Amount Superlatives and Measure Phrases

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AMOUNT SUPERLATIVES AND MEASURE PHRASES

by

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This manuscript has been read and accepted for the Graduate Faculty in Linguistics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

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E. Cameron Wilson

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This dissertation provides a novel analysis of quantity superlatives by bringing together research on three interrelated topics: superlative ambiguity, semantic constraints on measure constructions, and the internal structure of the extended nominal phrase. I analyze the quantity words, most, least, and fewest as superlatives of quantificational adjectives (Q-adjectives), but argue that these are often embedded inside a covert measure construction, rather than directly modifying the overt noun. I also introduce novel data showing that the measure phrases that appear in overt pseudopartitive constructions have more complex internal structure than previously assumed. Specifically, they may contain adjectives, including superlative inflection in which case a definite article may introduce the measure phrase. The question of how superlative morphology is interpreted inside a measure phrase opens the door to a new analysis of measure nouns and measure pseudopartitive constructions. This approach is then applied to the analysis of quantity superlatives as covert measure pseudopartitives. The result is a model that accounts for the difference in relative readings available for Q-superlatives and their non-quantificational counterparts in English, with implications for superlative interpretation across languages.
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CONTENTS

1 Introduction .................................................................................................................................................. 1

2 Some Issues with Superlatives and Measure Constructions ................................................................. 2

  2.1 Superlatives ........................................................................................................................................... 9
      2.1.1 The absolute reading ...................................................................................................................... 9
      2.1.2 Relative readings – the movement approach .............................................................................. 14
      2.1.3 Relative readings – the in situ approach ..................................................................................... 18
      2.1.4 NP-internal relatives and a combined approach ....................................................................... 25
      2.1.5 Quantificational superlatives .................................................................................................... 33
      2.1.6 Problems with combined approach for most/least/fewest .................................................... 37

  2.2 Measure Pseudopartitites .................................................................................................................... 41
      2.2.1 Two types of measure phrase ....................................................................................................... 41
      2.2.2 Semantic properties of measure pseudopartitives .................................................................... 47
      2.2.3 Problems with monotonicity / extensivity ............................................................................. 53
      2.2.4 Complexity of measure phrases ............................................................................................... 57
      2.2.5 The NP-internal relative reading of superlative measure phrases ...................................... 68

  2.3 Chapter Summary.................................................................................................................................. 69

3 Measure Pseudopartititives Proposal ........................................................................................................ 72

  3.1 Partitive MON head ............................................................................................................................. 74

  3.2 Dimensions and the ontology of parthood and scales ....................................................................... 77
3.2.1 Dimensions ................................................................. 78
3.2.2 Scales ........................................................................... 79
3.2.3 Measure functions ......................................................... 81
3.2.4 Numbers versus cardinality degrees .............................. 82
3.2.5 Domains, sorts and dimensions in mereology .................... 83
3.3 Partitive semantics of measure constructions (first pass) ............ 85
  3.3.1 Measure nouns .............................................................. 86
  3.3.2 Full measure phrases .................................................... 87
  3.3.3 Composition of MONP .................................................. 90
3.4 Dimensional parthood ....................................................... 93
  3.4.1 Moving towards a notion of “relevant part-whole relation” ..... 95
  3.4.2 Formal definition of dimensional parthood ....................... 99
3.5 Partitive semantics of measure constructions (revised) ............... 101
3.6 Chapter summary .............................................................. 104

4 Q-superlatives Proposal .......................................................... 107
  4.1 Q-superlatives as covert Measure Phrases .......................... 110
    4.1.1 Q-adjectives and AMOUNT .......................................... 110
    4.1.2 Syntax for deriving NP-internal reading ......................... 114
    4.1.3 Agreement mismatch in Flemish .................................... 118
  4.2 Semantics of q-superlatives .............................................. 121
    4.2.1 The meaning of q-adjectives and AMOUNT .................... 122
    4.2.2 Q-adjectives in a covert pseudopartitive ....................... 124
4.2.3 Deriving NP-internal readings for q-superlatives ................................128

4.3 The covert structure and non-q-superlatives .....................................136

4.3.1 Constraint on adnominal adjectives ..............................................136

4.3.2 Adnominal adjectives and AMOUNT ..........................................141

4.4 Implications and Limits of the Proposal ...........................................143

4.5 Chapter Summary .............................................................................145

5. Conclusion .........................................................................................147
LIST OF FIGURES

1 Cupcakes A - D ........................................................................................................ 10
2 Cupcakes A - E ........................................................................................................ 22
3 Mini-cupcakes ...................................................................................................... 26
4 Cupcake Lattice .................................................................................................. 34
5 Most Cupcakes ..................................................................................................... 36
6 More Mini-cupcakes ............................................................................................. 38
7 Two cupcakes is non-cumulative ......................................................................... 48
8 A 12-oz. bottle of room-temperature (70°F) water ............................................ 49
9 Some water in a bottle (with a portion of water, b, outlined) ............................... 53
10 Some water in a bottle (divided vertically) ............................................................. 56
11 Pepper Dimensions ............................................................................................. 78
12 Scale for length .................................................................................................... 80
13 Numbers versus Cardinality Degrees .................................................................. 82
14 Individuals in the set ounce .................................................................................. 86
15 Scale for TIME ..................................................................................................... 87
16 Twelve Ounces ..................................................................................................... 89
17 One inch of water in a bottle (divided vertically) ................................................... 94
18 Length-parts of a pickled pepper ......................................................................... 98
19 Length-part b of pickled pepper a ....................................................................... 99
20 Parts of a pickled pepper – including length-parts and non-length-parts. .......... 102
21 Three underlying structures for adnominal superlatives .................................. 134

1 All images are by the author—in some cases using modified stock photographs (credits on page 153).
## LIST OF TABLES

1. Definite Superlatives ................................................................. 40
2. Indefinite Superlatives ............................................................. 40
Chapter 1

Introduction

This dissertation takes a fresh looks at the syntax and semantics of quantity superlatives (Q-superlatives) in order to solve a puzzle about their relative readings. Data presented here show a conspicuous difference in the range of relative readings that is available for these in English, in contrast to the superlatives of other adjectives—a distinction which cannot be accounted for on existing approaches. I follow Bresnan (1973), Hackl (2009) and others in analyzing *most, least* and *fewest* as superlatives of adjectival *much, many, little* and *few*. But I argue that these are often embedded inside a covert measure construction, rather than directly modifying the overt noun. In order to account for the interpretation of superlative morphology inside measure phrases, I first propose a new analysis with an individual-based semantics for measure nouns. Measure pseudopartitives are treated like ‘true’ partitives, with a functional head that asserts a mereological relationship between two entities. This approach is then applied to the analysis of quantity superlatives as covert measure pseudopartitives. The resulting model explains the difference in relative readings available for Q-superlatives and their non-quantificational counterparts in English, and has implications for superlative interpretation across languages.

A puzzle

The research presented here grew out of a puzzle concerning the ‘NP-internal relative reading’—a type of relative reading first described by Pancheva and Tomaszewicz (2012) for Slavic
languages. In English, definite-marked constructions with adnominal Q-superlatives give rise to both NP-external and NP-internal relative readings, while non-Q-superlatives never produce NP-internal relative readings. The type of reading in question is illustrated in (1) where capitalization indicates a focusing pitch-accent on the noun *almonds*. Shifting the focus to the subject, as in (2), gives rise to a different relative reading.

(1) Lara ate the most ALMONDS.  
(2) LARA ate the most almonds.  

The first is ‘NP-internal’ because the focused element is inside the same nominal phrase that contains the superlative. The second has focus on an element external to that constituent. In either case, the focus facilitates a reading on which the degree associated with the focused constituent is compared to the degree associated with relevant alternatives. The first sentence is true just in case the amount of almonds that Lara ate is greater than the amount that she ate of any other nuts (or other relevant snack). The second sentence is true just in case Lara ate a greater amount of almonds than any other relevant person did.

The puzzling fact is that if *most* is replaced with the superlative of a non-quantity adjective in these sentences, the NP-internal relative reading is no longer available:

(3) Lara ate the biggest ALMONDS.  
(4) LARA ate the biggest almonds.  

The focus in on *Lara* in sentence (4) has the expected effect. It gives rise to a reading on which the almonds that Lara ate were bigger than the almonds anyone else ate. But the focus on *almonds* in sentence (3) feels unnatural. A possible interpretation is the hyperbolic use of the
superlative—Lara ate some almonds that were the absolute biggest that one could imagine. The focus then can be read as contrastive, and might sound natural in a context where it is important to clarify that it is almonds and not any other type of nuts that we are talking about. But the relative reading that parallels that of (1) is not available. Sentence (3) cannot be interpreted as asserting that the size of the almonds Lara ate was greater than that of any other nuts that she ate.

The NP-internal reading is also possible with fewest, and least as illustrated in (5), but again it disappears in the minimally different sentences with size or quality adjectives in (6).

(5)   a. Out of all the desserts, Lara bought the fewest CUPCAKES.
       b. Of all the sugars, Lara used the least MAPLE SYRUP.

(6)   a. Out of all the desserts, Lara bought the smallest/roundest CUPCAKES.
       b. Of all the sugars, Lara used the darkest/tastiest MAPLE SYRUP.

What distinguishes those relative readings that are exclusively possible with Q-superlatives from those that are possible across the range ofgradable adjectives, is the fact that the focused element is internal to the DP that contains the superlative morpheme. The focus may appear on any element inside this constituent, such as the adjective in (7) or the prepositional phrase in (9). The three superlatives most, least, and fewest are the only ones that give rise to this NP-internal relative reading in English:

(7)    Sunni ate [the most CHOCOLATE cake].
       ‘The amount of chocolate cake that Sunni ate was greater than the amount of any other variety of cake that he ate.’

(8)    Sunni ate [the tastiest/best/biggest CHOCOLATE cake].
       # ‘The tastiness/quality/size of chocolate cake that Sunni ate was greater than that of any other variety of cake that he ate.’
Rowan has read [the fewest science fiction books by ASIMOV].

‘The number of sci-fi books by Asimov that Rowan has read is less than the that of books by any other author that he has read’

Rowan has read [the shortest/worst science fiction books by ASIMOV].

# ‘The length/quality of books by Asimov that Rowan has read is less than that of sci-fi books by any other author that he has read.’

Straightforward attempts to combine the semantics of Q-adjectives with either the movement or the in situ theory of superlatives make the wrong predictions about internal relative readings for English. An approach along the lines of Szabolczi (1986), which assumes free movement of the superlative morpheme, overgenerates. It incorrectly predicts that the NP-internal relative reading should be available with size and quality superlatives as well as with Q-superlatives. On the other hand, an approach that assumes more constrained movement, like that of Pancheva and Tomaszewicz (2012), undergenerates. The focus association required for this reading to compose in situ on such an approach should be blocked by the definite article. This means that the NP-internal relative reading is expected to be unavailable no matter what kind of adjective the superlative is attached to.

To explain how the reading is derived just in those cases where the superlative is attached to a Q-adjective, I will argue for a novel syntax for these constructions. The structure I propose is based on that of measure pseudopartitives such as a small handful of nuts or three ounces of cake.

A partitive semantics for measurement

In attempting to account for the interpretation of superlatives inside measure phrases, I found it necessary to rethink existing models of (overt as well as covert) measure constructions. The new
proposal that comes out of this research is presented in chapter 3. A central problem is accounting for how the pseudopartitive construction relates scales that are based on onedimensional size comparisons (height, width, length etc.) to three-dimensional objects. A related problem concerns the application of this type of measurement construction to non-spatial dimensions such as time, temperature and even something as abstract as information.

I propose a novel approach on which measure nouns denote properties of individuals, rather than functions to degrees or scalar intervals. Using Krifka’s (1989) notion of ‘sorts’, I distinguish between semantic categories of individuals depending on which dimensions they extend along. Things that are of the same sort may participate in mereological parthood relations with each other. Parthood itself is understood to be parameterized for one of those dimensions, and the functional head that is spelled out by of in partitive and pseudopartitive constructions encodes this relationship.

Solving the puzzle

The model for measure pseudopartitives that I propose is extended to the analysis of Q-superlatives. When a quantity superlative (most, least, or fewest) is introduced by a definite article in English, I argue, it modifies a silent measure noun within a measure pseudopartitive structure. This presence of this silent element was first proposed by Kayne (2002, 2005) and it helps to explain differences in the distribution of Q- and non-Q-adjectives in English. I also present evidence from determiner-agreement in Flemish that serves to ‘make visible’ the silent measure noun. I adopt an in situ approach to relative readings, based on Heim (1999). This comes with the parsimonious assumption that the appearance of definite-marking has real and consistent semantic and syntactic effects. As part of an independent sub-constituent, the
superlative morpheme has its comparison class argument valued in situ by focus association. This analysis makes the correct predictions about available internal and external relative interpretations.

**Overview**

The dissertation is organized as follows: Chapter 2 is divided into two main sections. The first half reviews the major approaches to relative readings of superlative adjectives and presents the problem of NP-internal relative readings in English for both of these approaches. The second half focuses on pseudopartitive measure constructions. Of particular interest is the phenomenon of ‘monotonicity’ (Schwarzschild, 2002, 2006) which is shared between these constructions and Q-adjective constructions. This is in contrast to attributive measure constructions and non-quantificational adjectives which are ‘non-monotonic’. I also present new data showing that in the pseudopartitive construction, adjectives can appear as modifiers of measure nouns. These constructions include definite-marked measure phrases containing superlative adjectives. I conclude that a new approach to these measure constructions is called for.

Chapter 3 presents such an approach. Measure nouns are assumed to be sets of individuals—making their modification by adjectives straightforward. I propose that the pseudopartitive construction has ‘truly’ partitive semantics. Mereological parthood is parameterized for a dimension, and the ‘monotonic’ quality of measure pseudopartitives falls out from this dimensional parthood relationship. A constraint on the relationship between adjectives and nouns inside measure phrases is identified.

Chapter 4 returns to the problem of NP-internal relative readings of most, least and fewest. I argue that these readings are made possible by a covert pseudopartitive structure in
which the Q-adjectives modify a silent measure noun, AMOUNT. The constraint from Chapter 3 is used to explain why non-Q-adjectives cannot participate in this covert construction, and hence cannot generate the NP-internal readings in English. By insisting on a theory of superlatives that can account for these readings, I shed new light on the structure of DPs and the peculiar semantics of Q-adjectives. The nagging puzzle—how a particular relative reading is possible for just three words, most, least, and fewest—has important consequences for the structure of the extended noun phrase in English and for the analysis of overt measure phrases. Chapter 5 concludes.
Chapter 2

Some Issues with Superlatives and Measure Constructions

The proper treatment of quantification in natural language has been the preoccupation of semanticists for as long as the discipline has existed in modern times. This dissertation seeks to contribute to the endeavor by investigating some unexpected consequences of the interaction of superlative semantics with quantificational adjectives in English. The topic of superlatives is quite far reaching by itself, having implications for focus semantics, the meaning of the definite article and constraints on movement out of DP. We will also need to consider another type of quantified expression—measure pseudopartitives. Although our interest is primarily in constructions that have Q-adjectives inside the DP, we observe that the wider distribution of much/little, and many/few closely follows that of measure phrases like five pounds or two thirds. This suggests that a key to the unusual behavior of most, least and fewest may be found in an examination of measure constructions—indeed, I will argue that this is the case.

In this chapter, I will lay the foundation for a solution to the problem in NP-internal relative readings of most, least, and fewest by reviewing the relevant literature on each of these topics in turn. In the first section I discuss existing theories of superlatives. The two dominant approaches to relative versus absolute readings are compared, and a third approach is considered. This approach makes both derivations available in principle, modulo the presence of overt definite
marking. This theory holds promise, but as it stands, it cannot account for the relative readings of quantificational superlatives in English and similar languages.

In the second half of this chapter I consider the literature on measure phrases, in particular various approaches to constraints on the measure pseudopartitive construction. I motivate this shift by showing that quantity adjectives such as many and little closely mirror the syntax and semantics of full measure phrases. After observing the varying degrees to which existing approaches successfully account for these constraints, I introduce some new data that further indicate the need for a new way of modeling these constructions. I demonstrate that full measure phrases are syntactically full DPs, and include even more sub-structure (and accompanying semantic complexity) than what has previously been described. Pseudopartitive measure constructions allow for modification of the measure noun by both bare and superlative adjectives. Importantly, superlative pseudopartitive measure constructions also give rise to something like the NP-internal relative reading. In Chapter 3 I propose an analysis of these constructions that solves some problems that previous approaches have encountered, and easily allows for the full range of syntactic and semantic complexity, including the superlative examples.

2.1 Superlatives

There has been much attention given in the semantic literature to the relative vs. absolute readings of adjectival superlatives and, more recently, of the quantifier most as a kind of superlative (Heim, 1985, 1999, 2001; Szabolcsi 1986, 2012; Farkas & Kiss, 2000; Sharvit & Stateva, 2002; Hackl, 2009).
To illustrate these readings, let us consider a set of scenarios with at most four relevant cupcakes (shown in Figure 1), three relevant people (Jamie, Paul and Kerry) and three relevant days (Tuesday, Wednesday and Thursday).

![Figure 1: Cupcakes A - D](image)

The sentence in (11) has three possible interpretations, as paraphrased in (a-c) using the comparative.

(11)  *Jamie ate the biggest cupcake on Tuesday.*

   a. “Jamie ate a cupcake on Tuesday that was bigger than any other cupcake.”  *absolute*

   b. “Jamie ate a bigger cupcake on Tuesday than Paul or Kerry.”  *(ext) relative*

   c. “Jamie ate a bigger cupcake on Tuesday than on Wed. or Thurs.”  *(ext) relative*

The absolute reading (11a) compares cupcakes with respect to the degree of their size. The identification of the direct object in the sentence is not contingent on who the eaters are or when they were eaten. There is one absolute biggest cupcake (D), and the sentence asserts that Jamie ate it on Tuesday. The truth conditions of the relative readings are clearly different. For (11b), the reading which is facilitated by stress on *Jamie*, the sentence will be true or false depending on who ate which cupcake on Tuesday. For (5c), which is helped by stress on *Tuesday*, it is dependent on which cupcake Jamie ate on which day. There are two different theories of what exactly those truth conditions are and how they are derived.
The so-called *in situ* approach (Heim 1999; Farkas & Kiss 2000; Sharvit and Stateva 2002) takes the different readings to be primarily the result of context dependency. What is being compared is always cupcakes, but the subset of cupcakes under consideration varies depending on context. The location of a focus operator plays an important role in disambiguation, while the superlative morpheme itself remains inside the DP at LF.

The movement approach (Szabolcsi 1986) derives the different readings from syntactic ambiguity; there are multiple possible LF structures for (11), and in each one the superlative morpheme takes a different constituent as its external argument. The subject-relative reading (11b) compares not cupcakes but people, asserting that Jamie is the one associated with the highest degree of cupcake size eaten on Tuesday. The adjunct-relative reading (11c) compares days of the week, asserting that Tuesday is the day of the week associated with the highest degree of cupcake size eaten by Jamie. The variation in external argument is derived by the superlative morpheme raising out of the DP at LF.

After discussing the mechanics of the absolute readings, I review the movement approach in section 2.1.2. Then I lay out the *in situ* approach to relative readings and make an initial comparison of the two approaches in Section 2.1.3. Section 2.1.4 introduces the NP-internal relative reading and reviews Pancheva & Tomaszewicz’s (2012) combined approach, which accounts for the wide availability of this reading in Slavic languages. The last two subsections add quantificational superlatives into the picture with a discussion of Hackl’s (2009) treatment of sentences with *most* and *fewest* as superlatives of *many* and *few*. I show that even Pancheva and Tomaszewicz’s combined (movement and *in situ*) approach is insufficient to account for the English data when quantificational *most, least, and fewest* are considered.
2.1.1 The absolute reading

The absolute reading is treated similarly by both the movement and in situ approaches. Heim (1999) proposes the following denotation for the superlative morpheme, which has since been widely adopted:

\[
\text{[SUP]}(C)(R)(x) = 1 \text{ iff } \exists d(R(d)(x) & \forall y[y \neq x & y \in C \rightarrow \neg R(d)(y)])
\]

(there exists a degree, \(d\), such that \(x\) has the property, \(R\) to that degree, and for all \(y\), if \(y\) does not equal \(x\), and \(y\) is in the comparison set, \(C\), then \(y\) does not have the property \(R\) to degree \(d\).)

The comparison class argument, \(C\), is a set of type \(<e,t>\) which limits the domain of \([\text{SUP}]\) to those things (e.g. the cupcakes in Fig. 1) that are relevant in context. The second argument, \(R\), represents a property of type \(<d,<e,t>>\). On the absolute reading, \(R\) is saturated by the adjective-noun complex. Adjectives are assumed to be downward-scalar, mapping an individual to a degree such that it has the property in question to ‘at least’ that degree. The superlative (together with its restrictor, \(C\)) must sub-extract from the Degree Phrase and raise to a position inside the DP where it takes the noun in its scope.

Heim (1999) points out that, intuitively, the superlative carries the presuppositions that (i) \(x\) is a member of \(C\); (ii) there is at least one member of \(C\) other than \(x\) and (iii) all elements in \(C\) must be able to be mapped to some degree by the property \(R\). In our example, all the elements in \(C\) must be cupcakes with some degree of size, \(C\) must contain the thing Jamie ate, and it must contain at least one other thing. The definition of \([\text{SUP}]\) is revised to include these presuppositions in (13):

\[
\text{[SUP]} = \lambda C \lambda R \lambda x: x \in C \& \exists y \in C[y \neq x] \& \forall y[y \in C \rightarrow \exists d[R(d)(y)]] \Rightarrow \exists d[R(d)(x) \& \forall y[y \neq x \& y \in C \rightarrow \neg R(d)(y))]
\]

(presupposition) (assertion)
The LF of Jamie ate the biggest cupcake on its absolute reading is shown in (14). The semantic composition of the DP is given in (15).

(14)

(15) \[
\begin{align*}
\text{AP} &= \lambda d \lambda x [\text{size}(x) \geq d] \\
[\text{DegP}] &= [\text{AP}]([\text{Deg}]) = \lambda x [\text{size}(x) \geq t_1] \quad \text{by FA} \\
[\text{NP}_1] &= \lambda x [\text{cupcake}(x)] \\
[\text{NP}_2] &= \lambda x [\text{cupcake}(x) \land \text{size}(x) \geq t_1] \quad \text{by PM} \\
[\text{NP}_3] &= \lambda d \lambda x [\text{cupcake}(x) \land \text{size}(x) \geq d] \quad \text{by PA} \\
[\text{C-SUP}] &= \lambda R \lambda x \exists d (R(d)(x) \land \forall y [y \neq x \land y \in C \rightarrow \neg R(d)(y)]) \quad \text{definition} \\
[\text{NP}_4] &= [\lambda R \lambda x \exists d (R(d)(x) \land \forall y [y \neq x \land y \in C \rightarrow \neg R(d)(y)]) ([\text{NP}_3])] \\
&= \lambda x \exists d [\text{cupcake}(x) \land \text{size}(x) \geq d] \land \forall y [y \neq x \land y \in C \rightarrow \neg \text{cupcake}(y) \land \text{size}(y) \geq d]] \quad \text{by FA} \\
[\text{DP}] &= \lambda x : \exists d [\text{cupcake}(x) \land \text{size}(x) \geq d] \land \forall y [y \neq x \land y \in C \rightarrow \neg \text{cupcake}(y) \land \text{size}(y) \geq d]] \\
\end{align*}
\] (the unique individual x, such that x is a cupcake and there is some degree, d, to which it is big, and there is no cupcake y distinct from x in C, that reaches that degree of size)

The only cupcake in Figure 1 that satisfies the property of having a unique degree of bigness is cupcake D. This is because each of the other cupcakes reaches a degree of bigness that is also
achieved by D, due to the downward scalarity encoded in the adjective. The rest of the derivation is straightforward and is shown in (16).

\[(16) \quad \Box V P = \lambda y \text{[ate]}(x)(\forall x: \exists d[[\text{cupcake}(x) \land \text{size}(x) \geq d] \land \forall y[y \neq x \land y \in C \rightarrow \neg[\text{cupcake}(y) \land \text{size}(y) \geq d]])] \quad \text{by FA}
\]

\[\Box I P = [\text{ate}(j)(\forall x: \exists d[[\text{cupcake}(x) \land \text{size}(x) \geq d] \land \forall y[y \neq x \land y \in C \rightarrow \neg[\text{cupcake}(y) \land \text{size}(y) \geq d]])] \quad \text{by FA}
\]

The DP saturates the theme role of \textit{ate} and \textit{Jamie} saturates the agent role. On its absolute reading, the truth conditions of the full sentence depend on whether or not \textit{Jamie} ate that particular cupcake.

2.1.2 Relative readings – the movement approach

On Szabolcsi’s approach, the relative readings (11b&c) are derived by covert movement of the superlative morpheme to a position outside of the DP in which it is pronounced (Szabolcsi, 1986). In this higher position it takes the subject or adjunct of the sentence (\textit{Jamie} in 11b and \textit{on Tuesday} in 11c) as its external argument. This derivation requires that the definite article introducing the DP be treated as vacuous or as an allomorph of the indefinite article.\footnote{Szabolcsi’s original derivation had \textit{the} move with the superlative morpheme (while the adjective stays low). But since these do not form a constituent, Heim (1999) and other since have assumed instead that the movement approach should treat the definite article as “semantically vacuous” or else replaced by an existential quantifier. The question of definiteness and violation of island constraints will be explored in detail in section 2.3.} The semantic composition depends on the assumption that the DP in which the superlative appears is existential rather than referential. One way to achieve this is for the overt definite article to be
replaced by a silent counterpart of the indefinite article $A$, so that the DP is a quantifier phrase of type $<<e,t>,t>$. 

The LF of *Jamie ate the biggest cupcake* on this approach is shown in (17). The superlative DP QRs, and the superlative (with its comparison class argument) moves out of it to adjoin to the clause, creating constituent, $(IP_6)$ that denotes a complex superlative property. Finally, the subject itself raises to adjoin to this IP and is combined with the whole clausal superlative property by functional application.

(17)

$$
\begin{array}{c}
\text{Jamie} \\
\text{[C-SUP]} \\
1 \\
3 \\
\text{DP} \\
\text{the} = A \\
\text{NP}_2 \\
\text{DP} \\
2 \\
\text{IP}_1 \\
\text{VP} \\
\text{NP}_1 \\
\text{cupcake} \\
\text{AP} \text{deg} \text{big} \\
\text{Deg} \\
\text{t}_1
\end{array}
$$

(18)

$$
\begin{align*}
[VP] &= \lambda y [\text{ate}(t_2)(y)] \\
[IP_1] &= [\text{ate} (t_2)(t_3)] \\
[IP_2] &= \lambda x [\text{ate} (x)(t_3)] \\
[\text{NP}_1] &= \lambda x [\text{cupcake}(x)] \\
[\text{DegP}] &= \lambda x [\text{big}(t_1)(x)] \\
[\text{NP}_2] &= \lambda x [\text{cupcake}(x) \& \text{big}(t_1)(x)] \\
[A] &= \lambda P \lambda Q \exists x [P(x)\&Q(x)]
\end{align*}
$$

by FA 

by FA 

by FA 

by PA 

by FA 

by PM 

definition
\[ [\text{DP}] = [\lambda]([[\text{NP}_2]]) = \lambda Q \exists x [t_1-\text{big cupcake}(x) \& Q(x)] \quad \text{by FA} \]

\[ [\text{IP}_3] = [[\text{DP}_2]]([\text{IP}_2]) = \exists x [t_1-\text{big cupcake}(x) \& \text{ate}(x)(t_3)] \quad \text{by FA} \]

\[ [\text{IP}_4] = \lambda y \exists x [t_1-\text{big cupcake}(x) \& \text{ate}(x)(y)] \quad \text{by PA} \]

\[ [\text{IP}_3] = \lambda d \lambda y \exists x [d-\text{big cupcake}(x) \& \text{ate}(x)(y)] \quad \text{by PA} \]

\[ [\text{C-SUP}] = \lambda R \lambda x \exists d (R(d)(x) \& \forall y[y \neq x \& y \in C \rightarrow \neg R(d)(y)) \quad \text{definition} \]

\[ [\text{IP}_6] = [\lambda R \lambda x \exists d (R(d)(x) \& \forall y[y \neq x \& y \in C \rightarrow \neg R(d)(y)] ([\text{VP}_4]) \]

\[ = \lambda x \exists d [\exists z [\text{ate}(z)(x) \& d-\text{big cupcake}(z)] \]

\[ \& \forall y[y \neq x \& y \in C \rightarrow \neg \exists z [\text{ate}(z)(y) \& d-\text{big cupcake}(z)] \] \quad \text{by FA} \]

\[ [\text{IP}_7] = \exists d [\exists z [\text{ate}(z)(\text{Jamie}) \& d-\text{big cupcake}(z)] \\
\& \forall y[y \neq x \& y \in C \rightarrow \neg \exists z [\text{ate}(z)(y) \& d-\text{big cupcake}(z)]] \quad \text{by FA} \]

The sentence with this LF will be true just in case there is a degree, d, such that there exists a thing that Jamie ate which is a d-big cupcake, and for all other individuals in the comparison class it is not the case that there exists a thing that they ate that is a d-big cupcake. The comparison class is constrained (by the presupposition of SUP) to contain Jamie and at least one other individual, and to contain only (relevant) individuals who have the property of having eaten something which is a cupcake of some degree of bigness. In other words, it will be true in the scenario described above, where Jamie eats cupcake A (which reaches a particular degree of bigness, d) and his brothers eat cupcakes B and C, which do not reach that size.

When an element other than the subject is the point of comparison, then the subject remains low, and the adjunct QRs in order to serve as the external argument of the superlative.

This approach has been argued to have wider empirical coverage, especially with respect to the “upstairs de dicto” reading which we will discuss below. Hackl (2009) and Solt (2011) adopt the movement approach for the relative readings of Q-superlatives.
The movement approach depends on the assumption that the definite article, the, is semantically vacuous – replaced in the derivation with an existential quantifier. This serves two purposes, it makes the DP transparent for extraction of the superlative morpheme and, once the appropriate LF is generated, it is also necessary to generate the correct truth conditions. If the remnant DP had definite semantics, as in (19), the meaning would still compose to give the absolute reading, asserting that Jamie was the one out of his friends who ate the absolute biggest cupcake.

(19)  a. [Jamie [C-sup 1 [ ate [tx d-big cupcake (x)]]]]

\[\lambda y.\text{ate}(tx: t_1 -\text{big cupcake}(x))(y)\]

\[\lambda d \lambda y.\text{ate}(tx: d -\text{big cupcake}(x))(y)\]

\[\lambda y \exists d \text{ate}(tx: (d -\text{big cupcake}(x))(y) \land \forall z[y \neq z \& z \in C \rightarrow \neg \text{ate}(tx: (d -\text{big cupcake}(x))(z)\]

\[\exists d \text{ate}(tx: (d -\text{big cupcake}(x))(j) \land \forall z[y \neq z \& z \in C \rightarrow \neg \text{ate}(tx: (d -\text{big cupcake}(x))(z)\]

Szabolcsi demonstrates that, although they are overtly definite-marked, superlative DPs behave like indefinites according to a number of diagnostics. But treating the definite article as vacuous or replacing it with an indefinite article begs the question, why is this marking obligatory in English? Or to put it another way, why does the overt substitution of a for the shown in (20) not give rise to the relative reading?

(20)  #JAMIE ate a biggest cupcake.

This would seem to be a more transparent phonological realization of the semantics proposed on the movement approach, but it is instead a marked form. It can be interpreted in certain
contexts\textsuperscript{3}, but does not give rise to the (relative) truth conditions derived in (18). An advantage of in situ approaches, one version of which we will discuss next, is that they dispense with the problematic stipulation that definite-marking in superlatives is vacuous. However, once it is assumed that the definite article is semantically active in superlatives, more general problems with its precise denotation become relevant. We will consider these problems in section 2.1.4.

2.1.3 Relative readings – the in situ approach

Heim (1999) considers the possibility that the movement theory adds unnecessary machinery to account for variations in meaning that could simply be a result of context dependency. She tests whether variation of the comparison class (C) argument alone can be used to derive the full range of relative readings. Although Heim rejects this approach for reasons discussed below, a variant of it is adopted by Sharvit and Stateva (2002) and it is an important mechanism in Pancheva and Tomaszewicz’s (2012) solution to the problem of Bulgarian superlatives.

In spite of its name, the in situ theory does require some movement. The superlative (with its restrictor) must move within the DP just as it does in the derivation of the absolute reading described above. However, the definite article is assumed to create an island out of which the superlative morpheme cannot extract. Therefore, further movement involving the superlative and its comparison class argument must be movement of the entire DP from within which the superlative is interpreted.

In principle, any set of alternatives that is salient in the discourse may serve to value C, but Heim shows that focus can force the salience of a particular set of alternatives and so play a

\textsuperscript{3} See, e.g. Herdan & Sharvit (2006) and Coppock & Beaver (2014) for discussion of indefinite superlatives in English.
disambiguating role. Her mechanism for restricting C through association with a focus operator is based on von Fintel’s (1994) formulation of Rooth’s (1985, 1992) alternative semantics. Whenever there is a focused element in the sentence, it introduces alternatives of the same type. The focus (F-) value of each constituent containing the focus can be calculated alongside the ordinary (O-) value by substituting in each salient alternative to that constituent and collecting the resulting values in a set. At the point where an operator (~) is merged, it makes the F-value of its sister available as an alternative set for subsequent semantic operations. Heim’s constraint requires that C be a subset of the grand union of the alternative set, S.

To illustrate, the LF for *Jamie ate the biggest cupcake*, with focus on *Jamie*, is given in (21). The superlative DP is raised to be outside the scope of the focus operator. This movement is not triggered by a type mismatch as in QR, but is assumed to be freely available. That said, (21) is the only LF that will converge, because C and ~S must be discontinuous. If DP2 were to remain in situ, then wherever the operator were merged, it would either scope over or be in the scope of C, creating a loop of infinite regress.

(21)

![Diagram of LF for example sentence]

the [C-sup]1 t₁-big cupcake

~ S

2

[Jamie]ₚ ate t₂

DP₁

VP <t>

IP₁ <t>

IP₂ <t>

IP₃ <t>

IP₄ <t>

DP₂ <t>
DP₂ composes here just as it would for the absolute reading, with the superlative morpheme identifying the property of being the cupcake from the comparison class that reaches a unique degree of bigness (see (15) above). The difference is that C itself is now defined in terms of the alternative set, S. The focus operator, merged above IP₂ introduces the presupposition that there is a focus value of IP₂ containing at least one alternative to its ordinary value. And in this scenario, the focus value is the set that includes that property of being something Jamie ate, along with all properties of the same form in which relevant alternatives (Kerry, Paul) are substituted for Jamie. The grand union of this is the set of individuals that are things that someone relevant ate.

(22) Valuation of C

\[
\begin{align*}
\llbracket VP \rrbracket &= \lambda x[ate(t_2)(x)] \\
\llbracket DP_1 \rrbracket_f &= \text{jamie} \\
\llbracket IP_1 \rrbracket_o &= \text{ate}(t_2)(\text{jamie}) \\
\llbracket IP_1 \rrbracket_f &= \{\text{ate}(t_2)(\text{jamie}), \text{ate}(t_2)(\text{paul}), \text{ate}(t_2)(\text{kerry})\} \\
\llbracket IP_2 \rrbracket_o &= \lambda x \text{ ate}(x)(\text{jamie}) \\
\llbracket IP_2 \rrbracket_f &= \{\lambda x \text{ ate}(x)(\text{jamie}), \lambda x \text{ ate}(x)(\text{paul}), \lambda x \text{ ate}(x)(\text{kerry})\}
\end{align*}
\]

\[S \subseteq \{P: \exists y \in \{\text{jamie, paul, kerry}\} \land P = \lambda x[\text{ate}(x)(y)]\}\]

\[C = \cup S \subseteq \{x: \exists P \exists y \in \{\text{jamie, paul, kerry}\}[P(x) \land P = \lambda x[\text{ate}(x)(y)]\}\}\]

C must also still satisfy the presuppositions of SUP, (23), in order for the superlative to be defined.

(23) Presupposition of \([\llbracket SUP \rrbracket]\)

\[x \in C \land \exists y \in C[y \neq x] \land \forall y[y \in C \rightarrow \exists d(d-\text{big cupcake}(y))]\]

(x and at least one other thing are in the comparison class, C, and everything in C is a cupcake of some size.)
The only choice for C that will lead to a converging derivation is a set of cupcakes of some size that someone relevant ate. This is equivalent to the cupcakes in Figure 1 minus any of them that was not eaten by a relevant person. The DP will compose to denote the unique cupcake that is the biggest one out of those cupcakes Jamie, Kerry and Paul ate.

\[
\llbracket \text{DP}_2 \rrbracket = \lambda x: \exists d \left[\text{cupcake}(x) \land \text{big}(x) \geq d \land \forall y [y \neq x \land y \in C \rightarrow \neg \text{cupcake}(y) \land \text{big}(y) \geq d] \right]
\]

Where \( C \subseteq \{x: \exists d [\text{cupcake}(x) \land \text{big}(x) \geq d \land \exists P \exists y \in \{\text{jamie, paul, kerry}\} [P(x) \land P = \lambda x [\text{ate}(x)(y)]]\} \)

The ordinary value of \( \text{IP}_2 \) is passed up to \( \text{IP}_3 \) and predicated of the DP:

\[
\llbracket \text{IP}_3 \rrbracket = \llbracket \text{IP}_3 \rrbracket (\llbracket \text{DP}_2 \rrbracket) = \lambda x [\text{ate}(x)(\text{jamie})](\lambda x: \exists d \left[\text{cupcake}(x) \land \text{big}(x) \geq d\right] \ldots)
\]

The sentence will be true in case Jamie ate the unique cupcake that is the biggest of those anyone relevant ate.

**Comparison of the two approaches**

Several scenarios have been discussed in the literature as problematic for either the in situ or the movement account. The movement approach has problems whenever there is not a one-to-one relationship between superlative objects and agents, whereas the in situ approach is challenged by the existence of multiple objects that map to a single maximal degree. Some of these scenarios depend on subtle judgments, where one approach predicts infelicity while the other predicts falsehood. Let us consider the subject-relative reading of sentence (26). The verb has been changed for reasons that will become apparent. The truth conditions under the movement and in situ accounts are given in (a) and (b) respectively.
(26) Jamie photographed the biggest cupcake.

\[
\begin{align*}
\text{a. } & \exists d \exists z [\text{photographed}(z)(j) \land \text{d-big cupcake}(z)] \\
& \land \forall y [y \neq x \land y \in C \rightarrow \neg \exists z [\text{photographed}(z)(y) \land \text{d-big cupcake}(z)]] \\
& C \subseteq \{x: x \text{ is a relevant person}\} \\
\text{b. } & \text{photographed}(x) \exists d [\text{d-big cupcake}(x) \land \forall y [y \neq x \land y \in C \rightarrow \neg [\text{d-big cupcake}(y)])(j) \\
& C \subseteq \{x: \exists y \in \{y: y \text{ is a relevant person}\} \land [\text{photographed}(y)(x)]\}
\end{align*}
\]

First, let us consider a ‘multiple winners’ scenario. If Jamie and Kerry both photographed cupcake A, and Paul photographed cupcake B or C then, the truth conditions of the movement approach (26a) predict the sentence to be false. These truth conditions require a single individual agent to photograph cupcake of a size that no one else does. The \textit{in situ} truth conditions (26b) do not, and are satisfied as long as Jamie photographed cupcake A, regardless of whether anyone else did, too. Sharvit & Stateva argue that the oddness of a statement like (26) in this type of scenario is due to an additional implicature introduced by focus on the subject. Uniqueness of the photographer is not part of the assertion, but there is an implicature that all of the other alternative assertions in the focus set are false. Implicatures can be cancelled, however, and the sentence is, in fact, salvageable, as shown in (27). This datum seems to favor the \textit{in situ} approach.

(27) JAMIE photographed the biggest cupcake, but Kerry photographed it too.

Another problem for the movement approach that is raised by S&S is the converse scenario. In this case there is a single agent who is the winner, but multiple objects that reach the same largest degree. Figure 2 shows an additional cupcake, E, that is the exact same size as D. Let us say that in the ‘multiple objects’ scenario, Jamie photographed both D and E. Kerry took pictures of cupcakes A and B, and Paul of cupcake C.
Is sentence (26) true in this scenario? Jamie is the unique photographer associated with the largest degree of cupcake, but there is no unique cupcake associated with that degree. The truth conditions in (26b) are undefined in this scenario because the uniqueness presupposition of *the* is not met. On the movement account, the definite article is replaced by an indefinite, so there is no uniqueness presupposition in (26a). Intuitions vary as to whether the sentence is true or whether it is infelicitous in this case. According to S&S, speakers who find (26) to be true in this scenario are able to construct a comparison class that includes just one of Jamie’s cupcakes. Speakers who include all of the photographed cupcakes in the comparison will find the sentence odd in this scenario. The movement approach predicts no such infelicity so, to the extent that some speakers do find the sentence odd, this datum again supports the *in situ* approach.

Now let us consider a combination of these scenarios that is instead problematic for the *in situ* approach. In this scenario, Jamie took a picture of cupcake D and Paul of the equally large cupcake E. The movement approach straightforwardly predicts that (26) is false, because Jamie’s photographic accomplishment is not associated with a higher degree than anyone else’s. The *in situ* approach predicts the sentence to be infelicitous because the presupposition that there is a unique biggest cupcake is not satisfied. However, in this case it is not possible to construct a comparison class that excludes cupcake E. The problem is perhaps more clearly illustrated by the negated sentence in (28).
(28) Jamie didn’t photograph the biggest cupcake, Paul photographed an equally big one.

Under negation, the presupposition of iota—that there is a unique biggest cupcake—is expected to persist, but instead it is interpreted as part of the assertion being negated. This type of scenario has been used to argue for the movement approach, but it is part of a larger puzzle about the definite article. As with other examples of presupposition disappearance, the intuition that the sentence is false, rather than undefined, could be attributed to something like local accommodation (Heim, 1983). (See Coppock & Beaver, (2014, 2015) for a different approach that severs the existence presupposition from the denotation of the definite article altogether).

Another challenging problem for the in situ account is presented by the ‘upstairs de dicto’ reading of superlatives in sentences with intensional verbs. Imagine that Jamie, Paul and Kerry each has described the size of cupcake they want to have to the baker, Steve. Jamie asked for an 8-oz cupcake while Kerry and Paul each indicated smaller sizes. Steve knows that each of them will be happy with a cake that is at least the size they described, but they would also be satisfied if they get a larger one. He can make the generalization in (29) comparing the desires of the brothers without making reference to any actual cupcake:

(29) JAMIE wants to eat the biggest cupcake.

The movement theory seems to make the correct predictions, supplying the LF in (a) with the truth conditions in (b):

(30) [Jamie [C-sup 1 [ wants [ to eat [x d-big cupcake (x)]]]]]

$$\exists d \left[ \text{wants}_{\text{w1}}(j) \right] P_1 = \left[ \lambda w \exists z[\text{eat}(z)(j) \& d\text{-big cupcake}(z) \text{ in } w] \& \right]$$
$$\forall y[y \neq x \& y \in C \rightarrow \neg \text{needs}(P)(y) \right] P_2 = \left[ \lambda w \exists z[\text{eat}(z)(y) \& d\text{-big cupcake}(z)] \text{ in } w \right]$$
This will be true in all of those worlds in which there exists a degree of cupcake size such that Jamie wants to eat that size of cupcake, and no other person’s wants depend on them eating a cupcake whose size reaches that degree.

By contrast, Heim (1999) concludes that the in situ theory with focus association cannot produce the correct truth conditions. In the survey scenario, there is no specific cupcake such that Jamie wants to eat that particular cupcake, so the biggest cupcake cannot scope over want. There have been various accounts for the upstairs de dicto reading proposed that do not require long movement of the superlative morpheme (Farkas & É. Kiss, 2000; Sharvit & Stateva, 2002). I do not tackle this problem here, but assume that it is not fatal to the in situ approach.

2.1.4 NP-internal relatives and a combined approach

Pancheva and Tomaszewicz (2012) observe that an additional type of reading is available in Slavic languages for superlatives inside indefinite noun phrases. For this type, the focused element and point of comparison is internal to the superlative NP. In English, NP-internal relative readings are only available for the superlatives of Q-adjectives. We will therefore briefly illustrate the readings for sentences with most in English, but save a more thorough discussion of Q-superlatives and the pattern of available readings in English for the end of this section.

To illustrate the NP-internal relative reading, let us revise our cupcake scenario once again. Jamie and his brothers decided to go in on a tray of assorted mini-cupcakes so that they can each sample more than one flavor. They purchased two dozen to share: eight chocolate, eight vanilla buttercream and eight red velvet with cream cheese frosting. Jamie liked the chocolate ones best so he ended up eating three chocolate mini-cupcakes and two each of the other flavors. Figure 3 shows the cupcakes purchased, with those eaten by Jamie circled:
In this situation it seems truthful to say of Jamie:

(31) He ate the most CHOCOLATE mini-cupcakes.
   He ate more chocolate mini-cupcakes than he ate of any other type. (internal relative)

The focus is on an element internal to the superlative NP: the property, chocolate. The salient interpretation is that the sentence is true just in case the number of chocolate mini-cupcakes that the subject ate is greater than the number of any other type of mini-cupcakes he ate. These truth conditions are different from the external relative reading. For example, even if Kerry ate four chocolate cupcakes the sentence would still be true as a statement about Jamie’s behavior, as his three chocolate cupcakes are a greater quantity than the two he ate of either of the other varieties.

In Slavic languages, Pancheva and Tomaszewicz (2012) report that NP-internal readings of superlatives are widely available. Not only Q-adjectives, but also regular gradable adjectives give rise to readings equivalent to that illustrated for most in (31). Bulgarian and Macedonian are especially interesting as they are the only Slavic languages with definite morphology, and this appears to interfere with the internal reading.
While definite marking is available in Bulgarian, it is not obligatory for superlative phrases to be definite marked. Bare singular superlative noun phrases can function as arguments. In such cases, for example in (32), both the NP-internal relative readings (a) and the external relative readings (b) are available.

(32)  
\[
\text{Rado izjade naj-vkusen} / \text{naj-goljam šokoladov tartlet} \quad \text{(Bulgarian)} \\
\text{Rado ate SUP-tasty-M.S / SUP-big-M.S chocolate-M tartlet.M} \\
\quad \text{a. "Rado ate a tastier/bigger chocolate tartlet than he ate of any other flavor" internal} \\
\quad \text{b. "Rado ate a tastier/bigger chocolate tartlet than anyone else ate" external}
\]

The most salient reading is the NP-internal one (a), and this is further facilitated by stress on šokoladov. The external (b) reading arises when stress is moved to Rado.

Definite-marking in Bulgarian takes the form of an apparent suffix, -t/-ta/-to/-te, commonly analyzed as a clitic that attaches phonologically to leftmost element in the NP.\(^4\) If the superlative DP is definite-marked, only the external relative reading is available:

(33)  
\[
\text{Rado izjade naj-vkusnija} / \text{naj-golemija šokoladov tartalet} \quad \text{(Bulgarian)} \\
\text{Rado ate SUP-tasty-M.S-DEF / SUP-big-M.S-DEF chocolate-M tartlet.M} \\
\quad \text{a. #"Rado ate a tastier/bigger chocolate tartlet than he ate of any other flavor" internal} \\
\quad \text{b. "Rado ate a tastier/bigger chocolate tartlet than anyone else ate" external}
\]

In order to explain this pattern of readings, P&T assume that both the movement derivation and the focus-derivation are in principle available in the grammar. In the absence of definite marking,

\(^4\) While there is much debate as to whether this postpositive position is derived through a syntactic, morphological or phonological process, there is some consensus that definite-marked phrases in Bulgarian contain a definite element in the head of the DP structure. (Franks 2001; Embick & Noyer, 2001; Dost & Gribanova 2006)
the superlative morpheme can escape the DP and the movement approach derives internal relative readings. For concreteness, we illustrate this below in (34) and (35).

(34)

(35) 

\[ \text{[C-SUP]} = \lambda R' \lambda P \exists d (R'(d)(P) \& \forall Q [Q \neq P \& Q \in C \rightarrow \neg R(d)(Q)]) \]

\[ \text{[D]} = \lambda P \lambda Q \exists x [P(x) \& Q(x)] \]

\[ \text{[DP]} = [\text{[D]} (\text{[NP]})] = \lambda Q \exists x [\text{tartalet}(x) \& t_2(x) \& \text{tasty}(t_3)(x) \& Q(x)] \]

\[ \text{[IP]}_3 = [\text{[DP]} (\text{[IP]})] = \exists x [\text{tartalet}(x) \& t_2(x) \& \text{tasty}(t_3)(x) \& \text{ate}(x)(\text{rado})] \]

\[ \text{[IP]}_4 = \lambda P \exists x [\text{tartalet}(x) \& P(x) \& \text{tasty}(t_3)(x) \& \text{ate}(x)(\text{rado})] \]

\[ \text{[IP]}_5 = \lambda d \lambda P \exists x [\text{tartalet}(x) \& P(x) \& \text{tasty}(d)(x) \& \text{ate}(x)(\text{rado})] \]

\[ \text{[IP]}_6 = \lambda x [\text{ate}(x)(\text{rado})] \]

\[ \text{[IP]}_7 = [\text{[ate}(t_2)(y)]] \]
\[ [IP_6] = [C - sup]([IP_5]) \]
\[ = \lambda P \exists d (\exists x [tartalet(x) \& P(x) \& tasty(d)(x) \& ate(x)(rado)]) \text{ by FA} \]
\[ \& \forall Q [Q \neq P \& Q \in C \rightarrow \neg \exists x [tartalet(x) \& Q(x) \& tasty(d)(x) \& ate(x)(rado))] \]

\[ [AP_1] = \text{chocolate} \]
\[ [IP_7] = [IP_6]([AP_1]) \]
\[ = \exists d (\exists x [tartalet(x) \& \text{chocolate}(x) \& tasty(d)(x) \& ate(x)(rado)]) \text{ by FA} \]
\[ \& \forall Q [Q \neq \text{chocolate} \& Q \in C \rightarrow \neg \exists x [tartalet(x) \& Q(x) \& tasty(d)(x) \& ate(x)(rado))] \]

“There is a degree such that there exists a thing that Rado ate that is a chocolate tartlet that reaches that degree of tastiness, and for no other property is it the case that Rado ate a tartlet of that property that it reaches that degree of tastiness.”

The superlative morpheme raises out of the DP and takes the property denoted by IP₅ as its internal argument. The property choco late raises to fill the external argument position.

On the traditional assumption that the definite determiner is vacuous, the exact same derivation would apply to (33). The prediction is that NP-internal relative readings would be just as salient in Bulgarian for (33) as for (32). By extension, the superlatives of non-quantificational adjectives should generate an NP-internal relative readings in English. But this is not the case. If we replace most in (31) with tastiest or any other gradable adjective, then the only possible reading is the absolute one (along with a sense that the stress on chocolate is awkward out of the blue):

(36) He ate the tastiest/biggest CHOCOLATE mini-cupcake.

a. “He ate a tastier/bigger chocolate mini-cupcake than he did any other type of cupcake.”  \textit{internal relative}

b. “He ate the tastiest/biggest chocolate mini-cupcake that there was.”  \textit{absolute}
Because the movement approach alone overgenerates, P&T reject the assumption that definite articles with superlatives are vacuous. They argue that movement of the superlative morpheme out of DP is only ever available in the absence of overt definite-marking. For definite DPs, relative readings can only be derived via focus-association. It turns out that NP-internal readings cannot be generated by this mechanism.

Let us see why the *in situ* approach fails to generate the internal (a) reading for (33). Recall that, while the definite article is pronounced as a suffix in Bulgarian, it is assumed to occupy the same syntactic position as determiners generally, as the head of DP. It is glossed here as $D_{\text{DEF}}$.

The problem is that there is no possible merge point for the focus operator that will generate an appropriate restriction on C. For the derivation to work, the comparison class should include maximal pluralities of tartlets that Rado ate of each of the relevant flavors. The LFs in (37a &b) represent two options for where to merge the focus operator.

(37)  
   a. [ (~S) $D_{\text{DEF}}$ [SUP-C] 1 [d1-tasty [chocolate]$_F$ tartlet] ] 2 Rado ate $t_2$  
   b. [ $D_{\text{DEF}}$ [SUP-C] (~S) 1 [d1-tasty [chocolate]$_F$ tartlet] ] 2 Rado ate $t_2$

For focus association to succeed, the ~ operator must scope over the focused constituent, but it must also be discontinuous with C. If the operator is inserted in a high position (a), then the derivation will crash because it contains a loop of infinite regress. The identity of the alternative set, S, depends on the focus value of a constituent that contains C. But the value of C depends on the identity of S. Inserting it in a lower position, as in (b), creates different problems. This configuration (shown in (38)) gives rise to conflicting demands on what can appear in C, and does not produce the correct truth conditions.
The squiggle operator picks up on the focus value of the lower AP, generating the alternative set, $S$. This is defined here as the focus value of $NP_4$. We apply existential closure to the degree argument to produce a set of the correct type. $C$ is defined as a subset of the grand union of $S$, so the focus operator will introduce a diversity of cupcake flavors into $C$.

\[
S \subseteq \left\{ P \colon \exists Q \in \{\text{choc, van. rv.}\} \wedge P = \lambda x \exists d [Q(x) \wedge \text{tartlet}(x) \wedge \text{tasty}(d)(x)] \right\}
\]

\[
C \subseteq \cup S \subseteq \left\{ x : \exists P \exists Q \in \{\text{choc, van. rv.}\} \wedge P = \lambda x \exists d [Q(x) \wedge \text{tartlet}(x) \wedge \text{tasty}(d)(x)] \right\}
\]

There are two problems with this. First, these truth conditions do not match the intuition that only those tartlets eaten by Rado are being compared. Because the VP is outside the scope of the focus operator, this component is not included in the restriction. The comparison class fails to restrict the comparison to tartlets eaten by Rado.

Second, the variation over alternative flavors which is introduced via focus is essentially erased by the presuppositions of the superlative morpheme itself. As we saw for the NP-external
reading above, the presuppositions are based on the (ordinary) value of the sister of SUP-C. So the C must satisfy the following requirements in order for the expression to be defined:

\[(40) \quad x \in C \land \exists y \in C[y \neq x] \land \forall y[y \in C \rightarrow \exists d[tasty(d)(y) \land chocolate(y) \land tartalet(y)]]\]

The comparison class must contain the external argument and at least one other individual, and all individuals in C must be chocolate tartlets of some degree of tastiness. This precludes there being any flavors other than chocolate in the comparison class. Thus, whenever [SUP-C] scopes over the focus operator, the variation that is introduced by focus is cancelled.

When definite marking is present, logical constraints on the focus association mechanism prevent an in situ derivation from composing to produce NP-internal readings, so only external relative readings are available. The NP-internal relative reading emerges in Bulgarian because it is possible for bare NPs, including superlative ones, to function as arguments. In these cases alone, the independent movement of the superlative morpheme out of DP can give rise to the internal reading.

The definite article can also be assumed to be the culprit for English, as it is always present with the superlatives of (non-Q) gradable adjectives. This explains the pattern of readings available for (36). Thus, P&T’s combined approach makes the correct predictions for gradable adjectives in Bulgarian and English. And the conclusion that the presence of definite marking in either language has real consequences for the compositional semantics is theoretically preferable to the alternative.

The problem arises when we consider the NP-internal reading of (31), where a quantity adjective is used in English. The combined approach that works so well for Bulgarian incorrectly predicts that the (a) reading of (31) should be unavailable. Furthermore, the indefinite
counterpart (41 below), is predicted to allow NP-internal readings, yet it does not. Instead, the proportional or majority reading emerges:

(41) Jamie ate most chocolate cupcakes.
    a. #“Jamie ate more chocolate cupcakes than he did of any other type.”   internal relative
    b. “Jamie ate the majority of (kinds of) chocolate cupcakes.”   proportional

In the next section we consider the arguments for treating most and related quantifiers as superlative adjectives, including Hackl’s (2009) compositional analysis of the proportional reading. This will lay the groundwork for returning to the problem of the NP-internal reading of the most.

2.1.5 Quantificational superlatives

So far, we have stuck to singular count nouns in order to describe the two approaches to superlatives. Non-quantificational superlatives are characteristically used to pick out a unique individual. In order to discuss quantificational superlatives it is necessary to expand our discussion to include plural and mass nouns. In this section we focus on plurals. Following Link (1983) I assume these are formed by application of a plural operator (the star operator). This takes the set of atomic individuals denoted by the bare noun, and forms a complete join semi-lattice without a bottom element. I assume the inclusive definition, whereby atomic individuals themselves are included in the extension of the plural along with their sums. In a world with four relevant cupcakes (e.g. the original cupcakes of Figure 1) the extension of cupcakes can be represented by the lattice in Figure 4, which contains the individual cupcakes and all possible sums thereof.
Bresnan (1973) was the first to argue that *most* is the superlative form of both *many* and *much*, just a *fewest* is somewhat more transparently the superlative of *few*. Szabolcsi (1986) observes that these Q-superlatives have relative readings that are analogous to the relative readings of ordinary gradable superlatives, although they do not have absolute readings. However, it wasn’t until Hackl (2009) that an explanation for the lack of absolute reading was suggested, along with a compositional analysis of the proportional reading of *most*. The relevant readings are illustrated in (42 and 43).

(42)  *Jamie ate (the) most cupcakes.*

a. “*Jamie ate a plurality of cupcakes that is more numerous than any other (relevant) plurality of cupcakes.*”  

b. “*Jamie ate a majority of the cupcakes.*”  

c. “*Jamie ate a more numerous plurality of cupcakes than Paul or Kerry ate.*”

---

5 In English, the proportional reading is more naturally expressed by a true partitive as in

(i) *Jamie ate most of the cupcakes.*

To illustrate his approach we will follow Hackl in ignoring that complexity for the moment and treat *most* as a lexical element equivalent to *most of the.*
(43) Jamie ate the fewest cupcakes.

a. #“Jamie ate a plurality of cupcakes that is less numerous than any other (relevant) plurality of cupcakes.”

b. #“Jamie ate a minority of the cupcakes.”

c. “Jamie ate a less numerous plurality of cupcakes than Paul or Kerry ate.”

Hackl’s analysis rests on the assumption that, for counting predicates like many, “non-identity” in the superlative must be interpreted as “non-overlap”. The definition of [\text{sup}] is re-written in (44) with non-overlap replacing non-identity. And the definitions of the morphemes many and few with which it combines are given in (45).

(44) \[ \lambda \forall \cupcake \lambda \exists \exists d \exists [(\cupcake(x) \& |x| \geq d) \land \forall y [\cupcake(y) \& |y| \geq d)] \] (presupposition)

\[ \exists d (\cupcake(x) \& |x| \geq d) \land \forall y [\cupcake(y) \& |y| \geq d] \] (assertion)

(45) \[ \text{[many]} = \lambda d \lambda P \lambda x [P(x) \& |x| \geq d] \]

\[ \text{[few]} = \lambda d \lambda P \lambda x [P(x) \& |x| \leq d] \]

The absolute reading, (42a), if defined, would have the truth conditions in (46).

(46) \[ \text{[DP]} = \exists x : \exists d [(\cupcake(x) \& |x| \geq d) \land \forall y [\cupcake(y) \& |y| \geq d]] \]

(the unique/maximal x, such that x is a plurality of cupcakes and there is some degree, d, to which it is numerous, and there is no plurality of cupcakes y disjoint from x in C, that is numerous to that degree)

But, as Hackl argues, it is logically impossible for such an expression to be defined. The comparison class is constrained by the last conjunct of the presupposition in (44) to contain only what is in the extension of the sister to [\text{C-sup}], which is the plural NP \text{cupcakes}. Therefore we get a comparison class that looks like the lattice in Figure 4, above.
The comparison class must include the external argument (what Jamie ate) and at least one non-overlapping entity. This presupposition bars the maximal sum (A+B+C+D) from being a candidate for the x argument. But that maximal plurality is the only one that is uniquely more numerous than all the rest. If this is excluded by the superlative presupposition, then the uniqueness presupposition of the definite article can never be met. For example, the plurality of three cupcakes shown in Figure 5 does satisfy the presuppositions of [C-sup]: the sum A+B+C leaves the non-overlapping D cupcake as a distinct element in the comparison class. But whenever a plural domain based on four atoms is considered, there are logically not one but four possible sums of three. (in Figure 5 there is A+B+C, A+B+D, A+C+D, B+C+D). None of these is more numerous than the others.

![Diagram of most cupcakes](image)

**Figure 5: Most Cupcakes**

There is never a *unique* or maximal sum that satisfies the presuppositions of SUP and so an absolute reading is logically impossible. (See Dobrovie-Sorin, 2015) for an extension of this argument to mass denotations of *most* as well).

With the impossibility of definiteness in this context established, the proportional reading of bare *most* is easily explained as the indefinite counterpart to the non-existent absolute reading.
If the definite article is replaced by the silent existential quantifier, then no conflict of presuppositions arises. The DP will have the denotation in (47).

\[(47) \quad \lambda P \lambda x \exists d[[*\text{cupcake}(x) \& |x| \geq d] \land \forall y[y \cap x = \emptyset \& y \in C \rightarrow \neg[*\text{cupcake}(y) \land |y| \geq d]]] \land P(x)\]

If \(\lambda x.\text{Jamie ate } x\) is true of the three cupcakes highlighted in Figure 5 (A+B+C) or any one of the other possible sums of three, then the sentence will be true. In scenarios with any number of cupcakes the same logic will apply: sums that are greater than half of the total will always satisfy the expression.

Relative readings are possible because the comparison class is constructed differently. On the movement analysis (which Hackl uses) it contains cupcake-eaters and not pluralities of the cupcakes themselves. On the focus analysis, the sums that make up the comparison set are the maximal sums actually eaten by each relevant individual.

Overall, Hackl’s analysis makes a strong case for the decompositional analysis of *most*, and *fewest* as superlatives of adjective-like *many* and *few*. However, when we apply this assumption straightforwardly we run into problems with the NP-internal relative readings.

### 2.1.6 Problems with combined approach for *most/least/fewest*

Now we are ready to tackle the puzzle at the center of our inquiry, the NP-internal relative readings of superlatives. Let us revise our cupcake scenario once again to illustrate this phenomenon. Jamie and his brothers have purchased two dozen mini-cupcakes, as described above. But let’s add the complication that the baking was somewhat irregular, and not all of the mini-cupcakes were the same size. The cupcakes are illustrated below, and the particular ones that Jamie ate are again circled.
In this situation it seems truthful to say (48) with stress on *chocolate* and the interpretation in a:

(48)  *Jamie ate the most CHOCOLATE mini-cupcakes.*

   a. “Jamie ate more chocolate cupcakes than vanilla or red velvet ones”  *(int) relative*
   b. #“Jamie ate more chocolate cupcakes than Kerry or Paul did.”  *(ext) relative*
   c. #“Jamie ate chocolate cupcakes that are more numerous than any of the other chocolate cupcakes.”

The location of the stress precludes the external relative reading (b), and the absolute (c) reading of the quantity superlative is logically impossible, as discussed in the previous section. In contrast, it is not possible to assert (49) with stress on *vanilla* and produce the parallel NP-internal reading:

(49)  *Jamie ate the biggest VANILLA mini-cupcakes.*

   a. #“Jamie ate bigger vanilla cupcakes than he did chocolate or red velvet cupcakes.”  *(int) relative*
   b. #“Jamie ate bigger vanilla cupcakes than Kerry or Paul did.”  *(ext) relative*
   c. “Jamie ate vanilla cupcakes that were bigger than any of the other vanilla cupcakes.”  *absolute*
The only salient reading with this intonation is an absolute reading (c). The stress on vanilla still sounds awkward, unless a larger discourse context facilitates a contrastive interpretation: “He didn’t eat the biggest RED VELVET cupcakes…”. But no manipulation of context or intonation can make the (a) reading come through.

This internal relative reading is illustrated above for most as a superlative of many. It also arises for most as a superlative of the mass quantity adjective much as well as for the negative Q-superlatives fewest and least.

(50)  
\[ \text{Kerry ate the most PEACH cobbler.} \]  
“Kerry ate more peach cobbler than he did any other type of cobbler.”  
(int) relative

(51)  
\[ \text{Kerry ate the least BLACKBERRY cobbler.} \]  
“Kerry ate less blackberry cobbler than he did any other type of cobbler.”  
(int) relative

(52)  
\[ \text{Jamie ate the fewest VANILLA cupcakes.} \]  
“Jamie ate fewer vanilla cupcakes than he did any other type of cupcake.”  
(int) relative

In English, there is a clear contrast between Q-superlatives, which give rise to both internal (48a) and external (48b) relative readings, and other superlatives, which do not give rise to internal readings (49a), but only to external readings (49b).

In Bulgarian, quantity superlatives pattern like other gradable adjectives, so P&T easily include these cases in their combined approach. The quantity superlatives give rise to NP-internal readings only when they appear in indefinite phrases (53). Definite-marking on the quantificational superlative DP blocks that reading (54).

(53)  
\[ \text{Rado izjade naj-mnogo/ naj-malko šokoladovi tartaleti} \]  
(Russian)  
Rado ate SUP-many / SUP-few chocolate-M.PL tartlet-M.PL  
a. “Rado ate a more/fewer chocolate cupcakes than he ate of any other flavor”  
b. “Rado ate a more/fewer chocolate cupcakes than anyone else ate”  
Bulgarian
The patterns for English and Bulgarian definite and indefinite superlatives are given in Tables 1 and 2 below.

<table>
<thead>
<tr>
<th>TABLE 1: Definite Superlatives</th>
<th>External relative</th>
<th>Internal relative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(movement or in</td>
<td>(movement</td>
</tr>
<tr>
<td>BULGARIAN</td>
<td>situ derivation)</td>
<td>derivation only)</td>
</tr>
<tr>
<td>Q-superlatives (naj-mnogo, naj-malko)</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>Non-Q-superlatives (naj-vkusnija, naj-golemija)</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>ENGLISH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q-superlatives (the most, the fewest, the least)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Non-Q-superlatives (the tastiest, the biggest, etc.)</td>
<td>✓</td>
<td>#</td>
</tr>
</tbody>
</table>

Leaving aside the indefinites for the moment, it is clear that the availability of the NP-internal relative reading for definite-marked *most, fewest* and *least* in English is unexpected. As it stands, it seems that while the movement approach alone overgenerates, Pancheva & Tomaszewicz’s combined approach instead undergenerates for English.

<table>
<thead>
<tr>
<th>TABLE 2: Indefinite Superlatives</th>
<th>External relative</th>
<th>Internal relative</th>
<th>Proportional</th>
</tr>
</thead>
<tbody>
<tr>
<td>BULGARIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q-superlatives (naj-mnogo, naj-malko)</td>
<td>✓</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>Non-Q-superlatives (naj-vkusen, naj-golem)</td>
<td>✓</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>ENGLISH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q-superlatives (most, *fewest, *least)</td>
<td>#</td>
<td>#</td>
<td>✓</td>
</tr>
<tr>
<td>Non-Q-superlatives (*tastiest, *biggest, etc.)</td>
<td>-</td>
<td>-</td>
<td>#</td>
</tr>
</tbody>
</table>
The situation is further complicated when we add bare (indefinite) *most* to the paradigm. In English this gives rise to the proportional or ‘majority’ reading instead of the NP-internal relative reading predicted by P&T’s analysis. This suggests a significant syntactic and/or semantic difference between English and Slavic Q-superlatives, particularly in terms of how they combine with definite marking. Because the existing model works well for Bulgarian, we will focus on the analysis of English quantificational DPs.

In order to arrive at an analysis that can predict the seemingly anomalous pattern, we first take an excursion into another type of quantity expression in English, the measure pseudopartitive. The second half of this chapter introduces the syntactic and semantic properties of this construction and reviews approaches that attempt to account for them. I show that the measure phrases in pseudopartitives are in fact more complex than has previously been assumed, and can sometimes take the form of superlative DPs.

### 2.2 Measure Pseudopartitives

Schwarzschild (2006) discusses semantic parallels between degree phrases containing Q-adjectives and ‘monotonic’ measure phrases that appear in the pseudopartitive construction. These contrast with the DegPs of non-quantificational adjectives, which pattern with ‘non-monotonic’ measure phrases. In order to understand the different behavior of the superlatives *most/fewest* versus *best/tastiest* in English, this section will examine these measure constructions and the notion of monotonicity.

#### 2.2.1 Two types of measure phrase

**Attributive measure phrases**
There are two distinct syntactic forms that measure phrases can take. We will discuss the forms these take in English, but note that across diverse languages these two types of measure phrase are distinguished from each other by various morphological and syntactic means. I follow Schwarzschild (2006) in referring to the first, simpler type as **attributive** measure phrases (AMPs). These consist of an obligatory numeral plus an uninflected unit or measure noun. Their distribution is similar to that of non-quantificational adjectives. For the most part they are restricted to directly modifying an NP.

(55)  
   a. John ate my **three-ounce** goat cheese log.  
   b. John ate my **small/delicious** goat cheese log.

Like *small* and other size adjectives, AMPs appear above kind-denoting modifiers (like *goat*) and below determiners, numbers and quantity adjectives. Cinque (2010) has observed that there is a default or neutral ordering of various types of attributive adjectives. This is illustrated in (56) where the ordering (*size*>weight>shape>color) given in (a) is the unmarked order. When *heavy* is moved to different positions, the effect is unnatural, although the phrases could be acceptable within a particular context or with a particular prosody—for example with strong focus pitch-accent on *heavy* in (56c).

(56)  
   a. The many big heavy rectangular red bricks  
   b. ?The many **heavy** big rectangular red bricks (marked)  
   c. ?The many big rectangular **heavy** red bricks (marked)  
   d. #The many big rectangular red **heavy** bricks  
   e. *The **heavy** many big rectangular red bricks.*

---

6 The last example, which the attributive adjective is moved above *many* is significantly worse than the others. It seems to be syntactically ill-formed, pointing to a special status or position of Q-adjectives in the structure of the extended NP.
AMPs are subject to similar, if not identical constraints on their position vis-à-vis other modifiers, although re-positioning of twenty-pound is harder to accommodate in (b) and (c) below than it was for the adjective.

(57)  
\begin{itemize}
  \item a. The many big twenty-pound rectangular red bricks
  \item b. #The many twenty-pound big rectangular red bricks
  \item c. #The many big rectangular twenty-pound red bricks
  \item d. The many big rectangular red twenty-pound bricks
  \item e. *The twenty-pound many big rectangular red bricks
\end{itemize}

Another notable difference between heavy and twenty-pound is that the latter is able to appear in the position closest to the noun in the (d) example. This corresponds with a reading on which it describes a particular type of brick, just as goat describes a type of cheese in the earlier example. The measure phrase 80-degree has similar distribution to warm. With this description, though, the ‘type’ reading of the measure phrase is harder to imagine, and most speakers find (59d) unacceptable.

(58)  
\begin{itemize}
  \item a. That beautiful, shallow, warm Caribbean water
  \item b. ?That warm, beautiful, shallow Caribbean water \ (marked – focus on beautiful?)
  \item c. ?That beautiful, warm, shallow Caribbean water \ (marked – focus on shallow?)
  \item d. #That beautiful, shallow, Caribbean warm water
\end{itemize}

(59)  
\begin{itemize}
  \item a. That beautiful, shallow, 80-degree Caribbean water
  \item b. #That 80-degree, beautiful, shallow Caribbean water
  \item c. #That beautiful, 80-degree, shallow Caribbean water
  \item d. #That beautiful, shallow, Caribbean 80-degree water
\end{itemize}

To a limited extent, AMPs can also combine with attributive (pre-nominal) adjectives as in (60).
The combination of measure-phrase plus adjective seems to be primarily used to disambiguate the orientation intended for one-dimensional measures. Where the dimension is unambiguous, as with temperature or weight, the combination of measure phrase and adjective is ill formed: *ten-pound-heavy, *eighty-degree-warm. (Although see Schwarzschild (2005) for a different approach to constraints on this pre-adjectival usage.)

The adjective-like quality of AMPs is especially obvious in Slavic languages, where they also exhibit adjectival morphology. In Bulgarian, the measure constructions synonymous to those illustrated above are generally formed by means of an adjectival suffix (-ov).

Full measure phrases

The measure phrases that appear in the pseudopartitive construction behave less like adjectives and more like independent nominal phrases. Will call these full measure phrases (FMPs) for reasons that will become apparent. While AMPs are limited to the constructions described above, FMPs have a much wider distribution. Even the simplest form of these measure phrases – a
numeral plus unit noun – differs from the examples above in that number marking on the measure noun is obligatory in English.\(^7\)

(62)  
   a. ten feet of warm water  
   b. *ten foot of warm water

We will have more to say about this fact, and other ways in which these are syntactically more complex than attributive MPs below. But let us begin by observing that their wider distribution in the clause mimics that of Q-adjective phrases such as much, a little and (the) most, just as that of attributives mimics the limited distribution of quality adjectives.

   Within the extended AP, FMPs appear as modifiers of predicative adjectives. And, again like Q-adjectives, they can specify a differential amount in comparative constructions:

(63)  
   a. John is three years old  
   b. John is three years older than Steve.  
   c. John is much older than Steve.

They can also be have a differential reading before the comparative forms of the quantity adjectives more/less:

(64)  
   a. John has three ounces more goat cheese than Steve  
   b. John has much less goat cheese than Steve.

Full measure phrases also occur outside of the DP. They appear as the objects of verbs and prepositions (a) and even as modifiers of locative and directional prepositions (c). In these environments, too, they have the same distribution as various forms of Q-adjectives (b,d).

\(^7\) The same is not true for all languages: Rothstein observes, for example, that in Dutch plural marking on kilo and liter is optional (2017: 52). Number marking is a consistent feature of full measure phrases in (General American) English, however, so we use it as a diagnostic to distinguish these from attributive measure phrases.
(65)  a. John ran three miles/for an hour on Tuesday.
b. John ran (the) most on Tuesday.
c. The best strawberries can be found five yards in from the gate.
d. The best strawberries can be found a little in from the gate.

The presence of FMPs in the extended projections of nouns, verbs and even prepositions is evidence for parallels between these domains. The link between telicity of VPs and quantization of NPs has been famously explored by Krifka (1989). Likewise, Champollion (2012) seeks to unify the constraints on use of FMPs introduced in the verbal domain by for/in with the constraints on nominal measure constructions. Such cross-categorial extensions are beyond the scope of this dissertation.

There are two constructions in which full measure phrases act as modifiers of (or quantifiers over) nouns. These are partitives (66) and pseudopartitives (67). Again, the (b) examples show that Q-adjectives appear in the same configurations, modulo the missing of in (67)b.

(66)  a. John ate three ounces of my goat cheese.
b. John ate (the) most of my goat cheese.

(67)  c. John ate my three ounces of goat cheese.
d. John ate (the) most goat cheese.

I will limit the following discussion to these two binominal constructions – contrasting them with the attributive construction discussed above. I will argue in Chapter 4 that pseudopartitive measure constructions, like that in (67a), hold the key to understanding the exceptional behavior of most/least/fewest inside DP.
Any approach to measure partitives and pseudopartitives must account for a number of semantic and syntactic properties of the measure phrases and substance NPs in these constructions. Section 2.2 of this chapter identifies the most well-studied of these properties variously called ‘monotonicity’ or the ‘extensive’ or ‘additive’ quality of the measurements. Section 2.3 examines the treatment of these constructions to date, picking out aspects of existing accounts that we will want to make use of as well as those that are problematic. In 2.4 we turn our attention to the complexity within FMPs that has mostly been overlooked, and the additional problems this raises for the accounts discussed.

2.2.2 Semantic properties of measure pseudopartitives

The attributive construction (in which an AMP directly modifies an NP) is acceptable with any combination of measure noun and substance noun, as long as the entity in question can be construed as having the property being measured. In contrast, it has been observed that the pseudopartitive construction is only acceptable for substance NPs that have a non-trivial mereological structure and for measures that have a particular relationship to that structure.

To understand these constraints we must say a few words about mereology. Link (1983) proposed that the extensions of plural and mass first-order predicates have lattice structures. Krifka (1989) assumes that the entire domain of any nominal predicate is structured in this way. To formalize this, he describes such domains in terms of an abstract predicate, S, that characterizes individuals “of a certain sort.” Its extension is structured as a complete join semi-lattice without a bottom element. The basic sum formation operation, \( S \), and all mereological relationships within this domain (\( \subseteq S, \equiv S, \circ S \)) are relative to a particular sort (as indicated by the
subscript). This allows us to define higher-order properties of particular predicates that have that sort as their domain.

For a pseudopartitive to be acceptable, the substance NP must be non-quantized, meaning that it must have cumulative reference within its domain. Krifka (1998) defines this as follows:

(68) **(Strict) Cumulative reference:**

\[
\text{CUM}_S(P) = \text{def} \exists x \exists y [P(x) \land P(y) \land \neg x = y \land \forall x \forall y [P(x) \land P(y) \rightarrow P(x \cup_S y)]]
\]

A predicate has Cumulative reference w.r.t. a domain, S, iff it contains at least two distinct entities and whenever the predicate is true of any two entities it is also true of the sum of those entities.

Mass nouns and bare plural count nouns have cumulative reference, while singular count nouns and those that are modified by numerals do not (assuming an exact reading of numbers). For example, if we sum two distinct entities, x and y that are each in the set denoted by *two cupcakes* within the sort of objects, O, the result is an entity \(x \cup_O y\) that is not in that set (Figure 7).

![Figure 7: Two cupcakes is non-cumulative](image)

The measure function encoded by the measure noun is also subject to an additional semantic constraint. According to Krifka, it must be an **extensive** measure. Simply stated, this is a
property, such as weight, that increases as the size of an entity increases. (An intensive property, by way of contrast, is one like color which is independent of the size of the object).

Schwarzschild (2002) formulates a similar, but not identical property, which he calls **monotonicity** (after Lønning, 1987). We will return to Krifka’s system later, but for the moment, I will base my exposition on Schwarzschild’s concept. A dimension is monotonic with respect to a part-whole structure if any proper part of any individual necessarily measures strictly less than the whole on that dimension.\(^8\)

(69) **Monotonicity**
\[
\text{Monotonic} _s (\text{DIM}) : \forall x \forall y \text{ } x \sqsubseteq_S y \rightarrow \mu_{\text{DIM}}(x) < \mu_{\text{DIM}}(y)
\]

(A dimension dim is monotonic w.r.t. the parthood relation, $S$, iff whenever $x$ is a proper part of $y$, the measurement of $x$ on that dimension is strictly less than the measurement of $y$ on that dimension.)

As an illustration, let us cleanse our mental palates by considering the bottle of water in Figure 8.

The contrast in acceptability between (70) and (71) can be understood in terms of monotonicity.

![Figure 8: A 12-oz. bottle of room-temperature (70°F) water](image)

---

8 This is definition is simplified for the sake of concreteness at this point. In fact, Schwarzschild (2006) spends some time describing the notion of “the relevant part-whole structure”. We will return to this when we discuss the problem of one-dimensional measures in the next section.
(70) John drank **twelve fluid ounces** of water.

(71) #John drank **seventy degrees Fahrenheit** of water.

The NP *fluid ounce* encodes measurement on the volume scale. *Volume* is extensive with respect to water because the volume of any proper part of it will always be strictly less than the volume of the whole. For example, the portion of water, *a*, outlined by the oval in Figure 8 might measure one or two ounces. As a proper part of something that we know to be twelve ounces, we can safely assume that it measures less than twelve ounces itself. The unacceptability of (71) reflects the fact that *temperature* is not monotonic with respect to *water*. If the twelve ounces of water in the bottle measures seventy degrees, then the sub-portion, *a*, will also measure (approximately) seventy degrees.

While physicists may characterize temperature as an inherently intensive property, it can qualify semantically as monotonic if we combine it with a different substance NP. Specifically, it can be a monotonic dimension of measurement in relation to entities that are not physical, three-dimensional objects. The pseudopartitive construction becomes acceptable when *degrees Fahrenheit* is paired with a substance noun that denotes heat itself, or the change of state of an entity on the temperature dimension as in the following example:

(72) We expect **two degrees Fahrenheit** of global warming in the next decade.\(^9\)

The substance NP, *global warming*, has cumulative reference. Consider the sum of two ‘portions’ of global warming: a rise in temperature from 0.5° C to 1.5° C and a subsequent rise from 1.5° to 2°. The sum of these is the total change from 0.5° to 2°, and this is also in the

---

\(^9\) Adapted from an example in Champollion (2010).
extension of *global warming*. If we consider a proper subpart of this larger *global warming* event—say the initial rise of one degree, it will measure strictly less than the whole. Intuitively then, temperature is a monotonic dimension in this context.

**A note on syntax : Measure vs. individuating structure**

By referring to them as phrases, we have implicitly assumed that, like AMPs, FMPs are constituents in and of themselves. In fact, apparent measure pseudopartitives are ambiguous between a structure in which the number and measure noun form a constituent and one in which the number takes scope over a constituent containing both the measure and substance nouns. The syntax we will be assuming for the first structure is based on Schwarzschild (2006). But work by Rothstein (2009) and Brasoveanu (2008) on Hebrew and Portuguese respectively, points to the existence of the second type of structure that is available cross-linguistically. We will see in the next section that English makes use of both.

Schwarzschild (2006) proposes the following structure for measure pseudopartitives. On his account, *of* is the spell out of a functional head in the extended projection of the substance NP. This MON head introduces a measure phrase in its specifier. While other accounts treat the relevant constraints as applying globally to the pseudopartitive construction, on this account it is the MON head that brings with it the presupposition that the dimension of measurement is one that is monotonic “on the relevant part-whole relations” (p.73).

(73) \[ \text{MONP} \]

\[ \text{DP} \]

\[ \text{three cups} \]

\[ \text{MON} \]

\[ \text{of} \]

\[ \text{NP} \]

\[ \text{coffee} \]
Rothstein (2009) points to the example of container nouns to argue that certain measure pseudopartitives are ambiguous between the ‘measure’ structure in (74) and the ‘individuating’ structure in (75). She does not ascribe any syntactic or semantic function to of in either structure.

(74)  
```
  DP  
   |  
  NP  
   |  
 MeasP N  
   |   |  
 NUM Nmeas three cups (of) coffee
```

(75)  
```
  DP  
   |  
  NP  
   |  
 NumP  
   |   |  
 NUM N  
   |   |  
 t_i cups (of) DP coffee
```

Brasoveanu (2008) goes further. He assumes that Schwarzschild is correct in that the basic meaning of measure nouns is degree-based, but argues that not only container nouns, but also canonical unit nouns such as liter participate in an individuating structure like that in (75). Contra Rothstein, the complement of the measure noun is a bare substance noun (or possibly NP), not a DP. Presumably this is because the meaning of the ‘nominalized’ unit of measure in the individuation structure is built on the part-whole structure of the mass or plural noun in its complement.
### 2.2.3 Problems with monotonicity / extensivity

All of the accounts we have mentioned assume that, like attributive measure constructions, pseudopartitives directly relate a number, degree or interval on a scale to the individuals in the set denoted by the substance NP. The problem of relating lattice structures of individuals of type $e$, to scale structures of degrees type $d$, is not trivial. This becomes apparent when we consider measure nouns such as ‘inches’ and ‘meters’ that make reference to one-dimensional size of three dimensional entities. Consider the perfectly acceptable pseudopartitives underlined in (76).

(76)  
   a. We need two inches of ginger for the recipe.
   b. There are nine yards of silk in a sari.
   c. John is buried under two meters of rocks.
   d. The road to Oz is miles of yellow bricks.

The one-dimensional unit nouns refer to measurement along a different dimension in each case. But LENGTH is not monotonic on the part-whole structure of ginger nor is DEPTH monotonic on the part-whole structure of rocks. To see why, consider the example of water in a bottle again, as illustrated in Figure 9.

![Figure 9: Some water in a bottle (with a portion of water, $b$, outlined)](image)
We have established that *water* has cumulative reference within sort O. But if we use our simple definition of monotonicity, based on sort O, it turns out that *DEPTH* is not monotonic on this material parthood relation of sort O. We can prove this by identifying a portion of water, b, which is a proper subpart of the whole quantity of water. Portion b also measures 3 inches on the *DEPTH* scale. Therefore it is not the case that *DEPTH* is monotonic on this structure.

\[
\text{Monotonic}_O (\text{DEPTH}) \text{ iff } \forall x \forall y \ x \sqsubseteq_O y \rightarrow \mu_{\text{DEPTH}}(x) < \mu_{\text{DEPTH}}(y)
\]

\[
b \sqsubseteq_O a \rightarrow \mu_{\text{DEPTH}}(b) < \mu_{\text{DEPTH}}(a)
\]

\[
b \sqsubseteq_O a = 1
\]

\[
3'' < 3'' = 0
\]

\[
1 \rightarrow 0 = 0
\]

So, thus far the monotonicity constraint predicts that (78) should be ill-formed.

\[
\text{(78) John left an inch of water in the bottle}
\]

For this reason, Schwarzschild does not equate the mereological structure of the substance noun predicate (*water*) with the part-whole structure referenced by monotonicity. Schwarzschild instead discusses the notion of “the relevant part-whole relation.” For example, the ‘parts’ in Figure 9 would be horizontal layers of water. This captures the idea the part-whole structure in question is a partitioning of an entity in a particular context, not the mereological structure of the entire set denoted by the NP predicate. However, if it is not supplied by the substance NP then it is not clear how the part-whole relation is defined or how it is identified for a particular context.

For the sake of thoroughness we should note that the constraints on pseudopartitives formulated by Krifka (1989, 1998) suffer the same problem as our simplified version of monotonicity in (69). Krifka asserts that a pseudopartitive is acceptable just in case it contains an extensive measure function, \(\mu\), that is compatible with the domain, S, of the substance noun. A
measure function is extensive if it is the case that the sum of the measure of any two non-overlapping parts is equal to the measure of the sum of those parts, and a part of any entity that measures greater than zero also necessarily measures greater than zero. Champollion (2014) translates this as follows:

\[(79)\] **Extensive**

\[\mu \text{ is extensive iff}
\]

a. for any \(a, b\) that don’t overlap, \(\mu(a) + \mu(b) = \mu(a \sqcup b)\); and

b. for any \(c, d\), if \(c\) is a part of \(d\) and \(\mu(d) > 0\) then \(\mu(c) > 0\)

Krifka also states that the ordering (or scale), \(R\), referenced by the measure should be a ‘continuation’ of the part relation in \(S\), which amounts to the requirement that measurement on this dimension be a homomorphism from \(S\).

\[(80)\] **Compatible**

\[\mu_R \text{ is compatible with } S \text{ iff } \forall x \forall y [x \sqsubseteq_S y \rightarrow \mu_R(y) \geq \mu_R(x)]\]

Compatibility is similar to our original formulation of the monotonicity requirement (69), except that it is weak enough to admit one-dimensional measures. For example, the relations between \(a\) and \(b\) satisfy it, since equality of degrees in the consequent is sufficient.

\[(81)\] \[b \sqsubseteq_O a \rightarrow \mu_{\text{DEPTH}}(a) \geq \mu_{\text{DEPTH}}(b) \]

However, the \((a)\) clause of the definition of extensive is problematic. While one-dimensional measures are compatible with three-dimensional predicates, they do not meet the definition of extensivity. Consider the slightly different partition of the water in our bottle in Figure 10.
Unlike \(a\) and \(b\), in Figure 9, the two portions \(c\) and \(d\) here are non-overlapping. But they both measure the same depth. Therefore the depth measure is not extensive on Krifka’s definition:

\[
\mu \text{ is extensive iff}
\begin{align*}
\text{a. for any } a, b \text{ that don’t overlap, } & \mu(a) + \mu(b) = \mu(a \sqcup b) \\
& \\
& \mu_{\text{DEPTH}}(c) + \mu_{\text{DEPTH}}(d) = \mu_{\text{DEPTH}}(c \sqcup d) \\
& 3'' + 3'' = 3'' = \text{FALSE}
\end{align*}
\]

Again, the attempt to fully formalize the constraint on the type of measurement that is acceptable in pseudopartitive constructions breaks down when scale structures of one-dimensional measures are related to three-dimensional parthood relations. The reader can verify for themself that the same problem we have illustrated with \(\text{DEPTH}\) will apply to \(\text{LENGTH}\), \(\text{HEIGHT}\), \(\text{WIDTH}\), etc.

Champollion discusses some other specific cases of this problem in detail in his 2010 dissertation. He arrives at a formal solution by defining the constraint on measure pseudo-partitives in terms of the higher-order property of Stratified Reference. I will consider his proposal briefly in Chapter 3, and take inspiration from the notion of ‘strata’, although my
approach ultimately will be based on very different assumptions about the denotations of measure nouns.

2.2.4 Complexity of measure phrases

So far we have only looked at measure pseudopartitives that consist of a numeral and a unit or container noun before the MON head. But as Schwarzschild (2006) notes, measure phrases in this type of construction may contain weak quantifiers in place of numerals. Even when numbers do fill the quantifier position, it is significant that they differ from attributive measure constructions in that a plural number triggers plural marking on the measure noun. It is based on these facts that we have named them FMPs – full measure phrases – indicating that they are syntactically maximal projections of the measure nouns. While Schwarzschild represents FMPs as DP constituents, he gives only a limited picture of the size and complexity of these measure phrases.

Indefinite determiners and plural marking in Measure phrases

FMPs in a pseudopartitive construction may contain indefinite determiners in place of (or in addition to) numerals, as can be seen in (83). This is in contrast to ‘attributive’ measure phrases in which only numerals are allowed, as in (84).

(83)  a. one mile of wire  
      b. a mile of wire  
      c. four units of insulin  
      d. several units of insulin  
      c. some (fifty) pounds of lobsters

10 Some pounds is not entirely natural sounding to my ear, but a quick Google search turned up 196,000 results for the string some pounds of. There is also the construction some [number] pounds/ounces/inches.
For the moment, let us put aside the question of which particular determiners can and cannot appear in this structure. The examples in (83) provide evidence that there is a D position in the structure of the measure phrase itself.

The presence of plural morphology itself can be taken as evidence that these phrases are (at least) full DPs. Sauerland (2003) presents a theory of number-marking on which plural agreement is checked above the DP level by a silent number operator. He argues that, while all NPs enter a derivation with (inclusively) plural denotations, a semantic number operator, Φ, introduces the presuppositions associated with number marking on the noun. The unmarked, singular form of a count noun has the stronger presupposition. Therefore, once a number operator is introduced, plural morphology is licensed just in case the referent is semantically non-singular. This is illustrated in (85) for a simple DP, three delicious lobsters.¹¹

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¹¹ Existing approaches to measure pseudopartitives, which assume that measure nouns take a numeral of type n as argument, do not allow for the composition of this type of measure phrase. So in order to account for these examples, there are two options. The first is to contrive a way for determiners to combine with the types of denotations that have been assumed for measure nouns. For example, by positing a mechanism like existential closure over the numeral argument, and/or allowing determiners to be of flexible type, quantifying over degrees rather than over individuals. I assume this is what e.g. Schwarzschild (2006) has in mind. In Chapter 3 I will argue for the second option, which is to treat measure nouns more like ‘ordinary’ nouns—as sets of individuals—and assume that they combine with determiners and numbers in the conventional way. The structures that follow preview this approach by introducing numerals in a NumP projection, but this is merely for convenience as we will not present an argument for this approach until later.
The absence of plural morphology on attributive measure nouns doesn’t preclude their having plural semantics. Contra Rothstein (2017), I understand expressions like (86) to denote a plurality of millimeter units or pound units.

(86) a. five-millimeter wire  
     b. two-pound lobsters

An attributive NP, failing to merge with a determiner, never reaches the size required for this checking to occur. Therefore morphological plural marking, itself uninterpretable, is unlicensed within this too-small constituent. This is shown below for the ungrammatical DP, *two-pounds lobsters. I assume that this attributive measure phrase is introduced by the a functional head in the extended NP of the substance noun along the lines of what is proposed for adjectives by e.g. Cinque 2010 and Alexiadou 2001.
The entire xNP, with the measure phrase in a lower specifier merges with a determiner and then with a number operator which checks the plural feature on the substance noun. But no additional number operator is present to check a plural feature on the measure noun. If *pounds* is marked plural, then this unchecked feature causes the derivation to crash. The only possible derivation is one in which *pound* is unmarked and has no plural feature to check, as in (88)
Conversely, the fact that measure phrases in the pseudopartitive construction, as in (89), do exhibit plural morphology indicates that they are not just larger constituents than attributive measure phrases, but they are in fact \( \Phi P \)s, which necessarily embed full DPs.

(89)  
\begin{align*}
a. & \text{five miles of wire} \\
b. & \text{two pounds of lobsters}
\end{align*}

The plural morphology on \textit{two pounds} must be licensed by a \( \Phi \) operator within the Measure Phrase constituent. (90) shows this embedded \( \Phi P \) structure. We follow Schwarzschild in assuming the MONP projection is part of the extended projection of the substance noun and the measure phrase is merged in its specifier.
It is possible that the numeral raises to the measure-phrase internal D position (as Krifka (1989) and others assume for DPs with bare numerals in general). In what follows we will revert to speaking in terms of DP rather than $\Phi P$, but this is just a shorthand, leaving in place the assumption that $\Phi$ is present as an extra layer on all DPs.

**Adjectival modification**

If we are correct in treating measure phrases as full DPs, it follows that adjectival modification of measure nouns should be available. At first glance this seems to be the case. The examples in (91) are acceptable with a variety of adjectives before the measure noun.

(91)  
  a. She added **three generous/strong teaspoons** of molasses.  
  b. He ate **a small/crunchy handful** of walnuts.

However, as discussed in Section 2.2.2 above, container-type nouns are often ambiguous between the measure reading associated with the pseudopartitive structure that we are concerned with, and an individuating reading that derives from a different structure. In the individuating structure, what looks like a measure noun is the lexical head of the whole phrase. For example, the word *cup* is ambiguous between an amount and a container reading. This is indicated by the difference in possible continuations given in parentheses:

(92)  
  a. Twenty cups of coffee was served (in a large urn/ *with saucers and spoons)  
  b. Twenty cups of coffee were served (*in a large urn/ with saucers and spoons)

In the first example, the number marking on the auxiliary agrees with the singular feature of *coffee*. This is predicted if (92) has a measure pseudopartitive structure like (90) where the
singular $\Phi$ operator has higher scope. In the second example, the auxiliary is marked plural. This means the subject of the sentence is a plurality of individual cups, not a quantity of coffee and the plural operator associated with *cups* has highest scope. The individuating structure in (93) corresponds to this reading.

(93) $$\Phi_{PL} P_{PL}$$

The XP is a complement of the head noun, which could be analyzed as a PP or a DP. In an individuating construction, any adjectives appearing between the numeral and the (apparent) measure noun would not form a measure phrase constituent. Instead they would be modifiers of a larger $[N of NP]$ constituent. This appears to be the case for the quality adjectives, *strong* and *crunchy*, in the above examples. We will use constituency tests to show that, in fact, these adjectives are not able to appear inside a measure DP in the pseudopartitive structure. They are only admissible in an individuating structure.

It-clefting is one test that reveals this non-constituency. Focusing the entire direct object constituent as an it-cleft is fine in (94a, c). But if the string that should form a measure phrase is focused, the sentences sound extremely unnatural (94b, d).
(94)  a. It was **three strong teaspoons of molasses** that she added.
    b. #It was **three strong teaspoons** that she added of molasses.
    c. It was **a crunchy handful of walnuts** that he ate.
    d. #It was **a crunchy handful** that he ate of walnuts.

Topicalization yields the same result. (In order to facilitate an interpretation with focus on some
another part of the sentence than the object, I have added additional material in (95).)

(95)  a. **Three strong teaspoons of molasses**, she added to the first version of the recipe.
    b. #**Three strong teaspoons**, she added of molasses to the first version of the recipe.
    b. **A crunchy handful of walnuts**, he ate every day for his breakfast.
    c. #**A crunchy handful**, he ate of walnuts everyday for his breakfast.

What this shows us is that the sentences in (91) are only completely acceptable if the objects are
parsed in an individuating construction as in (93). The constituent that the adjective modifies
must contain the substance noun:

(96)  a. three **strong** [teaspoons of molasses]
    b. a **crunchy** [handful of walnuts]

Whatever the relationship is between the pairs of nouns in these examples, they are not
acceptable if parsed as true measure pseudopartitive constructions. But this appears to be more of
a semantic mismatch than a syntactic restriction on measure phrases. The judgments are very
different when the adjective can be construed as specifying the size of the unit or quantity in
question.
If we change the adjectives to *generous* and *small* respectively, then the it-clefted and topicalized versions become much better. There is no longer a difference between the acceptability of the a and b sentences or the c and d sentences in (97)

(97)  
   a. It was three generous teaspoons of molasses that she added.  
   b. It was three generous teaspoons that she added of molasses.  
   c. It was a small handful of walnuts that he ate.  
   d. It was a small handful that he ate of walnuts.

The topicalized sentences sound most acceptable when a focus pitch-accent is added to the stranded substance noun. We will return to the significance of this later, but for now I simply indicate this prosodic feature with capitals:

(98)  
   a. Three generous teaspoons of molasses, she added to the fist version of the recipe.  
   b. Three generous teaspoons, she added of MOLASSES to the first version of the recipe.  
   b. A small handful of walnuts, he ate every day for his breakfast.  
   c. A small handful, he ate of WALNUTS everyday for his breakfast.

These are true measure pseudopartitive constructions: the quantifier, be it a numeral or an indefinite article, forms a sub-constituent with the adjective and the measure noun. We can do away with one alternative explanation for the grammaticality of these sentences. Skeptics might argue that the apparent constituents are formed by first extraposing the *of molasses* and *of walnuts*, leaving the remnant DP free to move. But the failure of the tests for *strong* and *crunchy* above in (94) and (95) serve to confirm the validity of the constituency tests. For whatever reason, the extraposition analysis is not available for individuating measure constructions and
therefore cannot explain the success of (97) and (98), which therefore truly show constituency of the measure DPs in question.

**Superlative measure phrases**

Not only are bare adjectives possible inside measure phrases, they can also be elaborated with overt degree morphology. As we saw in the first section of this chapter, even the absolute reading of superlatives requires movement of the superlative morpheme to take scope over the adjective and noun as a constituent. So if an adjective modifying a measure noun can bear superlative morphology, then the constituent it belongs to must have space above the point where the AP merges for the superlative to raise to. In fact, superlative measure phrases do exist in English. Furthermore, these provide evidence that it is possible for a measure phrase to be introduced not only by indefinite determiners, but also by *the*. This possibility arises just in case superlative morphology is present.

(99) a. She added **the most generous teaspoons** of sugar.
    b. He ate **the smallest handful** of walnuts.

The following sentences, applying the same topicalization test as used in (95) and (98) above, confirm the constituency of the definite-marked superlative measure DPs—including the definite article.\(^\text{12}\)

\(^{12}\) The reader may note that these phrases do not pass the *it*-clefing tests as shown in (i) and (ii):

i. ??*It was the most generous teaspoons that she added of sugar.*
ii. ??*It was the smallest handful that he ate of walnuts.*

The failure of *it*-clefing here is due to information structure rather than non-constituency of the bolded phrases. A relative superlative DP fails to denote inside of an *it*-clef because the effect of the construction is to place focus on that constituent. As we saw in section 2, it is necessary for focus to be assigned to...
(100)  
  a. The most generous teaspoons, she added of sugar.
  b. The smallest handful, he ate of walnuts.

Not only are the sentences in (100) felicitous, they lend themselves to a relative reading where the substance noun receives focus. (100a) could mean that the person in question used a more generous-sized teaspoon of sugar than of any other ingredient. (100b) could mean that the person in question ate a smaller handful of walnuts than he did of any other type of nuts. We will return to this and its relevance for the NP-internal relative reading of Q-superlatives in the next section.

To summarize, we have demonstrated that measure nouns are count nouns that have their own extended NP projections. They can be modified by (appropriate) adjectives, and ultimately merge with indefinite determiners. They can even merge with the definite determiner, *the*, when the adjective is in the superlative form. The fact that both determiners and adjectives—including superlatives can be merged *inside* a measure phrase constituent strongly suggests that it has the syntactic structure of an ordinary DP, embedding a fully elaborated NP. This conclusion is hard to reconcile with the treatment of measure nouns as fundamentally different from other nouns. For example, Champollion considers a measure noun to be a unit function from degrees to numbers. *Teaspoon* maps a numeral value to the degree associated with a certain volume. On Rothstein’s analysis, too, measure nouns take bare numerals of type $n$ as their arguments, while regular nouns are modified by a numeral that has been shifted to an adjective type. But if measure nouns themselves can, in principle, be modified by adjectives, then there is no need to postulate two different modes of combination with numerals.

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some constituent external to the superlative-marked DP in order for a covert focus operator to be merged. This is why (i & ii) are so unnatural. Topicalization, as in (100), is a more appropriate constituency test because it has the right kind of information structure.
2.2.5 The NP-‘internal’ relative reading of superlative measure phrases

Let us briefly return to the interpretation of superlative FMPs and their relationship to the problem of NP-internal relative readings of quantity superlatives in English. The examples from the previous section are repeated here alongside parallel constructions with quantity superlatives in place of the nominal measure phrases. For both constructions in (101), focus on the substance NP gives rise to the reading on which a quantity of molasses is compared to that of some other ingredient. And in (102), the salient readings compare amounts of different types of nuts, or different snacks that the subject ate.

(101) a. She added the most generous teaspoons of MOLASSES.
    b. She added the most MOLASSES.

(102) a. He ate the smallest handful of WALNUTS.
    b. He ate the fewest WALNUTS.

It is clear in the pseudopartitive (a) constructions that the superlative morpheme compares the sizes of the units of measure. But indirectly, the result of using more generous teaspoons or handfuls to measure out the sweetener or nuts is a larger overall quantity of those things. This is essentially the same effect that comes out directly with Q-superlatives. In the absence of a mediating unit noun, the (b) constructions have what we have been calling an NP-internal relative reading.

When the reading derives from FMPs, the presence of an additional nominal element means that the problematic ‘NP-internal’ focus is actually external to the measure DP that contains the superlative. In terms of the syntax, then, there is no mystery as to how focus association between the comparison class of [SUP] and the focused element is achieved. We have
shown that the definite article forms a constituent with the FMP, exclusive of the substance noun. This entire constituent can raise to take clausal scope, creating an LF in which C and the focus are disjoint.

(103)

The focus operator scopes over the entire clause, so it will give rise to an alternative set in which the subject and verb are constant, while the content of the substance NP varies over walnuts and relevant alternatives to them.

While the syntax is fairly straightforward, the semantic composition of this construction is not. If a measure noun such as handful denotes a function from numbers to individuals (Krifka 1989, 98; Rothstein 2017) or from numbers to scalar intervals (Schwarzschild 2006), then it is not at all clear how it can compose with ordinary adjectives, let alone with a superlative adjective and definite article. In order to fully account for this reading, a model for the composition of measure pseudopartitives is needed that is able to accommodate complex FMP constituents.

2.3 Chapter Summary

In this chapter we have reviewed the two major approaches to relative readings of superlatives: the movement approach (Szabolcsi, 1986; Heim 1999; Hackl, 2009) and the in situ approach
(Heim, 1999; Sharvit & Stateva 2002). We have concluded that, while there are problems with both theories, the *in situ* approach has greater empirical coverage. For English it is also preferable because it does not require deletion of the definite article. Clearly, the presence or absence of overt definite-marking has semantic import when it comes to the availability of the NP-internal relative readings that are at the heart of our inquiry. This is further reason to prefer an approach that does not treat the definite article as empty or redundant.

We have also seen that there is evidence for, and clear advantages to treating *much, little, many* and *few* as adjectival. A decompositional approach to *most, fewest* and *least* that identifies them as superlatives of these Q-adjectives is preferable the one that analyzes them as monolithic generalized quantifiers. Hackl’s (2009) approach is able to generate the majority reading of bare *most* and provides a compelling explanation for the non-existence of a ‘minority’ reading for *fewest*. It also allows us to account for the external relative readings Q-superlatives give rise to on parallel with other gradable adjectives.

But when it comes to the NP-internal relative readings, this parallel treatment seems to break down. Both the movement and *in situ* approaches to relative superlatives make the wrong predictions for English. The former overgenerates—predicting that NP-internal readings should be available for Q-superlatives and non-Q-superlatives alike. And the latter undergenerates, predicting that quantity superlatives should never allow these readings in English. What is needed, then, is an adjectival approach to these quantity words that is nevertheless able to distinguish between their syntax/semantics and that of non-quantificational adjectives.

In the second half of the chapter we considered the work of Schwarzschild (2006), who observes semantic parallels between Q-adjectives and what we label FMPs (full measure phrases) in the measure pseudopartitive construction. This work distinguishes between the
simplex, attributive measure phrases which directly modify their substance NPs, and the full measure phrases that Schwarzschild proposes are introduced by a functional (MON) head. A survey of the literature on measure pseudopartitives reveals that, while the concept of ‘monotonic’ or ‘extensive’ measures is crucial to understanding which FMPs may appear with which substance nouns, there is a fundamental problem with defining this property. Nouns such as inch and mile that refer to one-dimensional measures of three-dimensional objects do not satisfy the definitions, unless the concept of mereological parthood itself is ‘relativized’ in a way that has yet to be formalized.

We have also demonstrated that FMPs have even more complex internal structure than previously observed. Definite-marked measure phrases containing superlative adjectives are able to give rise to a relative reading that is strikingly similar to the NP-internal relative reading of most, least and fewest. This suggests that superlative Q-adjectives are introduced in a structure like that of FMPs, in which they form a ‘measure DP’ constituent with the definite article. In order to solve the problem of how Jamie ate the most CHOCOLATE cupcakes has the reading that compares Jamie’s chocolate cupcake consumption to his consumption of other flavors, then, we need a satisfactory theory of measure pseudopartitives that can accommodate complex measure DPs. Such a theory should ideally not only stipulate but explain the monotonicity constraint, and it should be able to distinguish between acceptable one-dimensional measures and those that are ‘truly’ non-monotonic with respect to the substance NP. The next chapter will present a new approach to measure constructions that meets these criteria, using an individual-based denotation for measure nouns. A key element of this approach will be formalizing the notion of ‘the relevant part-whole relation’ as a dimensionally-parameterized mereological parthood relation.
Chapter 3

Measure Pseudopartitives Proposal

In this chapter, I propose a new approach to measure pseudopartitives. Most approaches to date only seriously consider constructions with simple measure phrases that contain a numeral plus either a unit measure or a container noun (Krifka 1989, Champollion, 2010, 2015; Rothstein 2008, 2010, 2017). The findings of the previous chapter demonstrate the need for a model that can accommodate vague measure nouns, as well as the full range of determiners, modifiers and morphology that appear inside measure phrases. Such a model must also incorporate (or better yet explain) the monotonicity constraint, and it must do so in such a way that the acceptability of pseudopartitives with one-dimensional and two-dimensional measures is predicted. I achieve this by modeling measure nouns as individual-based count predicates. An important component of this proposal is that mereological parthood itself is parameterized for a particular dimension.

I begin with the assumption that measure phrases in these constructions are DPs which refer to (or quantify over) entities of type e, rather than degrees or scalar intervals. This measure argument denotes a (material or abstract) entity that is bounded on a the relevant dimension. The substance NP, which describes a (material or abstract) entity with certain qualities, is quantized by its relation to this argument. The function of the MON head on this approach is partitive. It asserts that the measure phrase it introduces is a material part\(^{13}\) of the plurality or mass described.

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\(^{13}\) The term ‘material part’ best describes the relationship in those cases where physical objects and substances are concerned. The metaphorical extension of this model to events and to abstract entities such
by the substance NP. I assign MON a denotation similar to what is proposed by Ionin et al (2006) for *of* in ‘true’ partitives. While the ‘part’ argument itself denotes an individual, not a degree or interval, it is (often) characterized by its size along some dimension, which I will continue to represent using degree semantics, (albeit with a very minimal definition of scales).

In order to analyze these ‘monotonic’ measure constructions as partitives, we arrive at the conclusion that mereological parthood itself must be understood as a dimension-specific relationship. I draw on Champollion’s (2010) notion of ‘strata’ and Krifka’s (1989) ‘sorts’ to formalize the dimensional parthood relation. What Schwarzschild defines as a presupposition of monotonicity then falls out from constraints on the parthood relations introduced by the MON head. The entity described by the measure DP must be able to be construed as a dimensional part with respect to the sort referenced by the substance NP.

Because measure phrases are modeled as individual-based, this approach is able to cover not only simple unit + number phrases, but also measure phrases with vague amount nouns that don’t correspond to exact measurements. It is also straightforward to derive more elaborated measure phrases such as *three brief moments* and *the smallest handful*. Adjectives and determiners within such measure DPs can be assumed to have their conventional denotations and no polysemy or type-shifting is required. However, we will want to account for limits on which modifiers are acceptable with which measure nouns. I relate this to a more general semantic constraint on adjective-noun pairings, which can nevertheless be made fairly precise within the domain of measure phrases.

This model for the syntax and semantics of measurement sets the stage for a solution to NP-internal relative readings of both superlative pseudopartitives with overt measure nouns (*the* as “ideas” and quantities of heat has the same formal properties but applies to different domains and dimension as we shall see.)
the smallest handful of walnuts) and the covert pseudopartitive construction that I will propose underlies Q-superlatives (the most/least/fewest walnuts). The constraint on adjective-noun pairings inside measure phrases will be one part of the solution to why non-Q-superlatives cannot appear in the covert construction and hence cannot generate NP-internal relative readings.

3.1 Partitive Mon head

We have established that the full measure phrases appearing in pseudopartitive constructions are relatively complex constituents in and of themselves. The presence of plural morphology, adjectival modification, and weak quantifiers indicates that they should be analyzed syntactically as DPs rather than DegP or NPs. In order to understand how this full DP constituent is then integrated into the larger pseudopartitive measure construction with the substance NP, let us first consider a close cousin, the so-called ‘true partitive’ construction. Alongside the pseudopartitives we have been considering, there are the very similar sentences in (104). These differ from the constructions in the previous chapter (repeated here for convenience as (105)) only in that the substance noun is preceded by a determiner.

(104)  a. She added three generous teaspoons of the/her/that molasses.
        b. He ate a small handful of the/his/those walnuts.

(105)  a. She added three generous teaspoons of molasses.
        b. He ate a small handful of walnuts.
The syntactic form and level of complexity of the measure phrase constituent in partitives and pseudopartitives is the same (as demonstrated by the fact that the identical measure phrases are acceptable in (105) and (104)). This means that whatever their internal syntax and semantics is, they can be expected to denote the same type of argument or predicate in either construction. True partitives are also subject to the monotonicity constraint. Dimensions that are non-monotonic with respect to the substance noun are unacceptable in these constructions:

(106)  #John drank seventy degrees Fahrenheit of the water.

I assume, following Schwarzchild (2006) that the constraint is somehow introduced by the MON head in pseudopartitives. Schwarzchild assumes that of in both partitives and pseudopartitives is the spell out of the same functional head, though he does not expand on what is required for MON to compose with a definite DP in the former case. The implication of this assumption is that the measure phrase in both types of construction is a predicate of scalar intervals, introduced with the presupposition that the scale must be one that is monotonic.

On the analyses proposed by Barker (1998) and Ionin et al. (2006), the measure phrase in a ‘true’ partitive construction is a predicate of individuals. The morpheme, of, is a transitive preposition which asserts that this individual is a material part of the entity denoted by the lower

14 Schwarzchild suggests that because MON has a higher F value (Grimshaw, 1990) than D, of must precede the determiner in a definite xNP, and this results in a partitive construction like (i):

(i)  [MonP [Five inches] [of [DP that [ribbon]]]]

However, it easy to show that the reverse order is also possible. A definite determiner can appear above a measure phrase as in (ii) as well. Since only weak quantifiers can appear as part of measure phrases, the demonstrative must be interpreted as an element in the xNP of the substance noun.

(ii)  [DP That [MonP [five inches] [of [ribbon]]]]
Barker argues that partitive *of* must assert *proper* parthood, in order to account for the anti-uniqueness effects. However, Ionin and colleagues give a pragmatic explanation for these effects and instead have improper parthood in their denotation.\footnote{Notice that proper-parthood of ‘true’ partitives is a cancellable inference, not a part of the truth-conditional meaning of these constructions, as the examples in (i) and (ii) demonstrate:}

Their entry, which I label **PART** is shown in (107). It takes an individual that denotes the ‘whole’ and returns the property of being a part of that individual.

(107) Partitive head denotation:
\[
[[\text{PART}]]_{<e,et>} = \lambda x \lambda y. y \sqsubseteq x
\]

The entry for the **MON** head that I propose to start from is based on this. I will argue that the monotonicity constraint is active in both partitives and pseudopartitives because both **Part** and **MON** make reference to parthood in their assertions.

Rather than taking a DP of type *e* as internal argument like the **Part** head, **MON** takes an argument of type <*e,t*>, and returns a transitive property. This makes it compatible with the **MONP** structure for pseudopartitives that we are assuming. The order of part and whole arguments is reversed, so that **MONP** composes to denote a property of the individual that is the whole. This structure is shown in (109).

(108) **MON** head denotation (initial):
\[
[[\text{MON}]]_{<et,<e,et>} = \lambda P \lambda y \lambda x. P(x) \land y \sqsubseteq x.
\]
In a pseudopartitive construction such as this, the entity described by the substance noun is not definitely identified or quantized at the point in the derivation when $MON$ is merged. The assertion that it contains a material part that has a certain minimal size therefore serves to narrow down the possible referents to things that themselves have at least that size. This is in contrast to a ‘true’ partitive construction in which the whole is already identified or quantized and the identity of the measure phrase constituent in no way modifies that whole.

### 3.2 Dimension and the ontology of parthood and scales

Before going farther I let me pause to clarify the concepts and formalisms that I make use of. Some of these are familiar from the literature. I adopt Krifka and Champollion’s (2016) definition of classical extensional mereology (C.E.M), but I will expand on Krifka’s (1989) notion of ‘sorts’ to distinguish between various categories of individuals that are all of type $e$, yet which cannot participate in parthood relations with each other. I assume a very minimal definition of scales, rejecting the idea that these are ‘calibrated’ to a particular unit (Rothstein, 2017), or that they are homomorphous with sequences of rational numbers. The notion of a **dimension**, as I will use it, is quite flexible and contextually dependent. Nevertheless, I assume that the grammar makes reference to the concept of dimension in the valuation of both **scales** and
sorts. The way in which a scale and a sort that are built on the same dimension relate is consistent and can be formalized, while the particular interpretation of the dimension at the interface with the cognitive-interpretive system depends on world knowledge and context.

3.2.1 Dimensions

The term dimension (DIM) refers to a particular way in which an entity extends in (real or abstract) space/time. This is necessarily relative to a particular context. For the extension of objects in space along one dimension this may be understood in terms of an axis in space. Some dimensions that are available as interpretive frameworks in Figure 11 include the diameter of the single pepper (LENGTH 1), the axis that follows the natural curve of that pepper (LENGTH 2) or the length of the row of peppers (LENGTH 3).

![Pepper Dimensions](image)

Figure 11: Pepper Dimensions

The various dimensions of AREA are also relative to a particular point of view. Just as the curve of the pepper might be part of the meaning of LENGTH 1, the meaning of an AREA dimension could be limited to extension on a flat plane, or could translate to the curved surface of an object.
Dimension may also refer to aspects of what are normally considered *intensive* properties or qualities, such as temperature, brightness etc. Human cognition seem to be able to imagine these (and language to represent them) as quasi-substances that exists in an abstract space. Importantly, we understand that this abstract space is not coextensive with three-dimensional space but orthogonal to it.

The dimension of temperature \((\text{TEMP})\) does not track any real spatial dimension. But due to the metaphor whereby the property *heat* is imagined as a substance, we can talk about extension along the temperature dimension. We can further observe that nominals referring to change of state events, such as *global warming*, are conceived of as quasi-substances that extend on the \(\text{TIME}\) dimension as well as in the abstract space of the properties themselves.

The way in which an old-fashioned thermometer measures heat by means of the expanding or contracting volume of mercury serves as a particularly clear visual. But the same metaphorical extension can apply to *brightness, redness, wisdom, love* etc. though the relative size of quantities of these may be vague and highly subjective.

### 3.2.2 Scales

A *scale* is a total ordering of abstract degrees, where a degree represents the size of an entity along some dimension. Natural language makes reference to these cognitive objects (degrees and scales) to rank the relative size of individuals along a particular dimension. I assume that there is a single scale of abstract one-dimensional length-degrees \((S_L)\), which is referenced by adjectives such as *tall, long, wide*, and measurements such as *inch, centimeter, mile*, etc. regardless of whether they describe height, depth, length or some other orientation in space. This scale is depicted in Figure 12, with some arbitrary degrees \((d_a, d_b, d_c, d_d)\) and an interval, \(I_{cd}\), labeled for
purposes of exposition. This scale has a lower bound and no upper bound, corresponding to the intuition that there is minimum length (or width, etc.) that an object can have in order to exist in space, but there is no maximal length.

![Scale for length](image)

Figure 12: Scale for length

The scales for LENGTH, AREA and VOLUME are disjoint and I do not assume any mapping between their degrees. The reason for this is that I assume that expressions of size along these dimensions in human language are based on our primitive sense of relative size. Mathematical relationships between measurements or between numbers that we are able express using language are deduced from properties of the real world that we observe. The physics and logic underlying these facts need not be part of the linguistic system used to express them.

Scalar intervals may be defined as sub-sections of a scale. The interval \(<d_b, d_d>\) is a set that includes those two degrees and every degree that falls between them. I assume that these intervals themselves cannot be ‘measured’ (contra Schwarzschild 2006). If scales are dense (Fox and Hackl, 2006) then between any two degrees on a scale there is an infinite number of degrees. And since scales are abstractions—they do not exist in space/time—there is no way to distinguish between the ‘size’ of two non-overlapping intervals such as \(<d_b, d_d>\) and \(<d_a, d_b>\) on \(S_{\text{LTH}}\).

\[\text{We can say that if one interval properly contains another it is “larger” in some sense. Technically, the assertion that there is no way to compare the size of non-overlapping intervals on a scale is only true if in}\]

80
3.2.3 Measure functions

A measure function is a relationship between individuals and scales, parameterized to a dimension. It takes an individual that extends along any dimension in a real or abstract space, and maps it to a degree on the scale that denotes its size along that dimension. Each measure function references a unique scale. For example, the measure function in \((\mu_{\text{L, DIM}})\) can map the first pepper in Figure 11 (repeated below) to a degree that represents its width, if the dimension is construed based on the axis labeled \text{LENGTH 1}, or to a degree that represents its (curvilinear) length if the dimension is construed based on the axis labeled \text{LENGTH 2}.

(Figure 11, Pepper a)

Measurement along two distinct dimensions of an entity or entities may, of course, be mapped to the same degree as long as the dimensions both refer to the same scale.\(^{17}\)

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\(^{17}\) Because all one-dimensional spatial measure functions map to the same scale \((S_1)\), comparisons like the following are possible:

(i) The board is three inches longer than the table is wide.
(ii) I’m two feet shorter than the pool is deep.

The adjectives \textit{long, wide}, etc. narrow down the possible interpretations of the dimensions in these expressions, but they do not indicate distinct sets or orderings of degrees.
3.2.4 Numbers versus cardinality degrees

There is evidence that human cognition relies on two distinct systems for representing cardinality (Dehaene 1997) and that this is reflected in the language faculty.

Degrees of cardinality are not numbers. Counting allows for precise comparison at any magnitude, while, I assume, following Solt (2011) that the scale of cardinality is based on a more primitive approximate number system (ANS), which quickly loses its precision for quantities greater than three or four. The relationship between degrees and numbers can be conceptualized as indicated by the illustration in Figure 13. The lowest degrees of cardinality can be definitely identified with the numbers 1, 2, and 3. But the higher degrees are cannot be defined in relation to numbers, only in relation to each other (the ordering of the scale).

![Figure 13: Numbers versus cardinality degrees](image)

Although numbers are based on a procedure of counting and not on a concept of size on a dimension, they are also context-dependent in a way that is similar to the way the dimensions referenced by scales is context-dependent.\(^\text{18}\) For our purposes it will suffice to represent ordinal numbers in the object language as modifiers of type \(<<e,t>,<e,t>>\). They take a property of individuals, \(P\), as an argument, and return a property of individuals that have \(P\) and that add up to a certain exact number of \(P\)-atoms. The general formula for number denotations is given in (110).

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\(^{18}\) Indeed, there are many factors to be taken into consideration when deciding what counts as a particular number in a particular context. See Rothstein 2010 and 2017 for thorough discussion of this issue.
\[(110) \quad \llbracket n \rrbracket = \lambda P \land \lambda x. P(x) \land |x_p| = n\]

For example, the entry for the number three given in (111) is relative to the property of the count-predicate it modifies. So when it combines with the plural NP, plant, the resulting NP picks out individuals that are sums of atomic plants, each containing three ‘plant-atoms’.

\[(111) \quad \llbracket \text{three} \rrbracket = \lambda P \land \lambda x. P(x) \land |x_p| = 3\]
\[
\llbracket \text{plants} \rrbracket = \lambda x. *\text{plant}(x) \\
\llbracket \text{three plants} \rrbracket = \lambda x. \ast \text{plant}(x) \land |x_{\text{plant}}| = 3
\]

### 3.2.5 Domains, sorts and dimensions in mereology

Link (1983) proposes that the extensions of plural and mass first-order predicates have lattice structures. Krifka (1989) assumes that the entire domain of any predicate is structured in this way. To formalize this, he describes these in terms of an abstract predicate that characterizes a domain of a certain sort. Its extension is structured as a complete join semi-lattice without a bottom element. He distinguishes explicitly between three sorts: O, the sort of individuals, E of events, and T, of temporal intervals. Each of these is structured as a mereology, but is disjoint from the others. I adopt this notion, but apply it differently from Krifka, who mainly uses the first two sorts to separate parthood relations within the domain of individuals (of type e) from those within the domain of events (of type v). Our inquiry is limited to the domain of individuals, yet within this type I distinguish between different semantic categories, for which I use the label sorts.
Krifka expresses ambivalence as to whether countable objects and mass substances should be considered parts of a single sort, but we will assume that they are, and identify this as sort O. In our model, the extension of O includes all of the material entities in the world that extend three-dimensionally and all sums thereof. However, it does not include any individuals that do not occupy three-dimensional space. Abstractions such as ideas, beauty, or destruction, we will assume do not belong to sort O, regardless of whether they belong to count or mass predicates. While these are predicates of individuals, type e, the individuals do not occupy three dimensional space in the same way and so cannot participate in material parthood relationships with physical objects and substances.

A large group of these non-material nominals are those which extend in time (as well as space). For example, a day, some dancing, and the trip from NY to Boston, are all phrases that refer to or quantify over individuals that are events or activities rather than material things. We will assume that these, too, belong to type e, but form a separate sub-domain. The predicate, A, produces the lattice that structures this domain of activities and actions. This separation of sorts is necessary because parthood relations between events and activities (sort A) are disjoint from the material parthood relations of physical objects (sort O). Intuitively it makes sense to assert that jumping rope for ten minutes is a mereological part of an exercise routine, or that a one-foot segment of rope is a mereological part of a six-foot jump rope. But the relationship between a jump rope and an exercise routine is not a mereological one. Even though these are of the same syntactic category and type, we intuitively feel that the concepts they represent belong to disjoint subdomains.

19 The question of the lexical relationship between nominal predicates of individuals that are eventive (our sort A) and verbal predicates of events (Krifka’s sort E) is an interesting one, but not our main concern. We will simply assume that they have separate domains and therefore relationships between nominal predicates and verbal predicates must be mediated by thematic heads or adpositions, regardless of whether the nominal is of sort A or O.
The ability of human language to refer to abstract entities which do not extend or exist in three-dimensional space alerts us to the existence of additional sorts. For example we can imagine that there is a sort which structures the domain of individuals that belong to the sets denoted by knowledge, ideas and information. In the age of computers we can even measure the ‘space’ these take up in terms of bits, gigabytes and terabytes. Hence, entities in this sort extend on a dimension corresponding to relative size of data. Let us assume that sorts can be generated on an ad-hoc basis for any set of individuals that extend on one or more dimensions.

Krifka identifies a mereological relation as formally identified with its sort by its subscript. I adopt this convention along with the assumption that such a relation is only defined between individuals in the extension of that sort. Thus for any sort, Z, the relations (x ≤_Z y, x ⊔_Z y, x ⊏_Z y, x ⊤_Z y) are defined as long as x and y belong to sort Z, in which case they denote the appropriate relations in Classical Extensional Mereology. In section 3.4 a refinement—the notion of dimensional parthood—will be introduced. For the moment we will proceed with the tools discussed here to begin constructing an individual-based semantics of measure nouns and phrases using concrete examples from sorts O and A.

3.3 Partitive semantics of measure constructions (first pass)

In this section I propose an individual-based denotation for measure nouns that will facilitate the composition of full measure phrases in all their complexity. This will allow us to model pseudopartitive measure constructions in terms of the mereological parthood relation asserted by the MON head. I will begin with the specific examples of a weight measure noun – ounce, and a time measure, hour.
3.3.1 Measure nouns

In simple terms, *ounce* is the set of discrete individuals within sort O that have a certain weight. For example, of the things pictured in Figure 14 this set contains: the sum of the two half-ounce weights on the right (c); one of the loose peppers next to the jar (b), and the portion of brine that fills the bottom of the mason jar pictured there to just below the one-fluid oz. mark (a).

![Figure 14: Individuals in the set ounce](image)

Similarly, *hour* denotes the set of individuals that are events of a certain duration: John exercising from six to seven AM, each movement of the sun across 15° of the sky, the last 4,800 heartbeats that I experienced, etc. The property that the individuals in each of these sets has in common is their equal size along some dimension. Everything in sort O can be mapped along the weight dimension to some degree on the weight scale ($S_{WGHT}$). Of those things, the extension of *ounce* contains all the individuals that are mapped to the same constant degree on the scale. Everything in sort A extends in time, and the set denoted by *hour* contains individuals that map to the same constant degree on the time scale, ($S_{TIME}$), as shown in Figure 15.
For convenience, I will label the constant on the relevant scale with a subscript \( d_h = d_{\text{hour}} \) but in principle the ‘name’ of the degree is derived from the name of the set of like-sized entities that map to it, not the reverse. The denotation of \textit{hour} incorporates the measure function and is a property of individuals, not a degree or set of degrees. In other words, it is important to that on our minimal definition, scales do not themselves make reference to units of measure.

\[
(112) \quad \llbracket \text{ounce} \rrbracket = \lambda x. \mu_{\text{WGHT}}(x) = d_{\text{ounce}} \\
= \{ \text{a medium-sized Greek pepper, a one-ounce lead weight, a portion} \\
\text{slightly less than 1 fluid oz. of pickle-brine} \}
\]

\[
\llbracket \text{hour} \rrbracket = \lambda x. \mu_{\text{TIME}}(x) = d_{\text{hour}} \\
= \{ \text{John’s exercise, a 15° sun movement, those 4,800 heartbeats…} \}
\]

### 3.3.2 Full Measure Phrases

Measure nouns in this model can be pluralized by Link’s star operator like ‘ordinary’ count nouns. I assume that this operator is introduced by the Number (NUM) head. It takes an NP that denotes a set of atomic individuals and creates a predicate that holds of the atoms in that set and
any sums thereof. The pluralized noun *ounces*, therefore, denotes the lattice of everything that is an atomic ounce as well as any sums formed from atomic ounces.

\[
\text{(113)} \quad [\text{NUM}_{\text{PL}}] = \lambda P_{<c,t>} \lambda y_c: \forall x[P(x) \to \exists z[\text{ATOM}(z) \& z \subseteq O x]]. y \in *\lambda x_c. P(x)
\]
\[
= \lambda P\lambda y.*P(y)
\]

\[
\text{(114)} \quad [\text{NUM}_{\text{PL}}](\langle\text{ounce}\rangle) = \lambda y. y \in *\lambda x_c. \mu_{\text{WGHT}}(x) = d_{\text{ounces}}
\]
\[
= \lambda y. *\text{ounce}(y)
\]

A cardinal number may adjoin as a specifier of this plural NumP, taking the property (*ounces*) as the criterion of atomicity.

\[
\text{(115)} \quad [\text{twelve}] = \lambda P\lambda x: \text{PL}(P). P(x) \& |x_p| = 12
\]

\[
\text{(116)} \quad [\text{twelve ounces}] = \lambda x. *\text{ounce}(x) \& |x_{\text{ounce}}| = 12
\]

A sum of individuals that each measure an ounce on the weight dimension and that contains exactly twelve distinct atoms (that each have the ounce property)

An important consequence of this is that Kratzer’s counting principle (2012:168) will apply to the interpretation of numbers inside measure phrases.

\[
\text{(117)} \quad \text{Counting Principle}
\]

A counting domain may only contain non-overlapping individuals.

While there are potentially an infinite number of ways to divide the pickled peppers in the mason jar into one-ounce parts, out of these only non-overlapping individuals may simultaneously be counted as *ounces*. For example, the portions outlined by dotted lines in Figure 16 may be counted as twelve discrete ounces, but the circled portion may not count as a thirteenth.
On the other hand, the predicate *twelve ounces* itself could apply to any portion of matter in a given domain that satisfies the counting principle. If the weight of the glass jar itself is one and a half ounces, then *twelve ounces* holds of the material the jar is made up of plus a 10½-ounce portion of its contents. Measure nouns and measure phrases refer to atomic individuals and sums, but because these terms make no reference to properties other than size on some dimension these are odd collections of individuals. As such, the set denoted by *twelve ounces* has a potentially infinite number of members within any domain.

For concreteness, we will assume that the measure NP *twelve ounces* merges with a covert existential quantifier, as defined in (118). The DP then has the denotation in (119).

\[
\exists \lambda P \lambda y. P(y) & Q(y)
\]

\[
\exists \text{twelve ounces} = \lambda Q \exists y. \text{*ounce}(y) & |y| = 12 & Q(y)
\]

As an NP, *twelve ounces* has in its extension every portion of matter in the sort O, that is a sum of twelve individuals each of which can be counted as a distinct *ounce*. The existentially
quantified DP, *twelve ounces*, is of type \(<e,t,t>\). It will take a property of individuals and return the assertion that there exists an individual that has that property which is also a sum of twelve distinct ounce-atoms. Now that we have (at least provisionally) defined the measure phrase constituent we will see how it composes with the substance NP in a pseudopartitive construction.

### 3.3.3 Composition of MONP

In (120), below, the definition of MON is still provisional, but is slightly updated. Having adopted the notion of sorts which generate disjoint mereologies, we must assume that anything encoding such a relationship has a parameter for this sort. If we take a plural NP, *peppers*, (of sort O) as our substance property, then MON will necessarily encode the parthood relation that is generated by this sort, \((\subseteq O)\). The construction will be interpretable if the measure DP can be construed as something that is also in the extension of O. The MON head combines with the substance NP by functional application, to generate a transitive property of type \(<e,<e,t>>\).

(120)

\[
\begin{align*}
\llbracket \text{NP}_{\text{subs}} \rrbracket &= \lambda x. \ast \text{pepper}(x) \\
\llbracket \text{MON}_O \rrbracket &= \lambda P \lambda y \lambda x. P(x) \land y \subseteq O x. & \text{definition} \\
\llbracket \text{MON}' \rrbracket &= \llbracket \text{MON}_O \rrbracket (\llbracket \text{NP}_{\text{subs}} \rrbracket) = \lambda y \lambda x. y \subseteq O x \land \ast \text{pepper}(x) & \text{by FA}
\end{align*}
\]

This new property is meant to take an individual as its argument and to return a predicate of individuals that are sums of atomic peppers and that contain that individual as a material part. Instead of a referential DP, however, the existentially quantified measure DP merges in its specifier, as shown in (121).
The type mismatch between the measure DP and Mon' is resolved by QR, in case the containing DP is indefinite. If the containing DP is definite, then QR is blocked and we must include an empty operator in order to interpret the indefinite measure phrase inside the opaque DP. The derivation of this definite case is shown in (122).

Following Sharvy (1980) I assume that the definite article applied to plurals denotes the maximal sum of the individuals that have the property as long as such an entity exists, otherwise
it is undefined. Because this contains another mereological relationship—the sum operation—we will assume that, like the MON head, the definite article has a sort parameter.

(123) \[ \text{the}_0 = \lambda P : \exists x [x \in \exists o P], \exists o P \]

(124)

\[
\begin{align*}
[\text{MON}] &= [\text{MON}'] (t_i) = \lambda x. t_i \in_o x \land * \text{pepper}(x) \quad \text{by FA} \\
[\text{NP}_2] &= [\text{MONP}] (t_i) = t_i \in_o t_2 \land * \text{pepper}(t_2) \quad \text{by FA} \\
[\text{NP}_3] &= \lambda y. y \in_o t_2 \land * \text{pepper}(t_2) \quad \text{by PA} \\
[\text{NP}_4] &= [\text{DP}_{\text{Meas}}] ([\text{NP}_3]) = \exists x [* \text{ounce}(x) \land |x_{\text{ounce}}| = 12 \land x \in_o t_2 \land * \text{pepper}(t_2)] \quad \text{by FA} \\
[\text{NP}_5] &= \lambda y \exists x [* \text{ounce}(x) \land |x_{\text{ounce}}| = 12 \land x \in_o y \land * \text{pepper}(y)] \quad \text{by PA} \\
[\text{NP}_6] &= [\text{NP}_3] = \lambda y \exists x [* \text{ounce}(x) \land |x_{\text{ounce}}| = 12 \land x \in_o y \land * \text{pepper}(y)] \quad \text{OP is empty} \\
\text{[DP]} &= [\text{the}_0] ([\text{NP}_6]) = \exists o \ (\lambda y \exists x [* \text{ounce}(x) \land |x_{\text{ounce}}| = 12 \land x \in_o y \land * \text{pepper}(y)]) \\
& \quad \text{where } * \text{ounce} = \lambda y. y \in * \lambda x. \mu_{\text{WGHT}} (x) = d_{\text{ounce}}
\end{align*}
\]

The DP will be defined if there exists a plurality of peppers that materially contains something that is a sum of twelve distinct individuals each of which is an ounce, and if defined it will refer to the maximal such entity. If the presuppositions are met, then the sentence *John ate the twelve ounces of pickled peppers* will have the truth conditions in (125).

(125) \text{ate} (\exists o (\lambda y \exists x [x \in * \lambda z. \mu_{\text{WGHT}} (z) = d_{\text{ounce}}] \land |x_{\text{ounce}}| = 12 \land x \in_o y \land * \text{pepper}(y)]), j )

---

20 For simplicity, I am ignoring the domain restriction that necessarily comes with such a definition. *The peppers* refers to the sum of peppers in a place and time relevant to the discourse, not all peppers in the universe that have ever existed. The sum operator applied to a singular NP, then refers to the unique individual in the context that has the property, if such an individual exists, and is undefined otherwise.

21 I have nothing further to say about this parameterization of the article at this time. It does have interesting implications for the semantics of DPs. One possibility is that this is somehow responsible for the fact that degree operators such as the superlative morpheme cannot raise out of definite-marked DPs. I leave this to future research.
This asserts that there is something that John ate, which consists of the maximal entity that is peppers, and that contains something that is a sum of twelve atomic individuals that can each be mapped to dounce on the weight scale.

### 3.4 Dimensional parthood

At this point it is necessary to revisit the notion of monotonicity and, in particular, the sticky problem that arises when the monotonicity constraint is applied to one- and two-dimensional measures of three-dimensional objects and substances. The reader will recall from Chapter 2, that a measurement of depth is predicted to be unacceptable in (126) because the dimension DEPTH is not extensive with respect to the NP *water*.

\[(126) \text{ There is one inch of water left in the bottle.}\]

A slightly modified version of the relevant illustration from Chapter 2 is repeated here as Figure 17. Recall that we are assuming that there is a single scale for LENGTH/DEPTH etc. The measure function is indexed for the vertical DEPTH axis in the scenario described here. This measure function is not extensive because it is not additive: the sum of the measures of the two portions \((\mu_{L,DPHT}(a) + \mu_{L,DPHT}(b))\) is not the measure of the sum of the two portions \(\mu_{L,DPHT}(a \sqcup b)\).
Figure 17: One inch of water in a bottle (divided vertically)

Depth also fails the criterion of monotonicity, as long as we insist on mereological parthood in the definition. The part $b$ is a proper part of the whole quantity of water, but it does not measure strictly less than the whole on the depth dimension.

A similar problem arises for our proposal that measure nouns themselves are sets of individuals of a certain size. Parallel to *ounce*, the word *inch* has the definition in (127), and the $\text{MONP}$ denotes the set of individuals that have a mereological part that is in this set, as shown below.

\[
\begin{align*}
(127) \quad & \llbracket \text{inch} \rrbracket = \lambda z. \mu_{L \text{DPHT}}(z) = d_{\text{inch}} \\
(128) \quad & \llbracket \text{MONP} \rrbracket = \lambda y \exists x. \mu_{L \text{DPHT}}(x) = d_{\text{inch}} \land x \subseteq_{O} y \land *\text{water}(y)
\end{align*}
\]

The problem is that the following sets also contain this same quantity of water:

\[
\begin{align*}
(129) \quad & \text{a. two inches of water} \\
& \text{b. } \lambda y \exists x [x \in *\lambda z. \mu_{L \text{DPHT}}(z) = d_{\text{inch}}) \land |x_{\text{inch}}| = 2 \land x \subseteq_{O} y \land *\text{water}(y)]
\end{align*}
\]

\[
\begin{align*}
(130) \quad & \text{a. } n \text{ inches of water} \\
& \text{b. } \lambda y \exists x [x \in *\lambda z. \mu_{L \text{DPHT}}(z) = d_{\text{inch}}) \land |x_{\text{inch}}| = N \land x \subseteq_{O} y \land *\text{water}(y)]
\end{align*}
\]
(129) is verified by the existence of parts a and b in Figure 10. Each measures one inch on the depth dimension, so there are “two inches of water” in the jar. And one can imagine subdividing these parts further to find any number of disjoint individuals that each measure one-inch depth, to verify (130). In fact, the number becomes meaningless because the water could in principle be divided into any number of increasingly thin one-inch depth portions. A solution to this problem lies in formalizing Schwarzschild’s ‘relevant part-whole relation.’

3.4.1 Moving towards a formal notion of ‘relevant part-whole relation’

Krifka states that the measure phase must be an extensive measure function that is compatible with the lattice structure of the substance NP. But as we have shown in Chapter 2, it is not logically possible for any one- or two-dimensional measurement to satisfy his definition of compatibility with three-dimensional individuals. Schwarzschild’s formulation of the monotonicity constraint can be seen as an improvement on this because it is weak enough to admit measurements of length and depth. While Schwarzschild’s notion of “the relevant part-whole relation” is not spelled out formally, it does capture the idea that the constraint on measure pseudopartitives depends not only on the properties of the measure phrase, but on how the substance NP is understood to be partitioned. I believe Champollion (2015) underestimates the potential of this. As he interprets Schwarzschild’s approach, “measure phrases do not test for monotonicity with respect to the mereological part-whole relation, but only with respect to a part-whole relation which [Schwarzschild] sees as contextually supplied” (p. 125). This implies that there is only one possible mereological part-whole relation, and that context could not play a role in supplying the parameters of that relation.
Nevertheless, Champollion himself comes close to formalizing the notion of “parthood along a dimension” in his definition of the higher-order property of Stratified Reference. According to Champollion (2015a: 110ff) “stratified reference requires a predicate that holds of a certain entity or event to also hold of its parts along a certain dimension and down to a certain level of granularity” (emphasis added). But what is a ‘part along a dimension’? According the definition of Stratified Reference, it is one that measures “very small” along that dimension, or according to Restricted Stratified Reference, simply parts that are each smaller than the whole on that dimension. Herein lies the problem. In fact, an entity can be divided into parts that measure very small on a certain dimension even if the partitioning itself is unrelated to that dimension. This is what Champollion’s formula generates. It is sufficient as a presupposition, allowing LENGTH and DEPTH measures to satisfy the constraint. But if we are to define measure nouns themselves as sets of material parts, we need something that will actually generate the ‘strata’ that both Schwarzschild and Champollion seem to have in mind.

Because we live in a world of three-dimensional objects, we default to thinking of material parthood as a relationship between masses of “stuff”. But things can be partitioned not only volumetrically, but also along other dimensions. An object with length can be conceived of as having a natural lengthwise partition. Countable objects are naturally divisible into collections of smaller numbers of those objects or into the atomic individuals their descriptors denote. We can apply the same spatial logic to the partitioning of non-material things. Activities, such as running and jumping, can be partitioned along a temporal dimension. Heat can be partitioned into temperature-degree parts.

Dimensional parthood is a mereology which embeds a total ordering ‘orthogonal’ to a dimension on the parts of an entity. An entity can be a dimensional part of another if both
extend along (and hence can be measured on) that dimension. For example, both (countable) objects and (non-countable) substances that are physical entities may participate in the parthood relation on the volume dimension since both share and extend in the same three-dimensional space.

Parthood can also be defined along non-spatial dimensions, for example within the domain of events. Consider a twenty-minute exercise routine that consists of jumping-jacks and jogging. Each jumping jack is a bounded, atomic event, while the jogging is an atelic activity. But with respect to the larger event of the exercise routine, all of these are time-parts of it.

Three-dimensional objects have parts on various dimensions. As we observed in section 3.2, even the three basic dimensions, length, width and height, are understood relative to a particular context. The Strand bookstore in NYC advertises that it is home to “18 miles of books”. Within this context, we picture books standing in rows on shelves. The dimension of the individual book that is counted towards the length is the one that is usually the smallest – the thickness of the spine, not the height or width of the book. But it is important to bear in mind that what the Strand is selling is not the abstract width of the books, but the individual, readable books themselves. Each complete book is a length-part of the group of adjacent books on one shelf, and these shelf-fulls of books are in turn length-parts of the total quantity of books in the store.

In (131), two inches refers to an amount measured along an axis that follows the curve of the pepper in Figure 18. Length-parts in this context are parts sliced orthogonal to this axis.

(131) We need two inches of pepper for this soup.
When describing a one or two-dimensional parthood relation on a three-dimensional mass substance (which is how singular pepper must be interpreted in (131)), the notion of “strata” becomes useful. In case it is not clear, it is worth reiterating that the notion “length-part” here refers to a segment of actual pepper, as in the part labeled b in Figure 18.

Being a length-part is not the same as being a material part with some consistent measurement on the length dimension. For example, the figure below show two sub-parts of b (which are also subparts of a). These are each material parts which measure the same length as b, but which should not count as “length parts” of a. The part labeled d, has been partitioned not only on the length axis, but also along the height of the pepper. The part labeled c has additionally been partitioned width-wise. These both count as parts on the volume dimension. But they are not lengthwise strata. Only the super-part, the whole slice, b, is intuitively a length-part of a.
To formalize this notion, I will introduce a total ordering that picks out the parts that are strata, or “slices” from among parts that also vary along dimensions other than the dimension of partition. We need this ordering to exclude parts such as c and d which are equal in length to b, but that do not count as length-parts of the whole pepper because they involve parthood along the height and/or width dimension as well as length.

3.4.2 Formal definition of dimensional parthood

To distinguish between the mereological, material parthood relationship encoded by a domain, such as O, and the total ordering that we want to define, we will continue to use square symbols (⊆, ⊏, etc.) for the former, but switch to angled symbols (>) for the latter. What I will call the orthogonal part ordering (>_{a,L}) is a total ordering that ranks super-parts above sub-parts of a that have the same length. Looking back at Figures 18 and 19, b >_{a,L} c and b_{a,L} > d on this ordering. The parts d and c are not ordered because neither is a part of the other, but we can assert that (c⊔d) >_{a,L} d.
Orthogonal part ordering for length (LGTH) of an entity, $a$:

$$x \geq_{a, L} y \iff x \subseteq_0 a \land x \supseteq_0 y \land \mu_{L, \text{DIM}}(x) = \mu_{L, \text{DIM}}(y)$$

$x$ is greater than $y$ on the ordering $\geq_{a, L}$ iff $x$ is a part of $b$ and $y$ is a proper part of $x$ that is mapped to the same degree as $x$ on the length scale by its measure function.

A part that is maximal on this ordering will be a slice of the whole, where the plane of partition is orthogonal to the axis of measurement. Thus a length-part of $a$ is defined as a part that is maximal on the length-orthogonal part ordering for $a$.

The length parthood relation:

$$b \subseteq_L a \iff b \subseteq_0 a \land b = \max(\geq_{a, L})$$

$b$ is a length part of $a$ iff it is a part (in $O$) of $a$ that is maximal on the orthogonal part ordering for length of $a$.

Based on the sort $O$ and the scale for length, we can define a sort $L$ of length parts and their sums relative to some dimension. This sort is one which is ‘less fine grained’ than $O$, but is still a mereology. Like ordinary material parthood, this relationship is reflexive. Any individual in the sort $L$ is a length-part of itself. But the only way to partition an entity into two length parts is along the plane orthogonal to the dimension on which length is perceived. Two entities can be combined to form a sum, by the join operation, but this sum will only be in the domain of $L$ itself if the two parts are non-overlapping on the length dimension.

This definition can be generalized to define parthood along any dimension in any sort. A dimensional part of an object, $a$, that is in sort $S$ is a part that is maximal with respect to the orthogonal part ordering ($\geq_{a, \text{DIM}}$).
(134) Dimensional Parthood relation

\[ b \sqsubseteq_{\text{DIM}} a \leftrightarrow b \sqsubseteq_{\text{Z}} a & b = \max(>_{\text{a,DIM}}) \]

Where \( x \succ_{\text{a,DIM}} y \leftrightarrow x \sqsubseteq_{\text{Z}} a & x \sqsupset_{\text{S}} y & \mu_{\text{DIM}}(x) = \mu_{\text{DIM}}(y) \)

3.5 Partitive semantics of measure constructions (revised)

By revising the denotation of \( \text{MON} \) to encode dimensional parthood, the problem of one-dimensional measures is finally resolved. The definition of monotonicity itself, which is a the presupposition introduced by \( \text{MON} \), is likewise revised to refer to dimensional parthood. Instead of asserting that the entity described has the DP in its specifier as an O-part or an A-part generally, it asserts that it has this DP as a \( \text{DIM} \)-part.

(135) \(< [\text{MON}_{\text{DIM}}] = \lambda P \lambda y \lambda x. y \sqsubseteq_{\text{DIM}} x & P(x) \)

Intuitively, the assertion that an entity with a certain property is a dimensional-part of a whole only makes sense if the ‘whole’ is a thing that extends and participates in a mereology on that dimension. This means that any property ascribed to it within the substance NP must have divisive reference relative to that dimension. A property has divisive reference on a dimension just in case any entity that is a dimensional-part of something that has the property also has that property:

(136) **Dimensional divisive reference:**

\[ \text{DIV}_{\text{DIM}}(P) =_{\text{def}} \forall x \forall y [P(y) \land x \sqsubseteq_{\text{DIM}} y \rightarrow P(x)] \]

A predicate has divisive reference w.r.t. a dimensional sort iff whenever the predicate is true of an entity it is also true of any dimensional-part of that entity.

(137) \(< [\text{MON}_{\text{DIM}}] = \lambda P \lambda y \lambda x: \text{DIV}_{\text{DIM}}(P). y \sqsubseteq_{\text{DIM}} x & P(x) \)
For example, *rope*, is a predicate that has divisive reference w.r.t. the length dimension, but not with respect to the diameter dimension. A length-part of rope is still rope, but a diameter-part of rope is usually just a collection of fiber.

\[
\text{DIV}_L(*\text{rope}) = \forall x \forall y[*\text{rope}(y) \land x \subseteq y \rightarrow *\text{rope}(x)]
\]

\[
\text{DIV}_{\text{DIAM}}(*\text{rope}) = \forall x \forall y[*\text{rope}(y) \land x \subseteq_{\text{DIAM}} y \rightarrow *\text{rope}(x)]
\]

This is why the pseudopartitive *five inches of rope*, which might refer to any dimensional parthood relation with both *five inches* and *rope* in its domain, cannot be interpreted as referring to portion that is five inches in diameter.

With this in place, the simple denotation of *inches* as a lattice of individuals that each measure one-inch can be rehabilitated. While *five inches* itself might refer to five parts that overlap each other on the relevant dimension, we can assume that MON is distributive on its ‘part’ argument, so each ‘inch’ must be a length-part of the whole, therefore non-overlapping.

Figure 20: Parts of a pickled pepper—including length-parts and non-length-parts.

\[
\text{⟦two inches⟧} = \lambda x. *\text{inch}(x) \land |x_{\text{inch}}| = 2
\]
The NP, *two inches*, includes both the sum (b⊔Oc) and the sum (e⊔Of) in its denotation, but the truth conditions of the MON head will only be satisfied by sums that consist of two one-inch entities that are each length-parts of the peppers.

The LF and the rest of the derivation for the pseudopartitive phrase *two inches of pepper* are shown in (140) and (141)

(140)  
\[
\begin{array}{c}
\text{DP} \\
\text{D} \\
\text{NP}_6 <et> \\
\text{OP}_2 \\
\text{NP}_5 <et> \\
2 \\
\text{NP}_4 <t> \\
\text{DP} <<et><t> > \\
\exists \text{two inches} \\
\text{NP}_3 <et> \\
1 \\
\text{NP}_2 <t> \\
\text{MONP}_{<e,t>} \\
\text{MON'}_{<e,e,t>} \\
\text{MON} \quad \text{of} \\
\text{pepper} \\
\text{NP}_1 <e,t> \\
\end{array}
\]

(141)  
\[
\begin{align*}
\llbracket \text{MONP} \rrbracket &= \lambda x \ t_1 \subseteq x \land \text{*pepper}(x) & \text{by FA} \\
\llbracket \text{NP}_2 \rrbracket &= \llbracket \text{MONP} \rrbracket (t_2) = t_1 \subseteq t_2 \land \text{*pepper}(t_2) & \text{by FA} \\
\llbracket \text{NP}_3 \rrbracket &= \lambda y. \ y \subseteq t_2 \land \text{*pepper}(t_2) & \text{by PA} \\
\llbracket \exists \text{two inches} \rrbracket &= \lambda Q \exists x. \text{*inch}(x) \land |x_{\text{inch}}| = 2 \land Q(x) \\
\llbracket \text{NP}_4 \rrbracket &= \llbracket \text{DP}_{\text{Meas}} \rrbracket (\llbracket \text{NP}_3 \rrbracket) = \exists x. \text{*inch}(x) \land |x_{\text{inch}}| = 2 \land x \subseteq t_2 \land \text{*pepper}(t_2) & \text{by FA} \\
\llbracket \text{NP}_5 \rrbracket &= \lambda y \exists x. \text{*inch}(x) \land |x_{\text{inch}}| = 2 \land x \subseteq y \land \text{*pepper}(y) & \text{by PA}
\end{align*}
\]
The set of individuals that are in the extension of pepper, and that contain some length-part which is itself composed of two atomic length-parts of that entity, each of which measures one inch.

The NP may of course merge with either a definite or an indefinite determiner to produce the argument denoted by the full measure pseudopartitive construction.

By parameterizing the parthood relation in this way, we are able to model measure nouns and the pseudopartitive expression they appear inside as relationships between individuals.

3.6 Chapter Summary

The relation between the denotation of a measure phrase and the part-whole structure of the object(s) or substance being measured is an essential to the acceptability of pseudopartitives. In this chapter I have proposed an approach to this phenomenon that models measure nouns themselves as predicates of mereological parts of the substance NP. I have shown that there is a fundamental problem with relating one-dimensional measures to three-dimensional objects. The flattening that is inherent in mapping between individuals and scales that measure functions encode leads to intractable complications for existing theories of measure pseudopartitives. On Schwarzschild’s (2006) approach it means that the monotonicity constraint cannot be fully formalized, as it depends on a vague concept of ‘relevant’ part-whole relations. And on Krifka’s
(1989,1998) approach, one-dimensional measures fail to satisfy the additive property of extensivity and are incorrectly predicted to be unacceptable.

On the partitive approach presented here, this problem is resolved by parameterizing the mereological parthood relation itself for the dimension referenced by the measure noun. The dimensional parthood ($\subseteq_{DM}$) relation is essentially a means of formalizing our cognitive ability to conceive of partitioning into ‘slices’ along a particular dimension and so abstract away from more fine-grained parthood relations. With this tool in place, it is possible to model measurement as counting of individual parts of a certain size, rather than mapping from numbers to scalar intervals or directly to a property of the measured entity. With an individual-based meaning for measure nouns, the syntactic and semantic complexity of full DP measure phrases is expected and no longer poses a problem for analysis.

In this chapter I have focused on unit measure phrases such as *ounce*, *inch* and *hour*, in order to demonstrate the viability of an alternative to conventional approaches that treat these as fundamentally different from other common nouns. Many measure nouns are more vague in their size than precise units. In these cases we cannot posit a definite degree in their lexical entries. But they do specify dimension as well as other idiosyncratic information. Vague size measures such as *clump* and *blob* denote material volume-parts of solid or semi-solid objects. Events that extend in time may be expressed using vague but nevertheless countable time-parts such as *moment*, *while*, or simply *time*. These measure nouns lend themselves to modification by size-denoting adjectives of the appropriate dimension. Container measures, in particular, seem amenable to adjectival modification, as in *a heaping teaspoon* or *a small handful*. The composition of a superlative measure phrase on this model is quite straightforward, and as we
will see in Chapter 4, and allows focus-association to generate the full range of relative readings that are available.
Chapter 4

Q-Superlatives Proposal

The words *much, little, many* and *few* have successfully been analyzed as gradable adjectives – words that directly or indirectly modify nominal predicates by mapping individuals to scalar degrees. The superlative forms, *most, least* and *fewest*, give rise to ambiguity in a way that further identifies them with such adjectives as *best, tastiest* and *smallest*. The fact that indefinite *most* in English (and many other languages) generates a majority reading, has also been successfully explained using standard adjectival syntax and degree-based semantics along with reasonable assumptions about plurality and counting. But the parallel between quantity and quality superlatives seems to break down when it comes to the particular subtype of relative reading that is the topic of this dissertation.

As we noted in Chapter 2, Section 4, the ‘NP-internal relative reading’ is only possible with definite-marked quantity superlatives in English, and not with the superlatives of other gradable adjectives. For example, on the NP-internal reading, *John ate the most WALNUTS* (with focus on *walnuts*) is true just in case the amount of walnuts John ate exceeds the amount of any other type of nuts that he ate. As analyzed by Pancheva and Tomaszewicz (2012), the focus association required for this reading should be blocked, rather than facilitated, by the definite article English. On an *in situ* derivation the DP-internal position of both the superlative morpheme (with its comparison class argument) and the focused constituent must either lead to a
loop of infinite regress, or a conflict between presuppositions where one essentially cancels out the alternatives required by the other.

On the other hand, an approach that treats the definite article as vacuous, generating relative readings by movement of the superlative morpheme itself out of the definite DP, overgenerates. The movement approach incorrectly predicts that the reading should be available for all gradable adjectives. But a sentence such as *John ate the tastiest WALNUTS* cannot be interpreted as true in a scenario where the walnuts John ate were tastier than anything else he ate—unless it is also the case that they were the (absolute) tastiest of all the walnuts. So, both the movement and the *in situ* approaches to relative superlatives make the wrong predictions for English.

What is needed, then, is an adjectival approach to these quantity words that is nevertheless able to distinguish between their syntax/semantics and that of non-quantificational adjectives. The first step in my proposal is establishing that, while *many, much, few* and *little* are adjectival, their distribution in some contexts diverges from that of other adjectives, and converges with that of Full Measure Phrases (FMPs). Based on this evidence, I propose that Q-adjectives can merge with a silent measure noun, forming an FMP that denotes a quantity of matter (or of some eventive or other abstract entity).

In such cases, the Q-adjective does not modify the substance noun directly, but participates in a covert measure pseudopartitive structure.
This constituency parallels that of superlative measure pseudopartitives with overt measure nouns, such as *the biggest handful of candy*. The MONP refers to the set of things that are chocolate cake that contain a dimensional part that is a thing of a certain size on that dimension. The superlative adds the restriction that this part is the thing of maximal size from within some comparison class.

Within this structure, the Q-superlative forms part of a constituent with the definite article which is distinct from the larger substance DP. The substance DP itself is indefinite, allowing the measure DP to extract and remerge with the full clause. A brief excursion into the phenomenon of agreement mismatch in Flemish quantity expressions provides support for this analysis.

Having motivated this DP-within-a-DP structure, we will see how it explains the fact that quantity superlatives are able to generate the elusive NP-internal relative readings. Assuming a conventional treatment of the definite article as a sum operator, we will use an *in situ* approach to relative superlatives. This leaves Pancheva & Tomaszewicz’s explanation for the impossibility of NP-internal readings in place for non-quantificational superlatives. The superlative morpheme must be interpreted from within the definite-marked DP in which it originates, but this constituent is different depending on whether the underlying structure is simple adnominal modification or an (overt or covert) pseudopartitive.
In the case of *most*, *least*, and *fewest*, the superlative morpheme is interpreted from within the definite-marked full measure phrase, but this whole constituent is able to extract from the indefinite substance DP which contains the focused element. It is therefore possible to merge a focus-operator in a position where it is discontinuous with the superlative, but scopes over the remnant substance NP. The comparison class of the superlative can be valued by focus association, giving rise to the NP-internal relative reading. The same derivation is available when a dimensional adjective modifies a measure noun in an overt pseudopartitive. I argue, however, that the silent *amount* noun can only be modified by Q-adjectives and not by those that refer to a particular (non-cardinality) dimension.

In the absence of an overt measure noun, then, an ordinary gradable superlative must have its comparison class argument valued from within the simplex DP projected from the noun that it directly modifies. This is the same constituent that contains the focused element, making valuation of the comparison class by focus association logically impossible.

### 4.1 Q-superlatives as covert Measure Phrases

#### 4.1.1 Q-adjectives and *amount*

**Q-adjectives**

Let me begin by defending the claim that *many*, *few*, *much*, and *little* are adjectival. Hoeksema (1983) argued for this categorization of the first two of these based on their distribution. While determiners in English are not iterable, it is possible for *many* to appear below a definite article or other determiner.²²

---

²² Solt (2014) observes that while most gradable adjectives are acceptable after any determiner, this is not the case with Q-adjectives. For example (ii) shows the quantifiers *some* and *all* cannot precede *many*: 
Kayne (2005) follows Jespersen (1970) in citing the synthetic comparative and superlative forms of all four words as evidence for their adjectival status. The comparative and superlative morphemes—whether they are pronounced as affixes or are suppletive—only combine with adjective stems. Within other grammatical categories (nouns, verbs, adverbs and prepositions) comparisons can be expressed, but the comparative and superlative do not combine with the words directly.

(145)  

a. many, more, most  
b. much, more, most  
c. few, fewer, fewest  
d. little, less, least

(146)  

a. more tall than wide = taller than wide.  
b. more machine than man / *machiner than man  
c. more for than against / *forer than against  
d. more slowly than carefully. *slowlier than carefully  
e. more skipping than running / *skippinger than running

In some ways, though, the distribution of Q-adjectives differs from that of other adjectives. For example, Kayne (2002) notes that in English, gradable adjectives cannot stand alone as arguments; in the absence of a more precise nominal they must be followed by the pronoun

(i) The/those/his/some/all intelligent students.  
(ii) The/those/his/*some/*all many students.
one/ones (147). Elision of the noun/pronoun is sometimes possible, as in (147d), but is marginal.

But with quantity adjectives the presence of such a pronoun is always unacceptable (148).

(147)  a. Famous/beautiful ones can be found in this park.
        b. *Famous/beautiful can be found in this park.
        c. I had big candies/a big candy and Jay had small ones/a small one.
        d. ?I had big candies/a big candy and Jay had small/a small.

(148)  a. *Few/many/much/little one(s) can be found in this park.
        b. Few/many/much/little can be found in this park.
        c. *I had few/many/much/little candy/candies and Jay had many/few/much/little one(s).
        d. I had few/many/much/little candy/candies and Jay had many/few/much/little.

Rather than take the examples in (147) and (148) as evidence that many and its ilk are not adjectival, Kayne (2002, 2005) maintains that they are adjectives which directly modify a silent noun. This is the position I will take. Furthermore, I propose that this silent element can be identified as a measure noun.

A silent AMOUNT noun

The above constructions, in which non-Q-adjectives cannot stand alone but Q-adjectives must, are also contexts in which an FMP may serve as an argument. In fact, when we replace the adjectives with measure phrases, we get a familiar pseudopartitive measure construction in the first conjunct of (149b).

(149)  a. Six tons can be found in this park.
        b. I had a small handful of candy/candies and Jay had a big handful.
If we hypothesize that a Q-adjective plus silent AMOUNT noun replaces an overt FMP, we arrive at a reasonable explanation as to why the pronoun *one(s)* is ungrammatical—there is already a nominal element occupying that position.

(150)  
a. Few/many/much/little AMOUNT(s) can be found in this park.  
b. *Few/many/much/little AMOUNT(s) one(s) can be found in this park.

(151)  
a. I had little/much AMOUNT(s) (of) candy and Jay had much/little AMOUNT(s).  
b. I had few/many AMOUNT(s) *(of) candies and Jay had many/few AMOUNT(s).

The measure pseudopartitive in (149b) does not form a perfect minimal pair with the Q-adjective constructions in (151). The overt FMP with *candy/candies* has the additional element, *of*, which we have analyzed as the MON head. But the inclusion of this preposition is only marginally acceptable with the mass Q-adjectives, much/little in (151a), and it is unacceptable with many/few (151b).

While Schwarzschild (2006) does not posit any silent noun in Q-adjective constructions, he does argue that a silent exponent of the MON head is present in this construction. Recall that the MON head was proposed as a way to account for the contrast between non-monotonic attributive measure phrases (AMPs) such as *three-inch* or *one-degree-Celsius* and monotonic FMPs such as *three inches* and *a single degree Celsius* *(of global warming)*. Schwarzschild observes that adjectives of quantity and quality are similarly split. Adjectives such as *long* and *warm* are ‘non-monotonic’ in that they distribute over all (accessible) parts of the NPs they modify. *Many* and *few* are monotonic, as cardinality is an inherently monotonic property. For any plural NP denoting a ‘whole’ that measures some cardinality, a proper part of it (counting only atoms) will necessarily measure less on the cardinality scale.
Much and little are not specified for a particular dimension and are therefore ambiguous, for example (152) (Schwarzschild’s ex.79) could refer to either an excessive weight or an excessive volume of gold.

(152) He put too much gold in the ring.

But the ambiguity is restricted to a choice among dimensions that are monotonic with respect to gold. It is not possible to interpret this phrase as referring to an excess of purity or hue.

The approach to measure pseudopartitives presented in the previous chapter does not identify monotonicity itself as a presupposition, but as the result of constraints on which ‘sorts’ of entities can participate in which dimensional parthood relations. Still, the parthood relation itself is introduced by MON on this approach, so the fact that Q-adjectives exhibit monotonicity indicates that this morpheme is part of the semantics of their composition with a substance NP.

This still leaves unanswered the question of why MON should be silent in the Q-adjective constructions. I suspect this is a side-effect of the measure noun being silent. As a DP-internal functional head, of appears in many binominal constructions and has a role in case-licensing of the ‘extra’ noun. Case licensing is only required for overt elements (Chomsky 2001) so of must be pronounced when two overt nominal elements are related to each other, but is not required when one of these is a silent noun.23

### 4.1.2 Syntax for deriving NP-internal reading

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23 This reasoning brings into question the idea that of is itself a spell-out of the MON head. It may be that the co-occurrence of this phonological element and the semantic contribution of MON is purely coincidental.
In this section I will first remind the reader why the *in situ* approach cannot generate the internal reading for ordinary adjectives merged inside a definite DP. I will then show how the (covert or overt) pseudopartitive structure makes the reading available for superlative measure constructions, including Q-superlatives.

The kind of sentences we are concerned with are propositions containing a focused element—either a noun or an NP-internal modifier of that noun—where the NP is further modified by a superlative adjective. The sentence in (153) is such a proposition, where the superlative is an ordinary non-Q-adjective. Were an NP-external constituent focused, such as the subject, a relative reading would be available on which the degree of tastiness was compared to that enjoyed by other subjects. But the equivalent NP-internal relative reading is not possible, only an absolute reading is possible for (153) as shown by the two glosses.

(153) He ate [the tastiest CHOCOLATE cake].
   a. He ate the chocolate cake that was the tastiest chocolate cake that exists.  *(absolute)*
   b. #He ate chocolate cake that was tastier than any other flavor of cake that he ate.  *(int)*

As we saw in Chapter 2, the relative reading (153b) cannot be composed because there is no position in which the focus operator can be merged that will allow the comparison class argument of the superlative to be valued. Following the assumptions we adopted in the previous chapters, the superlative DP (bracketed in (153)) may optionally raise to take scope over the clause. This gives rise to the LF in (154).
For focus association to succeed, the \( \sim \) operator must scope over the focused constituent, but it must also be discontinuous with C. If the operator is inserted in a high position (A), then the derivation will crash because it contains a loop of infinite regress. The identity of the alternative set, S, depends on the focus value of the DP constituent that contains C. But the value of C depends on the identity of S.

Inserting it in a lower position (B) creates different problems. Here, the focus operator’s requirement for alternatives conflicts with the presupposition of \([\text{SUP}]\). The operator requires that degrees of tastiness of at least one alternative to chocolate cake be included in that set. But the superlative morpheme requires that everything in the comparison class belong to the set denoted by its sister node, i.e. the set of degrees of tastiness of chocolate cake. This means that the alternatives constructed by the focus operator that are not chocolate cake cannot form part of the subset that is the comparison class. Effectively, this produces the absolute reading. Assuming, with P&T, that definite-marked DPs are islands for degree extraction makes it possible to explain why internal relative readings are unavailable for non-Q-superlatives. Relative readings are only available if they are of the external variety because only these can be derived using the \textit{in situ} approach.
On the other hand, if the superlative adjective is modifying a measure noun, then the definite article forms part of the measure phrase in the specifier of MONP. The focused element—be it the substance noun itself or a lower modifier thereof—is not part of this constituent. Assuming that an existential determiner is merged with the larger xNP projected from the substance noun, the superlative measure phrases is free to extract as shown in (155).

(155)

The *in situ* derivation of a relative reading is now straightforward. As the LF in (156) shows, the squiggle operator merges with the clause where it scopes over the focused modifier, chocolate, inside the remnant object DP. The superlative measure phrase then remerges in a higher position. The comparison class argument inside this constituent is now discontinuous with the focus operator and can be valued by focus association.

(156)
In Section 4.2 I elaborate on the meaning of the silent amount noun and of Q-adjectives and the constraints on which adjectives may appear inside measure phrases generally, as well as the reason amount can only be modified by Q-adjectives. I then provide a formal semantic account for the derivation sketch here. In the meantime, the last part of this section provides evidence from Flemish that supports the hypothesis that there is in fact such a null nominal element in the type of construction we have been discussing, and that the definite article forms part of a separate constituent with superlative Q-adjectives in just those cases where the NP-internal relative reading is generated.

4.1.3 Agreement mismatch in Flemish

It seems straightforward to assume that when a single overt determiner precedes a single overt noun, that it is part of the xNP of that noun. The structure I am proposing contains two null elements and the reader may be therefore be skeptical of such a baroque scheme. In English there is no morphological means of verifying which adjective or determiner is associated with which lexical head. But other languages have a richer agreement morphology within the DP, providing clues to their hidden structure.

According to Roelandt (2014) Flemish Dutch has an NP-internal relative reading of het meeste (‘the most’). The reading is available with a peculiar form, in which the definite article does not agree with the noun in number and gender. The following examples (Koen Roelandt, pc.) illustrate two points. First, Flemish normally requires agreement between the definite article and the noun it introduces. For this reason (157) is ungrammatical. Second, (158), which has the expected agreement between the article and noun, shows that the NP-internal relative reading (a)
is unavailable with non-quantificational superlative adjectives, while the NP-external relative (b) and absolute (c) readings are available.

(157) *Jan heeft het beste platen van Zappa.  
Jan has the best records by Zappa

(158) Jan heeft de beste platen van Zappa.  
Jan has the best records by Zappa

a. #“John has better albums by Zappa than by anyone else” internal
b. “John has better albums by Zappa than anyone else does” external
c. “John has the best albums by Zappa that exist” absolute

Unlike English, but like German and Northern Dutch, meeste (most) is preceded by a definite article on its proportional reading in Flemish. As with beste in (158), the article agrees with the phi features of the noun. This construction can also give rise to the external relative reading, but not the internal one.

(159) Jan heeft de meeste platen van Zappa.  
Jan has the most records by Zappa

a. #“John has listened to more records by Zappa than by any other band” internal
b. “John has listened to more records by Zappa than anyone else has.” external
c. “John has listened to the majority of records by Zappa that exist” proportional

But in addition to the construction in (159) Flemish allows a neuter singular definite article to precede meeste when it modifies a plural NP as in (160).

(160) Jan heeft het meeste platen van Zappa.  
Jan has the most records by Zappa
The phrase *het meeste* can also appear adverbially in Northern Dutch as well as Flemish, and in both dialects the neuter singular form could indicate agreement with a neuter mass noun. But as an adnominal modifying a non-neuter mass noun or plural count noun it is only acceptable for Flemish speakers.\(^\text{24}\) The following examples show the range of available readings for both the agreeing and non-agreeing construction. The object is focus fronted in order to verify that *het meeste platen van Zappa* is a constituent, ruling out an adverbial interpretation.

(161) *De meeste platen van Zappa heeft Jan beluisterd.*

*the*pl.fem most records *by* Zappa *has* John *listened-to* (Flemish)

a. "John has listened to more records by Zappa than by any other band" *internal*
b. “John has listened to more records by Zappa than anyone else has.” *external*
c. “John has listened to the majority of records by Zappa that exist” *proportional*

(162) *Het meeste platen van Zappa heeft Jan beluisterd.*

*the*sing.neut most records *by* Zappa *has* John *listened-to* (Flemish)

a. “John has listened to more records by Zappa than by any other band” *internal*
b. “John has listened to more records by Zappa than anyone else has” *external*
c. "John has listened to the majority of records by Zappa that exist” *proportional*

When the definite article agrees with the noun in number and gender, both the proportional (161c) and the NP-external relative (161b) readings are available, but just as with English bare *most*, the NP-internal relative reading is not. When the definite article does not agree, as in (162), the proportional reading is not available, but the NP-internal relative reading becomes available

\(^{24}\) Although Coppock (2018) reports that some speakers who do not identify as Flemish also offered non-agreeing *het meeste instrumenten* and *het meeste koffie* as translations for NP-external relative readings in her survey, I expect that such speakers would also be able to parse these with an NP-internal relative reading, but leave the verification of this prediction to future work.
in addition to the NP-external reading. Thus the non-agreeing form, *het meeste* NP, patterns with *the most NP* in English.

In order to explain the apparent failure to check phi features, Roelandt proposes that the neuter determiner in the non-agreeing construction introduces a DP that is projected by a null NP. According to Roelandt, it is the silent nominal that checks the neuter singular features of the determiner. This definite DP is merged in a specifier of the extended projection of the indefinite DP projected by the overt noun. This essentially matches the structure that I have proposed for *the most NP* in English. The specifier of the overt NP is that which is made available by the MON head, and the null NP is the silent AMOUNT measure noun.

\[(163)\]
```
  DP
 /\       \\
\[\exists MONP\]
  /\      \\
DP    MON'
  /\    /\   \\
D    NP MON platen van Zappa
```

The fact that *het meeste* in this construction precedes a silent measure noun is made visible by the failure to agree with the overt substance noun. In English, the poverty of DP-internal agreement morphology makes the same structure indistinguishable on the surface from one in which the definite article merges directly with the substance NP.

### 4.2 Semantics of Q-superlatives

\[25\] Also perhaps relevant is the fact that the Dutch/Flemish words *deel* (part) *bedrag* (amount) and *aantal* (number) are all neuter singular: *het meeste deel* = ‘the most part’. An alternative analysis is that Flemish default agreement is neuter singular and a null element triggers this.
4.2.1 The meaning of Q-adjectives and AMOUNT

An important feature that measure nouns have in common is the notion of a discrete, bounded entity or sum of entities. The null measure noun, AMOUNT, should be understood to encapsulate this notion in some way as well. It has a bundling function, which I represent here (164) as the existence of a property on which the argument is an atom. The definition of ATOM is given in (165). As it involves mereological relationship of overlap (\(\sqcap\)) it is parameterized for dimension.

(164) Definition of silent AMOUNT noun  
\[
\left\lceil \text{AMOUNT}_{\text{DIM}} \right\rceil = \lambda x. \exists P. \text{ATOM}_{\text{DIM}}(x, P)
\]

(165) Definition of Atom  
\[
\forall P \forall x \text{ATOM}_{\text{DIM}}(x, P) \iff P(x) \land \neg \exists z [z \neq x \land z \sqcap_{\text{DIM}} X \land P(z)]
\]

The dimension on which non-overlap applies is underspecified. Just as with more precise measure constructions, the dimension must ultimately be construed in some uniform way across the proposition. An adjective may modify this, according to the general rule for measure noun modification posited in Chapter 3. This may only be an adjective that maps to the same scale as the dimension referenced by the measure noun. Since the dimension of AMOUNT is underspecified, the only adjective that may modify it is one that is likewise underspecified. The adjectives much and little, given in (166), satisfy this requirement.\(^{26}\)

(166) a. \([\text{much}]\) = \(\lambda d \lambda x. \mu_{\text{DIM}}(x) \geq d\)  
b. \([\text{little}]\) = \(\lambda d \lambda x. \neg \mu_{\text{DIM}}(x) \geq d\)

\(^{26}\) It is important to be clear that, while I have been using the shorthand AMOUNT to identify this silent element, it is not identical to the English word amount. The latter presumably has a slightly higher level of specification, although it is difficult to say what that consists of. This is made evident by the fact that amount can be modified by generic adjectives of size such as large and tiny, but the string *much amount is ill-formed.

122
In (167) the structure for the covert measure phrase with *much* is depicted. For simplicity of exposition, I fill the degree argument with the deictic element, *this*, which points to some definite degree (d_c) in the context of utterance.

(167)  
\[ \text{DP}_{\text{Meas}<e,t>} \rightarrow \exists \text{NP}_{<e,t>} \rightarrow \text{DegP}_{<e,t>} \rightarrow N_\emptyset = \text{AMOUNT}_{<e,t>} \]

\[ \text{Deg} \quad \text{this} \quad \text{A} \quad \text{much} \]

(168) Composition of the FMP *this much*

\[ [[\text{AMOUNT}_{\text{DIM}}]] = \lambda x \exists P. \text{ATOM}_{\text{DIM}}(x,P) \]
\[ (= \lambda x. \text{AMT}_{\text{DIM}}(x)) \]
\[ [[\text{much}}] = \lambda d \lambda x. \mu_{\text{DIM}}(x) \geq d \]
\[ [[\text{this}]] = d_c \]
\[ [[\text{DegP}]] = \lambda x. \mu_#(x) \geq d_c \]
\[ [[\text{NP}]] = \lambda x. \text{AMT}(x) \land \mu_{\text{DIM}}(x) \geq d_c \]
\[ [[\exists]] = \lambda P \exists Q x. P(x) \land Q(x) \]
\[ [[\text{DP}]] = \lambda Q \exists x. \text{AMT}_{\text{DIM}}(x) \land \mu_{\text{DIM}}(x) \geq d_c \land Q(x) \]

The measure NP composes as shown in (168) to denote the property of being an atomic amount on some dimension, that is mapped to at least the indicated degree by the measure function for that dimension. As any measure noun in an FMP, AMOUNT can merge with a plural NUM head to generate a lattice of atomic amounts and their sums. The adjectives *many* and *few* can combine with the NumP of any pluralized measure noun in an FMP, since everything in the extension of a plural predicate necessarily has some degree of cardinality. It is reasonable, therefore, to assume
that plural amount may also co-occur with *many and few*. The LF and denotation of the FMP, *this many*, is shown in (169), with the meaning of *AMT expanded for clarity.

\[(169) \quad [\exists [\text{this many}] \ [\text{NUM [AMOUNT]]}] = \lambda Q \exists x. \lambda x \exists P. x \in * \lambda z (\text{ATOM}_d(z, P)) \land \mu_d(x) \geq d_c \land Q(x)\]

It is worth being explicit here, that (169) does not entail that the atoms of the property, P, that is existentially bound within the amount noun’s denotation, are also atoms of whatever property the variable Q stands in for. AMOUNT_d is analogous to a number word such as *dozen*. It represents some quantity that is part of the lattice that is structured on the cardinality dimension. An atom of *dozen*, in a phrase such as *a dozen cupcakes* is not the same as an atom of *cupcakes*. It denotes a group of objects that has a certain degree on the cardinality scale, and which does not overlap with any other such group. *Two dozen* does not map to a degree on the cardinality scale equivalent to 2. It consists of two non-overlapping parts that each has cardinality of (approximately) 12, hence the degree of that total entity on the cardinality scale will be equivalent to the degree that (approximately) 24 individuals of any predicate can be mapped to.

\[(170) \quad \text{ATOM}_{\text{DIM}}(x, [[\text{dozen}]]) \leftrightarrow \text{dozen}(x) \land \neg \exists z [z \cap x \land \text{dozen}(z)]\]

x is an atom of the property dozen iff x is a dozen and there is nothing that overlaps with dozen on the cardinality dimension that is also a dozen.

In essence this is one way of formalizing Kratzer’s counting principle. It is part of the logic of count nouns to ‘deny’ the existence of any internal parts of the entities they refer to that might otherwise qualify as individuals with the property they denote.

\[4.2.2\quad \text{Q-adjectives in a covert pseudopartitive}\]
To illustrate how the covert full measure phrases containing Q-adjectives compose with their overt substance NPs, let us consider the following sentence:

(171) John ate this much pepper.

Due to the polysemy of *pepper*, and the deictic nature of *this*, there are many contexts in which we can imagine this phrase being uttered, and many dimensions on which the construction could reasonably be interpreted. The speaker might be referring to a slice of raw chili pepper and indicating the length of the portion John consumed by holding her forefinger and thumb a few millimeters apart. Or she might be referring to a huge portion of ground black pepper, the volume of which is indicated by holding up a handful of dirt.

The rest of the derivation proceeds very much like the derivation of an overt measure pseudopartitive according to the model developed in Chapter 3. The MON head (172) is silent, but has the same denotation as its overt counterpart, and is also parameterized for dimension. MON encodes a partitive relation and carries the presupposition that its first argument is a property that has divisive reference on the dimension of parthood. In order for the construction to be defined, then, this dimension is constrained by the substance NP.

(172) $[[\text{MON}_{\text{DIM}}]] = \lambda P \lambda y \lambda x: \text{DIV}_{\text{DIM}}(P). \ y \subseteq_{\text{DIM}} x \land P(x)$

(173) $\text{DIV}_{\text{DIM}}(P) = \text{def} \forall x \forall y [P(x) \land x \subseteq_{\text{DIM}} y \rightarrow P(y)]$

The NP *pepper* belongs to the sort of three-dimensional objects in the world and therefore has divisive reference on the weight and volume dimensions, as well as one-dimensionally along any number of possible axes, such as length, diameter, etc. MON introduces the assertion that an
additional argument—the Measure DP merged in its specifier—is a part of its external argument on one of these dimensions.

\[(174)\]

\[
\begin{array}{c}
\exists \text{ this much AMOUNT} \\
\text{MONP} _t \\
\text{MON'} _{e,t} \\
\text{MON' } _{e,e,t} \\
\text{NP}_{\text{Subs} } _{e,t} \\
\end{array}
\]

The measure phrase (DP_{Meas}) is an existential generalized quantifier. It therefore must QR, in order to be interpretable, and leaves behind a trace. The remnant of \text{MONP} will then merge with its own silent existential determiner, to form another quantified DP, as shown in (175).

\[(175)\]

\[
\begin{array}{c}
\exists \\
\text{DP}_{\text{subs} } _{(e,t),t} \\
\text{MONP} _{(e,t)} \\
\text{MON' } _{(e,e,t)} \\
\text{MON } \\
\text{NP}_{\text{Subs} } _{(e,t)} \\
\text{pepper} \\
\end{array}
\]

The \text{MONP} denotes the property of being an individual that is pepper, and that has whatever entity this trace stands for as a part. Parthood of course being defined in terms of one of the dimensions on which pepper can be meaningfully divided. In one of the scenarios described above, the deictic \textit{this} referred to a certain degree of length indicated by gesture. The meaning of \text{MONP} in that scenario is the set of things that are (fresh chili) pepper, that each contain a length-part that the length-measure-function (\(\mu_{L\text{DIM}}\)) maps to at least that degree. The full sentence will
be true just in case there exists something in this set that John ate. The proposition has the LF in (176) and composes as in (177).

(176)

(177)

\[
[[\text{MON}]] = [[\text{MON}']](t_i) = \lambda x. t_i \in \text{DIM} x \land *\text{pepper}(x) \\
[[\exists]] = \lambda P \lambda Q \exists y[P(y) \land Q(y)] \\
[[\text{DP}_{sub}]] = \lambda Q \exists x. t_i \in \text{DIM} x \land *\text{pepper}(x) \land Q(x) \\
[[\text{IP}_1]] = \lambda x \text{ate}(x,j) \\
[[\text{IP}_2]] = \exists x. t_i \in \text{DIM} x \land *\text{pepper}(x) \land \text{ate}(x,j) \\
[[\text{IP}_3]] = \lambda y \exists x. y \in \text{DIM} x \land *\text{pepper}(x) \land \text{ate}(x,j) \\
[[\text{DP}]] = \lambda Q \exists x. \text{AMT}_{\text{DIM}}(x) \land \mu_{\text{DIM}}(x) \geq d_c \land Q(x) \\
[[\text{IP}_3]] = \exists x \exists y. \text{AMT}_{\text{DIM}}(x) \land \mu_{\text{DIM}}(x) \geq d_c \land x \in \text{DIM} y \land *\text{pepper}(y) \land \text{ate}(y,j)
\]

‘There is some pepper that contains a dimensional part that reaches \(d_c\) on the scale for that dimension and John ate that thing.’

This could be interpreted as true according to the frame of the length-dimension described on the previous page. In another context, the interpretation of the scale and dimension referenced by
*this much* might be quite different. A scenario that involves ground pepper naturally gives rise to an interpretation of *much* based on the volume scale and dimension.

Now that we have a syntax and semantics for the covert measure construction in which Q-adjectives appear, we can finally piece together the complete derivation for the NP-internal relative reading. In the next section we will return to the familiar example sentence, *Jamie ate the most CHOCOLATE cupcakes*.

### 4.2.3 Deriving NP-internal readings for Q-superlatives

The term “NP-internal relative reading” turns out to be something of a misnomer when it comes to quantity superlatives. The hypothesis we have pursued is that the object in a sentence like (178) has a DP-within-DP structure. So, while the focused element and the superlative morpheme are both contained in the larger substance NP, the superlative morpheme is more immediately a part of the smaller NP of the silent measure noun, *AMOUNT*. This structure, previewed above in (143), is repeated here as (179).

(178) Jamie ate [the most CHOCOLATE cupcakes]

(179)
Unlike the existentially quantified DP *this much amount* that we considered in the previous section, the superlative measure DP is of type $e$. There is no type mismatch forcing it to QR, but I assume that the movement is nevertheless available. As long as the moved element is a maximal projection and there are no barriers to extraction, movement is free.

With the measure phrase moved out, the substance DP composes to have the ordinary and focus values as shown in (180). The dimension of parthood is identified throughout as cardinality for convenience, as the plural count noun makes this a salient dimension. But because *most* is the superlative form of both *many* and *much* it is also possible to evaluate the truth conditions based on some other dimension, such as weight or volume. A crucial constraint on this is the presupposition of MON that the dimension in question be one on which its sister has divisive reference. The NP *chocolate cupcakes* has divisive reference on the cardinality, weight and volume dimensions, but not on the temperature or purity dimension, for example.

(180) Composition of the Substance DP ($\text{DP}_{\text{subs}}$)

$\text{\llbracket AP\rrbracket}_o = \lambda x[*\text{chocolate}(x)]$

$\text{\llbracket AP\rrbracket}_F = \begin{cases} 
\lambda x[*\text{chocolate}(x)] \\
\lambda x[*\text{vanilla}(x)] \\
\lambda x[*\text{redvelvet}(x)]
\end{cases}$

$\text{\llbracket NP}_1\rrbracket = \lambda x[*\text{cupcake}(x)]$

$\text{\llbracket NP}_2\rrbracket = \lambda x[*\text{cupcake}(x) \land *\text{chocolate}(x)]$

$\text{\llbracket \text{MON}_e\rrbracket} = \lambda P \lambda x \lambda y. P(y) \land x \sqsubseteq y$ by PM

$\text{\llbracket \text{MON}'\rrbracket}_o = \text{\llbracket \text{MON}_e\rrbracket}(\text{\llbracket NP}_2\rrbracket) = \lambda x \lambda y. *\text{cupcake}(y) \land *\text{chocolate}(y) \land x \sqsubseteq y$ by FA

$\text{\llbracket \text{MONP}\rrbracket}_o = \text{\llbracket \text{MON}'\rrbracket}(t_2) = \lambda y. *\text{cupcake}(y) \land *\text{chocolate}(y) \land t_2 \sqsubseteq y$ by FA

$\text{\llbracket \text{Ex}\rrbracket} = \lambda P \lambda Q \exists y[P(y) \land Q(y)]$

$\text{\llbracket \text{DP}_{\text{subs}}\rrbracket}_o \Rightarrow \lambda Q \exists y[\text{cupcake}(y) \land *\text{chocolate}(y) \land t_2 \sqsubseteq y \land Q(y)]$ by FA

$\text{\llbracket \text{DP}_{\text{subs}}\rrbracket}_F \Rightarrow \begin{cases} 
\lambda Q \exists y[cc(y) \land *\text{choc}(y) \land t_2 \sqsubseteq y \land Q(y)] \\
\lambda Q \exists y[cc(y) \land *\text{van}(y) \land t_2 \sqsubseteq y \land Q(y)] \\
\lambda Q \exists y[cc(y) \land *\text{red-vel}(y) \land t_2 \sqsubseteq y \land Q(y)]
\end{cases}$
The fact that the measure DP raises out of the larger substance DP is crucial to the derivation. If the measure phrase were to remain low, the superlative morpheme and the focused modifier chocolate would be contained in the same constituent. This constituent would furthermore exclude the subject and verb phrase, which are essential components of the alternative set. With the measure DP moved to the outermost position of the clause, it is possible for the squiggle operator to merge with a constituent (IP₃) that contains these along with the focused element, as shown in (181). At the same time it remains discontinuous with the comparison class argument of [SUP].

(181)

Composition of IP₄ and the Comparison Class

\[
\llbracket \text{IP}_1 \rrbracket = \llbracket \text{ate}(t_3)(j) \rrbracket
\]
\[
\llbracket \text{IP}_2 \rrbracket = \lambda x \llbracket \text{ate}(x)(j) \rrbracket
\]
\[
\llbracket \text{IP}_3 \rrbracket^\circ = \llbracket \text{DP}_{\text{subs}} \rrbracket^\circ (\llbracket \text{IP}_2 \rrbracket) = \exists y \llbracket \text{ate}(y)(j) \land ^*\text{cc}(y) \land ^*\text{choc}(y) \land t_2 \in y \rrbracket
\]

by PA

\[
\llbracket \text{IP}_3 \rrbracket^\circ = \llbracket \text{DP}_{\text{subs}} \rrbracket^\circ (\llbracket \text{IP}_2 \rrbracket) = \exists y \llbracket \text{ate}(y)(j) \land ^*\text{cc}(y) \land ^*\text{van}(y) \land t_2 \in y \rrbracket
\]

by FA

\[
\llbracket \text{IP}_3 \rrbracket^* = \begin{cases} \\
\exists y \llbracket \text{ate}(y)(j) \land ^*\text{cc}(y) \land ^*\text{choc}(y) \land t_2 \in y \rrbracket \\
\exists y \llbracket \text{ate}(y)(j) \land ^*\text{cc}(y) \land ^*\text{van}(y) \land t_2 \in y \rrbracket \\
\exists y \llbracket \text{ate}(y)(j) \land ^*\text{cc}(y) \land ^*\text{redv}(y) \land t_2 \in y \rrbracket \\
\end{cases}
\]
\[ [\text{IP}_4]^0 = \lambda x \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{choc}(y) \land x \subseteq y] \] 

S \subseteq [[\text{IP}_4]]^F = \left\{ \begin{array}{l} 
\lambda x \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{choc}(y) \land x \subseteq y] \\
\lambda x \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{van}(y) \land x \subseteq y] \\
\lambda x \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{redv}(y) \land x \subseteq y] 
\end{array} \right. 

\cup S \subseteq \{ x : \exists P \in \{ \text{choc, van, redv} \} \land \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land P(y) \land x \subseteq y] \}\}

Finally, we see in (185) that while \([SUP]\) is still inside the FMP that is introduced by the definite article, its C argument is in such a position that the comparison class can be positively valued from within that constituent. The contents of the comparison class are constrained by the presuppositions of the superlative morpheme to be a subset of things that can be mapped to some degree by NP_4. This means that everything in C is an AMOUNT or sum of AMOUNTS, that can be mapped to some degree of cardinality.

The comparison class is also valued by focus association with S, whose contents are derived above, in (182). Note that (183 a & b) are logically equivalent predicates. A set of chocolate cupcakes and sums of chocolate cupcakes that Jamie ate is equivalent to a set of things that are parts on the count dimension of such individuals and sums.

\[ (183) \quad \begin{align*} 
\text{a.} & \lambda x \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{choc}(y) \land x \subseteq y] \\
\text{b.} & \lambda y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{choc}(y)] 
\end{align*} \]

Based on this equivalency, the denotation of the alternative set and comparison class can be reduced to those shown in (184)

\[ (184) \quad S \subseteq [[\text{IP}_4]]^F = \left\{ \begin{array}{l} 
\lambda y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{choc}(y)] \\
\lambda y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{van}(y)] \\
\lambda y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land^*_\text{redv}(y)] 
\end{array} \right. 

C \subseteq \cup S \subseteq \{ y : \exists P \in \{ \text{choc, van, redv} \} \land \exists y [\text{ate}(y)(j) \land^*_\text{cc}(y) \land P(y)] \}\}

131
Everything in S is either a sum of chocolate cupcakes that Jamie ate or of vanilla cupcakes or red-velvet cupcakes that he ate. In order for the construction to be defined, C must contain a subset of these sums of cupcakes, and each of those sums must have some degree of ‘many-ness’.

(185)

Plugging in the denotation of AMOUNT that we arrived at in Section 4.2.1 to the superlative measure DP, finally leads to the derivation in (186) of a coherent superlative FMP.

(186) Composition of Measure DP

\[
[[\text{AMOUNT}_\#]] = \lambda x \exists P. \text{ATOM}_\#(x, P) \\
\quad ( = \lambda x. \text{AMT}_\#(x)) \\
[[\text{NUMP}]] = \lambda x. *\text{AMT}_\#(x)) \\
[[\text{DegP}]] = \lambda x. \mu_\#(x) \geq t_1 \\
[[\text{NP}_3]] = \lambda x. *\text{AMT}_\#(x) \land \mu_\#(x) \geq t_1 \\
[[\text{NP}_4]] = \lambda d \lambda x. *\text{AMT}_\#(x) \land \mu_\#(x) \geq d \\
[[\text{SUP -C}]] = \lambda D_{*\text{AMT}_\#(x)} \lambda x \exists d. D(x) \land \forall y \in C [y \neq x \rightarrow \neg D(y)] \\
[[\text{NP}_5]] = \lambda x \exists d. *\text{AMT}_\#(x) \land \mu_\#(x) \geq d \land \forall y \in C [y \neq x \rightarrow \neg [ *\text{AMT}_\#(x) \land \mu_\#(y) \geq d]]
\]
\[ [\text{DP}_{\text{Meas}}] = \mathbf{1}_x \exists d . \, \text{AMT}_\#(x) \land \mu_\#(x) \geq d \land \forall y \in C \ [y \neq x \rightarrow \neg [\text{AMT}_\#(x) \land \mu_\#(y) \geq d]] \]

‘the amount (that is in the comparison class) that reaches some degree of cardinality, that nothing else (in the comparison class) reaches.’

The comparison class includes all of the sums of chocolate cupcakes that Jamie ate or of vanilla cupcakes or red-velvet cupcakes that he ate. So if defined, this DP will denote the maximal sum of cupcakes of one of these flavors that was consumed by Jamie. If Jamie ate an equal number of cupcakes of two different flavors, the expression will fail to refer. If he ate a greater number of chocolate ones than of either of the other flavors, it will pick out the maximal sum of chocolate cupcakes that he ate, because that is the sum that reaches the highest degree on the cardinality scale. Likewise, if he ate a larger number of some other flavor, it will refer to the maximal sum of cupcakes of that flavor that he ate.

This measure DP—which has come to refer definitely to a sum of cupcakes due to the comparison class argument—will combine with the ordinary value of \( IP_6 \). The proposition will be true just in case that predicate holds of the sum of cupcakes in question. Just as the denotation of the comparison class was simplified above, we can simplify the ordinary value of \( IP_6 \) based on the logical equivalence in (183). The composition of these truth conditions is shown in (187).

(187)

\[
[IP_6]^o = [IP_5]^o = \lambda x \exists y [\text{ate}(y)(j) \land *\text{cc}(y) \land *\text{choc}(y) \land x \subseteq y] \\
= \lambda y [\text{ate}(y)(j) \land *\text{cc}(y) \land *\text{choc}(y)]
\]

\[
[IP_7] = \text{ate}(ix)(j) \land *\text{cc}(ix) \land *\text{choc}(ix)
\]

Where \( ix = 1_x \exists d . \, \text{AMT}_\#(x) \land \mu_\#(x) \geq d \land \forall y \in C \ [y \neq x \rightarrow \neg [\text{AMT}_\#(x) \land \mu_\#(y) \geq d]] \)

‘Jamie ate the chocolate cupcakes that were the sum of cupcakes that reached a degree of cardinality that no other sum of any variety of cupcakes that Jamie ate reached.’
This will be true just in case Jamie ate a greater number of chocolate cupcakes than he did of any other kind of cupcakes—the NP-internal truth conditions.

We have concluded that the covert measure phrase construction is able to generate an NP-internal relative reading because the subextraction and raising of the entire superlative measure DP is possible. This derivation is also, of course, available when a superlative adjective modifies an overt measure noun in the same configuration. But if the superlative adjective is part of a DegP that is merged directly in an xNP that contains a focused element, then the reading cannot be generated. The definite article in this case is merged with that entire xNP and blocks extraction of the superlative morpheme (or of any sub-constituent that contains it). These possible superlative configurations are shown in Figure 21.

Figure 21: Three underlying structures for adnominal superlatives (cont. next page)
C. Covert measure pseudopartitive

The direct modification structure (A) has the comparison class argument of the superlative and the focused element ‘trapped’ together within a single definite-marked DP. Therefore C cannot be valued by focus association. The pseudopartitive structures in (B) and (C) each have a definite-marked DP generated inside an indefinite one, so extraction of the former makes possible focus association between the C argument and a focused element left behind in the remnant of the latter.

There is still a missing link in the argument that Q-adjectives give rise to an apparent ‘NP-internal’ reading based on the covert structure in (C), while other gradable adjectives cannot. This is the claim that only Q-adjectives can combine with the silent amount measure noun. I argue in the next section that restricted availability of the covert structure follows from two things: the definition of silent AMOUNT that we are proposing; and a constraint on adjectival modification of nouns for which we have already seen empirical evidence.
4.3 The covert structure and non-Q-superlatives

4.3.1 Constraint on adnominal adjectives.

In Chapter 2 we observed that while full measure phrases may in principle contain adjectives, it is not possible for just any adjective to appear inside the measure DP of a pseudopartitive. For example, constituency tests demonstrate that the adjective *generous* in (188) modifies the measure noun directly, while *sweet* in (189) can only be a modifier of a constituent that contains the measure noun and substance NP together—the individuating construction.

(188)  a. She added three *generous* teaspoons of brown sugar.
       b. It was three generous teaspoons that she added of brown sugar.

(189)  a. ?She added three *sweet* teaspoons of brown sugar
       b. #It was three sweet teaspoons that she added of brown sugar.

How exactly the individuating measure construction is composed is a question that is beyond the scope of this dissertation, but the fact that the adjective cannot directly modify the measure noun in this sentence is significant. The difference between the two adjectives is that *generous* is interpreted here as ordering things in terms of their size (qua *teaspoonful*). Anything in extension of *teaspoon* has some degree of size. We are analyzing this as a predicate of individuals of sort O (things that occupy/extend in three dimensional space). Therefore everything in the extension of *teaspoon* is something that can be compared with respect to its size on the volume dimension.

The scale referenced by the adjective *sweet*, on the other hand, orders things in terms of the intensity of a certain aspect of their flavor. Everything in the extension of *teaspoons of brown*

---

27 See Brasoveanu (2008) for one analysis. An approach that is more in the spirit of the analysis of measure nouns that I have presented here might derive them as ‘true’ partitives where the internal argument of the partitive morpheme has a ‘kind’ denotation.
sugar has some degree of sweetness, but not everything in the extension of teaspoon alone does. As a measure noun, this word itself only specifies an amount of matter. There are many things in the sort O of matter that do not naturally fit in the domain of this adjective.\footnote{Of course, one may argue that it is possible to ‘taste’ and compare the sweetness of anything in sort O. I assume that this involves some coercion, especially when we consider things that consist of sub-parts that are not homogenous with respect to the sweetness property. This sort of semantic coercion must take place on a case-by basis and cannot apply to the whole sort \textit{en masse}. On the other hand everything in sort O extends in space and, intuitively, can be mapped to some degree by the volume measure function.}

Because measure nouns generally denote properties of size along some dimension, they tend to have very heterogeneous extensions that contains individuals with diverse qualities. There are even measure nouns such as mile that have individuals of completely different sorts in their extension: mile can be a predicate of sort A (as is the case with a mile of jogging) as well as sort O (a mile of copper wire). The general constraint on adjectival modification that is active here is that the extension of the NP must be able to be mapped to some degree by the measure function of the adjective in order for the adjective to modify it. Hackl (2000) models such a constraint as a presupposition of the adjective. It seems to be the case with measure nouns that whenever the measure function of a gradable adjective matches some dimension that is part of the denotation of the measure noun itself, the presupposition will be satisfied.

This is why adjectives of size that refer to the same dimension as the measure noun are acceptable inside full measure phrases. But adjectives that refer to dimensions not included in the denotation of the measure noun fail to satisfy the constraint. This is true even if the same scale is referenced by the measure noun and the adjective, as can be illustrated by the very minimal distinction between the acceptable measure phrases in (190) and the unacceptable one in (191).

(190) The rocket went up for [ten long miles].
(191) *The rocket went up for [ten high miles].
Using the conventions we have adopted here, Hackl’s presupposition can be formalized for *high* and *long* with the following denotations:

(192)  **Attributive high with presupposition:**

\[
[[\text{high}]] \equiv \lambda d \lambda P \lambda x. \forall y [P(y) \rightarrow \exists d [\mu_{\text{HGT}}(y) \geq d]]. \ P(x) \land \mu_{\text{HGT}}(x) \geq d
\]

defined if everything in the extension of P can be mapped to some degree on the length scale by the height measure function.

Once the degree argument is saturated, this predicate *d-high* can combine with an NP such as *building* or *altitude*, since these will satisfy the presupposition. The NP *mile*, although it refers to the length scale does necessarily refer to the height dimension. The NP *d-high mile* will therefore be undefined:

(193)  \[
[[\text{mile}]] = \lambda x. \mu_{\text{DIM}}(x) \geq \text{d}_{\text{mile}} \land \text{ATOM}_{\text{DIM}}(x, [\lambda x. \mu_{\text{DIM}}(x) \geq \text{d}_{\text{mile}}])
\]

\[
\forall y [[\text{mile}](y) \rightarrow \exists d [\mu_{\text{HGT}}(y) \geq d]] = \text{FALSE}
\]

\[[d\text{-high mile}] \text{ is undefined.}\]

The adjective *long* is minimally different. It is only specified for scale, while its dimension parameter is open (194). Therefore its presupposition can be satisfied by *mile* and compose as shown here:

(194)  **Attributive long with presupposition:**

\[
[[\text{long}]] = \lambda d \lambda P \lambda x. \forall y [P(y) \rightarrow \exists d [\mu_{\text{DIM}}(y) \geq d]]. \ P(x) \land \mu_{\text{DIM}}(x) \geq d
\]

\[
\forall y [[\text{mile}](y) \rightarrow \exists d [\mu_{\text{DIM}}(y) \geq d]] = \text{TRUE}
\]

\[[d\text{-long mile}] = \lambda x: \text{mile}(x) \land \text{ATOM}(x)_{\text{DIM}}(x, \text{mile}) \land \mu_{\text{DIM}}(x) \geq d
\]

For measure nouns, then, we can specify that an adjective may only modify the noun within an
FMP if the adjective refers to measurement on the same dimension that atomicity of the noun is defined on. Our earlier example, *three sweet teaspoons*, clearly fails this presupposition. The NP *teaspoon* is the property of being an atomic portion of matter that reaches a certain degree on the volume scale. It makes no reference to the ‘sweetness’ scale at all.

Because only adjective-noun combinations that satisfy this presupposition of dimension-matching may co-occur inside a full measure phrase, the overt measure pseudopartitive construction is only available for such pairs. This means that superlative adjectives must also satisfy the constraint in order to generate a relative reading with focus inside the substance NP. This is for the same reason that we have hypothesized that the NP-internal reading is only available with the covert pseudopartitive structure. Whether the measure noun is overt or covert, it is only in these cases that the comparison class argument of the superlative inside a subconstituent that can escape the substance DP constituent. This contrast is shown in (195) and (196) where the structures from Figure 21 are filled in with the appropriate examples.

(195) Structure A: Direct modification

\[
\text{DP} \quad \text{NP} \quad [\text{C-SUP}] \quad \text{DegP} \quad \text{NP} \\
\text{the} \quad \text{NP} \quad d\text{-}sweet \quad \text{teaspoon of [brown]F sugar}
\]
We predict, therefore, that the first example should not give rise to the corresponding relative reading where the sweetness of the teaspoon of brown sugar added is compared to the sweetness of the teaspoon of any other type of sugar added. But the second example is predicted to generate just such a reading with respect to size. It should be able to be interpreted with a relative reading comparing the sizes of the teaspoon of various sugars added. This prediction is born out:

(197)  She added the sweetest teaspoons of BROWN sugar.
    a. The teaspoons of brown sugar that she added were the
       sweetest teaspoons of brown sugar that you could imagine.  
       \textit{absolute}
    b. The teaspoons of brown sugar that she added were sweeter
       than the teaspoons she added of any other type of sugar.  
       \textit{relative}

(198)  She added the largest teaspoons of BROWN sugar.
    a. The teaspoons of brown sugar that she added were the
       largest teaspoons of brown sugar that you could imagine.  
       \textit{absolute}
    b. The teaspoons of brown sugar that she added were larger
       than the teaspoons she added of any other type of sugar.  
       \textit{relative}

The absolute readings are available in both cases, although the focus on \textit{brown} is unexpected out of the blue. It can only be interpreted as contrastive in (197a). In (198) it is possible to interpret
the focus as contributing to a valid relative reading. The measure noun *teaspoon* satisfies the presupposition of *large*, and as predicted this makes the reading in (198b) available.

### 4.3.2 Adnominal adjectives and AMOUNT

Now let us consider the silent measure noun that we have posited for the covert pseudopartitive structure. It has the entry in (199), denoting the set of individuals that are atomic on some property, with the dimension of parthood that atomicity is defined for underspecified for dimension. Ultimately the dimension will be constrained in the pseudopartitive structure by the requirements of the MON head, but at the point in the derivation at which an adjective directly modifies amount, this dimension is still unconstrained.

\[
\text{(199)} \quad \mathbf{AMOUNT}_{\text{DIM}} = \lambda x \exists P. \text{ATOM}_{\text{DIM}}(x, P)
\]

This begs the question: what adjective is there that has a presupposition permissive enough to be satisfied by such a noun? Even the adjective *long* which is also underspecified for dimension is still constrained to those dimensions that can be compared on the length scale. But the silent AMOUNT noun might refer to a portion of some abstract substance such as *light* or *fear* that does not map to any degree on the length scale. The presupposition failure that results from using *long* as an adnominal modifier of the silent measure noun is shown in (200):

\[
\text{(200)} \quad \mathbf{long} = \lambda d \lambda P \lambda x. \forall y[\mathbf{P}(y) \rightarrow \exists d[\mu_{\text{L DIM}}(y) \geq d]]. \ P(x) \land \mu_{\text{L DIM}}(x) \geq d
\]

\[
\forall y[\mathbf{AMOUNT}_{\text{DIM}}(y) \rightarrow \exists d[\mu_{\text{L DIM}}(y) \geq d]] = \text{FALSE}
\]

\[
[d\text{-}long \ AMOUNT] \ is \ undefined.
\]
The only adjectives whose denotations are sufficiently underspecified are *much* and *little*. These may map an individual to a degree on any scale that is defined for their dimension parameter once that is valued. Like the *amount* noun itself, these adjectives have a dimension parameter that is open until the point in the derivation at which the measure DP merges in the specifier of *MON*. The composition of *much* with amount is shown in (201) and the reader can verify for themself that antonym, *little*, will satisfy the presupposition as well.

(201) $[[\text{much}]] = \lambda d \lambda P \lambda x : \forall y [P(y) \rightarrow \exists d [\mu_{\text{DIM}}(y) \geq d]]. \ P(x) \land \mu_{\text{DIM}}(x) \geq d$

$\forall y [[\text{amount}_{\text{DIM}}](y) \rightarrow \exists d [\mu_{\text{DIM}}(y) \geq d]] = \text{TRUE}$

$[[\text{d-much amount}_{\text{DIM}}]] = \lambda x \exists P. \text{ATOM}(x)_{\text{DIM}}(x,P) \land \mu_{\text{DIM}}(x) \geq d$

The case of *many* and *few* is slightly different. These do not have an open scale and dimension, but are specified for cardinality. Although the dimension parameter of *amount* is open, the fact that it denotes atoms (of some property of individuals) means that anything in its extension has some degree of cardinality. Any atom or sum of atoms (of any sort) has some degree of cardinality, so in fact any count noun will satisfy the presupposition of *many* or *few*.

(202) $[[\text{many}]] = \lambda d \lambda P \lambda x : \forall y [P(y) \rightarrow \exists d [\mu_{\text{DIM}}(y) \geq d]]. \ P(x) \land \mu_{\text{DIM}}(x) \geq d$

$\forall y [[\text{amount}_{\text{DIM}}](y) \rightarrow \exists d [\mu_{\#}(y) \geq d]] = \text{TRUE}$

$[[\text{d-many amount}_{\text{DIM}}]] = \lambda x \exists P. \text{ATOM}(x)_{\text{DIM}}(x,P) \land \mu_{\#}(x) \geq d$

We can now assert that the only adjectives whose presuppositions are able to be satisfied by the silent *amount* noun that we have posited, are the four Q-adjectives: *much* and *little* by virtue of their (completely) open dimension parameter; *many* and *few* by virtue of *amount* being a count noun. The claim, for which we now have an explanation, that only Q-adjectives may directly
modify the silent amount noun, in turn supports the hypothesis that other gradable adjectives
cannot generate the NP-internal relative reading because they cannot appear in the covert
pseudopartitive.

(203) Structure C: Covert measure pseudopartitive

When the Q-adjective merges with a superlative morpheme inside this structure, an NP-internal
relative reading can be generated. Non-Q-superlatives can generate the parallel reading when
they modify an overt measure noun that satisfies their own presupposition, based on the
underlying structure in (196) above. But if a non-Q-superlative appears without an overt measure
noun, we can continue to assume that the structure in (203) is not available.

4.4 Implications and limits of the proposal

While this proposal is an argument against movement of the superlative morpheme out of
definite-marked constituents, it does not preclude a movement analysis for superlative
constructions in other languages, especially in the absence of definite-marking.²⁹ The proposed

²⁹ Indeed there is strong evidence to support the movement approach to relative readings for most Slavic
languages (Pancheva & Tomaszewicz, 2012), as well as Japanese (Aihara, 2009) and Syrian Arabic
(Hallman, 2016).
solution to the problem of NP-internal relative readings of Q-adjectives ultimately lends support to Pancheva & Tomaszewicz’s (2012) combined approach. Universal Grammar allows for a movement derivation to generate relative readings, *but only in the absence of a definite D head.*

The approach to relative readings argued for here relies on movement of a definite-marked constituent containing the superlative morpheme and its comparison class argument. The difference between readings available for Q- and non-Q superlatives emerges from a difference in the complexity of the underlying structures that are generated to express *quantities* as opposed to *qualities* of a nominal. Q-superlatives modify a silent amount noun inside a measure phrase constituent which can move separately from the substance noun. Non-Q-superlatives modify the overt noun directly, and so are generated in a constituent that also immediately contains that noun and any other pre- or post-nominal modifiers. Because the definite article is assumed to be a barrier for extraction of the superlative morpheme, this leads to the observed differences in interpretation for Q- and non-Q superlatives in English (as well as Flemish).

Can this approach cover all instances that have been claimed to require movement of the superlative morpheme in English? In its present state, this proposal does not solve all of the problems that have been raised for *in situ* derivations. For purposes of exposition, I have relied on a denotation for the definite article as a sum operator, which has been sufficient for the argument presented here. But there are instances both within and outside of the realm of superlatives where there is reason to believe this is an oversimplification. The existence presupposition that is represented as part of the denotation of *the* is problematic for deriving the upstairs *de dicto* reading, as well as for simpler cases where this presupposition easily disappears. Nevertheless, the evidence here indicates that a comprehensive account of relative readings of superlatives must not simply ignore the role of definite marking. In English, Flemish
and Bulgarian, the presence and form of the definite article have real interpretive effects. These have been explained here in terms of both syntactic constraints on movement and the semantic function of selecting the maximal element from within a domain of individuals.

4.5 Chapter Summary

In this chapter I have proposed an approach to most, least, and fewest that treats them as genuinely adjectival, yet is nevertheless able to account for many of the ways in which they differ from other gradable adjectives. I have shown how the NP-internal relative reading can be generated for just these Q-superlatives within a covert pseudopartitive structure.

The argument presented here depends on an in situ approach to relative readings. The definite article is assumed to be a sum-formation operator and to create a DP that is opaque for degree-morpheme extraction. Without this constraint on movement, the difference in available interpretations for Q-superlatives and non-Q-superlatives would remain a mystery. Insofar as it is successful, then, this proposal provides support for the in situ approach to relative readings in English. Or to put it differently, it is an argument against an approach that allows unconstrained movement of the superlative morpheme.

The partitive model for overt pseudopartitives developed in Chapter 3 provides a framework for the composition and interpretation of the covert structure that (I argue) underlies Q-superlatives. That model also proves important to understanding the role of dimension in constraints on adjective-noun combinations that ultimately restrict this covert structure to these few underspecified adjectives. It may be possible to combine the syntax that I propose here with
a different semantic model for quantity adjectives\textsuperscript{30} and find an alternative solution to the puzzle of NP-internal relative readings. The constituency of the definite article with most is the essential element that allows focus association to value the comparison class argument of the superlative, and this does not depend on the semantics of measure nouns or of much/many that I have proposed. However, an advantage of the particular model presented here is that it can also account for the parallel distinction that exists in the domain of overt measure pseudopartitives: when focus is pronounced within the substance NP, the associated relative reading can only be generated if the superlative directly modifies the measure noun. Any approach that models measure nouns themselves as predicates of scalar intervals must treat these adjectives as predicates of predicates of scalar intervals. While such a model is not inconceivable it would introduce an undesirable level of complexity to the theory that I believe is unnecessary.

\textsuperscript{30} For example, Solt (2014)’s treatment of Q-adjectives as degree operators
Chapter 5

Conclusion

This dissertation began with a puzzle about a particular type of relative reading. This NP-internal relative reading was observed to be available in English for the quantity superlatives *most, least, and fewest* but not for superlatives of any other gradable adjectives. While the movement approach to superlatives overgenerates the reading, the *in situ* approach appears to undergenerate. The *in situ* approach predicts that the focus association between an operator and the comparison class argument of the superlative should be impossible or at least ineffective in generating such a reading—for quantity and non-quantity superlatives alike.

I have argued that the key to solving this puzzle lies in a novel syntactic analysis that is suggested by semantic parallels between full measure phrases and Q-adjectives. Expanding on Kayne’s (2002, 2005) proposal that these adjectives modify a silent nominal element, I have hypothesized that this covert element is a highly underspecified measure noun. As modifiers of silent *AMOUNT*, the four adjectives in question are often embedded inside a covert measure construction, rather than directly modifying the overt noun that they precede.

An important component of this analysis is the claim that the measure phrases appearing in pseudopartitives have all the structural and semantic complexity of full DPs. I have shown that full measure phrases may contain adjectival modification of the measure noun, and that superlative morphology makes it possible for a definite article to introduce the measure phrase.

This in turn leads to the conclusion that *the most AMOUNT* is a constituent that is able to extract
out of the indefinite DP that contains it, creating an LF configuration that allows for the derivation of the puzzling relative readings.

The semantics of these complex pseudopartitives constructions raises new questions. What began as a small technical question—how adjectives and superlative morphology are interpreted inside a measure phrase—grew into a novel approach to measure nouns and measure pseudopartitive constructions. Rather than treat these as directly mapping a substance noun to a scale, I have proposed an model in which measure nouns denote material parts of the entities denoted by the substance NP. The functional head MON forces the interpretation of dimension to be one that is monotonic, but this is not an arbitrary presupposition. Monotonicity is a direct result of parthood itself being necessarily parameterized for dimension.

The model that I have proposed brings together a familiar, highly constrained approach to the derivation of relative readings with a more novel approach to the semantics of measurement. I have shown that this model can account for behavior of quantity superlatives which seems exceptional, while maintaining that their semantics is fundamentally in line with that of other superlative adjectives. While the puzzle that inspired the development of this model is fairly limited, the implications of this work for understanding the syntax-semantics interface are more widespread. Full measure phrases and quantity words are pervasive in language, appearing in a wide range of syntactic environments across categories. Therefore, I am afraid that I have only just scratched the surface of the implications of this model.
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