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Russellian Treatments of Anaphora

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RESUMEN

El interés fundamental de este artículo es explorar, en el marco de una teoría russelliana defendida por Evans y Neale, algunos procedimientos de recuperación del contenido de los así llamados pronombres "burrito". Como consecuencia de hacer esto, desarrollamos una concepción funcional de la anáfora "burrito" basada en la teoría de cuantificadores generalizados (GQ). En acuerdo con aquella concepción, dichos pronombres denotan funciones de elección que satisfacen una cierta condición paramétrico-contextual.

ABSTRACT

Several years ago Gareth Evans got inspiration from the Russellian account of definite descriptions to advance the first cogent semantic analysis of anaphora and, in particular, of the so-called "donkey" anaphora. Later Stephen Neale proposed a substantial improvement of Evans' theory. According to the Evans-Neale view, donkey pronouns go proxy for Russellian definite descriptions. The main concern of this paper is to explore, given this Russellian background, the recovery procedures of pronominal content for sentences where such pronouns are embedded in. In the course of doing so, we work out a functional conception of donkey anaphora grounded in the generalized quantifiers (GQ) approach. According to that conception, such pronouns denote choice functions satisfying a certain parametric condition provided by the context.

Anaphoric reference is perhaps one of the most pervasive features of discourse in natural language and thereby deserves to be studied in its own right. A pronoun is said to refer anaphorically if it is used to refer to that which other expression — the "antecedent phrase"— was used to refer to. The salient problem about anaphora, when the antecedent phrase is quantified by expressions like 'every', 'a', 'some' and so on, is how we are to explain the connection between the pronoun and that antecedent. Accordingly, most semantic studies of anaphora have concentrated on explaining the nature of that connection. These studies focused on a restricted kind of anaphoric phenomenon — called, after work by Geach, "donkey anaphora" —, the examination of which will also restrict the focus and the scope of our research here. The general purpose of those studies has been to answer a question: the question whether the anaphoric connection can be explained *only* in logical terms.

In such a case, the relation pronoun-antecedent would be submitted only to those logical principles and laws governing the construction of any quantified sentence. Nevertheless, that question cannot be successfully confronted unless an adequate explanation of how we are to recover the content of the donkey pronoun is provided. Thus, working out empirically satisfactory recovery procedures is a challenge to any semantic donkey anaphora theory. We hope that what we are going to say here on those procedures helps you to understand why the answer to the previous general question should be negative.

I. Neale-Evans original treatment

The proposal we are going to develop relies on three general assumptions. First, since in our semantic representations of some natural language fragments we will intensively use restricted quantifier (RQ henceforth) schemas instead of first order (FO henceforth) ones, we introduce some Tarskian definitions for the former (in these cases we will talk about *determiners* rather than *quantifiers*). These definitions stipulate that if Φ and Ψ are well formed formulae [wffs], *u* is a variable, and Q a natural language determiner, then, '[Q*u*: Φ](Ψ)' is a wff.

(1) '[all x_k: Φ](Ψ)' is satisfied by **s** if and only if [iff] Ψ is satisfied by *every* sequence **s'** that both satisfies Φ and differs from **s** at most in the *k*-th position.

(2) '[some x_k: Φ](Ψ)' is satisfied by **s** iff Ψ is satisfied by *at least one* sequence **s'** that both satisfies Φ and differs from **s** at most in the *k*-th position.

(3) '[most x_k: Φ](Ψ)' is satisfied by **s** iff Ψ is satisfied by *most* sequences **s'** that both satisfy Φ and differ from **s** at most in the *k*-th position.

Second, since any satisfactory semantic approach to anaphora requires interaction with some general syntax principles we must accept the following standard definition of "is anaphoric on":

(4) An expression α is anaphoric on an expression β iff (i) the semantic value of α is determined, at least in part, by the semantic value of β, and (ii) α is not a constituent of β, i.e. the syntactical analysis of α does not depend on the linguistic construction which β is embedded in (therefore, β functions like the grammatical *antecedent* of α).[1]

Third, since the antecedents of donkey pronouns are not simple referring expressions but quantified phrases, it is plausible to admit the following generalization, based on suggestions made by Quine [Quine (1960)] and Geach [Geach (1962, 1972)]: pronouns anaphoric on quantified phrases operate mostly as bound variables at the (restricted) quantifier level.

Now, we start to understand why explaining donkey anaphora is a kind of pressing problem when we realize that most natural languages can give rise to anaphora on quantified antecedents that, although respecting definition (4), violates the third assumption. It is what semanticists call a type of *unbound* anaphora and donkey anaphora is a species of that type. Semantically speaking, this means that donkey pronouns are not within the scope determined by the quantified noun phrase [QNP] which their antecedents are embedded in. In linguistic jargon, we say they are not *c-commanded* by their antecedents, i.e. they are not a part of a branching node dominating the latter.[2] Despite that, donkey pronouns are not constructed on coordinate-clause structures, i.e. they remain a part of the whole sentence. The following are the classical examples, discussed first by Geach (we use brackets and lexical coindexing to stress the connection antecedent-pronoun):

(5) Every man who owns [a donkey]$_1$ beats *it*$_1$.

(6) Every owner of [a donkey]$_1$ beats *it*$_1$.

The most interesting aspect of these sentences is that the quantificational force of the antecedents of the pronouns is apparently modified. For instance, sentence (5) seems to assert that each donkey owner beats *all* the donkeys he owns. That is to say, the apparent existential force of the indefinite NP *a donkey* becomes — as rightly pointed out by Geach — the force of a universal quantification of the type *all donkeys that he owns*. This modification of the quantificational force of the antecedent can generate a binding problem. So, the (unrestricted) FO representation of sentences (5) and (6) given in (7) below will misrepresent their truth-conditions. That is to say, the FO structure (7) cannot capture the universal binding (or *U-reading*) of the pronoun by its antecedent.

(7) $(\square x)(\square y)[(\text{man } x \;\&\; (\text{donkey } y \;\&\; x \text{ owns } y)) \rightarrow (x \text{ beats } y)]$.

Furthermore, the possibility suggested in (8) is worse as it contains the free variable ‘y’ in the consequent.

(8) $(\square x)[(\text{man } x \;\&\; (\square y)(\text{donkey } y \;\&\; x \text{ owns } y)) \rightarrow (x \text{ beats } y)]$.

Geach took notice of this problem in the sixties and gave a strictly logical solution.[3] Then, in the seventies, Evans [Evans (1977, 1980)] offered a different but cogent response to it.[4] Evans' analysis relied heavily on a Russellian background. More recently, Neale [Neale (1988, 1990)] proposed a comprehensive improvement of Evans' theory. Our intention from now on is to examine this improved account.

Neale, following Evans, contends that donkey pronouns can be interpreted as — they "go proxy for"— definite descriptions or, by using the term Evans coined, they are E-type pronouns.[5] On this analysis, the anaphoric relation does not arise through the binding of the pronoun by its quantified antecedent. Rather, it is the common descriptive material and the uniqueness presupposition imposed on the definite description that secure that both the antecedent and the pronoun denote the same object(s). Intuitively, this means that donkey (and unbound) pronouns can be interpreted as descriptions of the form *the F* or *the F that is G*. Thus, the interpretation process takes place in the course of trying to fix the descriptive content of the pronoun. According to Neale, the descriptive content of the pronoun is *directly* reconstructed. That is to say, the pronoun is descriptively reconstructed according to a rule that, by respecting Tarskian (and linguistic) constraints, copies lexical material just from the antecedent, without any additional processing. Finally, as Neale recognizes, whereas pragmatic factors have some bearing on the complete specification of the description in question, they are explicitly left out of the rule of pronominal content reconstruction (we will come back to this point later). The whole significance of the above interpretation of the donkey pronoun can be stated in the following rule, called **P5** rule by Neale.

(**P5**) If x is a pronoun that is anaphoric on, but not c-commanded by, a quantifier '[Dx:Fx]' that occurs in an antecedent clause '[Dx:Fx](Gx)', then x is interpreted as the most "impoverished" definite description directly recoverable from the antecedent clause that denotes everything that is both F and G [Neale (1990), p.182].

Neale calls the pronouns recovered by **P5** rule, **D-**(rather than **E**-)**type** pronouns.

Let us now consider problematic cases (5) and (6) again. We will represent first the QNP *every man who owns a donkey* of (5). Its RQ structure generated by Neale's theory is the following.

(9) [every x: man x & [a y : donkey y](x owns y)].

(9) allows us to clearly represent the restrictive relative clause *who owns a donkey*. This means that relative pronouns like *who* are treated as variables bound by the determiner affecting the whole clause, in this case, by the determiner *every man*. Thus, we attach to the RQ schema of the determiner — through the

conjunction '&' — the quantificational phrase binding the variables of the restrictive clause. By doing so, we obtain the schema '[*Q*x:*F*x & [*Q*y:*G*y](*P*xy)]', which is reflected in (9). Moreover, we know that, at the syntactical level, relative pronouns must be c-commanded by their determiners. Now, since the pronoun *it* in the verbal phrase (VP) of (5) is not c-commanded by its antecedent, the pronoun cannot be characterized as a bound anaphora. In consequence, **P5** determines its descriptive content. As the antecedent of *it* is constituted by the indefinite NP and everything it c-commands — i.e. '[a y: donkey y](x owns y)' —, the most impoverished definite description specifying the content of the pronoun and the final representation of sentence (5) will correspond to structures (10) and (11) respectively.

(10) [the y: donkey y](x owns y).

(11) [every x: man x & [a y: donkey y](x owns y)]
([the y: donkey y & x owns y](x beats y)).

Neale-Evans treatment has several advantages to commend it. First, according to Neale, this theory provides an analysis of donkey sentences that "(a) delivers the correct (Geachian [i.e. universal]) truth conditions, and (b) honours a Russellian treatment of singular indefinite description" [Neale (1990), p. 236]. A second virtue of Neale's analysis is related to an immediate problem that any account interpreting donkey pronouns as definite descriptions in disguise is bound to confront. The problem is that, given the standard Russellian interpretation of definite descriptions, donkey pronouns must imply a *uniqueness* presupposition, which normally is supposed to be pragmatically processed.[6] Instead, Neale proposes a semantic approach to uniqueness according to which "in many such cases unbound anaphoric pronouns […] are, from a semantic perspective, *numberless*" [Neale (1990), p. 234]. Neale's proposal is constructed on the suggestion that expressions like *whoever wrote Waverley* may be translated as definite descriptions that are neutral with respect to semantic number. That is to say, those expressions can be indifferently rendered into singular or plural QNPs. Thus, Neale defines the disjunctive numberless description *the F or the Fs* by means of the set-theoretical schema in (12).

(12) [**whe** x: *F*x](*G*x) is true iff $*\mathbf{F} - \mathbf{G}*=0$ and $*\mathbf{F}*\geq 1$.

Neale concludes that if antecedents of D-type pronouns are number-neutral, then we should interpret such pronouns "anaphoric on quantifier phrases of the form 'every F', 'all Fs', and 'each F' as semantically numberless" [Neale (1990), p. 235]. We will call the proposal behind schema (12), the *numberless hypothesis* (NH).

During the last years this initially attractive analysis has come under sharp scrutiny. As a result, Neale's theory faces a set of interesting counter-examples. We are going to focus here on a group of them. We call the examples according to their initial formulations (we use italics to indicate anaphoric linkage).

(13) Every person who has *a* credit card pays his/her bill with *it*.
(EXISTENTIAL READING; [Pelletier and Shubert (1989)]).

(14) Every boy danced with *a girl*. *She* was a ballerina.
(TELESCOPING CASES; [Sells (1985)]).

(15) Every person who bought at least *two* beers here bought five others along with *them*.
(SAGE PLANT CASES; [Heim (1990)]).

Sentence (13) raises a problem for Geachian truth-conditions, because it is evident that the donkey pronoun *it* does not have universal force. Admittedly, native English speakers will understand that the pronoun refers to *some or one* rather than *all* credit cards everybody may carry, i.e. (13) entails (for English speakers) an existential or *E-reading* of the pronoun.

Sentence (14) represents a challenge for Neale's **P5** rule, when applied across-discourse. The basic reason lies in the fact that a Russellian treatment of donkey pronouns forces the latter to accept different scope interactions with the rest of the determiners in the sentence. Thus, donkey pronouns must interact with the following wide scope reading of the determiner 'every' in the antecedent sentence of (14):

(16) [every x: boy x]([a y: girl y](x danced with y)).

Although (16) does not *necessarily* express the preferred reading of the antecedent sentence of (14), there are contexts that would suggest felicity conditions for it [see Sells (1985)]. Now, on the assumption that this reading is available, **P5** stipulates that the pronominal content must be recovered by taking into account the relevant determiner *a*, its restriction, *girl*, and the scope, *danced with*. However, under such circumstances, the whole anaphora sentence will come out as the non-well-formed RQ structure (17) below.

(17) [the y: girl y & x danced with y](y was a ballerina).

Finally, the general issue at stake in sentence (15) concerns the extent of application of NH. Very roughly speaking, the reason is that the description that Neale's theory obtains for the pronoun in (15) entails a commitment to a particular semantic aspect, distributivity. Thus, if the distributive description associated with such a pronoun happens to be "each of the beers" (the numberless effect is irrelevant here), then, in using that description, we will make incorrect predictions in some contexts, e.g. in contexts where one has bought exactly *six* beers and not *seven*, as the sentence implies. For, in such a case, we will get for the whole sentence the reading "every man who bought at least two beers bought five beers along with each of the beers he bought". It is not difficult to realize this latter reading could be true in a scenario where everybody bought just six beers [see Lappin and Francez (1994)].

II. The Functional Generalized Quantifier Analysis

In order to visualize a solution to the problems that Neale's account faces, we are going to introduce in this section a treatment of donkey anaphora based on Generalized Quantifier theory (GQ henceforth) and developed mainly by Lappin [Lappin (1989)] and Lappin and Francez [Lappin and Francez (1994); L&F henceforth]. Two fundamental aspects of these approaches will be examined. They are (a) a commitment to an E-type view of pronouns, and (b) a functional treatment of E-type pronouns (we will call this functional account based on GQ theory, the *functional* GQ theory or FGQ). Before doing so, we need to explain the formal background behind GQ.

The basic framework of GQ is that formulated in Barwise and Cooper [Barwise and Cooper (1981)] and Cooper [Cooper (1983)]. A well-known characteristic of this framework is its treatment of NPs that denote set of sets. Linguistically speaking, for any NP, the set it denotes will contain all and only the sets which are related to the set denoted by its so-called N' *restriction* and satisfy the condition imposed by its determiner (*Det*). Thus, a sentence of the form [NP+VP] is true iff the set that is the extension of the VP is included in the set of sets denoted by the subject NP. By doing so we get, for instance, the representations in (18'), (19') and (20') for (18), (19) and (20) respectively (**E** corresponds to the domain of entities, **S** and **P** to sets of individuals who sing and are philosophers, respectively, and **X** to a set of sets in **E**).

(18) Every philosopher sings.

(19) Some philosopher sings.

(20) No philosopher sings.

(18') $\mathbf{S} \in \{\mathbf{X} \subseteq \mathbf{E}: \mathbf{P} \subseteq \mathbf{X}\}$.

(19') $\mathbf{S} \in \{\mathbf{X} \subseteq \mathbf{E}: \mathbf{X} \cap \mathbf{P} \neq \varnothing\}$.

(20') $\mathbf{S} \in \{\mathbf{X} \subseteq \mathbf{E}: \mathbf{X} \cap \mathbf{P} = \varnothing\}$.

This basic explanation should meet our practical and theoretical purposes here. According to L&F's account, the GQ view compositionally represents the interpretation of the plural donkey sentence (21) by means of (22).[7]

(21) Every man who owns three$_1$ donkeys beats them$_1$.

(22) $|$Every man who owns three donkeys beats them$|$ = true iff
(Men $\cap$ {*a*: $*${b: own (*a,* b)} $\cap$ Donkeys$*\geq 3$ }) $\subseteq$ {c: beats (c, e_1) & ... … & beats (c, e_3)}.

As we can see, the interpretation of the subject NP of (21) is given by an intersective set with the cardinality of at least three (numbers are not directly represented as predicates of sets here but as expressing cardinality parameters over sets). The pronoun comes out as an E-type pronoun (represented by the elements e_1 & ....& e_k) that, for each man *a*, denotes the elements of the intersective set, i.e. the set of at least three donkeys that *a* owns. On the other hand, the verb *beat* will be represented in (22) by {c: beats(c, e_1) & … … & beats(c, e_k)} when the interpretation of the subject NP of (21) is applied to its VP. This representation helps us to see how helpful the intersective set is to determining the content of the E-type pronoun. Also, if the sequence e_1 … … e_k ($1\leq k$) denotes the set of individual terms such that for each individual *u* which belongs to the intersective set of men who own at least three donkeys, e_i is one of the at least three donkeys which *u* owns,[8] then e_i can be represented as a function $f_i(u)$. This function is such that for each appropriate *u*, $f_i(u)\in(\{b$: own(*u, b*)} $\cap$ Donkeys), and $f_i(u) \neq f_j(u)$. Thus, schema (22) says that (21) is true iff every man who owns at least three donkeys beats each of the donkeys in the intersective set of at least three donkeys that he owns, which is the correct E-type interpretation of the sentence. As a result, the interpretation of the paradigm donkey sentence in the left hand side of (23) below becomes unproblematic. The standard U-reading in the right hand side of (23) is obtained by making the obvious change in the cardinality parameter of (22).

(23) $|$Every man who owns a donkey beats it$|$ = true iff
(Men $\cap$ {*a*: {*b* : own (*a, b*)} $\cap$ Donkeys $\neq\varnothing$}) $\subseteq$ {c: beats(c, e_1) & … ... & beats(c, e_k)}.

Structure (23) provides indeed the required E-type interpretation, namely that every man who owns a donkey beats every donkey he owns. Moreover, in the GQ functional approach, E-type pronouns, in accordance with Neale's NH, become semantically numberless. In the present proposal, the grammatical number of a donkey pronoun is determined by the *cardinality bounds* of its antecedent, i.e. by "the minimal cardinality bound (upper or lower) associated with the determiner of its antecedent NP" [L&F (1994), p. 396; see also Lappin (1989), p. 282]. Because in both (22) and (23) the lower cardinality bounds are three and one respectively, we get in the first case a grammatically plural pronoun, and, in the second, a singular one. The functions denoted by the E-type pronouns can, accordingly, be interpreted as mapping individuals to *maximal collections* of individuals. Thus, the interpretation is subject to a *cardinal maximality constraint*, which is specified by the cardinality bounds of the plurality parameter of the intersective set.

Even though the FGQ conception depicted until now promises a general solution to the donkey anaphora problem, it is clear that it cannot go very far because the problematic cases discussed previously remain, nonetheless, beyond its reach. Therefore, it seems necessary to extend FGQ so as to make it apt to deal with such cases. The following two claims have been suggested in order to do so [L&F (1994)]:

(f1) Maximal collections are *sums of individuals* or *i-sums*.

(f2) Given an E-type function, ***f*** must satisfy the following maximality constraint: *for each argument x for which f*(x) *is defined, the function selects the supremum in the set of i-sums in its range*.

Condition (f1) can be spelt out in the following terms. According to Link [Link (1987)], **i**-sums are formed by a particular operation ω_i on a domain E of atomic individuals. An **i**-sum term can be, for instance, '$a\ \omega_i\ b$' where *a* and *b* are atomic individuals. '$a\ \omega_i\ b$', in Link's words, "is supposed to denote a new entity in the domain of individuals which is made up from the two individuals denoted by *a* and *b*" [Link 1987, p. 151]. Such an **i**-sum does not denote the set consisting of the values of *a* and *b* "but rather another individual of the same kind as [the value of *a* and *b*]" [Link (1987), p.151]. In Link's system we have finally predicates constructed from standard one-place predicates like $|F|$, which denote the set of all **i**-sums that are in the extension of $|F|$ in E. Characteristically, Link symbolizes those predicates as '*F'. '*F' is, intuitively speaking, a pluralized predicate that adds (sets of) **i**-sums to the extension of F.[10]

Let us consider how L&F understand (f2). Let *I* be a set of **i**-sums. Then the supremum of the set *I* is the smallest $j \in I$ (the least upper bound) such that every $I \in I$ is a part of *j*.[11] Therefore, E-type pronouns understood as functions whose range is *I* select the smallest **i**-sum in *I* such that every other **i**-sum is a member of it. Also given the presence of pluralized predicates in Link's system, L&F represent numerical determiners as one-place predicates on sets. Hence the predicate o*wns* in paradigm sentence (5) above can now be understood as a pluralized relational predicate **owns*, which applies to the elements of the set defined by the one-place predicate **1**_*donkey*, i.e. the set of **i**-sums of donkeys with a cardinality of at least one. Thus, we capture now the interpretation of (5) by means of (24) below.

(24) (Men ∩ {*a*: {*b*: **owns* (*a, b*)} ∩ **1**_*donkey* ≠∅}) ⊆
{c: **beats*(c, *f*(c)) }.

According to (24), (5) is true iff everyone who owns a **i**-sum of at least one donkey beats the entity which is the **i**-sum value of ***f***(c). In other words, (24) implies that every man who owns at least one donkey beats every donkey that he owns, which corresponds to the standard U-reading associated with (5).[12] Finally, L&F's theory allows the introduction of a special kind of function, a choice function. In short, L&F maintain that if we cancel the maximality constraint in (f2), ***f***(x) becomes a choice function. Cancelling the maximality constraint will be prompted by pragmatic considerations associated mainly with the lexical content of the VP present in the donkey sentence. Consequently, in FGQ a donkey function must be sensitive not just to the determiner of the N' restriction but also to other features of the sentence that interact with context and pragmatic information.[13] Whenever the maximality constraint in (f2) is suspended or cancelled, the function maps individuals to just *one* of the **i**-sums in its range. We shall henceforth symbolize the cancellation and the application of such a maximality constraint as *!**f**(x)* and $^{+}$***f****(x)*, respectively.

Let us now consider E-readings like in (13) above. Since, under the E-reading, that sentence (or more exactly the content of its VP) does not require that every dime be put into the meter, maximality can be suspended. Hence the correct semantic representation of (13) comes out in (25).

(25) (Person ∩ {*a*: {*b*: **has* (*a,b*)} ∩ **1**_*credit card* □ι}) ⊆
{c: **pays_ the_ bill_with* (c, -***f***(c)) }.

In this case, -***f***(c) is a choice function that, for a person c who has an **i**-sum of credit cards with cardinality of at least 1, yields one of the **i**-sums of credit cards with a cardinality of at least 1 as the value of the function. If the maximality constraint in (f1) is applied to ***f***(c) we get $^{+}$***f***(c), i.e. we get a function whose **i**-sum is the supremum containing all c's credit cards. Since, according to L&F, "when the maximality condition on ***f***(c) is suspended, a donkey sentence is true iff there is at least one choice function ***f***(c) for which the specification of its truth conditions holds" [L&F (1994), p. 406], (25) provides the E-reading of (13), as expected. With respect to the pragmatic considerations determining the suspension of the maximality constraint, L&F answer that such considerations have to do with "implied cardinality restrictions [of the VP] on the size of the **i**-sum which can serve as the value of [...] the pronoun. This implied restriction is pragmatically based and involves real world knowledge" [L&F (1994), p. 407].

Also, it is not difficult to figure out how FGQ deals with the complex sage plant cases (sentence (15)), where Neale's as well as other analysis fail. In such cases, as far as cancellation of the maximality constraint is inevitable, we end up with a choice function representing the pronoun.[14]

It is telescoping cases (sentence (14)) that nevertheless remain a serious obstacle for FGQ. In order to remove that obstacle, FGQ needs to endow itself with a recovery rule to do the job as **P5** does.

III. FUNCTIONAL RECOVERY RULES IN GQ

To give an idea of the difficulty that telescoping cases pose to FGQ let us come back to **P5**. As we said, **P5** allows us to recover directly the content of the donkey pronouns by copying material from their quantified antecedents, which is then rendered as an "impoverished" definite description. That description denotes everything which is part of both the restriction and the scope of the RQ in the antecedent. This explanation of Neale's theory tends to suggest, rather imprecisely, that RQs play a passive role in the recovery process. This is due to the general character of the formulation of **P5**. This rule can nonetheless be specified in a way that clarifies the contribution that (restricted) quantifiers present in the antecedents make to the determination of the content of E-or D-type pronouns. According to Neale, every natural language quantifier can be evaluated in terms of its *logical maximality* and therefore the recovery of the content of a pronoun anaphorically related to a quantifier will be sensitive to that maximality. Neale's formulation of the maximality condition is the following:

(LM) A quantifier '[*D*x:*F*x]' is *maximal* iff '[*D*x:*F*x](*G*x)' entails '[every x: *F*x](*G*x)', for arbitrary *G*.

So, quantifiers of the form 'the F', 'each F', 'every F', 'all Fs', among others, are logically maximal. According to Neale, given condition (LM), **P5** can be written as the conjunction of the following subrules:

(**P5a**) If x is a pronoun that is anaphoric on, but not c-commanded, by a nonmaximal quantifier '[*D*x:*F*x]' that occurs in an antecedent clause '[*D*x:*F*x](*G*x)', then x is interpreted as '[the x: *F*x & *G*x]'.

(**P5b**) If x is a pronoun that is anaphoric on, but not c-commanded, by a maximal quantifier '[*D*x:*F*x]' that occurs in an antecedent clause '[*D*x:*F*x](*G*x)', then x is interpreted as '[the x: *F*x]'.

Rules **P5a** and **P5b** are altogether more powerful than **P5** alone. This can be seen by reflecting on the examples in (26) and (27) below:

(26) [The inventor of bifocals]$_1$ was a genius; *he*$_1$ ate a lot of fish.

(27) [The inventor of bifocals]$_1$ had [a nice house]$_2$; *he*$_1$ used to decorate *it*$_2$ every year.

For example, a direct application of **P5** to the anaphora sentence in (26) provides us with the RQ representation in (28).

(28) [the x: inventor of bifocals x & x was a genius](x ate a lot of fish).

But, according to Neale, (28) does not meet English speakers intuitions. Such speakers would expect the pronoun *he* in (26) to induce a "laziness" effect in the rephrasing, as specified in (29) below. This implies that the material recovered in the definite description of (29) is reduced to the nominal (of the N' restriction) of the antecedent, i.e. the expression *inventor of bifocals*.

(29) The inventor of bifocals ate a lot of fish.

Given that similar arguments can be produced for the rest of maximal quantifiers, a rule which captures the relation of these quantifiers to their pronouns seems to be needed. **P5b** is the rule in question. By means of that rule the expected laziness effects are immediately obtained. Thus, because the determiner of the antecedent QNP of *he* in (26) is logically maximal, **P5b** generates for instance the following representation for the whole anaphora sentence.

(30) [the x: inventor of bifocals x](x ate a lot of fish).

Natural language rephrasing of (30) is (29) above. By contrast, since the determiner of the antecedent QNP of the pronoun *it* in (27) is non-maximal *–a F*, the **P5a** rule must be applied. So, by applying **P5a** to the pronoun *it* and **P5b** to the pronoun *he,* we obtain, for (27), representation (31).[15]

(31) [the x: inventor of bifocals x]([whe y: nice house y & x had y](x used to decorate y)).

In light of these applications is clear that the content of rules **P5a** and **P5b** entails two stages. On the one hand, both intuitively constrain the anaphoric linkage between antecedents and E-type pronouns by relying on a property that the antecedents have or fail to have, namely, logical maximality. On the other hand, having evaluated that property, the rules recover *directly* the descriptive content associated with the pronoun by copying material from the antecedent.

Let us now look at L&F's solution to the pronominal content recovery problem within a functional setting. The most remarkable aspect of L&F's proposal is that recovery of pronominal content depends on the scope assignments which antecedent QNPs are subject to. Initially, L&F formulate their solution by means of the following rule (we will call it **GQE-Ta**).

(**GQE-Ta**) Let ***f***(x) be the function associated with a donkey pronoun whose antecedent NP is a QNP. If QNP is interpreted as within the scope of another quantified NP, QNP', the *domain* of ***f***(x) is the intersective set defined in terms of the N' restriction of Q' (the determiner of QNP'), and the *range* of the ***f***(x) is the set of the **i**-sums in the intersective set defined in terms of the N' restriction of Q (the determiner of QNP) [L&F (1994), p. 405].

Simple inspection of the representations for the standard cases of donkey anaphora shows that **GQE-Ta** yields the correct results. This can be verified, for instance, in the schema (32), the GQ representation of the paradigm donkey sentence (5).

(32) $(\text{Men} \cap \{a\text{: } \{b\text{: } {*owns}\,(a, b)\} \cap \mathbf{1}\_donkey \neq \varnothing\}) \subseteq \{\text{c: } {*beats}(\text{c}, f(\text{c}))\}$.

As the QNP antecedent *a donkey* must be interpreted within the scope of *every man,* the domain of ***f***(c) is defined as the intersective set of the N' restriction of *every*, namely, '$Men \cap \{a\text{: } \{b\text{: } {*owns}(a, b)\} \cap \mathbf{1}\_Donkey\}$'. Likewise, the range of the function is defined as the set of individuals in the intersective set defined by the N' restriction of the determiner for a given value of *a*, i.e., '$\{b\text{: } {*owns}(a, b)\} \cap \mathbf{1}\_Donkey \neq \varnothing\}$'. The resulting specification of the function associated with the pronoun *it* is formulated in (33). It determines the correct range of the function that, provided the maximality condition, allows us to specify the U- reading of (5).

(33) ***f***(c)= a function from men who own (an **i**-sum of) at least one donkey into the set of (maximal **i**-sums of) at least one donkey that they own.

L&F also claim that **GQE-Ta** enables them to get the correct range of the functions for any relative clause case within donkey sentences. On the other hand, they concede that whereas **GQE-Ta** does apply to the second donkey pronoun (*it*) in conditional donkey sentence (34) below, it does not to the first one (*he*).

(34) If [a farmer]$_1$ owns [a donkey]$_2$, *he*$_1$ beats *it*$_2$.

The general solution, in their words, for this problem goes as follows:

> The antecedent of *he* is not within the scope of another quantified NP [*a farmer*], and so the value of the function associated with *he* does not depend upon the selection of an argument in the way that the value of the denoted by the pronoun *it* in [(34)] does. We characterize the function *f*(x) associated with *he* as assigning the same value to each individual which it takes as an argument. For every x 0 *E*, *f*(x) is the same **i**-sum [L&F (1994), p. 417].

Therefore, according to L&F, the NP denotation of the pronoun is constructed in terms of the maximal — provided the maximality condition on the function *f*(x) — **i**-sum wich is an element of the intersective set '$Farmer \cap \{a: \{b: {*}owns(a, b)\} \cap \mathbf{1}\_Donkey\}$', i.e. the set of sets containing the maximal **i**-sum of farmers who own a sum of at least one donkey. As a consequence of that, the domain of the function associated with *he* becomes simply *E*, the universe of entities. As a result, they offer the following rule:

(**GQE-Tb**) If QNP is not interpreted as within the scope of another quantified NP, then the domain of ***f***(x) is *E*, and the range of ***f***(x) is the set of **i**-sums in the intersective set defined in terms of the N' restriction of Q [L&F (1994), p. 418].

By means of rule **GQE-Tb** we can now specify the donkey function associated with the pronoun *he* in (34) by means of the one in (35). Thus, the complete representation of the sentence comes out as in (36).

(35) ***f***(x)=a function from *E* into the set of sets containing the maximal **i**-sum of farmers who own at least one donkey.

(36) $(Men \cap \{a: (\{b: {*}owns(a, b)\} \cap \mathbf{1}\_donkey \neq \emptyset)\}) \neq \emptyset \rightarrow ((Men \cap \{a: \{b: {*}owns(a, b)\} \cap \mathbf{1}\_donkey \neq \emptyset\}) \subseteq \{c: {*}beats(c, {}^{+}\boldsymbol{f}(c))\})$.

As the reader can check, the interpretation of (36) provides clearly the U-reading of (34). Moreover, **GQE-Tb** enables us to deal with conditional donkey sentences where the E-reading is prevalent, as in case (13) above.[16]

We are now in a position to explore an empirically significant difference between **P5a**, **b** and **GQE-Ta**, **b**: whereas the first are *sensitive to the logical maximality* of the determiners, the second are *sensitive to the restric-*

tion of such determiners.[17] This difference generates in its turn different predictions in some cases. In order to envisage those differences let us focus again on telescoping cases.[18] Sentence (37) is an example.

(37) [Every boy]$_1$ danced with [a girl]$_2$. Afterwards, *he*$_1$ gave *her*$_2$ flowers [Neale (1990)].

Under the standard interpretation of (37) where 'every' takes wide scope, **P5b** recovers the pronominal content of *he* as indicated in representation (37').

(37') ***he*** = [whe x: boy x].

As we already know, Neale's rules recover the content of the pronouns in question by taking into account only the nominal (of the N' restriction) of the subject NP in the first conjunct of each sentence.

Let us see how L&F's rules work in this case. At the surface level at least, the subject NPs in the first conjunct of the sentence is not within the scope of the object NP. So, the domain of the functions associated with the pronoun *he* must be constructed in accordance with the rule **GQE-Tb**. As we saw, regarding (34) L&F claim that the denotation of the pronoun *he* "is constructed in terms of the **i**-sum, which is an element of the intersective set [...] (the set of sums of at least one man who own sums of at least one donkey)" [L&F (1994), p. 417]. So, we can functionally construct the pronoun *he* of (37) in accordance with (37'').

(37'') ***he*** = a function from entities in *E* into the set of **i**-sums in the intersective set of boys who dance with sums of at least one girl.

As a result, different predictions for the anaphoric sentences of (27) and (37) are obtained depending on which rules — Neale's or L&F's — we choose for recovering the content of the pronoun *he*. Regarding (37), under **GQE-T** rules, one ends up associating the value of the function specified in (37'') with the description in (37''') below.

(37''') The boy (or boys) who danced with a girl.

The description in (37''') does not coincide with the description generated by the specification of the pronoun in (37'). In (37''') the description is constituted by the nominal and the VPs of the antecedent sentences of (37). By contrast, the description specified by representation (37') consists of the nominal only. So, description (37''') cannot evidently be adequate.

There exists however a way of rebutting this criticism. The explanation by L&F paraphrased above was intended to apply to cases like sentence (34) where the pronoun is anaphoric on the indefinite determiner 'a F' and not on the universal determiner 'every F'. Consequently, the representation (37'') and the description generated by it do not correspond to the E-type pronoun *he* in the anaphora sentence of (37); thus, no descriptive problem has been posed to **GQE-T** yet. This answer is cogent because *he* in (34) is effectively anaphoric on an indefinite determiner. Nevertheless, it seems to create another problem. L&F's rules specify that the range of the function is recovered from the intersective set determined by the N' restriction of the antecedent QNP of the pronoun. Since we do not want to recover the range of the function associated with *he* in (37) by using (37''), we have to look for another intersective set different from that associated with (37''). Unfortunately, rules **GQE-T** do not tell us how to proceed under such circumstances. Take sentence (37) again. Given that the determiner of the subject NP of the antecedent sentence of (37) is 'every', L&F must assign to (37) representation (38) below.

(38) $Boy \subseteq \{a\text{: } \{b\text{: } {*}danced(a,b)\} \cap \mathbf{1}\_girl \neq \varnothing\}$.

Now, according to **GQE-Tb**, the denotation of the pronoun *he* (its corresponding set of **i**-sums) must be recovered from "the intersective set defined in terms of the N' restriction" of the determiner. But the N' restriction of the determiner in this case is only the nominal and, as shown by (38), this restriction cannot determine an intersective set. Consequently, there is no set of **i**-sums defined in terms of that restriction that constitutes the range of $\boldsymbol{f}$(x); at least not according to **GQE-T** rules.

Finally, the difficulty above may become more pervasive if we allow for scope interactions, what the reader can check by considering (37) again.[19]

IV. **P5** AS A FUNCTIONAL RECOVERY RULE

The discussion of **P5a**, **b** rules at the beginning of section III and the empirical problems with **GQE-T** rules examined by the end of the same section urge us to consider the possibility of a new kind of functional recovery procedure, which preserves the best of both rules. In order to do that, four important requirements must be minimally argued for here.[20] First, the problems faced by **GQE-T** indicate that a functional rule works more efficiently if the constraint that requires the extraction of the range of the functions from the intersective set is modified. Second, these problems do not seem to affect the key aspect of L&F's rules, namely their sensitivity to the restriction of the antecedents of donkey pronouns. To carry out this refinement, we will draw a distinction between proper (N') restriction and the scope (S) of the determiner. The goal of this and other modifications is to determine the set or sets of **i**-sums available in the clause, which can be associated with the potential range of the function.

Third, we believe that it is the demands of logical maximality articulating **P5 a**, **b** that will determine which set or sets of the potential range of the donkey function are picked out as the *actual* range of the function. Four, there is strong evidence against keeping in any functional version of recovery rules the "directness" of recovery implied by **P5**.[21] In compensation, the abandonment of directness permits in particular overcoming an already noticed weakness of Neale's theory: its inability to deal with pragmatic or non-logical information.

The increase in context-sensitive information is coming from two sources. Firstly, the information concerning domains — i.e. concerning the arguments of the function — will be recovered mainly in accordance with background and contextual knowledge.[22] Secondly, as regards ranges of donkey functions, usually the relevant information will be the one directly determined by **P5a**, **b**. In this case, we will build up the range by considering whether or not the determiner of the antecedent of the pronoun is logically maximal, in Neale's sense. Nevertheless, it is also possible to determine indirectly the range of the donkey pronouns. This happens when the domain of the function depends upon the determination of the range of another donkey function. The entire philosophical significance of this last modification is, it seems to us, clear enough: successful recovery of the content of donkey pronouns cannot rely on logical principles and information only.

We are now in a position to suggest a set of rules for reconstructing **P5a**, **b** in a functional setting. Therefore, in accordance with **GQE-T** rules, in this setting donkey pronouns are treated as functions satisfying the minimal requirements formulated above. We specify first the rule to process the domain of the donkey function (we call it **D-Tdom**).

(**D-Tdom**) *The domain of the function f(c) associated with a donkey pronoun **P** anaphoric on a QNP is restricted by our non-logical, background knowledge about the i-sum, set of i-sums or intersective set that the antecedent NP of **P** denotes*.

Specification of the range of the donkey function will require distinguishing between a *nominal restriction* (NR) and a *scopal restriction* (SR) of the determiner (Det). Syntactically speaking, NR corresponds basically to the head of the NP coindexed with the pronoun, and SR corresponds to the sentence (the sister) to which the NP is adjoined. In terms of RQ schemas like, for instance, '[*D*x:*F*x](*G*x)', we can say that NR stands for (the set determined by the predicate) '*F*x' and SR for (the set determined by the predicate) '*G*x'. It takes three subrules specifying how the range of the donkey function is processed (we call them **D-Trg** rules).

(**D-Trg a**) *If f(x) is a single function associated with a donkey pronoun **P** whose antecedent is a NP with a logically maximal Det,* *then the range of f(x) determined by Det is equal to the cardinally maximal set of i-sums associated with NR.*

(**D-Trg b**) *If f(x) is a single function associated with a donkey pronoun **P** whose antecedent is a NP with a logically non-maximal Det then the range of f(x) determined by Det is equal to the intersective set constituted by the sets associated with both NR and SR.*

(**D-Trg c**) *If the denotation of a donkey pronoun **P** depends on the denotation of another donkey pronoun **P’** then the domain of the function **f**(x) associated with **P** depends on the range of the function **g**(y) associated with **P’**.*

We clarify now some methodological questions behind our rules. First, it should be clear that **D-Trg a-c** incorporate the constraints discussed above. **D-Trg a** and **b** express the direct recovery process of the range of the donkey function whereas **D-Trg c** formulates the indirect process. Moreover, considerations of cardinal maximality are not necessary in **D-Trg b** since presence of logically non-maximal determiners in the antecedent of the donkey pronoun may cancel the cardinal maximality condition. Finally, it is worth stressing with respect to **D-Trg b** that standard or simple sets (sets with atomic individuals as their members) can be part of the intersective set determining the range. However, at least *one* set of **i**-sums is obviously needed in order to determine the intersective set.

Second, we clarify some aspects of **D-Tdom**. This rule allows us to introduce now background and common knowledge, which can be understood as the set of presuppositions and beliefs presumably shared by all speakers and hearers of donkey sentences, i.e. their “common ground.”[23] Also, we insert the apparently redundant clause “non-logical” into **D-Tdom** just to exclude irrelevant information concerning the “bare” entities in a given model or situation.

In what follows, it is briefly explained how our proposal deals with the major problematic case discussed earlier in this paper, the telescoping case in (14). In (39’) and (39’’) we formulate the two schematic RQ scopal representations of its first sentence together with the functional representation of the anaphora sentence (‘B’ and ‘G’ correspond to the set of — **i**-sums of— boys and girls respectively, and ‘D’ to the set of — ordered pairs of — dancers). Finally, (39’a) and (39’’a) specify the range and domain of the function.

(39’) □$^{5/+}$*f* { [[□B:∗B∗≥n][(□x)x0B]] ([[□G:∗G∗≥1] [(□y)y0G]](*Dxy)) & (□c)(*B^{5M+}*f*(c)) }.

(39’’) □$^{5/+}f$ { [[□G:*G *≥1][(□y)y0G]] ([[□B:*B*≥n] [(□x)x0B]](*Dxy))
& (□c)(*B^{5M+}f(c)) }.

(39’a) **she** = $^{5M+}f^{ns}$= domain: boys who danced with some girl or girls.
RANGE: the maximal intersective set of girls (with a cardinality of at least 1) whom somebody in the domain danced with (x **D-Trg b**).

(39’’a) **she** = $^{5M+}f^{ns}$= domain: boys who danced with somebody
RANGE: one of the values in the maximal intersective set of girls (with a cardinality of at least 1) who every boy in the domain danced with (x **D-Trg b**).

Schema (39’) (where *a girl* takes the narrow scope reading) and the specification of the function associated with the pronoun in (39’a) suggest a promising solution to the problem created by sentences like (14) within Neale’s and L&F’s theory. Those who danced with values of a singular **i**-sum, with a cardinality of at least 1, belonging to the set of girls, are boys who danced with some girl or girls. The set of boys determines therefore which girls are ballerinas. Thus, this information is, in part at least, recovered indirectly from the relevant characteristics constraining the domain and imposing particular conditions on the values in the range.[24]

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NOTES

[1] A constituent, in grammatical analysis of sentences, is a basic linguistic unit such as SUBJECT, Noun Phrase (NP), Verbal Phrase (VP), DETERMINER, etc. The constituent structure analysis gives rise to branching diagrams, which can aditionally be represented using brackets and coindexing.

[2] The technical definition is the following: a phrase X c-commands a phrase Y iff neither of X or Y dominates the other and the first branching node dominating X, dominates Y; for details see May (1985).

[3] Based on the idea that donkey pronouns go proxy for repeated, identical, ocurrences of their antecedents; this is what Geach called “laziness effect”.

[4] Similar ideas can be traced back to Parsons (1978) and Cooper (1979).

[5] Anyway, there remains an important difference between Evans’ E-type pronouns and pronouns that go proxy for definite descriptions, namely, the Kripkean

rigidity of E-type pronouns that Neale rejects. For an extensive discussion of the difference between Neale's and Evans' treatments see Neale (1990), pp.184-91.

[6] For discussion see Chierchia (1995), Heim (1990) and Kadmon (1990).

[7] We are assuming here that *own* (*a, b*) is an abbreviation for the set of ordered pairs <*a, b*> which belongs to the set *Own*, i.e. such that *a* owns *b*. For a more recent explanation of the GQ theory see Kearns (2000) and for general issues connecting GQ accounts and donkey anaphora see de Swart (1998).

[8] $\{e_1 .... e_k\}=(\{b: \text{own}(u, b)\} \cap \text{Donkeys})$.

[9] Our exposition is obviously very simplified; for more detail see Link (1987).

[10] For a philosophical rationale of **i**-sums, see Link (1987), p. 151.

[11] For more on this topic, see Partee, ter Meulen and Wall (1993), p. 276.

[12] See Lappin and Francez (1994), pp. 403 ff.; for more details on (24) see Quezada (2001), ch. 5.

[13] This implies that L&F's view is not committed to any a priori constraint concerning the determination of the choice function.

[14] For more details on this case see Quezada (2001), ch. 5.

[15] According to Neale's theory, the pronoun in question can be represented in two ways as a result of assigning different scopes to the definite descriptions which interact with quantifiers.

[16] To check this and other E-reading cases see Quezada (2001), ch. 6.

[17] For more on these differences see Quezada (2001), ch. 6.

[18] I am deeply grateful to Prof. Lappin (p.c.) for several clarifications related to the discussion below.

[19] In (38) *a girl* takes narrow scope; if *every boy* does, we get another schema. For this and other problems with FGQ see Quezada (2001), ch. 6.

[20] Quezada (2001), chs. 5-6 contains a long discussion of these issues and how they bear on the general question about the status of donkey sentences. As a consequence, we advocate there the idea that, in essence, those sentences are semantically non-specific.

[21] For empirical and otherwise arguments supporting these opinions see Quezada (2001), ch. 6.

[22] See Gauker (1997), p. 11. For more on domains of discourse see Stalnaker (1972) and Lewis (1979).

[23] This notion derives from work by, among others, Stalnaker (1974), and Heim (1990).

[24] To check application of our rules to sage plant and other different cases, see Quezada (2001), ch. 6.

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