwise (8a) would be trivially true, on the universal reading. Some prefer universal readings with existential import (e.g. with $\mathit{all}_{\mathrm{ei}}(A, B) \Leftrightarrow \emptyset \neq A \subseteq B$), but, without narrowing, that has an equally undesirable effect: each of (8a,b) would then imply that most people have grandchildren. The narrowing effect was observed in Barker 1995. Although there are a few cases where narrowing seems not to be in force, and some where it doesn't affect truth conditions (see below), a vast number of sentences with possessives simply get the wrong truth conditions without narrowing.

4. The Possessor Relation

Semanticists agree that the choice of possessor relation is *free* in the following sense:

(Free) For any possessive NP, however predictable and semantically describable its *usual* possessor relation is, circumstances can always be found where that same possessive NP is used with *another* possessor relation, not derivable from grammatical or lexical information, but provided only by the context.

We conclude that a general treatment of possessive determiners should leave a free parameter R for this relation. Further mechanisms can then describe how R is (usually) fixed when it comes from, say, a relational noun like "sister".

Let $R_a = \{b : R(a, b)\}$ (the set of things R'd by a), and $\mathit{dom}_A(R) = \{a : \exists b \in A \text{ s. t. } R(a, b)\}$ (the set of objects that R things in A).

5. The Meaning of Possessives

In view of the rule (poss), a semantic operator *Poss* (taken to interpret the possessive 's) should ideally take a type $\langle 1 \rangle$ quantifier Q as argument, in addition to the already mentioned parameters Q_2 and R. But this makes it difficult to enforce narrowing when the possessive NP is quantified, since in general the set C cannot be recovered from $(Q_1)^C$. We therefore take both Q_1 and C as arguments, and define (for CONSERV and EXT Q_1, Q_2; the universe M can therefore be suppressed):

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

So quantification with Q_1 is narrowed to $\mathit{dom}_A(R)$ (in both arguments, by CONSERV). For certain unquantified possessive NPs we can use facts like $I_j = (\mathit{all}_{\mathrm{ei}})^{\{j\}}$, $C^{\mathrm{pl}} = (\mathit{all}_{\mathrm{ei}})^C$, $I_j \vee I_m = \mathit{some}^{\{j,m\}}$; this seems somewhat *ad hoc*, but apparently suffices for all the NPs actually allowed in (poss).

The semantic rule corresponding to (plex), on the other hand, is straightforwardly compositional and merely sets the Q_2 parameter to the interpretation of the first Det.

This is seen to give the desired truth conditions. Forgoing narrowing would mean using $\mathit{Poss}^{\mathrm{w}}$ instead, defined (for CONSERV and EXT Q_1, and EXT Q) by

(10) $\mathit{Poss}^{\mathrm{w}}(Q, Q_2, R)(A, B) \Leftrightarrow Q(\mathit{dom}_A(R) \cap \{a : Q_2(A \cap R_a, B)\})$

When Q_1 is symmetric, one sees that $\mathit{Poss}^{\mathrm{w}}((Q_1)^C, Q_2, R) = \mathit{Poss}(Q_1, C, Q_2, R)$, but in most other cases, using $\mathit{Poss}^{\mathrm{w}}$ gives the wrong result.

The chosen syntactic and semantic rules also account successfully for iterated possessive constructions, as in

(11) Mary's sisters' friends' children were there.

(12) One of John's ex-wives' previous husbands were millionaires.

(13) One of John's ex-wives' previous husbands was a millionaire.

(14) Both of many of my friends' parents work.

as well as the non-acceptability of

(15) #Many of some of John's books are stained.

6. Possessives and Definiteness

In the literature on possessives one often finds statements that possessive are definite (e. g. Lyons 1986, p 124, Abbott 2004, p 123). However, as soon as one goes beyond simple possessives like "John's", this is just not the case. More precisely, using the notion of definiteness from Barwise and Cooper 1981, one can show that

(16) if Q_1 is definite, so is $\mathit{Poss}(Q_1, C, \mathit{every}, R)$,

but when Q_1 is not itself definite, or when readings other than the universal one is used, the possessive is generally not definite.

A different claim, which seems quite common but is rarely spelled out in detail, is that possessives somehow 'contain' a definite. Such accounts, which we will call *definiteness accounts*, appear to use an analysis along the following lines:

(17) a. At least two of most students' books are stained.
  b. For most students x, at least two of the books of x are stained.
  c. For $Q\ x$, Q_2 of the A's R'd by x are B.
  d. $Q(\{a : Q_2\ \mathit{of\ the}(A \cap R_a, B)\})$

The locution "Q_2 *of the*" in the last line is interpreted out by a semantic rule for structures generated by (plex) when the final Det is definite, and one then sees that

(18) $Q(\{a : Q_2\ \mathit{of\ the}(A \cap R_a, B)\}) \Leftrightarrow \mathit{Poss}^{\mathrm{w}}(Q, Q_2, R)(A, B)$

Definiteness accounts usually (a) do not implement narrowing, and (b) prefer an analysis of "the" using (depending on the syntactic number) either $\mathit{the}_{\mathrm{sg}}(A, B) \Leftrightarrow |A| = 1\ \&\ A \subseteq B$ or $\mathit{the}_{\mathrm{pl}}(A, B) \Leftrightarrow |A| > 1\ \&\ A \subseteq B$. We already commented on (a); for another example, note that using $\mathit{Poss}^{\mathrm{w}}$ for

(19) Firemen's wives worry about their husbands.

gives the undesirable consequence that all firemen are married. As to (b), we note that this too gives wrong results in many cases, and that all_{ei} should be used instead. For example, even if narrowing is enforced in (19), using the_{pl} would produce the entailment that firemen are bigamists![3]

Summing up, *provided* the definiteness account is amended to (a) somehow take care of narrowing, (b) use all_{ei} instead of the_{sg} or the_{pl}, and (c) allow that the implicit parameter Q_2 is always present, it seems to be extensionally equivalent to the account we offer here. The definiteness account uncovers at least a trace of the definite article in possessives (in the condition $A \cap R_a \neq \emptyset$, present in *Poss* as well as $Poss^{\mathrm{w}}$). However, this looks like an indication of *existence* rather than of *definiteness*.

Let us come back to the restrictions on the rule (plex), which, we believe, are roughly as follows (where "partitive" means 'of the form [Det of Det]'):

(plex-restr) (i) The left Det must *not* be: basic possessive, or definite, or partitive. (ii) The right Det *must* be either basic possessive or definite; it *cannot* be partitive.

For some corroboration, consider

(20) a. few of the boys
b. each of the three girls
c. two of every student's books
d. *Mary's of the three boys
e. *the of the three boys
f. *the two of the three boys
g. *two of Mary's of the three boys
h. *two of three of Mary's girls

The standard view, however, is that only (plural) definites are allowed after [Det of]. Holding onto that view, while acknowledging that possessives are usually not themselves definite, requires some version of the definiteness account of possessives; we saw in (17) how this account analyzes "Q_2 of Q_1 C" on a form containing instead "Q_2 of the C", where a definite is indeed following [Det of]. But another, and perhaps simpler, idea is instead to revise the standard view along the lines of (plex-restr) above, which allows *both* definites and (basic) possessives after [Det of].[4]

[3] Other examples show that it also doesn't work to use the_{sg} for many 'singular' cases.

[4] The semantic rule corresponding to (plex) indicated above does not work when the second Det is not a possessive, so a separate rule for this case is needed. The use of these two rules can be seen in

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

It is structurally ambiguous whether "two" quantifies over boys or books. But in the latter case, there are still two possibilities. If the rule for possessives is used, each boy is missing two books, so up to twenty books are missing in all. But if the rule for definites is used, only two books are missing, among books owned by any of the boys. Each of these three readings seems entirely plausible.

7. Possessives and Monotonicity

A type $\langle 1, 1\rangle$ quantifier Q is $\textsc{Mon}\uparrow$ ($\textsc{Mon}\downarrow$) if $Q_M(A, B)$ and $A \subseteq A' \subseteq M$ ($A' \subseteq A$) implies $Q_M(A')$. It is $\uparrow\textsc{Mon}$ or *persistent* ($\downarrow\textsc{Mon}$ or *anti-persistent*) if the corresponding holds for the left argument. The following left properties are also useful: Q is $\uparrow_{\mathrm{SE}}\textsc{Mon}$ ($\downarrow_{\mathrm{NW}}\textsc{Mon}$) if $Q_M(A, B)$ & $A \subseteq A' \subseteq M\,(A' \subseteq A)$ & $A - B = A' - B$ implies $Q_M(A', B)$, and it is $\downarrow_{\mathrm{NE}}\textsc{Mon}$ ($\uparrow_{\mathrm{SW}}\textsc{Mon}$) if $Q_M(A, B)$ & $A' \subseteq A\,(A \subseteq A' \subseteq M)$ & $A \cap B = A' \cap B$ implies $Q_M(A', B)$. Q is *smooth*, if it is $\downarrow_{\mathrm{NE}}\textsc{Mon}$ and $\uparrow_{\mathrm{SE}}\textsc{Mon}$, and *co-smooth*, if it is $\downarrow_{\mathrm{NW}}\textsc{Mon}$ and $\uparrow_{\mathrm{SW}}\textsc{Mon}$. One can show that, under CONSERV, smoothness implies $\textsc{Mon}\uparrow$. In fact, almost all $\textsc{Mon}\uparrow$ determiner denotations are smooth, so (co-)smoothness seems to be a highly significant property for natural language quantifiers.

Possessive determiners provide a rich source of quantifiers with various monotonicity properties, usable e. g. to test hypotheses about how monotonicity relates to other linguistic phenomena, in particular to the distribution of polarity items.

The monotonicity properties of *Poss*(Q_1, C, Q_2, R) are determined by those of Q_1 and Q_2 in interesting ways. For right monotonicity we have:

(21) If Q_1 and Q_2 are right monotone in the same (opposite) direction, it holds that *Poss*(Q_1, C, Q_2, R) is $\textsc{Mon}\uparrow$ ($\textsc{Mon}\downarrow$).

Left monotonicity yields too many cases to describe here; we mention just one:

(22) Let Q_2 be $\downarrow\textsc{Mon}\uparrow$ and co-symmetric [i.e. $Q_2\neg$, defined by $Q_2\neg(A, B) \Leftrightarrow Q_2(A, A-B)$, is symmetric], and Q_1 be smooth and positive [i.e. $Q(A, B) \Rightarrow A\cap B \neq \emptyset$]. Then *Poss*$(Q_1, C, Q_2, R)$ is weakly $\downarrow\textsc{Mon}\uparrow$ and weakly smooth.[5]

Example: *most professors'* (universal reading).

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[5] *Weak* versions of left downward monotonicity properties add the condition $C \cap dom_A(R) = C \cap dom_{A'}(R)$ in the antecedent; cf. the existence requirement for possessives mentioned above.