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Article abstract

The article extends the analysis of English donkey anaphora, developed by Gareth Evans and improved by Stephen Neale, beyond those cases where the antecedents are singular count noun phrases, to those where the antecedents are either plural count noun phrases or mass noun phrases. The extension is based on an analysis of English grammatical number developed elsewhere cf. Gillon (1992). Its application here requires that a suggestion adopted by Neale—namely, that the grammatical number of pronouns in these cases is semantically inert—be relinquished. It is shown on independent grounds that the suggestion is untenable.

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GRAMMATICAL NUMBER AND DONKEY ANAPHORA IN ENGLISH

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1. Introduction

THIRTY years ago, Peter Geach (1962) brought to our attention a kind of sentence, the statement of whose truth conditions puzzled Medieval thinkers. They have come to be known as donkey sentences, for reasons the two prototypical examples given below make clear:

(1) a. Every farmer who owns a donkey beats it.
b. If a farmer owns a donkey, he beats it.

Sentences such as these continue to be a puzzle to semanticists, for they seem to escape any straightforward syntactic and semantic treatment.

In particular, they point up the inconsistency of three prima facie plausible assumptions: first, that indefinite noun phrases are restricted existential quantifiers; second, that the antecedent of the third person personal pronoun is the indefinite noun phrase; and third, that a third person personal pronoun whose antecedent is a quantified noun phrase functions in natural language in a way analogous to the way a bound variable functions in quantification theory.

Consider the first sentence. Either the indefinite noun phrase, 'a donkey', has scope wider than 'every farmer', or it has narrower scope. The alternatives are given in notation below:

(2) a. $[\text{a donkey}]_y$ $[\text{every farmer}]_x$ [x owns y and x beats y].
b. $[\text{every farmer}]_x$ $[\text{a donkey}]_y$ [x owns y and x beats y].

If, on the one hand, the indefinite noun phrase 'a donkey' has scope wider than the noun phrase 'every farmer', then the sentence would mean that there is at least one donkey which every farmer owns and beats. But this is clearly not the most salient construal.

If, on the other hand, the indefinite noun phrase has narrower scope, then the sentence would mean that, for every farmer, there is a donkey which he owns and beats. But this interpretation requires that each farmer has a donkey, which the sentence in (1a) does not.[1] The most salient construal of the sentence in (1b), according to many, including Peter Geach, is this:

(3) Every farmer beats every donkey he owns.

Responses to the enigma of donkey anaphora divide into two, depending on which of the above assumptions is modified. On the one hand, there are those which give up the assumption that indefinite noun phrases are restricted existential quantifiers. This has led to Discourse Representation Theory, advocated by Kamp (1981), Heim (1982), and Kadmon (1990), among others. On this view, indefinite noun phrases introduce restricted free variables, and the truth of such sentences is defined in terms of the existence of verifying variable assignments. On the other, there are those which give up the assumption that anaphoric third person personal pronouns are functioning on the analogy with bound variables in quantification theory

This second approach has its origin in an observation by Quine (1960, section 23), which was endorsed Michael Bennett in unpublished work, and was developed within a Montague framework of semantics both in published work by Robin Cooper (1979) and in unpublished work by Terence Parsons (1978). Quine's observation seems to have been made independently by Evans (1977), who also used it to elaborate a non-Montague treatment of donkey anaphora. Evans's treatment has been developed recently in a most promising way by Neale (1990). His treatment is distinguished from Evans's in two ways. First, Neale uses restricted quantification, rather than binary quantification. Second, he is more clear about the precise nature of semantics of the pronouns involved in such anaphora.

My aim here is to show how Neale's elaboration of Evans's treatment of donkey anaphora can be modified to encompass a range of donkey anaphora broader than what has been treated previously. Treatment of the enigma of donkey anaphora has concentrated primarily on cases where the antecedent is a singular count noun phrase, as in (1a) or (1b) above. But, in fact, not only do plural count noun phrases serve as antecedents, but so do mass noun phrases, as shown below.

(4) a. Every farmer who owns a donkey beats it.
    b. Every farmer who owns donkeys beats them.
    c. Every farmer who owns livestock beats it.

(5) a. If John owns a donkey, John beats it.
b. If John owns donkeys, John beats them.
c. If John owns livestock, John beats it.

What I will show below is that the unmarked cases of donkey anaphora are those in which the antecedents are mass noun phrases, that a degree of markedness is introduced when the antecedents are plural count noun phrases, and that strong markedness appears when the antecedents are singular count noun phrases. This empirical observation, if correct, suggests that the source of the enigma of donkey anaphora lies with the singular grammatical number of the third person personal pronouns and their antecedents. Neale's modification of Evans's treatment relies on a suggestion by Martin Davies (1981, p. 175), among others, namely that the singular grammatical number of singular pronouns involved in donkey anaphora is semantically inert. I hope to show that Neale's treatment can be made to have a broader empirical compass, and that at least part of the enigma surrounding the kind of donkey anaphora exhibited in cases where the antecedents are singular count noun phrases, if it is coupled with a theory of grammatical number in English which takes the appearance of grammatical number at face value, rather than as an illusion.

The first task, then, is to provide an account of grammatical number in English, especially insofar as it bears on nouns and their phrasal projections as well as third person personal pronouns in their anaphoric function. The next task is to show how to apply this account. The first application will be to cases of what will be termed 'descriptive pronouns' which do not involve cases of donkey anaphora. The second application will be to cases of donkey anaphora itself. At this point it will become clear that donkey anaphor with singular count noun phrases as antecedents are a breed apart. I shall then show how the account of grammatical number I am urging, which takes the grammatical number of singular pronouns in donkey anaphora at face value, fares better than the alternative.

2. English Nouns

English nouns can be partitioned into four classes: which class an English noun is in depends on whether or not it can occur with determiners and whether or not it admits of the contrast between singular and plural. On the one hand, it is generally recognized that pronouns and count nouns admit the contrast between singular and plural, even if the phonological realization is sometimes the same

(e.g., 'deer'). It is also generally recognized that proper names and mass nouns do not admit of such a contrast, being either singular alone or plural alone. On the other hand, proper names and pronouns do not admit determiners, though sometimes the definite article comes to be incorporated into a proper name; while mass nouns and count nouns do, though they need not. (See Vendler 1967, ch. 2.5-2.7 for further discussion.) In short, there are four kinds of nouns, depending on which characteristic applies from each contrasting pair: proper names, pronouns, mass nouns, and count nouns (the last two taken together comprise common nouns).

Table 1

	occurs with a determiner	admits the contrast of singular and plural
proper name	–	–
pronoun	–	+
mass noun	+	–
count noun	+	+

2.1 English Common Nouns: Mass versus Count

Nouns have associated with them two pairs of features: $\pm CT$, whereby mass nouns and count nouns are distinguished from one another, and $\pm PL$, whereby singular and plural nouns are distinguished from one another. $\pm CT$ are lexical features, and hence stipulated in a noun's lexical entry; whereas $\pm PL$ are syntactic features, freely assigned, modulo certain constraints. To begin with, any noun with the feature +CT must be assigned exactly one of the features, $\pm PL$; and any noun with the feature –CT must be assigned the feature –PL. The assignment of the features $\pm PL$ conforms to certain restrictions. One restriction is lexical. Some nouns have their grammatical number specified lexically. Thus, for example, *police*, which is a count noun, has the feature +PL specified in its lexical entry.[2] Plural mass nouns all have the feature +PL specified in their lexical entries.

The other restrictions are syntactic. The first is the fact that there is agreement between the grammatical number of determiners and the grammatical number of the nouns they modify. The table below provides some routine examples.

Table 2

this chair	*this chairs
these chair	these chairs
that water	*that odds
those water	those odds

Another restriction is that inflected verbs agree in grammatical number with their subjects.

(6) a. This person is always punctual.
b. *This person are always punctual.
(7) a. This water is lukewarm.
b. *This water are lukewarm.
(8) a. *Those odds is good.
b. Those odds are good.

These two restrictions are respected if one assumes that the features of a count noun are assigned to its first dominating noun phrase node (i.e., its maximal projection) and that the features assigned to a determiner must be consistent with the features of its first dominating noun phrase node.

It is also true that a conjoined noun phrase is plural, even if its conjuncts are singular.

(9) a. John and Mary are leaving.
b. *John and Mary is leaving.
(10) a. The wiring and the piping are in the storeroom.
b. *The wiring and the piping is in the storeroom.

This can be handled by a simple rule: the feature of a conjoined noun phrase is the sum of the features of the conjuncts, where the sum of xPL_i is –PL if $i = 1$ and +PL otherwise (where x ranges over + and – and i enumerates the i^{th} conjunct in the conjunction).[3]

The pairs of features $\pm CT$ and $\pm PL$ impose semantic conditions. To make clear what these conditions are, I shall turn to the introduction of a few

mereological and set theoretic concepts. Let an object formed from one or more members of a given background set be an aggregate. For example, let the background set have exactly three distinct elements: **a**, **b**, and **c**. Then, exactly seven aggregates can be formed from its elements: *a*, *b*, *c*, *ab*, *ac*, *bc*, and *abc*.

If **a**, **b**, and **c** are concrete particulars, then so are *ab*, *ac*, *bc*, and *abc*. In addition, each concrete particular can be seen as a minimal aggregate. In other words, the concrete individual **a** can be seen as an aggregate *a*, the smallest aggregate which can be formed from **a**. Not all aggregates have atomic constituents. Those which do are also known as pluralities. The set of tables in a room can form an aggregate whose atomic constituents are precisely the tables in the room: the aggregate in question here is a scattered object, cf., Indonesia is a scattered object. The entire volume of space in a room forms an aggregate, but it has no atomic parts.

A plurality is not the same as a collective, or a group: a plurality is nothing more than the sum of its atomic constituents, whereas a collective is more than the sum of its atomic consituents. The constituency of a collective can change without the collective changing. As is well known, not only can the members of a collective come and go with the collective remaining intact, but the very same people may make up two distinct collectives. What is crucial to collectives is that they are subject to constituting conditions which determine how the members of the collective constitute the collective of which they are members; whereas pluralities do not have such constituting conditions. Indeed, as Simons (1987, ch. 4.4) has pointed out, a plurality can be seen as the limiting case of a collective: a plurality is a collective without conditions governing its constitution.

The set of aggregates accruing to the formation of aggregates from elements of a background set has the algebraic structure of a complete join semi-lattice with a unit and without a zero. The relation of being a sub-aggregate is a partial ordering on the set of all aggregates formed from the background set. The elements of the background set are the minimal aggregates in the set of all aggregates; while the aggregate formed from all of the background set's elements is the unique maximal aggregate, that is, the greatest aggregate or unit aggregate.

In addition, an aggregation is defined to be a set of aggregates with the requirements that their join yield the greatest aggregate (that is, the unit aggregate) and that it be minimal, in the sense that, no aggregate in the set is a proper sub-aggregate of any other aggregate in the set.

When a noun has the feature +CT, its denotation is the set whose members are all and only those minimal aggregates of which the noun is true. In other words, it is the largest subset of the domain of discourse such that the noun is

true of each element in the set. The noun 'table' is a count noun, hence it has the feature +CT. Its denotation is the set of all tables in the universe of discourse. When a noun has the feature –CT, its denotation is the set whose sole member is the greatest aggregate of which the noun is true. The noun 'artillery' is a mass noun, hence it has the feature –CT, so its denotation is the set whose sole element is the greatest aggregate of artillery formed from the universe of discourse.

It is well known that demonstrative noun phrases, quantified noun phrases, and interrogative noun phrases in English exhibit different patterns: interrogative noun phrases form overtly discontinuous structures (i.e., move at S-structure), while demonstrative and quantified noun phrases do not; quantified noun phrases exhibit different scope-like interpretations, while demonstrative noun phrases do not.[4] It is not surprising, then, that these different kinds of noun phrases are sensitive to the features $\pm PL$ in different ways.

The denotation of a demonstrative noun phrase is the denotation of its N-bar, modulo any further restriction imposed on it by its determiner. Now every noun phrase has grammatical number. The semantic import for a demonstrative noun phrase of singular grammatical number is that its denotation be one, while that of plural grammatical number is that its denotation may be one or greater.

It might be asked why the cardinality of a plural demonstrative noun phrases might be allowed to be one. Are there cases where the grammatical number is plural but the denotation is one? Yes, plural mass nouns have a denotation of one, but have the grammatical number of plural. Second, if the cardinality of a plural noun phrase were required to be greater than one, then the following sentences would not be true.

(11) a. These men (Mark Twain and Samuel Clemens) are the same man.
b. The numbers 2^2 and $\sqrt{16}$ are identical.

I now turn from the semantics of demonstrative noun phrases to how they are evaluated with respect to the predicates of which they are arguments. A predicate is evaluated, not with respect to the denotation of a demonstrative noun phrase which is its argument, but with respect to the elements in an aggregation constructed from the demonstrative noun phrase's denotation, where the choice of aggregation is determined by one's knowledge of the world and one's context. Such flexibility accounts for why it is that, when different piles of leaves are touching different bundles of wires, the following sentences (due to Lauri Carlson) are true.

(12) a. These leaves are touching those wires.
b. This foliage is touching that wiring.

In the first case, there is a way of assembling the individual leaves into aggregates of leaves and the individual wires into aggregates of wires such that each aggregate of leaves, that is, each pile of leaves, is touching some aggregate of wires, that is some bundle of wires, and each aggregate of wires is being touched by some pile of leaves. In the second case, there is a way of breaking up the largest aggregate of foliage into sub-aggregates of foliage and the largest aggregate of wiring into sub-aggregates of wiring such that each sub-aggregate of foliage, that is, each pile of foliage, is touching some sub-aggregate of wiring, that is, some bundle of wiring, and each sub-aggregate of wiring is being touched by some sub-aggregate of foliage.

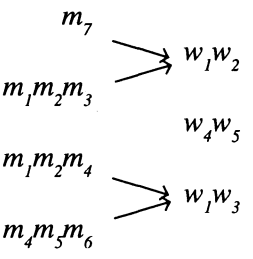
Having stated and illustrated the principles governing plural demonstrative noun phrases, I turn to those governing plural quantified noun phrases. As always, a denotation is associated with a count noun, namely, the largest subset of the domain of discourse of each of whose members the noun is true. But the quantifier is restricted, not to the count noun's denotation, but to an aggregation built from that denotation. The choice of aggregation is partially constrained by the features $\pm PL$. If the feature assigned to the noun phrase node of the quantified noun phrase is +PL, then the choice of the aggregation is unconstrained; but if it is –PL, then the choice is constrained to the least aggregation, that is, the set of all the minimal aggregates of the count noun's denotation — which is, of course, just the count noun's denotation. Notice that this is analogous to the constraint imposed by these features on the denotation of demonstrative noun phrases. Next, if the quantifier is universal, then the predicate must be true of each aggregate in the aggregation to which the quantifier is restricted; and, if it is existential, then the predicate must be true of at least one aggregate in the aggregation to which the quantifier is restricted.

To see how the principles work, consider this sentence with plural quantified noun phrases.

(13) All men in the room endorsed some women.

Suppose the denotation of 'men' is $\mathbf{m}_1$, $\mathbf{m}_2$, $\mathbf{m}_3$, $\mathbf{m}_4$, $\mathbf{m}_5$, $\mathbf{m}_6$, and $\mathbf{m}_7$ the denotation of 'women' is $\mathbf{w}_1$, $\mathbf{w}_2$, $\mathbf{w}_3$, $\mathbf{w}_4$, and $\mathbf{w}_5$. Suppose further that the men form committees of various sizes (including committees of one), say, m_7, $m_1m_2m_3$, $m_1m_2m_4$, and $m_4m_5m_6$, and that the women too form committees, say, w_1w_2, w_4w_5, and w_1w_3. Finally, suppose that there is an endorsement of the female committees by the male committees, as depicted below.

Figure 1



The situation certainly renders the sentence in (13) true and that it is so can be derived by any rule which assigns clausal scope to quantified noun phrases. First, the quantified noun phrases in the sentence in (13) can be assigned the scopal configuration shown in (14).

(14) $[_S\ [_{NP}$ All men $]_x\ [_S\ [_{NP}$ some women $]_y\ [_S\ [_{NP}\ x\ ]\ [_{VP}$ endorsed $[_{NP}\ y\ ]]]]]$:

Next, the following two sets are aggregations formed from the denotation of 'men' and 'women' respectively.

(15) a. $\{m_7, m_1m_2m_3, m_1m_2m_4, m_4m_5m_6\}$
b. $\{w_1w_2, w_4w_5, w_1w_3\}$

Finally, each aggregate in (15a) bears the relation of endorsing to some aggregate in (15b).

Quantified count noun phrases range over elements in the aggregation formed from elements in the denotation of the noun phrase's count noun. Quantified mass noun phrases also range over elements in the aggregation formed from the denotation of the noun phrase's mass noun, which is the greatest aggregate in the domain of discourse of which the mass noun is true. In many cases, the choice of aggregation is virtually arbitrary.

(16) a. All water is wet.
b. All information is valuable.

In other cases, the choice is constrained by common knowledge.

(17) a. All luggage in this store sells for under forty dollars.
b. Some ammunition found by the police is fifty caliber.
c. No livestock in this pasture weighs more than one hundred kilograms.

2.2 English Third Person Personal Pronouns

Third person personal pronouns are pronouns, and hence exhibit singular / plural contrast. However, third person personal pronouns have antecedents, and to that extent, they are subject to principles of agreement in grammatical number. In particular, the grammatical number of a pronoun is that of its antecedent.

(18) a. *The man* admires *himself.*
b. **The man* admires *themselves.*
(19) a. *The men* think that *they* are great.
b. **The men* think that *he* is great.
(20) a. *This equipment* maintains *itself.*
b. **This equipment* maintains *themselves.*

If a pronoun has a split antecedent, it is plural.

(21) a. *John* told *Mary* that *they* should meet.
b. **John* told *Mary* that *he / she* should meet.

Not surprisingly, this can be handled in a way perfectly parallel to the earlier treatment of agreement between a conjoined noun phrase and a verb of which it is the subject: the feature of a pronoun with an antecedent is the sum of the features of its antecedent noun phrases, where the sum of xPL_i is –PL if $i = 1$ and +PL otherwise (where x ranges over + and - and i enumerates the i^{th} antecedent noun phrase).

In addition to registering grammatical number, English third person personal pronouns, in their singular forms, also register gender. Since we shall need to be clear about the nature of gender in English, let me begin with a brief review of the relevant facts.

As is well known, gender is of two kinds: grammatical and notional. In Indo-European languages, notional gender often arises from determinable properties pertaining to sex and animacy.[5] Many Indo-European languages have, in addition, grammatical gender, which amounts to the assignment of nouns to different inflectional classes. Latin, for example, has three grammatical genders — masculine, feminine, and neuter; French has just two — masculine and feminine; while English has none, though in earlier stages it, like Latin, had three.

Agreement with respect to gender can arise both grammatically and notionally. In languages I have mentioned, adjectives have different forms and the choice of form depends on the gender of the nouns they are modifying. Thus, for example, the adjective for 'interesting' in French has at least two

forms 'intéressant' and 'intéressante'. If it occurs modifying a masculine noun such as 'livre' ('book'), then the first form is chosen to yield 'livre intéressant'; if it occurs modifying a feminine noun such as 'pièce' ('play'), then the second form is chosen to yield 'pièce intéressante'. Agreement can also be determined notionally. When a pronoun is used to refer to an object, the gender of the pronoun is generally that of an appropriate common noun for the same object. It is possible for the demands of grammatical and notional agreement can conflict. Thus, for example, the French word for teacher, 'professeur', is masculine. However, teachers are commonly women. Suppose one wants to say that a particular teacher, who is a woman, is attractive. Neither 'Le professeur est beau', where the masculine form of the adjective for beautiful, 'beau', is selected to satisfy grammatical agreement, nor 'Le professeur est belle', where the feminine form of the adjective for beautiful, 'belle', is selected to satisfy notional agreement, are acceptable, Lyons (1968, ch. 7.3.6).

English no longer has grammatical gender and so adjectives are no longer required to agree with the nouns they modify. English does, however, have notional gender, which is found only in the system of pronouns, in particular, the third person singular personal pronouns. Roughly, 'it' is used primarily with respect to entities which are not human; 'she' with respect to entities which are female, typically human; and 'he' with respect to entities which are male, typically human. Notional gender is not without its grammatical quandries: which pronoun does one use to refer to a person who has undergone a sex change operation?

What is relevant here is that notional gender in English can conflict with grammatical number. This can occur when the antecedent of the third person personal pronoun is a grammatically singular quantified noun phrase whose domain of quantification contains entities some of which satisfy the condition for the selection of one version of the third personal singular personal pronoun, say the masculine form, and others satisfy the condition for the selection of another version, say the feminine form.

There are three ways to make the selection. The one which is historically first is the one which patterns with most Indo-European languages, namely, the one where the masculine form of the pronoun is autohyponymous between a sense in which the relevant objects in the domain are considered masculine and human and a sense in which they are considered merely human.

For many speakers of English, the masculine form of the third person singular personal pronoun is not autohyponomous: it has but one sense, the narrower one. For these speakers, the first sentence below

(22) Every child loves his mother.

entails that all the children are boys. The question arises: how can such speakers assert, in one sentence, using the word 'child' in the singular, what is expressed by the following two sentences?

(23) a. Every boy loves his mother.
b. Every girl loves her mother.

One possibility is to conform to the requirement that a pronoun agree with its antecedent in grammatical number and to use a disjunction of singular pronouns, as exemplified below.

(24) Every child loves his or her mother.

Many speakers, however, find such disjunctions cumbersome, especially in protracted discourse. The other possibility, then, is to use the 'nearest' pronoun which neutralizes the difference in gender. The 'nearest' such pronoun is the third person plural personal pronoun.

(25) Every child loves their mother.

It is important to observe that those speakers who resort to the third person plural personal pronoun have not completely abandonned the requirement pertaining to grammatical number of pronouns with antecedents entirely. None of these speakers tolerates a singular pronoun with a plural antecedent.

(26) a. All chairs are in their place.
b. *All chairs are in its place.

Moreover, I have found that such speakers nonetheless conform to the generalization when notional considerations are not relevant, preferring the first sentence in each pair below to the second.

(27) a. Each cat licks its whiskers.
b. *Each cat licks their whiskers.
(28) a. Every chair is in its place.
b. *Every chair is in their place.

2.3 Types of Usage

As is well known, though third person personal pronouns are used with antecedents, they are not always so used. Sometimes they can be used deictically. Thus, for example, a person can point to a man in a crowd and say

(29) He is a friend of mine.

The deictic usage, however, need not involve a demonstration. Sometimes, the referent may be evident from context. A medic, arriving on the scene of an accident, can very easily inquire about the state of a single injured woman, asking simply

(30) How is she?

Indeed, as Geoffrey Nunberg (1993, p. 23) has observed, the referent may be remote. Walking through the Taj Mahal, the speaker who says

(31) He certainly spared no expense

can use the third person personal pronoun, without any demonstration, to refer to Shahjahan, the Taj Mahal's builder.

But what about pronouns with antecedents. Traditional grammar tells us that such pronouns are substitutes for their antecedents. The prototypical cases involve pronouns whose antecedents are nouns. Hence the term pronoun, that which stands for a noun.

(32) a. *John* thinks that *he* is smart.
b. *John* thinks that *John* is smart.

Early generative grammar, recognizing that, not nouns, but noun phrases, serve as antecedents, formalized the traditional view as a rule of pronominalization, a rule whereby a sentence containing a third person personal pronoun and its antecedent is derived from one with two occurrences of the same noun phrase. Thus, the sentences (32a) and (32b) have the same deep structure, their surface structure difference residing in the pronominalization rule applied to the deep structure of the second sentence and not the first.

(33) a. *The boy* thinks that *the boy* is smart.
b. *The boy* thinks that *he* is smart.

As Quine (1960) and Geach (1962) made clear, an analysis of third person personal pronouns as substitutes for their antecedents, implies that a pair of sentences which differ from one another only insofar one has a pronoun with an antecedent while the other has the pronoun's antecedent substituting for the pronoun, should be synonymous. The pairs of sentences in (33a) and (33b) are indeed synonymous, but none of the three pairs below exhibit synonymity.

(34) a. *No boy* thinks *he* should join the party.
b. No boy thinks no boy should join the party.
(35) a. *Each boy* likes *his* night-cap.
b. Each person liked each person's night-cap.

(36) a. *Some man* thinks that whiskey is good for *him*.
b. Some man thinks that whiskey is good for some man.

Quine and Geach suggested that pronouns in these sentences be viewed on an analogy with bound variables of logic.

Geach (1962, p. 112) has opined that, aside from what he calls pronouns of laziness, all uses of the third person personal pronoun with antecedents are cases which should be viewed as bound variables. Quine (1960, art. 21), in contrast, remarked on uses of third person personal pronouns with antecedents which he thought should be treated, not as bound variables, but as degenerate definite noun phrases.

An example of such a use of the third person personal pronoun is found in (37a).

(37) a. John bought a carpet and Harry cleaned it.
b. John bought a carpet which Harry cleaned.

As Evans pointed out, if all third person personal pronouns with antecedents should be analyzed as bound variables, then the pair of sentences above should be synonymous. But clearly they are not. The former sentence implies a uniqueness which the latter does not. Rather, the following form a synonymous pair.

(38) a. John bought a carpet and Harry cleaned it.
b. John bought a carpet and Harry cleaned the carpet John bought.

Indeed, precisely what distinguishes third person personal pronouns with antecedents here from those which have an analogy with bound variables of logic is their replaceability by a definite noun phrase whose descriptive content is determined by the least clause containing its antecedent.

Third person personal pronouns with antecedents can be distinguished into those which can be replaced by a suitable definite noun phrase, thus termed 'descriptive pronouns', and those which cannot be, bound pronouns. This distinction is re-enforced by an observation due to Bosch (1983), who remarked that bound pronouns cannot be replaced by definite noun phrases.[6]

(39) a. **No boy* thinks *the boy* should join the party.
b. **Each* person liked *the person's* night-cap.
c. **Some man* thinks that whiskey is good for *the man*.

How, then, are descriptive pronouns to be handled? Parsons (in unpublished work dated to 1978) and Cooper (1979) suggested that they be treated as deictic pronouns, which Montague treated on the analogy of the free variables of logic. (This idea seems to go back to Reichenbach 1947 art. 55.) But this assimilation

is implausible, for reasons pointed out by Evans (1977, end of section 5) and repeated by Heim (1982; 1990). Deictic pronouns do not have antecedents; but descriptive pronouns do. If descriptive pronouns were merely deictic, then the synonymous sentences of 'John has a wife' and 'John is married' would provide sufficient context for the third person personal pronoun 'she' to refer to John's wife in each of the following two sequences of sentences.

(40) a. John has a wife. She is very pleasant.
b. *John is married. She is very pleasant.

In fact, only the first sequence, the only one of the two which furnishes an antecedent for 'she', permits the pronoun to denote John's wife.

Evans (1977; 1980), apparently unaware of the work of Cooper and Parsons, had another treatment of descriptive pronouns. He suggested treating these pronouns, which he called E-type pronouns, as rigid designators whose referents are fixed by description recoverable from the smallest clause containing the pronoun's antecedent, cf. Evans (1977, section 4A and section 6B). To see how this is supposed to work, let me turn to some simple examples.[7]

The essence of Evans's rule for the interpretation of descriptive pronouns is this: The denotation assigned to a descriptive pronoun is the set of objects from the universe of discourse such that they satisfy the restriction in the quantified noun phrase and they satisfy the sentence frame of the smallest clause containing the antecedent.

(41) a. John bought *a carpet* yesterday, and Harry cleaned *it*.
b. John bought *carpets* yesterday, and Harry cleaned *them*.
c. John bought *carpeting* yesterday, and Harry cleaned *it*.

The denotation of 'it' in (41a) is the largest set of carpets bought by John yesterday. The fact that the descriptive pronoun is singular requires that the denotation have a cardinality of one. The denotation of 'them' in (41b) is the same as that for 'it' in (41a), namely, the largest set of carpets bought by John yesterday, except that, since the descriptive pronoun is plural, the cardinality of the denotation can exceed one. Finally, the denotation of 'it' in (41c) is the set whose sole element is the largest aggregate of carpeting bought by John yesterday. The descriptive pronoun is singular, which requires that the denotation have a cardinality of one.

The same principle carries over to universally quantified noun phrases. Since the things which satisfy the restriction of the noun phrase is a subset of the things which satisfy the clause frame without the quantified noun phrase, only the restriction needs to be taken into consideration.

(42) a. John bought *every carpet in the store* yesterday, and Harry cleaned *them* today.
b. John bought *all the carpets in the store* yesterday, and Harry cleaned *them* today.
c. John bought *all the carpeting in the store* yesterday, and Harry cleaned *it*.

These semantic principles imply that the descriptive pronouns should be replaceable by definite noun phrases recapitulating the content of the antecedent clause. Moreover, they explain the anomaly evinced by the following sentences.

(43) a. *John bought *no carpet* yesterday, and Harry cleaned *it*.
b. *John bought *no carpets* yesterday, and Harry cleaned *them*.
c. *John bought *no carpeting* yesterday, and Harry cleaned *it*.

The anomaly is not that these sentences are false, but rather than they are odd. And their oddity has an explanation in terms of the analysis being presented. The denotation of the descriptive pronoun is the set of objects from the universe of discourse such that these objects satisfy the restriction in the quantified noun phrase and they satisfy the sentence frame of the smallest clause containing the antecedent. But the antecedent clause's requires that there be no such objects.[8]

However, once a descriptive pronoun acquires a non-empty denotation, collective and distributive readings are available, as shown below.

(44) a. *John gathered *a donkey* in the barn, and Harry vaccinated *it*.
b. John gathered *donkeys* in the barn, and Harry vaccinated *them*.
c. John gathered *livestock* in the barn, and Harry vaccinated *it*.

The denotation of 'them' in (44b) is the largest set of donkeys any pluralities of which were gathered by John in the barn. And the denotation of 'it' in (44c) is the set whose sole element is the largest aggregate of sub-aggregates of which were gathered by John in the barn.

It is important to remark that descriptive pronouns are not subject to grammatical agreement; that is to say, descriptive pronouns are not required to have the same grammatical number as their antecedents. In (45a) below, the antecedent of the third person plural personal pronoun is the singular noun phrase 'a term paper'. Grammatical number is determined notionally, arising from the fact that the values in the range of the indefinite noun phrase are determined by the choice of values in the range of the universally quantified noun phrase.

(45) a. Each student turned in a term paper. They had been prepared on a word processor.
b. Each student turned in a term paper. The term papers turned in (by each student) had been prepared on a word processor.

These very same examples also require that Evans's rule be modified. The denotation of the descriptive pronoun 'they' in (45a) need not be the set of term papers each one of which every student turned in, but rather the set of term papers each one of which was turned in by some student. Thus, when the antecedent of a descriptive pronoun is within the scope of a quantified noun phrase, the set of objects satisfying the restriction on the antecedent satisfy the antecedent clause, with the quantifier parameterized to values in its range.

It is important to observe here that the grammatical number of the descriptive pronoun is doing semantic work. The plural grammatical number of the pronoun permits its denotation to exceed one, a necessary condition for any prima facie plausible interpretation. Put another way, should the pronoun be of singular grammatical number, the sentence takes on a perfectly respectable, though unusual, interpretation.

(46) Each student turned in a term paper. It had been prepared on a word processor.

On the basis of the principles adduced so far, this sentence is true, either because there is only one student and he turned in one term paper; or because there are several students but they turned in the same term paper.

3. Donkey Anaphora

Strikingly, while the syntactico-anaphoric configuration in (1a) is more complex than that in (45a), the semantic principles are the same. Thus, the values of the pronoun and its antecedent may, and usually do, vary with the values over which the quantified noun phrase ranges. But, as we shall see below, so long as we confine our attention to cases of descriptive pronouns with mass noun phrases or plural count noun phrases as antecedents, the very semantic principles outlined above carry over, without any unwanted consequences.

(47) a. Every tourist who bought *a carpet* shipped *it* home.
b. Every tourist who bought *carpets* shipped *them* home.
c. Every tourist who bought *carpeting* shipped *it* home.

Only sentences of the kind found in (47a) pose a problem.

Consider the following case first.

(48) Every tourist who bought *carpeting* shipped *it* home.

Here the descriptive pronoun and its antecedent are both within the scope of the quantified noun phrase 'every tourist'. Hence, the denotational value of the descriptive pronoun is the set of things which satisfy the restriction in the quantified noun phrase and satisfy the sentence frame of the small clause containing the antecedent, parameterized to a choice of tourist. That is, for a given tourist, the denotational value of the descriptive pronoun is the set whose sole element is the largest aggregate of sub-aggregates of which the tourist bought. This is precisely the interpretation of the following sentence.

(49) Every tourist who bought *carpeting* shipped *the carpeting he bought* home.

Parallel considerations yield a parallel analysis of the following sentence, whose interpretation is truth-conditionally equivalent to the second.

(50) a. Every tourist who bought *carpets* shipped *them* home.
b. Every tourist who bought *carpets* shipped *the carpets he bought* home.

Surely the sentence is true if each tourist bought two or more carpets and sent each of them home. And it is surely false if some tourist who bought only two carpets fails to send either of them home. I suspect that the sentence is true and false in the following limiting cases as well. Each tourist bought exactly one carpet and sent it home, and some tourist bought exactly one carpet and did not send it home. My reason for this was given earlier: the feature of +P L permits, but does not require, that the associated denotation be greater than one. Surely the following statement excludes even those with only one pet.

(51) No one with pets is permitted to live in this building.

As is well known, problems arise when the antecedent is a singular indefinite noun phrase.

(52) a. Every tourist who bought *a carpet* shipped *it* home.
b. Every tourist who bought *a carpet* shipped *the carpet he bought* home.
c. *Every tourist* shipped home every carpet *he* bought.

The second sentence suggests that the relation from tourists to carpets is functional, that is, for each tourist there is a unique carpet to be considered, while the third sentence does not. Some theorists, including Geach (1962),

Kamp (1981), and Heim (1982), consider the first sentence to be more accurately paraphrased by the third sentence than by the second. However, the analysis given above requires that the first sentence be more accurately paraphrased by the second than by the third.

It must be conceded straight off that, although speakers' intuitions as to whether or not, for a given tourist, more than one carpet is involved are often ambivalent, such cannot be the general explanation, for no such ambivalence can be invoked with regard to the first sentence below, as pointed out by Heim (1982).

(53) a. Every woman who bought *a sage plant* here bought eight others along with *it*.
b. *Every woman who bought a sage plant here bought eight others along with the sage plant she bought.

Every woman explicitly has nine sage plants associated with her.

3.1 Singular Descriptive Pronouns as Semantically Inert

Neale (1990) accepts that the correct paraphrase of the sentence in (52a) is the sentence in (52c). To compensate for this, Neale endorses a suggestion by Martin Davies (1981, p. 175), to the effect that the grammatical number of the singular third personal person pronouns in the configurations of donkey anaphora is semantically inert. The upshot of his suggestion is that a donkey sentence, such as the first sentence below, turns out to have the same truth conditions as the second.[9]

(54) a. Every tourist who bought *a carpet* shipped *it* home.
b. Every tourist who bought *a carpet* shipped *the carpet or carpets* he bought home.

Moreover, this suggestion enables the analysis given above to provide a correct semantics for the sentences of the kind remarked upon by Heim. Thus, the sentence in (53a) above is true just in case every woman who bought at least one sage plant bought eight other sage plants along with each of the sage plants she bought.

As attractive as it is, I must confess to being sceptical about the Davies' suggestion, since it is not grounded in any general account of grammatical number in English. Earlier, we did see evidence to the effect that plural noun phrases may have a singular denotation; but what evidence is there that singular descriptive pronouns may have a plural denotations?

Neale (1990, section VI) brings to our attention cases such as the first sequence of sentences below:

(55) a. *Every adult Swiss male* owns a gun. *He* is required to do so by law.
b. *Every adult Swiss male* owns a gun. *They* are required to do so by law.

How might this sustain the view that singular descriptive pronouns are semantically inert? Here is a fairly compelling argument: bound pronouns are c-commanded by their antecedents, while descriptive pronouns are not.[10] In neither case above are the pronouns c-commanded by their antecedents. Hence, they must both be descriptive pronouns. Indeed, we see that cases like the second can be nicely handled by the semantics for descriptive pronouns given earlier. (See the discussion of (42a) above.) Hence, the grammatically singular number of the pronoun in the (55a) must be semantically inert.

However, even if Neale is right about the case just discussed, it is of no avail in the case of relative clause donkey anaphora, for if Davies's suggestion applies to these configurations, then both of the following sentences should be acceptable and synonymous.[11]

(56) a. Each person who saw *every film* at the festival praised *them*.
b. *Each person who saw *every film* at the festival praised *it*.

But they are not.

In fact, sentences such as those in (55a) and (55b) lend no support to Davies's suggestion. Neale (1990, p. 137) points out, contra Evans (1980, p. 341) — and I concur with Neale's judgement in the matter — that the first sentence in the pair below has a perfectly sensible interpretation, provided that there is only one frisbee major this year.

(57) a. *Every frisbee major* got a job this year. *He* is very happy about it.
b. *Every frisbee major* got a job this year. *They* are very happy about it.

But, on Davies' suggestion, there should be no such contrast, for the singular grammatical number of the third person personal pronoun in (57a) is semantically inert.

Indeed, the natural account for the sequence of sentences in (57a) is that it becomes acceptable precisely to the extent that the pronoun's singular grammatical number cancels the expectation established by its antecedent that the relevant denotation is greater than one. But such an account entails that the grammatical number of the descriptive pronoun is semantically active, not semantically inert, contrary to Davies' suggestion. Moreover, the configuration in (57a) is not the only one where a descriptive pronoun's singular gram-

matical number may cancel the expectation established by its antecedent that the relevant denotation is greater than one. Just such a cancellation arises in connection with the configuration found in the sentences in (46). In fact, I have found several speakers, including myself, who find that the sentence in (56b) can be salvaged in the same way as those in (46) and (55b).

So Davies's suggestion not only entails the wrong consequences for donkey anaphora arising from relative clauses but also lacks empirical support. As a result, one might ask: what is wrong with the argument adduced above in support of Davies's suggestion? The answer is that it has a false premiss, namely, that pronouns, to be bound by their quantificational antecedents, must be c-commanded by them. As a matter of fact, the evidence is that the pronoun in (55a) is not bound. After all, one of the tests for whether or not a third person personal pronoun is descriptive is whether or not a quantified noun phrase whose determiner is 'no' can serve as its antecedent. Observe that should 'every' in (55a) be replaced by 'no', the sequence becomes unacceptable, as one would expect from the discussion of (43a) above; whereas, a similar replacement in (55a) leads to no infelicity.

(58) a. **No frisbee major* got a job this year. *He* is very unhappy about it.
b. *No adult Swiss male* owns a gun. *He* is prohibited from doing so by law.

One reason for resisting the rejection of this false premiss is the widespread feeling that the scope of a scope-taking operator must be confined to the sentence in which it occurs. But this feeling is belied by the facts. It is known from the work of Craige Roberts (1989), for example, that modal operators may take scope across sentential boundaries. In the sequence of sentences below, the mood of the second clearly signals that it is modally within the scope of the protasis of the first sentence.

(59) If Edna forgets to fill the birdfeeder, she *will* feel very bad. The birds *will* get hungry.

3.2 An Alternative E-Type Analysis

What alternative is there to the suggestion that singular descriptive pronouns have semantically inert grammatical number? The answer to this question lies, I believe, in a re-consideration of the data which motivated the adoption of Davies's suggestion in the first place.

To begin with, there are sentences where their Geachian paraphrases, paraphrases like the one in (52c), fail, while the Quinean paraphrases, paraphrases like the one in (52b), work perfectly well.[12]

(60) a. Each man who has *a son* wills his entire fortune to *him*.
b. Each man wills his entire fortune to each son of his.
c. Each man who has *a son* wills his entire fortune to *the son he has*.

The sentence in (60b) is committed to ascribing an impossible will to each man with more than one son. The sentences in (60a) and (60c) carry no such commitment.

Second, the instances where the Geachian paraphrases of relative clause donkey anaphora seem better than Quinean ones form a small sub-class of a class of antecedents comprising the semantically most marked case. How is it that sentences such as the one in (52c) are semantically marked? Recall, to begin with, that the characteristic which distinguishes mass nouns and their phrasal projections from count nouns is that mass nouns are unspecified as to atomicity, and that predicates evaluated with respect to them are unspecified as to whether the relevant aggregates in the associated aggregation are atomic or not. Recall also the characteristic which distinguishes plural count noun phrases from singular ones: predicates evaluated with respect to plural count noun phrases are unspecified as to whether the relevant aggregates in the associated aggregation are atomic or not, whereas predicates evaluated with respect to singular count phrases are required to be evaluated with respect to the aggregation of atomic aggregates. Thus, singular count noun phrases are semantically most marked. Yet, the definite noun phrase paraphrase works perfectly well in both of the less marked cases; and it fails only in a few instances of the marked case, instances which will be examined shortly in more detail.

Third, the optimality of the paraphrase of a descriptive pronoun by a definite noun phrase is subject to variation as a result of pragmatic factors. To see this, let us consider several empirical generalizations. The first, which is based on an observation by Irene Bellert (unpublished work), is that the informational content of a definite noun phrase replacing a descriptive pronoun cannot exceed that of its antecedent. This holds whether the anaphoric connection is inter-sentential or intra-sentential.

(61) a. Our neighbor has *a dog*. *The animal* has rummaged through our garbage can a dozen times.
b. ?Our neighbor has *an animal*. *The dog* has rummaged through our garbage can a dozen times.
(62) a. Every farmer who buys *a donkey* vaccinates *the animal* as soon as possible.
b. *Every farmer who buys *an animal* vaccinates *the donkey* as soon as possible.

The second generalization is that a descriptive pronoun cannot be used when its informational content is too impoverished to permit a satisfactory determination of its antecedent. Again, this holds whether the anaphoric connection is inter-sentential or intra-sentential.

(63) a. *Bill bought *a donkey* and *a mule*. He fed *it* carrots and *it* rutabagas.
b. Bill bought *a donkey* and *a mule*. He fed *the donkey* carrots and *the mule* rutabagas.

(64) a. *Every farmer who bought *a donkey* and *a mule* fed *it* carrots and *it* rutabagas.
b. Every farmer who bought *a donkey* and *a mule* fed *the donkey* carrots and *the mule* rutabagas.

And, of course, in many cases a descriptive pronoun and a suitable definite noun phrase are in free variation.

(65) a. John bought a carpet and Harry cleaned it.
b. John bought a carpet and Harry cleaned the carpet John bought.

(66) a. Every teacher who expells *a student* from class must accompany *him* to the principal's office.[13]
b. Every teacher who expells *a student* from class must accompany *the student (he expells)* to the principal's office.

(67) a. Every sponsor who endorsed *a mayoral candidate* contributed to *his* campaign fund.
b. Every sponsor who endorsed *a mayoral candidate* contributed to *the candidate's* campaign fund.

The foregoing generalizations suggest the following account of why many speakers prefer the Geachian paraphrase of (52b) over the Quinean one. The definite noun phrase in the Quinean paraphrase contains superfluous informational content, thereby imparting to it undue prominence, the result of which is to impose a sense of singularity greater than what would be imposed by the pronoun. This conjecture is borne out, in my judgment, by the following sentences, where the suggestion of singularity of donkey per farmer is weakest in the first sentence, strongest in the last, and intermediate in the middle one.

(68) a. Every farmer who bought *a donkey* had *it* vaccinated immediately.
b. Every farmer who bought *a donkey* had *the animal* vaccinated immediately.
c. Every farmer who bought *a donkey* had *the donkey he bought* vaccinated immediately.

One outstanding question remains to be addressed: what is to be done about sentences such as the one in (53a)? Here, we can turn to an insight of Kadmon (1990, section 3.6). She sets forth the following: suppose that someone buys a sage plant. Either the person buys fewer than nine, or the person buys at least nine. In the former case, the sentence is false, no matter which sage plant is selected as the value of the descriptive pronoun. In the latter case, the sentence is true, no matter which sage plant is selected as the value of the pronoun.

4. Conclusion

I have undertaken to show how the approach to donkey anaphora, developed by Evans and improved by Neale can be extended to encompass a range of data broader than what has been previously considered. In particular, I have shown how such anaphora works when the antecedents are not only count noun phrases, singular and plural, but also mass noun phrases. To do this, I replaced the suggestion by Davies adopted by Neale with a syntactic and semantic account of grammatical number, developed elsewhere, cf. Gillon (1992). In this discussion, I have confined my attention to donkey anaphora in relative clauses. For reasons of space, I have not discussed the data pertaining to donkey anaphora in conditionals. However, the analysis worked out here carries over to such cases.

Notes

1. Replacing the 'and' with 'then' will not help.

2. This specification is to be distinguished from phonological specifications pertaining to the phonological realization of the features $\pm PL$. For example, 'mouse' in the plural is realized as 'mice'; 'deer' in the plural is still realized as 'deer'; and 'means' in the singular is still realized as 'means'; etc.

3. Usages appearing to resist these restrictions are well known, being thoroughly documented in the more complete descriptive grammars of English such as Jespersen (1909, v. 2, ch. 3) and Quirk & al. (1985, ch. 10.34 ff). For a discussion of these usages in connection with the stated restrictions, see Gillon (1992).

4. More precisely, singular quantified noun phrases exhibit different scope-like interpretations, while singular demonstrative noun phrases do not. As a reviewer has pointed out, there are cases where plural demonstrative noun phrases and interrogative noun phrases exhibit scope-like interpretations.

5. In Swahili, notional gender may pertain to shape, texture, color, and edibility, cf. Lyons (1968, ch. 7.3.4).

6. This is just a special case of Principle C of Binding Theory. What needs to be remarked is that, in many cases, Principle C can be defeated by stress; this special case cannot be.

7. Evans (1977, section 6A) considers neither plural count noun phrases nor mass noun phrases. As a consequence, the treatment here is a departure from Evans. In addition, Neale (1990, p. 130 ff.) has adduced evidence to show that, in some cases at least, these pronouns do not behave like rigid designators. Neale suggests that they are pronouns which go proxy for definite noun phrases. For simplicity of exposition, I shall not go Neale's route.

8. Context can nonetheless provide an interpretation for these pronouns. No office employee attended the Christmas party. They went out to a local pub instead. That is, the office employees went out to a local pub instead.

9. I am grateful to my colleagues Nigel Duffield and Myrna Gopnik for discussion of the issues raised in this section.

10. C-command is a relation defined on the nodes within the phrase marker of a sentence.

11. The sentences and judgements, which coincide with my own, are those of Shalom Lappin (1988, p. 267). I am grateful to Paul Hirschbühler for bringing this article to my attention.

12. Such sentences are adaptations of a sentence ascribed to Barbara Partee.

13. I constructed this pair of sentences on the model of the following unwitting usage of donkey anaphora by Geoffrey Nunberg (1993, p. 9): "So if a teacher asks a child what happened to the parental permission form for the class trip, the child cannot respond by saying 'We haven't signed the form yet.'"

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