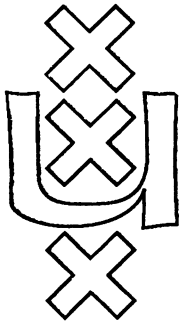
Institute for Language, Logic and Information

THE VARIABILITY OF IMPERSONAL SUBJECTS

Gennaro Chierchia

ITLI Prepublication Series
for Logic, Semantics and Philosophy of Language LP-90-06



University of Amsterdam

The ITLI Prepublication Series

1986
86-01 The Institute of Language, Logic and Information
86-02 Peter van Emde Boas — A Semantical Model for Integration and Modularization of Rules
86-03 Johan van Benthem — Categorial Grammar and Lambda Calculus
86-04 Reinhard Muskens — A Relational Formulation of the Theory of Types
86-05 Kenneth A. Bowen, Dick de Jongh — Some Complete Logics for Branched Time, Part I Well-founded Time,
86-06 Johan van Benthem — Logical Syntax Forward looking Operators
1987 87-01 Jeroen Groenendijk, Martin Stokhof — Type shifting Rules and the Semantics of Interrogatives
87-02 Renate Bartsch — Frame Representations and Discourse Representations
87-03 Jan Willem Klop, Roel de Vrijer — Unique Normal Forms for Lambda Calculus with Surjective Pairing
87-04 Johan van Benthem — Polyadic quantifiers
87-05 Víctor Sánchez Valencia — Traditional Logicians and de Morgan's Example
87-06 Eleonore Oversteegen — Temporal Adverbials in the Two Track Theory of Time
87-07 Johan van Benthem — Categorial Grammar and Type Theory
87-08 Renate Bartsch — The Construction of Properties under Perspectives
87-09 Herman Hendriks — Type Change in Semantics: The Scope of Quantification and Coordination
1988 LP-88-01 Michiel van Lambalgen — *Logic, Semantics and Philosophy of Language:* Algorithmic Information Theory
LP-88-02 Yde Venema — Expressiveness and Completeness of an Interval Tense Logic
LP-88-03 — Year Report 1987
LP-88-04 Reinhard Muskens — Going partial in Montague Grammar
LP-88-05 Johan van Benthem — Logical Constants across Varying Types
LP-88-06 Johan van Benthem — Semantic Parallels in Natural Language and Computation
LP-88-07 Renate Bartsch — Tenses, Aspects, and their Scopes in Discourse
LP-88-08 Jeroen Groenendijk, Martin Stokhof — Context and Information in Dynamic Semantics
LP-88-09 Theo M.V. Janssen — A mathematical model for the CAT framework of Eurotra
LP-88-10 Anneke Kleppe — A Blissymbolics Translation Program
ML-88-01 Jaap van Oosten — *Mathematical Logic and Foundations:* Lifschitz' Realizabiility
ML-88-02 M.D.G. Swaen — The Arithmetical Fragment of Martin Löf's Type Theories with weak Σ-elimination
ML-88-03 Dick de Jongh, Frank Veltman — Provability Logics for Relative Interpretability
ML-88-04 A.S. Troelstra — On the Early History of Intuitionistic Logic
ML-88-05 A.S. Troelstra — Remarks on Intuitionism and the Philosophy of Mathematics
CT-88-01 Ming Li, Paul M.B.Vitanyi — *Computation and Complexity Theory:* Two Decades of Applied Kolmogorov Complexity
CT-88-02 Michiel H.M. Smid — General Lower Bounds for the Partitioning of Range Trees
CT-88-03 Michiel H.M. Smid, Mark H. Overmars Leen Torenvliet, Peter van Emde Boas — Maintaining Multiple Representations of Dynamic Data Structures
CT-88-04 Dick de Jongh, Lex Hendriks Gerard R. Renardel de Lavalette — Computations in Fragments of Intuitionistic Propositional Logic
CT-88-05 Peter van Emde Boas — Machine Models and Simulations (revised version)
CT-88-06 Michiel H.M. Smid — A Data Structure for the Union-find Problem having good Single-Operation Complexity
CT-88-07 Johan van Benthem — Time, Logic and Computation
CT-88-08 Michiel H.M. Smid, Mark H. Overmars Leen Torenvliet, Peter van Emde Boas — Multiple Representations of Dynamic Data Structures
CT-88-09 Theo M.V. Janssen — Towards a Universal Parsing Algorithm for Functional Grammar
CT-88-10 Edith Spaan, Leen Torenvliet, Peter van Emde Boas — Nondeterminism, Fairness and a Fundamental Analogy
CT-88-11 Sieger van Denneheuvel, Peter van Emde Boas — Towards implementing RL
X-88-01 Marc Jumelet — *Other prepublications:* On Solovay's Completeness Theorem
1989 LP-89-01 Johan van Benthem — *Logic, Semantics and Philosophy of Language:* The Fine-Structure of Categorial Semantics
LP-89-02 Jeroen Groenendijk, Martin Stokhof — Dynamic Predicate Logic, towards a compositional, non-representational semantics of discourse
LP-89-03 Yde Venema — Two-dimensional Modal Logics for Relation Algebras and Temporal Logic of Intervals
LP-89-04 Johan van Benthem — Language in Action
LP-89-05 Johan van Benthem — Modal Logic as a Theory of Information
LP-89-06 Andreja Prijatelj — Intensional Lambek Calculi: Theory and Application
LP-89-07 Heinrich Wansing — The Adequacy Problem for Sequential Propositional Logic
LP-89-08 Víctor Sánchez Valencia — Peirce's Propositional Logic: From Algebra to Graphs
LP-89-09 Zhisheng Huang — Dependency of Belief in Distributed Systems
ML-89-01 Dick de Jongh, Albert Visser — *Mathematical Logic and Foundations:* Explicit Fixed Points for Interpretability Logic
ML-89-02 Roel de Vrijer — Extending the Lambda Calculus with Surjective Pairing is conservative
ML-89-03 Dick de Jongh, Franco Montagna — Rosser Orderings and Free Variables
ML-89-04 Dick de Jongh, Marc Jumelet, Franco Montagna — On the Proof of Solovay's Theorem
ML-89-05 Rineke Verbrugge — Σ-completeness and Bounded Arithmetic
ML-89-06 Michiel van Lambalgen — The Axiomatization of Randomness
ML-89-07 Dirk Roorda — Elementary Inductive Definitions in HA: from Strictly Positive towards Monotone
ML-89-08 Dirk Roorda — Investigations into Classical Linear Logic
ML-89-09 Alessandra Carbone — Provable Fixed points in $I\Delta_0+\Omega_1$
CT-89-01 Michiel H.M. Smid — *Computation and Complexity Theory:* Dynamic Deferred Data Structures
CT-89-02 Peter van Emde Boas — Machine Models and Simulations
CT-89-03 Ming Li, Herman Neuféglise, Leen Torenvliet, Peter van Emde Boas — On Space Efficient Simulations
CT-89-04 Harry Buhrman, Leen Torenvliet — A Comparison of Reductions on Nondeterministic Space
CT-89-05 Pieter H. Hartel, Michiel H.M. Smid Leen Torenvliet, Willem G. Vree — A Parallel Functional Implementation of Range Queries
CT-89-06 H.W. Lenstra, Jr. — Finding Isomorphisms between Finite Fields
CT-89-07 Ming Li, Paul M.B. Vitanyi — A Theory of Learning Simple Concepts under Simple Distributions and Average Case Complexity for the Universal Distribution (Prel. Version)
CT-89-08 Harry Buhrman, Steven Homer Leen Torenvliet — Honest Reductions, Completeness and Nondeterminstic Complexity Classes
CT-89-09 Harry Buhrman, Edith Spaan, Leen Torenvliet — On Adaptive Resource Bounded Computations
CT-89-10 Sieger van Denneheuvel — The Rule Language RL/1
CT-89-11 Zhisheng Huang, Sieger van Denneheuvel Peter van Emde Boas — Towards Functional Classification of Recursive Query Processing
X-89-01 Marianne Kalsbeek — *Other Prepublications:* An Orey Sentence for Predicative Arithmetic
X-89-02 G. Wagemakers — New Foundations: a Survey of Quine's Set Theory
X-89-03 A.S. Troelstra — Index of the Heyting Nachlass
X-89-04 Jeroen Groenendijk, Martin Stokhof — Dynamic Montague Grammar, a first sketch
X-89-05 Maarten de Rijke — The Modal Theory of Inequality
X-89-06 Peter van Emde Boas — Een Relationele Semantiek voor Conceptueel Modelleren: Het RL-project
1990 SEE INSIDE BACK COVER

Instituut voor Taal, Logica en Informatie
Institute for Language, Logic and Information

Faculteit der Wiskunde en Informatica
(Department of Mathematics and Computer Science)
Plantage Muidergracht 24
1018TV Amsterdam

Faculteit der Wijsbegeerte
(Department of Philosophy)
Nieuwe Doelenstraat 15
1012CP Amsterdam

THE VARIABILITY OF IMPERSONAL SUBJECTS

Gennaro Chierchia
Department of Philosophy
University of Amsterdam
Department of Modern Languages and Linguistics
Cornell University, Morril Hall, Ithaca, NY 14853

ITLI Prepublications
for Logic, Semantics and Philosophy of Language
ISSN 0924-2082

Received July 1990

The Variability of Impersonal Subjects

Gennaro Chierchia
Cornell University

May 1990

My goals in the present paper are the following:

- sketch a theory of adverbs of quantification;
- use it to explore the semantics of impersonal subject constructions.

By impersonal subject constructions I intend to refer to structures such as those in (1).

(1) a. In Italia si beve molto vino.
b. In Italy si drinks a lot of wine.
c. In Italy, everybody/people drink a lot of wine.

Italian *si*, French *on* or German *man* are morphemes that can occur only as subjects and express non-specific or indeterminate human subjects. They mean something like *people*. I will focus on impersonal *si* in Italian but I hope that what I have to say will extend to related constructions in other languages as well.

These constructions are very interesting both syntactically and semantically. From a semantic point view their interest lies primary in the fact that impersonal subjects display a great deal of variability in their quantificational force, which ranges from quasi-universal (as in (1) –cf. the gloss) to quasi-existential as in (2):

(2) a. In Italia ieri si e' giocato male.
b. yesterday in Italy si played poorly.
c. yesterday somebody in Italy played poorly.

(2) could be naturally uttered having in mind a couple of prominent soccer players of the italian national team who did particularly poorly in yesterday's match. Such a variability seems to a considerable extent a function of the quantificational force of adverbs of quantification which may be present in the context (explicitly or implicitly). This dependency (which is the reason why I think the semantics of *si* cannot be studied independently of a theory of quantificational adverbs) is evidentiated by data such as the following:

(3) a. In Italia, i risultati dei concorsi si sanno sempre prima che i concorsi abbiano luogo.
b. In Italy the results of the competions si always know before the competitions take place.

Sentence (3) has the same truth-conditions as (4):

(4) In Italia everybody knows the result of competitions before they take place.

If (4) is true, (3) also is, and viceversa. Per contrast, (5), where the adverb of quantification is changed from *always* to *sometime*, is truth- conditionally equivalent to (6):

(5) a. In Italia i risultati dei concorsi talvolta si possono sapere prima che i concorsi abbiano luogo.

b. In Italy, the results of the competitions si can know before the competitions take place.

(6) In Italia there are people who can find out who will win a competition before it takes place.

This chamaleontic behavior, as Heim puts it, is typical of indefinites and has been extensively studied within the framework of Discourse Representation Theory (*DRT* – Heim [13], Kamp [16]). The leading idea within *DRT* is that indefinites are semantically variables without a quantificational force of their own. Their quantificational force comes from the context. In particular determiners like *every* or *most* and adverbs of quantification are analyzed as unselective binders capable of binding simultaneously all the variables in their scope. Thus *DRT* should constitute a good framework for studying the semantic variability of *si* and related constructions.

There are several puzzling aspects of the behavior of *si*, however, that need to be addressed before we can celebrate a new theoretical triumph for *DRT* and related frameworks. Consider for example a sentence like (7):

(7) a. Se si ruba si va in prigione.

b. If si steels si goes to prison.

Here the second occurrence of *si* is understood as "bound" by the first occurence. The first occurrence of *si* behaves like an indefinite, the second like a pronoun bound by the indefinite. So what is *si*? An indefinite, a pronoun or both? These and several other puzzles are what I hope to be able to shed some light on.

In studying the semantics of *si*, I will have to bypass several interesting problems. In particular, it has often been noted that *si* is associated with a sort of "empathy" phenomenon. When a speaker utters sentences like (1) or (2), it is as if he ideally includes himself in the relevant group or assumes the perspective of that group. I will not have anything to say about this effect here. I will rather concentrate on the quantificational force of *si* and on its anaphoric properties.

The present paper is organized as follows. In section 1 I will present the semantic framework that I will adopt. While this framework is much in the spirit of *DRT*, it also differs from classical *DRT*, in interesting ways, I think. In particular, it gives up the indefinites-as- free-variables ideology and goes back to the more traditional view that they are existentially quantified terms. But the framework to be presented enpowers existential quantification of certain dynamic properties that enable us to achieve the same effects as classical *DRT*. In section 2, I will present a theory of quantificational adverbs couched within the framework developed in section 1. In section 3 I will discuss the empirical properties of impersonal *si* and, after some syntactic preliminaries, the essence of my proposal. Finally in section 4, I'll consider the consequences of my proposal in relation to various properties of *si*.

1 The framework

The semantic framework that I will adopt is a version of Montague's Intensional Logic, with a dynamic twist to it, which I will now describe informally[1].

As, e.g. Stalnaker [26] argues, sentences affect the contexts in which they are uttered in many ways. They can increase the information of the illocutionary agents by narrowing down the alternatives under consideration. They can set up some discourse referents as potential topics of further discourse and shut others off. They

[1] My proposal is based on the work of Groenendijk and Stokhof [11] [12], to which I refer the reader for technical details. See also Chierchia [5].

can put constraints on possible continuations of the discourse, and so on. Without trying to cover here all the context changing functions of a sentence, we may wonder whether at least those that are of more direct relevance to anaphora may be formally represented in a system like *IL*.

Suppose that ϕ represents the truth-conditions of a sentence S. We might represent the way in which ϕ can be used to update the context in which it is uttered as:

(8) $\lambda p[\phi \wedge {}^{\vee}p]$, where p ranges over propositions

The function in (8) determines a set of propositions: those that constitute possible continuations of ϕ. (Throughout this paper I will freely switch back and forth between characteristic functions and the corresponding sets. So I will refer to something of type $\langle a,t\rangle$ sometimes as a function and sometimes as a set of a's.) Let us call functions of this type "update functions" and let us assume that sentences are semantically associated with them. So for example the sentence in (9a) will be associated with the update function in (9b):

(9) a. He_1 is blond

b. $\lambda p[\mathtt{blond}(x_1) \wedge {}^{\vee}p]$

The variable p in (9b) can be viewed as a "hook" to which subsequent pieces of discourse are going to be attached. To see why update functions represent an aspect of the context change potential of a sentence, we have to consider how discourse sequencing may be viewed (i.e. how this "hook" is going to be used).

But before we do that, there is a preliminary issue that should be addressed. In general propositions are thought of as a set of worlds. But the aspects of quantification we are concerned with here can be studied more profitably, I think, if we keep them separate from intensional matters and we look at them first in purely extensional terms. Accordingly, rather than regarding propositions as sets of worlds, let us think of them as sets of assignments to variables. So let us assume that ${}^{\wedge}\phi$ denotes the assignments with respect to which ϕ is true rather than the worlds in which ϕ is true, i.e. where ω is an assignment to variables, $[\![{}^{\wedge}\phi]\!]^{\omega} = \{\omega' : [\![\phi]\!]\omega' = 1\}$. We know that ultimately propositions cannot be modelled as sets of assignments. Nevertheless, it won't hurt making this assumption here, for as far as I can see adding intensionality doesn't affect what I want to say and merely complicate things. Following Lewis' [20] suggestion, let us think of the assignments that satisfy a formula ϕ as the "cases" which make ϕ true.

Sets of cases are partially ordered by an inclusion relation $\subseteq$. For example, it will generally hold for any ϕ and any ψ that ${}^{\wedge}[\phi \wedge \psi] \subseteq {}^{\wedge}\phi$, that ${}^{\wedge}\phi \subseteq {}^{\wedge}[\phi \vee \psi]$, and so on. The non empty minimal elements with respect to $\subseteq$ are singletons of the form $\{\omega\}$, where ω is an assignment. For all practical purposes singletons of this form can be identified with cases. This identification enables us to regard cases as particular propositions, namely the most specific ones. If we had worlds, it would be like identifying a world w with the singleton $\{w\}$, i.e. the proposition that univocally characterizes w. In what follows I will use $c_1, c_2, \ldots$ as variables ranging over proposition-cases.

On the view just sketched, an update function like the one in (9b) relative to a case ω will correspond to the following set of sets of cases:

(10) the set of all sets of cases that contain ω, if ω satisfies $\mathtt{blond}(x_1)$; the empty set, otherwise.

This reflects the fact that if $\omega(x_1)$ has the property of being blond, then any proposition also satisfied by ω will constitute a possible continuation of $\mathtt{blond}(x_1)$. If, on the other hand, the individual that the current case ω identifies as the value of x_1

doesn't have that property, then there is no way to successfully update the context with the information that that individual is blond.

This line of thinking can be exploited to formalize the idea that indefinites "set up discourse referents" as follows. The update function corresponding to (11a) can be taken to be (11b):

(11) a. A man walks in.

b. $\lambda p \exists x_1[\mathtt{man}(x_1) \wedge \mathtt{walk_in}(x_1) \wedge {}^{\vee}p]$

(11b) says that a possible continuation of (11a) must be a set of cases containing a case $\omega[u/x_1]$ which differs from the actual one at most in that x_1 is mapped onto u, where u is a man that walks in. Continuations of (11b) are going to land in the position of the variable p, that is inside the scope of $\exists x_1$. This makes the occurrence of $\exists x_1$ in (11b) "active". Let us flesh this out some more. Imagine, for example, a discourse constituted of (11a) followed by (9a), namely:

(12) A man walks in. He is blond.

How shall it be interpreted? Given the assumption that sentences denote update functions, the natural way to interpret discourse sequencing is as a kind of function composition. Let us denote this form of composition as ';', where ';' is defined as follows:

(13) $A\,;B = \lambda q[A({}^{\wedge}B(q))]$

Accordingly, (12) is interpreted as follows:

(14) a. A man walks in' ; he is blond' = $\lambda q[\lambda p \exists x_1[\mathtt{man}(x_1) \wedge \mathtt{walk_in}(x_1) \wedge {}^{\vee}p]({}^{\wedge}\lambda p[\mathtt{blond}(x_1) \wedge {}^{\vee}p](q))]$

b. $\lambda q[\exists x_1[\mathtt{man}(x_1) \wedge \mathtt{walk_in}(x_1) \wedge \mathtt{blond}(x_1) \wedge {}^{\vee}q]]$

(14a) reduces to (14b). (The interested reader can check in 1 in the Appendix the steps of the reduction). So as a result of composing these two functions, the denotation of the pronoun *he* lands in the scope of the quantifier associated with *a man*. This may give the reader the impression of an improper λ -reduction, where a variable which is free before the conversion ends up being bound after it. Such impression, however, is unwarranted for the cap operator $^{\wedge}$ in (14a) abstracts over cases. In the case at hand, it amounts to abstracting over x_1. In general, ${}^{\wedge}\phi$ corresponds to abstracting unselectively on all the variables free in ϕ. This makes the reduction in (14) sound.

So ';' can be viewed as a kind of dynamic conjunction. Dynamic because via ';' existential quantifiers can bind variables that lie outside of their syntactic scope. This dynamic quality of existential quantifiers contrasts with the way universally quantified NP's behave. Consider for example the following discourse:

(15) *Every man$_1$ walks in. He$_1$ is blond.

This sentence is ungrammatical in the interpretation indicated by the indices. I.e. quantifiers like *every* cannot, in general, bind variables that lie outside of their syntactic scope. They do not set up "discourse referents" that can be picked up in subsequent stretches of discourse. This means that the update function associated with the first sentence in (15) has to be:

(16) $\lambda p[\forall x_1[\mathtt{man}(x_1) \rightarrow \mathtt{walk_in}(x_1)] \wedge {}^{\vee}p]$

Here the place-holder p lies outside of the scope of $\forall x_1$: $\forall x_1$ is not "active". Occurrences of the variable x_1 that land in the position occupied by p will not be bound by $\forall x_1$ in this example. In Groenendijk and Stokhof's [11] [12] terminology, the

update function in (16) is a "test". It checks whether the current assignment ω satisfies the conditions that make *every man walks* true. If so, any set of assignments that contains ω constitutes an admissable continuation. Otherwise, we can't go on, i.e. we can't update the current context by means of (16).

The distinction betwen (11b) and (16) corresponds in *DRT* to the idea that universals introduce splitting of boxes, while existentials do not. This gives raise to a notion of "accessibility", which determines the configuration in which a pronoun can have a certain discourse marker as antecedent. The notion of accessibility that we get in the present theory is thus the same as the one familiar from *DRT*. While this notion of accessibility appears to be empirically supported by contrasts such as the one between (12) and (15), there are also well-known counterexamples to it, exemplified by sentences like:

(17) Every chess set comes with a spare pawn. It is taped on top of the box.

To develop a treatment of these phenomena, known as "modal subordination" (see e.g. Roberts [22]), is something that exceeds what we can attempt to do here.

So the version of *IL* that I envisage, is the same as Montague's with the modal and temporal operators '$\Box$', '$\Diamond$', 'F' and 'P' left out. Interpretations are only relativized to assignments, for we are not dealing with modal or temporal notions. "Intensions" are functions from assignments into extensions of the appropriate type. The cap '$^\wedge$' and cup '$^\vee$' operators are interpreted as follows:

(18) a. if $\alpha \epsilon ME_a$, then $[\![^\wedge\alpha]\!]^\omega = h$, such that for any assignment ω', $h(\omega') = [\![\alpha]\!]^{\omega'}$.

b. if $\alpha \epsilon ME_{\langle s,a\rangle}$, then $[\![^\vee\alpha]\!]^\omega = [\![\alpha]\!]^\omega(\omega)$

While the resulting system has an intensional flavour (because of the presence of '$^\wedge$' and '$^\vee$') its interpretation employs only extensional notions. Let us call it *DTT* (for "Dynamic Type Theory").

Given any formula ϕ (i.e. any member of ME_t), we use $\uparrow\phi$ ($= \lambda p[\phi \wedge {}^\vee p]$) to refer to the corresponding update function. Conversely, we may want to extract truth-conditional content from an update function A. This can be done as follows. We saw above that if a formula is true, it will have a non empty set of possible continuations. Thus in particular, we will be able to continue our discourse with a tautology. But this means that to say that an update A corresponds to something true (i.e. that the truth-conditional content associated with an update function holds in a given context) is to say that that update is non-empty, which in turn means that it contains the tautologous proposition $^\wedge T$. So, for any update A, we can get at its truth conditional content $\downarrow A$ simply by checking whether $A(^\wedge T)$ holds.

(19) $\downarrow A = A(^\wedge T)$

A simple computation shows that the following holds:

(20) a. $\downarrow\uparrow\phi = \phi$

b. proof: $\downarrow\uparrow\phi = \downarrow\lambda p[\phi \wedge {}^\vee p] = \lambda p[\phi \wedge {}^\vee p](^\wedge T) = [\phi \wedge {}^\vee{}^\wedge T] = \phi \wedge T = \phi$

Interestingly, the converse of this doesn't hold. I.e.:

(21) $\uparrow\downarrow A \neq A$

Let's check this with the example given in (11b):

(22) a. $\uparrow\downarrow[\lambda p \exists x_1[\mathbf{man}(x_1) \wedge \mathbf{walk_in}(x_1) \wedge {}^\vee p]] =$

b. $\uparrow[\lambda p \exists x_1[\mathbf{man}(x_1) \wedge \mathbf{walk_in}(x_1) \wedge {}^\vee p](^\wedge T)] =$

c. $\uparrow\exists x_1[\mathbf{man}(x_1) \wedge \mathbf{walk_in}(x_1)] =$

d. $\lambda p[\exists x_1[\mathtt{man}(x_1) \wedge \mathtt{walk_in}(x_1)] \wedge {}^{\vee}p]$

The variable p in (22d) is outside the scope of $\exists x_1$. Thus further occurences of x_1 that will land in the position of p will not be bound by $\exists x_1$, unlike what happens with (11b). Thus, in a sense, $\uparrow\downarrow$-sequences "close off" all the active quantifiers in an update function. In what follows, we will write ${}^{c}B$ for $\uparrow\downarrow B$.

One can use DTT to set up an interpretive procedure that assigns the meanings in (11b) and (16) to the respective natural language sentences in a compositional, Montaguesque fashion. One way to do this is roughly as follows. In translating the relevant level of syntax into DTT, one lifts systematically Montague's type t to $\langle\langle s,t\rangle,t\rangle$, viz. the type of update functions. Let us abbreviate $\langle\langle s,t\rangle,t\rangle$ as up (for "updates"). Accordingly, the denotations of predicates like *man* and *walk in* is lifted from $\langle e,t\rangle$ to $\langle e, up\rangle$ as follows:

(23) a. $\uparrow\mathtt{man} = \lambda x\lambda p[\mathtt{man}(x) \wedge {}^{\vee}p]$

b. $\uparrow\mathtt{walk_in} = \lambda x\lambda p[\mathtt{walk_in}(x) \wedge {}^{\vee}p]$

Similarly, the type of the denotation of the determiner a (taken extensionally) is lifted from $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$ into $\langle\langle e, up\rangle,\langle\langle e, up\rangle, up\rangle\rangle$ as follows:

(24) $a^{+} = \lambda P\lambda Q\lambda p\exists x[[P(x); Q(x)](p)]$, where the type of P and Q is $\langle e, up\rangle$

Then we get the simple translation pattern:

(25) A man walks in $\rightsquigarrow a^{+}(\uparrow\mathtt{man})(\uparrow\mathtt{walk_in})$

which reduces to (11b), by applying the relevant definitions (cf. 2 in the Appendix). An approach along similar lines is also possible for universally quantified NP's (cf. 3 in the Appendix).

A rather elegant treatment of the relative clause version of donkey anaphora emerges from this approach. Classic donkey sentences like (26a) and (27a) can be translated in a way that respects their surface constituent structure, schematically illustrated in (26b) and (27b)[2]:

(26) a. A man who owns a donkey beats it.

b. $a^{+}(\textit{man that owns a donkey'})(\textit{beats it'})$

(27) a. Every man who owns a donkey beats it.

b. $\textit{every}^{+}(\textit{man that owns a donkey'})(\textit{beats it'})$

In these structures, the translation of the pronoun *it* in the right argument is not in the scope of the NP *a donkey* in the left argument. Yet in virtue of the meaning assigned to a^{+} and $\textit{every}^{+}$ (where the former is given in (24)), (26b) and (27b) turn out to be equivalent to (28) and (29) respectively (cf. Groenendijk and Stokhof [12]):

(28) $\lambda p\exists x\exists y[\mathtt{man}(x) \wedge \mathtt{donkey}(y) \wedge \mathtt{own}(y)(x) \wedge \mathtt{beat}(y)(x) \wedge {}^{\vee}p]$

(29) $\lambda p[\forall x\forall y[[\mathtt{man}(x) \wedge \mathtt{donkey}(y) \wedge \mathtt{own}(y)(x)] \rightarrow \mathtt{beat}(y)(x)] \wedge {}^{\vee}p]$

So the truth-conditions and binding potential associated with (relative clause versions of) donkey sentences is the same as the one we find in classical DRT.

Sketchy though this may be, I hope it gives the reader a feeling for how the system works. The main point is to reconstruct DRT's insights concerning the binding capacities of indefinites, while maintaining that they are existentially quantified terms rather than free variables. This enables one to maintain that all NP's are of the same type (the type $\langle\langle e, up\rangle, up\rangle$), which we may call the type of dynamic

[2] I adopt the convention that α' is the translation of α into DTT.

generalized quantifiers. Besides formal elegance, this approach has arguably a number of empirical advantages over classical *DRT*. I will mention briefly two of them. The first is that if NP's are of different logical types, it becomes difficult to account for coordinate structures like:

(30) (A thieve and every guard that was pursuing him) rushed into the room.

On the present theory, all NP's have the same type and it is a conjoinable one (in the sense of Partee and Rooth [21]) and it should therefore be possible to handle these forms of coordination in terms of a simple cross-categorial coordination schema.

The second advantage of the present approach has to do with sentences like:

(31) Most men that have a donkey beat it.

If indefinites are free variables and quantifiers like *every* and *most* bind all the variables accessible to them, (31) is expected to mean that most man-donkey pairs that satisfy the left argument of *most* (the restriction, in Heim's terms) satisfy its right argument (the nuclear scope in Heim's terms). But it can be shown that this results in the wrong truth-conditions for sentences like (31). (31) involves counting men who have donkeys and comparing them with the men that beat their donkeys, rather than counting pairs. On the present approach, instead, determiners relate the dynamic counterparts of predicates. Thus there is no reason to expect that such a determiner will involve counting pairs (or n-tuples) rather than donkey-owning men[3].

At the same time, the present approach supports a theory of adverbs of quantification which is very close in spirit to Lewis's original proposal (and thus to the way they are treated in *DRT*). To this I now turn.

2 Adverbs of quantification

The leading idea developed within *DRT* is that the logical form of sentences with adverbs of quantification is as follows:

(32) $ADV(\phi)(\psi)$

where if/when clauses provide the left argument of adverbs of quantification, while the main clause provides the right argument. In *DRT*, *ADV* binds unselectively every indefinite in its scope. It is furthermore generally assumed that an adverb of quantification roughly equivalent to *always* is implicitly present in examples like (33):

(33) When a man is in the bathtub, he sings.

It is also generally assumed that the restriction of a quantificational adverb can be left implicit, as in:

(34) John always sings

(34) does not mean that John sings at all times, but only that he does so whenever some implicit conditions are satisfied (e.g. when he is happy, his mouth isn't full, etc.). Adverbs of quantification are also generally associated with a modality of some kind. But for simplicity, we will constrain ourselves to a consideration of their quantificational and anaphoric properties.

On our approach, indefinites are quantified NP's, not free variables. Hence the standard *DRT* account cannot be simply taken over. At the same time, the dynamic value of a sentence is a set of sets of cases. Thus we can rebuild in our framework Lewis' ideas in a fairly direct way. Intuitively, an adverb of quantification compares two sets of cases. For example, in *when a man is in the bathtub, he always sings*, we are comparing the cases in (35a) with those in (35b):

[3]For further discussion cf. Kadmon [15], Heim [14], Kratzer [17] and Chierchia [7].

(35) a. $\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c]$

b. $\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \mathbf{sing}(x) \wedge {}^{\vee}c]$

(35a) and (35b) denote sets of assignments. Which assignment they denote can be specified as follows:

(36) a. those assignments that differ from the current one at most in that x is mapped onto a man in the bathtub.

b. those assignments that differ from the current one at most in that x is mapped onto a man who is in the bathtub and sings.

To say that when a man is in the bathtub he always sings, is to say that the set (35a) is a subset of (35b). To say that when a man is in the bathtub he usually sings is to say that the cardinality of (35b) is greater than half of the cardinality of (35a). And so on. So adverbs of quantification can in general be viewed as relations between sets like those denoted by (35a) and (35b)[4].

Now, it is easy to see how to arrive compositionally at these sets. (35a) is simply the denotation of the when-clause (37) restricted to cases, (which, in the present set up are maximally specific propositions):

(37) a. A man is in the bathtub $\rightsquigarrow$ $\lambda p \exists x[\mathbf{man}(x) \wedge \mathbf{in_\ the_bathtub}(x) \wedge {}^{\vee}p]$

b. restricting a. to cases: $\lambda c[\lambda p \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}p](c)] =$
$\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c]$

In general, if A is an update function, we indicate by $!A(= \lambda c[A(c)])$ its restriction to cases.

(35b), the nuclear scope of the quantificational adverb, is the result of conjoining dynamically the when-clause with the main clause and taking the correponding set of cases. I.e.:

(38) a. $![\lambda p \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}p]; \lambda p[\mathbf{sing}(x) \wedge {}^{\vee}p]]$

b. $![\lambda p \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \mathbf{sing}(x) \wedge {}^{\vee}p]]$

c. $\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \mathbf{sing}(x) \wedge {}^{\vee}c]$

(38a) reduces to (38c) (= (35b)). We can then analyze a sentence like (39a) simply as (39b):

(39) a. When a man is in the bathtub, he always sings.

b. EVERY($\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c]$)
($\lambda c \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \mathbf{sing}(x) \wedge {}^{\vee}c)]$)

Here EVERY is the ordinary static meaning of the determiner *every*, only applied to cases[5]. Accordingly, (39b) reduces to:

(40) $\forall c[\exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c] \rightarrow \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge$
$\mathbf{sing}(x) \wedge {}^{\vee}c]]$

The semantics of (40) should be reasonably transparent. It says roughly: take any assignment to discourse markers such that x is mapped onto a man in a bathtub. Such an assignment must also be such that x is mapped onto someone who is singing. So (40) has the same truth-conditions as:

[4]This is how for example Stump's [27] insights on adverbs of quantification can be integrated with a *DRT*-like treatment of pronouns. See Chierchia [7] for further discussion.

[5]In *DTT*, EVERY will be represented as $\lambda P \lambda Q \forall c[P(c) \rightarrow Q(c)]$, where P and Q are of type $\langle\langle s,t\rangle,t\rangle$.

(41) $\forall x[[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x)] \rightarrow \mathbf{sing}(x)]$[6]

This seems to be as good an approximation to the meaning of (49a) as the one we find in classical *DRT*.

We have to fine tune our analysis slightly. If we apply it exactly as described to examples which contain indefinites in the main clause such as (42), we get wrong truth-conditions:

(42) When a man is in the bathtub he always sings a love song.

Our semantics would yield (43) as the value of (42):

(43) $\forall c[\exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c] \rightarrow \exists x \exists y[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \mathbf{love_song}(y) \wedge \mathbf{sing}(y)(x) \wedge {}^{\vee}c]]$

By working out the truth-conditions of (43) it is not hard to see that they turn out to be equivalent to:

(44) $\forall x \forall y[[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x)] \rightarrow [\mathbf{love_song}(y) \wedge \mathbf{sing}(y)(x)]]$

But this is wrong. What we need is an analogue of the existential closure of the nuclear scope of an adverb of quantification which we find in *DRT*. The right truth-conditions are given by the formula:

(45) $\forall c[\exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge {}^{\vee}c] \rightarrow \exists x[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x) \wedge \exists y[\mathbf{love_song}(y) \wedge \mathbf{sing}(y)(x)] \wedge {}^{\vee}c]]$

The only difference between (43) and (45) is that the second occurrence of c in (45) is outside of the scope of $\exists y$. This makes (45) equivalent to:

(46) $\forall x[[\mathbf{man}(x) \wedge \mathbf{in_the_bathtub}(x)] \rightarrow \exists y[\mathbf{love_song}(y) \wedge \mathbf{sing}(y)(x)]]$

We can amend our analysis accordingly by defining a quantifier EVERY' as follows:

(47) EVERY'$(A)(B)$ = EVERY$(!A)(![A;\ {}^{c}B])$, where the type of A and B is *up* and ^{c} is the closure operator defined in (21).

It can be shown that by using the schema in (47), we get the right results (cf. 4 in the Appendix).

We can take this as a basis for characterizing adverbs of quantification in general. If D is an ordinary determiner meaning (raised to the level of *up*), D' will be the meaning of the corresponding adverb of quantification, where D' is defined on the model of (47), i.e.:

(48) $D'(A)(B) = D(!A)(![A;\ {}^{c}B])$

Adverbs of quantification are relations among sentence denotations (i.e. update functions). Given two updates $\uparrow\phi$ and $\uparrow\psi$, we first extract the satisfaction sets of ϕ and ψ (i.e. the set of cases relative to which they hold). We then conjoin dynamically these satisfaction sets while closing the right argument. Finally we quantify, in the ordinary, static sense over the resulting sets. This enables us to see adverbs of quantification as generalized quantifiers of a kind and to relate their meanings in a systematic way to the meanings of the corresponding determiners. In what follows I will translate *always* as EVERY', *usually* as MOST', *never* as NO', etc.

This method of handling adverbs of quantification delivers what is known in the literature as the "symmetric" reading of sentences involving *usually*, like:

[6] A proof of this claim can be found in Chierchia [7].

(49) Usually, if Mary lends a book to a student, he returns it with insightful comments

The truth-conditions we get for (49) are describable roughly as follows: the number of assignments such that x is a book, y a student, Mary lends x to y, and y returns x with insightful comments must be greater than the number of assignments such that x is a book, y a student, Mary lends x to y but y does not return x with insightful comments. This reading appears to be adequate for (49). In classical *DRT*, this readings would correspond to a quantification over book-student pairs.

It has been noted, however, that sentence (49) has also at least two other readings. The first one is made salient in the following context:

(50) Mary's books have a different impact on her students and on her colleagues.

a. When Mary lends a book to A STUDENT, he usually returns it with insightful comments (while when she lends them to a colleague, he or she returns them with narrow minded criticisms).

b. Most books that are lent by Mary to a student are returned by him with insightful comments.

Capitals indicate here focal stress. The topic of the discourse in (50) is Mary's books. And the adverb of quantification doesn't seem to quantify over all cases in which the antecedent is true, but over the books that Mary lends to students. (50a), in other terms, seems to have the same reading as (50b).

The second alternative reading of (49) can be made salient by a context like the following:

(51) Mary's students have an erratic behaviour.

a. If Mary lends A BOOK to a student, he usually returns it with good comments (while if she lends them a tape, they don't know how to work with it).

b. Most students that are lent a book by Mary, return it with good comments.

In the context set up in (51), the topic is Mary's students and this is what the adverb of quantification appears to quantify over. Accordingly, (51a) seems to have the same meaning as (51b).

What emerges from this is that adverbs of quantification are highly sensitive to the topic/comment or theme/rheme structuring of the clauses they operate on. The theme or topic is mapped onto the restriction of the adverb. The comment or rheme is mapped into the nuclear scope. If/when clauses are generally construed as topics (and hence mapped onto the restriction). But sometimes the adverb of quantification can select as its restriction not the if/when clause as a whole but a subpart of it.

The reading that we get if the whole if/when clause is taken as the restriction correponds to a quantification over all the indefinites in it (i.e. corresponds to a quantification over n-tuples). This is symmetric reading discussed above. The reading that we get by associating the adverb of quantification with a topic selected from an if/when clause, is generally called an asymmetric reading. It corresponds to selecting one of the indefinites (the subject, direct object, indirect object, etc.) as the restriction for the quantificational adverb.

While no fully satisfactory treatment of this phenomenon will be forthcoming till focus isn't understood better[7], let me give an indication of how one might procede. To facilitate things, let us consider a concrete example, say the direct object asymmetric reading of (50), repeated here:

[7] See Rooth [23], [24] for an interesting attempt to develop a formal theory of association with focus.

(50) When Mary lends a book to A STUDENT, he usually returns it with insightful comments (while when she lends them to a colleague, he or she returns them with narrow minded criticisms).

Here we don't want the whole when-clause in the restriction of *usually*. We only want the unstressed material in the restriction. In other terms, the left argument of *usually* should be something like "books that are lent by Mary to a student". Now, the meaning of the when-clause, according to our proposal so far, will be:

(52) $\lambda p \exists x \exists y[\mathtt{book}(x) \wedge \mathtt{student}(y) \wedge \mathtt{lend}(y)(x)(m) \wedge {}^{\vee}p]$

Within the present set-up, it is possible to abstract, in a sense, over a variable which is already existentially quantified over. That is, it is possible to define compositionally an operation that maps (53a) into (53b):

(53) $\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge {}^{\vee}p] \rightsquigarrow \lambda x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x)]$

Informally, in our framework an existential with index n can bind variables with the same index even if they aren't in its syntactic scope. So, we can obtain dynamically add to (53a) something like $x = u$ and then abstract over u:

(54) a. $\exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x)] + x = u \rightsquigarrow \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge x = u]$

b. abstraction over u in a: $\lambda u \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge x = u]$

The result in (54b) is equivalent to (53b). In general, if A is an update function which contains an active occurrence $\exists x_n$ of an existential quantifier, we can turn it into a property by abstracting over x_n. One has to be careful about details[8]. But I will not do so here (cf. on this Chierchia [7]), for my concern is just to give an intuitive grasp of the options that the present system makes available to us. By making existential quantifiers dynamic, we can easily get them to act as free variables and hence abstract over them. We can have our cake and eat it too. This is one of the main novelty, I think, of the present framework.

Going back to example (52), we can abstract, along the lines just indicated on the topic (books, in the case at hand) and thus obtain:

(55) $\lambda x \lambda p \exists y[\mathtt{book}(x) \wedge \mathtt{student}(y) \wedge \mathtt{lend}(y)(x)(m) \wedge {}^{\vee}p]$

This is the desired restriction for the adverb of quantification.

Where do we go from here? The target is to assign to (50a) the same truth-conditions that (50b), repeated here, has:

(50) Most books lent by Mary to a student are returned by him with insightful comments.

The truth-conditions of (50b) are controversial. There are two main plausible candidates, namely:

(56) Most books lent by Mary to a student are books which are lent to and returned by a student to Mary with insightful comments.

(57) For most books lent by Mary to a student: Every student to whom Mary lent them returned them with insightful comments.

(56) and (57) are truth conditionally distinct. (56) requires that all the relevant students return books with good comments. For (57) to be true it suffices that the majority of Mary's books are returned with insightful comments by some of the students to which Mary lent them.

[8] Formally, for any update A with an active occurrence of $\exists x_n$ in it, let $\lambda u_n A =_{df} \lambda u[A; \uparrow u = x_n]$. See Chierchia [7] for details.

This is not the place to try to take a stand on the truth-conditions of *most*. Both readings in (56) and (57) can be represented in our (as in other) frameworks. What matters to our present concern is simply that we are able to assign to (50a) the same truth conditions as (50b), whatever the correct ones may turn out to be, because we can "re-open" an existentially quantified term. So, schematically, the asymmetric readings of ***usually*** can be gotten by a schema of the kind given in (58):

(58) $\text{MOST}_n(A)(B) = \text{MOST"}(\lambda x_n A)(\lambda x_n B)$

Where MOST" is the dynamic meaning of the determiner *most*. *Usually* can be interpreted as MOST' or MOST_n. MOST' gives us the symmetric reading, MOST_n the asymmetric one.

So, the idea is that adverbs of quantification can associate with a topic contained in an if/when clause. We can turn the arguments of the adverb of quantification into properties and use the (dynamic) meaning of the determiner *most* to combine them (whichever of its interpretations may be appropriate). The net outcome is that, for example, a sentence like (50a) gets the same reading as (50b), as desired. The approach I have sketched extends to all adverbs of quantification, as far as I can tell.

The sensitivity to focal structure of adverbs of quantification can be observed also when an overt restriction is absent. Rooth [24], for example, gives the following nice minimal pair:

(59) a. A u usually follows **a q**.

b. **A u** usually follows a q.

where italics mark focal stress. Here there is no restrictive if/when-clause and the content of the left argument of ***usually*** must be reconstructed from contextual clues. One such important clue is of course focal stress. Now, it seems that the most prominent (perhaps the only) interpretation of (59a) is that most u's follow a q. This is false of, say, English texts. On this reading, *is a u* is mapped onto the restriction (i.e. the left argument) of the adverb of quantification. In contrast with this, the most prominent interpretation of (59b) is that most q's are followed by a u, which is true of English texts. On this reading, it is *is a q* that is construed as the left argument of ***usually***.

The account we have developed extends in a natural way to these cases[9]. We saw that we can reopen an existentially quantified term. So, in particular, we can go from an NP meaning to its restriction as shown:

(60) $\lambda P \lambda p \exists x[\uparrow \mathbf{man}(x) \wedge P(x) \wedge {}^{\vee}p] \rightsquigarrow \lambda x[\mathbf{man}(x)]$

If NP' is a dynamic generalized existential quantifier, let NP* be the corresponding property[10]. Given a sentence S where NP_n is the topic, we can then extend our way of associating adverbs of quantification with the topic as shown:

(61) Usually $[_S ... \text{NP}_n ...] \rightsquigarrow \text{MOST}\ (\text{NP}_n{}^*, \lambda x_n\ \text{S'})$

Here I am assuming that the NP_n is not the element that bears focal stress, for generally focal stress falls withing the comment or rheme. NP_n is the theme or topic: that determines what we quantify over (and generally doesn't carry contrastive stress). For example, (59b) would be treated as follows:

(62) a. *A u* usually follows a q $\rightsquigarrow$ MOST (*a* $q_n{}^*$, λx_n [*a u follows* x_n'])

[9] Rooth [24] develops an account of the facts in (59), but I currently do not see how it would extend to the case where if/when clauses are overtly present).

[10] Formally, where NP_n' is a dynamic generalized existential quantifier, let NP* $=_{df} \lambda u[\downarrow \text{NP}(\hat{}[u = x_n])]$.

b. $\text{MOST}(\lambda x \mathtt{q}(x))(\lambda x \exists y[\mathtt{u}(y) \wedge \mathtt{follow}(x)(y)])$

This gives us the reading we want (i.e. that most q's are followed by u's). The assumption here is that adverbs of quantification have access to topics, whether they occur in a restrictive if/when clause or in a main clause. This property of adverbs of quantification is well known (cf. e.g. Rooth [24] or Krifka [18]). There are various ways to implement this, which depend on one's assumptions concerning binding, scope and focus. One possibility is to move the topic to a position where it is governed by the adverb of quantification. An equivalent possibility is to introduce the adverb of quantification via a Montague style quantifying in rule. A third possibility is to develop a recursive definition of focus along the lines explored in Rooth [23] [24]. In conclusion, there are two main aspects of my proposals concerning adverbs of quantification. One is the development of a version of Lewis' idea that they are quantifiers over cases in a way that is compatible with a uniform treatment of NP's. The second aspect is a mechanism whereby adverbs of quantification associate with topics. This mechanism exploits the possibility of reopening existentially quantified terms that the present view of quantification makes readily available. If D is a static determiner meaning, D' is the corresponding unselective adverbs of quantification (defined in (48)), D_n (n the index of the topic) is the selective, asymmetric adverb of quantification which selects a topic from the if/when clauses (as in (58)) and D(NP, S') (NP the topic in S) is the adverb of quantification that selects a topic from the main clause (as in (61)). All this are formally simple type-shifts on ordinary determiner-meanings and thus adverbs of quantification can be viewed as different incarnations of determiner-meanings. This second aspect of the proposal is as tentative as are the other proposals in the literature on association with topics. To make real progress on this score, focal structure need to be better understood. Equipped with this approach to quantificational adverbs, we can now turn to impersonal subjects.

3 Impersonal subjects as context dependent indefinites

3.1 Syntactic preliminaries

My main concern here is to study the quantificational and anaphoric properties of impersonal *si*. What I have to say about this is largely neutral, as far as I can tell, with respect to the syntactic properties of *si*, an interesting and complex topic in its own right. So, for example, the semantics that I will sketch is compatible with a flexible categorial syntax, such the one explored in, e.g., Bach et al. [2]. It is also compatible with a Government and Binding syntactic analyses of *si* (cf., e.g., Burzio [4] or Cinque [9]). In order to give some concreteness to my proposals, it is, however, useful to be able to relate it to some relatively precise syntactic analysis of the construction under consideration. Since the most explicit and detailed syntactic proposals in this domain are those developed within GB, I am going to adopt for the present purposes a GB-style syntax for *si*. In doing so, I will have to leave aside, however, many aspects of the syntax of *si* that while important to an overall understanding of how *si* and related constructions work do not affect, as far as I can the semantics of *si* in a central way.

Within the GB framework it is assumed that surface structures (SS's) are mapped into logical forms (LF's) which are then semantically interpreted. The map from SS into LF exploits an instance of move alpha (namely, quantifier raising, QR) which adjoins NP's to S (or IP) nodes, thereby fixing their syntactic scope. I will assume that semantics takes the form of a compositional, Montaguesque translation of LF into a logic (in our case, *DTT*). Concerning more specifically *si*, both Burzio [4] and Cinque [9] argue that *si* is a clitic adjoined to the INFL node (the node where clitics are generally placed, along with other inflectional, temporal and modal elements). So the structure of a simple sentence like (63a) is taken to be,

irrelevant details aside, something like (63b)

(63) a. Si sa.
Si knows.
People know.

b. $[_{IP}[_{NP}e_i]\ [_{I'}\ [_{I}si_i\ [_{VP}\ sa]]]]$

Si in (63b) is coindexed with the empty subject position (either by move alpha or, perhaps, by whatever form subject-verb agreement takes). It is structures of this sort that, I assume, are semantically interpreted.

It has been pointed out in the literature that there are several *si*'s. For example, when *si* is in construction with transitive verbs, we have two options. Either the verb shows singular agreement (i.e. it agrees with *si*). Or else the verb agrees with the object (which, in these cases, tends to be preposed). These options are illustrated in (64a) and (64b) respectively:

(64) a. Da qui si vede le montagne.
From here si sees (sn) the mountains. (pl)
From here, one can see the mountains.

b. Da qui le montagne si vedono bene.
From here the mountains (pl) si see (pl) well.
From here the mountains can be seen well.

(64a) is only marginally grammatical. The form in (64b), which is the more standard one, bears many similarities with passive and is sometimes called "si passivante". On top of this distinction, Cinque [9] has argued that besides an argument *si*, there is also a *si* which from the point of view of GB's θ-theory is not an argument. In spite of these differences, I believe that all these *si*-constructions have a common core of quantificational and anaphoric properties. This common core, which I will try identify in the next section, constitute the focus of present theory. My hope is that to be able to regard *si* as a semantically uniform phenomenon (at the appropriate level of abstraction).

With these preliminaries out of the way, I am going now to circumscribe the main empirical aspects of the quantificational and anaphoric properties of *si* that any semantics for it would have, I think, to accomodate.

3.2 Quantificational and anaphoric properties of *si*

Perhaps the most salient characteristic of impersonal *si* is the variability of its quantificational force, alluded to in the introduction. In habitual sentences like (65), *si* appears to have a quasi-universal force, as the paraphrase indicates.

(65) In Italia si beve molto vino.
In Italy si drinks a lot of wine.
In Italy, everybody/people drink a lot of wine.

For (65) to be true it has to be the case that in Italy people generally drink a lot of wine. This contrasts with non-habitual, episodic sentences, where *si* appears to have a quasi-existential force, as the example in (66) illustrates.

(66) a. Ieri in Italia si e' bevuto molto.
Yesterday in italy si drank a lot.
Yesterday in Italy people drank a lot.

b. Domani si berra' molto.
Tomorrow si will drink a lot.
Tomorrow people will drink a lot.,

These sentences talk about a particular contextually salient group of people, not about all people in general. For example, 66) could be uttered after a victory of the Italian soccer team, with reference to all or most Italians. But it also could be uttered by me after I won the New York State lottery, with reference to my Italian friends and relatives who are celebrating my sudden wealth. In this second case, (66a) is made true by the existence of a small group of Italians that drank a lot. This shows that both (65) and (66) are context dependent, but in different ways. In (65) the contextually understood restrictions are the typical ones of generic sentences: we are talking about adults in normal conditions (who at the relevant time weren't unconscious, or in jail, etc.). In (66) the context is set up by how the domain of quantification is selected by the conversational dynamics, by what is known to the illocutionary agents, and so on. The shifts in quantificational force exemplified by (65) and (66) appear to be quite similar to those in (67), discussed by Carlson and by many others after him.

(67) a. Dogs are barking in the courtyard.
b. Dogs bark (when they are hungry).

The bare NP *dogs* has a quasi-existential force in (67a) and a quasi- universal force in (67b). Carlson has argued that bare plurals denote kinds and that the different quantificational force of (67a) vs. (67b) is due to the fact that the predicate in (67a) is stage-level and talks about a particular spatio-temporal manifestation of the dog-kind, while the predicate in (67b) is individual-level and talks about the dog-kind in general. It should be noted in this connection in spite of this strong analogy, impersonal *si* does not seem to denote a kind (like, say, *people* or *humans*). Consider:

(68) a. On normal hicking trails, one meets a lot of people, but in the desert, people are pretty rare.
b. *Nel deserto, si e' piuttosto rari.
In the desert, si is pretty rare.

The predicate *rare* is kind-level: it can be meaningfully attributed only to kinds. And in fact, it is fine to attribute it to bare plural subjects, which supports the hypothesis that they denote (sometimes at least) kinds. *Si*, on the other hand, cannot easily take kind-level predicates, as (68b) shows. This is in spite of the pragmatic plausibility of the context (cf. 68a), and in spite of the fact that *si* is semantically plural (i.e. it can refer to groups)[11]. These facts suggest that *si* cannot be taken to simply denote something like the kind *humans*, and that one cannot simply lift to it Carlson's approach.

A second, related characteristic of impersonal si is the fact, noted in the introduction, that its quantificational force varies according to the type of adverb of quantification which may be present. This property, also shared by bare plurals and singular indefinite NP's, is illustrated in (69):

(69) Quando si fa cosi', succede sempre/spesso/qualche volta un disastro.
When si does so, happens always/often/sometimes a disaster.
When someone does that, a disaster always/often/sometimes happens.

Here the quantificational force of *si* varies just like the quantificational force of the indefinite *someone* in the English translation. Similar effects can be noted also when an overt if/when clause is absent:

[11] Morphologically the behavior of *si* with respect to plurality is complex: it triggers singular agreement on the main finite verb and plural agreement in the past participle or adjective:
- Si e' stanchi.
- Si is(sn) tired(pl).
- People are tired.
Cf. e.g. Burzio [4] for discussion.

(70) a. In Italia, qualche volta si puo' sapere chi vincera' un concorso prima del concorso stesso.
In Italy, sometime si can know who will win a competition before the competition itself.
Someone in Italy can find out who will win a competition before that competition has taken place.

b. In Italia, spesso si puo' sapere chi vincera' un concorso prima del concorso stesso.
In Italy, often si can know who will win a competition before the competition itself.
Most people in Italy can find out who will win a competition before that competition has taken place.

c. In Italia, si puo' sempre sapere chi vincera' un concorso prima del concorso stesso.
In Italy, si can always know who will win a competition before the competition itself.
Everyone in Italy can find out who will win a competition before that competition has taken place.

Here too *si* ends up being understood as being roughly equivalent to *someone*, *most people* or *everyone* depending of the quantificational adverb present in the sentence.

Further peculiar properties of *si* concern the kind of anaphoric elements that it can antecede. *Si* can antecede, for example, reflexives:

(71) Si_j e' troppo spesso ingiustificatamente orgogliosi di se' stessi_j.
Si is too often proud of oneself without justification.
People are too often proud of themselves for no reason

Moreover, *si* can control an infinitive. That is, given the standard GB analisys of infinitives as clauses with a null pronominal PRO as subject, *si* can act as the antecedent of PRO:

(72) Si_j e' cercato di [PRO_j vincere].
Si tried to win.
People tried to win.

However, *si* cannot antecede an ordinary pronoun:

(73) *Si_j e' detto che loro_j hanno sbagliato.
Si said that they were wrong.
People_j said that they_j were wrong.

This sentence is only grammatical if the embedded pronominal subject *loro* is understood as disjoint in reference from the reference of *si*. The same applies to the null pronominal subjects (usually indicated as *pro*) that Italian, being a null subject language, allows:

(74) *Si_j e' detto che pro_j vinceranno.
Si_j said that pro_j will win.

In this connection, it should also be noted that *si* can, as it were, antecede itself. This happens in conditionals, as noted in the introduction:

(75) Se si ruba, si va in galera.
If si steals, si goes to prison.
If one steals, one goes to prison.

Here the two occurrences of *si* are understood as co-varying. We get a donkey-type dependency between them.

To my knowledge, no satisfactory analysis of these phenomena that does justice to the semantics of *si* is currently available. In what follows, I would like to propose that they all receive a simple and interesting account on the basis of the approach to adverbs of quantification sketched above and other independently plausible assumptions on the nature of the contructions with which *si* interacts.

3.3 The proposal

The quantificational variability of *si* make it a prime candidate to analyzing it as an indefinite within *DRT*. In the latter framework, this would lead us to interpret *si* as a variable that gets its quantificational force from the environment. In our elaboration of *DRT*'s insights, we would expect, accordingly, to be able to interpret *si* by means of a dynamic existential quantifier. A reasonable approximation to its meaning would be something like (76a):

(76) a. $\lambda P \lambda p \exists x_{arb}[C(x_{arb}) \wedge P(x_{arb}) \wedge {}^{\vee}p]$

b. $\lambda P \lambda p \exists x[\mathbf{woman}(x) \wedge P(x) \wedge {}^{\vee}p]$, where P is of type $\langle e,t \rangle$

This proposal can be best understood by comparing (76a) with (76b), viz. our proposed analysis of the meaning of the NP *a woman*. (76a) and (76b) are dynamic generalized quantifiers. They differ in two ways. First, we assume that *si* carries a distinguished index $_{arb}$ and that a variable x_{arb} carrying that index is sortally restricted to ranging over groups of humans. In other terms, the variables associated with *si* are distinct from other (sortally unrestricted) variables. This is one way of capturing the fact that *si* cannot be understood as referring to non humans. The second difference between (76) and (76b) concerns the fact that the domain of quantification in (76b) is narrowed down to the set of women. This domain in ordinary quantificational NP's is determined by the common noun (or nominal phrase) that a determiner (*a* in the case at hand) is in construction with. With *si*, however, no such restriction is explicitly provided. As we saw above, this restriction is specified by the context. A simple way to account for this is to assume that the restriction for *si* (i.e. what would be the left argument of a determiner) is given in the form of a variable C ranging over predicates. The value of this variable is set differently in differently contexts. This technique for handling context-dependency has been exploited in several occasions[12]. Eventually and hopefully it may become superfluous once context dependency will be understood better. On the basis of this hypothesis, a simple (episodic) sentence like (77a) is associated with update function in (77b):

(77) a. Si e' ballato. $\rightsquigarrow$ si'(dance')
Si danced.

b. $\lambda p \exists x_{arb}[C(x_{arb}) \wedge \mathbf{dance}(x_{arb}) \wedge {}^{\vee}p]$

The truth-conditions associated with (77b) would be expressed in *DRT* as shown in (78):

(78) x_{arb}
$C(x_{arb})$
$\mathbf{dance}(x_{arb})$

So (77b) (or (78)) says that there is a contextually salient group of people that dances (we are ignoring tense only for simplicity). This seems adequate as a rendering of the truth-conditions of a sentence like (77a). It captures the fact that *si*

[12] See for example Siegel's [25] treatment of subsective adjectives.

in an episodic sentence seems to be interpreted existentially, where the domain of quantification is restricted to humans and further restricted by contextual factors.

Before moving onto more challenging aspects of the behavior of *si*, one thing should be noted. *Si* is not a noun phrase like *a woman*. It is a clitic, viz. a verbal affix. A natural move, in this connection, might be to analyze it not as a generalized quantifier as we just did, for it doesn't really act as such (e.g. it doesn't conjoin with other generalized quantifiers). We can analyze *si*, rather, as an operation on predicates. Such an operation, call it si_{arb}, maps predicates into updates and is defined as follows:

(79) $si_{arb}(Q) = \lambda p \exists x_{arb}[C(x_{arb}) \wedge Q(x_{arb}) \wedge {}^{\vee}p]$

This treatment of *si* paralles fairly standard assumptions about the semantics of passive. Passive is quite generally viewed semantically as an operation that reduces the adicity of a relation by existentially quantifying over the slot of the relation that corresponds to the subject[13]. While passive operates on transitive verbs (i.e. verbs that are interpreted as a two- or more-place relations), si_{arb} is not so restricted: it can operate on any property and maps it into a proposition. So, the present proposal amounts to saying that semantically *si* is essentially similar to passive. This is natural in view of the known syntactic similarities between si and passive mentioned above and widely discussed in the literature.

I would like to suggest that all the observed properties of *si* follow from analyzing it as in (79). In the following section, I will consider all of them in turn.

4 Consequences

4.1 How do adverbs of quantification affect the force of *si*?

In looking at the interaction between adverbs of quantification and *si* we will limit ourselves first to cases that do not involve anaphoric dependencies between occurrences of *si*. I.e. for now we will exclude from consideration cases like (75) above. Below (in section 4.7) we will come back to the latter cases.

Adverbs of quantification either quantify over cases or over topics. For simple sentences like (69) above, repeated here, it will make no difference which readings we choose, for their different readings turn out to be equivalent.

(69) Quando si fa cosi', di solito succede un disastro.
When si does so, usually happens a disaster.
When someone does that, usually a disaster happens.

If we use *usually* as a quantifier over cases (as per the general schema in (48) above) we get:

(80) $\text{MOST}(\lambda c \exists x_{arb}[C(x_{arb}) \wedge \texttt{does_that}(x_{arb}) \wedge {}^{\vee}c])(\lambda c[\texttt{a_disaster_happens} \wedge {}^{\vee}c])$

This says that most cases where people behave in a certain way are cases where a disaster happens, which seems correct and is equivalent to the reading we would get by associating *usually* with the only possible topic in the when-clause, namely *si*. Different adverbs of quantification would result, of course, in different quantificational forces for *si*.

If the if/when clause contains other indefinites besides *si*, we would expect to have different options. We should be able to select the symmetric reading (by quantifiifying over cases) or an asymmetric one (by choosing one of the indefinites as topic). Thus we should expect the sentence to be ambiguous. That this is indeed so can be seen by considering examples like the following:

[13] See, e.g., Dowty [10] or Bach [1] for explicit proposals along these lines.

(81) Nella comunita' degli artisti, se si sceglie di vivere in un villaggio, di solito il villaggio e' pittoresco e secluso.
In the artists' community, if si chooses to live in a village, the village is usually picturesque and secluded.
Among artists, if one chooses to live in a village, it is usually picturesque and secluded.

Here the adverbial *among artists* acts as a domain restrictor for the variable associated with *si*. There are, then, three ways to understand (81). We can understand it as a claim about artists. The question that we would be seeking an aswer for, in this case, would be: among the artists that live in a village, how many live in a secluded and picturesque one? The reading of (81) that would constitute an aswer to this question is the subject asymmetric one (which will be obtained by using MOST_{arb}). Or we can understand (81) as a statement about villages inhabitated by artists. In this case we would be seeking an answer to: of the villages inhabited by artists, how many are picturesque and secluded? The reading of (81) according to which it would constitute an answer to this question is the object asymmetric one (obtained by using MOST_n, n the index of the object). Or, finally, we could be wondering about the frequency of certain choices by artists: of the pairs $\langle u, v \rangle$ such that u is an artist who lives in v, how many are such that v is pitoresque and secluded? (81), on its symmetric reading, constitutes an answer to this question (and would be obtained by choosing MOST').

As is generally the case with ambiguities of this sort, the context (i.e. the topic of the discourse, the inherent features of the situation described, etc.) may select one reading over another. For example, I think that against the set up in (82a), the most plausible reading of (82b) is the object asymmetric one:

(82) a. Non molti tipi di macchine sono dotate di batterie che non richiedono manutenzione.
Not many kinds of cars are equipped with maintainance-free batteries.

b. Se si possiede una macchina, di solito bisogna controllarle l'acqua della batteria.
If si owns a car, usually it is necessary to check to it (cl.) the water of the battery.

Here we are talking about how many cars require checking their batteries periodically. (82b) can well be true even if a lot of people own, say, a Nissan Stanza Wagon, whose battery is maintainance free.

The point of these examples is to show that when *si* occurs in an if/when close it behaves just like we would expect, given our theory of quantificational adverbs.

Let us turn now to cases where *si* occurs in a main clause with an overt quantificational adverb and no if/when clause. The relevant examples are cases like (70b) repeated here:

(70) In Italia, spesso si puo' sapere chi vincera' un concorso prima del concorso stesso.
In Italy, often si can know who will win a competition before the competition itself.
Most people in Italy can find out who will win a competition before that competition has taken place.

Here the restriction of the adverb of quantification is partly provided by the adverbial *in Italy* and partly must be reconstructed from contextual clues. In these cases *si* tends to be understood as part of the restriction. It is in fact difficult to construct cases where *si* is understood as part of the nuclear scope of the adverb

(but cf. below). There is a plausible explanation for this tendency, I believe. *Si* is an indefinite restricted by a contextually specified property. This means that the property or properties that determine the range of humans under consideration has to be somehow given in the context for the utterance to be felicitous. This in turn means that these properties will have to be known or old, viz. part of the topic rather than part of the comment, part of the restriction of the adverb rather than part of its nuclear scope. In the case at hand, therefore, (70b) will be interpreted as:

(83) MOST $(\lambda x_{arb}[\texttt{in_Italy}(x_{arb})])(\lambda x_{arb}[\texttt{in_Italy}(x_{arb}) \wedge \texttt{find_out_etc.}(x_{arb})])$

This is the very same type of construal of quantificational adverbs discussed in connection with Rooth's example (59).

While mapping *si* onto the nuclear scope is difficult, it isn't impossible, as the following example (modelled on an example by Greg Carlson) shows:

(84) In una nave Romana, di solito si tirava su l'ancora a mano.
In a Roman ship, usually si pulled up the achor by hand.

This says that for most Roman ships there was someone who would pull up the anchor without the help of any machine. The *si* here is construed as an existential quantifier under the scope of the quantifier *most*. Thus Roman ships are mapped onto the restriction of *most* and *si* into its nuclear scope.

The point that emerges from these considerations is that semantic variability of *si* under adverbs of quantification indeed seems to follow up to a considerable level of detail from our hypothesis on the semantics of *si* and our approach to quantificational adverbs.

4.2 Why is *si* a quasi-universal quantifier in generic sentences?

Obviously this is a very complex topic and we cannot do justice to it. But we can give a fairly explicit indication of the line one can follow. Consider for example a typical generic *si*-sentence like:

(85) In Olanda, si mangia aringa.
In the Netherlands, si eats herring.

The consensus which I believe emerges from current literature on genericity centers around the idea that generics involve modalized quantificational structures akin to those associated with adverbs of quantification[14]. The basic idea is that a sentence like (84) is interpreted roughly as shown (86):

(86) In Holland always, when one is hungry, not sick and more generally not in conditions that prevent eating herring, one does eat herring.

In (86) there are two important parts. One is an adverb of quantification (*always*). And the second part is the implicit restrictions on this adverb. What they are depends on the nature of the activity in question. To actually spell this out involves a lot of hard work. But the important point for us is that the basic structure of a sentence like (86) can essentially be reconducted to the structure of adverbs of quantification. A rough approximation to what (86) means would be:

(87) EVERY $(\lambda x_{arb}[\texttt{in_Holland}(x_{arb}) \wedge C(x_{arb})])(\lambda x_{arb}[\texttt{in_Holland}(x_{arb}) \wedge C(x_{arb}) \wedge \texttt{eat_herring}(x_{arb})])$

This reading would be obtained by taking *si* as the topic of an implicit *always*-like adverb of quantification. This, which is in line with what emerges from current research on this difficult topic, suffices to explain why *si* tends to have a quasi-universal force in generic contexts.

[14] See e.g. the papers collected in Krifka [19].

4.3 Why can *si* antecede reflexives?

The interpretation of reflexives involves identifying two slots in a relation. This means that given a relation R we will need an operation (call it **refl**) that identifies two slots in R, e.g. if R is two-place:

(88) $\mathbf{refl}(R) = \lambda x[R(x)(x)]$

So in fact reflexivization amounts to attributing a reflexive property to an argument[15]. Now, groups of humans however selected can of course be meaningfully attributed reflexive properties. So nothing prevents *si* from anteceding reflexives. Predicating reflexive predicates of a sortally restricted variable per se is not going to lead sortal deviance: it will depend on the nature of the predicate. The logical translation of e.g. (89a) will be as shown in (89b)

(89) a. Si e' orgogliosi di se stessi.

b. $\exists x_{arb}[C(x_{arb}) \wedge \lambda y[\mathtt{proud_of}(y,y)](x_{arb})]$

This means essentially that the relation between a reflexive and its antecedent is not direct (i.e. it is not like the relation between $\forall$ and x in $\forall x P(x)$), it is mediated by an operator, an abstractor that identifies two designated slots. If we were to represent this as a relation at LF, we might do so along the following lines:

(90) John likes himself $\rightsquigarrow$ $[John^i O^i_j[likeself_j]]$

In (90) the reflexive-antecedent relation is factored out in two components: a relation between the reflexive and an operator (to be interpreted as the operation *self*) and a predication relation between an operator and an argument (the subject in this case)[16]. This view of reflexives as operator-bound anaphoric elements seems to be needed, among other things, to handle cases of VP anaphora like (91)

(91) John likes himself and Bill does too

The VP proform *does* here has to be interpreted as self-liking. This entails that there must be a binder for the reflexive inside the VP. Williams [29] proposed a pronoun rule to do this. I think that something very similar to what Williams proposed is needed to interpret reflexives in general (and not just in VP-anaphora contexts).

I must emphasize that there are many options as to the exact status of reflexives at LF. But the point is that I know of no way of interpreting reflexives that doesn't resort at some level to an operation that identifies two arguments of a relation, creating a reflexive property. And there is no reason why we shouldn't be able to predicate such a property of humans, the range of the denotation of *si*. This is why *si* is a legitimate antecedent for reflexives.

4.4 Why can si antecede PRO?

Let us consider next the case of infinitives. Within the GB theory, infinitives are taken to be clausal structures of the form in (92).

(92) $[_S$ PRO to win]

Dowty [10], myself (Chierchia [5] [6]) and others have provided several arguments in favour of the view that semantically infinitives do not denote propositional creatures (like sets of worlds or states of affairs) but properties. This means that the control relation, exemplified in (93) must be understood as a kind of predication relation, along lines similar to what Williams [30] proposed.

[15] Explicit proposals along these lines can be found in Bach and Partee [3] and Szabolcsi [28].

[16] Another possibility is that reflexives move to INFL where they are construed (i.e. interpreted) as operators.

(93) John tried [PRO to win]

Semantically, (93) is interpreted as saying that John tries to have the property of winning. Given the assumptions we are adopting on the syntax of infinitives, this view, dubbed by Higginbotham the attributive view of control, entails that infinitives must be derived predicates, i.e. predicates that have the internal structure of a clause. An analogy with the logical syntax of the λ-abstractor may be helpful. Consider a λ-term like:

(94) $\lambda x[\mathtt{win}(x)]$ vs.$\mathtt{win}$

`Win` is a basic predicate, $\lambda x[\mathtt{win}(x)]$ a derived one. It is derived by abstracting over the fomula $\mathtt{win}(x)$. The syntax of English, it can be argued, makes a similar distinction. It also has basic, lexical predicates and derived ones, which have the internal syntactic structure of a clause. A case in point is constituted by relative clauses, like:

(95) John is a student one can rely on.

(95) says that John is a student and that one can rely on John. Thus the relative clause *one can rely on* is interpreted semantically as a predicate (attributed to John), but it clearly has the internal structure of a clause (with a gap). The attributive view of control maintains that the same holds of infinitives. Accordingly, PRO is interpreted as a λ- abstractor and the compositional semantics of (93) is simply:

(96) $\mathtt{try}(\lambda x[\mathtt{win}(x)])(j)$

This may arise as a purely interpretive procedure concerning PRO. Alternatively, there could turn out to be syntactic reasons to assume that PRO is at some syntactic level construed as (or with) an operator, say along the lines sketched in (97):

(97) [PRO to win] $\rightsquigarrow O_i[e_i \mathtt{to_win}]$

I will not take a stand on this issue here. Nor will I try to defend the attributive view of control, referring for that to the papers mentioned above. The point of relevance to our present concerns is that given the attributive theory of control, it follows immediately that *si* will be able to control, simply because it can of course enter a predication relation. Once more nothing prevent attribution of predicates to entities of the sort 'humans'. The logical representation of (98a) will simply be (98b):

(98) a. Si e' tentato di vincere.
Si tried to win.

b. $\exists x_{arb}[C(x_{arb}) \wedge \mathtt{try}(\lambda y[\mathtt{win}(y)])(x_{arb})]$

In (98), the complex predicate *try to win* is attributed to a group of humans. That seems to be all there is to say concerning *si*'s capacity to antecede PRO.

4.5 Why can't *si* antecede overt pronominals and *pro*?

Consider next the case of ordinary pronouns and of *pro*. Semantically these elements are simply interpreted as (sortally unrestricted) variables, which may be bound by a quantifier or whose value can be otherwise fixed by the context. We conjectured that *si* is an existential term with a distinguished index, designated as $_{arb}$. From this alone, it follows that the quantifier associated with *si* will be unable to bind other variables. In order for a quantifier $\exists x_i$ to bind a variable x_k, they must have the same index (i.e. it must be the case that $i = k$). But, by hypothesis, *si* carries an index distinct from the one of ordinary variables. This is a consequence of the fact that *si* is associated with variables of a special sort, restricted to ranging over

groups of human. While there might be other ways of obtaining sortal restrictions, the use of distinguished variables (or, equivalently, of distinguished indeces) is the canonical way to do it.

Attributing a predicate to a group of humans is no problem, if such a predicate can meaningfully attributed to humans. This is the basis of our account for 4.3 and 4.4. But when it comes to bind another pronoun it won't be possible across sortally different variables.

4.6 Further consequences

The generalization that emerges from the above considerations is that *si* will only be able to antecede operator bound elements, like, arguably, reflexives and PRO. This leads to try to look for other constructions that have been argued to involve operator-binding and check how *si* behaves with respect to them.

One class of cases that have been argued to involve a form of operator binding are parasitic gaps like:

(99) Here is the book that John filed without reading.

However, it turns out that we will not be able to test our prediction with parasitic gaps structures. The reason for this is that these constructions involve typically A'-binding (e.g. relativization or question formation) and *si* cannot be an A'-binder (it has no wh- counterpart and can't head relative clauses).

A class of cases where we can test the tenability of our hypothesis is provided by the long distance reflexive *proprio*. In view of its reflexive character, *proprio* must be operator-bound[17]. So *si* should be able to antecede it, and indeed this expectation is borne out:

(100) Spesso si$_i$ pensa che i propri$_i$ genitori siano creature senza sesso.
Often si thinks that self parents be (subjunc.) creatures without sex.

Another unrelated class of dependencies which are quite generally assumed to be mediated by operator-binding is constituted by tough-constructions. In Italian they are illustrated in (101a):

(101) a. Gianni e' difficile da accontentare.
Gianni is hard to please.

b. Gianni^j is hard O_i^j [PRO$_{arb}$ da accontentare t_i].

Chomsky [8] has proposed an analysis of these structure which, transposed in our current notation, would look like (101b). We should, accordingly, expect *si* to be able to control the object gap in tough-constructions. In fact, this is so:

(102) Se si e' difficili da accontentare, se ne pagano le conseguenze.
If si is hard to please, si of it (cl.) pays the consequences.
If one is hard to please, one must accept the consequences

Here *si* controls (via predication) the object gap of *accontentare*. These preliminary considerations show that our hypothesis appears to be supported beyond the data we originally considered.

4.7 Why can *si* antecede itself?

I have left the case where *si* apparently antecedes itself last, because it is of special interest to a theory of anaphora that wants to accomodate donkey-type dependencies. The most salient cases (in fact, the only cases, as we will argue) where an occurence of *si* seems to act as the antecedent of another occurrence of *si* is in conditionals like:

[17] In Chierchia [6] I have argued that there are also other independent reasons why *proprio* must be operator bound, reasons having to do with its special 'self-oriented' semantics.

(103) Senza alcuna eccezione, se si ruba si va in galera.
Without exception, if one steels one goes to jail

Let us see how this is to be analyzed. Recall that we are assuming, in line with *DRT*, that the role of if/when clauses is to restrict an adverb of quantification. When no adverb is overtly present, the presence by default of an always-like adverb is assumed. What does this predict in the case where *si* occurs both in the antecedent and in the consequent and the consequent of a conditional? It will depend by whether we go for the symmetric or the asymmetric reading. If we go for the symmetric reading, we quantify over cases and the two occurrences of *si* will be existentially quantified each by their own existential quantifier, so to speak. In this case the two occurrences of *si* will not co-vary, i.e. the second one (in the consequent) will not be understood as 'bound' by the first one (in the antecedent). If instead we go for the subject asymmetric reading, the two occurrences of *si* will be re-open (as is generally the case with asymmetric readings) and will be direclty linked by the adverb of quantification. This is what our approach predicts.

Let us flesh these predictions out by means of concrete examples, which will also enable us to test them. Consider a sentence like (104a). Its symmetric reading is going to be something like (104b):

(104) a. Se si fa cosi', non si capisce nulla.
If si does so, not si understand anything.
If one does that, one won't understand anything.

b. $\text{EVERY}'(\lambda p \exists x_{arb}[C(x_{arb}) \wedge \textbf{does_that}(x_{arb}) \wedge {}^{\vee}p])$
$(\lambda p \exists x_{arb}[C'(x_{arb}) \wedge \neg\textbf{understand_anything}(x_{arb}) \wedge {}^{\vee}p])$

(104b) has roughly the following truth-conditions:

(105) Every case in which people/someone (from a contextually specified set) does that is a case in which people/someone (from a contextually specified set) doesn't understand anything.

The two occurrences of *si* here are not dependent on one another. Each one is associated with its own existential quantifier. This does not exclude that the two occurences of *si* may in a sense be understood as covarying. The context variables C and C' in (104b) may pick the same group of people. And the only value of x_{arb} that satisfies the antecedent and the consequent might include all the members of the contextually specified group. In this case, (104a) can be understood as roughly to equivalent to something like (106):

(106) If we do that, we won't understand anything.

But this is arguably a pragmatic fact, not a matter of anaphoric dependency between the two occurrences of *si*. By playing with the context, we can make disappear the feeling of a dependency between the two occurrences of *si*. For example, it is very natural to imagine a professor uttering (104a) at a meeting with her T.A.'s in preparation for an exam. Then the value of x that satisfies the antecedent is the group of the professor with her T.A.'s. While the group that satisfies the consequent is the students. These two groups have no member in common.

This "now you see it now you don't"-effect is typical of pragmatic phenomena. I thus conclude that (104b) correctly characterizes one of the readings that (104a) has.

At the same time, we can select *si* as the topic. In this case (104a) would be interpreted roughly as:

(107) $\text{EVERY}_{arb}(\lambda p \exists x_{arb}[C(x_{arb}) \wedge \textbf{does_that}(x_{arb}) \wedge {}^{\vee}p])$
$(\lambda p \exists x_{arb}[C(x_{arb}) \wedge \neg\textbf{understand_anything}(x_{arb}) \wedge {}^{\vee}p])$

By definition of EVERY_{arb}, this is equivalent to:

(108) $\forall x_{arb}[[C(x_{arb}) \wedge \mathbf{does_that}(x_{arb})] \rightarrow \neg\mathbf{understand_anything}(x_{arb}]$
(cf. 5 in the appendix for details)

This gives us the reading according to which if x does that, x (and not somebody else) won't understand anything anymore. This reading is the one salient in (103) and gives the effects of *si* anteceding itself.

A question that arises in this connection is: is (104a) really ambiguous as our theory predicts? Couldn't it be the case that (104a) really only has, say, the reading in (104b) and that pragmatic factors trigger the understanding that the same value of x_{arb} satisfies the antecent and the consequent? The answer to this is no, for a very simple reason. A sentence like (103) can be taken to be false if a single human (from the relevant domain) steels but doesn't go to jail. If the only reading of (103) would be parallel to (104b) there would be no way to account for this fact. At the same time, (104a) cannot have just reading (108), for there are contexts where that sentence is true and yet the values of *si* that make it true are different.

There is a further prediction that our theory makes. The donkey-type effects in conditionals are due to the fact that adverbs of quantifications can associate with a topic and *si* can (and likes to be) a topic. Consequently, we shouldn't expect these affects to arise in contexts where donkey-dependencies do not arise via adverbs of quantifications, such as relative clauses. This indeed seems to be so. Consider:

(109) Ogni persona che si inviti a cena pensa che la si debba trattar bene.
Every person that si invites for dinner thinks that her si must treat well.
Every person that gets invited for dinner thinks that s/he should be treated well.

Here the pragmatic set up favours the reading where the someone who is expected to treat a guest well is the same that has invited that guest. Yet, on our semantics there is no way to get the first occurrence of *si* to bind the second. Hence, we expect that it should be impossible to take this sentence as false if there is an x such that someone is invited by x but doesn't expect him or herself to be treated well by x. And in fact, the thought described in (109) is perfectly consistent with a situation where the one who does the invitation is different from the one who is expected to be a good host. For example I can think that whenever I am invited, I should be treated well even if I know that sometimes the person who invites me and the person who actually hosts me are different. I don't think that cases parallel to (103) can be constructed using relative clauses.

It may be worth pointing out that it is not immediately obvious how to accomodate these facts within classical *DRT*. The translation of the present theory within classical *DRT* would assimilate *si* to an indefinite. So *si* would always introduce a discourse marker in the relevant box (in the terms of Kamp [16]) or would always be associated with a new variable (in the terms of Heim [13]). While this could be set up in a way as to lead to results similar to ours for most properties of *si*, it would yield only a reading equivalent to (104b) for the cases at hand and thus it would leave the fact that *si* seems able to antecede itself without an account. In order to obtain the present results, one would have to reproduce within *DRT* the present approach to adverbs of quantification.

5 Conclusions

In the present paper, I have first sketched a theory of adverbs of quantification as generalized quantifiers over cases (viewed as assignments to variables). This follows the lead of Lewis (Lewis) and subsequent work in *DRT*. Adverbs of quantification can either unselectively bind all the indefinites in a clause (but it should be noted

that unselective binding here is just a metaphor), or can select and associate with a topic. In either case, adverbs of quantification are generated by a formally simple schema from the meaning of the corresponding determiners. Furthermore, I have formulated the hypothesis that *si* is semantically interpreted in terms of an operation analogous to passive that introduces a (dynamic) existential quantifier over subjects. This hypothesis interacts with the theory of adverbs of quantification previously sketched and other independent assumptions concerning reflexives and infinitives so as to provide a rather simple account of the core quantificational and anaphoric properties of *si*. This is only a begining, for impersonal subject constructions are very complex. But the evidence we have considered suggests that the line we have undertaken is promising. The present results have been obtained within a framework where all NP's have a uniform semantics and where construction specific stipulations are reduced to a bare minimum (essentially: *si* is a context dependent indefinite).

6 Appendix

6.1 Dynamic conjunction: reductions for example (12)

$\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge {}^{\vee}p]; \lambda p[\mathtt{blond}(x) \wedge {}^{\vee}p]$
$\lambda q[\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge {}^{\vee}p](\hat{}\lambda p[\mathtt{blond}(x) \wedge {}^{\vee}p](q))]$, def. of ';' alphabetic change of variables
$\lambda q[\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge {}^{\vee}p](\hat{}[\mathtt{blond}(x) \wedge {}^{\vee}q])]$, λ-reduction
$\lambda q[\exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge {}^{\vee}\hat{}[\mathtt{blond}(x) \wedge {}^{\vee}q]]]$, λ-reduction
$\lambda q[\exists x[\mathtt{man}(x) \wedge \mathtt{walk_in}(x) \wedge \mathtt{blond}(x) \wedge {}^{\vee}q]]$, $\hat{}^{\vee}$-cancellation

6.2 Reductions for example (25)

$a^{+}(\uparrow\mathtt{man})(\uparrow\mathtt{walk})$
$\lambda P \lambda Q \lambda p \exists x[[P(x); Q(x)](p)](\uparrow\mathtt{man})(\uparrow\mathtt{walk})$, def. of a^{+}
$\lambda p \exists x[\uparrow\mathtt{man}(x); \uparrow\mathtt{walk}(x)](p)]$, λ-reduction
$\lambda p \exists x[\lambda y \lambda q[\mathtt{man}(y) \wedge {}^{\vee}q](x); \lambda y \lambda q[\mathtt{walk}(y) \wedge {}^{\vee}q](x)](p)]$, def. of $\uparrow$, alphabetic change of variables
$\lambda p \exists x[\lambda q[\mathtt{man}(x) \wedge {}^{\vee}q]; \lambda q[\mathtt{walk}(x) \wedge {}^{\vee}q]](p)]$, λ-reduction
$\lambda p \exists x[\lambda q[\mathtt{man}(x) \wedge \mathtt{walk}(x) \wedge {}^{\vee}q]](p)]$, def. of ';'
$\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{walk}(x) \wedge {}^{\vee}p]$, λ-reduction

6.3 Universal quantification

Let the logic of updates be defined as follows, for any A, B of type *up*:

negation $\sim A = \uparrow\neg\downarrow A$

disjunction A **or** $B = \sim[\sim A; \sim B]$

implication $A \Rightarrow B = \sim[A; \sim B]$

A dynamic universal determiner can then be defined as follows:
$every^{+} = \lambda P \lambda Q \lambda q \forall x[[P(x) \Rightarrow Q(x)](q)]$

6.4 Adverbs of quantification: example (41)

EVERY'$(\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{in_the_bathtub}(x) \wedge {}^{\vee}p])(\lambda p \exists y[\mathtt{love_song}(y) \wedge \mathtt{sing}(y)(x) \wedge {}^{\vee}p])$, unreduced translation of (41)
EVERY$(!\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{in_the_bathtub}(x) \wedge {}^{\vee}p])(![\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{in_the_bathtub}(x) \wedge {}^{\vee}p]; {}^{c}\lambda p \exists y[\mathtt{love_song}(y) \wedge \mathtt{sing}(y)(x) \wedge {}^{\vee}p]])$, definition of EVERY'
EVERY$(!\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{in_the_bathtub}(x) \wedge {}^{\vee}p])(![\lambda p \exists x[\mathtt{man}(x) \wedge \mathtt{in_the_bathtub}(x) \wedge {}^{\vee}p]; \lambda p[\exists y[\mathtt{love_song}(y) \wedge \mathtt{sing}(y)(x)] \wedge {}^{\vee}p]])$, definition of 'c'

$\text{EVERY}(!\lambda p\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge{}^{\vee}p])(![\lambda p\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge$
$\exists y[\mathtt{love_song}(y)\wedge\mathtt{sing}(y)(x)]\wedge{}^{\vee}p]])$, definition of ';'
$\text{EVERY}(\lambda c\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge{}^{\vee}c])(\lambda c\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge$
$\exists y[\mathtt{love_song}(y)\wedge\mathtt{sing}(y)(x)]\wedge{}^{\vee}c]])$, definition of '!'.
$\forall c[\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge{}^{\vee}c]\rightarrow\exists x[\mathtt{man}(x)\wedge\mathtt{in_the_bathtub}(x)\wedge$
$\exists y[\mathtt{love_song}(y)\wedge\mathtt{sing}(y)(x)]\wedge{}^{\vee}c]]$, definition of EVERY given in footnote 5.

6.5 Subject asymmetric readings with si

Se si fa cosi', non si capisce nulla.
If si does so, not si understand anything.
If one does that, one won't understand anything.

Definitions:
$\text{EVERY}_{arb}(A)(B) = \text{EVERY}(\lambda u_{arb}A)(\lambda u_{arb}B)$ (where for any A of type up: $\lambda u_n A$ (n any index) is defined as in footnote 8)

$$\text{EVERY} = \lambda P\lambda Q\lambda q\forall x[[P(x)\Rightarrow Q(x)](q)]$$

Translations:
si fa cosi $\rightsquigarrow \lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge{}^{\vee}p]$
non si capisce nulla $\rightsquigarrow \lambda p\exists x_{arb}[C(x_{arb})\wedge\neg\mathtt{understand_anything}(x_{arb})\wedge{}^{\vee}p]$
Se si fa cosi' di solito non si capisce nulla $\rightsquigarrow$
$\text{EVERY}_{arb}(\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge{}^{\vee}p])$
$(\lambda p\exists x_{arb}[C(x_{arb})\wedge\neg\mathtt{understand_anything}(x_{arb})\wedge{}^{\vee}p])$

Reductions:
$\text{EVERY}(\lambda u_{arb}\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge{}^{\vee}p])(\lambda u_{arb}\lambda p\exists x_{arb}[C(x_{arb})\wedge$
$\neg\mathtt{understand_anything}(x_{arb})\wedge{}^{\vee}p])$, def. of EVERY_{arb}.
$\text{EVERY}(\lambda u[\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge{}^{\vee}p];\uparrow u = x_{arb}])(\lambda u[\lambda p\exists x_{arb}[C(x_{arb})\wedge$
$\neg\mathtt{understand_anything}(x_{arb})\wedge{}^{\vee}p];\uparrow u = x_{arb}])$, def of $\lambda u_n A$.
$\lambda P\lambda Q\lambda q\forall x[[P(x)\Rightarrow Q(x)](q)](\lambda u\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge u = x_{arb}\wedge$
${}^{\vee}p])(\lambda u\lambda p\exists xarb[C(x_{arb})\wedge\neg\mathtt{understand_anything}(x_{arb})\wedge u = x_{arb}\wedge{}^{\vee}p])$, def of EVERY.
$\lambda q\forall x[[\lambda u\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge u = x_{arb}\wedge{}^{\vee}p](x)\Rightarrow\lambda u\lambda p\exists x_{arb}[C(x_{arb})\wedge$
$\neg\mathtt{understand_anything}(x_{arb})\wedge u = x_{arb}\wedge{}^{\vee}p](x)](q)]$, λ-red.
$\lambda q\forall x[[\lambda p\exists x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})\wedge x = x_{arb}\wedge{}^{\vee}p]\Rightarrow\lambda p\exists x_{arb}[C(x_{arb})\wedge$
$\neg\mathtt{understand_anything}(x_{arb})\wedge x = x_{arb}\wedge{}^{\vee}p]](q)]$, λ-red.
$\lambda q[\forall x_{arb}[C(x_{arb})\wedge\mathtt{fa_cosi}(x_{arb})]\rightarrow\neg\mathtt{understand_anything}(x_{arb})]\wedge{}^{\vee}q]$, def. of $\Rightarrow$ and tautological transformations.

References

[1] Bach, E. (1980), "In Defense of Passive", *Linguistics and Philosophy*, 3: 297-341.

[2] Bach, E., R. Oehrle and D. Wheeler (1988), *Categorial Grammar and Natural Language Structure*, Kluwer, Dordrecht and Boston.

[3] Bach, E. and B.H. Partee (1980), "Anaphora and Semantic Structure", in Kreiman and Ojeda (eds.) *Proceedings of the CLS Parasession on Anaphora*, Chicago.

[4] Burzio, L. (1986), *Italian Syntax. A GB-Approach*, Kluwer, Dordrecht and Boston.

[5] Chierchia, G. (1984), *Topics in the Syntax and Semantics of Infinitives and Gerunds*, Ph. D. Diss., University of Massachusetts at Amherst. Published by Garland, New York in 1989.

[6] Chierchia, G. (1990a), "Anaphora and Attitudes De Se" in R. Bartsch, J. van Benthem and P. van Emde Boas (eds.) *Language and Contextual Expressions*, Foris, Dordrecht.

[7] Chierchia, G. (1990b), "Anaphora and Dynamic Logic", ITLI prepublication series, University of Amsterdam.

[8] Chomsky, N. (1981), *Lectures on Government and Binding*, Foris, Dordrecht.

[9] Cinque, G. (1988), "On Si constructions and the Theory of Arb", *Linguistic Inquiry*, 19: 521-582.

[10] Dowty, D. (1982), "Grammatical relations and Montague grammar", in Jacobson P. & G. Pullum *The nature of syntactic representation*, Reidel, Dordrecht.

[11] Groenendijk, J. & M. Stokhof (1989), "Dynamic predicate logic", Amsterdam, ITLI, to appear in *Linguistics and Philosophy.*

[12] Groenendijk, J. & M. Stokhof (1990), "Dynamic Montague grammar", in *Proceedings of the second symposium on logic and language, Hajduszoboszlo, Hungary, September 5–8, 1989.*

[13] Heim, I. (1982), *The semantics of definite and indefinite noun phrases*, dissertation, University of Massachusetts, Amherst.

[14] Heim, I. (1990), "E-Type Pronouns and Donkey Anaphora", forthcoming in *Linguistics and Philosophy*, 13: 137-178.

[15] Kadmon, N. (1987), *On unique and non-unique reference and asymmetric quantification*, dissertation, University of Massachusetts, Amherst.

[16] Kamp, H. (1981), "A theory of truth and semantic representation", in Groenendijk, J., T. Janssen & M. Stokhof (eds.), *Formal methods in the study of language*, Amsterdam, Mathematical Centre, 277-322.

[17] Kratzer, A. (1989), "Stage Level vs. Individual Level Predicates", in Krifka [19].

[18] Krifka, M. (1989a), "The Relational Theory of Generics" in Krifka [19].

[19] Krifka, M. (1989b), *Genericity in Natural Language*, University of Tubingen, Technical Report.

[20] Lewis, D. (1975), "Adverbs of Quantification" in E. Keenan (ed.) *Formal Semantics*, Cambridge University Press, Cambridge.

[21] Partee, B. & M. Rooth (1983), "Generalized conjunction and type ambiguity", in Bäuerle, R., C. Schwarze, Ch. & A. von Stechow (eds.), *Meaning, use and interpretation of language*, Berlin, De Gruyter.

[22] Roberts, C. (1987), *Modal Subordination, Anaphora and Distributivity*, Ph. D. Diss., University of Massachusetts at Amherst.

[23] Rooth, M. (1985), *Association with Focus*, Ph.D. Diss., University of Massachusetts at Amherst.

[24] Rooth, M. (1989), "Indefinites, Adverbs of Quantification and Focus", ms., AT&T Bells Labs, Murray Hill, NJ.

[25] Siegel, M. (1975), *Capturing the Adjective*, Ph. D. Diss., University of Massachusetts at Amherst.

[26] Stalnaker, R. (1978), "Assertion" in P.Cole (ed.) *Syntax and Semantics 9: Pragmatics*, Academic Press, New York.

[27] Stump, G. (1981), *Formal Semantics and Pregamatics of Free Adjuncts and Absolutes*, Ph.D. Diss., Ohio State University. A revised version is published with the title *The Semantic Variability of Absolute Constructions*, Kluwer, 1985.

[28] Szabolcsi, A. (1987), "Variables in Syntax: Are There Any?" in J. Groenendijk, M. Stokhof and F. Veltman (eds.) *Proceedings of the 6th Amsterdam Colloquium*, University of Amsterdam.

[29] Williams, E. (1977), "Discourse and Logical Form", *Linguistic Inquiry*, 8: 101-139.

[30] Williams, E. (1980), "Predication", *Linguistic Inquiry*, 11: 203-238.

The ITLI Prepublication Series

1990

Logic, Semantics and Philosophy of Language

LP-90-01 Jaap van der Does — A Generalized Quantifier Logic for Naked Infinitives
LP-90-02 Jeroen Groenendijk, Martin Stokhof — Dynamic Montague Grammar
LP-90-03 Renate Bartsch — Concept Formation and Concept Composition
LP-90-04 Aarne Ranta — Intuitionistic Categorial Grammar
LP-90-05 Patrick Blackburn — Nominal Tense Logic
LP-90-06 Gennaro Chierchia — The Variablity of Impersonal Subjects
LP-90-07 Gennaro Chierchia — Anaphora and Dynamic Logic
LP-90-08 Herman Hendriks — Flexible Montague Grammar
LP-90-09 Paul Dekker — The Scope of Negation in Discourse, towards a flexible dynamic Montague grammar

LP-90-10 Theo M.V. Janssen — Models for Discourse Markers

Mathematical Logic and Foundations

ML-90-01 Harold Schellinx — Isomorphisms and Non-Isomorphisms of Graph Models
ML-90-02 Jaap van Oosten — A Semantical Proof of De Jongh's Theorem
ML-90-03 Yde Venema — Relational Games
ML-90-04 Maarten de Rijke — Unary Interpretability Logic
ML-90-05 Domenico Zambella — Sequences with Simple Initial Segments

Computation and Complexity Theory

CT-90-01 John Tromp, Peter van Emde Boas — Associative Storage Modification Machines
CT-90-02 Sieger van Denneheuvel, Gerard R. Renardel de Lavalette — A Normal Form for PCSJ Expressions
CT-90-03 Ricard Gavaldà, Leen Torenvliet, Osamu Watanabe, José L. Balcázar — Generalized Kolmogorov Complexity in Relativized Separations
CT-90-04 Harry Buhrman, Leen Torenvliet — Bounded Reductions

Other Prepublications

X-90-01 A.S. Troelstra — Remarks on Intuitionism and the Philosophy of Mathematics, Revised Version
X-90-02 Maarten de Rijke — Some Chapters on Interpretability Logic
X-90-03 L.D. Beklemishev — On the Complexity of Arithmetical Interpretations of Modal Formulae
X-90-04 — Annual Report 1989
X-90-05 Valentin Shehtman — Derived Sets in Euclidean Spaces and Modal Logic
X-90-06 Valentin Goranko, Solomon Passy — Using the Universal Modality: Gains and Questions
X-90-07 V.Yu. Shavrukov — The Lindenbaum Fixed Point Algebra is Undecidable
X-90-08 L.D. Beklemishev — Provability Logics for Natural Turing Progressions of Arithmetical Theories
X-90-09 V.Yu. Shavrukov — On Rosser's Provability Predicate
X-90-10 Sieger van Denneheuvel, Peter van Emde Boas — An Overview of the Rule Language RL/1
X-90-11 Alessandra Carbone — Provable Fixed points in $I\Delta_0+\Omega_1$, revised version