Comparative Quantifiers

by

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Abstract

The main goal of the thesis is to present a novel analysis of comparative quantifiers such as *more than three students.* The prevalent view on such expressions advocated in Generalized Quantifier Theory is that they denoted generalized quantifiers ranging over individuals – entirely on a par with expressions like *every student, some student(s),* etc. According to this view, *more than three* is a determiner (like *every*) that is, even though morpho-syntactically complex, semantically a simplex expression that can – in terms of its interactions with the syntactic environment it appears in – be viewed as denoting simply a relation between sets of individuals.

The proposal that will be developed in this thesis maintains on the other hand that expressions like *more than three* are also semantically complex. More specifically, an analysis of comparative quantifiers will be given that is fully compositional down to level of the formation of comparative determiners. The proposal is based on concepts that are independently needed to analyze comparative constructions. Three main pieces will be argued to form the semantic and syntactic core of comparative quantifiers: a degree function expressed by *MANY*, a degree description given by the numeral and the comparative relation expressed by the comparative morpheme –*er*. Importantly, each of the three pieces can be empirically shown to interact in predictably and (partially) independent ways with elements inside the quantifier as well as with elements in the matrix clause. These interactions are unexpected unless comparative quantifiers are built in the syntax. Giving a fully compositional analysis is therefore not just conceptually appealing but also required to explain new empirical generalizations. The more general enterprise that this thesis hopes pave the way is giving a uniform and fully compositional analysis of comparative quantificational structures that does not exist so far.

Thesis supervisor: Irene Heim
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Acknowledgments

It has been a great privilege to study at MIT, which provided me with an environment to learn that I can't imagine being better suited to engage my ever curious mind. Faculty, students and visitors alike create an intellectual atmosphere of collaborative effort from which I have profited in more ways than can be described in this short note. Among the people I have benefited the most are (in alphabetical order) Calixto Aguerro-Bautista, Karlos Arregi, Sjef Barbiers, Rajesh Bhatt, Jonathan Bobaljik, Marie-Claude Boivin, Noam Chomsky, Bridget Copley, Dave Embick, Kai von Fintel, Danny Fox, Elena Guerzoni, Ken Hale, Morris Halle, Irene Heim, Sabine Iatridou, Roumi Izvorski-Pancheva, Idan Landau, Meltem Kelepir, Alec Marantz, Lisa Matthewsson, Jon Nissenbaum, Maire Noonan, Gina Rendon, Jay Rifkin, Wayne O'Neil, Francesca Panzeri, Orin Percus, David Pesetzky, Norvin Richards, Uli Sauerland, Jeanette Schaeffer, Philippe Schlenker, Liz Spelke, Ken Wexler, Susi Wurmbrand, Kazukho Yatzushiro, and many others who will hopefully forgive me for not mentioning their names. It doesn't do much justice to simply list the names of these people, I hope they know how much I appreciate their intellectual as well as personal company.

The danger of living in such a stimulating environment as MIT lies in getting interested in too many things at the same time. When I couldn't ignore the need anymore to settle on a thesis project and concentrate on it, very little time was left. I am deeply grateful to my committee members Irene Heim, Kai von Fintel and Danny Fox for taking me under their wings despite the little time that was left and the much too ambitious project I had in mind. Foremost I want to thank Irene who has been supportive with her time and energy to a much higher degree than I deserved. Her ability to see through often confused ideas the core of something valuable helped me immensely to keep on going. Equally important was her incredibly acute sense for linguistic facts which helped me sort through a notoriously difficult empirical domain. She is in many ways a role model — most importantly though in her Socratic approach to theorizing which puts great value to understanding where we don't understand anymore. Working with Kai has helped me greatly in developing and sharpening ideas that seemed more like foggy impressions before talking to him. Looking back I wish I had had more time discussing things with him. Even though or probably because we were fellow students over three years, Danny is probably the person I learned most from during the time I spent at MIT. His ability to see through convoluted theories and complicated facts the bare bone structure of a theory or an argument has helped me immensely during classes and projects as well as during writing the thesis. Probably even more important is his and Jon Nissenbaum's friendship. I can't imagine surviving the ever present pressure at MIT without their help, encouragement and advice. To have had Jon as office mate for 5 years has been a wonderful privilege, both intellectually as well as personally. The numerous discussions the three of us had on all sorts of issues in linguistics and matters much more important than that have deeply shaped my way of thinking.

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Chapter 1

Amount Comparison and Quantification: Basic Questions

1.1 Introduction[1]

The main concern of this thesis is the analysis of comparative quantificational expressions as exemplified by the expressions underlined in (1).

(1) a. John read <u>more than three books.</u>
    b. John read <u>more than half of the six books</u>.
    c. John read <u>more books than papers</u>*.*
    d. John read <u>more books than Bill (did/read/read papers)</u>.
    e. John read <u>more books than there are prime numbers smaller than 5</u>*.*

A quick inspection of these expressions reveals a number of similarities in form and meaning. With respect to form one notices for instance that all of them contain the comparative items *more* and *than* as well as plural nouns. A rough characterizing of the truth-conditions, on the other hand, involves in each of the sentences in (1) the measurement and comparison of amounts/cardinalities accompanied by some form of quantification over books. For instance, a paraphrase for (1)a displaying the truth-conditions more transparently would claim that there is a set of books read by John

[1] It is not possible to provide a comprehensive survey of the literature on generalized quantifiers as well as on comparatives. The discussion is necessarily selective and organized around presenting the issues central to the thesis rather than doing complete justice to previous work.

whose cardinality is bigger than 3. Similarly, (1)b claims that there is a subset of books read by John within the contextually given set of 6 six books whose cardinality is bigger than the cardinality of any subset that contains half the books. In (1)c on the other hand, the number of books read by John is compared to the number of papers read by him, in (1)d to the number of books/papers read by Bill, etc. In all cases, then, there is an existence claim about a set of books read by John whose cardinality is compared to some other cardinality described by the comparative quantificational constructions.

The differences between the underlined expressions are confined to what the number of books read by John is compared with, i.e. what the standard of comparison is and how the standard of comparison is described in each case. In (1)a,b and e for instance the same standard of comparison – cardinality 3 – is described by the numeral *three*, a complex partitive phrase *half of the six books* and the clause *than there are prime numbers smaller than 5* respectively. In (1)c and d, on the other hand, different standards of comparison are provided by the bare plural NP *papers* and various reduced clauses such as *than Bill did, than Bill read, than Bill read papers*, etc.

The expressions in (1) are only a small sample of a much richer paradigm of comparative quantificational structures displaying the same similarities and differences sketched above. The paradigm can be easily generated by substituting various comparative relations e.g. *fewer*, *less, as many as*, *enough*, *too many*, *so* *many*, etc. for *more* (*than*).[2] Given the richness of the domain and the systematicity in the properties that are and aren't shared, naturally the following question arises:

(2) To what extent do the "surface" similarities in form and meaning among comparative quantificational structures reflect deep/structural similarities among these constructions?

Initially, it seems that the answer to this question should be framed within a uniform analysis of all comparative quantificational expressions given that these constructions express closely related meanings using overlapping sets of means to express these meanings. It is somewhat unexpected then that there is, to my knowledge, no serious attempt in the literature to give a uniform analysis of all comparative quantificational structures. In fact, there is very little work on the question in (2) to begin with despite the fact that there are two very rich and distinguished research traditions within generative linguistics that cover sub-parts of the paradigm in (1).

On the one hand, there is Generalized Quantifier Theory (GQT) which provides an analysis of expressions like *more than three books, more than half of the books* in (1)a and b as generalized quantifiers entirely parallel to the treatment expressions like *every book, some books, no books,* etc. receive. In a nutshell, the claim of GQT is that these phrases are projected from a determiner quantifier *every, some, more than three,* etc. that takes the noun phrase *student(s)* as argument to yield a quantifier phrase (QP) that denotes a generalized quantifier which can be

[2] Unfortunately, I will not be able to discuss many of these constructions, in particular equatives and counterfactual comparatives or how-many questions in any detail. Instead, I will focus on what I take to be the paradigm case and leave it for future research to extend the results to these constructions.

thought of as family of sets. The compositional semantics of generalized quantifiers therefore talks about the (lexical) meaning of determiners, the meaning of NPs and finally how the two are combined to yield a generalized quantifier. For instance, the quantifier *every student* is said to be projected from the determiner *every,* which denotes the subset relation therefore requiring two set denoting expressions to combine with to yield truth-conditions.

Comparative quantifiers such as *more than three students* are analyzed in the same way. I.e. the conglomerate *more than three* is analyzed as quantificational determiner that takes the NP *students* as argument and yields a generalized quantifier that denotes in any given universe the set of sets that contain four or more students. While it is clear that comparative determiners are internally more complex than determiner quantifiers like *every, some,* etc. GQT maintains that the internal composition of comparative determiners is irrelevant for their behavior in a sentential context. The compositional semantics of comparative quantifiers can therefore abstract away from the components that encode measurement and comparison of amounts and confine reference to these components to the meta-language description of the truth-conditions.

Expressions like *more books than Bill* however do not fit straightforwardly into this format and are therefore left unanalyzed by GQT. To find a treatment for expressions such as those listed in (1)d and e one has to consult the rich body of work on comparative constructions. This literature analyzes them as amount comparatives providing a treatment similar to the one that expressions like *taller* *than six feet, taller than Bill, a more expensive book than Bill did*, etc. receive. Crucially, explicating the compositional semantics and syntax of the components that encode measurement and comparison of amounts — which typically involve a degree function, the comparative relation and degree descriptions — seems indispensable for any insightful analysis of amount comparatives as they provide the skeleton of comparative constructions in general. Comparative quantifiers like *more than three students*, however, have not been analyzed in these terms[3] because it is not evident that an insightful analysis of the compositional semantics of comparative quantifiers needs to refer to measurement and comparison of amounts.

The only cases that have endured some property rights disputes are so called "doubly headed NPs" like *more books than papers* in (1)c and their verbal counterparts *more students read than write* that have been analyzed e.g. by Keenan(1987) and Beghelli(1994) as generalized quantifiers projected from a discontinuous determiner *more … than …* while Kennedy(2000) sketched a treatment of doubly headed NPs as comparative constructions.

The main goal of the thesis is to argue for a uniform analysis of all comparative quantificational expressions as comparative constructions. Specifically, it is argued that even the most unlikely candidates for such a treatment namely comparative determiners like *more than three* have to be analyzed as comparative

[3] Nerbonne(1994) is arguably an exception even though there is no serious attempt to generalize the analysis to run of the mill comparative constructions. See section 1.4 for more discussion. Cf. also Pinkham(1982) for some remarks about comparative quantifiers.

constructions. I.e. comparative determiners cannot be treated as "near lexical" items. Instead their internal structure needs to be explicated revealing the same components that characterize any other (amount) comparative construction: a measure function, a comparative relation and a standard of comparison. The argument is based on rather compelling evidence showing partially independent interactions between these components and material inside as well as outside of the DP.

Before proceeding any further, it is necessary to establish some terminology and background assumptions as well as notational conventions that will facilitate the discussion (section 1.2). I will then lay down the basic tenets of both approaches to comparative quantificational structures detailed enough to delimit the empirical domain that will have to be accounted for by a uniform analysis. Section 1.3 sketches the analysis of comparative quantifiers as given in the GQT tradition while section 1.4 gives the "classical" analysis of amount comparatives as well as a sketch of a treatment of comparative quantifiers based on standard assumptions about comparative constructions. Such a treatment has to my knowledge not been worked out in any detail. I will call it nevertheless "the classical approach" to contrast it with the one that I will be developing in the chapters to come. Section 1.5 concludes with an overview of the thesis.

1.2 Background Assumptions and Notational Conventions

For reasons of explicitness and to ensure a large degree of mutual intelligibility between the work presented in this thesis and the existing literature on quantification and comparatives, the discussion is placed within the Principles and Parameters framework broadly understood (cf. Chomsky(1981), Chomsky(1994)).[4] In this framework, surface structures are enriched by a variety of covert syntactic operations that yield syntactic structures called logical forms (LFs) that interface with the interpretative component. The fundamental assumption governing the interaction between syntactic structures and their interpretation is the principle of compositionality which demands that the interpretation of a complex expression is function of its parts and the way these parts are put together. Keeping the interpretative component small has proven to be a useful guiding principle in the investigation of LFs in that it puts the focus on the one hand on the syntactic operations that generate LFs with the expectation that there should be independent support for the operations and on the other on the compositional semantic properties of the lexical entries that project a given LF. Following this tradition and in particular Heim&Kratzer(1998), I will assumed a rather simple interpretive component comprised of the set of basic rules of semantic composition listed in (4) - (7) where the familiar double brackets $[\![\ ]\!]$ represent the interpretation function and $[\![\alpha]\!]^{a}$ stands for the semantic value of α under the assignment a.

[4] I believe that many of the insights and proposals made in this thesis can be stated without a deep commitment to the Principles and Parameters framework.

(3) **Terminal Nodes**

If α is a terminal node and neither an index nor a trace or pronoun, then $[\![\alpha]\!]^{a} = [\![\alpha]\!]$ (i.e. independent of the assignment function) and specified in the lexicon.

(4) **Functional Application (FA)**

If α is of the form $[\beta\ \gamma]$, then $[\![\alpha]\!]^{a} = [\![\beta]\!]^{a}([\![\gamma]\!]^{a})$ or $[\![\alpha]\!]^{a} = [\![\gamma]\!]^{a}([\![\beta]\!]^{a})$ depending on which one of β and γ is a function and which is an expression of the appropriate type to be its argument.

(5) **Predicate Modification (PM)**

If α is of the form $[\beta\ \gamma]$ and β as well as γ are of type $<e,t>$ then
$[\![\alpha]\!]^{a} = \lambda x \in D_e.\ [\![\beta]\!]^{a}(x) = 1$ and $[\![\gamma]\!]^{a}(x) = 1$

(6) **Predicate Abstraction (PA)**

If α is of the form $[\beta\ \gamma]$ and β a number (index) then $[\![\alpha]\!]^{a} = \lambda x \in D_e.\ [\![\gamma]\!]^{a[\beta/x]}$
Where $[\![\gamma]\!]^{a[\beta/x]}$ represents the semantic value of γ under the modified assignment $a^{[\beta/x]}$ which is just like a except for the assignment of x as the value of $a(\beta)$

(7) **Traces and Pronouns Rule**

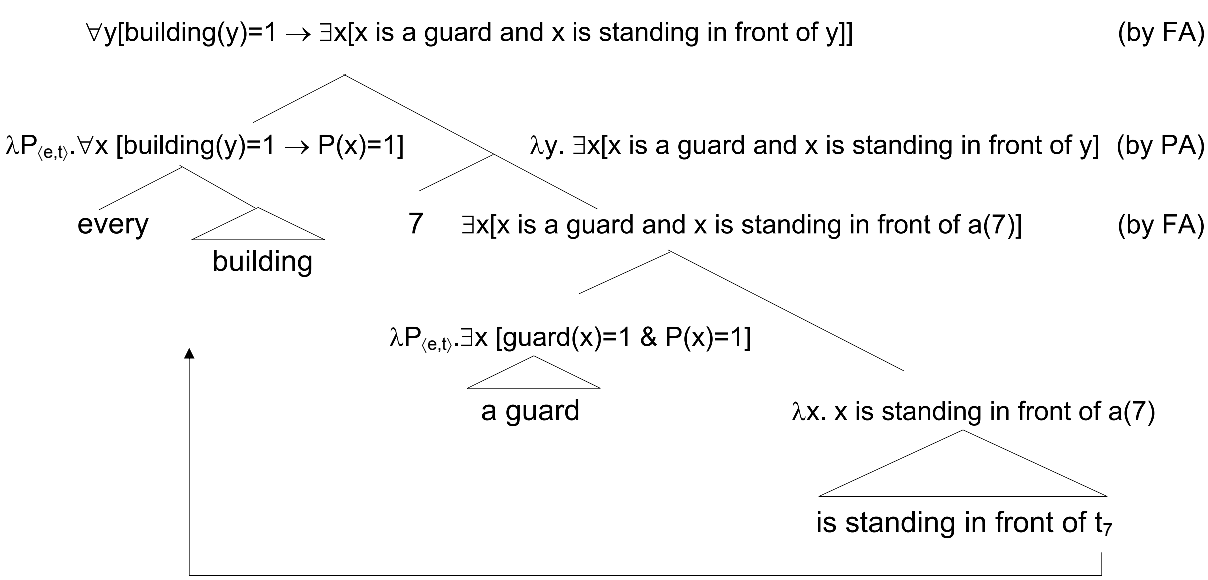
If α is a trace or pronoun with index β, then $[\![\alpha]\!]^{a} = a(\beta)$

Since the central concern of the thesis is the syntactic structure of comparative determiners as it determines their semantic composition, I will focus on the LFs of comparative determiners and the sentences they appear in and largely abstract away from surface syntactic properties such as word order if they do not affect the interpretation. Among the syntactic operations relating surface structures to LFs that will be assumed without further justification are covert (phrasal) movement operations as well as some form of ellipsis formation which relates structures that contain phonetically empty material to structures that are fully specified with respect to the semantic component. Hence, every LF that will be proposed in this thesis can be directly and fully compositionally interpreted using the semantic machinery introduced above. To give an example, the sentence in (8)a will be assumed to have the LF indicated in (8)b generated by moving covertly the phrase *every building* to a sentence initial position as indicated by the arrow. (8)c indicates the main steps in derivation of the truth-conditions of the sentence assuming the compositional machinery introduced above and appropriate lexical entries for determiners, nouns, verbs etc.

(8) a. A guard is standing in front of every building.

b. [every building $]_7$ [a guard is standing in front of t_7]

c. ⟦*A guard is standing in front of every building.*⟧^{a} = 1 iff For every building there is a guard that is standing on front of it.



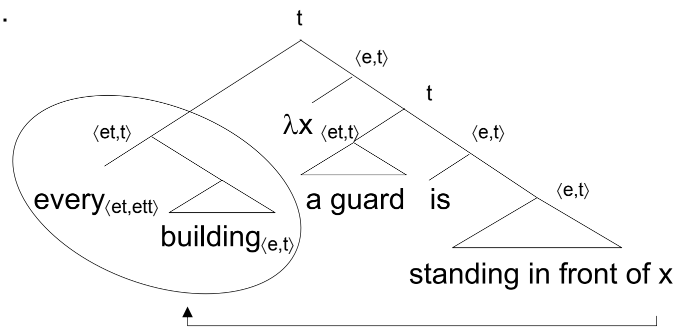
Movement leaves behind a trace in the base position of the moved constituent.[5] Furthermore, the moved phrase is co-indexed with the trace. Following Heim&Kratzer(1998), I will assume that the index on the moved constituent is adjoined to the landing site creating the configuration for predicate abstraction to apply. The sister node of the moved constituent will therefore be interpreted as predicate (type $\langle e,t \rangle$ as indicated in (8)c).

As is already obvious form the tree in (8)c, I will – in general – not provide fully explicit LFs with denotations for every node in a tree. Instead, to keep things readable and the essential parts in focus, I will use abbreviated LFs assuming appropriate denotations for parts that are not discussed. I will typically not use syntactic category labels and instead resort to annotating trees with the familiar semantic types which indicate the compositional properties of particular nodes. Furthermore, it is often convenient to use instead of the indices marking the head and trace of a chain a lambda operator followed by a variable for the head index and a variable for trace. Finally, I will abstract away from intensions whenever possible. This results in a tree structure representation for (8)a as given in (9)b below which is more concise and hopefully also more legible.

[5] Recent work (cf. Fox(1998), Sauerland(1998), etc.) argues that traces aren't simple variables as indicated in (9)c. Instead they are said to be copies of the moved phrase ("The Copy theory of Movement" cf. Chomsky (1993)) that are converted to a definite description at LF. For my purpose the precise nature of traces is not essential. Therefore, I will stick to the simpler picture and amend it only when necessary.

(9) a. A guard is standing in front of every building.

b.



In addition to the conventions about LFs and tree structures, I will employ the notational conventions listed in (10).

(10) Notational conventions

a. *Italics* are used for expressions of the object language

b. $[\![\alpha]\!]^{a}$ refers to the interpretation function that assigns an expression α its semantic value relative to an assignment function a, if there is no superscript given, it is assumed that the denotation of α is assignment independent (i.e for all assignments a,a' $[\![\alpha]\!]^{a} = [\![\alpha]\!]^{a'}$).

c. I will employ the familiar lambda notation to describe functions. For instance, the function N^{+1} which maps every natural number to its successor can be defined as: N^{+1} := f: $\mathbf{N} \rightarrow \mathbf{N}$
for all $n \in \mathbf{N}$, $f(n) = n + 1$ or more concisely
as: $N^{+1} := \lambda n{:}\ n \in \mathbf{N}.\ n + 1$

d. **Bold face** is a short hand to refer to the semantic value of the bold faced expression. No distinction is drawn between a set and its characteristic function if that should be the semantic value of an expression. For instance, the semantic value of *student* can be given as follows
$[\![\textit{student}]\!]$ = **student**: = $\{x \in D_e: x \text{ is a student}\}$ or equivalently
$[\![\textit{student}]\!]$ = **student**: = $\lambda x \in D_e.\ x$ is a student
Note that set theoretic operations are well-defined when used in conjunction with the bold face notation if the semantic value of the expression is (the characteristic function of) a set.

e. Semantic types provide a convenient shorthand to described the combinatorial properties of a given expression. I will employ e for individuals in the domain, t for truth-values, s for worlds, times, situations. Furthermore, putting any two types σ and τ within angled brackets to form the ordered pair $\langle\sigma,\tau\rangle$ represents a function from things of type σ to things of type τ.

f. The ⟨~~strike-through~~⟩ notation indicates elided material.

1.3 Comparative Quantifiers in Generalized Quantifier Theory[6]

Generalized Quantifier Theory (GQT) is primarily concerned with the analysis of quantificational expressions such as *every student, no student, some student, most students,* etc.[7] These phrases are analyzed as maximal projections of a quantificational determiner *every, no, some, etc.* and therefore often labeled "quantificational DP" (or for short QP).[8] The semantic value of the expression *every student* on the other hand is referred to as the "Generalized Quantifier" (GQ) expressed by *every student, no student, some student, etc*. The most basic occurrence of a QP is in subject position as in (11).

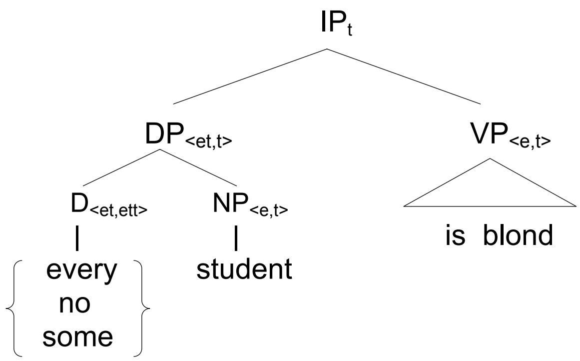
[6] It is not possible here to give a thorough overview of Generalized Quantifier Theory. I will for the most part restrict my attention to the comparative quantifiers. Readers who are not familiar with GQT are referred to Keenan(1996) and Keenan&Westerstahl(1997) among many others for introductory literature.

[7] This is not to say that GQT is not concerned with the analysis of adverbial and modal quantification, however its origins are in the analysis of determiner (or D-)quantification.

[8] Cf. Szabolcsi(1984), Abney(1987) and many after them.

(11) a. Every/no/some student is blond.

b.



Since NPs as well as VPs are analyzed as characteristic functions of sets – abstracting away from intensions - the denotation of the quantificational determiner *every* and the QP *every student* can be given as in (12)a and b respectively or equivalently employing the bold face convention as in (13)a,b.

(12) a. $[\![$*every*$]\!] = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.$ for all x st. P(x) =1, Q(x) =1

b. $[\![$*every student*$]\!] = \lambda Q_{\langle e,t\rangle}.$ for all x st. x is a student, Q(x) =1

(13) a. $[\![$*every*$]\!] = \lambda P.\lambda Q.\ P \subseteq Q$

b. $[\![$*every student*$]\!] = \lambda Q.\ \mathbf{student} \subseteq Q$

(13)a,b display more prominently one of the basic insight of GQT into the semantics of natural language quantification namely that the denotation of a QPs (i.e. the GQ expressed by the QP) is a family of sets of individuals (type <et,t>). The GQ expressed by *every student* for instance is the family of sets that contain the set of students as subset. Quantificational determiners in turn are viewed as denoting functions from sets to families of sets or – maybe more intuitively – as denoting relations between sets of individuals. For instance, the determiner *every* can be viewed as denoting the subset relation. The truth-conditions associated with a universally quantified sentence as in (14)a can therefore be given as in (14)b or equivalently (14)c employing the relational perspective.

(14) a. Every student is blond.
b. $[\![$*Every student is blond*$]\!]$ = 1 iff for all x st. x is a student, x is also blond
c. $[\![$*Every student is blond*$]\!]$ = 1 iff **student** $\subseteq$ **blond**

This treatment can be easily generalized to a variety of quantificational determiners and their Boolean combinations. The short list in (15) will suffice to demonstrate this.

(15) a. $[\![$*some student*$]\!]$ = λQ. **student** $\cap$ Q $\neq \emptyset$
b. $[\![$*some*$]\!]$ = λP.λQ. P $\cap$ Q $\neq \emptyset$

(16) a. $[\![$*no student*$]\!]$ = λQ. **student** $\cap$ Q = $\emptyset$
b. $[\![$*no*$]\!]$ = λP.λQ. P $\cap$ Q = $\emptyset$

(17) a. $[\![$*all students*$]\!]$ = λQ. **student** $\subseteq$ Q
b. $[\![$*all*$]\!]$ = λP.λQ. P $\subseteq$ Q

(18) a. $[\![$*some but not all students*$]\!]$ = λQ. **student** $\cap$ Q $\neq \emptyset$ & **student** $\cap$ (D – Q)[9] $\neq \emptyset$
b. $[\![$*some but not all*$]\!]$ = λ.P.λ**Q**. P $\cap$ Q $\neq \emptyset$ & P $\cap$ (D – Q) $\neq \emptyset$

This rather simple analysis gives an elegant way of describing the truth-conditions associated with *every, some*, *no* etc. and it fits nicely with the independently given syntax of DP constituents. Extending this treatment to quantifiers such as *most students, more than half of the students, more than three*

[9] A - B := {x: x $\in$ A & x $\notin$ B}

students, between three and nine students, exactly three students, at least/at most three students etc. is straight-forward. Here are some examples.

(19) a. $[\![$*most students*$]\!] = \lambda Q.\ |\mathbf{student} \cap Q| > |\mathbf{student} - Q|$
b. $[\![$*most*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| > |P - Q|$

(20) a. $[\![$*more than three students*$]\!] = \lambda Q.\ |\mathbf{student} \cap Q| > 3$
b. $[\![$*more than three*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| > 3$

(21) a. $[\![$*exactly three students*$]\!] = \lambda Q.\ |\mathbf{student} \cap Q| = 3$
b. $[\![$*exactly three*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| = 3$

(22) a. $[\![$*more than three but less than nine students*$]\!] = \lambda Q.\ 3 < |\mathbf{student} \cap Q| < 9$
b. $[\![$*more than three but less than nine*$]\!] = \lambda P.\lambda Q.\ 3 < |P \cap Q| < 9$

Some additional complexities, however, arise with these determiner quantifiers that are worth pointing out. First notice that in the representation of the truth-conditions associated with these determiners more than just Boolean operations over sets is needed. In particular, reference is made to the measure function "the cardinality of" as well as to cardinalities themselves and comparative relations such as "<" and "≤" that are defined for the cardinalities of a set but not the set itself. We can use this observation as heuristic for delimiting the class of comparative quantificational determiners from the view point of GQT as follows: comparative quantificational determiners are those in which the employment of the measure function "the cardinality of" and a comparative relation such as "≤" or "=" in the representation of the truth-conditional import is essential.[10] Since this heuristic makes no reference to the syntax of these determiners, expressions such as *zero, more than zero, one or more, at least one,* etc. are not comparative quantificational simply because the representation of the truth-conditions associated with them can do without any comparative machinery. The claim that is implicit in this heuristic is that there are no significant semantic generalizations that would carve out comparative quantificational determiners as identified by the syntax as natural class. Accordingly, no attempt is made in GQT to decompose comparative quantifiers any further than identifying the restrictor and nuclear scope of the generalized quantifier against the remainder. In other words, the denotation of (comparative) determiners is mechanically "factored out" from the meaning of (comparative) QPs according to the following recipe: identify the syntactic constituents that denote the restrictor and the scope of the generalized quantifier, the remainder is then called the "quantificational determiner." Attribute to the so found determiner the Boolean and comparative operations necessary to represent the truth-conditions of the generalized comparative quantifier adequately.

Following this recipe and the rather inclusive heuristic of calling everything a comparative quantifier that makes essential use of measure functions such as "the cardinality of" and comparative relations in the representation of the truth-conditions,

[10] Notice that this heuristic works only in conjunction with the assumption that determiners relate two sets of individuals. A first order rendition of *more than n* (n finite) could be given as a sequence of n+1 existential quantifiers in conjunction with a non-identity condition on their associated variables (e.g. *more than three* (A)(B)= $\exists x \exists y \exists z\ [x \neq y \neq z\ \&\ A(x)=A(y)=A(z)=B(x)=B(y)= B(z)=1]$). Similar remarks are applicable for all cardinal determiners (see discussion on sortal reducibility below).

the following list can now be given as a more extensive albeit far from exhaustive sample of the empirical domain of comparative determiners. (The labels assigned to each sub-group more or less follow Keenan(1996).

(23) Cardinal determiners

> *three, more than three, fewer/less than three, exactly three, at least three, at most three, a dozen, an even/odd number of,* etc.

(24) Indefinite, vague and intensional determiners

> *few, many, several, (in)finitely many, a few, more than just a few, approximately ten, about ten, too many/few, not enough,* etc.

(25) Proportional determiners

> *two out of (every) three, two thirds of the, ten percent of the, more than 50 per cent of the, less than one third of the,* etc.

(26) Indefinite, vague and intensional proportional quantifiers

> *many/few out of every ten, a lot of the, most(of the), more than half of the, too many out of every ten, not enough out of every ten,* etc.

(27) Two place (comparative) determiners[11]

> *more ... than ... , at least as many ... as ..., exactly as many ... as ..., the same number of ... as ...,* etc.

(28) Boolean combinations of the above[12]

> *three or four (of the), more than three but less than nine (of the), between three and nine (of the), not more than nine (of the), either fewer than five or else more than a hundred, many but not too many, not as many … as …,* etc.

[11] See below for discussion.

[12] I will not be able to discuss exceptives such as *all but two (of the),* etc.

Even this rather incomplete list of exemplars of comparative determiners suffices illustrates how rich the empirical domain is as well as the need for a systematic treatment of comparative determiners. A case in point concerns the relationship between what look to be simple comparative determiners like bare numerals like *three*, or indefinite cardinals like *many* and *few* and those that employ them e.g. *more than three, more than a few, fewer than three, two out of three, between two and five, more than two but less than five,* etc. The usual strategy in addressing this issue would be to determine the basic building blocks as well as the principles of assembling these building blocks to more complex determiners. Somewhat surprisingly, there is no attempt in QGT of pursuing this strategy that would go further than explaining the behavior of Boolean combinations of determiners as a function of the basic determiners and their Boolean combinators. All other determiners are treated as "quasi-lexical" expressions entirely on a par with determiners like *every, some,* etc. even if they appear to be complex judging from their morpho-syntactic make-up.[13] At first sight, this seems to be a fairly unattractive position as an empirical domain displaying the hallmarks of compositionality is essentially pushed into the lexicon. It is important, however, to see that an important empirical claim is hidden behind this position. Specifically, treating comparative determiners as "near-lexical" items does not necessarily entail that there couldn't be any further structure to complex determiners. Nor is it entailed that the parts that are

[13] Keenan&Westerstahl(1997: 854) for instance use the term "lexical and near lexical determiners" to refer to comparative determiners among others while van Benthem(1986) calls them "tightly knit compounds."

put together to form a complex determiner do not have their own independent meanings. Quite obviously, numerals, measure nouns as well as various kinds of comparative operators have their independent meanings and no GQ-theorist would deny that. The real claim of GQT hidden behind the label "near-lexical" is rather that whatever the basic elements and their composition are that are employed in the formation of complex determiners, these means are irrelevant for behavior of the whole conglomerate. I.e. to understand the meaning and behavior of complex determiners a compositional analysis of its internal make up is not required — they can be treated as opaque and impenetrable wholes just like idioms as far as their interaction with their syntactic environment is concerned. The only demand that comparative determiners impose on their environment is that it furnishes two sets of individuals – just like any other determiner quantifier.[14] This position gets its support from the fact that all important generalizations and classifications over determiner quantifiers are stated in terms of properties of functions that relate two sets of individuals. Comparative determiner quantifiers are no exception. To indicate weight of this argument I will give a quick overview of some of the main results of GQT and show how they apply equally successfully to comparative determiners.[15]

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[14] An analogy from physics comes to mind: The gas laws provide a very elegant and satisfactory explanation of the dependencies between pressure, temperature, volume and mol quantities of a gas even though no reference is made to the actual properties of the single molecules the gas is comprised of. A similar state of affairs could be given in the case of comparative quantifiers. Even though we know that comparative determiners are built from more basic pieces, these pieces are not independently detectable when put to the task of forming a determiner.

[15] For a more complete survey see e.g. Keenan&Westerstahl(1997).

1.3.1 Some Properties of Comparative Quantifiers

Barwise&Cooper(1981) and many researchers following them observed that the NP argument of a quantificational determiner plays a prominent role in the expression of the quantificational meaning associated with a QP. Intuitively, the NP sets the stage as to which individuals will be considered by the quantifier. It restricts the domain of quantification to those individuals that satisfy the NP predicate so that for the evaluation of a quantified statement [Det NP VP] only those individuals are considered that satisfy the NP on the one hand and among those that satisfy the VP only those that also satisfy the NP.[16] This intuition can be given in precise terms as invariance condition on determiner meanings according to which for any two VP arguments (VP1, VP2) of determiner that have the same intersection with the NP, [[Det NP VP1]] = [[Det NP VP2]] whenever NP $\cap$ VP1 = NP $\cap$ VP2. This invariance condition is known as conservativity and given in the familiar form in (29).[17]

(29) **Definition:** Conservative
A possible determiner D is <u>conservative</u> iff for all subsets A,B of the universe E, D(A)(B) = D(A)(A$\cap$B)

To check whether a determiner is conservative, we check whether both sentences in pairs of sentences exemplified in (30) have identical truth-conditions.

[16] The domain of quantification is typically further constrained by the discourse so that only a subset of the individuals in the NP extension are considered.
[17] Barwise&Cooper(1981) call it the "live-on" property.

(30) a. Every/some/no student smokes.
b. Every/some/no student is a student who smokes.

This is clearly the case for the pairs in (30) as it is for comparative determiners exemplified in (31).

(31) a. Three/more than three/ more than half of the students smokes.
b. Three/more than three/more than half of the students are students who smokes.

Comparative determiners are conservative. In fact Barwise&Cooper(1981) proposed a widely accepted universal according to which all natural language determiners are interpreted as conservative functions.

(32) **Conservativity Universal**
Natural language determiners are interpreted as conservative functions.[18]

Conservativity is intuitively a very natural property for a determiner function to have and one might wonder whether there is any content to the conservativity universal and whether it is not trivial. It is in fact easy to think of functions that relate two sets of individuals in a way that is not conservative. One such function is the Haertig quantifier H defined in (33) which is clearly not conservative.[19]

(33) $H(A)(B) = 1$ iff $|A| > |B|$.

[18] Cf. Barwise&Cooper(1981), Keenan&Stavi(1987), etc.
[19] To see that H is not conservative, consider a case were $|B| > |A|$, so $H(A)(B)=0$ but $|A| > |A\cap B|$, so $H(A)(A\cap B) =1$

Hence, the universal is not trivial. There are even natural language expressions that seem to violate the universal. Consider the sentences in (34) which employ *only* seemingly as determiner function relating the set of students with the set of smokers. (34)a and (34)b differ however importantly in that the former is contingent while the latter is trivially true.

(34) a. Only students smokes.
 b. Only students are students who smoke.

This shows that *only* is not a conservative function and therefore a potential counterexample to the conservativity universal. Rather than giving up the universal, the consensus in the field seems to be to analyze only not as a determiner quantifier parallel to items like *every* but as adverbial (focus sensitive) quantifier. While this strategy is supported by the a variety of properties that characteristic of *only* and entirely missing with regular determiner quantifiers, the flipside of this move is often neglected in the discussion of conservativity: Even though *only* is an adverbial, it clearly has the hallmarks of quantificational items (non-referentiality, scope interactions with scope bearing operators, etc.) Since it is an adverbial quantifier that is non-conservative, the conservativity universal seems to be (primarily) a property of determiner quantifiers and not a property of quantification in natural language per se. This prompts immediately the question why only determiner quantifiers are universally conservative and suggests to look for an answer in terms of the syntactic properties of determiner quantifiers.[20]

A second property that is characteristic of comparative determiners as well as a great many others is that they "logical" in the sense that they are insensitive as to the which individuals constitute the universe. I.e. no matter which individuals a given universe contains, the interpretation of determiner quantifier will not change. This intuition is given formal precision as invariance condition over permutations of the universe.[21]

(35) **Definition:** Permutation Invariance
Let π be a permutation of E (a bijection from E to E). A determiner function D is <u>permutation invariant</u> over E iff for all A,B $\subseteq$ E and all permutations π
$D(\pi(A)\pi(B)) = D(A)(A\cap B)$.

Clearly, set theoretic and cardinality properties are preserved under permutations. Hence determiner functions whose truth-conditional import is based only on set-theoretic or cardinality properties are permutation invariant. This is clearly true for

[20] cf. Winter(1998) for an attempt attributed to Chierchia(pc.), Fox (2000 class lecture) for an attempt to derive conservativity as a consequence of DP movement and the interpretation of traces.
[21] To characterize the notion of the logicality, permutation invariance should be generalized and defined globally involving comparisons of models across different universes. Cf. Keenan& Westerstahl's(1997:850) notion of "isomorphism invariance." The definition in (35) is local cf. Keenan &Westerstahl(1997:849), but should suffice to give a precise enough characterization of the intuition.

comparative determiners like *more than three, more than half,* etc. as it is for most determiners in natural language.[22]

A related notion is that of "extensionality" which describes whether a given determiner is sensitive to the size of the universe. More precisely, a determiner is extensional if it is insensitive to the growth of the universe as defined in (36).

(36) **Definition:** Extension
A determiner function D satisfies <u>extension</u> iff for all universes E, E' st. $E \subseteq E'$ and $A,B \subseteq E, E'$, $D_E(A)(B) = D_{E'}(A)(B)$ [23]

In words, as long as the universe contains both sets that are related by the determiner function the truth-conditions for D(A)(B) that are obtained for a given universe E do not change if we increase the size of the universe but leave A and B unaffected. Again, this seems to be a very natural condition on determiner meanings saying that determiners only take properties of their arguments into consideration, but are not evaluated relative to the overall size of the universe. Interestingly, there are some determiners that are not extensional in this sense. Consider (37)a. If Mary's intention is have enough bachelors so that every girl friend of hers could find a spouse, the set of bachelors has to be at least as numerous as the set of girls friends of hers. Increasing the number of girl friends will affect therefore the truth-value of (37)a and we can conclude that *enough* is not extensional. Similar

[22] However, not all determiner functions are permutation invariant. E.g. Keenan&Westerstahl(1997), Keenan(2001) analyze *all … but John* as determiner function which is clearly not insensitive to the identity of the individuals of the universe.
[23] D is a global determiner that given a universe E returns a local determiner D_E.

observations can be made about *too many, too few,* etc. Even *many* and *few* don't seem to pass the test for extensionality if they are interpreted as *more/fewer than expected*.[24]

(37) a. Mary invited enough bachelors.
b. Mary invited too many/too few bachelors.
c. Mary invited many married men/few girl friends.

Keenan&Westerstahl(1997) and Keenan(2001) distinguish three natural subclasses of determiners – intersective, co-intersective and proportional determiners - with respect to which aspect of the sets A and B in a given quantificational statement D(A)(B) the determiner is sensitive to. Intersective (generalized existential) determiner only consider A and the intersection of A and B as defined in (38)a as invariance condition from which a more intuitive statement of intersectivity in (38)b can be deduced.

(38) a. **Definition:** Intersectivity
A determiner function D is intersective iff for all A,A', B,B' $\subseteq$ E
D(A)(B) = D(A')(B') whenever $A \cap B = A' \cap B'$
b. D is intersective iff for all A, B $\subseteq$ E : $D(A)(B)=D(A \cap B)(E)$

It is easy to see that *some* and *no* etc. are intersective determiners as are many comparative determiners: *more than three*, *at least/at most three*, *many,* etc. In fact

[24] cf. Fernando&Kamp(1996) for an analysis of *many* along these terms. Cf. also Partee(1988) and Herburger(1997) among others on the semantics of *many.*

the intersective comparative determiners (among others) satisfy an even stronger condition being sensitive only to the cardinality of the intersection of A and B.[25]

(39) **Definition:** Cardinal Determiners
A determiner function D is <u>cardinal</u> iff for all A,A', B,B' $\subseteq$ E
$D(A)(B) = D(A')(B')$ whenever $|A \cap B| = |A' \cap B'|$

Co-intersective determiners base the decision on whether a given quantificational statement D(A)B) is true A – B, i.e. the set of all elements of A that are not also on B.

(40) **Definition:** Co-Intersective Determiners
A determiner function D is <u>co-intersective</u> iff for all A,A', B,B' $\subseteq$ E
$D(A)(B) = D(A')(B')$ whenever $A - B = A' - B'$

Universal determiner quantifiers like *every, all* are co-intersective as well as exceptive determiner functions that are based on a universal determiner as in *all … but John, all …but six*, etc.[26] the distinction between intersective and co-intersective ("generalized universal") determiners is significant because, as Keenan(1993) shows – the set of conservative functions is the Boolean closure of the intersective and co-intersective functions. The elements of the third class – proportional determiners – are neither intersective nor co-intersective.[27] They are sensitive to

[25] Intersectivity is a very general formal characterization of determiners that are often labeled "weak determiners" which have distinct distributional properties from strong determiners (co-intersective and proportionality determiners in Keenan's terminology) Cf. Milsark(1974) and much subsequent work.
[26] Exceptives fall out of the scope of this thesis. Cf.Hoeksema(1989), von Fintel(1994), Moltmann (1995).
[27] Although the proportional determiners over given universe can be generated via Boolean combinations of intersective and co-intersective determiners as Keenan(1993) shows. As far as I can see, Keenan's result has the weakness that a given procedure of generating a proportional

proportions defined over the intersection of A and B and the cardinality of B. Keenan's(2001) definition repeated in (50).

(41) **Definition:** Proportionality
A determiner function D is proportional iff for all A,A', B,B' $\subseteq$ E
$D(A)(B) = D(A')(B')$ whenever $|A \cap B|/|A| = |A' \cap B'|/|A'|$

Some examples are like *more than half, most, seven out of ten, at most 10%*, etc. Note that all proportional determiners are comparative determiners in the sense that reference to cardinalities and comparison of these cardinalities is essential in the representation of the truth-conditions.[28] Proportional determiners figure prominently in the history of generative linguistics because they demonstrate the principled limitations of first order languages to adequately represent the expressive power of natural language quantification (cf. Barwise& Copper(1981)).[29] To see the content of this observation, it is useful to contrast the GQT treatment of arriving at and representing truth-conditions associated with quantifiers with that of a first-order treatment.

(42) a. Every student is blond.
b. $[\![$*Every student is blond*$]\!] = [\![$*every*$]\!]([\![$*student*$]\!])([\![$*blond*$]\!])$= 1 iff **student** $\subseteq$ **blond**

determiner as Boolean compound works on locally over a given universe. However there is no global procedure to generate proportional determiners from intersective and co-intersective determiners.

[28] Even cases like *every three seconds,* which are "pure frequency quantifiers," seem to rely on cardinality expressions of some sort.

[29] Kaplan(1965) is credited by Barwise&Cooper(1981) as the first to have proven in unpublished work that *most* is not first-order definable. Another early reference on the problematic status of *most* is Parsons (1970).

(43) a. Every student is blond.

b. $[\![$*Every student is blond*$]\!]$ = 1 iff $\forall x$ (student(x) $\rightarrow$ blond(x))

c. Procedure: Identify the quantificational element (*every*), write its corresponding PL symbol ($\forall$) at the beginning of the formula followed by a variable, identify the predicates, apply them to occurrences of the variable and relate the resulting terms with the propositional operator associated with the quantifier (for *every* it is material implication ($\rightarrow$)).

While the procedure of computing a representation of the truth-conditions in the GQT format is a one-liner, something like the series of steps given in (43)c have to be performed to arrive at the representation in (43)b. One of the reasons why constructing a first order representation of the truth-conditions is considerably more complicated than the GQT treatment is the fact that quantifiers are represented as unrestricted operators in the first order formulation. This entails that some cutting and splicing has to be done distorting the syntactic constituency of quantifiers to get to a first-order representation of the truth-conditions. While many determiners of natural language can be represented as unrestricted quantifiers, the crucial observation about proportional comparative quantifiers is that there is no adequate first order representation. I.e. no matter how complicated one can imagine a procedure of cutting and splicing one cannot arrive at an adequate representation using the first order format of unrestricted quantification. Even if we were to enrich the inventory of first order quantifiers so as to represent the numerical relation *more than half* directly it can be shown that the format of unrestricted quantification doesn't fit the meaning given by *more than half NP.*[30] To make the last point – it is not simply a matter of the lexical inventory of first order quantifiers – more clearly, the notion "sortal reducibility" in (44) is useful.

(44) **Definition:** Sortal reducibility
A determiner function D is sortally reducible iff for all A,B $\subseteq$ E
D(A)(B) = D(E)(…A…B…) where '(…A…B…)' is a Boolean function of A and B.[31]

Proportional determiners are not sortally reducible which means that the format of unrestricted quantification in conjunction with Boolean operations over the two sets A and B is not rich enough. Barwise&Cooper(1981:161) point out that there are at least two possible ways in which the apparatus could be enriched to accommodate expressions like *most, more than half,* etc.

> "One possibility is to expand the domain *E* of quantification to a bigger domain *E* $\cup$ *A*, where *A* includes numbers and functions from subsets of *E* to numbers. That is, one might mirror the high-order set-theoretic definition of "more than half" in the semantics by forcing every domain *E* to contain all of the abstract apparatus of modern set-theory.
> A different approach, one that model-theorists have found more profitable, is to keep the formal definition as part of the meta-language, and treat generalized quantifiers without bringing all the problems of set theory into the syntax and semantics of logic *per se*."

The second line is the one that characterizes approach taken by Barwise&Cooper's and GQT more generally. Natural language quantification is essentially and

[30] A proof is given in Barwise&Cooper(1981). For a simple method of convincing yourself of the principled nature of this observation, consider the expressive limitations that are imposed by being constrained to Boolean operations over 2 sets in a given universe which is a simple and intuitive representation of the expressive power of first order formulas.
[31] Taken from Keenan(2001).

irreducibly restricted quantification and it is regarded as virtue of the approach that no direct connection has to be assumed between the additional machinery that is necessary to give adequate representations of the truth-conditions of comparative quantifiers such as the measure function "the cardinality of" (symbolized with the familiar $|\ldots|$) or comparative relations ($<$, $\leq$, $=$) and the syntax of comparative quantifiers. I.e. none of this additional machinery is directly associated with a particular sub-constituent of the comparative QP and there is no attempt to decompose the quantifiers any further than identifying the restrictor and nuclear scope of the generalized quantifier against the remainder.[32]

The final set of properties that should be briefly mentioned are the montonicity properties of comparative determiners. We can define the properties <u>monotone increasing</u> ("up-ward entailing"), <u>monotone decreasing</u> ("downward entailing") and <u>non-monotonic</u> for both arguments of a determiner quantifier as in (45) to (47).

(45) **Definition:** Monotone Increasing

a. A determiner function D is <u>monotone increasing wrt. its restrictor</u> ($\uparrow$D) iff for all A,A',B $\subseteq$ E: if D(A)(B) = 1 & A $\subseteq$ A' then D(A')(B).

b. A determiner function D is <u>monotone increasing wrt. its nuclear scope</u> (D$\uparrow$) iff for all A,B,B' $\subseteq$ E: if D(A)(B) = 1 & B $\subseteq$ B' then D(A)(B').

(46) **Definition:** Monotone Decreasing

a. A determiner function D is <u>monotone decreasing wrt. its restrictor</u> ($\downarrow$D) iff for all A,A',B $\subseteq$ E: if D(A)(B) = 1 & A' $\subseteq$ A then D(A')(B).

b. A determiner function D is <u>monotone increasing wrt. its nuclear scope</u> (D$\downarrow$) iff for all A,B,B' $\subseteq$ E: if D(A)(B) = 1 & B' $\subseteq$ B then D(A)(B').

[32] For a brief discussion of montonicity properties of comparative determiners see 2.7

(47) **Definition:** Non-Monotonic

a. A determiner function D is <u>non-monotonic wrt. its restrictor</u> (‡D) iff neither ↑D nor ↓D

b. A determiner function D is <u>non-monotonic wrt. its nuclear scope</u> (D‡) iff neither D↑ nor D↓

Monotonicity properties of determiners are exploited for instance in giving a general characterization of the licensing environment negative polarity items (NPIs). I.e. according to Ladusaw(1979), NPIs are licensed in the argument of monotone decreasing functions. Comparative determiners can be organized into 3 groups in term so their monotonicity properties: Comparative determiners based on *more* as in *more than three NP* are increasing with respect to the nuclear scope, those based on *fewer* as in *fewer than three NP* are decreasing and determiners based on *exactly* as in *exactly three NP* are non-monotonic. In other words, the monotonicity properties of comparative determiners with respect to their nuclear scope are predictable from the monotonicty properties of the comparative relation (>, <, =) featured in the truth-conditions of the determiner.[33,34] The same is true for the monotonicty properties with respect to the restrictor – with the important exception of proportional determiners. I.e. since the "bigger than" relation is monotone increasing

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[33] The monotoncity definitions for determiners are just special cases of more general monotonicity notions characterizing functions between ordered sets as in (i) taken from Keenan&Westerstahl (1997:841).

i. Definition: Let A and B be partially ordered sets and F a function fro A into B,

a. F is <u>increasing</u> (=order preserving) iff $\forall$a,b $\in$ A, a $\leq$ b $\rightarrow$ F(a) $\leq$ F(b)

b. F is <u>decreasing</u> (=order reversing) iff $\forall$a,b $\in$ A, a $\leq$ b $\rightarrow$ F(a) $\geq$ F(b)

c. F is <u>monotonic</u> iff Fis increasing or F decreasing.

[34] Bare numerals are typically analyzed as employing '$\geq$'. Hence they monotone increasing.

on both its arguments,[35] comparative determiners based on that relation are increasing on both arguments as well.

(48) a. $[\![$*more than three*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| > 3$ ↑D↑
b. $[\![$*fewer than three*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| < 3$ ↓D↓
c. $[\![$*exactly three*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| = 3$ ‡D‡

Proportional determiners are once more exceptional in that their monotonicity properties are predictable from the employed comparative relation only with respect to the nuclear scope. They are non-monotonic in the restrictor no matter whether they are based on *more* or *less* or exactly.[36]

(49) a. $[\![$*more than half*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| > ½|P|$ ‡D↑
b. $[\![$*less than half*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| < ½|P|$ ‡D↓
c. $[\![$*exactly than half*$]\!] = \lambda P.\lambda Q.\ |P \cap Q| = ½|P|$ ‡D‡

1.3.2 Extension to 3- and 4-place Comparative Quantifiers

The GQT treatment of comparative quantifiers and quantifiers in general sketched above is not only attractive for its simplicity and generality but more importantly has provided the framework for stating important generalizations such as the conservativity universal. Keenan&Moss(1985), Keenan(1987), Beghelli(1994), Keenan&Westerstahl(1997) etc. have extended the treatment to the more complex

[35] A generalization of the monotonicity definition to cover relations will demand for a relation R to be increasing that for any a,a',b,b', if R (a,b) and a≤a' and b≤b' then R(a',b'). Etc.

[36] The monotonicity properties of Boolean combinations of comparative determiners on the other hand are entirely predictable based on the monotonicity of the basic determiners. See Smessaert(1996) for a general discussion.

determiners that can be seen as 3-plcace or even 4-place relations between sets of individuals. Comparative determiners once more figure prominently as the examples in (50)a-c show.[37]

(50) a. More students than professors came to the party.
b. More students read than write.
c. More students read than professors write.[38]

The by now familiar strategy of providing a GQT analysis of these quantified statements results in the stipulation that there are discontinuous 3- and 4-place comparative determiner functions *more…than…* in English whose lexical entries are given in (51).

(51) a. $[\![\textit{more … than …}_1]\!] = \lambda P.\lambda Q.\ \lambda R.\ |P \cap R| > |Q \cap R|$
b. $[\![\textit{more … than …}_2]\!] = \lambda P.\lambda Q.\ \lambda R.\ |P \cap Q| > |P \cap R|$
c. $[\![\textit{more … than …}_3]\!] = \lambda P.\lambda Q.\ \lambda R.\lambda S.\ |P \cap Q| > |R \cap S|$

Beghelli(1994) shows that these determiners satisfy the appropriately generalized definitions of conservativity, extensionality, permutation invariance and intersectivity. Furthermore and interestingly, he also shows that these comparative determiners are not reducible to Boolean combinations of binary determiner quantifiers.[39] I.e. they are inherently 3- and 4-place determiners even though they seem to have a

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[37] Keenan&Moss(1984) also consider *every … and…* as in *Every man and woman came.* as 3 place determiner. An in fact, determiner functions can be fully generalized to n-place functions. Cf. Keenan&Westerstahl(1997). Keenan(2001) admits that the compelling cases of n-ary (n>3) are all comparative determiners.

[38] Obviously, this paradigm can be enriched by substituting various comparative morphemes (*as many as, fewer than, etc*.) for *more than.*

[39] Unlike determiner functions like *no … or…* (A)(B)(C) which is reducible to *no (A) and no (B)(C)*.

common core meaning *more…than*$_0$ that is expressible by a 2-place determiner. Beghelli(1994) goes on to propose a abstract comparative determiner *more _than*$_0$ as given in (52)a that provides the core of all members of the family – however does not exist as lexical item. (52)b and c show how the comparative determiners discussed in (51) a and b can be viewed as derived versions of the abstract determiner *more_than*$_0$.

(52) a. $[\![\textit{more … than}_0]\!] = \lambda P.\lambda Q.\ |P| > |Q|$

b. $[\![\textit{more … than …}_1]\!] = \lambda P.\lambda Q.\lambda R.\ [\![\textit{more … than}_0]\!]\ (P \cap R)(Q \cap R)$

c. $[\![\textit{more … than …}_2]\!] = \lambda P.\lambda Q.\lambda R.\ [\![\textit{more … than}_0]\!]\ (P \cap Q)(P \cap R)$

d. $[\![\textit{more … than …}_3]\!] = \lambda P.\lambda Q.\lambda R.\ \lambda S.\ [\![\textit{more … than}_0]\!]\ (P \cap Q)(R \cap S)$

Note that – as Beghelli(1994) himself points out – the abstract comparative determiner *more…than*$_0$ defined in (52)a is not a conservative function – it is just the Haertig quantifier mentioned above – and would if it were to exist be an exception to conservativity universal. To reconcile these puzzling observations, Beghelli's suggests that there is nothing inherently wrong with the Haertig quantifier as long as it finds a format to express its meaning in which in can obey conservativity. Since it can't as a 2-place determiner, the only realizations it has in natural language is as 3 or 4 place determiner. Obviously, this suggestion only shifts the problem of what accounts for the uniformity in meaning across 3- and 4-place comparative quantifiers to a different level. We don't want to say that the Haertig quantifier is an item of natural languages – since it doesn't obey conservativity – hence the correspondence statements formulated in (52) cannot be strictly part of the language. The correspondence relations are not between (possible) determiner meanings. Instead, a function that is not expressible by a determine quantifier has to provide the semantic core namely the comparison of cardinalities. But this basically amounts to the claim that comparative determiners encode as part of their basic meaning the comparison of cardinalities. And if we want the correspondence statements in (52) to be part of the grammar then we need to decompose comparative quantifiers to the point where the basic component of comparison of cardinalities is accessible. Hence the semantic core of comparative should be given as in (53)a which is not a determiner meaning anymore. At this point it would be possible to add the simple 2-place comparative determiners like *more than three* to the list in (52) resulting in the paradigm in (53).

(53) a. $[\![\textit{more … than}_0]\!] = \lambda n \in N.\ \lambda m \in N.\ n > m$

b. $[\![\textit{more … than …}_1]\!] = \lambda P.\lambda Q.\lambda R.\ [\![\textit{more … than}_0]\!]\ (|P \cap R|)(|Q \cap R|)$

c. $[\![\textit{more … than …}_2]\!] = \lambda P.\lambda Q.\lambda R.\ [\![\textit{more … than}_0]\!]\ (|P \cap Q|)(|P \cap R|)$

d. $[\![\textit{more … than …}_3]\!] = \lambda P.\lambda Q.\lambda R.\ \lambda S.\ [\![\textit{more … than}_0]\!]\ (|P \cap Q|)(|R \cap S|)$

e. $[\![\textit{more …than …}_4]\!] = \lambda n \in N.\lambda P.\lambda Q.\ [\![\textit{more … than}_0]\!](|P \cap Q|)(n)$

The discussion in this section shows that the GQT project of analyzing comparative determiners entirely parallel to determiners like *every*, etc. is indeed quite successful. Comparative determiners behave like any other determiner with respect to a number of properties characteristic of determiner quantifiers in natural language. However, GQT faces a potentially serious difficulty in accounting for the common core that characterizes comparative determiners. Specifically, GQT is committed to the claim that the common core of comparing cardinalities is extralinguistic. If it were linguistically encoded, it would have to be a part of all comparative determiners that itself is not a determiner, necessitating a decomposition of comparative determiners that minimally makes reference to cardinalities and a comparison operation. Of course, to show that a decomposition of comparative determiners is necessary, requires genuine linguistic phenomena that identify comparative determiners as natural class. Since finding such phenomena is not a trivial task by any means, I will present in the next section a sketch of an analysis of comparative determiners along the lines of the treatment of amount comparatives. This will allow us to identify expectations as to where to look for empirical evidence showing that a decomposition of comparative determiners is indeed required.[40]

1.4 Comparative Quantifiers as Comparative Constructions

The decomposition of comparative quantifiers I will sketch is based on the simple observation that there are comparative quantificational expressions such as amount comparatives as exemplified in (54) for which it is quite obvious that the GQT treatment of comparative quantifiers cannot be straightforwardly extended.

(54) a. John wrote down more prime numbers than Bill.
b. John wrote down more prime numbers than Bill did.

[40] A case in point that will not be discussed in this thesis might be the issue why only proportional determiners are not sortally reducible. As far as I can see, there is no deep explanation of this fact in GQT. A decomposition analysis on the other hand might provide the ingredients of an account.

c. John wrote down more even numbers than Bill did prime numbers.
d. John wrote down more numbers than there are prime numbers smaller than 5.

Abstracting away from word order, a GQT treatment of these expressions would amount to claiming that *more than Bill, more than Bill did, more than Bill did prime numbers, more than there are prime numbers smaller than 5* are determiners. Clearly one would not want to call these "near lexical" determiners. More importantly, the semantics of these "determiners" cannot be simply stated as relation between any two sets.

(55) a. ⟦*more than three*⟧ = $\lambda P.\lambda Q.\ |P \cap Q| > 3$
b. ⟦*more than Bill*⟧ = $\lambda P.\lambda Q.\ |P \cap Q| > ??$
c. ⟦*more than Bill did*⟧ = $\lambda P.\lambda Q.\ |P \cap Q| > ??$
d. ⟦*more than Bill did prime numbers*⟧ = $\lambda P.\lambda Q.\ |P \cap Q| > ??$
e. ⟦*more than there are prime numbers smaller than 5*⟧ = $\lambda P.\lambda Q.\ |P \cap Q| > |\text{prime numbers smaller than } 5|$

The only case that sort of works, is (55)e but even there one has to ignore the fact that there is a clause and recover an expression that denotes a set of individuals whose cardinality can be compared to the cardinality of the intersection of the NP argument of the determiner and the matrix VP. An attempt to extend the discontinuous determiner *more … than …* doesn't fare any better since it also requires sets of individuals to combine with. The expressions however do not furnish these sets. Since we need an analysis of these constructions in any event, the strategy will be to extend that analysis to comparative quantifiers like *more than three* as well.

1.4.1 The Basic Elements of Comparative Constructions

To get started, it is useful to provide a baseline construction from the domain of comparative constructions and model the account of comparative determiners and amount comparatives as closely as possible after that.[41] For the most part the assumptions I will introduce here follow the exposition in Heim(2000) and are entirely standard — whenever I depart from what Heim(2000) calls the classical analysis it will be noted. Consider the sentences in (56)a and (57)a and their interpretation as paraphrased in (56)b and (57)b.

(56) a. John is taller than Bill.
b. "John's height exceeds Bill's height"
c. "There is a degree d st. John is tall to that degree and Bill is not that tall"

(57) a. John is taller than six feet.
b. "John's height exceeds 6'."
c. "There is a degree d st. John is tall to that degree and d is greater than 6 feet"

In these comparative constructions John's height is compared with some standard of comparison provided by the *than*-constituent. In the case of (56) the standard of comparison is Bill's height while in (57) it is simply the degree 6'. The claim that is

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[41] The syntax of comparatives provides an intriguingly rich empirical domain that has occupied generative linguists since the 70ies (Selkirk(1970), Bresnan(1973,1975), Hankamer(1973), Chomsky (1977), Jackendoff(1977), Hellan(1981), Pinkham(1982), Napoli(1983), Heim(1985), Grimshaw (1987), Corver(1990, 1997), Hendriks(1995), Kennedy(1997,1999), Lechner(1999) many others). It is impossible to survey all the work that has been done on the syntax. Instead I will present the main questions that will be relevant for this thesis and refer the reader to the rich literature for more detail on questions that are less important.

[42] Cf. Gawron(1995), Heim(2000).

expressed specifically is that John's height is greater than Bill's height and John's height is greater than 6' respectively. Upon reflection, these truth-conditions can also be paraphrased as in (56)c and (57)c which — albeit more cumbersome — have the advantage of being more transparently related to the actual syntax of the original sentences. According to the paraphrase in (57)c, there are three essential pieces to comparative constructions: A gradable predicate or degree function expressed by *tall;* an expression referring to a degree that provides the standard of comparison and a comparative relation. The interplay between these three basic pieces of comparative constructions and their compositional semantics is quite intricate and requires a few introductory remarks.

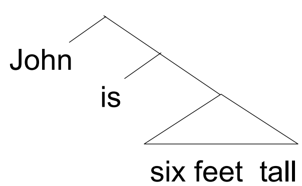
First, comparative constructions compare two degrees — in the cases above the degree of John's height and the degree of Bill's height or the degree 6 feet — and one of the main tasks of the analysis of comparatives is to explain how the two degrees that are compared are introduced and/or described by the syntactic pieces that comparative constructions are made of. Measure phrase comparatives such as (57) constitute arguable the simplest case of comparative constructions because the standard of comparison is overtly given by a measure phrase which can be taken to refer directly to a degree. I will therefore use the analysis of measure phrase comparatives as starting for developing an analysis of comparative quantifiers as comparative constructions. This is convenient since measure phrase comparatives also provide the closest match for comparative quantifiers as will become clear shortly. The second degree argument in (57) that eventually will "refer" to John's height is introduced by the gradable predicate *tall.* Gradable predicates are typically taken to denote relations between individuals and degrees. In the case of *tall* the relation holds between individuals with physical extent and degrees of height. I will assume specifically that *tall* denotes a characteristic function from degrees to (the characteristic function of) a set of individuals as described in the sample entry in (58)a. Measure phrases such *six feet* on the other hand will be treated as referring directly to a degree cf. (58)b. Given these assumptions, an elementary sentence like (59)a will have a structure as in (59)b.

(58) a. $[\![\textit{tall}]\!] = \lambda d.\lambda x.$ x is d-tall

b. $[\![\textit{six feet}]\!] = 6'$

(59) a. John is 6 feet tall

b.



Back to the measure phrase comparative in (57)a. Note that the matrix degree argument of *tall* is existentially bound in the paraphrase of the measure phrase as apparently no specific degree d to which John is tall is compared to 6 feet. The claim is simply that there is some degree d such that John is d-tall and d is greater than 6 feet. It appears then that an integral part of comparatives is a quantifier that ranges over degrees – for short a degree quantifier. Traditionally, it is assumed that the comparative morpheme *–er* does double duty. It introduces the (existential) degree quantifier as well as the comparative relation. Specifically, the idea in the classical analysis is that *–er than six feet* denotes a (restricted) degree quantifier as described in (60).

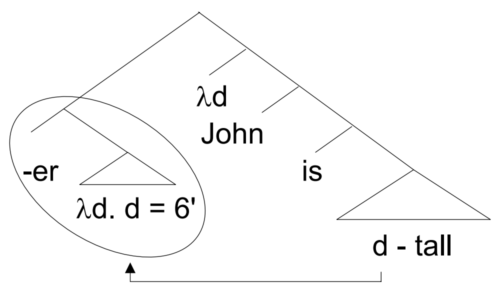
(60) ⟦*-er than 6 feet*⟧ = $\lambda D \in D_{\langle d,t \rangle}$. $\exists d$ [D(d) = 1 & d is greater than 6']

This degree quantifier is base generated in the degree argument position of tall. Since it is a quantifier, it needs to move to a clausal node to yield an interpretable structure, which results in a structure as sketched in (103).

(61) a. John is taller than 6 feet.

b. [-er than 6 feet $]_1$ [John is d_1-tall]

c.



d. ⟦*John is taller than 6 feet*⟧ = 1 iff $\exists$d st. John is d-tall & d is greater than 6'

For simplicity, it is assumed in (61) that there is no clausal node inside the AP. (Nothing in the discussion here depends on this assumption.) Hence the comparative quantifier has to move into the matrix. Movement creates a derived degree predicate with the λ-operator binding the degree trace following Heim& Kratzer(1998).

At this point a question arises: what is the set of degrees d st. John is d-tall? Degrees are elements on a scale. A scale on the other hand is an ordered set of elements. Degree functions such as *tall* express relations between individuals and degrees (elements of an ordered set), which have as inherent characteristic that they are monotone in the sense of (62). I.e. if it is true that John is 6 feet tall then it is also true that he is 5'11" inches tall and so on for every degree smaller than six feet.

(62) **Definition:** Monotonicity[42]

A function μ (type <d,et>) from degrees to sets of individuals A is monotone iff

$$\forall x \in A \text{ and } \forall d, d' \in D_d\ [x \in \mu(d)\ \&\ d' <_D d) \rightarrow x \in \mu(d')]$$

The set of degrees to which John is tall is then the set of all degrees from the bottom element of the height scale to the highest degree d on the height scale for which it is still true that John is tall to that degree.

The assumption about the quantificational force of the comparative morpheme *–er* deserves one more comment. Various proposals exist in the literature as to what the exact nature of the quantificational element in comparatives is (existential, universal, or maximal) and depending on the choice of the quantificational element what the comparison operation encoded in the comparative morpheme *–er* has to be. Since the choice is not essential to my purposes here, I will for the moment simply adopt without further discussion the proposal made in Schwarzschild&Wilkinson(to appear) and adopted by Heim(2000) which assumes a maximality operator as defined in (63) taken from Heim(2000) as part of the meaning of the comparative operator.[43]

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[43] See also von Stechow(1984), Rullmann(1995).

(63) Definition: Maximality
max: = $\lambda D_{<d,t>}$. the unique d st. D(d) = 1 & $\forall$d' [D(d') = 1 $\rightarrow$ d' $\leq$ d]

The comparative operator can now be viewed as comparing two maximal degrees given by the restrictor and scope argument. The relevant entry is given in (64).

(64) $[\![$*-er*$]\!]$ = $\lambda D_{<d,t>}$. $\lambda D'_{<d,t>}$. max(D) < max(D')[44]

In the case of measure phrase comparatives where the standard of comparison is given by a measure phrase these assumptions produce a conflict. Strictly speaking, the restrictor argument of *–er* given by the *than*-constituent has to denote a (characteristic function of a) set of degrees. To arrive at this while maintaining the basic assumption that measure phrases simply denote degrees, I propose a type-shifting operation similar to Partee's(1987) BE operation which maps an individual to its corresponding singleton. Again, the specifics of this type-shifting operation are not relevant here. I simply assume for the moment that there are two interpretations of measure phrases as given in (65)a and b.

(65) a $[\![$*six feet*$]\!]$ = 6'
b. $[\![$*six feet*$_{BE}]\!]$ = $\lambda d \in D_d$. d = 6'

Given these assumptions as well as the structure in (103) the truth-conditions that are derived are now much closer to the more intuitive paraphrases in (57)b.

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[44] Note that the lexical entry of the comparative operator defines it as a non-conservative function. If the restrictor set of *–er* is a subset if the nuclear scope set, then the maximal degree of the intersection of D and D' will be the same as the maximal degree in D.

(66) a. ⟦*John is taller than 6 feet*⟧ = 1 iff max {d: John is d-tall} > max {d: d = 6'}
b. "John's height exceeds the height of 6 feet"

In comparatives where the standard of comparison is not given directly via a measure phrase but is described by larger constituent,[45] the semantics inside the *than*-clause runs essentially parallel to the semantics in the matrix. Take (67)a – a case of comparative sub-deletion – as core example that displays the syntactic and semantic structure most transparently.

(67) a. The table is longer than the rug is wide.
b. * The table is longer than the rug is 5 inches wide.

As before, [*-er than the rug is wide*] is treated as degree quantifier that is base generated in the inner argument position of *long*. The *than*-clause itself contains its own degree function *wide.* The degree argument of *wide* however is abstracted over and cannot be filled by a measure phrase (cf. the ungrammaticality of (67)b) essentially parallel to abstraction over the argument position in a relative clause. Syntactically, we can assume that there is a silent operator that moves to the edge

[45] One of the main difficulties in the analysis of comparatives originates from the fact that there is a rich variety of possible *than*-constituents that proves to be difficult to capture under a uniform treatment of deriving a degree-predicate. The sample below gives an illustration of the variety.

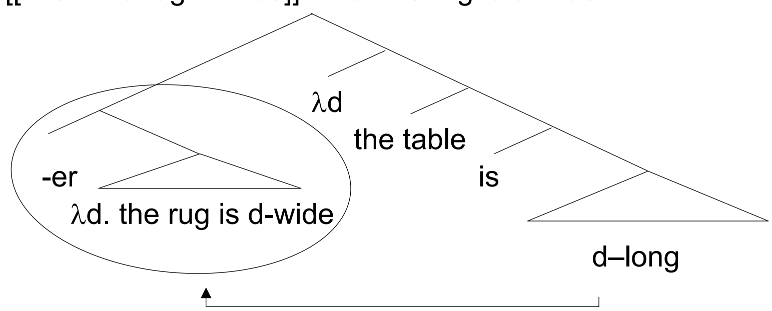
(i)	a.	John's rod is longer than 12 inches.	measure phrase comparative
	b.	John's rod is longer than Bill's feet.	phrasal comparative
	c.	John bought a longer rod than Bill.	Comparative Ellipsis
	d.	John bought a longer rod than Bill did <~~buy s d-long rod~~>.	Comparative Ellipsis
	e.	John bought a longer rod than Bill sold <~~a d-long rod~~>.	Comparative Deletion
	f.	John's feet are wider than his hands are ~~d-~~long.	Comparative Sub-Deletion

of the than-clause and A'-binds the degree trace.[46] This yields a denotation for the *than*-clause as in (68)b, which fits perfectly with the demands of the comparative morpheme *-er*. The final structure after movement of the degree quantifier is (68)c.

(68) a. The table is longer than the rug is wide.

b. [[than the rug is wide]] = λd. the rug is d-wide

c.



Comparatives that employ smaller *than*-clauses than instances of comparative sub-deletion are assumed to be semantically identical to sub-deletion however involve some form of ellipsis formation that conceals their structure.[47,48]

1.4.2 Amount Comparatives and Comparative Quantifiers

A "traditional" analysis of comparative quantifiers like *more than three* as comparative constructions follows the footsteps of the previous development of

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[46] cf. Chomsky(1977), etc. for evidence of wh-movement inside the *than*-clause and Kennedy(2000) for a summary of the syntactic properties of the *than*-clause in comparative deletion and comparative sub-deletion constructions.

[47] See Kennedy(2000) for a proposal of a uniform analysis of comparative deletion and comparative sub-deletion. See Lechner(1999) among others for a reduction of comparative ellipsis to comparative deletion plus gapping.

[48] I abstract away here from the question whether phrasal comparatives are semantically identical to clausal comparatives.

measure phrase comparatives.[49] That means we have to identify a degree function, a comparative operator that together with the than-constituent denotes a degree quantifier and a measure phrase referring to the standard of comparison.

Following Ross(1964), Bresnan(1973) and many subsequent researchers, I assume that the degree function in *more than three* is given by *many* – *more* being the morphological spell-out of *many+er. Many* itself is analyzed parallel to other degree predicates/functions such as *tall*. It takes as innermost argument a degree and then denotes (the characteristic function of) a set of individuals that are numerous to degree d.[50,51]

(69) $[\![\textit{many}]\!] = \lambda d.\lambda x.\ |x| = d$[52]

The degree argument of *many* in comparative quantifiers like *more than three* is given by the degree quantifier *–er than three* where *three* is taken to be a measure phrase referring to cardinality 3. The *than*-constituent itself on the other hand denotes the singleton containing 3. Finally, the degree quantifier *–er than three* has to move to a clausal node to yield an interpretable structure. These assumptions are summarized in (70) where – again for reasons of simplicity it is assumed that the

[49] As far as I know, nobody has attempted a "traditional" analysis as sketched here. The development is fairly straightforward and will provide a useful baseline for the proposal I will endorse in chapter 2.
[50] For the purpose of this and the next chapter it is sufficient to think of entities that are numerous to some degree as corresponding in some way to be made precise in chapter 4 to a set of individuals.
[51] See Cresswell(1976) for an alternative conception according to which plural NPs are degree functions.
[52] I will use 'x is d-many' and '|x| = d' interchangeably. See chapter 4 for a detailed discussion of what the somewhat unhappy clumsy locution 'x is d-many' amounts to.

degree quantifier can move into the matrix while the quantificational force of *more than three* can be attributed either to a silent existential Φ determiner closing off the DP [Φ d-many students].[53]

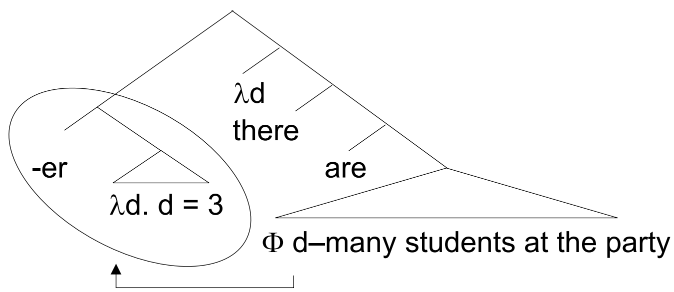
(70) a. There are more than 3 students at the party.

b. [-er than 5]$_1$ [there are d_1-many students at the party]

c. ⟦*There are more than 3students at the party*⟧ = 1 iff max {d: ∃x st. x is d-many students at the party} > max {d: d = 3}

d. "The number of students at the party exceeds/is bigger than 3"

e.



This treatment contains all the ingredients necessary to develop an analysis of amount comparatives as mentioned in (54). Again, we take the case of comparative sub-deletion as the most explicit structure and assume that some ellipsis process is responsible in cases where the *than*-clause is not fully visible in the surface syntax.

(71) a. Michael has more scoring titles than Dennis has tattoos.[54,55]

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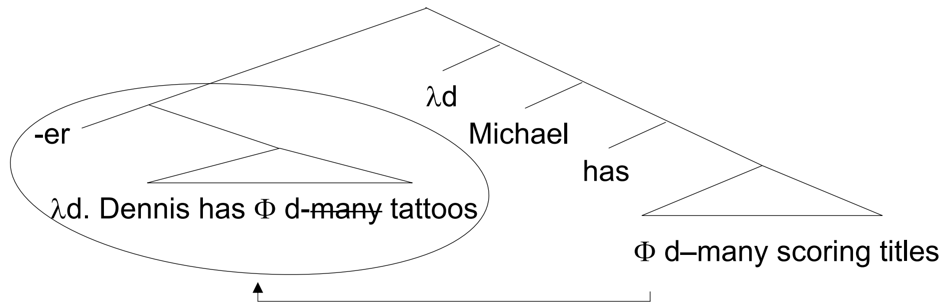
[53] Alternatively some mechanism of existential closure could be held responsible. The details are not crucial here.

[54] The example is taken from Kennedy(1997) who refers to the Chicago Tribune as the source.

[55] Note that the LF in (71)b abstracts away from the problem of QPs in object position.

b.



1.5 Three Empirical Questions

To be sure, the analysis sketched above leaves many important details of the analysis of comparative quantifiers as comparative constructions open. However, it is sufficiently detailed to contrast it with the approach of GQT to characterize the kind of empirical evidence that might require an analysis of comparative quantifiers along these lines. We have seen that the main difference between the GQT approach and the approach sketched above is how much of the comparative machinery that is essential to the truth-conditional import of comparative quantifiers is syntactically and semantically transparent. While the stance of GQT is that none of this rich machinery is semantically relevant, i.e. comparative determiners are opaque idiom-like units, the analysis of comparative determiners postulates that there are at least three pieces at work in the formation of comparative determiners. There is a degree function expressed by *many*, a measure phrase expressed for instance by a numeral and the comparative relation itself encoded as degree quantifier *–er than n*. The claim that comparative determiners are formed transparently in the syntax yields the expectation that the pieces they are comprised of – degree function, degree quantifier and measure phrase – could in principle interact independently with constituents outside of the determiner itself. More precisely, since the treatment is essentially parallel to the analysis f amount comparatives, the expectation is that comparative quantifiers show the same range of interactions between degree function, degree quantifier and degree description with material outside of the comparative construction that regular amount comparatives have. Clearly, if such evidence can be found, the GQT approach of treating comparative determiners as essentially idiomatic expressions cannot be maintained. On the other hand, if there are no detectable interactions of any of the pieces that comparative determiners are built from, the GQT point of view would be vindicated. The strategy and the organizational principle of the thesis is then to investigate whether the three pieces we have identified as providing the core of amount comparative constructions can be found to interact with material outside the determiner.

1.5.1 Detecting the Degree Quantifier: (Chapter 3)

The clearest case where we should expect to see an element of comparative quantifiers interacting independently of the other pieces with elements outside of the quantifier presents itself in from of the degree quantifier. Recall that GQT only assumes one quantificational element in comparative quantifiers, the fully compositional alternative on the other hand postulates a degree quantifier as well as an individual quantifier. Given the limited assumptions made so far, these two quantifiers should be able to take scope independently and the presence of could be detected if there is scope bearing intervening operator as schematized in (72).

(72) a. [-er than … [Op … [Φ d-many x …]]]
b. [Φ d-many x … [Op … [-er than …]]

Interestingly, there is well-know evidence from how-many questions that supports the expectation of scope splitting as described in (72)a. Consider the question in (73)a from Rullmann(1995:163) which has two possible interpretations that are paraphrases in (73)b and (73)c respectively.

(73) a. How many books does Chris want to buy?
b. What is the number n such that there are n books that Chris wants to buy?
c. What is the number n such that Chris wants it to be the case that there are n books that he buys?

Of interest to our purposes is the reading paraphrased in (73)c in which a modal operator apparently intervenes between the degree quantifier and the individual quantifier. The reading in question is therefore an instantiation of scope splitting as schematized in (72)a which cannot be explained unless two independent quantifiers are assumed. This observation buy itself is not yet detrimental to the GQT approach to comparative quantifiers simply because one could retreat to the position that *how-many* questions need not be analyzed as generalized quantifiers to begin with. Furthermore, similar scope splitting data with run of the mill comparative quantifiers have not been discussed to my knowledge. I will discuss this issue further in chapter

3 and provide clear data that show scope splitting with comparative determiners in specific contexts as well. Furthermore, it will be shown that comparative determiners display scope splitting exactly to the same that regular amount comparatives do, lending further credence to the claim that they are in terms of they are built in the syntax employing the same building blocks.

1.5.2 Detecting the Degree Function (Chapter 4)

The second set of contrasting expectations turns on the specific properties of the degree function *many* assumed to be an integral part of comparative determiners according to the comparative quantifiers as comparative constructions hypothesis. The property of interest that will be discussed in some detail in chapter 4 is that degree functions are defined only for individuals that can have the gradable property in question to some degree. In the case of *tall* for instance every individual that is said to be tall to some degree has to have some physical extent that can be measured in terms of height. The analogous expectation for amount comparatives is that only individuals that can be said to be numerous to some degree should be in the domain of the degree function *many.* I will argue in chapter 4 that this requirement of *many* is satisfied if the individuals are pluralities. This reasoning holds the key to giving a principled analysis of plural marking (in English) on NPs of a certain set of determiner quantifiers and is supported by the fact that amount relatives impose the same restrictions on their NP arguments as comparative determiners do. I will argue furthermore, that this account will lead to an insightful account of certain restrictions that comparative quantifiers are subjected to in conjunction with a particular class of collective predicates. Again, amount comparatives are shown to obey exactly the same restrictions that comparative quantifiers obey, lending further support to the proposal developed here. The point against the GQT approach to comparative quantifiers is essentially the same as above. Only if it is assumed that *many* is transparently at work in the formation of comparative determiners is it possible to detect its presence via interactions with material outside of the determiner such as the NP. Clearly for the GQT approach none of the properties of the degree function should be detectable.

1.5.3 Detecting the Measure Phrase (Chapter 2)

The final class of evidence that potentially distinguishes between the two approaches concerns the detectability of the measure phrase/numeral in comparative quantifiers. The next chapter discusses a variety facts that indicate quite compellingly that the measure phrase is indeed detectable as such <u>independent</u> of the comparative operator and the degree function *many*. These observations are initially equally puzzling for both the GQT approach and the "classical comparatives" approach discussed above. The important point however is that for the analysis of comparative quantifiers as comparative constructions such interactions are <u>in principle</u> within the realm of possibilities since the formation of comparative quantifiers is entirely compositional. The necessary amendments to account for these observations are therefore fairly natural while they would be quite out of character for the GQT approach.

To summarize then, the main point of contention between the two approach to comparative quantifiers discussed here is whether the presence of the three essential pieces of comparative quantifiers (degree function, degree quantifier and degree description/measure phrase) can be detected via interactions between them and elements in the DPs as well as the matrix. While the core claim of GQT is that such interactions do not exist, an analysis in terms of the independently needed syntax and semantics of comparative constructions in principle allows for this and in some limited cases even predicts such interactions.

The following chapters of the thesis investigate each of these questions. Chapter 2 is concerned with interactions of the measure phrase with the matrix predicate. Chapter 3 discusses interactions between the degree quantifier and the matrix and chapter 4 discusses effects of the presence of the degree function *many* inside comparative quantifiers. The finding in each case will be that such interactions do exist supporting the main claim of the thesis: Comparative quantifiers are formed entirely compositionally in the syntax. I.e. one has to recognize a syntactically realized module of amount measurement and comparison that can be shown to interact with elements inside the DP as well as the matrix. These interactions are unexpected for the idioms view, which will therefore be argued to be empirically inadequate.

Chapter 2

A Comparative Syntax for Comparative Determiners

2.1 Introduction

In chapter 1 the generalized quantifier approach to comparative quantification was contrasted with an analysis in terms of comparative syntax and semantics. The fundamental difference between the two approaches lies in how much of the comparative machinery is directly and transparently encoded in the syntax. While GQT maintains that none of the pieces that are essential to the truth-conditions of comparative quantifiers are syntactically transparent the analysis in terms of comparative syntax and semantics in principle allows and in limited cases predicts interactions between degree descriptions, measure function and comparative operator on the one hand and elements in the DP as well as the matrix on the other.

The present chapter discusses interactions between measure phrases and the matrix predicate. These facts are equally unexpected for both approaches to comparative quantification. I will argue that only the comparatives approach can be suitably amended to give a principled account of these facts. The amendment of the GQT approach to explain the data — although feasible — can be achieved only at the expense of giving up the systematic coverage of comparative quantifiers (cf. the discussion in the appendix). The modification of the comparatives approach on the other hand has to recognize an important insight of GQT, namely that quantification in natural language is essentially sortal. The proposal made in section 2.4 proposes a novel account for amount comparatives that merges the core insights from both approaches in the concept of a "parametrized/gradable determiner." This proposal yields surprising predictions for a variety of contexts that will be investigated in the subsequent sections and in chapter 3.

2.2 The Minimal Number of Participants Generalization with Comparative Determiners

Recall that the important claim of GQT is that there are no interactions between the pieces comparative determiners are made of and elements in the DP or the matrix. One instantiation of this general claim is the prediction that denotationally equivalent determiners behave uniformly - modulo independent differences. A case in point is the contrast in (74).

(74) a. ?? More than one student is meeting.[56]
b. At least two students are meeting.

Denotationally, *more than one* and *at least two* are equivalent if we restrict our attention to natural numbers and keep explicit or implicit reference to fractions out of

[56] For some speakers, (74)a gets better with an overt partitive as in (i) below. At this point, I have nothing to offer to explain the judgments of these speakers.

(i) a. More than one of the students are meeting.

the picture.[57] They even share the same set of monotonicity properties – both are increasing in both of their arguments. In fact, there is no readily available and independently motivated semantic property that distinguishes these two determiners hence the difference that accounts for the contrast in (74) cannot be located in the semantics. Winter (1998) proposes therefore that morphological number marking is the essential distinguishing factor. Specifically, plural agreement of the NP associated with the determiner *at least/no fewer than two* triggers the application of a special interpretation rule "dfit" ("determiner fitting") that is required by predicates like *meet* to yield an acceptable interpretation.[58] Winter's proposal is a natural development of GQT that attempts to incorporate plurality into the GQT-framework.[59] Even though it is a rich and well-worked out proposal it can easily be shown to be not general enough to cover a much more general phenomenon of which the contrast in (74) is just a limiting case.

First, under Winter's account morphological number marking is predicted to effect the grammaticality of sentence pairs contrasting *more than one NP* and *at*

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[57] D. Fox (p.c.) points out that examples as the following two sentences are not equivalent because *eating more than one apple* leaves the possibility open of eating one apple plus some part of another apple which would be overall less than what is required by *eating at least two apples*.

(i) a. John ate more than one apple
b. John ate at least two apples

To control for this complication the data discussed in this chapter do not allow an interpretation of *more than n* as equivalent to *at least n + 1/m* (n,m $\in$ N) for pragmatic reasons. This is obviously the case in the example in (74) since one student plus some part (smaller than the whole) of another student can't be meeting.

[58] A detailed discussion of the specifics of Winter's proposal is not crucial for the argument I present in this section.

[59] Cf. e.g. Link(1987), Van der Does(1991,1994,1996), among many others for proposals and discussion of issues that arise in attempting to develop GQT to be able to accommodate plurals.

least two NP only if the DPs are in positions that enter into number agreement with the VP. For English this means that only the subject position should show the contrast. This is however not correct. Specifically, a similar contrast to the one in (74) between *more than one* and *at least two* can be reproduced in the object position of predicates such as *separate* as shown in (75).

(75) a. ?? John separated more than one animal.
b. John separated at least two animals.

Amending Winter's proposal to these cases would amount to claiming that the VP (possibly including the subject) is semantically plural even though it agrees in number with the singular subject.[60] This move removes of course much of the force of the argument to make morphological number marking responsible for the contrast in (74). Worse even, the contrasts in (74) and (75) can be replicated with plural marked NPs in connection with predicates that require a higher number of participants than two.

To begin with, consider the examples in (76). The judgment, that my informants give on these sentences is very similar to the ones they give for (74)a and (75)a. Importantly, all of these examples involve plural marked NPs agreeing with the predicate in number, yet they are quite awkward. Furthermore, the oddness

[60] There is course evidence that plural objects effect the interpretation of the predicate. One widely discussed phenomenon is cumulative interpretations (cf. Scha(1981) and section 3.3 for discussion). The point against Winter's proposal is that these phenomena are too general to be linked to morphological agreement between object and verb or VP.

is independent of the specific particle, i.e. *more than* as well as *at least* are equally awkward with these predicates.

(76) a. ?? More than two/at least three students dispersed
b. ?? More than two/at least two policemen surrounded the bank.

At an intuitively level, it is rather obvious what goes wrong in these examples: *dispersing*, *surrounding the bank*, etc. are predicates that require more than just two or three participants to be well-formed. It is infelicitous to use them with subjects that leave the possibility open that smaller sets than required by the VP are involved. A bit more formally, we can say that predicates like *meet, gather, disperse, etc.* have a (lexically specified) minimal number of participants that the number specification of the subject NP conflicts with. *Meeting* involves 2 or more participants, *dispersing* requires some number that is sufficient to represent a crowd, etc. This simple observation suggests that the morphological number marking is not at the heart of the phenomenon under discussion.

A purely pragmatic account of these facts seems to be attractive at first sight but it can be easily shown to be not sufficient. One could argue that since the lexical meaning of predicates such as *meet, gather, disperse* comes with a minimal number of participants requirement, statements that include the minimal number or even a number below the minimal number as possibility are pragmatically awkward. Since the minimal number is already given by the predicate, such sentences would at best be un-informative in the case where the comparative quantifier ranges over sets of the size of the minimal number requirement or bigger or conflict with the number requirements of the predicate in cases were the quantifier ranges over sets smaller than the number requirements of the predicate. Note however, that this story cannot account for the full paradigm as it would predict *at least n* where n is the minimal number of participants as specified by the predicate to be awkward just as much as *more than n-1* is – contrary to fact. Hence, a purely pragmatic account might cover the cases in (76), however the contrast between *more than n-1* and *at least n/no fewer than n* remains unexplained.

The paradigm in (77) - (79) suggests that it is possible to generalize the contrast between *more than n-1* and *at least n*/*no fewer than n* systematically for all n >1 (n $\in$ N) as described in (81). The predicates get increasingly artificial with n increasing and the judgments accordingly difficult, however the contrast – subtle as it is – remains remarkably stable throughout the paradigm.

(77) a. ?? More than one student is meeting.
b. At least/no fewer than two students are meeting.

(78) a. ?? More than two students were forming a triangle.
b. At least/no fewer than three students were forming a triangle.

(79) a. ?? More than three students were standing in square formation.
b. At least/no fewer than four students were standing in square formation.

It will suffice for the purpose of the present discussion to assume that the minimal number requirement of predicates like *meet, disperse, form a triangle* etc. is (lexically) encoded as definedness condition. I.e. these predicates — let's call them "minimal number predicates" or VP_n where n is the minimal number — are defined only for arguments that correspond to sets of individuals with cardinality n or bigger.[61] Sample entries are given in (80)a-c, the general format is given in (80)d.

(80) a. $[\![meet]\!]$ = λx: x corresponds to a set of individuals with at least 2 members. x is meeting
b. $[\![gather]\!]$ = λx: x corresponds … with at least 3 members. x is gathering
c. $[\![\text{stand in square formation}]\!]$ = λx: x corresponds …with at least 4 members. x is standing in square formation[62]
d. $[\![VP_n]\!]$ = λx: x corresponds …with at least n members. VP(x) =1

With the help of this notation we can state the first still preliminary generalization about denotationally equivalent comparative quantifiers in conjunction with minimal number predicates.

The Minimal Number of Participants Generalization (preliminary version)

For all VPs with a minimal number of participants requirement n (VP_n), n > 1 ($n \in N$),

(81) a. *?? More than n-1 NP VP_n.*
b. *At least/no fewer than n NP VP_n.*

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[61] The question whether these arguments should be thought of as sets or individual sums is irrelevant for the present discussion. I will use the term "correspondence to a set" as cover term to abstract away from any specific choice.

[62] Assuming that *standing in square formation* has a minimal requirement of 4 as given in (80)c is glossing over a non-trivial issue. Presumably the minimal number presupposition comes from *square formation* and is inherited by the whole VP *standing in square formation.* The issue is under which circumstances minimal number presuppositions are inherited by larger constituents. For the case of *standing in square formation*, this can probably be subsumed under general principles of presupposition projection. However, cases where a simple numeral in conjunction with a certain predicate generates a minimal number definedness condition such as in (84)a and (85)a are harder to accommodate. Since these questions are not essential to the present purpose I leave it for future research to develop a general account of minimal number presuppositions that arise only as combination of elements that by themselves do not have such a presupposition.

The contrast described in generalization (81) can be replicated for object positions although it is increasingly difficult to find good predicates with a minimal number of participants requirement that is bigger than 2. The contrast in (83) represents such a case.

(82) a. ?? John separated more than one animal.
b. John separated at least/no fewer than two animals.

(83) a. ?? John arranged more than two students in triangular formation.
b. John arranged at least/no fewer than three students in triangular formation.

Similar contrasts can be constructed with a variety of predicates, in fact there seem to be few limitations aside from our imagination to finding examples that display the minimal number of participants generalization in one way or other. For instance, any argument slot and even adjuncts can have this property given a suitable choice of the other arguments. (84) displays the contrast with indirect objects and (85) with an instrument adjunct/prepositional argument.

(84) a. ?? To make sure that no one gets more than one candy, John distributed the 10 candies to more than 9 kids.
b. To make sure that no one gets more than one candy, John distributed the 10 candies to at least/no fewer than 10 kids.

(85) a. ?? To make sure that each of the 10 kids got at least one, John paid them with more than 9 candies.
b. To make sure that each of the 10 kids got at least one, John paid them with at least/no fewer than 10 candies.

There are even predicates that seem to distinguish between odd and even number of participants as can be seen in the examples (86) and (87) below.

(86) a. ?? More than 9 people got married to each other at 3 pm last Sunday.
b. At least/at most/no fewer than/no more than 10/8 people got married to each other at 3 pm last Sunday.

(87) a. More/fewer than/at least/most 10 students were grouped into two equal halves/groups.
b. ?? More/fewer than/at least/most 9 students were grouped into two equal halves/groups. [63]

For predicates like *get married to each other* the minimal number of participants generalization will in fact surface as contrast between *more than/fewer than* n_{even}*-1 NP* VP_{even} and *at least/at most/no fewer than/no more than* n_{even} *NP* VP_{even}. Likewise, for *be grouped into equal halves/groups,* on the other hand, odd numbers are awkward while even numbers will come out fine. Accordingly the

[63] At this point, an alternative take on the Minimal Number of Participants Generalization can be shown to be wrong. Recall from footnote 49 that *more than n-1* and *at least n* are equivalent only as long as fractions are kept out of the picture. All the examples in the text use predicates that control for this. However, one could argue that at the level where the comparative determiner is interpreted the distinction between natural numbers and rational numbers is not yet made. All that the semantics gives us for *more than n-1* is n-1 + 1/m (m>0). Hence, *more than n-1* leaves the possibility open that n-1 + 1/m NP VP_n which would violate the minimal number requirement of the VP and is therefore awkward in contrast to *at least n* which does not violate the minimal number requirements of the VP. If this were correct, however, then (87)c is predicted to be good because 10 + 1/m (m>0) students can be split into unequal groups. Arguing that with respect to the predicate *group into two unequal groups*, 10 is equivalent to 10+1/m (m>0) because only odd numbered sets can satisfy the number requirement of the predicate removes the force of the argument.

oddness is now attested with *at least/at most/no fewer than/no more than* n_{even} *NP* VP_{even} while *more than/fewer than* n_{even}*-1 NP* VP_{even} comes out ok.[64]

These examples show that the contrast is independent of the determiner particles *at least, no fewer than, at most, more than, etc.* and their associated semantic properties such as monotonicity. Decreasing as well as increasing quantifiers are equally sensitive to the generalization and — depending on the specific number of participants requirement of the predicate — can be felicitous or infelicitous. What all these facts suggest is quite surprising: the numeral seems to "projects out" of the DP even though it is deeply embedded in it to clash or match with the predicate. I.e. the oddness of the (a-) examples in these pairs is the same that we would get if we were to interpret *n-1 NP* VP_n.[65]

(88) a. ?? One student is meeting.
b. Two students are meeting.

(89) a. ?? Two students were forming a triangle.
b. Three students were forming a triangle.

(90) a. ?? Three students were standing in a square.
b. Four students were standing in a square.

(91) a. ?? 9 people got married to each other at 3 pm last Sunday.
b. 10/8 people got married to each other at 3 pm last Sunday.

[64] For "even/odd predicates" a more appropriate statement of the Minimal Number of Participants Generalization would be in terms of "proper minimal number of participants" rather than minimal. Throughout the thesis, I will use minimal to cover also these cases of proper number of participants.

[65] The reported judgments rely on embedding these sentences in a context that suppresses scalar implicatures for bare numeral DPs.

The generalization should therefore be stated in terms that reflect this parallelism.[66] In full generality, the Minimal Number of Participants Generalization can be given as in (92).

(92) The Minimal Number of Participants Generalization (general version)

For all m-place predicates with a (proper) minimal number of participants requirement n on the m'-th argument slot (in short $P_n^{m'}$), $n \geq 2$/n even/ etc. ;$1 \leq m' \leq m$; $n,m,m' \in N$ [67]

(93) a. $P_n^{m'}$ *(more than/etc. n-1 NP)* $^{m'} =_{in\ status} P_n^{m'}$ *(n-1 NP)* $^{m'}$
b. $P_n^{m'}$*(at least/etc. n NP)* $^{m'} =_{in\ status} P_n^{m'}$ *(n NP)* $^{m'}$

The notation in (93) is unfortunately not very transparent. Two points are important. First, the contrast between denotationally equivalent comparative quantifiers can in principle be replicated with any number in any argument slot provided a suitable choice of the predicate. Second, the status of the resulting sentences is parallel to the status of the minimally differing sentences that employ instead of the comparative quantifier a bare numeral DP. I.e whatever the awkwardness is that is detected with *more than n-1 NP* VP_n the generalization states that it will be the same as the one observed in the corresponding sentence *n-1 NP* VP_n.[68]

[66] Thanks to D. Fox (pc.) for pointing this out to me.
[67] $P_n^{m'}(NP)^{m'}$ is meant to refer to the predicate P which has a minimal number of participants requirement on the m'-th argument slot applied to NP at the m'-th argument slot.
[68] This means that it is not a genuine responsibility for linguistics to explain exactly what it is that speakers find awkward in these sentences. It is, for instance, conceivable that some "minimal number contrasts" can be detected only by subjects with a certain amount of knowledge of mathematics. The linguistic task is simply to provide a place where comparative quantifiers are parallel to bare numeral DPs.

The same argument that Winter(1998) makes for the case of *more than one* and *at least two* can be made for all cases covered in generalization (92) as well. I.e. denotationally these quantifiers are equivalent. Hence the systematic contrast between them as stated in the Minimal Number of Participants Generalization cannot be due to the semantics of *more than n-1 NP* and *no fewer than n NP*. Furthermore, we have seen that morphological number marking is orthogonal to the puzzle as well because the generalization holds for n>1. Almost all instances of the generalization are contrasting sentence pairs employing plural marked NPs in both sentences.[69]

Obviously then, Winter's proposal which makes crucial reference to morphological number marking is not able to account for this generalization. Worse even, there is no readily available fix-up for his theory in sight either. Winter's system cannot account for the fact that the numeral has to be taken into account for principled reasons, because the numeral – in good old generalized quantifier theory tradition – is treated as part of the complex and un-analyzable determiner *at least n, more than n,* etc in Winter's proposal. What the Minimal Number of Participants Generalization however suggests is that the numeral itself is the culprit. Somehow, the numeral "projects out" of the DP even though it seems deeply embedded in it to clash/match with the number requirements of the predicate. This is a rather surprising state of affairs and constitutes a major challenge not only for the GQ

[69] Number marking might very well have an effect in terms of how clear the contrast is, i.e. the contrast is sharpest between *more than one* and *at least 2*. It is however not the core of the phenomenon.

treatment of comparative determiners as idiomatic quantifiers but for compositional semantics in general.

We can sharpen the puzzle even further. The solution of the puzzle **has** to be a compositional one because denotationally the quantifiers in question are equivalent. That means that the offending clash between the numeral and the predicate has to happen "during" the calculation of the meanings of these sentences. Once the computation of the sentence is completed, they give rise to the same truth-conditions because they employ denotationally equivalent quantifiers. The conclusion, then, to be drawn from the Minimal Number of Participants Generalization is that the computation of the denotationally equivalent quantifiers *more than n-1 NP* and *no fewer than n NP* has to be different. More specifically even, the precise form of the MNPG suggests that the interpretation of the whole sentence *more than/etc. n-1 NP* VP_n involves at some point the evaluation of *n-1 NP* VP_n. Likewise, the interpretation of the whole sentence *no fewer than n NP* VP_n involves at some point the evaluation of *n NP VP* and the challenge for any theory is to give a principled way of achieving this while maintaining basic structural as well as semantic properties assigned to the constituent *more than/at least/etc. n-1 NP*.[70]

Given the MNPG then, GQT has to concede that *more than three* cannot be seen as opaque, unanalyzed unit. Minimally, the numeral has to be treated as

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[70] Krifka(2000) proposes a treatment of the items *more than, at least, at most* that could be used – if suitably amended – to account for the MNPG. However, such an account would give the traditional constituency of [[*more than n NP*] *VP*] in favor or a rather unorthodox parse [*more than* [*n NP VP*]]. I believe that there are strong reasons against such a parse at least for *more than n,* and *fewer than n* and consider this kind of solution therefore not viable.

syntactically accessible to the VP argument of the quantifier. At this point it might be natural to revive the idea that the fundamental reason why [*more than n-1 NP VP*] results in awkwardness is because the use of [*more than n-1 NP VP*] seems be felicitous only if [*n-1 NP VP*] is at least a possibility. This is clearly not the case with minimal number predicates VP_n. In other words, we could try to decompose *more than n* into a 3-place determiner *more than* and a numeral and equip *more than* with a presupposition that *n NP VP* is possible.[71]

(94) $[[\textit{more than}]] = \lambda n \in N.\ \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}\colon \Diamond(|P \cap Q| = n).\ |P \cap Q| > n$

This proposal works well for the data discussed so far. It has however one important weakness. (94) predicts the same effect of awkwardness no matter how the numeral argument is provided to the determiner *more than*. Interestingly this doesn't seem to be the case however. Consider the contrasts in (95) to (97).

(95) a. ?? More than one student is meeting.
b. More students than there are even prime numbers are meeting.

(96) a. ?? More than two students were forming a triangle.
b. More students than there are primes smaller than 3 were forming a triangle.

(97) a. ?? More than three students were standing in square formation.
b. More than students than there are primes smaller than 5 were standing in square formation.

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[71] *More than* comes quite close to van Stechow's proposal for *more* in amount comparatives. All I have added is the presupposition. Thanks to Mark Steedman and Stephen Crain for pointing out this possibility to me.

The point of the examples is that the same cardinality is described in both a and b sentences, nevertheless the b sentences markedly and consistently improve.[72] This shows that MNP-effect relies on the particular form in which the numeral is provided. The proposal in (94) however does not make reference to this and is therefore insufficient.[73]

2.3 The Idea in a Nut Shell: A Comparative Syntax

Recall from the previous section that the MNPG would follow if we can show that at some point in the interpretation of the whole sentence the constituents boxed in (98) have to be interpreted.[74]

(98)	a.	?? More than/etc.	$\boxed{\text{n-1 NP } VP_n.}$
	b.	At least/no fewer than/etc.	$\boxed{\text{n NP } VP_n.}$

The challenge is to provide this parse in a principled manner while maintaining the basic constituency. The idea to employ comparative syntax and semantics in the explanation of this puzzle comes from the simple fact that we can see comparative morpho-syntax overtly at work inside comparative determiners. The hope is more specifically that if we give a fully compositional analysis of comparative determiners similar to the one sketched in chapter 1, the MNPG could be accounted for as a by-

[72] Section 2.5 provides further and more minimal pairs displaying the same contrast..

[73] As we go along (chapter 3 and 4), more reasons will become evident that the proposal in (94) although on the right track is not sufficient.

[74] To keep things readable, (98) sketches only the parse for minimal number requirements associated with the subject position. Parses for other positions for can be given in a straightforward way.

product of the composition of comparative quantifiers. However, in order to achieve that, we have to show that the underlying structure of comparative quantificational statements as in (99)a and (100)b is similar to the paraphrases in (99)b and (100)b.

(99) a. ?? More than one student is meeting in the hallway.
b. ?? "More students are meeting in the hallway than how many students there are in $\boxed{\text{a meeting of one student in the hallway}}$."

(100) a. No fewer than two students are meeting in the hallway.
b. "No fewer students are meeting in the hallway than how many students there are in $\boxed{\text{a meeting of two students in the hallway}}$."

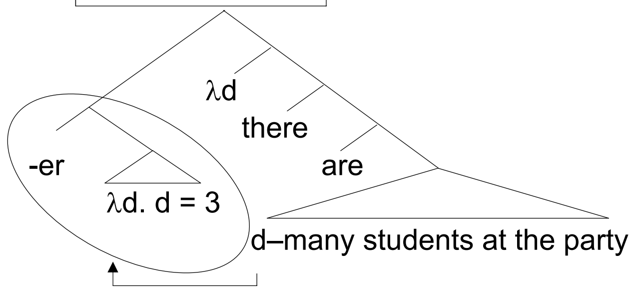
The generalization follows if it can be shown that the interpretation involves an analysis similar to the one suggested in the paraphrases because in the interpretation of the than-clause a clash between the number given in the comparative quantifier and the number requirements if the predicate occurs in (99) but not in (100). Notice that the essential piece in these paraphrases that accounts for the MNPG is the fact that the matrix-VP *meet in the hallway* is interpreted inside the *than*-clause as well as in the matrix.

The "traditional" analysis of comparative determiners as comparative constructions sketched in chapter 1 does not assume that and therefore cannot account for the MNPG. Recall that the classical analysis maintains that the measure function *many* is syntactically parallel to attributive gradable adjectives like *long.* The numeral on the other hand is on a par with measure phrases denoting a degree. Finally the comparative operator together with the *than*-clause denotes a degree quantifier that has to move to a clausal node to yield an interpretable structure as indicated in the tree in (101) repeated from chapter 1.

(101) a. There are more than three students at the party.

b. [-er than 3]$_1$ [there are d$_1$-many students at the party]

c.



d. ⟦*There are more than 3students at the party*⟧ = 1 iff max(λd. ∃x st. x is d-many students at the party) > max (λd. d = 3)

e. "The number of students at the party exceeds/is bigger than 3"

Note that the *than*-clause supposed by the classical analysis for measure phrase comparatives is deployed of any lexical material other than the measure phrase. In fact, nothing in the interpretation requires there to be anything else than a type shifting operation that relates a definite degree description in form of the measure phrase (or a proper name a degree) to its corresponding predicate.

In order to account for the MNPG using comparative syntax, we have to find a principled reason why the matrix-VP is interpreted inside the *than*-clause. The classical analysis of measure phrase comparatives as presented in chapter 1 does not offer such a reason. In particular, nothing in the interpretation of measure phrase comparatives requires the matrix-VP to be part of the *than*-clause. This means that if it can be shown that an account of the MNPG in terms of comparative syntax and semantics is correct, the analysis of measure phrase comparatives is more complicated than meets the eye and than the classical analysis assumes.

2.4 *MANY as* Parameterized Determiner

The proposal that I want to develop in this section to address the shortcomings of the classical analysis in accounting for the MNPG relies on two basic assumptions. The first — which I will assume for the moment without any further justification — is that the degree function *many* is interpreted in the *than*-clause as well as the matrix. The second assumption is that *many* is quite unlike gradable adjectives in that it requires for its interpretation in addition to the degree argument two more arguments which are provided by the NP and the VP. I.e. I will suggest that *many,* even though it denotes a gradable function, maintains the characteristics of a determiner — hence the label "parameterized or gradable determiner".

2.4.1 Bresnan(1973)

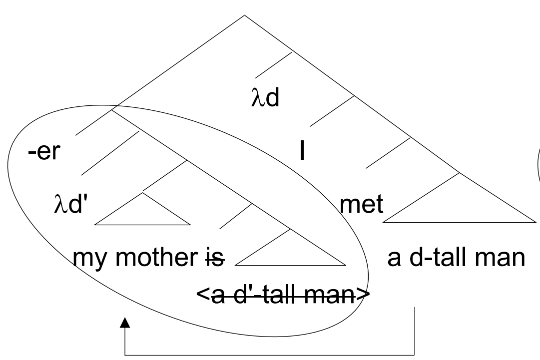
Given the assumption that the gradable function expressed by *many* is interpreted in the *than*-clause as well as the matrix, the task is to find a reason why also the VP has to be interpreted inside the *than*-clause. I would like to suggest that a parallel phenomenon from attributive comparatives first discussed in Bresnan(1973) leads the way an answer to this question. Consider the contrast between (102)a and (102)b from Bresnan(1973). As Bresnan observes the contrast is intuitively due to the fact that the sentences in (102)a,b are interpreted similarly to their respective paraphrases.

(102) a. ?? I have never seen a taller man than my mother.
"I have never see a taller man than my mother is a tall man"
b. I have never seen a man taller than my mother.
"I have never seen a man who is taller than my mother is tall"

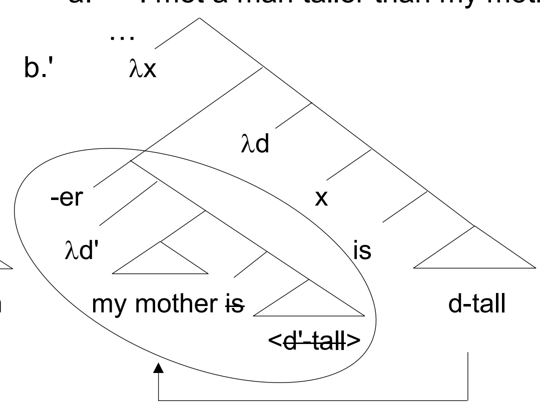
In other words, Bresnan's intuition is that (102)a is awkward because the attributively modified noun *man* has to be interpreted in the *than*-clause while (102)b has an analysis as reduced relative clause where the adjective *tall* is used predicatively. Assuming our classical analysis (which is in many respects a slightly updated version of Bresnan's own (1973) proposal) the situation can be displayed as in (103).[75]

(103) a. ?? I met a taller man than my mother. a.' I met a man taller than my mother.

b.



b.'



[75] I abstract away from extraposition of the *than*-clause here and in the discussion to follow.

As discussed in chapter 1, the classical analysis assumes that *–er than my mother* denotes a degree quantifier that is base-generated in the argument position of *tall*. Since the gradable adjective *tall* needs to be interpreted in the *than*-clause to get an interpretable structure, the base-generated configuration is one of antecedent containment. Antecedent containment is resolved via movement and copying/deletion of identical material from the matrix clause in the ellipsis site.[76] In the case of (103)b, the constituent that is copied into/elided in the *than*-clause is *a d-tall man* while in the case of (103)b it is *d-tall.*

Importantly, nothing in the semantics of comparatives enforces that the modified noun *man* is interpreted in the *than*-clause in (103)b. I.e. while the structures assigned in (103)b and (103)b' correctly predict the contrast it is not clear what the reason is that the ungrammatical structure in (103)b cannot have an alternative structure identical to the one in (103)b'. Certainly the alternative would be equally interpretable from the perspective of compositional semantics and wouldn't yield the selectional conflict between *my mother* and *man*. A survey of the literature reveals that nobody has identified a deep reason for this effect. Everybody basically has to add a syntactic stipulation to the effect that attributively used adjectives form an inseparable unit with the modified NP with respect to ellipsis resolution.[77]

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[76] I abstract away from the question what the syntactic constituent is that is copied and how it is that the copula *be* is deleted in the *than*-clause in (103)b even though it doesn't have an antecedent in the matrix. See Kennedy&Merchant(2000) for recent discussion.

[77] Bresnan(1973) assumes that the predicates *tall* and *tall man* are different and *tall* is not visible if it is part of *tall man* for CD. Hellan(1981), Pinkham91982), Gawron(1995) and Lechner(1999) all give essentially the same reason. Lechner(1999) for instance encodes it in a phrase structure stipulation according to which *tall man* is an AP containing the NP *man* while Gawron(1995), Hellan(1981)

Presumably the simplest account of this restriction is that a predicative adjective and its attributive twin are not considered identical with respect to ellipsis parallelism even though they are systematically related via type-shifting. (104) summarizes how this idea could be formally executed: (104)a gives the familiar attributive denotation of the gradable adjective *tall* while (104)b presents the predicative version. (104)c and (104)d on the other hand are possible type shifting operation that will systematically map predicative denotations into attributive denotations (TSH_1) or the other way around (TSH_2).[78]

(104) a. $[[tall_{Att}]] = \lambda d.\lambda P_{<e,t>}.\lambda x.\ P(x) = 1\ \&\ x$ is d-tall

b. $[[tall_{Pred}]] = \lambda d.\lambda x.\ x$ is d-tall

c. $TSH_1 = \lambda P_{<d,et>}.\lambda d.\lambda Q_{<e,t>}.\lambda x.\ Q(x) = 1\ \&\ P(d)(x) = 1$

d. $TSH_2 = \lambda P_{<det,et>}.\lambda d.\lambda x.\ P(d)(\lambda y.1)(x) = 1$

If parallelism is sensitive to the distinction between the attributive and predicative types of the adjective, then it will require that the elided adjective matches the antecedent adjective in type. This means that the elided adjective in (103)a requires an NP argument to yield an interpretable structure. Hence the whole AP-NP complex *d-tall man* has to be elided in the ellipsis site which explains the awkwardness of (103)a.

Pinkham(1982) stipulate a constraint similar to Bresnan's. Kennedy(1997), Kennedy&Merchant (2000), Zamparelli(1996), Larson(1988), Bierwisch(1987), Klein(1991) Heim(1985), von Stechow (1984) and Schwarzschild&Wilkinson(1999) either admit that they don't have anything to say or don't talk about it.

[78] The status of the type-shifting operation is immaterial for the discussion and can simply be thought of as convenient way of expressing a lexical generalization.

2.4.2 d-*MANY*

How could we extend this treatment to an account of the MNPG? Prima facie not at all, it seems, because the best we can do is to require the NP to be elided in the ellipsis site parallel to the discussion of Bresnan's cases. Hence we would stipulate two incarnations of a basic degree function *many* that are related via type-shifting operation.

(105) a. $[\![many]\!] = \lambda d.\lambda P_{\langle e,t\rangle}.\ \lambda x.\ P(x)= 1\ \&\ |x| = d$

b. $[\![many]\!] = \lambda d.\lambda x.\ |x| = d$

This is however not enough. To account for the MNPG we need the VP inside the *than*-clause as well. That means we need to extend the account of Bresnan's facts one step further. In other words, not only do we need an NP argument for the gradable function *many* we also need the VP to be an argument of *many*. Here is a simple extension of the entries in (105).

(106) $[\![many]\!] = \lambda d.\lambda P_{<e,t>}.\lambda Q_{<e,t>}.\ \lambda x.\ |x| = d\ \&\ P(x) = 1\ \&\ Q(x) = 1$

This stipulation does the job, however there seems to be something quite suspicious about this entry for *many.* It requires that the individuals it measures in terms of their cardinality satisfy two additional predicates as if it were a 3-place adjective. Even though there is nothing that would prohibit such a lexical item, adjectives of this sort, as far as I know, are not attested independently. A rather small amendment to the lexical entry in (106) however seems to make the proposal immediately more appealing. What if *many* were not a scalar predicate but instead a scalar or **parametrized determiner** (with the degree argument providing the "cardinality parameter" of the otherwise regular determiner meaning) as indicated in (107).

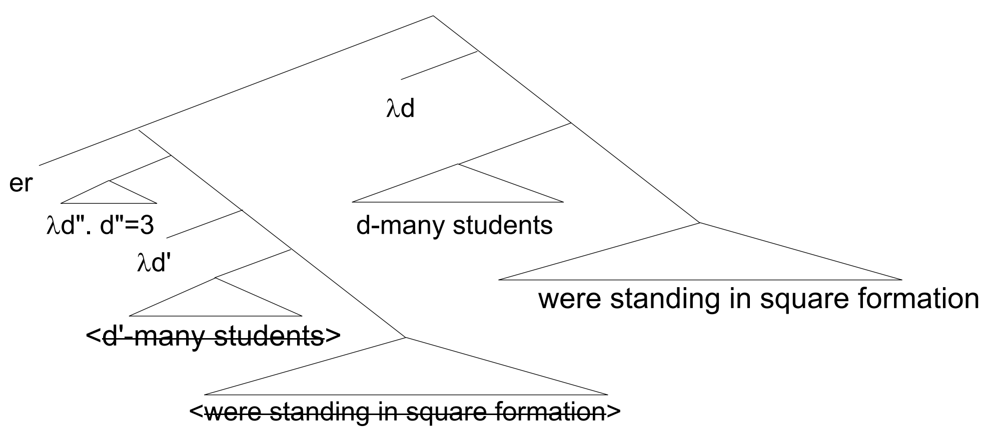
(107) $[[\mathit{many}]] = \lambda d.\lambda P_{<e,t>}.\lambda Q_{<e,t>}.\ \exists x\ [|x| = d\ \&\ P(x) = 1\ \&\ Q(x) = 1]$

We know independently of determiners that they take two predicative arguments. All we add here is a degree argument, which effectively turns a non-scalar determiner into a scalar determiner. In other words, the proposal for a lexical entry of *many* as gradable determiner as opposed to determiners that are not gradable (*every, some, etc.)* parallels the difference between scalar and non-scalar adjectives (*tall, …* vs. *dead, …*). Just as in the case of adjectives, we can pinpoint the fundamental difference between scalar and non-scalar function to the presence/absence of a degree argument. What remains to be seen is whether the lexical entry for *many* can be given enough content to be viewed as just one special instance within a much larger set of scalar functions in natural language.

I will delay the discussion of this question to chapter 4 and instead point out that the suggestion of a gradable determiner is not as unorthodox as it might seem. Surely the entry in (107) amounts to proposing a hybrid entity. It incorporates on the one hand explicitly the idea that *many* denotes a gradable function submitting it to the principles of comparative syntax. On the other hand, it incorporates also a fundamental insight if GQT, namely that quantification in natural language is always and essentially restricted quantification.[79] With the help of the parametrized determiner *many* we are almost ready to give an account of the MNPG. Take the by now familiar contrast between *more than three* and *no fewer than four* as in the examples below repeated from section 2.2. Given the assumptions so far the structure that is interpreted is as depicted in (108).

(108) a. ?? More than three students were standing in square formation.

b. [-er λd. d=3 & ~~d-many students were standing in square formation~~] [λd. d-many students were standing in square formation]



As usual, it is assumed that *–er* plus *than*-clause denotes a degree quantifier that is base generated in the degree argument position of the parameterized determiner *many.* To yield an interpretable structure, the degree quantifier has to move to a clausal node*.* Given the analysis of *many* as parameterized determiner we have now

[79] Von Stechow(1984) proposes a treatment of *more* in the discussion of amount comparatives in. that essentially incorporates the same suggestion that there scalar determiners. Von Stechow assumes that *more* rather than *many* has the properties of a determiner which has the un-welcome property that two entries for the comparative are needed. In the discussion below, it will become apparent that indeed *many* has determiner-like properties.

a principled reason for the assumption that the closest clausal node for the degree quantifier is in the matrix. Hence the comparative operator has to move into the matrix.[80] There is simply no available clausal node inside the DP. Furthermore, the assumption that *many* has to be interpreted inside the than-clause, a configuration of antecedent containment has to be resolved. Movement of the degree quantifier *–er than*… yields a structure in which the matrix provides identical material to elide the corresponding material in the ellipsis site.

The final piece needed in the account sketched in (108) is the assumption that the measure phrase/numeral moves inside the *than*-clause to the left periphery to create a derived degree predicate. It is also type-shifted into a predicative meaning to intersect with the landing site of the movement very much like a free relative.[81] I.e. I propose to extend the technical solution to measure phrase comparatives that was already needed in the classical analysis to the now enriched analysis of measure phrase comparatives with a clausal source for the *than*-constituent.[82] These steps effectively result in an interpretation of the *than*-clause that produces the MNPG.

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[80] Even if there is a clausal node inside the DP, it will be below the determiner and to allow lowering of the degree quantifier would result in a structure that does not allow resolution of antecedent containment — putting aside the severe difficulties such an operation would pose for the assigning an interpretation.

[81] See Pancheva-Izvorski(1999) for interesting work along these lines.

[82] Obviously this is rather unsatisfactory as the proposal cannot claim any deep insight into the phenomenon here. The point is that the revised proposal to account for the MNPG is on a par with the classical analysis in this respect. Measure phrases and in particular numerals seem to be leading a double life as proper names/definite descriptions of degrees and as degree-predicate. It seems plausible that once the special status degrees (points on a scale, intervals, equivalence classes, delineations etc.) is clarified we also get an answer to the question why they appear to be acquiring the meaning needed by their environment so easily. Pursuing these questions here would lead me too far a field. I have to leave it for future research.

The derivation of the contrasting *than*-clauses is summarized in (109) and (110) with the boxes indicating where the minimal number of participants presupposition of the VP conflicts or matches with the numeral parameter of the parameterized determiner *many.*

(109) a. ?? More than three students were standing in square formation.

b. [-er [λd. d=3]$_1$ ~~d_1-many students were standing in square formation~~]

c. $[\![$ *-er than* 3_1 d_1*-many students were standing in square formation* $]\!]$ = $\lambda D_{<d,t>}$. max(D) > max(λd. $\boxed{\text{d-many students are standing in square formation \& d = 3}}$)

(110) a. No fewer than four students were standing in square formation.

b. [-er [λd. d = 4]$_1$ ~~d_1-many students were standing in square formation~~]

c. $[\![$ *-er than* 4_1 d_1*-many students were standing in square formation* $]\!]$ = $\lambda D_{<d,t>}$. max(D) ≥ max(λd. $\boxed{\text{d-many students are standing in square formation \& d = 4}}$)

The paradigm in (109) and (110) shows that we have succeeded in providing — for principled reasons — a locus in the derivation of comparative quantifiers where the numeral specification of the comparative quantifier is checked against the presuppositional demands of the VP. This explains why we observe the MNPG even though the paired statements are eventually truth-conditionally equivalent. Note furthermore, we have a principled reason why minimal number effects disappear in sentences like (111)b even though it is truth-conditionally equivalent to (111)a.

(111) a. ?? More than three students were standing in square formation.

b. More students were standing in square formation than there are primes smaller than 5.

The reason is simply that the *than*-clause in (111)b does not contain the NP and VP of the matrix clause.

2.4.3 Measure Phrase Comparatives

In order to account for the MNPG it was crucial to assume that *many* had to be interpreted in the *than*-clause*.* This is a rather unusual assumption. Recall that the classical analysis of measure phrase comparatives didn't have any measure function in the *than*-clause. Instead it was assumed that the measure phrase can be mapped via type shifting into predicative meaning that is required by the comparative operator. If this were indeed the correct analysis, there would be no possibility of accounting for the MNPG. We can turn the table around and take the existence of the MNPG as evidence that the composition of measure phrase comparatives is more complex than the classical analysis would have it. In particular, we can take the MNPG to show that even in measure phrase comparatives a measure function and all its arguments are required to yield an interpretable structure. In other words, the MNPG provides evidence that even the most basic and supposedly clearest cases of phrasal comparatives namely measure phrase comparatives have a clausal source. This is rather surprising and if correct compelling empirical evidence for the claim that all comparatives are semantically clausal comparatives.

What could be the reason that even measure phrase comparatives have a clausal source? I do not have anything insightful to offer other than a rational based on a simply intuition: degrees (as e.g. denoted by measure phrases) are always degrees of something on some scale. The language doesn't seem to allow us to talk about "bare degrees".[83] They have to be licensed by a gradable function expressed by adjectives such as *tall,* which in turn is predicated of an individual. A bit more formally the speculation is this. Assume that measure phrases are definite descriptions or proper names (as in the case of numerals) of degrees. As such they cannot provide the restrictor for the degree quantifier *–er*. Hence they cannot directly compose with the comparative operator and therefore cannot be (Θ-)licensed by the matrix measure function. The only other possibility for a measure phrase under a comparative operator to be licensed (get a theta-role) is then to be base generated as the argument of a separate measure function. Hence the requirement for a measure function inside the *than*-constituent of measure phrase comparatives. While this rational is at best a place-holder for a component in the proposal that is not yet understood, the expectation is that all measure phrase comparatives should display effects similar to the MNPG observed with amount comparatives. More specifically, since the gradable function needs to be interpreted in both arguments of the degree quantifier, we should be able to detect its presence in the *than*-clause.

Consider in this vein the contrast between measure phrase comparatives with *rich* and *tall* as displayed in (112).

[83] Potential exceptions are identity statements over degrees such as *1 yard is more than 90 centimeters.*

(112) a. * Bill Gates is richer than 5 billion dollars.
b. Bill Gates is taller than 5 feet.

While measure phrase comparatives with adjectives such as *tall* are perfectly acceptable, the comparable construction employing *rich* instead of *tall* is ungrammatical.[84] Interestingly, to account for this difference it is not sufficient to simply stipulate that degrees of wealth/richness cannot be expressed by dollar amounts. If that were so, the sentence in (113)a in which the measure phrase refers to the difference between two degrees of wealth would be equally ungrammatical.

(113) a. Bill Gates is (more than) 5 billion dollars richer than Michael Jordan.
"Bill Gates is richer than Michael Jordan and the difference is 5 billion dollars."
b. Bill Gates is (more than) 5 inches taller than Michael Jordan.
"Bill Gates is taller than Michael Jordan and the difference is 5 inches."

The interesting observation is then that a measure phrase such as *5 billion dollars* can be used to refer to degrees of wealth/richness, however only if it is used to refer to a differential. Differential degrees are somehow less selective than standard of comparison degrees as to how they are expressed. How should we account for this difference? I would like to suggest that the selectivity is due to the idiosyncratic properties of *rich*. Note that even the positive form of *rich* cannot take a measure phrase argument unlike dimensional adjectives like *tall*.

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[84] Bierwisch(1987) points out that only dimensional adjectives are associated with numerical scales.
[85] For the point I would like to make in this section, it is irrelevant whether the paraphrase in (115)a or the more elaborate one (115)b is closer to the underlying structure. The important point is that the gradable function expressed by *rich* is in the *than*-clause.

(114) a. * Bill Gates is 5 billion dollars rich.
b. Bill Gates is 5 feet tall.

Obviously, we would like to relate the fact that *rich* cannot form a measure phrase comparative to the seemingly more basic fact, that it also cannot take a measure phrase argument in the positive. As pointed out above, the problem is not that dollar amounts couldn't be used to refer to degrees of richness. A rather immediate way of relating these tow observations is to assume that *rich* is interpreted in the *than*-clause as well as in the matrix clause as indicated in either one of the paraphrases in (115).

(115) a. * Bill Gates is richer than 5 billion dollars.
b. * "Bill Gates is richer than how rich 5 billion dollars are."
c. * "Bill Gates is richer than how rich somebody is who is 5 billion dollars rich." [85]

Exactly in this respect *tall* is different from *rich. Tall* can take measure phrases in the positive as arguments and it can also form measure phrase comparatives. The corresponding paraphrases in (116)b and (116)c seem acceptable as well compared to the paraphrases in (115).

(116) a. Bill Gates is taller than 5 feet.
b. ? "Bill Gates is taller than how tall 5 feet are."
c. "Bill Gates is taller than how tall somebody is who is 5 feet tall."

These observations lead us to expect a correlation between the possibility of adjectives allowing measure phrase arguments in the positive and the possibility of forming measure phrase comparatives as described in the Measure Phrase Correlation (117).[86]

(117) **Measure Phrase Correlation**

1. Gradable predicates that can take measure phrases as arguments in the positive can also have a phrasal comparative with a measure phrase.
2. Gradable predicates that can NOT take measure phrases as arguments in the positive also can't have a phrasal comparative with a measure phrase.

By and large this correlation is borne out as the data in (118) to (122) show. The data in (118) present a variety of degree functions that can take measure phrases as arguments in the positive.

(118) a. John weighs 155 pounds.
b. That book costs 5 dollars.
c. That artillery carries/shoots 10 kilometers
d. John is 6 feet tall.
e. John is 21 years old.
f. This book is 1 inch thick.
g. The serenade is 10 minutes long.
h. John drove 65 miles per hour (*fast).
i. This well is 50 meters deep.
j. This water is 30 degrees Celsius (*warm).
k. The sun is about 8 light minutes away from earth.
l. The drive way extends 2 feet into the neighbor's garden.

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[86] The negative twin in a pair of adjectives in polar opposition (tall-short, long-short, etc.) is a systematic exception to this correlation. I.e. even though (i)a is ungrammatical many speakers find the measure phrase comparative acceptable. See Bierwisch (1987/89), Kennedy(1997), etc. for discussion.

(i) a. * John is 5 feet short.
b. John is shorter than 6'8.

As the correlation in (117) leads us to expect, measure phrase comparatives based on these degree functions are equally grammatical cf. (119).

(119) a. John weighs more than 80 kilos
b. That book costs more than 5 dollars.
c. That artillery carries/shoots farther than 10 kilometers
d. John is taller than 6 feet.
e. John is more than 21 years old.
f. This book is thicker than 1 inch.
g. The serenade is longer than 10 minutes.
h. John drove faster than 65 miles per hour.
i. This well is deeper than 50 meters.
j. This water is warmer than 30 degrees Celsius.
k. The sun is farther than 8 light minutes (away from earth).

The data in (120) on the other hand show a variety of degree functions that cannot take measure phrases as arguments in the positive.

(120) a. * John is 125 pounds heavy.
b. * This book is 5 dollars expensive/cheap/costly/pricy.
c. * The sun is about 8 light minutes distant from earth.
e. * John is 2 marriages and divorces mature.
m. * John is 2 points good/dumb.

Again, as expected from the measure phrase correlation, these predicates cannot form measure phrase comparatives (cf. (121)) even though these measure phrases can be used to refer to the differential degree in regular comparatives as shown in (122).

(121) a. * John is heavier than 125 pounds.
b. * This books is more than 5 dollars expensive/cheap/costly/pricy.
c. * The sun is more than 8 light minutes distant from the earth.
e. * John is more than 2 marriages and divorces mature.
m. * John is better/dumber than 2 points.

(122) a. John is 125 pounds heavier than Bill.
b. This books is 5 dollars more expensive/cheap/costly/pricey than that book.
c. The sun is 8 light minutes more distant from the earth than the moon.
e. John is 2 marriages and divorces more mature than Mary.
m. John was 2 points better/dumber than Mary.

The measure phrase correlation points towards a close relationship between the positive and the comparative. The account of the correlation that I want to suggest hypothesizes that the presence of the degree function in both the matrix clause and the *than*-clause is responsible. [87] I.e. the ungrammaticality of (123)a repeated from above is due to the fact that there is no grammatical parse for *than*-clause that includes the degree function *rich* as the attempts in (123)b and c show.

(123) a. * Bill Gates is richer than 5 billion dollars.
b. * "Bill Gates is richer than how rich 5 billion dollars are."
c. * "Bill Gates is richer than how rich somebody is who is 5 billion dollars rich."

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[87] This entails also that the grammaticality of (122) where the measure phrases are used as differentials, it is not the same degree function that licenses the measure phrase. E.g in the case of (113) it is not *rich* which licenses the differential instead, I suggest, it is the degree function *much* that licenses differentials. Hence a fuller paraphrase of (113) could be given as below.

(113)a. Bill Gates is (more than) 5 billion dollars richer than Michael Jordan.
b. "Bill Gates is richer than Michael Jordan by an amount that is (more than) 5 billion dollars much."

The grammaticality of (124)a and (125)a on the other hand follows from the parallel observation that it is possible to construct a grammatical *than*-clause that includes the degree function *tall/long* as the paraphrases in (124)b and (125)b respectively indicate.

(124) a. Bill Gates is taller than 5 feet.
b. "Bill Gates is taller than somebody who is 5 feet tall."

(125) a. This rope is longer than 5 feet.
b. "This rope is longer than how long 5 feet are."

While the fact that the degree function has to be included in the *than*-clause is not understood it is comforting to observe that it is general property of comparatives and not just a quirk of amount comparatives. All measure phrase comparatives are clausal in nature. For some reason, the *than*-clause has to contain a degree function. This is enough to lend independent support to the stipulation that *many* is part of the *than*-clause in amount comparatives.

2.4.4 Summary

Let me summarize quickly the proposal before looking into some of the predictions that are made by this account. Comparative quantifiers such as *more than three students* are analyzed as measure phrase comparatives. The measure function *many* that the comparative syntax is based on has special properties that make it appear rather unlike gradable adjectives and much closer to regular quantificational determiners. In particular, the analysis proposes to treat *many* as **parameterized determiner,** which is — to be sure — a hybrid entity that combines insights on quantification from comparative syntax and semantics as well as GQT. Intuitively *many* can be though of as degree function that measures the cardinality of the VP denotation with respect to how many individuals it contains that satisfy the sortal restriction given by NP. It is furthermore assumed that measure phrase comparatives are superficially in an antecedent containment configuration that has to be resolved via movement of the degree quantifier denoted by [-er than-XP]. Interpretability restrictions demand that the degree quantifier moves into the matrix to a clausal node where the usual principles of semantic composition apply. After movement antecedent containment is resolved and the material in the *than*-clause can be elided. For independent reasons, we assumed that the degree function is always present in the *than*-clause. In the case of comparative determiners, this means that the parameterized determiner *many* is in the *than*-clause as well as the NP and VP arguments of *many* since *many* is a determiner that takes after absorbing its degree argument two predicative arguments (just like any other determiner). In addition, the *than*-clause contains the measure phrase given by the numeral so that we arrive at a constituent inside the *than*-clause (cf. (127) and (128)) that corresponds to the boxed material in (126) repeated from above.

(126) a. ?? More than/etc. | n-1 NP VP_n.

b. At least/no fewer than/etc. | n NP VP_n.

I have argued furthermore that this not only accounts for the MNPG but it also accounts for it in the right way because the parallelism between bare numeral NPs and comparative quantifiers as stated in the MNPG follows directly from the structures derived in the *than*-clause as paraphrased in (127) and (128).

(127) a. ?? More than one student was meeting in the hallway.

b. ?? "More students are meeting in the hallway than how many students there are in $\boxed{\text{a meeting of one student in the hallway}}$."

(128) a. No fewer than two students were meeting in the hallway.

b. "No fewer students are meeting in the hallway than how many students there are in $\boxed{\text{a meeting of two students in the hallway}}$."

2.5 Predicative Uses of *MANY* – Are there any?

The proposal of *many* as "parametrized determiner", i.e. as degree function with the properties of a determiner makes the immediate predictions that *many* is quite unlike adjectival degree functions such as *tall* which have the syntax of modifiers. One specific prediction in this respect is that there should not be any predicative uses of *many* and its comparative derivatives. Recall from the discussion above that there is a systematic and meaning preserving mapping via type-shifting operations between predicative and attributive denotations gradable adjectives like *tall*. It is easily verified that these type shifters cannot be applied to *many. Many* as proposed in (107) is simply not of the right type. For convenience the relevant entries are repeated below.

(129) a. $[[many]] = \lambda d.\lambda P_{<e,t>}.\lambda Q_{<e,t>}.\ \exists x\ [\ |x| = d\ \&\ P(x) = 1\ \&\ Q(x) = 1]$

b. $TSH_2 = \lambda P_{<det,et>}.\lambda d.\lambda x.\ P(d)(\lambda y.1)(x) = 1$

c. $TSH_3 = \lambda P_{<det,ett>}.\lambda d.\lambda x.\ P(d)(\lambda y.1)(x) = 1$

At first sight, this seems to be an unwelcome prediction given the grammaticality of sentences such as (130) which feature comparative as well as positive forms of *many* in post-copula position.

(130) a The Red Sox fans were more than enough to intimidate the Yankees fans.

b. While the Red Sox fans sent a large contingent, the Yankees fans were fewer/less than 200.

c. The guests were many women.

Note however that the post-copula environment does not provide the best test environment to establish that these comparatives are indeed interpreted as genuine predicates. Better test environments for genuine predicative use of constituent are the complement position of predicates such as *look,* which don't license Null Complement Anaphora. Interestingly, amount comparatives based on *many* are not grammatical in the complement position of *look* as the examples in (131) and (132) show.

(131) a. John looks tall.

b. * The guests look many.

(132) a. The Red Sox fans looked more numerous than the Yankees fans.

b. * The Red Sox fans looked more than the Yankees fans.

c. * While the Red Sox fans sent a large contingent, the Yankees fans looked fewer/less than 200.

The ungrammaticality of (132)b is especially surprising since its intended meaning is clearly expressible in the complement position of *look* — albeit only if a gradable adjective such as *numerous* as in (132)a is employed. Similar contrasts can be observed in the predicate position of small-clauses as shown in (133) and (134).

(133) a. Mary considers John tall.
b. * Mary considers the guests many.

(134) a. Mary considered the Red Sox fans more numerous than the Yankees fans.
b. * Mary considered the Red Sox fans more than the Yankees fans.

These facts are surprising for the classical treatment of amount comparatives which maintains that *many* is to be analyzed as adjective.[88] Minimally these facts show that *many* cannot be analyzed completely parallel to *tall*. Otherwise we would expect a predicative use to be available in these contexts. For the present proposal that treats *many* as parameterized determiner on the other hand, these facts are expected. To firmly establish this conclusion, an in-depth investigation of comparatives in copula-sentences has to be conducted.[89] Pending further data, the conclusion of this section is that the facts concerning predicative uses of amount comparatives surprisingly vindicated rather than challenged the proposal of *many* as

[88] Note also that proponents of the "adjectival theory of indefinites" (cf. Landmann(2000) for a recent defense) will have difficulties accounting for the fact that *many* does not have genuine predicative uses.
[89] Note that the prediction of the proposal that *many* is a gradable determiner rather than a gradable adjective predicts that predicative uses for comparative quantifiers are available to the extent that they are for other quantifiers. Winter(1998) for instance shows that the predicative use of a quantifier in Hebrew is flagged by an overt copula (indicating according to his proposal that a specific type-shifting operation took place) while typical predicates can do without copula.

parameterized determiner because it is expected under this approach that *many* will not display a parallel distribution to gradable adjectives like *tall*.

A corollary prediction concerns the possibility of *many* and its comparative derivatives to function as attributive modifiers and more generally interactions with other determiners in the same DP. Under the classical assumption that *many* is a gradable adjective *many* requires a determiner on top of the comparative. The proposal defended here on the other hand maintains *many* itself is a determiner. Hence it shouldn't be possible to stack another determiner on top of comparative determiners. The second prediction seems to be false given well-known facts as in (135).

(135) a. The many guests all brought presents.
b. ? The more than three guests all brought presents.

While the sentences in (135) aren't quite unobjectionably grammatical they are certainly not crushingly bad as one would expect if there were no determiner position available on top of *many.* This seems to be a real challenge for the proposal of *many* as parameterized determiner while it speaks in favor of the classical treatment. Fortunately, things are more complicated. First, if it were really the case that there is a freely available determiner slot on top of *many*, we would expect all kinds of determiners to be grammatical in that position. This is however clearly not the case as already the few data in (136)-(137) show.

(136) a. * Several/most/… many guests brought presents.
b. * Several/most/… more than three guests brought presents.

(137) a. * Some many guests brought presents.
b. * Some more than three guests brought presents.

The data in (137) are particularly interesting as there is no obvious reason why these sentences should be ungrammatical since they have grammatical counterparts. I.e. sentences in (137) simply use the overt version of the alleged covert existential quantifier that closes the DP according to the classical analysis. That is to say, both the classical approach and the proposal of *many* being a determiner have some explaining to do here. The former have to explain why it is that only a covert existential operator or an overt definite can head the DP embedding an amount comparative structure while the latter has to explain how it is possible to stack a determiner on top of a determiner and why this can only be done with a restricted set of determiners.

It is quite obvious that the proposal of *many* as parameterized determiner is forced to give a radically different analysis to the sentences in (135) than the classical approach. Specifically, since it is not possible to stack two determiners on top of each other, it has to be the case that each of these determiners heads their own DP. Even more radically, since *many* is a determiner that needs a clausal environment to be interpretable, the conclusion we are forced to is that there is a clause hidden inside the DP headed by the definite determiner. I would like to suggest specifically that these DPs contain a disguised amount relative clause that provides the right environment for the comparative quantifier. I.e. I submit that the sentences in (135) should be analyzed similarly to the sentences in (138) which are taken to contain amount relatives.

(138) a. The many guests <u>that there were</u> all brought presents.
b. The more than three guests <u>that there were</u> all brought presents.

There are two advantages to the claim that the sentences in (135) are amount relatives in disguise. First it is known that amount relatives have specific requirements on the external determiner. Carlson(1977a) observes that only universal determiners (*every,* free choice *any*, *all*), definites and partitives based on definites can head a DP containing an amount relative.[90] The set of determiners that can embed a comparative determiner appears to be a subset of those as the data in (139) and (140) show.

(139) a. * Several/most many/more than three guests brought presents.
b. * Every many/more than three guests brought presents.
c. * All/any many/more than three guests brought presents.

(140) a. Most of the many/more than 20 guests brought presents.
b. All/every one of the many/more than 20 guests brought presents.

The generalization that emerges here is that only definites and partitives based on definites can license an amount comparative inside the DP.

[90] Grosu&Landman(1998) propose that the unifying property of these determiner is that they preserve maximality which they assume to be an essential component of the semantics of amount relatives.

The second advantage of to the analysis of sentences as in (135) as disguised amount relatives is that *many* is provided with a different scope argument than the matrix VP (which is the scope argument of the higher definite determiner). d-*many* is computed inside the DP and does not have access to the matrix anymore. This predicts that the minimal number effect should disappear in those cases. Interestingly, this is exactly what happens as the contrasts in (141) and (142) show.

(141) a. ?? More than three students were standing in square formation.
b. The more than three students that there were were all standing in square formation.

(142) a. ?? More than two students were forming a triangle.
b. The more than two students that there were were all forming a triangle.

The contrast in (140) and (141) are exactly as predicted under the assumption that comparatives under the definite determiner are disguised amount relatives. Since the conclusion that these structures are amount relatives was virtually forced upon us given the proposal that *many* is a determiner, these data lend further support to the proposal developed in section 2.4.[91]

[91] Note that this is yet another case where the proposal discussed briefly in 2.2 of splitting *more than n* into *more than* and n with *more than* providing a presupposition that n NP VP needs to be possible falls short unless it can be argued that the presupposition does not project out of the DP *the more than n NP.*

2.6 Intensionalizing *Maximality*

While these observations seem in general rather promising, it might not have escaped the reader that the proposed analysis of comparative quantifiers faces a serious problem: Given the fact that the *than*-clause in comparative quantifiers analyzed as amount comparatives is clausal, it is not clear how the correct truth-conditions can be derived.

2.6.1 Two Problems for Getting the Truth-Conditions Right

The problem is illustrated most clearly with downward monotone quantifiers such as *fewer/less than 3 students* but an analogous problem arises with increasing quantifiers. Consider again the derivation of comparative quantifiers as proposed above which predicts truth-conditions as exemplified in (143)a and (143)b.

(143) a. ⟦*More students than three students were at my party*⟧ = 1 iff
max (λd. d-many students were at my party) > max (λd. d-many students were at my party & d = 3)

b. ⟦*Fewer students than three students were at my party*⟧ = 1 iff
max (λd. d-many students were at my party) < max (λd. d-many students were at my party & d = 3)

(143)a is predicted to be true only if the maximal number of students that are at my party is bigger than the maximal number of students that are at my party such that that number equals 3. Likewise, (143)b is predicted to be true only if the maximal number of students that are at my party is smaller than the maximal number of students who are at my party such that that number equals three. It turns out that the statement of these truth-conditions isn't just cumbersome, worse the predicted truth-conditions are radically incorrect. Specifically, in the case of decreasing quantifiers, the predicted truth-conditions can never be satisfied while in the case of increasing quantifiers, they are much too weak.

It is easier to see the problem of the predicted truth-conditions in the case of decreasing quantifiers as (143)b. Let's walk through some cases. Surely, if there are more than 3 students at my party, the sentence is predicted to be false which fits well with our intuitions. The crucial question is however what the predicted truth-conditions are if there are less than three students at my party. The intuitions are of course solid. These are exactly the situations under which the sentence is judged to be true. The problem is that the truth-conditions that are predicted by the current proposal are radically different. If there are less than three students at the party, the degree predicate in the *than*-cause will be empty because the intersection of {d: d-many students at my party} and {d: d=3} is empty. Presumably, maximality is not defined for the empty set; hence we would expect presupposition failure. But even if it were defined, it would return the degree 0. Since no degree can be smaller than 0, the sentence is predicted to be false rather than true. The third case to consider is when there are exactly three students at the party. That means that the sentence is true only if $3 < 3$. But this is of course false. The conclusion then is that (143)b and in fact all monotone decreasing comparative quantifiers have truth-conditions that can never be satisfied according to the proposed analysis.

A similar, though somewhat less dramatic problem arises with increasing comparative determiners as in (143)a. In this case the predicted truth-conditions are too weak. Consider again various circumstances: If there are more than three students at the party, the sentence is predicted to be true because the maximal degree that satisfies the matrix clause will be bigger than the maximal degree that satisfies the *than*-clause. If there are exactly three students at the party, the sentence is predicted to be false for the same reason its decreasing counterpart was false under these circumstances. Finally, if there are less than three but at least one student at the party, the sentence is predicted to be either undefined or true contrary to our intuitions. The reason for this unwelcome prediction is the same that we have observed in the previous section: if there are less than three students at the party, then the maximal degree satisfying the *than*-clause is either undefined or 0. If we assume that maximality is defined for the empty set, then the derived truth-conditions is that the maximal degree of students at the party has to be bigger than 0. This is satisfied as long is there is at least one student at the party. The last case to consider is if there are no students at the party. In this case, we either get undefinedness or again the prediction that the sentence is false because $0 > 0$ is necessarily false. We can summarize the curious set of truth-conditions predicted for (143)a and in fact every monotone increasing comparative quantifier as summarized in (144).

(144) A sentence employing an increasing comparative quantifier of the form *more than n NP VP* is predicted to be

- true if there is at least 1 x st. NP(x) = VP(x) = 1 unless[92]
- there are exactly n x st. NP(x) = VP(x)=1, in which case it is false, and
- undefined or false if there are zero x st. NP(x) = VP(x)=1.

The fact that we predict these truth-conditions is as disturbing as the obviously incorrect truth-conditions that were predicted for decreasing comparative quantifiers.

2.6.2 Diagnosing the Source of Problems

Even though the problems appear on the surface to be quite different — while decreasing comparative quantifiers are predicted to give rise contradictory truth-conditions, increasing comparative quantifiers have in general too weak truth-conditions according to the proposed analysis — they have the same origin: as soon as we put the VP as well as the NP together with the numeral in the calculation of the standard of comparison argument, the calculation is too sensitive to the actual state of affairs to give appropriate truth-conditions. For instance, if the number of students at the party is smaller than 3 in the case of (143), the maximal degree/cardinality assigned to the second term in the calculations in (143) will be 0 and any comparison operation based on a 0 standard of comparison will be trivial or undefined. Obviously, what is missing in this treatment is that we can make reference to numerosities without committing ourselves to a claim that there exists in

[92] For simplicity the statement is given only for comparative quantifiers in subject position. The observation naturally generalizes for comparative quantifiers in any argument position.

world of evaluation an entity/a set of individuals that is numerous to the degree specified by the numeral in the *than*-clause. In other words, it seems that including the VP in the calculation of the standard of comparison argument does not automatically entail an existence claim to the effect that there are 3-many students at the party. This seems paradoxical at first sight. After all, we had to go out of our way to find a reason why the VP had to be part of the computation of the *than*-clause only to find ourselves forced to assume that it doesn't have any truth-conditional import in the *than*-clause. How can we reconcile this paradoxical state of affairs?

2.6.3 The Remedy: Intensional Maximality

The remedy that I would like to suggest to resolve the paradox, is to optionally calculate the cardinality in the *than*-clause on the basis of the intension of *three students be at my party* rather than its extension. To give a first impression of the proposal, consider the two possible paraphrases for (145)a in (145)b and c.

(145) a. More than three students were at my party
b. "More students were at my party than how many students there are st. 3 students **were** at my party."
c. "More students were at my party than how many students there are st. 3 students **would be** at my party."

The salient difference between (145)b and (145)c is that only in the first case is the standard of comparison calculated based on the actual state of affairs. The import of the difference is not as obvious in the case of increasing comparative quantifiers as it is for decreasing comparative quantifiers cf. (146). (146)c employs a paraphrase that is less faithful to the actual syntax but displays more prominently what the basic insight behind the idea of calculating the standard of comparison based on the intension of *three students be at the party* rather than its extension is.

(146) a. Fewer than three students were at my party
b. "Fewer students were at my party than how many students there are st. 3 students **were** at my party."
c. "Fewer students were at my party than how many students there are **had there been** 3 students at my party."

If structures for the *than*-clause similar to the paraphrases in (145)c and (146)c could be derived, the problem of decreasing as well as increasing comparative quantifiers would be solved in a straightforward manner as the commitment to the existence of a set of students at the party with cardinality 3 in the actual world is suspended. In the paraphrases in (145)c and (146)c this is achieved by employing a modal operator in the *than*-clause. Rather than stipulation a separate covert modal operator inside the *than*-clause in comparative quantifiers for which there is no evidence other than it being necessary to derive contingent truth-conditions, I suggest that the maximality operator inside the degree quantifier can do the job. The intuition is rather simple. The maximality operator inside the degree quantifier as defined in chapter 1 and repeated in (147) for convenience takes a set of degrees as argument and returns the biggest element in that set. A natural extension of this semantics is to allow the maximality operator to find the biggest degree across worlds/situations. The relevant definition is given in (148).

(147) Definition: Maximality

$\max = \lambda D_{\langle d,t\rangle}.\iota d \text{ st. } D(d) = 1 \;\&\; \forall d' \, [D(d') = 1 \rightarrow d' \leq d]$

(148) Definition: Intensional Maximality

$\max = \lambda D_{\langle d,st\rangle}.\iota d.\ \exists w\ D(d)(w) = 1 \;\&\; \forall d' \forall w' \, [D(d')(w') = 1 \rightarrow d' \leq d]$

To make use of the intensional version of the maximality operator, the *than*-clause has to denote a set of degree-world pairs rather than a set of degrees. To achieve this on principled grounds I would like to advance the following proposal.

We begin by recognizing that lexical entries for predicates are more complicated than we pretended so far. Intuitively, their extension depends on the particular properties of the situation or world in which it is used. For instance the extension of *students at MIT* depends on the time at which this predicate is evaluated. To encode this dependency formally it will be assumed that predicates take as innermost argument a world/situation pronoun.[93] Even though this pronoun is phonetically not realized its syntactic and semantic properties are very much those of the more familiar personal pronouns. In particular, their semantic value depends on the assignment function relative to which the sentence is interpreted. Of course world/ situation pronouns can also be bound by an antecedent quantifier such as a modal or temporal quantifier. It will be assumed that for the purpose of this thesis tense can sufficiently approximated as existential quantifier ranging over situations.

[93] For convenience, I assume the situation semantic extension of possible world semantics as developed in Berman(1987), Kratzer(1989), Heim(1991), von Fintel(1994) etc. Situations are simply parts of possible worlds or equivalently, a world is a maximal situation in the sense that it is not a proper part of any other situation.

Tense is like any other quantificational element in natural language a restricted quantifier. Its restrictor – a set of situations – is given by a sparse relation "in" or "part of" introducing again a situation pronoun that can be bound from a higher quantifier over situations. If there is no higher situation binder and the situation variable remains unbound, it will be assumed that the assignment function assigns by default the utterance world/situation to this pronoun symbolized by s_0. For convenience, these pieces will be simply packed into the tense operator. We get sample entries for predicates as in (149)a while the basic format of the tense operator gets a semantics as in (149)b.[94]

(149) a. $[\![sick]\!] = \lambda s.\lambda x.$ x is sick in s

b. $[\![T(ense)]\!] = \lambda P_{<s,t>}.\ \exists s$ in s_0 st $P(s)=1$

The scope argument of Tense is given by the VP. According to the definition of the Tense operator in (149), the VP has to denote a function from situations to truth-values. I would like to suggest that this is exactly the node that provodes the antecedent for the ellipsis site in the *than*-clause in comparative quantifiers. The tense operator will take scope over both arguments of the comparative operator. Crucially, the situation pronoun inside the *than*-clause can be optionally quantified over by intensional maximality. The situation is summarized in the tree in (150)b.

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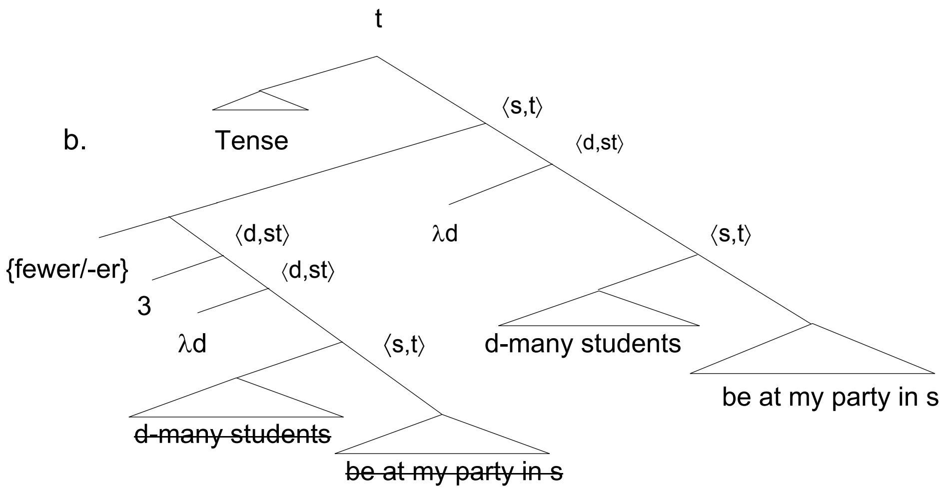
[94] I will not be concerned at all with the differences among tense. Instead, I assume that the entry in (149)b can be suitably adjusted for each specific tense by specifying the "in" relation. PAST could for instance be approximated as $\exists s$ preceding s_0. Of course it will be necessary to specify what precedence for situations means.

(150) a. Fewer/more than three students were at my party.[95]

b.



c. $\exists$s in s_0 st. max(λd st. d-many students were at my party in s) {<,>} max(λd. $\exists$s' st. d-many students were at my party in s' & d=3)

In the case of monotone decreasing comparative quantifiers the situation pronoun inside the *than*-clause has to be quantified over by the intensional maximality operator to derive contingent truth-conditions. Notice that the truth-conditions do not anymore demand from the evaluation situation that it contains 3 students that are at my party. All that is required is that there is **some** possible situation that contains 3 students at my party. In the case of monotone increasing comparative quantifiers the situation pronoun inside the *than*-clause can be quantified over by the matrix tense operator at least if there are three or more students at the party in the actual world. This gives the system enough flexibility to predict the right truth-conditions.

[95] Again there is a technical amendment to be noted regarding the interpretation of the numeral inside the *than*-clause. Strictly speaking the predicates "λd.d=3" and "λd.λs.d-many … in s" cannot be intersected. The easiest way to solve this problem is to assume that the measure phrase can be optionally of type ⟨d,st⟩.

Before looking for independent support for the rather unusual claim that the *than*-clause in at least some comparative constructions is an intensional domain, it is worth addressing the potential worry that assuming intensional maximality might undermine the account of the MNPG. Recall from section 2.2 that the minimal number requirement of predicates such as *meet* was assumed to be encoded as definedness condition. Since the *than*-clause at least in some cases is an intensional environment, it is conceivable that the minimal number presupposition is filtered out by the intensional maximality operator similar to existence presuppositions and would therefore predicted to be not detectable. Note however, that the minimal number presuppositions of predicates such as *meet* have to be satisfied in all (canonical) worlds.[96] It is part of the very meaning of minimal number predicates that they require a certain minimal number of participants. Any meeting event no matter which world is considered will have to have at least 2 participants. Suspending the commitment to the existence of a set of meeting individuals in the evaluation world as required by monotone decreasing comparative quantifiers does not entail that the meaning of *meet* itself changes. Embedding minimal number predicates under a modal operator will therefore not affect the minimal number presupposition. The

[96] Note that the sentences below sound perfectly fine. This can be reconciled with the proposal made in the text once we notice the special flavor of the modal operators that are required in sentences that are apparent exceptions to the MNPG: the set of worlds they quantify over seem to be contrasted with worlds that are in fundamental ways different from ours and the communicative value of the sentences below is that our world is such that …

(i) It takes more than one to have a meeting.
(ii) You need more than two to form a triangle.
(ii) Three cannot stand in square formation. I takes more than that.

account of the MNPG therefore is not undermined by the move of intensionalizing the maximality operator.

Since the proposal that some *than*-clauses are intensional environments is to my knowledge novel it would be important to find independent evidence in support of this idea. There are two essential features — a semantic and a corresponding syntactic one — to the proposed solution. On the semantic side, we have seen that even though measure phrase comparatives have a clausal source, the *than*-clause has to be a "pure degree description." The basic intuition is that pure degree descriptions are intensional objects (type ⟨d,st⟩) that are interpreted by the intensional version of the maximality operator. Two expectation can be derived from these claims: First it is expected that we find other cases where the *than*-clause needs to denote an intensional degree description without there being an overt modal operator. Second, in cases where there are pure degree descriptions without the presence of an intensional maximality operator, an overt modal operator will be required in the interpretation of the degree description.

The corresponding syntactic claim was that the intensionality of the *than*-clause has its source in the fact that the bare VP is copied into the *than*-clause. I will argue in the second section to follow that a variety of diagnostics for phrasal comparatives that have been discussed in the literature can be naturally captured under the perspective that the *than*-clause in phrasal comparatives is indeed a (very small) small clause — essentially a bare VP.

2.6.4 Semantic Correlates

On closer examination, the seemingly simple account of the MNPG proposed in 2.4, turned out to have non-trivial implications such as the need for the *than*-clause to span an intensional domain. The need to suspend any existence claims in the *than*-clause makes the MNPG even more puzzling. To account for the generalization the VP had to be part of the *than*-clause but at the same time we had to ensure that the VP is not detectable in any way other than through the definedness conditions. Interestingly this peculiar combination of affairs is not unique to amount comparatives. First of all we can extend that observation from comparative quantifiers to all measure phrase comparatives. Recall that all measure phrase comparatives have a clausal source as evidenced by the measure phrase (positive-comparative) correlation. The same reasoning that forced us to allow the *than*-clause to be intensional also provides the support for an intensional *than*-clause in cases such as (151).

(151) a. John is shorter/less tall than 7'8''.
b. This cable is thinner/less thick than 5 feet.

It is clearly not required that there is somebody in the evaluation world who is 7'8'' tall or that there is a cable that is 5 feet thick in order for (151)a and b respectively to be felicitous. Quite similar observations can be made also outside of the limited range of measure phrase comparatives. Consider the sentence in (152)a due to I. Heim (p.c.).

(152) a. They treated me worse than a slave.

b. "They treated me worse than they/one would treat a slave if they had one."

Again as the clausal paraphrase indicates, for (152)a to be felicitous (or even true) it is not required that they have/there is a slave in the evaluation world.[97] The need to abstain from any existence claim is exactly the same as the one we have observed with measure phrase comparatives. Since the interpretation of this comparative minimally requires the interpretation of a *than*-clause of the form "than how badly one/they treat a slave," the same solution that I have proposed for measure phrase comparatives suggests itself also for these cases. Specifically, if it is assumed that the *than*-clause contains only the bare VP and intensional maximality closes off *than*-clause as in (153).

(153) $[\![$*They treated me worse than a slave*$]\!]$ = 1 iff max {d:∃s they/one treats a slave d-badly in s} < max {d: they treat me d-badly in s_0}

These facts show then that the idea of intensional maximality finds applications in comparatives that are independent of measure phrase comparatives. The second piece of evidence that I would like to mention as providing support for the analysis

[97] It seems possible to turn this observation into a (weak) argument against so-called direct analyses of phrasal comparatives (cf. e.g. Hoeksema(1983,1984), Hendricks(1995) among many others). The general format of direct analyses is most clearly discussed in Heim(1985). The proposal is essentially that the same gradable function is successively applied to the two arguments that are compared under the scope of the relevant comparative operator. The format can be schematized as -er(x)(y)(f) = 1 iff f(x) > f(y). The relevant observation in (152) is that the degree function has to be intensional when applied to the standard of comparison argument (*a slave*) but extensional when applied to the matrix argument. Hence the degree functions are not identical and the format of the direct analysis is not applicable all structures that fit its structural description.

comes from a curious and ill-understood observation about amount relatives (cf. Carlson(1977), Heim(1987), Grosu&Landman (1998)). Recall that the flip side of the proposal advocated here is that pure amount descriptions/predicates are claimed to be intensional objects of type ⟨d,st⟩. I.e. specifically they provide a situation/world variable for a modal operator to quantify over. Evidence form amount relatives seems to corroborate this claim since this is exactly what is needed in certain cases of amount relatives where only the amount but not the substance is under discussion. Intuitively, amount relatives are relative clauses that seem to modify the amount of stuff denoted by the head noun rather than the individuals in its extension. Consider the data in (154) from Carlson (1977) and Heim(1987) respectively.

(154) a. I put everything I could in my pocket.
b. It will take us the rest of our lives to drink the champagne that they spilled last night.

The unmarked reading of Carlson's example in (154)a is not that I put everything in the pocket for which there is a possibility that I put it in my pocket. Assume that there are 50 rocks all of which by themselves fit in my pocket. (154)a — in its unmarked, so called "identity of amounts" reading (as opposed to the "identity of substance" reading) — doesn't mean that I put all of them in due succession in my pocket. Instead it says that I put as many of them as could fit together in my pocket. (154)b from Heim(1987) illustrates this effect more dramatically since the identity of substance reading is clearly not available. It would mean that it would take us the rest of our lives to collect all the champagne that they spilled last night and then drink it. Interestingly, as Grosu&Landman(1998) observe — without offering an explanation — following similar claims in Carlson(1977) pure amount relatives that do not license an identity of substance reading for pragmatic reasons require embedding under a modal operator. Consider the contrast in (155)b adapting Heim's(1987) example.

(155) a. It will take us the rest of our lives to drink the champagne that they spilled last night.
b. ?? It took me two weeks to drink the champagne that they spilled last night.

(155)b is rather awkward because it suggests that they drank last night the same champagne that it took me two weeks to drink. I.e. the relative clause in (155)b talks both about the amount and the substance. Embedding under a modal operator on the other hand as in (155)a makes it possible to suspend the substance reading of the amount relative clause and refer only the amount of champagne. The puzzle is why the pure amount reading of the amount relative is possible only if there is a suitable modal operator. I would like to suggest that this fact can be understood along the lines of the proposal made for than *than*-clause of measure phrase comparatives. The idea is simply that pure amount relatives arise just like pure degree descriptions when any existence claims are suspended about an individual/a substance that has the relevant amount/degree in the actual world. Just like pure degree descriptions pure amount descriptions are so to speak parasitic on a description of an entity. Unless the commitment to the existence of an entity in the actual world is suspended as achieved by a modal operator binding the situation/world pronoun inside the NP, the amount as well as the substance reading is generated.[98] Comparatives and amount relatives differ in one essential respect. While the comparative operator itself (in form of the intensional maximality operator) can suspend existence claims, amount relatives require a modal operator to do that. This supposed difference is corroborated by the contrast in (156)[99].

(156) a. ?? This year I earned the money that the basketball coach earned last year.

b. This year I earned twice the money that the basketball coach earned last year. "This year I earned twice as much money as the basketball coach earned last year."

(156)a is quite awkward for the same reason that (155)b is awkward. It entails that I earned the same money that was already handed out to the basketball coach last year. Once again this shows that unless there is a suitable modal operator, the pure amount reading is not available even if it is pragmatically they only sensible reading. Interestingly, the awkwardness disappears as soon as a comparative structure is superimposed. As the paraphrase of (156)b indicates, adding the (multiplicative) differential *twice* enforces a comparative structure — in this particular case it is an equative construction which by the same token that allowed us to derive contingent truth-conditions in the case of decreasing comparative quantifiers generates a "pure amount" reading in (156)b.

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[98] Unfortunately the syntax of amount relatives is not too well understood (cf. Grosu&Landman(1998) for discussion) so that I have confine myself to sketching the basic insight and leave it for future research to work out a concrete proposal.

[99] Thanks to Colin Phillips (pc) for the data.

2.6.5 Syntactic Correlates

The second claim essential to the account of measure phrase comparatives advanced in the present chapter concerns the claim that the intensionality of the *than*-clause is syntactically tied to the absence of tense in the *than*-clause. Recall that the structure given in (150)b assumes that syntactically, the *than*-clause is similar to a small clause or rather a bare VP (assuming the VP internal subject hypothesis). Intuitively, even though the *than*-clause is clausal in meaning in the sense that a complete theta-complex is utilized, it lacks the functional categories like tense that locate it relative to the utterance situation.[100] I'd like to suggest that the lack of tense in the *than*-clause of measure phrase comparatives correlates with the syntactic properties that distinguish so called phrasal comparatives from clausal comparatives. The evidence that distinguishes phrasal comparatives from clausal comparatives is entirely syntactic in nature.[101] Interestingly, it seems that the common characterization of the various syntactic differences is in terms of the "size" of the *than*-clause. I.e. even though these syntactic differences appear to be quite heterogeneous, they can be thought of as manifestations of the same basic syntactic property that distinguishes phrasal comparatives from clausal comparatives — while

[100] This is the reason for the somewhat peculiar paraphrases — "More students were meeting than there are in a meeting of one student" — that I have given to comparative quantifiers if analyzed in terms of comparative syntax.

[101] To my knowledge nobody has provided convincing evidence that the semantics of phrasal comparatives is different from clausal comparatives. Hoeksema(1983,1984) makes the strongest pitch for such a position taking NPI licensing as indicator for a different semantics. See von Stechow(1984b), Heim(1985) for critical remarks on his semantics and Hendriks(1995) remarks on the empirical facts concerning NPI licensing in Dutch which are more complicated actually not predicted by Hoeksema's proposal.

clausal comparatives have a fully specified (tensed) *than*-clause, the size of the *than*-clause in phrasal comparatives is that of a bare VP lacking any tense. The correlation between the presence of tense and size of the clausal domain as well as the syntactic difference that result from the specific size of the clause are well established.[102] I.e. more concretely, I would like to argue that the evidence that distinguishes phrasal comparatives from clausal comparatives consists of a variety of syntactic phenomena indicating transparency of the *than*-constituent with respect to which the matrix in the case of phrasal comparatives while their clausal counterparts are opaque. I will refrain in the following discussion from providing a detailed syntactic analysis of the phenomena since the important point is only to show that the *than*-clause of phrasal comparatives is in a variety of ways more transparent than the *than*-clause of clausal comparatives.

Bresnan(1973) first pointed out that some phrasal comparatives and in particular measure phrase comparatives such as the one given in (157)a cannot support the presence of a finite copula. This is predicted under the current proposal that only a bare VP is copied into the *than*-clause of measure phrase comparatives. There is simply no space for a tense operator. We can add to Bresnan's observation the parallel fact from comparative quantifiers that receive an analysis as measure phrase comparatives under the present proposal.

[102] See especially Wurmbrand(1998) for recent.

(157) a. This rope is longer than 6 feet (*are)[103]
"This rope is longer than how long 6 feet are"
b. There are more than 3 books (*are) on the table.
"There are more books on the table than how many books three books are "

As the paraphrases suggest, there is nothing semantically wrong with a copula in the *than*-clause. It is rather a purely syntactic property of measure phrase comparatives that they do not support functional categories. I do not have anything to offer that would explain this peculiarity. Given the assumptions from above, the observation is nevertheless important as it provides a principled reason why the *than*-clause in measure phrase comparatives spans an intensional domain.

The second set of contrasting observations are due to Hankamer(1973) and concern transparency with respect to Binding Theory. Specifcally, Hankamer(1973) observes that phrasal comparatives seem to form a binding domain with the matrix while clausal comparatives do not. The contrast in (158) illustrates this difference.

(158) a. No man is stronger than himself.[104]
b. * No man is stronger than himself is.
c. No man is stronger than he himself is.

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[103] An open question is why you can't even have the non-finite form of the copula in measure phrase comparatives.

(i) a. * This sope is longer than 6 feet (*be)
b. * There are more than three books (*be) on the table.

This doesn't follow from the present proposal. Alec Marantz (p.c.) suggests that it might be that the VP that is elided in the *than*-clause is too small to support the spell-out of any functional categories. I will have to leave this as an open problem here.

[104] The English examples are actually due to Hoeksema(1984). Hankamer(1973) used Greek. Cf. also Hendriks(1995) for similar examples from Dutch.

While the contrast is clear, the correct account is much less so. In particular, the ungrammaticality of (158)b might well be due to the anaphor being in position that nominative case is assigned to. What the grammaticality of (158)a shows then is that if there is a clausal source, it cannot be finite. This is of course compatible with the claim that the *than*-clause in (158)a is a bare VP and need to be taken to show that the *than*-constituent is a PP as Hankamer(1973) and Hoeksema(1983) did.

The third piece of evidence — "extraction transparency" — has been first observed again by Hankamer(1973) who pointed out that phrasal comparatives are transparent for wh-extraction while clausal comparatives are not as (159) indicates.

(159) a. ? You finally met somebody you're taller than.
b. * You finally met somebody you're taller than is.

Again the fact that phrasal comparatives are transparent for wh-extraction does not prove that the *than*-constituent is a PP. The contrast can be equally well accommodated under the assumption that the *than*-clause in phrasal comparatives is a small clause, which are known to permit wh-extraction more freely than finite clauses.

The final set of facts that will be briefly discussed here goes back to Heim(1985) and could be properly called "case transparency" vs. "case opacity" effects.[105] The idea is that the case of the constituent following the comparative particle *than* either mimics the case of its correlate in the matrix or is fixed seemingly

[105] See also Stassen(1984) for relevant cross-linguistic perspective.

assigned by the comparative particle *than* itself. German provides examples of both kinds with superficially phrasal comparatives. The examples in (160) to (162) taken from Heim(1985) show that the DPs that are compared — indicated with capitals — are matched in case. I.e. if the DP in the matrix that provides the first pair of the comparison has nominative then the DP after the *than*–particle bear nominative as well and so on for every morphological case.

(160) a. ICH habe dir bessere Schlagzeuger als DER KARLHEINZ vorgestellt.
I_{Nom} have you_{Dat} better $drummers_{Acc}$ than the $Karlheinz_{Nom}$ introduced
"I have introduced better drummers to you than Karlheinz (has)"

b. Ich habe DIR bessere Schlagzeuger als DEM KARLHEINZ vorgestellt.
I_{Nom} have you_{Dat} better $drummers_{Acc}$ than the $Karlheinz_{Dat}$ introduced
"I have introduced better drummers to you than to Karlheinz"

c. Ich habe dir bessere SCHLAGZEUGER als BASSISTEN vorgestellt.
I_{Nom} have you_{Dat} better $drummers_{Acc}$ than base-$players_{Acc}$ introduced
"I have introduced better drummers than base-players to you"

Certainly the most natural account of these case-matching effects can be given in terms of a clausal analysis. In particular, if the clause has to be identical to the matrix (with the exception of focused material) for ellipsis to apply, we expect exactly these effects. To give an example, consider again example (160)c and its underlying clausal analysis in (161)b.

(161) a. Ich habe dir bessere SCHLAGZEUGER als BASSISTEN vorgestellt.
I_{Nom} have you_{Dat} better $drummers_{Acc}$ than base-$players_{Acc}$ introduced
"I have introduced better drummers than base-players to you"

b. Ich habe dir bessere SCHLAGZEUGER vorgestellt als <~~ich dir gute~~>
I_{Nom} have you_{Dat} better $drummers_{Acc}$ introduced than <~~I you_{Dat} good~~>
BASSISTEN <~~vorgestellt habe~~>.
base-players <~~introduced have>~~
"I have introduced better drummers to you than I have introduced good base-players to you"

Interestingly, as Heim(1985) observes, there is a minimally different case to the one in (160)c that cannot be submitted to the same treatment. Consider (162)a and the attempt to give a clausal analysis parallel to the so successful strategy in (161) in (162)b. In particular, under a full blown clausal analysis one would expect nominative case on DP following *than* — contrary to fact. These facts seem to provide again evidence that there are syntactically two kinds of "phrasal comparatives" and one of them has the properties of a small clause which are known to be transparent for case assignment from outside.

(162) a. Ich habe dir BESSERE SCHLAGZEUGER als DEN SHELLY MANNE
I_{Nom} have you_{Dat} better $drummers_{Acc}$ than the Shelly $Manne_{Acc}$
vorgestellt.
Introduce
"I have introduced better drummers to than Shelly Manne"

b. Ich habe dir bessere SCHLAGZEUGER vorgestellt als
I_{Nom} have you_{Dat} better $drummers_{Acc}$ introduced than
der/*den Shelly Manne <~~ein guter Schlagzeuger ist~~>.
the_{Nom}/the_{Acc} Shelly Manne <~~a good drummer is~~>.
"I have introduced better drummers to you than Shelly $Manne_{Nom/*Acc}$ is a good drummer"

To summarize, there are four empirical domains that seem to suggest that at least some phrasal comparatives should be analyzed differently from supposing a full-blown clausal source. First, it has been observed that measure phrase comparatives cannot support a finite *than*-clause. Second, evidence from binding theory ("BT-transparency") suggested that phrasal comparatives cannot have a finite clausal source that would assign nominative case to the anaphor in subject position. Instead, the *than*-constituent seemed to form a binding domain with the matrix. Thirdly, phrasal comparatives can be transparent for wh-extraction ("extraction transparency") and finally, some phrasal comparatives are apparently transparent for case assignment ("case transparency"). A unified characterization of these facts presents itself in terms of the size of the *than*-constituent. In particular, the discussed contrasts are very similar to well-known contrast between small clauses and finite clauses. A "small clause" or "bare VP" analysis for phrasal comparatives not only has the important advantage of getting away with one meaning for comparative operator it also seems to provide the syntactic basis of accounting for the observed differences in a principled manner. While these correlating observations provide encouraging support for the proposal that phrasal comparatives sometimes have a *than*-clause consisting essentially of a bare VP, they do not constitute a proof. Nor should these unfortunately rather sketchy remarks about the syntactic difference between so-called phrasal and clausal comparatives be seen as explanation. All that was attempted in this section is to argue that the assumption of a *than*-clause that consists of a bare VP is syntactically not entirely unreasonable — supporting the prima facie attractive position that all comparatives have are clausal source for the *than*-constituent. Furthermore, we have seen that there is potentially corroborating evidence in support of this position. However, much work has to be done before a complete account of the syntax of phrasal comparatives can be given.

2. 7 Simple Extensions: *at least n, at most n, between n and m*

It is clear that the analysis developed for *more than three* should be extended to cover other comparative determiners like *at most three, at least three, between three and five, fewer than three* as well as to bare numeral DPs and eventually to proportional determiners like *more than half,* etc. While it is not possible to do this in any serious way here, I would like to sketch a treatment for the intersective comparative determiners *at least/most three* and *between three and five*.[106] The idea is simply to analyze *at least n, at most n and between n and m* as degree quantifiers parallel to the treatment of *–er than n.* For instance, *at most three* will be analyzed as set of sets of degrees such that there is no degree higher than three for which the scope argument is true.

(163) a. $[\![\textit{-er than n}]\!] = \lambda D_{\langle d,t\rangle}.\ \max(\lambda d.\ D(d)=1) > 3$[107]

b. $[\![\textit{at most n}]\!] = \lambda D_{\langle d,t\rangle}.\ \neg\ \exists d[d>n\ \&\ D(d)=1]$

c. $[\![\textit{at least n}]\!] = \lambda D_{\langle d,t\rangle}.\ D(n)=1$

d. $[\![\textit{exactly n}]\!] = \lambda D_{\langle d,t\rangle}.\ D(n)=1\ \&\ \neg\ \exists d[d>n\ \&\ D(d)=1]$

e. $[\![\textit{between n and m}]\!] = \lambda D_{\langle d,t\rangle}.\ D(n)=1\ \&\ \neg\ \exists d[d>m\ \&\ D(d)=1]$

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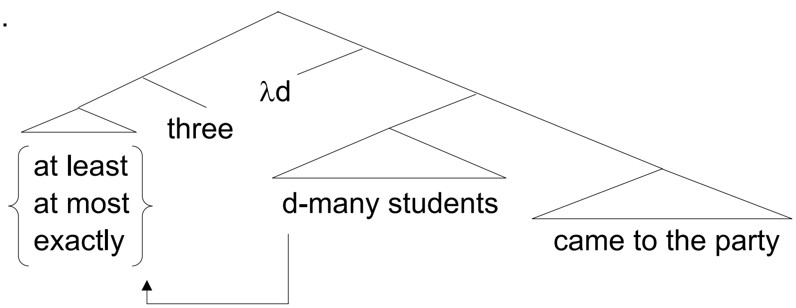
[106] I owe these extensions to Heim(2000c)

[107] I am abstracting away from the fact that the *than-clause* contains an NP and a VP.

Of course these degree quantifiers need to be licensed by an appropriate degree function*.* As in the case of *–er than n*, we can assume that they are base generated in the innermost argument slot of *many* and move for interpretability reasons to a clausal node. The structure we end up with is therefore as indicated in (164)b. (164)c-f indicate how the truth-conditions are derived.

(164) a. At least/most/exactly three/between three and five ⟨many⟩ students came to the party.

b.



c. ⟦*At least three students came to the party*⟧ = 1 iff [λd. d-many students came to the party](n)=1 iff $\exists$x[**students**(x) = **came to the party**(x)=1 & |x| = 3]

d. ⟦*At most three students came to the party*⟧ = 1 iff $\neg\exists$d[d>3 & $\exists$x[**students**(x) = **came to the party**(x)=1 & |x|=d]

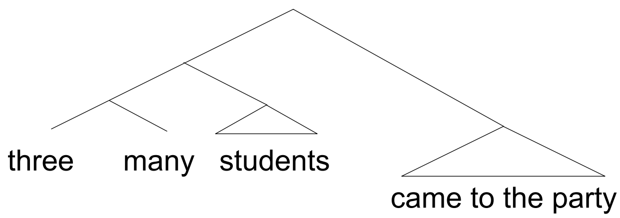
e. ⟦*Exactly three students came to the party*⟧ = 1 iff $\exists$x[**students**(x) = **came to the party**(x)=1&|x|=3] & $\neg\exists$d[d>3 & $\exists$x[**students**(x)=**came to the party**(x)=1 & |x|=d]

f. ⟦*Between three and five students came to the party*⟧ = 1 iff $\exists$x[**students**(x) = **came to the party**(x)=1&|x|=3] & $\neg\exists$d[d>5 & $\exists$x[**students**(x)=**came to the party**(x)=1 & |x|=d]

From this perspective it is natural to analyze bare numeral DPs such as *three students* to contain a hidden degree determiner *many* as well. The only difference to the modified numerals would be that *three* is a definite description of a degree and not a quantifier and can therefore stay in situ.

(165) a. Three ⟨many⟩ students came to the party.

b.



c. ⟦*Three ⟨many⟩ students came to the party*⟧ = 1 iff ∃x[**students**(x) = **came to the party**(x)=1 & |x| = 3]

Furthermore, the truth-conditions that are derived are identical to the truth-conditions we get for *at least n*. I.e. given the monotonicity principle mentioned in chapter 1[108] (165) just like (164)c would be true even if the number of students at the party were bigger than three. Of course, *at least n NP* and *n NP* differ in that the latter but not the former give rise to a "not more than n implicature" unless they appear in predicative positions. I will not attempt an account of this difference here and simply point out that whatever turns out to be the proper theory of scalar implicatures with numerals will have to take into account the difference between modified numerals and bare numerals. The proposal sketched here maintains this difference – *at least n, at most n, etc.* are degree quantifiers while bare numerals are definite descriptions of degrees and should therefore in principle be compatible with it.[109] Bare numeral DPs differ however in a number of other ways from modified numeral DPs that cannot be simply attributed to a difference in triggering scalar implicatures. For

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[108] The principle needs to be modified to cover gradable determiners as follows:

A function μ (type ⟨d⟨et,ett⟩⟩) from degrees to determiners is <u>monotone</u> iff
$\forall A,B \subseteq D$ and $\forall d, d' \in D_d$ [$\mu(d)(A)(B)=1$ & $d' < d$) $\rightarrow \mu(d')(A)(B)=1$]

[109] See Kadmon(1987), Krifka(1998), Landman(1998) for recent proposals.

instance, it is well known that bare numeral DPs give rise to the "wide scope indefinite" phenomenology while modified numerals do not.[110,111] The proposal here does not account for this difference and is therefore at best incomplete.

2.7 Summary

The salient difference between the GQT approach to comparative determiners — which maintains that comparative determiners are at least for the purpose of semantic composition opaque domains — and an analysis of comparative determiners as comparative constructions is that only the latter expects interactions of the building blocks of comparative determiners (comparative operator, measure phrase and degree function) with the environment. The present chapter discussed one particular set of interactions that compellingly document that the measure phrase inside comparative quantifiers (given by the numeral) interacts with the matrix VP. The observations were summarized in the general version of the MNPG with comparative determiners and are equally unexpected for both the GQT approach and the classical comparatives approach sketched in chapter 1 as they show that the numeral even though deeply embedded in the DP "sees" the presuppositional requirements of the matrix predicate.

The analysis of the MNPG that was developed in the subsequent sections had to amend the classical comparatives analysis in a variety of non-trivial ways.

[110] Cf. Fodor&Sag(1981), Reinhart(1997), Kratzer(1998), Winter(1998) among many others.

[111] In chapter 4 a related difference is discussed in some detail: bare numeral DPs akin to definite plurals can take genuine collective predicates while modified numerals typically cannot.

The most significant concerns the semantics of the degree function *many*. Unlike adjectival degree functions such as *tall* which have the syntactic properties of modifiers, *many* was shown to have the syntax of a determiner (after the innermost degree argument was absorbed). I.e. the proposal of the MNPG relied on insights of both GQT and the comparative quantifiers as comparatives approach. These two sets of properties were unified in the concept of a "parameterized" determiner meaning for *many*. On the one hand, *many* takes a degree argument ("the parameter") which subjects it to the syntax and semantics of comparative constructions. On the other hand *many* was shown to maintain the properties of a determiner. Independent evidence for this assumption came from the fact that amount comparatives based on *many* cannot appear in genuine predicative or attributive positions.

The second significant amendment to the classical analysis of comparatives had to be set in place to derive the correct truth-conditions. Specifically it was shown that the *than*-clause in measure phrase comparatives constitutes (at least in the case of decreasing quantifiers) an intensional domain. This unusual assumption was shown to have independent support in regular comparative constructions as well as in amount relatives. Finally, it was argued that there is a corresponding syntax to the observation that the *than*-clause is sometimes an intensional domain. Specifically, it was suggested that the intensionality arises because the *than*-clause does not contain any extended functional structure such as tense dominating the bare VP. It was suggested that this corresponds quite well with syntactic differences that have been discussed in the literature as distinguishing phrasal from clausal comparatives.

Properties of Comparative Determiners Revisited

Now that the analysis of comparative quantifiers as comparative constructions (at least in its outlines) stands clearly, we should go back to the GQT observations concerning comparative and see if we can still account for them. Let' start with the fact that comparative determiners are conservative. I.e. the support the equivalence schematized in (166)a as illustrated by the equivalent sentence pair in (166)b,c.

(166) a. D(A)(B) = 1 iff D(A)($A \cap B$) = 1
b. More than three students smoke.
c. More than three students are students who smoke.

According to the proposal developed in this chapter, we have to make sure that the LFs we would assign to both sentences yield identical truth-conditions. That this is indeed so can be seen when we inspect the LFs given in (167).

(167) a. [[-er λd. d = 3 & d-many students smoke] λd. d-many students smoke.]
b. [[-er λd. d = 3 & d-many students are students who smoke] λd. d-many students are students who smoke.]

Clearly, if the number of students that smoke is bigger than the number of smoking students had there been 3 smoking students, then it is also true that the number of students who are students that smoke is bigger than the number of students who are students that smoke had there been 3 students that are students who smoke. And vice versa. Comparative determiners are still conservative according to the new analysis is simply because the role of the NP has not changed in the construction of the quantifier meaning. This in turn is guaranteed by the claim that comparative determiners contain the determiner d-many which works just like any other determiner. Even though we built on top of a regular determiner a comparative module that shares a number of features of the non-conservative Haertig quantifier, the basic fact of conservativity of comparative determiner is maintained.[112]

Comparative determiners are obviously permutation invariant according to this analysis. All we added is a syntactically and semantically explicit module of measuring (d-many) and comparing cardinalities, which by definition is insensitive to the identity of the individuals in the universe. It is perhaps less easy to see why comparative determiners like *more than three* are extensional, i.e. insensitive to growth of the universe. After all, in section 2.6 we had to make the *than*-clause an intensional environment to get the truth-conditions right. It would seem then that comparative determiners are not insensitive to the size of the universe. Recall however, that the than-clause also contains the numeral whose denotation is the same across all worlds. This removes effectively all sensitivity to the size of the universe. More precisely, whether or not comparative determiners are extensional depends on how the standard of comparison is given. In case a measure phrase

[112] Hence the proposal is quite similar to Beghelli's idea with the important difference that we are not claiming that natural language supplies an abstract Haertig quantifier. Instead, it supplies comparative syntax and semantics needed independently for the semantics of comparatives.

(e.g. a numeral) provides the standard, the comparative quantifier is extensional because the standard of comparison is the same across all worlds. If however the standard of comparison is given in a manner that depends on the universe, then we expect the whole quantifier to be intensional. This appears to be the correct approach as the intensional determiners all seem to be comparative in nature where in many cases the standard of comparison is not linguistically present. Some clear cases are given in with the paraphrases indicating how the standard of comparison is dependent on the world in which the comparative is evaluated.

(168) a. Mary invited enough bachelors.
a.' 'Mary invited as many bachelors as needed (given certain requirements in w_0)'
b. Mary invited too many/too few bachelors.
b.' 'Mary invited more/fewer bachelors than she should have invited (given w_0)'
c. Mary invited many married men/few girl friends.
c.' 'Mary invited more married man/fewer girl friends than expected/she should have invited (given w_0)'

These few remarks are by no means meant to be an analysis of intensional determiners. All that is intended here is that the present analysis can pin-point precisely the origin of intensionality in comparative determiners. This is an improvement over the GQT treatment, which left us simply with the observation that some determiners are not extensional. To the extent that a compelling analysis can be built on top of the proposal developed in this chapter, we get additional support for decomposing comparative determiners.

Next, comparative determiners split into two classes: intersective (cardinal) determiners like *more than three* and proportional determiners like *more than half of* *the,* etc. First, determiners like *more than three* are intersective simply because they contain an existential individual quantifier d-*many*. It is much less obvious, however why proportional determiners are not intersective. After all, according to the present they contain the same existential quantifier that intersective comparative determiners contain. The difference has come from some place else then. Again it is useful to spell out a minimal extension of the present proposal that might given the beginnings of an analysis of proportional determiners like *more than half* to see where we would locate the culprit. Minimally we would have to assign (169)a an LF as in (169)b.

(169) a. More than half of the students smoke.

b. [[-er λd. d = half of the students & d-many students smoke] λd. d-many students smoke].

The standard of comparison is provided by *half of the students*, the detailed analysis of which is beyond the limits of this thesis. What I would like to point out is that it seems to be an essential feature of proportional determiners that they employ a standard of comparison that measures the cardinality of a portion of the NP-set. The question is, why natural language doesn't seem to be able to refer to proportional degrees of numerosity without the help of a "part of" function. I.e. why is the format of *d-many NP* where d is a proportion (1/3, etc.) not available. The examples in (170) and (171) make the difference clear.

(170) Assume that there are 60 students

a. More than 20 of the students smoke.

b. More than 20 of the individuals in the universe are students that smoke.

(171) Assume that there are 60 students

a. More than 1/3 of the students smoke.

b. ≠ More than 1/3 of the individuals in the universe are students that smoke.

While (170)a and b have identical truth-conditions (modulo presupposition) indicating that *more than 20 of the* is intersective, this is clearly not the case with the pair in (171). Hence there is something special about the proportional degree 1/3 to the effect that it is licensed only as degree of a portion of the NP presumably delivered part-of function. This function applies to the NP *the students* in (171)a and to *the individuals in the universe* in (171).

The monotonicity properties of comparative determiners, finally, are captured as well. In fact, as was pointed out in the discussion in section 1.3.1, the monotonicity of comparative determiners are – with the exception of proportional quantifiers – predictable from the monotonicity properties of the comparative relation (>, <, =) featured in the truth-conditions of the determiner. The proposal defended in this chapter provides an immediate reason for this generalization since the comparative relation is syntactically realized in form of a degree quantifier.[113] For instance, *at most n* is monotone decreasing with respect to both its arguments because in contains a negative existential degree quantifier "$\neg \exists d>n\ [D(d) = 1]$" that takes scope over both predicative arguments of *many*. Non-monotonic comparative quantifiers like *exactly n* and *between n and m* on the other hand are literally a

[113] I haven't given an analysis of *fewer*. Irrespective of the details, the analysis will have to account for the fact that the truth-conditional import of comparative determiners based on *fewer* is to be described by the '<'-relation which is monotone decreasing.

combination of a monotone increasing degree quantifier and a monotone decreasing degree quantifier each of which takes scope over both predicative arguments of *many*.

Summing up, I would like to maintain that the present proposal is doing quite well in providing accounts of the fundamental observations about comparative determiners that GQT has provided. In some cases, it seemed that the present analysis could open the door to deeper answers than GQT gives. Much research is needed here however. The proposal is only a beginning.

2.8 Appendix: A GQT-Analysis of the MNPG

This section discusses how the GQT treatment of comparative determiners could be amended to provide an account of the MNPG in terms of the syntax and semantics of multiply-headed noun phrases as argued for in Keenan&Moss(1984), Keenan(1987), Beghelli(1994), Keenan& Westerstahl(1998), Smaessart(1996) etc. The point that I want to make is that while it is not impossible to find a suitable amendment of GQT to account for the MNPG, the needed amendments do not come for free and are decidedly out of character for the GQT program as they seem to undermine the generality of the GQT approach to quantification.

2.8.1 Multiply-Headed Noun Phrases

We have seen that the interpretation of comparative quantificational structures such as *more than n-1 NP* VP_n requires the interpretation of *n-1 NP* VP_n

at some point in the derivation. This is rather reminiscent of the interpretation of the multiply-headed comparative quantifiers in (172) below.

(172) a. More students than professors came to the party.
b. Fewer children than adults knew the answer.
c. As many doctors as lawyers attended the congregation.

As discussed in chapter 1, the GQT approach of Keenan&Moss(1984) and subsequent work analyses *more … than …* as discontinuous determiner that takes two NP arguments to yield a generalized quantifier.

(173) a. $[[\textit{more … than…}]] = \lambda \mathbf{P}_{et}.\lambda \mathbf{Q}_{et}.\lambda \mathbf{R}_{et}.\ |\mathbf{P} \cap \mathbf{R}| > |\mathbf{Q} \cap \mathbf{R}|$
b. $[[\textit{no fewer… than…}]] = \lambda \mathbf{P}_{et}.\lambda \mathbf{Q}_{et}.\lambda \mathbf{R}_{et}.\ |\mathbf{P} \cap \mathbf{R}| > |\mathbf{Q} \cap \mathbf{R}|$

An immediate and well-come consequence of this analysis is that both NP arguments have to satisfy the selectional restrictions of the VP. This explains the oddness of sentences as in (174) where one of the two NPs — *planets of our solar system* — doesn't satisfy the selectional restrictions of the VP *come to the party.*

(174) a. # More students than planets of our solar system came to the party.
b. # More planets of our solar system than students came to the party.

To capture the Minimal Number of Participants Generalization in this approach even simpler comparative quantifiers have to be analyzed as multiply-headed NPs. Specifically, the sentences in (175)a and (176)a would have a parse similar to the one indicated in (175)b and (176)b respectively.

(175) a. ?? More than three students were standing in square formation.
b. *More students than three students were standing in square formation.*

(176) a. No fewer than four students were standing in square formation.
b. *No fewer students than four students were standing in square formation.*

To be able to interpret these sentences assuming a lexical entry for *more … than …* as in (173), the numeral has to receive a different treatment than commonly assumed in GQT where they are treated as quantificational determiners. A natural proposal would be to treat numerals as modifiers of the NP as in (177).

(177) $[[\textit{three}]] = \lambda P_{et}.\lambda X.\ |X| = 3\ \&\ P(X) = 1$[114]

Given these assumptions, the sentences in (175) and (176) will be ultimately interpreted as follows.

(178) a. [[*More students than three students were standing in square formation*]] = 1 iff **|students $\cap$ standing in square formation|** > **| three students $\cap$ standing in square formation|**
b. [[*No fewer students than four students were standing in square formation*]] = 1 iff **|students $\cap$ standing in square formation|** $\geq$ **| four students $\cap$ standing in square formation|**

The Minimal Number of Participants Generalization can now be explained by observing that the awkward sentences that violate the minimal number requirement have very weak truth-conditions maybe are even trivial ones because they involve as part of the calculation of the truth-conditions the term **|n-1 NP $\cap$ VP_n|** which is

[114] Again, for simplicity, it is assumed here that x is an individual that corresponds to a set of individuals.

either necessarily zero or undefined if it is assumed that the minimal number of participants requirement is encoded as presupposition.

2.8.2 Getting the Truth-Conditions Right

The analysis presented above — minimal as it is in its assumptions — faces the same challenge of getting the truth-conditions right that the proposal in section 2.4 had to overcome. Again, the problem is most readily apparent with monotone decreasing comparative quantifiers, which are predicted to yield structures that are necessarily false. To see this, consider the lexical entry for the discontinuous determiner *fewer … than …* which parallels the entry for *more … than …* as in (179).

(179) a. $[\![$*more … than…*$]\!] = \lambda P_{et}.\lambda Q_{et}.\lambda R_{et}.\ |P \cap R| > |Q \cap R|$
b. $[\![$*fewer … than…*$]\!] = \lambda P_{et}.\lambda Q_{et}.\lambda R_{et}.\ |P \cap R| < |Q \cap R|$

Assuming these entries, we derive a representation of the truth-conditions associated with the sentences as in (180)b that are analogous to the representation associated with multi-headed quantifiers as in (180)a.

(180) a. $[\![$*Fewer students than teachers were at my party*$]\!]$ = 1 iff
$|\textbf{students} \cap \textbf{be\_at\_my\_party}| < |\textbf{professors} \cap \textbf{be\_at\_my\_party}|$

b. $[\![$*Fewer students than three students were at my party*$]\!]$ = 1 iff
$|\textbf{students} \cap \textbf{be\_at\_my\_party}| < |\textbf{three students} \cap \textbf{be\_at\_my\_party}|$
c. $[\![$*More students than three students were at my party*$]\!]$ = 1 iff
$|\textbf{students} \cap \textbf{be\_at\_my\_party}| > |\textbf{three students} \cap \textbf{be\_at\_my\_party}|$

The problem is that sentences employing monotone decreasing determiners are predicted to be trivial because |**three students** $\cap$ **be_at_my_party**| = 0 if there are fewer than three students at the party or else |**three students** $\cap$ **be_at_my_party**| $\geq$ 3 in which case |**students** $\cap$ **be_at_my_party**| $\geq$ 3 as well. Hence the sentence can never be true. The corresponding problem with increasing determiners arises as well. In this case the predicted truth-conditions are too weak. (180)c will be true as long as there is at least one student at the party. This is so, because |**three students** $\cap$ **be_at_my_party**| = 0 if there are fewer than three students at the party and |**students** $\cap$ **be_at_my_party**| > |**three students** $\cap$ **be_at_my_party**| will be true as long as there is at least one student at the party.

The diagnostic as well as the remedy are essentially the same as the ones proposed in section 2.6. Since the VP is intersected with the numeral as well as the NP, the calculation of the comparison is too sensitive to the actual state of affairs to give appropriate truth-conditions. To avoid the problem, we have to calculate the cardinality on the basis of the intension of *three students be at my party* rather than its extension. This solves both problems in a straightforward manner as the commitment to the existence of a set with cardinality 3 in the actual world is suspended.

(181) a. ⟦*Fewer students than three students were at my party*⟧ = 1 iff
|**students** $\cap$ **be_at_my_party**| < |λw. **three students** in w $\cap$
λw. **be_at_my_party** in w|

b. $[\![$*More students than three students were at my party*$]\!]$ = 1 iff
$|$**students** $\cap$ **be_at_my_party**$|$ > $|\lambda$w. **three students** in w $\cap$
λw. **be_at_my_party** in w$|$

The additional piece that has to be provided here is a semantics for the measure function "| |" so that it optionally calculates the cardinality of a property rather than of a predicate. If we were to give lexical entries to the measure functions, then entries along the lines of (182)a,b for the extensional and intensional versions respectively would be adequate.

(182) a. $[\![\,|\;|\,]\!] = \lambda P_{<et>}$. the maximal number n st. there n-many x st. P(x) = 1[115]
b. $[\![\,|\;|^{i}\,]\!] = \lambda P_{<s,et>}$. the maximal number n st. there is a world w st. for n-many x P(x)(w)=1

2.8.3 Some Critical Remarks

At this point it is worth stepping back and taking stock of what is being claimed. We have seen empirical evidence in form of the Minimal Number of Participants Generalization to the effect that comparative determiners such as *more than n* are always bi-clausal similar to multiply-headed NPs at some level of interpretation. Extending the analysis of multiply-headed NPs to simplex comparative determiners leaves us with the question why there don't seem to be any simple ("mono-clausal") comparative quantificational structures. Recall that the

[115] We should note in passing that giving a lexical entry for the measure function "the cardinality of" is incompatible with the main stance of GQT, which is to deny the fact there is a linguistically encoded measure function inside comparative quantifiers.

semantics of comparative quantificational structures in a GQ setting is simply given as in (183)a rather than (183)b.

(183) a. $[\![\textit{more than n NP VP}]\!] = 1$ iff $|\mathrm{NP} \cap \mathrm{VP}| > n$

b. $[\![\textit{more than n NP VP}]\!] = 1$ iff $|\mathrm{NP} \cap \mathrm{VP}| > |n\ \mathrm{NP} \cap \mathrm{VP}|$[i]

The claim hidden in (183)a which seems to be disputed by the facts presented by the Minimal Number of Participants Generalization is that the cardinality *n* can simply be read off the structure by looking at the numeral inside the complex determiner. Importantly, nothing in the semantics of comparative quantifiers requires the more complicated calculation in (183)b. For the GQ treatment of comparative determiners, the Minimal Number of Participants Generalization is entirely unexpected. This became most obvious when we noted that in order to predict adequate truth-conditions assuming the bi-clausal analysis, we had to apply an intensional measure function. Intensionalizing the measure functions allows us to do in an important respect exactly what is claimed in (183)a namely make reference to "pure" cardinality without existential commitment. Given this, the bi-clausal analysis is even more surprising and the conclusion that is suggested quite compellingly is that the syntax of comparative quantificational structures is responsible for the Minimal Number of Participants Generalization. The GQ treatment of comparative determiners on the other hand can be rightfully criticized to be not faithful to the syntax to the extent that important mechanisms underlying the generation of quantificational structures are covered up. In other words, while it is possible to amend the GQT treatment so that it can provide an adequate description of the truth-conditions associated with comparative determiners, it is not close enough to the actual underlying mechanisms to count as explanation.

A potentially more worrying remark concerns the claims of GQT regarding the inventory of quantifiers. What the MNPG shows is that there are no comparative determiners that have the simple syntax of determiners such as *every*.[116] This by itself is just one more place where GQT helps us to discover gaps in the pandemonium of possible determiner quantifiers and not yet problematic. The problem is that the class of comparative determiners was delimited in chapter 1 as being comprised of those determiners that require the measure function "the cardinality of" as essential piece in the description of their truth-conditional import. We noted in passing that according to this definition, determiners such as *zero or more* are not comparative determiners since their truth-conditional import is identical to *some*. There is no need to make reference to a measure function. The implicit but important claim behind this seemingly idle terminological hairsplitting is that there is nothing in the semantics of comparative determiners as identified by their syntax that would unify them into a natural class. In other words, since the syntax is assumed to be irrelevant for the semantics of comparative determiners, it is predicted that there are no significant semantic generalizations to be stated in terms of comparative determiners as defined by the syntax. The MNPG and its account in an amended

[116] In the notation of Beghelli(1994), Keenan&Westerstahl(1997) these quantifiers are called $\langle 1,1\rangle$ quantifiers as opposed to the discontinuous determiner that give rise to multiply headed DPs which are of type $\langle\langle 1,1\rangle 1\rangle$.

GQT of comparative quantification are however in direct conflict with this claim. To make this observation more concrete consider what the amended GQT approach would say about the data in (184).

(184) a. ?? No fewer than/at least two students were split into two unequal groups.
b. Some students were split into two unequal groups.

Assuming that plurality of the NP in *some students* comes with a presupposition that that there are at least two individuals in the extension of *students*, one would expect that the awkwardness that is detectable in (184)a should also be detectable in (184)b. After all *some students* has the same truth-conditional import as *no fewer than/at least two students* according to GQT. Since there is a clear contrast between (184)a and (184)b (however weak the minimal number effect with predicates like *split into two unequal groups* might be), GQT has to recognize the different syntactic form of the determiners in order to account different behavior with respect to minimal number predicates. Reference to plurality in the spirit of Winter(1998) is obviously not helpful as both DPs are morphologically plural. But if we have to recognize the syntactic form and plurality is not at stake to delimit the determiner that give rise to the MNPG, it is at least good practice to do that in a way the uses independently needed assumptions about the differing syntax. What we know independently about the particles *-re than,* etc. is that they provide the core of comparative constructions. An analysis of comparative determiners as comparative construction becomes therefore the null-hypothesis also for the semantics and GQT at least as amended in this appendix fails to recognize this.

Chapter 3

Scope Splitting with Comparative Quantifiers

3.1 Introduction

Recall that the important difference between the GQT treatment of comparative determiners and the analysis developed in chapter 2 is that former maintains that comparative determiners are opaque impenetrable units while the latter proposes compositional treatment according to comparative determiners are built in the syntax from pieces that potentially interact independently with elements outside of the determiner or even the DP as seen in the MNPG. One of the pieces that was hypothesized to be an essential building block is the comparative operator. Following the traditional view on comparatives, it was assumed that the comparative operator is a restricted degree quantifier whose restriction is provided by the *than*-clause. The present chapter investigates whether there is evidence that supports this claim. In other words, the question we should ask is if we can find evidence that showing that comparative determiners contain a syntactically independent degree quantifier. I will argue in this chapter, following the reasoning in Heim(2000), that evidence for this claim comes in form of "scope splitting" as schematized in (185).

(185) [-er than … [Op … [∃x[x is d-many …]]]]

If there are data from comparative quantifiers that require an analysis along these lines, clearly the GQT cannot given an account for them because – according to GQT – there is only one (syntactically active) quantifier in the conglomerate *more than n* (*NP*) namely the determiner *more than n.* While I will provide crucial data to show the possibility of scope splitting with comparative determiner, it is somewhat curious to note that scope splitting is not generally available. Only in a very limited set of circumstances can it be observed. In other words, there appear to be severe restrictions on degree operator movement that are not understood. Important for the purpose of this thesis is that comparative determiners allow scope splitting to the same extent that other comparative constructions do. Furthermore, as I will argue in section 3.3 the restrictions of degree operator scope together with the specific proposal made in chapter 2 provide the key to understanding the scopal behavior of comparative quantifiers. These observations then lend further support to the general project of analyzing comparative determiner as comparative constructions.

3.2 Scope Splitting with Comparative Quantifiers

Any analysis of comparative determiners as comparative construction would assume that there are two in principle independent quantificational elements inside comparative quantifiers entirely parallel to the analysis of amount comparatives. On the one hand there is a degree quantifier and on the other there is an individual quantifier. In principle these two quantifiers are independent and either scopal order of the two quantifiers should be possible. Compelling evidence for the predicted independence would come from the phenomenon of "scope splitting" in either one of the two possible ways sketched in (186).

(186) a. [-er than … [Op … [∃x[x is d-many …]]]][117]
b. [∃x… [Op … [-er than …] & x is d-many]]

The present section examines in some detail whether each of the two configurations is empirically attested. In the first part (section 3.2.1 and 3.2.2), I will present data to support the existence of scope splitting as schematized in (186)a. This constitutes one more argument against the GQT approach to comparative quantifiers, which clearly does not allow for this possibility. The data however do not distinguish between the specific proposal made in chapter 2 and a more traditional analysis of comparative quantifiers, which would take *many* to be a modifier as sketched in chapter 1. The second part (section 3.2.3) discusses the schema in (186)b. This time, the proposal made in chapter 2 makes different predictions from a more traditional analysis. I will argue that the configuration in (186)b does in fact not occur just as predicted by the proposal in chapter 2. If this is true, then we want the theory of comparative quantifiers to predict this asymmetry. Since the proposal of *many* as parameterized determiner does that, the asymmetry is further support for that proposal which furthermore is independent from the MNPG.

[117] Note that *many* is treated here as adjectival modifier instead of a determiner. The existential individual quantifier is assumed to quantify over entities that correspond to sets of individuals.

3.2.1 Limitations for Degree Operator Scope

In chapter 1, well-known data from *how-many* questions were briefly discussed that show quite compellingly that quantification over degrees is independent of quantification over individuals. One piece of evidence comes from the possible readings *how-many* questions in conjunction with modal operators. The data in (187)-(189) taken from Rullman(1995) illustrate the phenomenon.

(187) a. How many books does Chris want to buy?
b. "What is the number n such that there are n books that Chris wants to buy?"
c. "What is the number n such that Chris wants it to be the case that there are n books that he buys?"

The first observation is that the question in (187)a has two possible interpretations as paraphrased in (187)b and c. The reading in (187)c is an instantiation of a scope bearing operator, in this case the modal verb *want,* separating the degree quantifier which seems to take scope over the modal from the individual quantifier which takes scope under the modal. Interestingly, the second reading disappears under certain circumstances. For instance if there is an intervening negative- or wh-island, only the de re reading survives as the data in (188) and (189) show.

(188) a. How many books did no student want to buy?
b. "What is the number n such that there are n books that no student wants to buy?"
c. * "What is the number n such that no student wants it to be the case that there are n books that he buys?"

(189) a. How many books do you wonder whether Chris wants to buy?
b. "What is the number n such that there are n books that you wonder whether Chris wants to buy?"
c. * "What is the number n such that you wonder whether Chris wants it to be the case that there are n books that he buys?"

This syntactic dependency of the reading under question indicates that scope splitting in *how-many* questions is subjected to classical locality constraints on movement dependencies. Applying the same rational to comparative quantifiers does not immediately yield similar results. Consider for instance the sentence in (190)a its paraphrases along the lines of the corresponding *how-many* question.

(190) a. Chris wants to buy more than five brooks.
b. "The number n st. there are n-many books that Chris wants to buy is bigger than 5."
c. "The number n st. Chris wants it to be the case that he buys n-many books is bigger than 5."

It appears that that the two paraphrases have identical truth-conditions. In fact the semantics of the comparative we assumed in chapter 2 and repeated for convenience in (191) together with the monotonicity assumption will predict the same truth-conditions no matter what the scope of the degree operator is.

(191) a. $[\![\textit{-er}]\!] = \lambda D_{<d,t>}.\ \lambda D'_{<d,t>}.\ \max(D) < \max(D')$

b. **Definition:** <u>Monotonicity</u>

A function μ from degrees to sets of individuals (type <d,et>) is <u>monotone</u> iff

$\forall x\ \forall d, d' \in D\ [\mu(d)(x) = 1\ \&\ d' <_{\mathbf{D}} d) \rightarrow \mu(d')(x) = 1]$

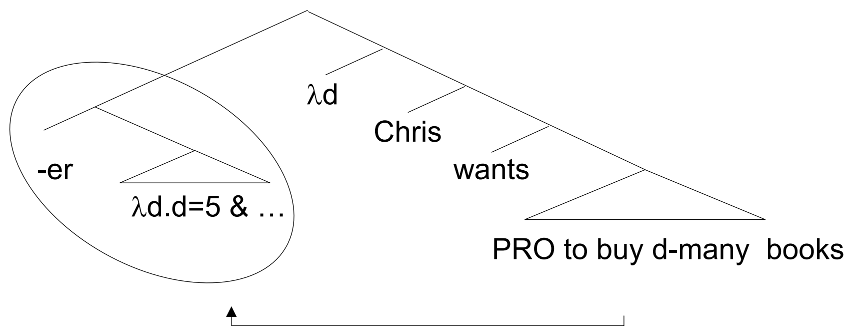
Given these assumptions, the resulting situation for the sentence in (190) is summarized in (192) – abstracting away from the complexities of the *than*-clause, which do not affect the resulting truth-conditions.

(192) a. Chris wants to buy more than five brooks.

b. $\forall$w $\in$ Acc max{d: Chris buys d-many books in w} > 5

c. [-er than 5 PRO to ~~buy d-many books~~]$_1$[Chris wants PRO to buy d$_1$-many books]

d.



e. max{d: $\forall$w $\in$ Acc Chris buys d-many books in w} > 5

According to (192)b the sentence is true if in all worlds in which Chris' desires are met (this set of worlds is abbreviated as "Acc"), the number of books he buys in those worlds is bigger than 5. (192)c-d indicate how the scope splitting configuration would arise if the degree quantifier *–er than 5 …* moves higher than the modal *want.* The resulting truth-conditions are such that the sentence would be true if the number of books he buys in all worlds in which Chris' desires are met – effectively the smallest number of books he buys in w so that w is still a desired world – is bigger than 5. But these are the same truth-conditions that we derived for (192)b. In fact, as Heim(2000) shows in detail, this is just an instance of a general difficulty in detecting degree operator scope via truth-conditions: given the semantics of the degree operator, only very few environments are predicted to yield different truth-conditions and would therefore allow detection of scope splitting. Take the examples in (193) and (194) for instance (both are from Heim(2000)) and their respective LFs schematized below.

(193) a. Every girl is taller than 5 feet.

b. $\forall x\ [\text{girl}(x) \rightarrow \max\{d: \text{tall}(x,d)\} > 5']$

c. $\max\{d: \forall x[\text{girl}(x) \rightarrow \text{tall}(x,d)]\} > 5'$

(194) a. Some girl is taller than 5 feet.

b. $\exists x\ [\text{girl}(x)\ \&\ \max\{d: \text{tall}(x,d)\} > 5']$

c. $\max\{d: \exists x[\text{girl}(x)\ \&\ \text{tall}(x,d)]\} > 5'$

(194)b says that every girl's height is above 5 feet while (194)c demands that the degree to which every girl is tall – the height of the shortest girl – is above 5 feet. Again these are identical truth-conditions and similar observations hold for (194). Examples that do in principle allow for truth-conditional difference depending on the scope of the degree operator involve non-monotonic quantifiers, exactly differentials or *less*-comparatives. Take the example in (195)c in which the comparative takes scope over the non-monotonic quantifier *exactly two girls.*

(195) a. Exactly two girls are taller than 5 feet.

b. $|\{x: \text{girl}(x)\ \&\ \max\{d: \text{tall}(x,d)\} > 5'\}| = 2$

c. # $\max\{d: |\{x: \text{girl}(x)\ \&\ \text{tall}(x,d)\}|=2\} > 5'$

According to the LF-sketch in (195)c the sentence has almost identical truth-conditions that we would assign *At least two girls are taller than 5 feet*. Assume that there are 3 girls with heights 5'5'', 5'6'' and 5'7''. The maximal degree to which exactly 2 girls are tall is 5'6'' which is bigger than 5'. Hence the sentence would be predicted to be true contrary to our intuition.[118] Similar observations hold for the cases in (196) to (199) assuming a lexical entry for *less* as in (198).

(196) a. John is 5' tall. Some girl is exactly 1 inch taller than that.

b. $\exists$x[girl(x) & max{d:tall(x,d)} = 5' + 1"

c. # max {d: $\exists$x[girl(x) & tall (x,d)} = 5' + 1"

" the tallest girl is 5'1'' "

(197) a. Every girl is exactly 1 inch taller than that.

b. $\forall$x[girl(x) $\rightarrow$ max{d:tall(x,d)} = 5' + 1"

c. # max {d: $\forall$x[girl(x) $\rightarrow$ tall (x,d)} = 5' + 1"

"the shortest girl is 5'1'' "

(198) $[\![\textit{less}]\!] = \lambda D_{<d,t>}.\ \lambda D'_{<d,t>}.\ \max(D) > \max(D')$

(199) a. Every girl is less tall than that.

b. $\forall$x[girl(x) $\rightarrow$ max{d:tall(x,d)} < 5'

c. # max {d: $\forall$x[girl(x) $\rightarrow$ tall (x,d)} < 5'

"the shortest girl less tall than 5' "

Heim(2000:8) summarizes these observations in the following generalization (attributed to Kennedy whose thesis was the first attempt at systematically investigating the scope possibilities of the comparative)

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[118] In cases where there is no maximal degree to which exactly 2 girls are tall – say all three girls are 5'6'' the maximum would be undefined. In these situations *at least 2 girls are taller than 5'* would be predicted to have truth-conditions from the ones we would assign to the LF in (195)c.

(200) Kennedy's Generalization[119]
If the scope of a quantificational DP contains the trace of a degree quantifier it also contains the degree quantifier itself.

Heim(2000) does not have an explanation for this generalization (cf. Kennedy(1997) for a different analysis of comparatives from which it follows). Important for my purposes is that Kennedy's generalization effectively eliminates a whole set of structures which could have been used to find evidence for scope splitting. The case is not lost yet, however. In fact, again due to Heim(2000), we know that there are cases where the comparative seems to take scope over an intervening operator.

3.2.2 Scope Splitting over Intensional Operators

Note that Heim's statement of Kennedy's generalization explicitly mentions quantificational DPs. Nothing is said about modal operators[120] – with good reason as

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[119] Schwarzschild&Wilkinson(to appear), following Larson(1988), extend Kennedy's generalization to quantifiers contained in the *than*-clause of clausal comparatives. It appears that quantifiers need to out-scope the comparative. Schwarzschild&Wilkinson argue against a QR solution to this problem and give an inherently scope free treatment of comparatives. I do not have the space to discuss their proposal in detail, however I would like to point out that the scope splitting observations discussed in the next section cannot easily be accommodated within their proposal.

[120] The fact that the comparative cannot take scope over negation – or downward monotone functions in general is explained along the lines of Rullman(1995). Roughly the idea is that the maximal degree to which x is not d-tall is undefined because there is no maximal degree to which x is not tall. There are a number of weaknesses with this account, probably the biggest is that scalar adjectives that seem to have a defined upper and lower limit (*full, empty,* etc.) should allow wide scope of the comparative over negation. The intuitions are less than crisp, however it seems that (i) and (ii) could not be used to describe a situation in which the bottle is less than a third full as.

(i) The bottle isn't more than 2/3 full/filled.
\# max(d: the bottle is not d-full} > 2/3 (of whatever the capacity of the bottle is.)

(iii) # If the bottle isn't more than 2/3 full, we have to get another one.

it is precisely in environments in which the scope-bearing element is a modal operator that scope splitting with comparatives can be observed. Consider the example in (201), again taken from Heim(2000) and its two respective LFs with the structures sketched in c representing the scope splitting structure.

(201) a. (This draft is 10 pages long.) The paper is required to be exactly 5 pages longer than that.

b. $\forall w \in Acc$: max{d: this paper is d-long in w} = 15 pages ("exactly 15 pp")

c. max {d: $\forall w \in Acc$: this paper is d-long in w } = 15 pages ("minimally 15pp")

(201)a can be understood to convey a minimal length and an exactly length. According to the "exact length" reading, the paper is exactly 15 pages long in all worlds in which the requirements are fulfilled. This reading is generated by the LF in (201)b. The second LF simply specifies a minimal length of 15 pages. Nothing in the requirements would prevent the paper to be longer than 15 pages. Importantly, both readings are attested for (201)a as are the corresponding readings for the examples in (202) and (203).

(202) a. The paper is allowed to be exactly 5 pages longer than that.

b. $\exists w \in Acc$: max{d: this paper is d-long in w} = 15 pages

c. max {d: $\exists w \in Acc$: this paper is d-long in w } = 15 pages

(203) a. The paper is required to be less long than that.

b. $\forall w \in Acc$: max{d: this paper is d-long in w} < 10 pages

c. max {d: $\forall w \in Acc$: this paper is d-long in w } < 10 pages

We can observe similar readings with amount comparatives as indicated in the examples in (204) (206).

(204) a. (Bill read 3 papers.) John is required to read exactly 2 papers more than that/Bill.
b. $\forall w \in Acc$: max{d: J reads d-many papers in w} = 5 papers ("exactly 5 pp")
c. max {d: $\forall w \in Acc$: J reads d-many papers in w } = 5 papers ("minimally 5 pp")

(205) a. John is allowed to read exactly 2 papers more than that/Bill.
b. $\exists w \in Acc$: max{d: J reads d-many papers in w} = 5 papers
c. max {d: $\exists w \in Acc$: J reads d-many papers in w } = 5 papers

(206) a. John is required/needs to read fewer papers than that/Bill.
b. $\forall w \in Acc$: max{d: J reads d-many papers in w} < 5 papers
c. max {d: $\forall w \in Acc$: J reads d-many papers in w } < 5 papers

Furthermore and importantly, the same ambiguity is present with simple comparative determiners as the examples in (207) and even more clearly in (208) show.[121]

(207) a. John is required/needs to read fewer than 5 papers.
b. $\forall w \in Acc$: max{d: J reads d-many papers in w} < 5 papers
c. max {d: $\forall w \in Acc$: J reads d-many papers in w } < 5 papers

(208) a. At MIT one needs to publish fewer than 3 books in order to get tenure.
b. At MIT one needs to come up with fewer than 5 brilliant ideas to get tenure.

(209) a. At MIT one needs to publish at most 2 books in order to get tenure.
b. At MIT one needs to come up with at most 4 brilliant ideas to get tenure.

[121] Exactly differentials based on measure phrase comparatives as in (i) are somewhat awkward. To the extent that they are acceptable, however, they seem to show the same ambiguity while the split reading seems to not/be less readily available in (ii). Judgments are dicey (with focus being an important factor) and require further investigation.

(i) a. ? John is required to read exactly 2 more than 3 papers.
b. $\forall w \in Acc$: max{d: J reads d-many papers in w} = 5 papers ("exactly 5 ")
c. max {d: $\forall w \in Acc$: J reads d-many papers in w } = 5 papers ("minimally 5 ")

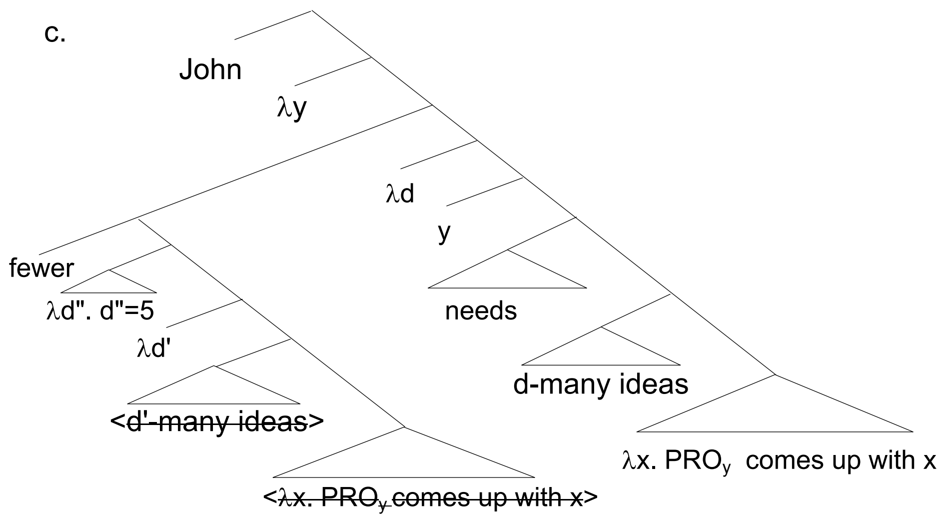
(ii) a. John is required to read exactly 5 papers.

The pragmatically favored interpretation of the sentences in (208) and (209) allows for the possibility of publishing more than 2 books/having more than 4 brilliant ideas. I.e. anybody who is more productive than what the sentences in (208) require won't be excluded from getting tenure. Clearly this reading is different from the pure de dicto reading, which would claim that too much productivity will hurt your aspirations of getting tenure. It is also different from the de re reading that was available for all sentences discussed so far. However, the sentences in (208) preclude the de re reading because of the use of creation verbs. The achievement that is required to get tenure certainly is not that there is a set of books whose cardinality is smaller than three such that one has to publish these books. More clearly even, it would be a rather strange demand to have some brilliant ideas that "already exist" and one has to come up with them during the pre-tenure time. In other words, the salient split reading of the sentences in (208) is not about any already existing set of books with cardinality smaller than 3/etc. such that one has to publish/come up with. An adequate representation of the split reading requires then that the NP has be in the scope of the modal operator while the degree quantifier takes scope over the modal. Therefore, splitting off the degree quantifier from the NP as required to represent the salient reading of the sentences in (208) entails that the degree quantifier is separated from the degree quantifier. The structure that would be assigned to generate the scope splitting sketched in (210).

(210) a. John needs to come up with fewer than 5 ideas.

b. [-er λd. d=5 & ~~PRO$_1$ comes up with d-many ideas~~] [λd. John$_1$ needs PRO$_1$ to come up with d-many ideas

c.



It is assumed in the tree in (108)c, that the comparative quantifier *d-many clubs* moves to a clausal node before comparative syntax is resolved. The degree quantifier [-*er than …*] then moves higher than the matrix modal verb (which is to not copied into the *than*-clause) and the subject *John* binds both instances of PRO.

The fact that split readings do exist seems to constitute an insurmountable obstacle for the GQT approach to comparative quantifiers. To represent that reading, we need the degree quantifier take scope higher than the modal operator while the individual quantifier takes scope below the modal operator. Obviously, this means that there have to be two different quantificational elements inside comparative quantifiers. I.e. even if one would want to maintain an GQT account of the MNPG as discussed in the appendix of chapter 2, one would have to do so at the expense of leaving the scope splitting facts unaccounted for because GQT maintains that only the individual quantifier is syntactically active.[122] For the classical analysis as well as the theory proposed in chapter 2 which analyze comparative quantifiers as comparative constructions on the other hand, these data are expected.[123]

3.2.2 A Note on Van Benthem's problem

Scope splitting as discussed above does not distinguish between the classical analysis and the particular proposal made in chapter 2. All that is required to explain the scope splitting data discussed in the previous section is that comparative quantifiers contain a degree quantifier as well as an individual quantifier and that these two are syntactically independent of each other. The two lines of thinking about comparative quantifiers make however different predictions when it comes to the possibility of scope splitting where the individual quantifier out-scopes the degree quantifier. More specifically, in analyses using classic al assumptions according to which *many* is a modifier, in principle both scope orderings are possible while according the proposal developed in chapter 2 the degree quantifier always out-

[122] Likewise, it seems that Krifka's(1998) analysis of modified and non-modified numeral quantifiers (*at least three NP*, *more than three NP*, three NP, etc.) could not readily account for the observations about scope splitting because Krifka does not assume that the particles *more than, etc.* are actually degree operators. Instead, they are analyzed as focus particles. This means that Krifka doesn't assume that there is a degree quantifier independent of the individual quantifier which is however exactly what is required to account for the scope splitting observations.
[123] Cf. Heim(2000) for additional arguments in favor of scope splitting. Sharvit&Stateva(ms) give an alternative account for split (in their terminology "upstairs de dicto") readings.

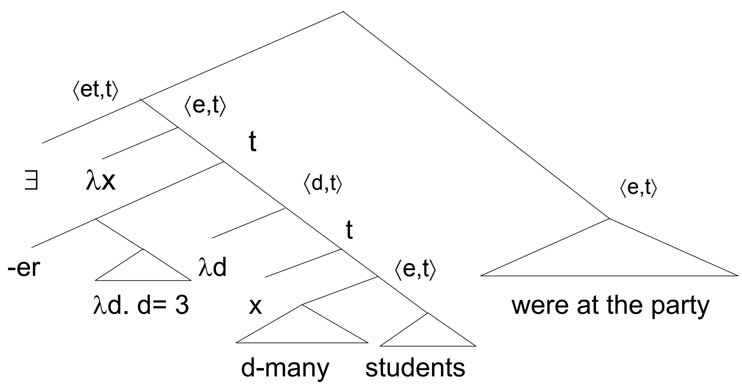
scopes the individual quantifier for principled reasons. This is because the degree quantifier was assumed to be base generated in the degree argument position of the parameterized determiner *many* and had to be moved to a clausal node not only to satisfy its interpretational requirements as generalized (degree) quantifier but also to allow resolution of antecedent containment. Since the individual quantifier in comparative quantifiers is expressed by the degree function *many* itself, the claim about antecedent containment immediately predicts that the degree quantifier always has to be higher than the individual quantifier. For principled reasons then it is impossible that the individual quantifier out-scopes the degree quantifier. The predictions of this proposal regarding scope splitting are as schematized in (211).

(211) a. [-er than … [Op … [d-many x …]]]
b. * [d-many x … [Op … [-er than …]]

An account in the spirit of the classical analysis as sketched in chapter 1 would not necessarily make these predictions. Since *many* is treated as modifier parallel to gradable adjectives rather than a determiner, the classical analysis predicts also the possibility that the individual quantifier takes scope over the degree quantifier – if it is assumed that there is a clausal node inside the DP (or AP) that provides the relevant environment to support comparative syntax. Since *many* would be treated as modifier parallel to *tall* rather than as determiner, some other determiner has to do the work of combining the DP with the rest of the clause. A commonly held assumption is that there is a phonetically empty determiner with the semantics of an existential quantifier ("∃") which closes the whole DP [*more than three students*]. The structure that would result using these assumptions is sketched in the type-annotated tree in (212)b.

(212) a. Fewer than three students were at the party.

b.



As long as the DP (as assumed here for convenience) or the AP provides a clausal node so that the degree quantifier can be interpreted, the individual quantifier can out-scope the degree quantifier. The specific assumption made in the tree in (212) is that DPs have a subject position (possibly filled by PRO) that is later on abstracted over to satisfy the semantic needs of the determiner.[124] Under these assumptions, it is possible that the individual quantifier out-scopes the degree quantifier. In fact the basic order reflects this particular scope relation.

Allowing for this possibility introduces however a well-known problem —sometimes referred to as van Benthem's problem — that in fact any adjectival theory of

[124] Note that this structure does not predict the MNPG. The VP is not an argument of *many* and will therefore not be interpreted inside the *than*-clause. This is however exactly what is required to account for the MNPG.

indefinites faces with decreasing quantifiers.[125] Consider the truth-conditions that are derived assuming a structure as in (212) as given (213)b and paraphrased in (213)c.

(213) a. Fewer than three students came to the party.

b. $[\![$*Fewer than three students came to the party*$]\!]$ = 1 iff ∃X [max {d: X is a d-numerous set of students} < max {d: d=3} & X came to the party]

c. "There is a set of students whose cardinality is smaller than three and that came to the party"

Van Benthem's problem is that the truth-conditions given in (213)b are decidedly too weak. Since it is always possible to find a smaller subset satisfying the cardinality requirement of the comparative determiner, the sentence would be predicted to be true even if there is a set of students with cardinality bigger than three that came to the party. The general solution to van Benthem's problem is to have the maximality operator that is part of the semantics of the comparative morpheme take scope over the existential individual quantifier. Compare the LF-sketch and its associated truth-conditions in (213) with the one in (214) which assumes that the comparative operator out-scopes the individual quantifier.

(214) a. $[\![$*Fewer than three students came to the party*$]\!]$ = 1 iff [max {d: ∃X st. X is a d-numerous set of students & X came to the party} < max {d: d=3}

b. "The maximal degree to which there is a set of students that came to the party is smaller than the degree 3"

The analysis proposed in chapter 2 automatically and only generates an LF as sketched in (214) and avoids therefore van Benthem's problem for principled

[125] Cf. Winter(1998), Landman(2000) for recent discussion.

reasons.[126,127,128] The alternative sketched above however has to provide an additional reason why the narrow scope for the degree-quantifier never occurs with monotone decreasing determiners.

This argument does not appear to be very compelling because it is conceivable that there is a pragmatic explanation for the fact that the reverse scope order is never attested. Since the scopal relation that gives rise to van Benthem's problem essentially results in trivial truth-conditions (as long as the NP restrictor is not empty) one could simply appeal to the fact such a sentence would be essentially useless. I.e. one could appeal to one of the Gricean rules of proper conversation (e.g. "make the strongest statement supported by your knowledge") to exclude the

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[126] Note that the GQT approach provides exactly the same solution to van Benthem's problem as the proposal in chapter 2 although everything happens in the meta-language. Recall from chapter 1 that the semantics for *fewer than three* would be as in (i). "| |" corresponds to "the maximal degree d st. …

(i) $[\![\textit{more than three}]\!] = \lambda P.\lambda Q.\ |P \cap Q| < 3$

[127] Paul Pietroski(pc) points out that there is a potentially serious problem with the claim that the matrix clause of comparative quantifiers is always closed under maximality. Specifically, if the matrix doesn't have a defined maximum as in the sentence in (i), we should get undefinedness apparently contrary to fact. Since the set of prime numbers is infinite, there is no maximum. I have nothing insightful to offer, would however point out that the problem is quite general and not restricted to the scope argument of comparative quantifiers. In the examples in (ii) e.g. the same problem occurs for the than-clause.

(i) More than three prime numbers are bigger than 4.
(ii) a. There are more real numbers than there are primes.
b. More reals than primes are between 1 and 3.

[128] Along them same lines as the previous footnote, asymmetries in NPI licensing in comparative constructions (NPIs are generally licensed in the *than*-clause and not licensed in the matrix) are problematic for the claim that the matrix clause of a comparative structure is closed off by a maximality operator just like the *than*-clause. (cf. Hoeksema(1983), Rullman(1995), von Stechow(1984), among others). Clearly, should it turn out to be the case that maximality closes off both clausal argument of a comparative operator, maximality cannot be the sufficient to license NPIs. See Schwarzschild&Wilkinson(2000) for more recent discussion.

narrow scope structure. I'd like to argue that such a pragmatic solution is insufficient. Let's take a closer look at this pragmatic solution. The proposal says that the wide scope reading is chosen because it is the stronger of two possible statements. Not only that, the structure that gives rise to van Benthem's problem actually has trivial truth-conditions because any number of students at the party – even if there are zero students – will verify the sentence. Therefore, the structure that gives rise to van Benthem's problem should always lose out over the competing structure that assigns wide scope to the degree quantifier. Note however, that it is possible to make a sentence under the van Benthem scope relation have non-trivial truth-conditions. We simply need to add another condition. For instance the sentence in (215)a does not have trivial truth-conditions anymore – even if the individual quantifier out-scopes the degree quantifier.

(215) a. Fewer than 10 but more than three students came to the party.
      b. More than three students came to the party.

As a matter of fact, the truth-conditions of (215)a are exactly the same as the truth-conditions of (215)b if (215)a has a parse in which the individual quantifier out-scopes the degree quantifier. The reading seems to be however not available, i.e. the two sentences in (215) are judged to have different truth-conditions. Notice however that this does not show that the reading in question is structurally not available for (215)a. We can appeal to the Gricean maxim of brevity to explain why the reading in question is not detectable for (215). A sketch is given in (216).

(216) a. The speaker uttered "Fewer than 10 but more than three students came to the party."

b. If the speaker wanted to convey the meaning that more than three students came to the party, she could have done so in a different/shorter manner. Specifically, the speaker could have uttered "More than three students came to the party."

c. Since the speaker didn't use the form that would be preferred by brevity, there must have been a reason to use the longer form.

d. The reason is that the longer form has also a stronger meaning than the shorter form.

e. Therefore, the speaker intended to convey the stronger meaning.

This reasoning then will explain why the weaker reading is not detectably for sentences like (215)a. By the same token, we might suspect that the stronger reading of (215)a is not a structural property of the sentence but arises as quantity implicature. I.e. the Gricean reasoning opens up the possibility that the sentence in (215)a actually has only the structure in which the individual quantifier takes scope over the degree quantifier. The interpretation is simply strengthened via quantity implicature based on brevity.

(217) a. Fewer than 10 but more than three students came to the party.

b. Truth-conditions supported by the structure:

"There is a set of students whose cardinality is bigger than three and smaller than 10 st. that set of students came to the party."

c. Implicature:

"There is no set of students with cardinality 10 or bigger that came to the party."

If this were the case, we would expect to be able to cancel the quantity implicature, which seems to be unexpectedly difficult as the failed attempt in (218) indicates.

(218) a. I was really disappointed because fewer than 10 students came to the party.
b. # In fact 11 students came to the party.

We can sharpen this test even further. Consider the sentence in (219)a.

(219) a. ?? Fewer than 10 but more than 9 students came to the party.
b. More than 9 students came to the party.

(219)a is decidedly awkward. It is either interpreted as contradiction or one is forced to consider an amount of students at the party that is between 9 and 10. I.e. one is forced to interpret the sentence as saying something like 9 ½ students came to the party. But this interpretation is awkward given world knowledge. If the stronger meaning would simply arise as an implicature, surely we would expect that the implicature is suspended given the fact that the stronger meaning is contradictory and therefore entirely unfit to communicate information. I take these observations to show then that the reading generated by the structure that has the degree quantifier take scope over the individual quantifier is a true property of the structure itself and does not simply arise as quantity implicature. The next question to ask is why it appears to be impossible to interpret the sentence in (219)a as its truth-conditional twin given in (219)b? I.e. why are we forced to assign a contradictory meaning to that sentence which should be just as unusable as a sentence with trivial truth-conditions. Note that the unavailability of a non-contradictory reading for (219)a is predicted if the only structure that is available for the sentence is the one in which the degree quantifier takes scope over the individual quantifier.

A defender of a pragmatic approach on the other hand will of course not fail to point out that these facts can be explained again by appealing to brevity. Since the missing reading would have exactly the same truth-conditions as the sentence in (219)b which is much less prolific than its competitor in (219)a that reading is blocked. That means, the fact that (219)a is judged to be contradictory does not show that the reading generated with narrow scope for the degree operator isn't structurally supported. It simply shows that the reading isn't available because it is blocked by the briefer competitor. Intuitively this stance is not very appealing because the effect seems rather striking to me and uncharacteristically strong to be explained by a pragmatic rule that prefers a shorter way of conveying the same information over a longer one. This is of course not a knockdown argument against a pragmatic account. Can we show that appealing to blocking by brevity is not sufficient to explain the effect in (219)? Notice first of all that the availability of *more than n-1* does not block the use of *no fewer than n* even though the latter is arguably longer than the former. Appealing to brevity then has to be supplemented by a theory that tells us when exactly one form counts as more prolific than its competitor. For the contrast in (219), a natural guess for why brevity matters in this case would be to notice that the longer form is a conjunction of two determiners[129] while the competitor has no conjunction. It is easy to see that this is not sufficient though. That the brevity condition has to be more sensitive still because in this general form it would also predict that (220)a would be blocked by (220)b contrary to fact since

[129] It is not essential to the argument whether the determiner s are conjoined or some other constituent.

fewer than n but at least n-1 yields the same truth-conditions as *exactly n-1* (keeping fractions out of the picture).

(220) a. Fewer than 10 but at least 9 students came to the party.
b. Exactly 9 students came to the party.

A more sensitive condition for brevity is therefore required and a promising candidate seems to be something like this: the longer version of expressing the same meaning is blocked by the shorter expression if the longer is a conjunction of the shorter and an expression that doesn't contribute any additional information. However, at least on a cursory inspection of the data this seems to be not a correct generalization either. Consider for instance the examples in (221).

(221) a. Between 9 and 10 or 11 students came to the party
b. Between 9 and 11 students came to the party

(221)a has exactly the same truth-conditions as (221)b. It also fits the structural description of the most recent version of the brevity condition and should therefore be blocked contrary to fact. I will leave it at these cursory remarks and tentatively conclude, that van Benthem's reading for decreasing comparative quantifiers is — if available at all — confined to meta-linguistic discourse. If this is correct, then scope splitting as schematized in (186)b and repeated below does not occur either simply because the structure in which the individual quantifier takes scope over the degree quantifier does not occur.

(222) a. [-er than … [Op … [∃X st. X is d-many …]]]
b. * [∃X … [Op … [-er than …] & X is d-many]]

Under classical assumptions, which generate the reading and attempt to exclude it on pragmatic grounds, this is unexpected. The proposal in chapter 2 however predicts this asymmetry and is therefore empirically better supported.

3.3 A Brief Note on the Scope of Comparative Quantifiers

It has been observed by Beghelli(1995), Beghelli&Stowell(1996), Szabolcsi (1996a,b) among others that comparative quantifiers are severely limited in taking inverse scope.[130] Roughly speaking, comparative quantifiers in object position are confined to take narrowest scope. Assuming that this generalization is roughly correct, this limitation is – as pointed out by these authors – prima facie unexpected under an unconstrained QR-theory to quantifier scope und should find a principled explanation. A detailed discussion of the relevant data, which are notoriously difficult to pin down because a number of variables need to be kept track of simultaneously (distributive vs. cumulative vs. collective readings, strong vs. weak construal of the quantifier, etc.) as well as their account, which is part of a larger project of explaining restrictions on quantifier scope in terms of phrase structure universals (in their framework comparative quantifier take narrow scope because the position they are licensed in is lower than the position other quantifiers are licensed in) goes beyond

[130] Beghelli(1995) uses the term "Counting Quantifiers."

the scope of this section. Instead, I would like to sketch briefly how the analysis developed in chapter 2 provides a framework within which the scope possibilities of comparative quantifiers can be explained as function of the properties of the components of comparative quantifiers, thus avoiding recourse to construction specific rules.

The proposal developed in chapter 2 identifies the following three determinants for the scope possibilities of comparative quantifiers: 1. Restrictions on degree operator scope as summarized in Kennedy's generalization. 2. Scope possibilities for the indefinite quantifier *d-many NP* and 3. The fact that the degree operator has to out-scope the individual quantifier. More concretely, since the degree operator always out-scopes the individual quantifier and there are severe limitations to the scope possibilities of the degree quantifier, the present proposal generates the expectation that, the scope possibilities of the whole comparative quantifier are limited by the scope possibilities of *d-many NP* in conjunction with the limitations on degree operator scope. The scope properties of *d-many NP* are not directly observable because *d-many NP* is probably never employed in its bare form.[131] A good first approximation can be obtained however if we compare *d-many NP,* which is a symmetric, plural existential quantifier, with its non-gradable, plural existential counterpart *some NP-Pl*. It is well-known (cf. Carlson(1977b) among many others) that *some NP-Pl* has two distinct incarnations namely a "strong" and a

[131] Even if we analyze *many NP* as the positive form of *d-many NP,* as is highly suggestive given the project defended here, it is not clear that the positive form is simple given by *d-many NP* and not as *pos-many NP* e.g. Cresswell(1976), von Stechow(1984) among others which is interpreted as concealed comparative to interpreted along the lines of "more than the average".

"weak" one. The latter is obtained if the determiner *some* is phonetically reduced to "*sme*" while the former employs a stressed version of the determiner and is at least in many cases construed as overtly or covertly partitive *some of the NP-Pl*. *Sme NP-Pl* behaves quite similar to bare plurals in that it takes narrowest scope. *Some (of the) NP* on the other hand has a wider range of scope possibilities and behaves like a positive polarity item. Except for the positive polarity behavior, this distinction seems to be observable with comparative quantifiers as well. One instantiation can be seen in the availability of antecedent contained deletion (ACD) with weak and strong versions of these quantifiers.

(223)a. ?? John read sme books (that) Bill did.
b. ?? John read more than three books (that) Bill did.
c. ?? John read books (that) Bill did.

(224)a. John read some of the books (that) Bill did.
b. John read more than three of the books (that) Bill did.

While both *sme NP-Pl* and *more than three NP* are quite reluctant in licensing ACD just like the bare plural in (223)c their partitive counterparts in (224) improve markedly under ACD. Along the same lines, we can observe that only the partitive versions of comparative quantifiers seem to be able to take inverse scope relative to clause-mate negation. I.e. while (225)a is clearly false (225)b has a true reading as well.[132]

(225)a. Ken Hale doesn't speak more than three languages spoken in Australia.
b. Ken Hale doesn't speak more than three of the languages spoken in Australia.

[132] The sentences are due to D. Fox (pc.)

Scope splitting over negation, i.e. a situation in which the degree quantifier scopes over negation while the individual quantifier stays below negation is of course not possible because degree quantifiers cannot cross over negation independently. I will take these observations as preliminary evidence to suggest that the parallelism between *sme NP-Pl* an *d-many NP* on the one hand and *some of the NP* and *d-many of the NP* on the other is warranted. Since I do not have a worked out analysis of partitives and in particular partitive comparatives, I will follow the time-honored tradition of leaving that part of the empirical domain for future research and assume for *d-many NP* that it is scopally constrained just like *sme NP* is.

With this in mind, let's take a quick look at the scope interactions of comparative quantifiers with other quantifiers which are more intricate than the facts about negation. Recall that Kennedy's generalization from section 3.2 and repeated in (226) below for convenience imposes severe restrictions on the scope possibilities of the comparative.

(226) <u>Kennedy's Generalization</u>
If the scope of a quantificational DP contains the trace of a degree quantifier it also contains the degree quantifier itself.

Heim's formulation of the generalization allows for quantifiers that scope below the degree function to stay within the scope of the comparative. One instance of this is given in the example in (227)a taken from (Heim2000: fn11).

(227)a. Every student showed up less often than that.

b. [-less than that-often [λd. every student showed up d-often]]

c. max{d: $\forall$x[student(x) $\rightarrow$ x showed up d-often} < that-often

As the sketched LF in (227)b and the derived truth-conditions indicate, (227)a has a reading in which the universal quantifier *every student* stays within the scope of the comparative. According to this reading it happened less often than that that every student showed up. This does not violate Kennedy's generalization because the degree function d-*often* already takes scope over *every student*, hence nothing forces *every student* to move higher than the comparative. We can extend this reasoning directly to comparative quantifiers in subject position and observe that quantifiers in the scope of comparative quantificational subjects do not necessarily scope higher than the subject.[133,134]

(228)a. More than three students read exactly two books.

b. max{d: $\exists$X[X is d-many & students(X) & $\forall$x[x$\in$X $\rightarrow$ 2!y[book(y)=1 & x read y} > 3

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[133] Judgments about scope interactions between comparative and other quantifiers are in general difficult to assess. Aside from the usual precautions regarding the possibility of inverse scope relative to a universal quantifier, comparative quantifiers give rise to cumulative readings (Scha1981). The data presented here are selected because they seemed to yield the clearest judgments. However they only cover a small portion of the empirical domain. For instance, I do not discuss cumulative readings.

[134] For many of the scope data discussed in this section, it is essential to represent a distributive operator. I will assume that it is part of the meaning of *many* however even though the specific choice as to how distributivity is represented does not affect the observations here. To make the LFs as transparent as possible, I will directly write the semantic effect of distribution into formula. To this end, I will use capital X as variable that is d-many and small x to refer to individuals in X. Distribution then is stated as $\forall$x $\in$X …

Inverse scope of comparative quantifiers, i.e. the possibility of a comparative quantifier in object position to take scope over a quantificational subject, however should be subject to Kennedy's generalization – modulo partitivity. This prediction seems to be borne out. Consider the example in (229) which doesn't seem to have a construal as in (229)b which would generate the truth-conditions described in (229)c.[135]

(229)a. Exactly 2 girls read more than three books.

b. [-er than 3 [λd. exactly 2 girls [λx. d-many books [λy. x read y]]]][136]

c. # max{d: 2!x[girl(x) & $\exists$Y[Y is d-many & $\forall$y[y$\in$Y $\rightarrow$ x read y} > 3

According to (229)c, the sentence would be true in a situation with three girls (G1,…,G3) where G1 read 4 books, G2 read 5 and G3 read 6 books. This is so because the maximal number such that there are exactly 2 girls that read that many books is 5 and 5 is bigger than 3. Clearly, the sentence in (229) does not have this reading. It is unambiguously false in the described situation. Note that it seems equally impossible for the sentence in (229)a to have the LF sketched in (230)b which would yield the truth-conditions indicated in (230)c.

(230)a. Exactly 2 girls read more than three books.

b. [-er than 3 [λd. d-many books [λy. exactly 2 girls [λx. x read y]]]]

c. # max{d: $\exists$Y[Y is d-many & $\forall$y [y $\in$ Y $\rightarrow$ 2!x[girl(x) & x read y} > 3

[135] It is assumed that *exactly n NP* can be treated as a unit wrt. scope interactions with other quantifiers.

[136] I abstract away form complications in the *than*-clause whenever possible.

(230)c would allow for a situation in which each book in a set containing more than 3 was read by exactly two potentially different girls. In other words the upper limit of girls reading books is bigger than 2. Again, (230) does not seem to have a reading like that. Similar observations hold, for all comparative quantificational objects.

(231)a. Exactly 2 girls read more books than journals.
b. Exactly 2 girls read more books than that
c. Exactly 2 girls read more than half of the (6) books.
d. Exactly 2 girls read more books than John (did/expected/…)
e. Exactly 2 girls read more books than there are primes smaller than 5.

Consider next sentences with a universally quantified subject and decreasing comparatively quantified objects as the sentences in (232)a-f.

(232)a. Every girl read fewer than three books.
b. Every girl read fewer books than journals.
c. Every girl read fewer books than that
d. Every girl read fewer than half of the (6) books.
e. Every girl read fewer books than John (did/expected/…)
f. Every girl read fewer books than there are primes smaller than 5.

If the degree operator could take scope over the universal quantifier, we would expect these sentences to have in addition to the surface scope reading two additional readings schematized in (233)b (the scope splitting reading) and (233)c (the reading where the whole comparative DP scopes over the universal).

(233)a. Every girl read fewer than three books.

b. # $\max\{d: \forall x[\text{ girl}(x) \rightarrow \exists Y[Y \text{ is d-many } \& \ \forall y[y \in Y \rightarrow x \text{ read } y\} < 3$

c. # $\max\{d: \exists Y[Y \text{ is d-many } \& \ \forall y \ [y \in Y \rightarrow \forall x[\text{ girl}(x) \rightarrow x \text{ read } y\} < 3$

d. $\forall x[\text{ girl}(x) \rightarrow \max\{d:\exists Y[Y \text{ is d-many } \& \ \forall y[y \in Y \rightarrow x \text{ read } y\} < 3$

(233)b would be false in a situation where e.g. there are 2 girls, each read a different set of 2 books so that in total 4 books would be read by girls. (233)a however is not judged to be false in such a situation. (233)c on the other hand would allow for a girl to have read 3 or more books as long as the biggest set of books such that all girls read them has a cardinality smaller than 3. Again (233)a would be unambiguously false if there where a girl that read more than 3 or more books indicating that the comparative quantifier cannot take scope over the universal. Similar observations hold for the other sentences in the paradigm in (232) and the preliminary conclusion is that comparative quantificational objects cannot take scope over universally quantified subjects. Negative quantified subjects provide yet another clear case in which comparatively quantified objects cannot take scope the subject.

(234)a. No girl read more than three books.

b. No girl read more books than journals.

c. No girl read more books than that

d. No girl read more than half of the (7) books.

e. No girl read more books than John (did/expected/…)

f. No girl read more books than there are primes smaller than 5.

Consider again the three possible LFs for the simplest case in the paradigm in (234) as given in (235)b-d.

(235)a. No girl read more than three books.

b. # max{d: $\neg\exists$x[girl(x) & $\exists$Y[Y is d-many & $\forall$y[y$\in$Y $\rightarrow$ x read y} > 3

c. # max{d: $\exists$Y[Y is d-many & $\forall$y [y $\in$ Y $\rightarrow$ $\neg\exists$x[girl(x) & x read y} > 3

d. $\neg\exists$x[girl(x) & max{d:$\exists$Y[Y is d-many & $\forall$y[y$\in$Y $\rightarrow$ x read y} > 3

The scope splitting configuration would be true as long as there is some number of books bigger than 3 such that no girl read that many books. Therefore nothing would prevent there to be a girl who read more than three books. Clearly, this reading is not available for (235)a. The alleged reading in given (235)c has essentially the same flaw. It would allow for a girl to have read 4 or more books as long as there is a set of books with cardinality bigger than 3 such that no girl read any book in that set. The observations discussed so far are in concordance with Beghelli(1995), Beghelli&Stowell(1996) and Szabolcsi(1996) who claim that comparative quantifiers take narrowest scope. What is new up to this point is the observation that all amount comparatives – also those that are not amendable to a GQT treatment are subject to this restrictions. Furthermore, we saw that all comparative quantificational constructions are scopally limited in the same way which seems unexpected under the above mentioned phrase structure accounts as these are designed to be specific to quantificational phrases. Instead these observations suggest that we need an alternative account that covers all comparative quantificational constructions. The proposal developed in chapter 2 offers a framework within which this can be done once the restrictions on the scope of *sme NP-Pl* vs. *some of the NP* and on degree operator scope are understood. Future research will have to show whether this project is indeed feasible.

3.4 Summary

In the present chapter, two sets of non-trivial predictions of the proposal that *many* is a parameterized determiner were discussed. Both predictions were argued to be essentially correct and provide therefore further support for the theory developed in this thesis. The first set of predictions concerned the phenomenon of "scope splitting." The term refers to facts that seem to indicate that there are two independent quantifiers inside the comparative quantifiers — one quantifier encoded by [*–er than …*] ranges over degrees and the other ranges over individuals. The evidence that was discussed (based on work by Heim(2000)) in support of this position were cases in which the degree quantifier takes scope over an intervening operator while the individual quantifier had to take scope under the intervener. These facts showed that there are two syntactically independent quantifiers inside comparative quantifiers, which is an immediate and seemingly insurmountable argument against the GQT approach to comparative quantifiers for which it is virtually a defining characteristic that none of the degree semantics is assumed to be syntactically active. The predictions that proposal developed in chapter 2 makes with respect to scope splitting are however more specific. In particular, scope splitting is predicted to be possible only in the form of a higher degree quantifier being separated from the lower individual quantifier as schematized again in (236)

(236) a. [-er than … [Op … [d-many x …]]]
b. * [d-many x … [Op … [-er than …]]

The reason for this specific set of predictions is that for principled reasons the degree quantifier always has to take scope over individual quantifier. In this respect, the proposal developed in chapter 2 is different from an analysis of comparative quantifiers as comparative constructions based on classical assumptions according to which *many* would be scalar adjective rather than a determiner. An argument in favor of the first position was presented based on the fact that it automatically provides the general solution to van Benthem's problem with decreasing quantifiers while analysis based on classical assumptions has to add an additional stipulation to the effect that the degree quantifier always out-scopes the individual quantifier in case of decreasing comparative quantifiers. The second set of facts briefly discussed in this chapter concern the limited scope possibilities for comparative quantifiers. Specifically, the claim that the degree quantifier in comparative quantifiers always out-scopes the individual quantifier together with the severe limitations on degree operator scope (expressed in form of Kennedy's generalization) and the scope limitations of existential plural quantifiers predicted that comparative quantifiers take narrow scope with respect to quantifiers that c-command them at surface structure. It was argued that this prediction is correct for comparative quantifiers - following previous work (eg. Beghelii(1995) – as well as for amount comparatives that are not analyzed as quantifiers. The fact that all comparative quantificational structures (and in fact all comparatives) seem to be subject to the same restrictions supports a uniform analysis of comparative quantificational structures as comparatives.

Chapter 4

Amount Comparatives and Plural Predication

4.1 Introduction

The analysis of amount comparatives proposed in chapter 2 was developed in order to account for facts that showed that the numeral/measure phrase in amount comparatives interacts with material seemingly outside of its reach. The discovery of these facts and their analysis in terms of a comparative syntax for comparative quantifiers concluded the first argument against the GQT treatment of comparative quantifiers as idiomatic expressions. In chapter 3, it was argued that also the degree quantifier that is assumed to be part of the structure of comparative quantifiers according to the proposal developed in chapter 2 is syntactically active. Specifically, it was argued that the degree quantifier can be detected via scope interactions with other scope bearing elements in the DP as well as in the matrix clause. Both chapters provide compelling arguments against the Generalized Quantifier Theory approach to comparative quantification according to which none of the semantically essential components of comparative quantifiers (comparative operator, measure phrase and degree function) is syntactically transparently realized.

The present chapter has two goals: First, the semantics the gradable determiner d-*many* is discussed in some detail filling in important hole in the account. Up to this chapter, I have assumed that statements of the sort "x is d-many" make sense without giving any specifics as to how this could possibly be the case. I will argue that *many* should be conceived of as <u>measure function</u> – just like *tall* and in fact any other degree function. The core notion of a measure function is that it relates individuals that have some gradable property with elements on a scales so that the place on the scale associated with any given individual reflects the extent to which it has the gradable property in question. Based on a specific requirement of measure functions – they presuppose that the individuals they relate to the scale are orderable in ways that reflect the ordering of the scale – I will develop a third argument showing that a proper part of comparative determiners namely the degree function expressed by the parameterized determiner *many* interacts partially independently with the matrix in predictable ways. Again, this is unexpected for the "idioms-approach" as it not only shows that the pieces that comparative quantifiers are built from retain their independent properties in comparative quantifiers but in addition these properties are transparent to their environment. Foreshadowing the main point, I will argue that the NP- and VP-arguments of *many* need to range over pluralities, i.e. entities that can be ordered in a way that reflects directly the number of atomic parts they have. In languages like English, plural morphology plays an important determinant whether a given predicate ranges over pluralities or over atomic individuals only. These two factors put together, predict among other things that the NP-argument of a comparative determiner is plural marked. This is not only correct for comparative determiners but in general for NPs in all amount comparatives. In fact, quite generally it is shown that all amount comparatives, whether they come in form of comparative determiners or comparative constructions, impose exactly the same requirements with respect to plurality on their arguments. This uniformity would be unexpected unless there is common core to all these constructions.

4.2 Gradable Predicates express Measure Functions[137]

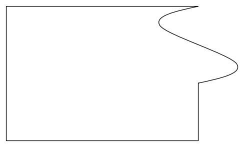
Fundamental to any comparative construction is a gradable predicate (that I have referred to in a somewhat lose way of talking using the label "degree function") Gradable predicates such as *tall, long* or *old* that can be true of individuals to a smaller or larger degree.[138] They contrast with non-gradable ones such as *rectangular, American* or *dead*, which are either true of an object or not. There is no sense in which an object could be rectangular/dead/American (have the American citizenship) to some degree.[139] For instance the figure in (237) is not 75% rectangular even though it satisfies a seemingly reasonable definition of rectangularity to 75% (i.e. it has three out of the required four angles with 90 degrees and it is closed.)

[137] There is extensive literature — see e.g. von Stechow(1984), Bierwisch(1987,1989), Klein (1982, 1991), Kennedy (1997) etc. — that discusses the issues that will be simply introduced here as needed thoroughly and insightfully so that I can limit myself here to the minimum that is needed to develop these basics for the special case of amount comparison (the specifics of which on the other hand haven't been much discussed.) The assumptions used in this thesis are for the most part entirely standard; non-standard assumptions will be introduced and justified only as needed.

[138] I will use adjectives to introduce the basics of the analysis of comparatives. In English, gradable expressions can also be nouns, NPs, adverbials and VPs.

[139] There are closely related predicates like *satisfies the criteria for rectangularity, is similar to a rectangular object,* etc. that are gradable. Some contexts force initially non-gradable properties to be interpreted as gradable property.

(237) ?? The figure below is 75% rectangular.



Following a widely accepted practice, we have encoded the difference between expressions denoting gradable functions and expressions that denote non-gradable functions simply by stipulating that the former but not the latter have an additional argument slot that is to be filled by a degree description. Sample entries that display the contrasting assumptions are given in (238) and (239).

(238) a. $[\![\textit{tall}]\!] = \lambda d \in D_d.\lambda x \in D_e$. x is d-tall

b. $[\![\textit{warm}]\!] = \lambda d \in D_d.\lambda x \in D_e$. x is d-warm

(239) a. $[\![\textit{rectangular}]\!] = \lambda x \in D_e$. x is rectangular

b. $[\![\textit{dead}]\!] = \lambda x \in D_e$. x is dead

c. $[\![\textit{American}]\!] = \lambda x \in D_e$. x has the American citizenship[140]

The lack of a degree argument explains the awkwardness of constructions such as comparatives, which require a degree argument, with non-gradable adjectives.

(240) a. ?? The figure above is very rectangular.

b. ?? The figure above is more rectangular than a pentagon.

The assumption that gradable predicates are expressed by elements with a degree argument while non-gradable ones are not is however not sufficient to

[140] There are of course different uses of *American,* e.g. "made in America," etc.

explain even very basic observations about degree predicates. Consider the awkwardness of sentences such as the ones in (241).

(241) a. ?? The Atlantic Ocean is (on average) 6 feet tall.
b. ?? John is 2 feet long/longer than Bill.
c. ?? Newton's theory of gravitation is wealthier than Einstein's.

Even though both *tall* and *long* are degree functions as evidenced by the fact that they occur in comparative constructions or by the even more elementary observation that they can take measure phrases as arguments, they cannot be predicated of any run of the mill individual. It appears that degree predicates also have specific requirements on the individuals they can be applied to. The individuals must have the property to some degree. Theories for instance aren't wealthier than others simply because they cannot own anything. Hence they are also not wealthy to some degree, which explains the awkwardness of (241). A similar observations comes form the behavior of scalar predicates under negation. Consider the sentences in (242) employing the non-scalar predicate *American* and (243) employing the scalar predicate *tall* under sentential negation.

(242) a. John is not American.
b. => John doesn't have the American citizenship.
c. =/> John has some citizenship.

(243) a. John is not tall.
b. => John is short or it is not clear whether he is tall or not.
c. => John has some height/is tall to some degree.

All we can conclude from the fact that John is not American is that John is in the complement of the predicate *has the American citizenship*. It does not follow for instance that he has some citizenship other than the American one. This is quite unlike what we are licensed to infer from (243)a. If you know that John is not tall, it follows that he is either short or it is not clear whether he is short or not.[141] It also follows that John has some height/is tall to some degree. Scalar predicates seem to presuppose that the individuals in their domain have some degree of tallness/height, cleverness, niceness, etc.[142] But what exactly does it mean for an individual to have some degree of height/cleverness/etc. The answer to that question that is implicit or explicit in anybody's analysis of scalar predicates is that the individuals in the domain of *tall* must be orderable in a way that reflects the extent to which they are tall, i.e. according to their height.[143] In general, the individuals in the domain of a degree functions must be orderable along the dimension associated with the degree function. Let's keep track of this claim by adding definedness conditions on both the degree argument and the individual argument. Sample entries are given in (244).

(244) a. $[\![\textit{tall}]\!] = \lambda d \in D_{Height}.\lambda x\text{: } x \in D_e$ & x ordered wrt. height. x is d-tall
b. $[\![\textit{warm}]\!] = \lambda d \in D_{Temp}.\lambda x\text{: } x \in D_e$ & x ordered wrt. temperature. x is d-warm

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[141] The issue whether there are extension gaps in the denotation of scalar predicates is not important for the point. Both claims entail that John has some height.

[142] Analogous observations can be made with respect to the degrees that gradable predicates can take.

(i) a. ?? John is 98 degrees Fahrenheit tall.
b. ?? The Atlantic Ocean is 10 kilometers square deep.

[143] For this to be possible, an individual needs to have some physical extent that is oriented vertically.

Of course we still need to clarify what it means to be orderable with respect to a property P. The theory of measurement provides the tools to do that in form of the notion of a "measure function." Following Krantz et. al. (1971) and abstracting away for the moment from any linguistic applications, a measure function is a function that maps individuals to degrees. Obviously, not any mapping between individuals and degrees should be viewed as measure function. Only those mappings qualify that reflect the extent to which the individual has the property. For this to be the case, the mapping minimally needs to preserve the ordering among the individuals in its domain. The intuition behind order preservation is quite simple: a mapping between individuals and elements on a scale is order preserving if the position of the individuals in the order is reflected in the position of the element on the scale they are mapped to. In the case a height, for instance, we want taller individuals to be related to bigger degrees of height. Importantly, the notion of order preservation, presupposes that the domain of a measure function is already an ordered set. Following Krantz et.al. (1971) I will assume that the domain of a measure function has to at least satisfy the conditions for a weak order as defined in (245). Based on that the notion of an ordinal measure function can be defined as in (246).

(245) **Definition:** <u>Weak Order</u>

Let A be a nonempty set of individuals and $\leq_{\mathbf{A}}$ a binary ordering relation on A. The relational structure $\langle A, \leq_A \rangle$ is said be a <u>weak order</u> iff

i. $\forall x,y \in A$ either $x \leq_A y$ or $y \leq_A x$ (connectedness)
ii. $\forall x,y,z \in A$ if $x \leq_{\mathbf{A}} y$ and $y \leq_A z$ then $x \leq_A z$ (transitivity)
iii. $\forall x \in A \; x \leq_A x$ (reflexivity)

(246) **Definition:** Ordinal Measure Function

Let A be a weakly ordered set with $\leq_A$ representing the ordering relation. A function μ from A to degrees D is an ordinal measure function iff

$\forall x,y \in A$, if $x \leq_A y$, then $\mu(x) \leq_{\mathbf{D}} \mu(y)$ (order preservation)

Returning to linguistic applications of these notions, we note that the lexical entries given in (244) bear close resemblance to the notion of measure function as characterized in (246). In fact we can view gradable predicates essentially as expressing measure functions, albeit with a somewhat different hierarchical structure imposed on their arguments. While measure functions as defined in (246) are functions from individuals to degrees – type $\langle e,d \rangle$ - the lexical entries for adjectives such as *tall* stipulates that they denote functions from degrees to functions from individuals to truth-values.[144] The notion of a Krantz-measure function is therefore not directly applicable. To keep the core notion of an order-preserving mapping between individuals and degrees for functions of type $\langle d,et \rangle$ we need to relate functions of type $\langle d,et \rangle$ systematically to a Krantz-measure function. The intuition is simply that we can recover for each function of type $\langle d,et \rangle$ ϕ a corresponding Krantz-measure function μ_ϕ if ϕ relates all individuals in a given set to the same degree and individuals in different sets to degrees in an order preserving way. [145] More formally,

[144] Cf. Kenndy(1997) for a proposal for the meaning for gradable adjectives that mimics the abstract definition of a measure function closer than the proposal made here.

[145] The move from functions to sets is only valid between characteristic functions and their corresponding set. Scalar predicates such as *tall* are sometimes said to be partial functions and can therefore not be though of as sets of individuals. Note however that partiality of scalar predicates is feature of the positive form of the scalar predicate only. In a framework where scalar predicates are

we can define the notion that "ϕ expresses a Krantz-measure function μ_ϕ" as in (247).

(247) **Definition:** Expressing a Krantz-measure function

Let ϕ be a function of type $\langle d,et \rangle$ with D_ϕ the set of degrees in its domain and A_ϕ the set of individuals in its domain and μ_ϕ a corresponding Krantz-measure function. We say that ϕ expresses a Krantz-measure function μ_ϕ iff

$$\forall d \in D_\phi \, \forall x \in A_\phi: \max\{d: \phi(d)(x)=1\} = \mu_\phi(x)$$

(247) requires for a degree function to express a measure function that the maximal degree to which an individual has the gradable property in question is the degree that the corresponding measure function assigns to this individual. Now the intuition that scalar predicates in natural language are degree functions and impose and ordering on their domain can be stated in precise terms as in (248).

(248) **Claim:** Scalar predicates in natural language express Krantz-measure functions.

The significance of the claim that scalar predicates express measure functions can be seen when we ask what accounts for the validity of such basic inferences as in (249).

(249) a. Bill is exactly 6 feet tall.
b. John is taller than 6 feet.
c.=> John is taller than Bill.

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modeled as degree function, partiality is encoded in terms of the degree argument. Once the degree argument is taken in by the degree function, the resulting predicate is total again.

If degree functions like *tall* would be able to denote arbitrary relations between degrees and individuals, then nothing would guarantee the inference from (249)a and b to (249)c or for that matter the equally valid inference from (249)a and c to (249)b. The claim that *tall* expresses a Krantz-measure function provides the basis for the validity of these inferences by reducing the validity of these inferences to the validity of the inferences in (250).

(250) a. Bill's height is exactly 6 feet.
b. John's height is bigger than 6 feet.
c.=> John's height is bigger than Bill's.

Note that the conditions imposed by ordinal measure function are quite weak. For instance nothing guarantees that the distance between two individuals in the order will correspond in a direct way to the distance between the degrees the measure function returns for these individuals. All that is guaranteed is that the initial ordering is preserved in the ordering of the degrees. For many cases this weakness doesn't seem to matter. However as soon as we want to specify the difference between the extent to which two individuals have a gradable property, ordinal measure functions are not strong enough. For instance, comparatives with explicit differentials are not covered by ordinal measure functions. Hence nothing we said so far about *tall* guarantees the inference in (251).

(251) a. Bill's height is exactly 6 feet. John's height is exactly 6'1''.
b. => John is exactly 1'' taller than Bill.

For this purpose, we need the stronger notion of an additive measure function, which in turn requires that its domain is closed under some concatenation operation. For extensive measures such as length, mass or duration (extent in time) Krantz et. al.(1971:73) provide the notion of a closed extensive structures.[146]

(252) **Definition:** $<A, \leq_A, ©_A>$ is a Positive closed extensive structure iff

Let A be a nonempty set of individuals and $\leq_A$ a binary ordering relation on A and © a closed binary operation on A. The triple $\langle A, \leq_A, ©_A \rangle$ is a positive closed extensive structure iff

i. $<A, \leq_A>$ is a weak order and $\forall$ $x, y, z_1, z_2 \in A$
ii. $(x ©_A (y ©_A z)) =_A ((x ©_A y) ©_A z)$ (Weak Associativity)
iii. $(x \leq_A y)$ iff $(x ©_A z) \leq_A (y ©_A z)$ iff $(z ©_A x) \leq_A (z ©_A y)$ (Monontonicity)
iv. If $x <_A y$, then for any z_1, z_2 there is a positive integer n such that $(nx ©_A z_1) \leq_A (ny ©_A z_2)$ where nx is defined inductively as 1x=x; $(n+1)x = nx ©_A x$) (Archimedean)
v. $x \leq_A (x ©_A z)$ (Positivity)

Based on this definition, the notion of an additive measure function for a positive extensive structure is defined simple as in (253).

(253) **Definition:** Additive Measure Function for closed extensive structures

Let A be a weakly ordered in a closed extensive structure $\langle A, \leq_{A,}, ©_A \rangle$. A function μ from A to degrees D is an additive measure function for $\langle A, \leq_{A,}, ©_A \rangle$ iff

i. $\forall x, y \in A$, if $x \leq_A y$, then $\mu(x) \leq_D \mu(y)$ (order preservation)
ii. $\forall x, y \in A$ $\mu(x ©_A y) = \mu(x) + \mu(y)$ (additivity)[147]

[146] It is clear that attributes such as temperature, density etc. require a different axiomatization. I.e. additive measure functions for temperature cannot be based on a simple concatenation operation. See Krantz et. al (1971) for discussion.

[147] '$=_A$' and '$<_A$' can be defined in terms '$\leq_A$', conjunction and negation as follows:

$\forall x, y \in A_{\leq}$ $x <_A y$ iff $x \leq_A y$ & $\neg$ $y \leq_A x$.

$\forall x, y \in A_{\leq}$ $x =_A y$ iff $x \leq_A y$ & $y \leq_A x$.

4.3 Measuring Cardinality

Now that the semantic core of scalar predicates is sufficiently explicit, we can proceed to the next step. I.e. given that claim that *many* is a scalar determiner rather than a scalar predicate, we need to show how a function from degrees to determiner meanings can be seen to express a measure function. It is not obvious how this can be done. Let me proceed in two steps. First, we want to clarify the requirements of the measure function "the cardinality of." I will do that by giving an analysis of the scalar adjective *numerous* in terms of a straightforward extension of the treatment of *tall.* To be more precise, I will give a treatment of the adjective *numerous'* which should be thought of as the adjectival version of *many*.[148] For this it will be necessary to clarify what sorts of individuals can be related to natural numbers in an order preserving way. In a second step, I will show how the insights from the treatment of *numerous'* can be carried over to the treatment of the determiner *many.*

4.3.1 *Numerous'*

Recall from the discussion above that scalar predicates such as *tall* are modeled as functions from degrees to sets of individuals. Furthermore, it was claimed that these predicates express Krantz-measure functions. To keep track of this property, we equipped lexical entries of scalar predicates with definedness

[148] The properties of the existing adjective *numerous* are more complicated. E.g. *numerous* is unlike *many* in that it seems to range over group-individuals while *many* is a determiner that demands from its NP and VP arguments to range over pluralities.

conditions that ensure on the one hand that only degrees on the scale associated with the scalar predicate can be the internal argument and on the other that only individuals that are orderable with respect to that scale can be in the set denoted by the scalar predicate once it absorbed a degree argument.

(254) a. $[\![\textit{tall}]\!] = \lambda d \in D_{Height}.\lambda x$: $x \in D_e$ & x orderable wrt. height. x is d-tall

b. $[\![\textit{long}]\!] = \lambda d \in D_{Length}.\lambda x$: $x \in D_e$ & x orderable wrt. length. x is d-long

What happens if *tall* is used attributively? Clearly the definedness condition that the individuals in the domain of *tall* are subject to is inherited by the attributive version of *tall.* This means that the individuals the NP argument of $\textit{tall}_{Att}$ ranges over are subject to the same condition that they be orderable with respect to length. We can keep track of this observation – even though it should be thought of as an instance of presupposition projection – by given lexical entry as in (255).

(255) $[\![\textit{tall}_{Att}]\!] = \lambda d \in D_{Height}.\lambda f$: $f \in D_{\langle e,t\rangle}$ & $\forall y \in Dom_f$: y orderable wrt. λx. height. f(x)=1 & x is d-tall

I.e. $\textit{tall}_{Att}$ can take only those NPs as arguments that denote a function whose domain is compatible with the orderability condition of *tall*. Extending this reasoning to *numerous'* seems straightforward and produces lexical entries as in (256)a,b.

(256) a. $[\![\textit{numerous'}]\!] = \lambda d \in D_{Card}.\lambda x$: $x \in D_e$ & x orderable wrt. cardinality. x is d-numerous

b. $[\![\textit{numerous'}_{Att}]\!] = \lambda d \in D_{Card}.\lambda f$: $f \in D_{\langle e,t\rangle}$ & $\forall y \in Dom_f$: y orderable wrt. cardinality. λx. f(x)=1 & x is d-numerous

I.e. *numerous'* denotes a degree function that returns after absorbing the degree argument a function that is defined only for individuals that can have the property measured by *numerous* – cardinality – to some degree. As before, the attributive version of *numerous'* will impose the same requirement on the domain of the function denoted by the NP argument of *numerous'$_{Att}$*.[149]

But what are individuals that "have cardinality to some degree"? It seems that regular individuals do not fit the bill. Instead we need individuals that correspond in some sense to sets of individuals. After all cardinality seems to be a property of sets and not of individuals. I propose therefore that individuals in the domain of scalar functions that express the "cardinality of measure function" are pluralities. Even though this is a natural hypothesis, it is worth seeing just how pluralities could be the kind of entities that fit exactly the requirements discussed above.[150] The next section is therefore a quick review of some of the key concepts in the semantics of plural predicates.

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[149] It seems clear that we need a treatment of this sort to analyze sentences like

(i) a. The students are numerous.
b. The Yankees fans are more numerous than the Red Sox fans.
c. The numerous Yankees fans blocked all the exits.

[150] Cf. Cresswell(1976) and following him von Stechow(1984), Doetjes(1996) Yabushita(1999) among others for essentially the same intuition however executed in a different way. Cresswell proposes to analyze plural NPs (and mass nouns) directly as degree function parallel to gradable adjectives while the semantics of *many* and *numerous* is left open. Nerbonne(1995) on the other hand assumes like this work does that a measure function is part of the meaning of comparative quantifiers that demands that the NP is plural.

4.3.2 Excursus: The Semantics of Plural Predicates

For much of the chapter the precise modeling of pluralities does not matter. I will assume simply a version of Link's(1983) logic of plural terms. According to Link the naïve conceptualization of the difference between singular and plural predicates – the former denote (characteristic functions of) sets of individuals, the latter denote the set of all non-empty subsets of the set denoted by the singular predicate – should be replaced by a mereological approach according to which plural predicates range or mereological sums of individuals called pluralities. I will follow this tradition and adopt the following assumptions. The domain of individuals E contains both regular individuals as well as pluralities. E is partially ordered with the "individual part of" relation $\leq_I$ defined in (257) providing the ordering relation. [151]

(257) **Definition:** individual part $\leq_I$: For any $x,y \in E$,

(i) $x \leq_i x$

(ii) $x = y$ iff $\forall z\ [z \leq_i x \rightarrow z \leq y\ \&\ z \leq_i y \rightarrow z \leq_i x]$

(iii) $x \leq_i y$ iff $\forall z\ [z \leq_i x \rightarrow z \leq_i y]$

Based on $\leq_i$ we can define mereological summation $\oplus$ (which is an instantiation of the Boolean join operation) as that binary operation that returns for any 2 elements in E the least upper bound of these two elements (cf. (258)).

(258) **Definition:** individual sum $\oplus$: For any $x,y \in E$, $x \oplus y$ is the unique $z \in E$ such that

(i) $\forall u\ [u \leq_i x \text{ or } u \leq_i y \rightarrow u \leq_i z]$ and

(ii) $\forall z'[\forall u[u \leq_i x \text{ or } u \leq_i y \rightarrow u \leq_i z'] \rightarrow z \leq_i z']$

[151] The definitions are adopted from Heim(2000) lecture notes.

E is closed under $\oplus$ (i.e. for any two individuals in E also their corresponding i-sum is in E) and contains atomic as well as non-atomic individuals where atomic individuals can be defined as those that do not have any proper individual parts.

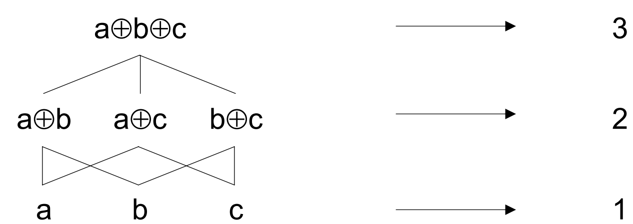
(259) **Definition:** <u>Atomic individuals</u>

$\forall x \in E$, x is an <u>atomic individual</u> (*At*(x) =1) iff $\neg \exists y \in E\ [y \leq_i x\ \&\ y \neq x]$

Let's take a look at a small subset A of E, where A = {a, b, c, a$\oplus$b, a$\oplus$c, b$\oplus$c, a$\oplus$b$\oplus$c}. The inherent ordering given by the $\leq_i$ relation present in A can be transparently represented in a Hasse-diagram (260)b.

(260) a. A = {a, b, c, a $\oplus$ b, a $\oplus$ c, b $\oplus$ c, a $\oplus$ b $\oplus$ c}

b.



Based on the ordering induced by $\leq_i$ we want to define in the next step a measure function "the cardinality of" along the lines discussed above. Specifically, the "cardinality of" should be a function that maps elements in A in an order preserving way to natural numbers as indicated by the arrows in (260)b. I.e. we want a measure function that maps each atomic individual in A to 1, each i-sum consisting of exactly

2 atomic parts to 2 etc. The definition in (261) ensures this by demanding that non-overlapping individuals are related to degrees in an additive manner.[152,153]

(261) **Definition:** Additive Measure Function ("the cardinality of")

Let $\langle A,\leq_i,\oplus\rangle$ be a relational structure with $\langle A,\leq_i\rangle$ a complete join semi-lattice closed under $\oplus$. A function μ from A to degrees $D \subseteq N$ is an additive measure function iff

i. $\forall x,y \in A$ if $x \leq_i y$ then $\mu(x) \leq \mu(y)$ (order preservation)

ii. $\forall x,y \in A$ if $\neg\exists z\, [z \leq_i x$ and $z \leq_i y]$ then $\mu(x \oplus y) = \mu(x) + \mu(y)$ (additivity)

To sum up, given the claim that the domain of individuals contains regular individuals as well as pluralities (i-sums), we can define a measure function that effectively corresponds to the counting function "the cardinality-of." The question that is centrally important for our purpose is how natural language makes reference to pluralities on the one hand and to the measure function defined in (261) on the other. The second question we have given a preliminary answer in the claim that *numerous'* expresses the 'cardinality-of' measure function. The first question requires a few remarks still.

Let's begin by pointing out that there seem to be predicates that due to their inherent meaning range over atomic individuals (e.g. *student, have blue eyes,* etc.) as well as predicates that seem to range only over collections of individuals (e.g. *gather, couple,* etc.). Furthermore, we know that predicates that inherently range over individuals have incarnations in which they range over pluralities as well. To

[152] Cf. Krifka(1989) for a similar definition.

[153] Note that the definition does not allow us to count zero individuals. I.e. there is no individual that is assigned degree zero in a complete join semi-lattice. I will have to leave it for future research to extend the definition so that expressions like *more than zero students, fewer than one students* etc. can be covered.

give an account of that phenomenon, we can avail ourselves of an operator that turns a predicate that inherently ranges over atomic individuals only, into a predicate that ranges over i-sums of atomic individuals. I will adopt the familiar *- operator as defined in (263).

(262) **Definition:** *-operator

Let X be a set. Then *X is the smallest set that satisfies the following two conditions:

(i) $X \subseteq {}^*X$

(ii) $\forall y \forall z[[y \in {}^*X \ \& \ z \in {}^*X \rightarrow y \oplus z \in {}^*X]$

I.e. if X is a predicate that by its lexical meaning ranges over atomic individuals, then *X ranges over those atomic individuals as well as the i-sums formed over the atomic individuals in X. If X ranges already over pluralities, then the *-operator is vacuous. Following Link(1983) I will assume that the plural morpheme (at least when it attaches to nominal predicates) in English encodes the *-operator. Hence we can give a semantics for the plural morpheme as in (263).

(263) $[\![PL]\!] = \lambda f \in D_{\langle e,t\rangle}.\ \lambda x \in D_e.\ x \in {}^*\{y: f(y) = 1\}$[154]

This makes good sense as it provides a natural account of one of the hallmarks of plural predicates namely that they support cumulative inferences of the sort exemplified in (264).

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[154] Notice again that this lexical entry of the plural morpheme does not exclude atomic parts of pluralities, which is controversial assumption. See e.g. Ojeda(1993) for a similar position and below for arguments in favor of it.

[155] Again, this is just a notational device describing the fact that the orderability presupposition of *numerous* is inherited by the NP via presupposition projection.

(264) a. John is a student. Mary is a student. Sue …
b.=> John and Mary and Sue … are students.
c. * John and Mary and Sue … is/are a student.

I.e. if it is true that John is a student, Mary is a student, etc. then it is also true that the conjunction of all individuals that are in the extension of *student* are students. On the other hand it is not true and in fact ungrammatical to predicate the singular predicate *a student* of the conjoined subject. If we think of proper name conjunctions as denoting pluralities (i-sums), certainly a natural assumption, then this inference is directly accounted for by the assumption that *students* is the *-ed version of *student*. These assumptions are convenient because we can give a more palatable lexical entry for *numerous'*. First, we can encode the condition of the predicative *numerous'* that the individuals in its domain are orderable with respect to cardinality simply by demanding that the domain of *numerous'* is the entire universe E ("$*D_e$" in the lexical entry in (265)a) containing both atomic and non-atomic individuals and not just the subset of E containing only atomic individuals (D_e). If the domain of *numerous'* were D_e then the orderability condition would be satisfied only trivially: each individual would be mapped to the same number. Second, the definedness condition on the individuals is inherited by the NP argument of the attributive version of *numerous*. That means that the NP needs to be a *-ed predicate.[155] If the NP would be allowed to range over atomic individuals only, the orderability condition would be trivialized.

(265) a. $[\![\textit{numerous}']\!] = \lambda d \in D_{Card}.\lambda x: x \in {}^*D_e.$ x is d-numerous

b. $[\![\textit{numerous}'_{Att}]\!] = \lambda d \in D_{Card}.\lambda {}^*f \in D_{\langle e,t\rangle}.\ \lambda x \in {}^*D_e.\ {}^*f(x)=1$ & x is d-numerous

As shown in the next section, this format turns out be quite useful when we attempt an extension of the treatment of *numerous'* to *many*.

4.3.3 *MANY*

Recall the task at hand: we need to show that the conception of a gradable determiner *many* is supported by the basic semantics of scalar functions in natural language. As argued above, key to this project is to show that we can think of *many* as expressing a measure function along the lines scalar predicates like *tall* or *numerous'* express measure functions. The difficulty was that the format of a determiner meaning – a relation between sets – does not lend itself easily to the same reconstruction that scalar predicates allowed. What would it mean for a function to relate natural numbers to a relation between sets in an order preserving fashion? I would like to suggest that the answer can be given in much the same way that a treatment for *numerous'* was given. I.e. we can recover the notion of the 'cardinality-of' measure function in *many* by building into the lexical semantics of *many* the basic predicate *numerous'.* More precisely, the *many* expresses the same measure function *numerous'.* As in the case of *numerous*'$_{Att}$, we need all the predicative arguments of *many* to be *-ed. In addition we need of course an existential quantifier. This results in the lexical entry in (266).

(266) $[\![many]\!] = \lambda d \in D_{Card}.\lambda{*}f \in D_{\langle e,t\rangle}.\lambda{*}g \in D_{\langle e.t\rangle}.\exists x$ st $*f(x)=*g(x) = 1$ & x is d-numerous

The proposed lexical entry for *many* in (266) in conjunction with the idea that plural morphology is required in English to ensure that pluralities are in the extension of a predicate generates a number of non-trivial predictions. The next section pursues some of these predictions.

4.4 Some Applications and Amendments

Since *many* requires from its NP and VP-arguments that they are *-ed, i.e. that they range over pluralities, the proposal predicts in general that the predicative arguments of *many* are flagged in whichever way a given language chooses to distinguish *-predicates from predicates that range over atomic individuals only. In languages like English, plural morphology plays an important role at least in the case of nominal predicates. In fact, given the assumption that in English the plural morpheme on nominals denotes the *-operator we predict that the NP argument of *many* is plural marked. In addition, we predict that the VP-argument of *many* is *-ed and ranges over the same pluralities that the *-ed NP ranges over. Furthermore, we predict that the same requirements should be observed in comparative quantifiers as well as in amount comparatives since *many* is present in all comparative quantificational constructions. These predictions are shown to be essentially correct, once independent factors in the denotation of predicates are brought to bear.

4.4.1 Plural Morphology on Nominal Predicates

Let's begin with the easiest case. Predicates like *student* are inherently, presumably because of their encyclopedic meaning, predicates that are true of regular individuals. Plural morphology, as shown above, will transform the basic predicate *student* into one that ranges over pluralities of students. When put to the task of providing the restrictor argument of a comparative determiner they are predicted to require plural morphology. This is of course correct in the general case as the data in (267) illustrate.

(267) a. More/(no)fewer/etc. than five students came to the party.
b. * More/(no) fewer than/etc. five student came to the party.

This observation is for a number of reasons less trivial than it looks at first sight. First, plural marking cannot be directly viewed as function of the denotation of the comparative quantifier nor can it be simply attributed to the numeral. If that were the case, the NPs in the following quantifiers would all have to be singular.

(268) a. Fewer than two student*(s) came to the party.[156]
b. More than zero (but fewer than 2) student*(s) came to the party.
c. After talking to one philosophy student, John says: I talked to enough/too many philosophy student*(s).
d. Mary was more helpful. She talked to more student*(s) than that.

[156] The notation *student*(s)* is meant to indicate ungrammaticality if the plural morpheme were left out.

There is a well-known exception: NPs that combine with the numeral *one* are singular. Note however that this is a very specific exception that seems to be tied to the lexical item *one*. Even denotationally equivalent numerals like 1.0 require plural marking of the NP.[157]

(269) a. More/fewer than one student came to the party.
b. More/fewer than 1.0 student*(s) came to the party.

Furthermore, the same requirement holds for NPs in amount comparatives, irrespective of the standard of comparison. I.e. even in the case where the *than*-clause provides for all intents an purposes the same degree 1 that the numeral *one* does as in (270)c, plural marking is required.

(270) a. More student*(s) than professor*(s) came to the party.
b. More student*(s) than Bill thought came to the party.
c. There are more odd number*(s) on the board than there are even prime*(s).

The conclusion I would like to draw from these facts is that the exceptional behavior of *one NP*s is not due to the semantics of the construction. Instead it seems to be a peculiar fact about the lexical item *one.* Hence, the prediction that NP arguments of *many* and its comparative derivatives need to carry plural morphology is correct. Singular NPs cannot feature as arguments in amount comparatives because they range over atomic individuals only and a set of atomic individuals cannot be related

[157] Cf. Krifka(1987,1989), Ojeda(1991).

to natural numbers in a non-trivial order preserving way.[158] Note that this does not exclude the possibility that the arguments of *many* are singletons because the *-ed version of a predicate that is true of only one individual is again a predicate that is true only of one individual. This is as it should be because we don't want to lose the ability to count singletons. What is excluded however is that the NP or VP arguments of *many* are predicates that are true of more than one atomic individual but not their i-sum.

4.4.2 Genuine Collective Nouns

A different case presents itself in the form of so called (genuine) collective nouns like *basketball team, brigade, cohort, group, couple* etc. Genuine collective nouns do not seem to range over regular individuals. A single person cannot be a couple all by him/herself. Likewise, a single person cannot be – at least the regular case – a group, a basketball team, a cohort etc. From this simple observation one might conclude that these are predicates that range inherently over collections of individuals rather than regular individuals and plural morphology should therefore be at least redundant – recall that the *-operator is vacuous on predicates that are inherently closed under $\oplus$. This reasoning leads to the expectation that when genuine collective nouns are put to the task of providing the restrictor argument of

[158] The proper way of thinking about this restriction is probably in terms of conflicting presuppositions. I.e. the singular morpheme on a function f presupposes that only atomic individuals are in the domain of f+Sg (??*John and Mary are a student* is not false but rather a presupposition failure) while *many* presupposes that its predicative arguments are *-ed.

many plural morphology should at least not be required. However, as is well-known, this is incorrect as the data in (271) show – again for both comparative quantifiers as well as amount comparatives.

(271) a. More/(no) fewer than two committee*(s)/couple*(s) are meeting.
b. More/no fewer trio*(s) than quartet*(s) were/*was in the room.
c. John met with more/no fewer couple*(s)/team*(s)/group*(s)/…than there are/*is a committee*(s)/Bill had expected.

To reconcile these facts with the present proposal, we need to find a reason for plural marking on collective nouns when they function as arguments of *many.* Of course, the need for plural marking would follow automatically from the proposal if the individuals in the extension of singular collective nouns could not be measured by *many* with respect to how many individual parts they are made of. I.e. if we can show that the individuals in the extension of genuine collective nouns are not pluralities modeled as i-sums of regular individuals but instead are atomic "group-individuals" whose members are linguistically not transparently accessible (at least for *many*) plural morphology would be required just as it is in the case of nouns like *student*. This has indeed been argued for at various places (e.g. Schwarzschild (1996), Winter(1998) among others). I will simply adopt that position and provide two simple but compelling arguments in favor it. Recall form section 4.3.2 that one of the hallmarks of *-predicates is that cumulative inferences are supported. This is true for genuine collective predicates as well however the cumulative inferences are based on group-individuals rather than regular individuals. Consider a situation in which both (272)a and b are true, i.e. Mary is involved with two people, and the possible cumulative inferences.

(272) a. John and Mary are a couple/team.
b. Mary and Bill are a couple/team.
c.=/>??John and Mary and Bill are a couple.
d. =/>??John and Mary and Bill are (two) couples.
e.=> John and Mary and Mary and Bill are couples.

None of the versions in (272)c or d can be inferred (in fact they sound rather awkward). Instead, (272)d in which Mary is mentioned twice in both conjuncts referring to the two couples has to be used to convey the valid inference. This pattern is parallel to the cumulative inference discussed in (264) with one important difference: the atomic individuals entering into the cumulative inference are couples rather than the individuals John, Mary and Bill. This is exactly what we would expect if the pairs of individuals were the atomic elements in *couples*.

A parallel point can be made when we consider counting inferences with genuine collective nouns. Take (273)a for example from which we seem to be able to infer (273)b since every couple consist of exactly two people.[159]

(273) a. No fewer than two couples came to the party.
b.=> No fewer than four people came to the party.

This means that the entities that are counted in (273) are couples (i.e. pairs of individuals) rather than people in a couple relation. Again, this is exactly as expected

[159] Abstracting away from cases where one person is part of two couples at the same time. If we were to allow cases like that as well we could conclude that at least 3 people came.

if the atomic elements in the extension of *couples/teams/groups* etc. are couples/ teams/groups etc. rather than their members. It also says that we can't model couples simply as i-sums made of exactly 2 individuals. Note that the same observations about counting is observed in multiply headed comparatives and in fact in all amount comparatives. (274) and (275) illustrate the point I.e. if we exclude "overlapping couples" we can reason from a sentences in (274) and (275) to the corresponding b sentences.

(274) a. More couples than singles came to the party.
b. => There are at least twice as many people at the party that are in a couple relationship as there are singles.

(275) a. John talked to more couples than Bill did to singles.[160]
b.=> John talked to at least twice as many people as Bill did.

This is not surprising from the perspective advocated here according to which comparative quantifiers and amount comparatives share a common counting procedure provided by *many*.

4.4.3 Essentially Plural Nouns

The third class of nominal predicates relevant for this discussion are so called "essentially plural" predicates like *(twin-)brothers, colleagues, neighbors, friends, 2nd-degree cousins,* etc. Like genuine collective nouns, these predicates seem to ranger over collections of individuals only. I.e. one cannot be a twin-brother all by

[160] Assume that Bill only talked to singles and no individuals in a couple relation.

oneself just as much as one cannot be a couple all by oneself. Essentially plural predicates differ therefore from pluralized individual predicates like *students,* which do seem to range over atomic individuals as well i-sums of atomic individuals, as argued above. A simple observation that supports these distinctions comes from the (in-)felicity of the b-continuations denying the claims made in the a- sentences in (276) to (278).

(276) a. No couple(s)/trio(s)/basketball teams/ etc. came. (genuine collective predicates)[161]
b. # False. John came.

(277) a. No 2nd degree cousins/neighbors/ etc. came. (essentially plural predicates)
b. # False. John came.

(278) a. No students/fans/friends of John/fathers etc. came. (plural individual predicates)
b. False. John came.

It is intuitively clear that regular individuals are not in the extension of collective nouns. Therefore it is infelicitous to deny the claim that no couples/basketball teams/ etc. came as in (276)a by pointing out that John came even if John is in a couple relation ship/part of a basketball team etc. The same infelicity is observed with essentially plural nouns – unless these predicates are understood relationally with a silent indexical object argument.[162] Pluralized individual predicates such as *student*

[161] Plural marking of the collective noun has no effect on the judgment.

[162] Since it seems to be always an option to understand e.g. *friends* as *friends of pro* or *friends of somebody* the infelicity is less compelling. The clearest cases are those for which a relational use with a silent indexical object would require a rich context. *2nd-degree cousins* is such a case because there is nothing in the encyclopedic meaning that would support a *2nd degree cousin of pro* construal out of the blue. This difference can be seen e.g. in the relative ease with which one can utter

on the other hand support such a denial, which supports the idea that regular individuals are in the extension of plural individual predicates. Note that these few remarks are not meant to be a full account of these facts. They simply indicate a fundamental difference between these three kinds of predicates that all at an intuitive level range over collections of individuals: only pluralized individual predicates range over regular individuals as well as i-sums. Collective as well as essentially plural predicates range only over collections of individuals.

Form these observations, we should now expect that essentially plural predicates can feature as NP argument of *many* without being *-ed. After all, they seem to be inherently *-ed predicates. As in the case of collective nouns, this expectation is not borne out however. In fact, essentially plural nouns are always plural marked. If they are not, they denote relations between atomic individuals. As such they are not fit to provide the restrictor of a comparative determiner or feature as NP argument of *many* in amount comparatives just like regular count nouns.

(279) a. More than three friend*(s) of John came to the party.
b. More friend*(s) of John than he had expected came to the party.

In other words, nouns like *neighbors, 2nd-degree cousins,* etc. are essentially plural predicates only if hey are plural marked and not used relationally. The prediction that essentially plural nouns are plural marked is therefore trivially true. That doesn't

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sentences as in (i) where (i) has can be uttered with relative ease typically understanding John to be a friend of a speech act participant.

i. a. # John is a 2nd-degree cousin.
b. John is a friend.

mean however that essentially plural predicates wouldn't provide an important test ground for the theory developed in this thesis.

Note first of all that even though essentially plural predicates like genuine collective predicates do not range over regular individuals, cumulative inferences based on regular individuals are supported by essentially plural predicates as shown in (280). This is in stark contrast to genuine collective predicates.

(280) a. John and Mary are colleagues/2nd-degree cousins/etc. John and Sue are colleagues//2nd-degree cousins/ etc.
b.=> John, Mary and Sue are colleagues/2nd degree-cousins/ etc.

Second, when we look at counting inferences we see that the individuals that are counted in the extension of essentially plural predicates are regular individuals rather than pairs, etc. of individuals as in the case of collective nouns. The data in (281) and (282) illustrate once more that comparative quantifiers and amount comparatives are identical in this respect. Both establish regular individuals as unit of counting.

(281) a. No fewer than 2 twin-brothers/colleagues/neighbors came.
b.=> No fewer than 2 people came.

(282) a. John talked to more twin-brothers/second degree cousins than Bill did to singles.
b.=> John talked to at least as many people as Bill did.

The last observation is quite puzzling and requires an amendment of the treatment of *many.* To appreciate the puzzling status of essentially plural predicates, compare the minimally different pair of predicates *couple* and *twin-brothers.* Both are predicates that are defined only for 2-memebered collections of regular individuals. Nevertheless we are forced to count pairs of individuals when the noun *couples* provides the NP argument of *many* and regular individuals when it is the noun *twin-brothers*. I suggested above that the problem presented by *couples* can be dealt with once we have a precise way of modeling group individuals as being atomic. A way of visualizing what needs to be achieved is given in (283) where A is a portion of the domain of *couples* assuming that E contains exactly 6 atomic individuals a,…,f, with (a⊕b) representing a couple, and ( ) indicating that it is a group-individual rather than a simple i-sum.[163, 164]

(283) a. A = {(a ⊕ b), (c ⊕ d),(e ⊕ f), (a⊕b) ⊕(c⊕d), …}

b. (a⊕b)⊕(c⊕d)⊕(e⊕f) ⟶ 3

(a⊕b)⊕(c⊕d) (a⊕b)⊕(e⊕f) (c⊕d)⊕(e⊕f) ⟶ 2

(a⊕b) (c⊕d) (e⊕f) ⟶ 1

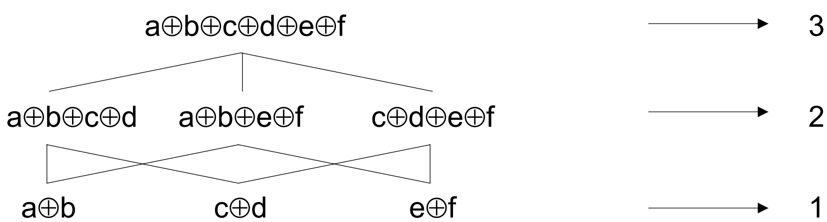
The measure function expressed by *many* as defined in (261) will assign non-overlapping elements in this lattice to natural numbers additively. It will assign the pair (a⊕b) degree 1, the plurality of pairs (a⊕b)⊕(e⊕f) degree 2 and so on. In other words it will count couples rather than the individuals that the couples are made of,

[163] The proper modeling of group–individuals is a complex issue that is beyond the reach of this thesis. Cf. Landman(1989), etc.
[164] The semi-lattice in (284) does of course not represent the entire domain since possible couples (a⊕c), (a⊕d), etc. and their i-sums are not included in the portion of the displayed lattice.

which is exactly what we want. This treatment however cannot be administered to essentially plural predicates like *neighbors, twin-brothers, etc.* The extension of these predicates is a set of pluralities rather than a set of group-individuals as evidenced by the cumulative inferences. The domain of *twin-brothers* can be partially modeled for instance as in (284) assuming again that the universe contains only the atomic individuals a,…,f.

(284) a. A = {a ⊕ b, c ⊕ d, e ⊕ f, …}

b.



The problem is that since the domain of *twin-brothers* does not contain any regular individuals the measure function expressed by *many* defined in (261) predicts the assignment of degrees as indicated above. This is so because according to the definition in (261) the measure function needs to satisfy only two conditions: 1. Order preservation, which guarantees that the 2-membered i-sums are assigned to a smaller number than the 3-membered i-sums which in turn are assigned to a smaller number than the 4-membered i-sums. 2. Non-overlapping i-sums are counted additively. If we take for instance a⊕b⊕e⊕f the number it is assigned to by the measure function μ needs to be the sum of whatever μ assigns to its non-overlapping parts. Since there are no individuals in the domain, all that is required is that μ(a⊕b⊕e⊕f) = μ(a⊕b) + μ(e⊕f). But this is satisfied by the assignment indicated in the diagram in (284) which is clearly not the way we count *twin-brothers.* So the measure function we have worked with up to this point is not covering all the cases it should. We need to amend the definition in a non-trivial way.

1st Amendment: Counting Atomic Parts

It is fairly easy to pinpoint the problem that the measure function defined in (261) encountered when we asked it to count *twin-brothers*. It simply starts to count at the wrong level. I.e. instead of starting the count with the individuals that stand in the twin-brother of relation to some other individual, it assigned the smallest number to twin-brother pairs. While this was the right decision for counting *couples* it is clearly the wrong move with essentially plural predicates. The reason for this failure is that the measure function is not sensitive to the distinction between group-individuals e.g. the pairs in the extension of *couples* and the minimally different pluralities, e.g. the semi-lattice generated over 2-memebered i-sums. But what exactly is this difference? A basic intuition seems to be that e.g. couples are in an important sense treated by the language as if they were atomic individuals like students in that they do not have proper parts while twin-brothers are not atomic.[165] Support for this way of looking at the difference comes from the basic facts about cumulative inferences. While cumulative inferences based on regular individuals are supported by essentially plural predicates, they are not by genuine collective predicates. Instead, cumulative inferences are valid for group-individuals with

[165] (cf. Schwarzschild(1996), Winter1998,among others for the same intuition.

genuine collective predicates. What goes wrong then in the counting of *twin-brothers* is that the atomic individuals that twin-brothers are made of are ignored and we need to make the measure function expressed by *many* sensitive to the atomic parts of the individuals that are measured. Assuming a basic predicate *atomic* (*At*) as defined in (259) we can give now an amended definition of the measure function that is expressed by *many* as in (285).

(285) **Definition:** Additive Measure Function ("the atomic cardinality of")

Let $\langle A,\leq_i,\oplus\rangle$ be a relational structure with $\langle A,\leq_i\rangle$ a complete join semi-lattice closed under $\oplus$. A function μ from A to degrees $D \subseteq N$ is an additive measure function iff

i. $\forall x,y \in A$ if $x \leq_i y$ then $\mu(x) \leq \mu(y)$ (order preservation)

ii. $\forall x,y \in A$ if $\neg\exists z\, [z \leq_i x$ and $z \leq_i y\,]$ then $\mu(x \oplus y) = \mu(x) + \mu(y)$ (additivity)

iii. $\forall x \in A$ if $\neg\exists y\, [y\in A \;\&\; y\leq_i x \;\&\; y\neq x \;\&\; \exists z_1,z_2,\ldots [z_1 \leq_i x \;\&\; z_2 \leq_i x \;\&\; \ldots \;\&\; z_1\neq x \;\&\; z_2\neq x \;\&\; \ldots \;\&\; z_1\neq z_2\neq \ldots \;\&\; At(z_1)=1 \;\&\; At(z_2)=1 \ldots]$ then $\mu(x) = \mu(z_1) + \mu(z_2) + \ldots$ (atomic parts)

(285) is like the original measure function defined in (261) except that we added a new condition that makes sure that the smallest number that any plurality in A can get is the sum of all its atomic parts. Hence, the twin-brother pair a⊕b will be assigned degree 2 rather than 1 and any plurality containing a⊕b will be assigned a degree ≥2. Given this we should give a slightly different rendition of the lexical entry for many as in (286).

(286) $[\![MANY]\!] = \lambda d\in D_{Card}.\lambda{}^*f\in D_{\langle e,t\rangle}.\lambda{}^*g\in D_{\langle e,t\rangle}.\exists x\, {}^*f(x) = {}^*g(x) = 1$ & x has d-many atomic parts.

This lexical entry for *many* is useful because it displays two things prominently that might be considered suspicious about the proposed amendment. First, the definition of the measure function that *many* expresses is able to look at any plural individual not just 2-membered i-sums and assign it a degree of numerosity by counting its atomic parts. This generalization is necessary to cover cases that are similar to *twin-brothers* except that the smallest pluralities are comprised of more than 2 individuals (e.g. the smallest number of *quadruples* is 4, etc.). The result is a very powerful procedure that raises the question why the other two conditions are still needed. In fact, it looks like they really aren't simply because the counting procedure is defined as a sequence of existential quantifiers ranging over atomic parts accompanied by a non-identity condition on the variables they bind. The second question that arises quite naturally concerns the notion "atomic part of." Consider again the counting inferences with collective nouns. We are licensed to infer from the fact that at least 2 couples came that at least 4 people came.

(287) a. No fewer than two couples came to the party.
b.=> No fewer than four people came to the party.

Cleary what accounts for this inference is the fact that couples are pairs of individuals and ach pair consists of exactly 2 individuals. The problem is that the definition of *many* as counting atomic parts commits us to the claim that the inference in (287) is licensed through world knowledge only because the atomic parts that *couples* are made of are linguistically not accessible. This is dubious because we have predicates like *numerous* that seem to be able to do exactly that. Let me emphasize that this time, I am considering the lexical item that really exists in English and not *numerous'* which I made up to facilitate the discussion of how we can think of *many* expressing a measure function. The lexical item *numerous* that does exist in English actually has slightly different properties that *numerous'* or *many* in that – as Winter(1998) shows – it ranges over group individuals as described by genuine collected predicates. For instance, it is acceptable to say things like (288)a,b and c even though the NPs are in the singular.

(288) a. The foreign affairs committee is more numerous than the civil rights committee.
b. A trio is more numerous than a couple/duo.
c. A trio is more numerous than a duo by one.

Interestingly, *numerous* seems to count the members those group-individuals just like *many* counts the atomic of pluralities. Otherwise (288)b would not be understood to convey a truism nor would be it be possible to license differential phrases as in (288)c.[166] I.e. the comparison that is conducted between the numerosities of couples and trios considers again regular individuals and not pairs or triples of individuals. While *many* is a degree function that is blind to the fact that group-individuals are made up of atomic individuals as well *numerous* is not. The analysis of *numerous* requires the modeling of group–individuals in a way that allows us to recover a

[166] This observation also shows that the fact that comparative determiners and amount comparatives (that are not based on the adjective *numerous*) behave identically with respect to counting inferences is not trivial. The existence of *numerous* documents that the parallelism doesn't follow on conceptual grounds. Instead, it has to be due to the fact that comparative quantifiers and amount comparatives employ the same degree function *many* that expresses the counting procedure.

measure function inside *numerous* that has the same properties that the measure function *many* encodes. It has to denote an order-preserving mapping between cardinalities and group-individuals according to how many members the group-individuals have.[167] Note that the measure function as defined in (285) will not cover at the same time *many* and *numerous.* This is as it should be, given the above discussion, because we want *numerous* to count group-individuals (symbolized as (a⊕b) in (283)) and *many* to count pluralities (symbolized as a⊕b). It seems then that we need a second, minimally different counting function for *numerous* that executes the same counting procedure that (285) does and differs only in that it is defined for group-individuals (employing a suitably amended notion of atomic part). To be sure, this can be done. However, a more attractive alternative seems to assume only one counting procedure that is expressed by both *many* and *numerous* and instead encode the different requirements in terms of how these measure functions are expressed by the two degree functions.[168] What stands in the way of such a proposal is that the notion of "atomic part of" is too bland. The next section proposes a modification of the (atomic) part of relation and an amendment of the treatment of

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[167] As soon as we change the degree function, the triviality disappears. E.g. the sentences in (i)a and b are not trivial anymore either because the units of measurement aren't atomic individuals (as e.g. in the case of *heavy*) or need to be specified to be atomic individuals for the sentences to be trivial (ic).

(i) a. This trio is heavier/larger/bigger than that duo.
    b. A trio is more than a duo.
    c. A trio consists of more people than a duo.

[168] Having two almost identical counting procedures differentiated only by ontology raises the question how they are related and whether we want to take a ontological commitments induced by properties of the language as sufficient grounds to impose the same ontology to non-linguistic cognition such as counting.

many so that it determines directly which part-of relation the measure function expressed by *many* should use to count the individuals in its domain.

2nd Amendment: Units of Measurement/Counting

The intuition I would like to pursue to address the questions mentioned in the previous section is to relativize the "part of relation" to the basic predicate that is *-ed. I.e. we modify the definition of the i-$\leq$ relation to "i-part of in P" where P is a function of type $\langle e,t \rangle$ as given in (289).

(289) **Definition:** <u>individual part of in P $\leq_I$:</u> For any x,y $\in$ D,

(i) $x \leq_i x$

(ii) $x = y$ iff $\forall z\ [z \leq_i x \rightarrow z \leq y\ \&\ z \leq_i y \rightarrow z \leq_i x]$

(iii) $x \leq_i y$ iff $\forall z\ [z \leq_i x\ \&\ P(z) = 1 \rightarrow z \leq_i y]$

Now only those individuals x are parts of some individual y if they are parts of y and also in the extension of the predicate P. The definition of atomic individual is likewise modified as in (290).

(290) **Definition:** <u>Atomic individual in P</u>

$\forall x \in P$, x is an <u>atomic individual in P</u> (*At*(x) =1) iff $\neg \exists y \in E\ [\ P(y)=1\ \&\ y \leq_i x\ \&\ y \neq x]$

The intuition behind these "local" definitions of the (atomic) part of relation[169] is that the atomic individual parts of a plurality of couples are individuals that are in the extension of the basic predicate *couple,* hence couples. The atomic i-parts of a

[169] Of course the global notion *part of* can be recovered by simply saying that P is E.

plurality of students are individual students. For essentially plural predicates we need a part-of relation that gives us access to regular individuals – e.g. for *twin-brothers* those that stand in twin-brother of relation to someone. Assuming for the moment that this can be derived in a principled way, we have a local notion of the part-of relation that effectively replaces the parenthesis introduced above to distinguish group-individuals from pluralities. The second piece that is needed to give a uniform treatment of *numerous* and *many* is that each degree function specifies which predicate the part-of relation used by the measure function it is relativized to. Specifically, we want *many* to count *couples* in terms of couples, *students* in terms of students and *twin-brothers* in terms of individuals that are twin-brothers of someone. *Numerous* on the other hand needs to work more like the *member of* relation in that it counts *couples* in terms of its individual members. Actually, it seems that *numerous* as well as *outnumber* seem to be flexible as to how they count. Consider (291)a in a situation where there are 2 quartets and 3 duos. (291)a can be both true and false in this situation depending on whether the members are counted or the groups. The same is true for (291)b.[170]

(291) a. The quartets/groups of four outnumber the duos/groups of two.
b. The string sections are more numerous than the wind sections.

[170] Although, when *numerous* is combined with nouns that carry number information (*quartets*, etc.), it appears to be biased to count groups. The bias can be counterbalanced if the groups are clearly unequal in number (e.g. *The groups of 200 are more numerous than the groups of 3*.).

This seems to suggest that the context determines to some extent how *numerous* and *outnumber* count.[171] *Many* on the other hand appears to rely exclusively on its NP-argument. For instance, (292)a is clearly false in the situation described above while (292)b is unambiguously true. There are 2 quartets and 3 duos. The overall number of musicians is irrelevant for *many.*

(292) a. John invited more quartets than duos.
b. John invited fewer quartets than duos.

This suggests a modification of the lexical entries so that *many* always consults the NP in determining the part-of relation while *numerous* uses a context dependent variable C.

(293) a. $[\![\textit{many}]\!] = \lambda d \in D_{Card}.\lambda {}^{*}f \in D_{\langle e,t\rangle}.\lambda {}^{*}g \in D_{\langle e,t\rangle}.\exists x {}^{*}f(x) = {}^{*}g(x) = 1$ & x has d-many atomic f-parts.
b. $[\![\textit{numerous}]\!] = \lambda d \in D_{Card}.\lambda C \in D_{\langle e,t\rangle}.\lambda x \in {}^{*}D_e$. x has d-many atomic C-parts.[172]

The idea is then that counting is always done relative to a unit of counting and degree functions need to be specified as to which unit of counting they employ. Counting is obviously not alone in this respect. For instance, we can measure the height of individuals using different units of measurement – meters, feet, etc. It seems quite plausible in fact to assume that all degree functions need to be specified just how they measure a given individual. A serious investigation of this

[171] Shcwarzschild's(1996) notion of "cover" might be useful here.
[172] Possibly the syntax plays a more important role as it seems that attributive *numerous* is just as dependent on the NP as *many* is.

proposal would require a detailed study of syntax and semantics of measure phrases that is beyond the scope of the thesis.[173] Yet another question that I will have to leave for future research is what the special properties of essentially plural nouns are so that when it comes to using them to provide the unit predicate in a counting structure, you can simply resort to the blandest form of the relational predicate e.g. *twin brother of somebody*.[174]

4.5 Genuine Collective VPs and Comparative Quantifiers

This section discusses empirical evidence that supports the claim that comparative quantifiers extend their definedness conditions to the VP – it needs to be *-ed just like the NP argument. Since plural morphology seems to be not a reliable indicator for the presence of the *-operator in VPs, I will following Dowty(1986), Brisson(1998) and Winter(1998) in extending the classification of nominal predicates into genuine collective, essentially plural and individual predicates to verbal and adjectival domain. (4.5.1) The proposal to analyze *many* as gradable determiner makes non-trivial predictions as to which kinds of NPs should

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[173] Clearly a study of the DP syntax of so-called classifier languages would be immediately relevant to see whether the proposal has any merit.

[174] It is tempting to analyze *twin-brothers* as covertly reciprocal version of the relational noun as in *twin-brother of each other.* I.e. if we can derive *twin-brothers* in the syntax from the relational noun it might be possible to recover in the same structure the predicate *twin brother of somebody*. Note this suggestion points towards another difference between essentially plural nouns and genuine collective nouns. Only the former can be used with a reciprocal.

(i) a. colleagues/neighbors/twin-brothers/etc. of each other

b. * couples/team/committee/etc. of each other be compatible with which kinds of VPs. In a nutshell it is expected that both NP and VP have to range over the same pluralities if they are the arguments of *d-many.* This is shown to be essentially correct and according to Winter(1998) just a special case of a more general restriction that all quantificational determiners are subject to (4.5.2). However, as will be shown in (4.5.3), there is a special environment ("generic readings") in which comparative determiners display different selectiveness than "true" quantifiers arguing contra Winter(1998) that *many* should not be analyzed completely on par with true quantificational determiners with respect to these effects. Furthermore, it is easy to see that all amount comparatives display exactly the same behavior with respect to predicate compatibility that comparative determiners do. Taking these pieces together will form a further argument in favor of the proposal that analyzes *many* as gradable determiner common to all comparative quantificational structures and that has both properties of determiner and degree functions.

4.5.1 Morphological and Semantic Number

One of the basic tasks of the theory of plurality is to explain which DPs that "correspond" in some way to a plurality of individuals can function as argument of predicates that are intuitively true of a plurality of individuals and — vice versa — which predicates can take such DPs as arguments. Clearly (in languages such as English) this task involves clarifying the relation between plural morphology and semantic plurality. Following Link(1983), it was proposed that morphological plural marking reflects semantic plurality in that it expresses the *-operator. Semantic plurality was simply assumed to be characteristic of *-ed predicates whose extension is closed under ⊕. Unfortunately — as is well known — a straightforward 1-to-1 mapping between morphological number and semantic number is not feasible. The picture has to be complicated and refined in a number of ways allowing for mismatches in both directions. I.e. there are morphologically plural marked DPs that are intuitively semantically not plural and there are intuitively "plurality denoting" DPs that are morphologically singular. The examples in (294) illustrate both classes.

(294) a. John is using the scissors to trim the trousers.
b. The committee was gathering in the hallway.
c. The committee has to elect a representative.

Despite the fact that both DPs *the scissors* and *the trousers* are morphologically plural, it is not necessary for (294)a to be true that John is using more than one pair of scissors to trim the pants nor is it required that he is trimming more than one pair of pants. This shows that plural marked DPs like *the scissors* can denote simple individuals completely parallel to singular definite DPs like *the hammer*. (294)b,c on the other hand illustrate that predicates like *gather* and *elect a representative* which intuitively can be true only of collections of individuals can be predicated of a morphologically singular DP. This goes to show that singular marked DPs can apparently denote collections of individuals and VPs can range over such collections without being plural marked. Conversely, predicates cannot be classified simply into "collective predicates," i.e. those that range over collections of individuals (*meet*, *elect the president,* etc.) and "distributive predicates," i.e. those that range over regular individuals only (*have blue eyes, etc.*). A third category, typically referred to as "mixed predicates" needs to be recognized (*lift the piano,* etc.). They seem to be able to range both over individuals as well as collections of individuals. To illustrate the point, consider the paradigms in (295) - (296).

(295) a. John and Mary have blue eyes
b. John has blue eyes and Mary has blue eyes.
c. The professors have blue eyes.
d. ?? The committee has blue eyes. [175]

(296) a. John and Mary met in the hallway.
b. ?? John met in the hallway and Mary met in the hallway.
c. The professors met in the hallway.
d. The committee met in the hallway.

(297) a. John and Mary lifted the piano.
b. John lifted the piano and Mary lifted the piano.
c. The professors lifted the piano.
d. The committee lifted the piano.

Predicates like *have blue eyes* are true only of regular individuals. Therefore, the sentences in (295)a,c have to be interpreted distributively. For (295)a,c to be true, each professor/each of John and Mary has to have blue eyes. Conversely, collections of individuals as denoted by *the committee* cannot be said to have blue eyes. Predicates like *meet in the hallway* are true of collections only. It is infelicitous

[175] The example is from Landmann(2000).

to claim that *John met in the hallway and Mary met in the hallway* even if it is true that John and Mary met in the hallway. The predicate *lift a piano* finally seems to be ambiguous as it can be predicated of singular individuals as well as collections. Pluralization seems to come in when these observations are extended to quantificational subjects. Singular quantifiers are compatible only with distributive predicates and distributive readings of mixed predicates while their plural counterparts are also compatible with collective predicates and collective readings of mixed predicates.

(298) a. All the/no/some/etc. students have blue eyes.
b. Every/no/some student has blue eyes.

(299) a. All the/no/some/etc. students met in the hallway.
b. * Every/no/some student met in the hallway.

(300) a. All the/no/some/etc. students lifted a piano.
b. Every/no/some student lifted a piano.

These observations are summarized in table 1.

Table 1: Distributive, Collective and Mixed Predicates

	Every student	**All the students**	**The students**	**The committee**	**John and Mary**
Distributive	Every student has blue eyes.	All the students have blue eyes.	The students have blue eyes.	#The committee has blue eyes.	John and Mary have blue eyes.
Collective	*Every student met in the hallway.	All the students met in the hallway.	The students met in the hallway.	The committee met in the hallway.	John, Mary and Bill met in the hallway.
Mixed	#Every student lifted the piano.	All the students lifted the piano.	The students lifted the piano.	The committee lifted the piano.	John, Mary and Bill lifted the piano.

The traditional classification of plural predicates distinguishes at least "distributive" predicates like *smile* that are true of atomic individuals, "collective" predicates like *meet* that are defined only for a plurality of individuals and "mixed" predicates like *lift the piano* that can be interpreted either way leading to ambiguity in case of plural subjects.[176] On the DP end of the picture at least the following can be distinguished with respect to compatibility with plural predicates: singular quantificational DPs like *everyone of the students* that range over (atomic) individuals, plural quantificational DPs like *all the students,*[177] definite plural DPs like *the students*, singular "bunch-denoting" DPs like *the committee* and conjoined DPs such as *John and Mary*.

There is a considerable variety of theories to account for these facts. The proposals vary with respect to ontological assumptions (what do bunch denoting DPs refer to, what definite plural DPs refer to, what to plural quantifiers quantify over, etc.) as well as what the linguistically realized means to refer to these entities are.[178] Rather than surveying these proposals here, I follow Winter(1998) who points out that it has been notoriously difficulty to pin down the intuitively satisfying classification of distributive, collective and mixed predication to their corresponding linguistic means of expressing them. Winter(1998) in fact goes so far as to reject any

[176] Since "mixed" predicates give rise to a semantic ambiguity only plural subjects, the '#' in table one is meant to indicate that there is no ambiguity between a collective and a distributive reading in these cases. *Every student lifted the piano* has only a distributive reading while *The committee lifted the piano* seems to only have a collective reading.

[177] I will use *all the students* instead of *all students* to avoid complications resulting from generic readings.

[178] Scha(1981), Link(1983,1987,1991), Dowty(1987), Roberts(1987), Landman(1989a,b), Verkuyl (1993), van der Does(1992,1994), Kamp&Reyle(1993), Schwarzschild(1992,1996), Lasersohn (1994), Brisson(1998), Winter(1998), are just the beginning of a rather lengthy list of work in this field.

linguistic significance of this typology. He develops an alternative typology instead that is based on observations first pointed out in Dowty(1986).

4.5.2 The Dowty-Winter Generalization

Dowty(1986) discusses a particular difficulty for the traditional classification that comes from the observation that there are two classes of collective predicates exemplified by *meet* on the one hand and *elect a president* on the other. Interestingly, the difference between these two classes of collective predicates seems to be related to the notion of distributivity. I.e. in some sense, collective predicates like *meet* are distributive while predicates like *elect a president, be numerous, be a good team, outnumber the professors, constitute a majority* etc. aren't. This difference is indicated by a surprising selectivity of these predicates for quantificational arguments. Consider the contrast in (301) and (302).

(301) a. The students were gathering in the hallway.
b. All the students were gathering in the hallway.

(302) a. The students elected a president.
b. * All the students elected a president.
c. * Every student elected a president.

Both predicates *gather in the hallway* and *elected a president* are "collective" in the sense that they can be true only of a collection of individuals. Nevertheless, the plural quantificational DP *all students* is ungrammatical as subject of the latter kind of predicate just like its singular counterpart *every student* is. Dowty(1986) observes that the difficulties in (302)b and (302)c are intuitively very similar in nature. Both sentences suggest that every member of the set of students elected a president. More precisely, the presence of the quantificational phrase seems to impose the validity of — using Dowty's term — "distributive sub-entailments" which are not licensed by the predicate. How is this different from predicates like *meet* and *gather* so that *every student* is ungrammatical with these predicates as well while *all students* is not? Dowty's insight is that *meet* and *gather* do in fact license "distributive sub-entailments" albeit only down to the minimal number requirement discussed in chapter 2. To illustrate this fact, consider the intuitively valid inferences sketched in (303).

(303) Assume there are 10 students. If it is true that …

… The students are (all) meeting in front in the hallway.

a. ⇒ There is a group of 9 students meeting in the hallway.

b. ⇒ There is a group of 8 students meeting in the hallway.

⇒ …

I.e. if it is true that the 10 students are meeting in the hallway then it is also true that 9 students are meeting in the hallway and so on down to the minimal number required to have a meeting. The difference in compatibility with *every student* and *all students* can be attributed to a difference in morphology. While *every student* is singular quantifying over atomic entities and therefore requiring distributive sub-entailments down to atomic individuals, *all students* is plural. It quantifies over plural entities and requires distributive sub-entailments only down to plural individuals. Collective predicates like *elect a president* on the other hand do not license any sub-entailments. It certainly doesn't follow from the fact that the 10 students elected a president that there is a group of 9 students that also elected a president. What we observe then in the contrast in (302) is that there are DPs that — for some reason to be made explicit — require their scope argument to license distributive sub-entailments down to the units they range over. Even though this requirement seems related to the fact that these DPs are quantificational in nature as Dowty(1986) notes, he leaves it open what exactly it is in the meaning of *all students, etc.* that imposes the licensing of distributive sub-entailments. Winter(1998) develops the idea that the DPs that are sensitive to the presence of distributive sub-entailments are all quantificational DPs within a larger account of DP syntax and semantics. Consider the examples in (304) to (306) built after examples from Winter(1998) showing that indeed the generalization is broader than a systematic contrast between *every* and *all.*

(304) a. The girls elected a president.
b. The committee elected a president.
c. * All the/several/no/etc. girls elected a president.
d. * Every/no girl elected a president.

(305) a. The girls constitute a majority.
b. The committee constitutes a majority.
b. * All the/several/no etc. girls constitute a majority.
c. * Every/no girl constitutes a majority.

(306) a. The girls outnumber the boys.
b. The foreign affairs committee outnumbers the welfare committee.
b. * All/several/no etc. girls outnumber all the boys.
c. * Every/no girl outnumbers every boy.

The data in (307) and (308) built after examples from Winter(1998) — originally however due to Dowty(1986) — illustrate the fact that the difference between quantificational DPs and non-quantificational DPs can also be observed with mixed predicates.

(307) a. The students voted to accept the proposal
b. The committee voted to accept the proposal
c. Every student voted to accept the proposal
d. All the students voted to accept the proposal

(308) a. The students weigh 200 lbs.
b. The committee weighs 200 lbs.
c. Every student weighs 200 lbs.
d. All the students weigh 200 lbs.

This time the observation is not one of a difference in grammaticality rather it is a difference in interpretation. Consider the difference in interpretation between (307)a,b and (307)c,d. While for the a,b-cases to be true it is required that the students as a group/the committee as such voted in favor of the proposal, which allows for individual students/committee members to abstain or even disapprove the cases in (307)c and (307)d make a stronger claim: all students have to have approved in order for to be true. Analogous observations can be made for the examples in (308). This difference in interpretation is indeed rather reminiscent of the contrast in grammaticality in the examples in (304) to (306) and should fall under the same explanation. In each of these cases the inference from the sum-total of individuals making up the group to the individuals themselves is not warranted.

The difference between these two classes of "collective" predicates is rather reminiscent of the distinction we drew within "collective" nominal predicates. I.e. predicates like *meet in the hallway* seem to be the verbal counterparts of essentially plural nominal predicates like *friends, colleagues, 2nd-degree cousins* while *elect a president, outnumber the professors, constitute a majority* are the verbal counterparts of genuine collective predicates like *committee, group,* etc.[179]

Given this parallel between nominal and verbal predicates a new organization of the basic observations about which DPs can combine with which VPs suggests itself.

Table 2: Individual Predicates, Essentially Plural and Genuine Collective Predicates

	Det	**NP**	**VP**
Individual Predicates (Atom Predicates)[180]	Every/a/no/the All/most/no/more than 3 The/three/some	student students students	has blue eyes have blue eyes
Essentially Plural Ps (Set Predicates)	Every/a/no/the All/most/no/more than 3 The/three/some	(colleague of pro) colleagues colleagues	was meeting in the hallway were meeting in the hallway
Genuine Collective Ps (Atom Predicates)	Every/a/no/the All/most/no/more than 3 The/three/some	committee committees committees	has elected a president have elected a president

[179] Winter in fact elevates these observations to a criterion for establishing a new typology of predicates — "atom predicates" and "set predicates." (Winter(1998:214))

The Every/All-Criterion:

> An English predicate is called an *atom predicate* if and only if the status (acceptability/ truth-conditions) of the sentence obtained by combining it with an *every* noun phrase is indistinguishable from the status of the sentence we get when it is combined with an *all* noun phrase. Predicates that lead to distinguishable sentences are referred to as *set predicates*

[180] "Atom predicates" and "Set Predicates" is Winter's terminology.

Clearly, DPs based on individual nouns such as *all/every/no/ … student(s)* should be compatible with individual VPs such has has/have blue eyes but not with genuine collective VPs. Likewise genuine collective DPs of any shape should be compatible with genuine collective VPs but not with individual predicates. Furthermore, *-ing the predicates (e.g. via plural morphology on nouns) does not alter these facts because the *-ed predicates still range over pluralities of individuals on the one hand and pluralities of groups on the other. This is basically correct. The only exception to these predictions are given by definite and indefinite plural and bare numeral individual DPs like *the students, three students, some students,* etc. which are in principle compatible with genuine collective VPs such as *elect a president, constitute a majority,* etc. The interesting cases are once again provided by essentially plural predicates which seem to behave in some respects like individual predicates while in others like genuine collective predicates. For instance, essentially plural VPs are compatible with individual DPs as long as they are plural (*all/most/etc students./*every/no/etc. student met*). They are however also compatible with genuine collective DPs irrespective of whether they are plural marked or not (*all/ every/etc. committee met*). Essentially plural DPs on the other hand are compatible with individual VPs (*all colleagues have blue eyes*) but incompatible with genuine collective VPs unless the determiner is definite, indefinite or a bare numeral (**all/ most/etc./the/some/three students elected a president*). The puzzle is then to account for the additional possibilities to combine predicates that inherently do not range over the same kinds of individuals. The two factors are pluralization of the noun and choice of the determiner. More specifically, plural definite, indefinite and bare numeral DPs based on individual or essentially plural nouns can take on genuine collective VPs indicating that they can denote group-individuals. Quantificational determiners on the other hand are restricted to the compatibilities given by the predicates alone. More specifically, plural quantificational DPs based on individual nouns or essentially plural nouns cannot acquire an interpretation that would allow them to range over group-individuals – hence they are incompatible with genuine collective VPs.

Winter's account of this asymmetry is twofold. On the one hand, plural definite individual or essentially plural DPs have an additional interpretation denoting group-individuals. Their indefinite and bare numeral relatives can in essence be interpreted as definite plural DPs.[181] Hence, they have the same additional possibility that definite plural DPs have. Quantificational DPs on the other hand cannot be interpreted as definite DPs and are therefore incompatible with genuine collective VPs. They are sensitive – in Dowty's terms – to the availability of distributive sub-entailments in the VP because distributivity is built into the definition of the meanin of quantificational determiners. Recall that generalized quantifiers denote relations between sets. Relations between sets however are defined in terms of quantification over the elements of these sets. Quantificational determiners therefore always rely on the VP being a predicate of the atomic elements in the NP. Singular quantifiers

[181] The proposal more specifically is that plural indefinite and bare numeral DPs can be closed off by a silent choice function variable (type ⟨et,e⟩). This allows him to relate the observations discussed here to the independent phenomenology of "wide scope indefinites."

like *every student* are incompatible with genuine collective predicates like *elect a president* because *elect a president* cannot be true of regular individuals. Plural quantifiers like *all students* are essentially reduced to quantification over atomic individuals in Winter's account. I.e. there is no quantification over pluralities in Winter's theory and therefore no possibility to transform a DP that ranges over pluralities into one could range over atomic group individuals. (For specifics of his proposal see the appendix). This claim is of course incompatible with the proposal for comparative quantifiers developed here because it relies on existential quantification over pluralities. Winter's account therefore cannot be adopted at least for comparative quantifiers.[182] We need to find a different reason why comparative quantifiers based on individual or essentially plural nouns are incompatible genuine collective VPs.

4.5.3 A proposal for Comparative Quantifiers

Even though Winter's specific proposal is not available to us, we can give a closely related account of the inability of comparative quantifiers based in individual or essentially plural nouns to take on genuine collective verbal predicates. Intuitively, the reason is that the elements in the extension of genuine collective VPs cannot be

[182] The fact that comparative quantifiers behave differently from bare numeral quantifiers wrt. compatibility with genuine collective VPs is a strong argument against extending the analysis of *more than three students* to *three students* by analyzing the latter as '3-many students.' I will have to leave the analysis of bare numeral DPs for future research.

(i) a. * More than three students were the team that won the cup.
    b. Three students I know were the team that won the cup.

counted in terms of the counting units provided by the NP. I.e. rather than blaming the existential quantifier hidden inside *many* directly we can pinpoint the problem as a conflict between the requirements of the measure function expressed by *many* and the elements in the extension of genuine collective predicates. The crucial piece is in the account is that *many* is said to measure the VP-extension with respect to how many individuals it contains that satisfy the NP predicate. This means that the VP-extension as well as the NP-extension has to be a measurable domain. More specifically, the elements in the NP and VP extension have to be orderable with respect to the individual part of relation in a way that allows an order preserving mapping of these elements into the natural numbers. This approach make a couple of non-trivial predictions.

Prediction 1: Generic Readings

From the sketch of the idea given above it is evident that the reason that "true" quantifiers like *all, every, no* etc. are incompatible with genuine collective predicates is quite different in nature from the reason why comparative quantifiers are incompatible. While in the case of comparative quantifiers, the requirements of the measure function *many* are responsible, it is the built in distributivity of true quantifiers (for the moment adopting Winter's story for true quantifiers[183]) that accounts for their difficulty to take on genuine collective VPs. It is therefore prima facie expected that there could be environments where comparative quantifiers differ

[183] Which is actually problematic given the overall picture developed here.

from true quantifiers in their compatibility with genuine collective predicates. Indeed these environments exist and therefore support an account that distinguishes these two quantificational expressions. Consider first the data in (310) built after Winter(1998).

(309) a. # More than three students are a good team.
b. * More than 3 students were a team that participated in the race.

Winter notes in passing that for some speakers (309)a is marginally grammatical albeit under a special, generic interpretation. I agree with this observation. However, I found that my informants accepted comparative quantifiers in conjunction with "genuine collective predicates" in generic contexts generally. Interestingly, this effect cannot be observed with true quantifiers such as *all, both, no, most*. The paradigms in (310) and (311) give an initial taste of the effect.

(310) a. More than 3 students can be/*were a team that participated in the race.
b. Exactly four students can be/*were a good team.
c. Between four and ten students can be/*were a good team.
d. More/less than eleven students can be/*were a good team.
e. At least/most twelve students can be/*were a good team.
f. Few/many students can be/*were a good team.

(311) a. * All the students can be a good team.
b. * None of the students can be a good team.
c. * Most of the/most students can be a good team.

This shows then that there are independent reasons to account for the incompatibility of "true" quantifiers on the one hand and comparative quantifiers on the other with genuine collective predicates. At his point I do not have an account of these exceptions. However, I would like to point out that, cumulative inferences over regular individuals are valid with generic genuine collective predicates as in (312) but not with episodic genuine collective predicates (313).

(312) a. John and Mary are a group/can elect a president.
b. Mary and Sue are a group/can elect a president.
c.=> John, Mary and Sue are a group/can elect a president.

(313) a. John and Mary were a group/elected a president.
b. Mary and Sue were a group/elected a president.
c.=/> John, Mary and Sue were a group/elected a president.
d. => John and Mary and Mary and Sue were a group/elected a president.

If we take cumulative inferences as guiding principle as to what kinds of individuals are counted, then these observations support the claim that the sensitivity of comparative quantifiers for genuine collective predicates is to be stated in terms of the atomic parts made available by the predicate. Even though I am not offering an account of the behavior of genuine collective predicates in generic environments, there is still an argument against Winter simply because we have found an environment in which (a subset of) comparative determiners behave differently from true quantifiers like *all, etc*. Comparative quantifiers turn out to be ambivalent with respect to genuine collective predicates, which is not expected under Winter's proposal. In particular, if comparative quantifiers in conjunction with genuine collective predicates are interpreted generically, then no conflict arises. Note that the account of this effect cannot be to say that the genuine collective predicates are not "genuine collective" anymore since true quantifiers are still incompatible.[184] This is prima facie evidence that supports a different treatment of comparative quantifiers on the one hand and "true" quantifiers on the other. However, if such a treatment is required, much of the original appeal of Winter's proposal is lost as no uniform treatment of determiner quantifiers (in the sense of GQT) is possible.

Prediction 2: Embedding under the Definite Determiner

From the discussion in chapter 2, we know that embedding comparative quantifiers under a definite determiner imposes an alternative analysis as disguised amount relatives according to which the comparative syntax is resolved inside the DP. We can extend this prediction to the phenomena at hand as follows: The account sketched in this chapter relied on the claim that the presupposition of the measure function *many* is inherited by both its arguments. This was shown to predict that VPs that do not range over pluralities that are countable in terms of the units introduced by the NP yield awkwardness with comparative determiners. Extending

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[184] Note also that it doesn't seem to be the case that – for whatever reason – the subset of weak quantifiers in question can get "referential readings" in connection with generic predicates which would make them similar to bare numeral DPs. I.e. the quantifiers in question do not seem to show wide scope indefinite phenomenology even in conjunction with generic predicates. Consider (i) modeled after Ruys(1995) in the familiar situation where there are many relatives that would in various combinations make lousy teams and therefore not deserve any monetary investment while only 4 would together form a good enough team to bet some money on. It seems that the sentence is false under the described scenario indicating as that only narrow scope is available for modified numerals irrespective of whether the predicate is generic or not.

(i) If more than 3 relatives of mine can be a team I will start betting.

an analysis as disguised amount relatives as enforced by stacking a definite determiner on top of a comparative quantifier predicts that the definedness condition of *many* need not be satisfied by the matrix VP anymore since the clausal environment is provided by the amount relative. We predict then that in these circumstances the incompatibility of comparative quantifiers with genuine collective predicates disappears. This prediction seems to be borne out as the data in show (314).

(314) a. The more than three students that there were were the team that won the cup.
b. ?? More than three students were the team that won the cup.

Prediction 3: Genuine Collectivity in Amount Comparatives

Another prediction that is made by the claim that the definedness conditions of *many* are responsible for the incompatibility of comparative quantifiers with genuine collective predicates is that it should extend straightforwardly to all NPs and VPs in amount comparative constructions. This expectation is borne out as the data in (315)-(317) show.

(315) a. More students/neighbors than colleagues/students have blue eyes.
b. More students/colleagues have blue eyes than Bill had expected.
c. # More teachers than groups of students have blue eyes.
d. # More groups of students have blue eyes than Bill had expected.

(316) a. More (groups of) students than teachers/colleagues were meeting.
b. More (groups of) students/colleagues were meeting than expected.

(317) a. # More students/neighbors than teachers/colleagues were numerous constituted a majority/weighed exactly 800lbs.

b. # More students/colleagues than expected were numerous/constituted a majority/ weighed exactly 800lbs.

c. More groups of students than Bill had expected were numerous/constituted a majority/weighed exactly 800lbs.

Importantly, the parallelism between amount comparatives and comparative quantifiers with respect to these predicate-predicate restrictions is not expected under Winter's account and provides therefore another compelling argument to pursue a uniform analysis of comparative quantifiers and amount comparatives.

4.5.4 Appendix: Winter(1998)

Recall from the discussion in 4.5.2 that Winter attempts an account of the determiner restriction with genuine collective predicates that reduces all cases to be the case that disqualifies *every student* form being the subject of a genuine collective predicate. The first step in this reduction consists of a "brute force stipulation" to the effect that there is no semantic difference between the singular and plural determiner quantifiers (*all, every,* no_{Sg}, no_{Pl}, *etc.*). All of them are of type <et,ett>. Plural morphology plays however an important role in the interpretation of the NP and the VP argument of the determiner quantifier. Winter assumes that there is a strict correspondence between singular and plural predicates and the type of their denotation. Specifically, singular marked predicates range over atomic individuals, hence are of type <e,t>, plural marked predicates range over sets of atomic individuals (type <et,t>). Given these assumptions, plural marked arguments of a quantificational determiner yield a type mismatch and should yield prima facie uninterpretability. The situation is rescued, so Winter's proposal, via a special interpretation rule called "determiner-fitting" (dfit) triggered by the presence of morphological plurality. (318) summarizes the proposal (cf. Winter 1998: 230).

<u>Determiner Fitting</u>

(318) Let *D* be a standard determiner (<et,ett>)
$dfit(D) =_{def} \lambda A_{ett}.\lambda B_{ett}.D\ (\cup A)(\cup (A \cap B))$

Step 1: (intersection): The verb denotation is modified by intersecting it with the plural noun denotation. (cf. conservativity)

Step 2: (union) The two sets of sets are then "unioned" before they serve as arguments for the determiner.

Effect of number marking:
Singular marked constituents range over atomic individuals (e.g. $NP_{Sg.}$, $VP_{Sg.}$ are type <e,t>
Plural marked constituents range over sets of individuals (NP_{Pl}, $VP_{Pl.}$ are type <et,t>.

The application of this rule resolves the type mismatch between the quantificational determiners like *all* (<et,ett>) and the plural marked NP which denotes a set of sets (<et,t>). To see how this works, consider the computation of the meaning of sentences as in (319).

(319) a. All students met in the hallway.
b. Several/no/etc. students met in the hallway.

The rule proceeds in two steps: first a complex predicate *students are meeting* is formed by intersecting ⟦*students*⟧ and ⟦*are meeting*⟧. Both constituents are morphologically plural marked, therefore denote a set of sets.[185] After set intersection, grand union returns a set of individuals, which is of the right type to be the scope argument of a regular quantificational determiner. The second part of "determiner fitting" involves unionizing the plural NP in the restrictor position of the quantificational determiner to a set of individuals.

Winter motivates step 1 of the determiner-fitting rule as a possible derivational account of the conservativity property of natural language determiners. Importantly, in his system step 1 is also required to get the truth-conditions right. To see this, consider example (320)a and its truth-conditional content described in (320)b.

(320) a. At least 5 students met.
b. 'For at least 5 students it is the case that there is at least one other person out of this group of at least 5 that he/she met with.'

The crucial point is that for (320) to be true, it is not sufficient that at least 5 students participated in some meeting, say with a professor. There has to be a meeting for each of the at least 5 students with at least one member of that same group. Determiner fitting insures that this will be the case because it demands that the intersection of ⟦*students*⟧ and ⟦*are meeting*⟧ contains at least 5 students. Crucially,

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[185] In Winter's proposal morphological number marking of the VP has a semantic consequence just as much as it changes the denotation of NPs — singular predicates range over individuals while plural marked predicates range over sets of individuals.

for a set of individuals to be in the extension of the predicate *are meeting* it has to contain at least 2 members. This means, that in the extension of $[\![$*students*$]\!] \cap [\![$*are meeting*$]\!]$ are sets of meeting students of cardinality 2 or greater. The sentence will be true, if the total number of students in the extension of *are meeting* (after grand union) is 5 or bigger, which is a faithful representation of the truth-conditions associated with (320)a.[186]

To see how the problem that "plural" quantificational determiners have with genuine collective predicates like *be a good team* can be reduced to the ungrammatically of *every student is a good team* it is helpful to work with an example. Assume that there are 10 students (1,2,…,10) and 2 professors (a,b) which form the following good teams: T_1 = {1,2,3}, T_2 = {4,5} and T_3 = {6,7,8,9,10} T_4 = {a,b}.[187] The extensions of various predicates relevant for the computation of the sentence in (321)a are given in (322) assuming the usual definition of the plural and singular operator ($pl(X) = \{A \subseteq X: A \neq \emptyset\}$, $sg(X) = \{x \in E: \{x\} \in X\}$).

(321) * All students are a good team.

[186] There is a complication in this account that is not central to my concerns but should be mentioned. Strictly speaking, Winter's account works only if all the modifiers of the NP are intersected with the main verb as well. Otherwise, it would be possible that (320) is true in a situation in which there are 5 students who met some other student, say a first-year student, that is not part of the group of 5.

[187] For simplicity a team will be represented as set of individuals here which is sufficient for the discussion. If that assumption is not held, the problem of quantificational determiners becomes formally more evident however the underlying intuition is more obscured.

(322) a. $[\![$*student*$]\!]$ = {1,2,3,4,5,6,7,8,9,10}

b. $[\![$*students*$]\!]$ = {1,…,{1,2}, …,{1,2,3}, …,{1,2,3,4,5,6,7,8,9,10}}

c. $[\![$*is a good team*$]\!]$ = {{1,2,3},{4,5},{6,7,8,9,10},{a,b}}

d. $[\![$*are a good team*$]\!]$ = {{1,2,3},{4,5},{6,7,8,9,10}, {a,b},{{1,2,3},{4,5}}, {{1,2,3}, {6,7,8,9,10}},…,{{1,2,3},{4,5},{6,7,8,9,10}.{a,b}}}[188][189]

e. **students** $\cap$ **are a good team** = {{1,2,3},{4,5},{6,7,8,9,10}}

f. $\cup$(**students** $\cap$ **are a good team**) = {1,2,3,4,5,6,7,8,9,10}

As mentioned above, the denotation of *good team* is a set of "impure atoms" – represented here again as sets of individuals. Plural marking of the VP *be a good team* creates a set of sets impure atomic individuals ("the set of sets of good teams") as given in (322)d for the assumed model. Step one of determiner-fitting requires that the intersection of *students* and *are a good team* is computed. This results in the case of (322) in the same denotation that *students* has which after unionizing it to fit the type requirements is a set of individuals all of which are students and **a member of a good team**. The problematic step happens exactly in forming the grand union of the intersection, which involves the move from sets of individuals to their members. While this step is considered unproblematic in the case of *students* it is precisely here where the nature of genuine collective predicates causes problems. As Dowty(1987) already observed, the distinguishing property of genuine collective predicates is exactly that they do not license distributive sub-entailments. Unionizing a set of sets however seems to presuppose that the relation of the set to its

[188] Quines innovation is assumed again here although it is not required to make the point.

[189] It is not immediately obvious that plural marking of the VP has any interpretational consequences. For the discussion here it is not relevant to take a position. Therefore both singular and plural denotations of the VP are given in the example.

members is transparent so that "no information is lost" in the mapping from the set to its members or the other way around. In this manner, Winter gives a formal account of Dowty's fundamental intuition. His actual proposal is however more ambitious than this. It is embedded in larger theory of DP syntax and semantics that is too far-reaching for me to discuss here.

4.6 Summary

The present chapter served 2 purposes: First I tried to spell out what exactly it means for a determiner to be "gradable." I argued that the core insight of approaches that analyze gradable predicates as degree functions is that they express Krantz-measure functions. Measure functions denote order-preserving mappings between individuals and degrees. Hence the domain of gradable predicates needs to be orderable with respect to the scale specified by the predicate. *Many* was argued to be just a special case. It expresses the 'cardinality of' measure function. The individuals that can be measured in this way are pluralities. Specific to *many* is that it is a gradable determiner rather than a predicate. It takes two predicative arguments and returns a truth-value. Both predicative arguments of *many* have to range over pluralities. They need to be *-ed.

(323) $[\![\textit{many}]\!] = \lambda d \in D_{Card}.\lambda {}^*f \in D_{\langle e,t\rangle}.\lambda {}^*g \in D_{\langle e,t\rangle}.\exists x\, {}^*f(x) = {}^*g(x) = 1$ & x has d-many atomic parts in f.

This predicts that the predicative arguments of *many* need to be flagged in whichever way a language flags *-ed predicates. For English, plural morphology on nouns encodes the *-operator. This results in a principled account for the fact that NP arguments of comparative determiners need to be plural in English. The proposal furthermore, requires that each predicative argument of *many* ranges over pluralities that can be counted in terms of the same kinds of atomic individuals. This accounts for predicate-predicate restrictions with comparative determiners observed in Winter(1998). Finally, since the core of all amount comparative constructions is given by the same gradable determiner function *many* – comparative determiners are a special case – it is expected that amount comparatives as whole display exactly the same need that the NPs and VPs are *-ed as well as the same predicate-predicate restrictions. This massive parallelism between amount comparatives and comparative quantifiers is not expected unless they share fundamental similarities that are expressed in the syntax in essentially the same ways. I.e. the surface similarity between comparative quantifiers and various amount comparative constructions should be taken as a reflection of a deep/structural similarity and therefore support a uniform treatment. The work presented in this thesis hopefully provides the beginnings of a uniform analysis that analyses all constructions as comparative constructions. More specifically, comparative determiners like *more than three* are decomposes into three parts: a degree function *many,* a comparative operator *–er* and a measure phrase *three.* All three pieces have been shown to interact partially independently with material outside of the determiner. These findings strongly support a decompositional analysis. Future research has to show how the treatment of *more than three* can be extended to cover more complicated comparative determiners like *more than half* as well as amount comparatives like *more books than Bill*.

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