QUANTIFICATION AND (UN)CERTAINTY

by

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Abstract

In natural language, vagueness abounds. In the sentence *John served approximately 50 sandwiches*, for example, there is potential indeterminacy in what counts as a sandwich, what counts as an event of serving, and what quantities qualify as *approximately fifty*. In this dissertation I explore sentences like these in the context of two questions: *i*) What is the nature of vagueness? and *ii*) How should quantifiers be analyzed? I address these questions through case studies of a variety of modifiers, focusing on *approximately*, *maybe*, and *about*, as in *John served approximately/maybe/about 50 sandwiches*. Comparing modal modifiers like *maybe* to non-modal modifiers like *approximately*, I argue that vagueness is a systematically heterogeneous phenomenon by identifying fundamental differences in the vague readings these two classes of modifiers produce. In particular, I highlight their differing felicity in contexts that do not allow certain intermediate-value interpretations, such as *It's Susan's birthday today, and she's maybe/#approximately thirty* (here Susan can be exactly 30, 31, etc., but not 30.5, etc.). I further use this contrast to identify modal content in modifiers like *about* and *like* that previously received non-modal accounts. The modal account I develop makes a range of predictions, and I investigate in depth the modal concord readings it predicts. In doing so, I uncover surprising concord readings between modal modifiers and rising intonation. To account for this, I provide a semantic account of rising intonation as an epistemic possibility operator. Finally, as a key issue in answering questions (*i*) and (*ii*) is understanding the compositional interaction between these modifiers and the items they modify, I investigate quantifier composition. I focus in particular on *approximately* and *about*, which I argue support a decompositional approach to quantifiers due to their distribution across different syntactic constructions and the different categories of items over which they quantify (e.g. *What John served was approximately {50 sandwiches/beef stroganoff}* vs. *John served approximately {50 sandwiches/#beef stroganoff}*). Taken together, the denotations of these modifiers I develop and the means I provide for their composition account for a range of behaviors support a heterogeneous view of vagueness and decompositional approach to quantifiers.

Committee:

Steven Gross (chair), Justin Halberda, Géraldine Legendre, Akira Omaki , Kyle Rawlins

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1 Introduction

Natural language provides many ways to mark our utterances as vague, and understanding this vagueness has long been an important study in semantics and pragmatics. In this dissertation, I investigate vagueness through the lens of approximation, shedding light on the issue of heterogeneity in vagueness. In particular, I address two large questions in the semantics literature, as described below.

(1)

1. What is the nature of vagueness?
   - Is it a homogeneous phenomenon?
     - If not, what sub-types are there and why?
2. How should quantifiers be analyzed?
   What are quantifiers?
   - Are quantifiers compositional?
     - How do they compose?

What is the nature of vagueness? A wide range of modifiers mark phenomena that have been characterized as vagueness, approximation, hedging. A recent area of interest in formal semantics and pragmatics has been in understanding to what extent these related phenomena differ, and to what extent they are in fact the same (Pinkal 1995; Kennedy 2007; Sauerland and Stateva 2007). For example, Sauerland and Stateva (2007) note a distributional difference among the modifiers, illustrated in (2). Here we see that non-modal *approximately* can combine with numerals like *fifty*, but it cannot combine with expressions like *beef stroganoff*. Modal *maybe*, however, can combine with *beef stroganoff*.[1]

(2) a. John served approximately fifty sandwiches.
b. #John served approximately beef stroganoff.
c. John served maybe beef stroganoff.

Sauerland and Stateva use this asymmetry to construct an analysis wherein these different types of modifiers lead to different types of vagueness, and I likewise take data like this as evidence that not all vagueness is alike. This raises several important questions about the nature of vague phenomena, including exactly which phenomena fall under this general category and what the parameters of such a category would be. In this dissertation, I provide answers.

I build on Sauerland and Stateva's analysis, providing an explicit account of the approximative readings these modifiers produce. I focus on contrasts between sentences like (3b)-(3c) to highlight

[1] Note that the intonational contours favored by these modifiers differ.

novel and fundamental differences between modal-induced and non-modal-induced vagueness.

(3) a. John served fifty sandwiches. (imprecise)
b. John served approximately fifty sandwiches. (vague, non-modal)
c. John served maybe fifty sandwiches. (vague, modal)

Most notably, I identify the modals' ability to license discontinuous alternatives (defined below in (41)). This contrast is seen most clearly in examples like (4).

(4) a. It's Susan's birthday today, and she's thirty. (imprecise)
b. #It's Susan's birthday today, and she's approximately thirty. (vague, non-modal)
c. It's Susan's birthday today, and she's maybe thirty. (vague, modal)

As a whole, I argue for a heterogeneous view of vagueness, one that is divided not only by (im)precision of an expression, but also by whether or not the vagueness is generated through modal content. This argument is developed through case studies of the interaction between vague expressions and their modifiers. In particular, I target the interaction between epistemic modal modifiers and the scalars they modify in sentences like (5).

(5) There were $\underbrace{\text{maybe}}_{\text{modal}}$ $\underbrace{20}_{\text{scalar}}$ people at the party.

I identify behavior unique to these modal-containing vague readings, which I use to support a heterogeneous view of vagueness. I then demonstrate that this behavior occurs not only between scalars and (recognized) modals, but also between scalars and other modifiers, including *like* and *about*, which have not traditionally been treated as modal. Based on this behavior, in conjunction with other characteristically modal behaviors (e.g. participation in modal concord), I reanalyze these modifiers as modal. I then examine the behavior of modal modifiers under rising intonation, and, finding it to be modal in nature, I propose a new modal analysis of rising intonation.

How should quantifiers be analyzed? The modifiers that I focus on in this dissertation form a syntactic unit with a range of items, including numerals, nominals, and determiners. To understand their behavior as a unit, we must also understand the compositional interactions of their parts. Through the investigation of modals I present, and in particular modal quantifiers, I provide evidence in favor of a decompositional approach to quantification, focusing on the distributional asymmetries represented in (6)-(7).

(6) a. John served approximately/ about 50 sandwiches.
b. John served #approximately/#about beef stroganoff.

(7) a. What John served was approximately/ about 50 sandwiches.
b. What John served was approximately/#about beef stroganoff.

I discuss the distribution of these modifiers in combination with numerals (e.g. *approximately 50*) and with non-scalar expressions (e.g. *beef stroganoff*) that have been coerced into a scalar reading (e.g. *approximately beef stroganoff*)[2], and I show their distribution to follow from the argument requirements under the decompositional analysis I adopt, which builds off of Hackl (2000). These comparisons also bring to light a contrast among quantifiers in their ability to modify non-scalar items, demonstrated in (8).

(8) a. What John served was {approximately/about/around/a good} fifty sandwiches.
b. What John served was {approximately/#about/#around/#a good} beef stroganoff.

If quantifiers are compositional, as I argue, one would expect then to decompose in a predictable way into a fixed set of items that combine according to some grammar. The framework I import from Hackl (2000) forms quantifiers from an inventory of three elements: a degree function, a degree quantifier, and a measure phrase. Through the extensions I propose, I maintain this basic inventory, and this generates the interesting generalization that all measure phrases, from *fifty* to scalar uses of *beef stroganoff*, are uniformly (coerced into) type *d*(egree) (cf. Kennedy 2011, a.o).

1.1 Vagueness

Vagueness has a long been an area of philosophical interest, and it and related topics have spawned a host of at times overlapping and inconsistent definitions. Generally, the existence of borderline cases has been taken to be the hallmark of vagueness (Sorensen 2012). Following Kennedy (2011) I will consider vague sentences to have three distinguishing characteristics.[3]

(9) Distinguishing characteristics of vagueness
1. Contextual variability of truth conditions
2. The existence of borderline cases
3. Giving rise to the sorites paradox

[2]These coerced readings were not investigated in Sauerland and Stateva (2007).

[3]Cf. Smith (2008); Égré and Klinedinst (2011); Burnett (2012), who use borderline cases (objects which are neither clearly p or $\neg p$), blurred/fuzzy boundaries (inability to pinpoint the transition from p to $\neg p$), and susceptibility to the Sorites Paradox. See also Keefe (2000).

To illustrate these, Kennedy uses the example sentence in (10), where the gradable adjective[4] *expensive* is considered to be the source of vagueness.

(10) The coffee in Rome is expensive. (Kennedy 2011, p. 520)

The contextual variability of truth conditions in this sentence are due to its truth or falsity being reliant on an implicit comparison.[5] This can be seen in contexts and sentences in (11), where in one context, (10) is true, while in the other it is not.

(11) a. [Comparing Rome and home, where the price of coffee in Rome is drastically greater than the price of coffee from home]
The coffee in Rome isn't expensive. (= false)

b. [Comparing Rome and Nome, where the price of coffee in Nome is drastically greater than the price of coffee in Rome]
The coffee in Rome isn't expensive. (= true)

Kennedy highlights the existence of borderline cases in (10) by comparing prices as in (12). While there are cases that can be confidently classified as 'expensive' or 'not expensive' in a given context, there are still borderline cases which cannot be classified as either.

(12) a. The Mud blend at \$1.50/pound → not expensive

b. The Organic Kona at \$20/pound → expensive

c. The Swell Start Blend at \$9.25/pound → ?

And finally, he demonstrates how, even when the context is fixed and a clearly expensive case has been identified, the Sorites Paradox emerges.

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[4] Following Kennedy and McNally (2005); Kennedy (2007, a.o.), gradable adjectives are adjectives that map their arguments to degrees (e.g. *John is six feet tall* maps John's height to 6 feet). These degrees can be compared using a variety of degree modifiers (e.g. *more*, *less*, *very*, *too*, *enough*). An example of this is shown in (ia), which contrasts with the non-gradable adjective *atomic* in (ib).

(i) a. John is very tall.
b. #That bomb is very atomic. (Kennedy and McNally 2005, p. 347)

Gradable adjectives come in two varieties, relative and absolute. Relative gradable adjectives (e.g. *long*, *old*, *expensive*, *tall*, *short*) map to some contextually-supplied standard (or for some, the degree can be specified by a measure phrase, e.g. *6 feet tall*). Absolute gradable adjectives, on the other hand, do not rely on a contextually-supplied standard, and they are classified as either maximum-standard or minimum standard. Maximum-standard adjectives (e.g. *full*, *empty*, *dry*, *open*, *closed*) map to an endpoint (e.g. *full* maps to endpoint or maximum degree on a scale of fullness). Minimum-standard adjectives map to any above-zero point (e.g. *wet* maps to any non-zero degree on a scale of wetness).

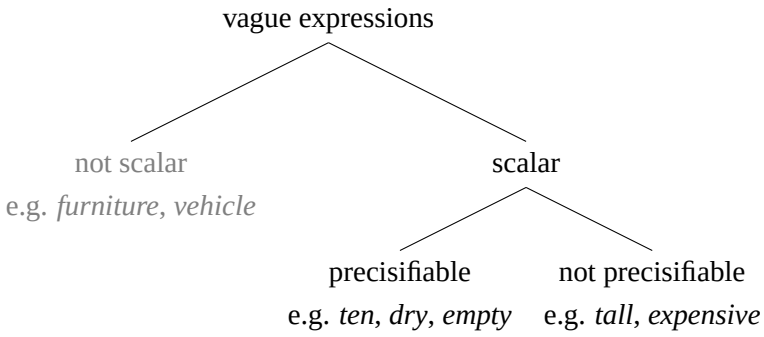
[5] Contextually-variable truth conditions alone are not sufficient for vagueness (e.g. indexicals like *I* and *now*, relational nouns like *citizen* and *mother*, see Van Rooij (2011), Kennedy (2011)).

(13) P1. A $5 cup of coffee is expensive (for a cup of coffee). (Kennedy 2011, p. 520)
P2. Any cup of coffee that costs 1 cent less than an expensive one is expensive (for a cup of coffee).
C. Therefore, any free cup of coffee is expensive.

Here, by accepting the premises in P1 and P2, which appear true, one is lead to the conclusion in C, which is clearly false.[6] For an overview of accounts of these phenomena, see Kennedy (2011); for a more in-depth look, see Williamson (1994); Keefe and Smith (1997); Fara and Williamson (2002).

A large focus in the literature has been on determining what kind of logic vagueness requires. For example, can borderline cases be adequately accounted for in a standard two-value (true/false) logic? Does it require a third value, or perhaps even infinite values? These studies often treat vagueness as a unified phenomenon (cf. Fine 1975; Lewis 1979; Keefe 2000; Fara 2000; Smith 2008; Égré and Klinedinst 2011, a.o.), but some have questioned whether vagueness is best treated this way (cf. Pinkal 1995; Soames 1999; Kennedy and McNally 2005; Kennedy 2007; Sauerland and Stateva 2007; Morzycki 2011; Husband 2011, a.o.). They point to splits like those in (14), which separates scalar expressions from non-scalar expressions (a branch that will not be explored in this dissertation)[7] [8] and expressions that naturally allow a precise interpretation from those that do not. This contrast will be explored in Section 1.1.1.

(14)



[6] To see this in greater detail, note that if you accept P1 and P2, then any $4.99 cup of coffee is expensive. Then if any $4.99 cup of coffee is expensive, any $4.98 cup of coffee is expensive, ..., and if any $0.01 cup of coffee is expensive, then any $0.00 cup of coffee is expensive.

[7] Soames (1999) refers to the class of scalar predicates as Sorites predicates because the can lead to the Sorites Paradox, discussed above.

[8] Scalars are terms that make reference to an ordered set of degrees (e.g. *tall* references an ordered set of degrees of height). A scale, as defined in Burnett (2012), can be thought of as "a triple $\langle D_d, >, \phi \rangle$, where D is a set, $>$ is an ordering on D_d, and ϕ is a dimension (i.e. height, baldness etc.)," (Burnett 2012, p. 208). See also Cresswell (1976); Rotstein and Winter (2004); Kennedy and McNally (2005).

1.1.1 Vagueness and imprecision

Following the criteria outlined in (9), relative gradable adjectives like *expensive* (demonstrated in (13)) and *tall* are clearly vague, as are nouns like *heap*. Absolute gradable adjectives like *full* and *bald* can likewise emerge as vague. For example, note the Sorites Paradox with *full* in (15).

(15) P1. A cup of coffee filled to the brim is(/can be called) a full cup of coffee.
P2. Any cup of coffee that contains one drop less than a full cup of coffee is(/can be called) a full cup of coffee.
C. Therefore, any empty cup of coffee is(/can be called) a full cup of coffee.

On 'round' readings, numerals like *five* also appear to be vague.

(16) P1. A $4.99/$5.00 cup of coffee can be called a $5 cup of coffee.
P2. Any cup of coffee that costs 1 cent less than what can be called a $5 cup of coffee can be called a $5 cup of coffee.
C. Therefore, any free cup of coffee is a $5 cup of coffee.

Under an exact reading of absolute gradable adjective and numerals, however, P2 can be rejected. I will refer to these expressions as *imprecise*.

(17) **Imprecision:** the vague behavior demonstrated by predicates in imprecise contexts, where the same predicate in some precise context does not demonstrate vague behavior

These varying contexts are exemplified below. In (18), precision is not important, so *full* can be used to describe a theater that is at capacity, as well as one that simply contains more people than usual. In (19), however, precision is important, as the difference between at capacity and simply containing more people than usual is relevant, and we find that imprecise descriptions are not acceptable.

(18) Low-precision contexts
a. [Describing a movie theater where every seat is occupied to the person sitting next to you]
The theater is full.
b. [Describing a movie theater where more seats than usual are occupied to the person sitting next to you]
The theater is full.

(19) High-precision contexts
a. [Describing a movie theater where every seat is occupied to the ticket seller so that he knows whether or not he can sell more tickets]
The theater is full.
b. [Describing a movie theater where more seats than usual are occupied to the ticket seller so that he knows whether or not he can sell more tickets]

#The theater is full.

We see the same contrast in (20) and (21). In (20), precision is not important, so *five* can be used to describe the price of a cup of coffee that cost $5.00 exactly, as well as one that cost $4.50. In (21), where the difference between $5.00 and $5.00 is relevant, precision is important.

(20) Low-precision contexts

a. [Casually describing a cup of coffee that costs $5.00]
This cup of coffee costs five dollars.

b. [Casually describing a cup of coffee that costs $4.50]
This cup of coffee costs five dollars.

(21) High-precision contexts

a. [Cashier describing a cup of coffee that costs $5.00 to the customer they are ringing up]
This cup of coffee costs five dollars.

b. [Cashier describing a cup of coffee that costs $4.50 to the customer they are ringing up]
#This cup of coffee costs five dollars.

Note that relative gradable adjectives like *expensive* and *tall* can have specific interpretations in the right context.

(22) According to store policy, coffee that costs $5 or more per cup is considered 'expensive'. Yours only cost $4.99, so it's not expensive.

(23) The manufacturer specifies that pants with legs 33 inches or longer are 'tall'. These have a 32.5 inch inseam, so they are not tall.

This precise reading, however is typically not available to relative gradable adjectives, so I will not consider these to be imprecise.[9,10,11] Below I will focus on imprecision-type vagueness and its

[9] Note also that precise uses of relative gradable adjectives rob them of their gradability. For example, these adjectives in their precise sense cannot appear with degree modifiers like *very*.

(i) According to store policy, coffee that costs $5 or more per cup is considered 'expensive'. Yours cost $20, so it's (#very) 'expensive'.

[10] See also Burnett (2012)'s argument for natural precisification of relative gradable adjectives.

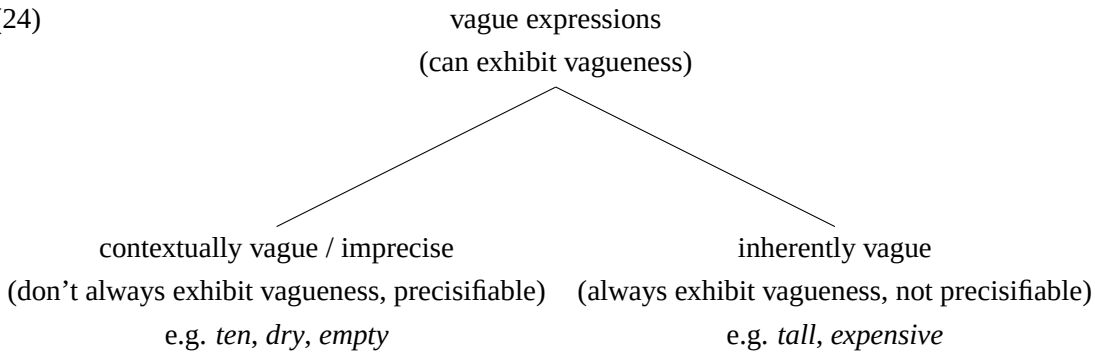
[11] Pinkal (1995) contrasts these uses with what he calls *natural precisification*, which numerals and absolute gradable adjectives allow. His example of unnatural precisification (Pinkal 1995, p. 100):

(i) a. Is the Santa Maria fast?

associated modifiers.

There are a variety of views on imprecision. Kennedy (2007), for example, considers imprecision to be "a phenomenon that is distinct from vagueness, though typically exists alongside it," (Kennedy 2007, p. 24) . I will assume that vague behavior matches the criteria in (9), and some (what I call inherently vague) expressions always show this behavior, while some (what I call contextually vague or imprecise) expressions only sometimes show this behavior. This distinction is shown in (24). As (24) reflects, my methodological approach assumes the existence of a superordinate category uniting these two categories. This assumption is analytically useful in guiding my comparisons between these two categories, but little hinges on the presence and precise identity of this superordinate category. My focus is, as will be made clear below, on a lower category, and the level to which the contrasts I establish 'percolate up' is not of great importance.

(24)



With imprecision (as well as with scalarity, mentioned in (14)), we see our first piece of evidence for a heterogeneous view of vagueness.

1.1.2 Analyses of imprecision

How should imprecision be analyzed? Consider the sentence in (25).

(25) Mary arrived at three o'clock. (Lasersohn 1999, p. 522)

When uttering this sentence, can the speaker ever truthfully assert that Mary arrived at three o'clock? When exactly *is* three o'clock? What moment or moments exactly constitute the arrival of Mary? Could a (pedantic) hearer always object *No, she actually arrived at 3:00.01* or *3:00.001* or *3:00.0001*, etc? Such concerns may lead us to believe some combination of the following:

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b. If fast means "faster than 14 knots", then the Santa Maria is fast; if it means "faster than 15 knots", then she is not fast.

Here he describes the precisification as unnatural because it must be stated explicitly and its boundaries are "chosen at random," (Pinkal 1995, p. 99).

A. Language is very precise, and we are constantly saying things that are false or that we cannot know to be true (view highlighted in Lasersohn (1999))[12]

B. Language allow us to speak imprecisely yet truthfully (view highlighted in Krifka (2009))

Lasersohn treats numerals like *three* in (25) as having only a precise meaning. When numerals are used in their imprecise or round sense, we grant what Lasersohn terms *pragmatic slack* in interpreting them as if they were true. Rounding as in (20b) (repeated in (26) below) results in a false statement, but it may be close enough to the truth for practical purposes to be treated as if it were true.

(26) [Casually describing a cup of coffee that costs $4.50]
This cup of coffee costs five dollars.

The range of values that are considered close enough for practical purposes are those that fall within *five*'s *pragmatic halo*.[13] So while *five* denotes a single exact value *i*, it is pragmatically associated with other values within *i*'s halo, i.e. ones whose distance from *i* is pragmatically ignorable in the context. This is sketched in Figure 1. Under this approach, these expressions are not

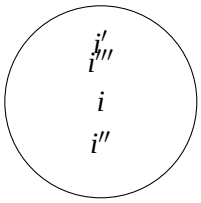

Figure 1: *i* with its halo containing i', i'', and i''', which differ from *i* only in pragmatically ignorable ways.

semantically vague. They have precise truth conditions, and imprecision arises only pragmatically.

Hedges *roughly* and *loosely speaking* are termed *slack regulators*, and they manipulate pragmatic halos, functioning to more-or-less expand the denotation of an item to include its halo[14]. For

[12]Some theories treat non-imprecise vague predicates similarly, e.g. supertruth in Supervaluation (Williamson 1994; Van Fraassen 1966, a.o.) occurs when a proposition is true under all levels of precision, so if Mary's arrival was agreed to be at 3 : 00 exactly, (25) would be supertrue.

[13]Lasersohn writes: "Given an expression α denoting some object x, I like to think of the set the context associates with x as arrayed around x in a sort of circular cluster, so I will call this set,together with its ordering relation, the PRAGMATIC HALO of x, or, extending the terminology, as the pragmatic halo of α", (Lasersohn 1999, 527) and "$H_C(\alpha)$ is understood to be a set of objects which differ from $[\![\alpha]\!]^{M,C}$ only in ways which are pragmatically ignorable in C; $\leq_{\alpha,C}$ is an ordering of $H_C(\alpha)$ according to similarity to $[\![\alpha]\!]^{M,C}$", (Lasersohn 1999, 548).

[14]Lasersohn analyses these expression as asserting that this item is not part of its halo ($[\![\textbf{loosely speaking } \Phi]\!]^{M,C} = \bigcup H_C(\Phi) - [\![\Phi]\!]^{M,C}$ (Lasersohn 1999, 545)). This exclusion, however, may be pragmatic instead of semantic.

example, while ⟦**five**⟧ is only true for 5 exactly, ⟦**roughly five**⟧ is true for values that differ from twenty in pragmatically ignorable ways.

In contrast to Lasersohn, Krifka (2009) treats numerals as representing ranges, and his focus is on how this range is determined. For example, though technically they represent the same distance, *11.265 kilometers* seems much more precise than *7 miles*. Krifka expresses this phenomenon with the Round Number Round Interpretation (RNRI) principle.

(27) **RNRI principle:** Round number words tend to have a round interpretation in measuring contexts. (Krifka 2009, p. 110)

Krifka assumes that numerals (i.e. number words) pick out a range of values, which he represents as $i \pm ir$ (i = the precise value of the numeral, r = level of precision).[15] For example, when *twenty* means 20 precisely, $r = 0$. Otherwise, $r > 0$ and *twenty* represents a range centered around 20.[16] He then derives the RNRI principle from a preference for simple expressions (i.e. some form of economy) and strategic communication. When a speaker utters a number, the intended level of precision (r) is not overtly conveyed to the hearer, but Krifka claims that it can be deduced, roughly, using game-theoretic strategic communication.

Krifka sees determining a level of precision as comparable to scale granularity,[17] as reflected in the Coarsest Scale Principle.

(28) **The Coarsest Scale Principle:** If a measure expression α occurs on scales that differ in granularity, then utter α implicates that the most coarse-grained scale on which α occurs is being used. (Krifka 2009, pp. 119-120)

The reference to scales is utilized in other works (e.g. Sauerland and Stateva 2007) to represent precision, paralleling our technical use of rounding physical measurements.

Sauerland and Stateva (2007) discuss lexical items that affect the precision of vague assertions, such as those involving round numbers. They claim that the distribution of these lexical items points to two different kinds of vagueness: scalar and epistemic. They describe scalar vagueness

[15] In terms of Lakoff (1973), i might be considered a core property, r and incidental property.

[16] Krifka suggests that a numeral like *thirty-nine* would optimally represent 39, less optimally represent 38 and 40, yet less optimally represent 38 and 41, and so one. He suggests that this could be captured using a normal distribution, but for ease of exposition he uses ranges.

[17] This ignores the fact that r's effect is proportional to the size of i, while his scales are even. This seems empirically hard to test, since it would be difficult to control for context.

as vagueness that relates to expressions that denote a point or interval on a scale (e.g. numerals), and the role of scalar approximators is to set the coarseness of the granularity function used to evaluate the scalar. While they claim otherwise[18], their scalar vagueness appears to correspond to imprecision.

(29) More precise scalar approximators

a. Set granularity to finest

b. Approximators include *exactly*, *absolutely*, *completely*, *precisely*, *perfectly*

(30) Less precise scalar approximators

a. set granularity to coarsest

b. Approximators include *approximately*, *about*, *partially*, *sufficiently*, *roughly*

They further distinguish scalar approximators into ones that relate to a scale midpoint (*exactly*) and ones that related to a scale endpoint (*absolutely*, *completely*, *totally*).

Epistemic vagueness, on the other hand, relates to expressions that have no (known) precise meaning (e.g. *heap*). Sauerland and Stateva propose that such expressions differ in their extensions across worlds.

(31) More certain epistemic approximators

a. Universal epistemic quantification

b. Approximators include *definitely*, *positively*, *for sure*, *certainly*

(32) Less certain epistemic approximators

a. Existential epistemic quantification

b. Approximators include *more or less*, *maybe*, *-ish*

They remark that scalar approximators have a more limited distribution than epistemic approximators, as demonstrated in (33).

(33) a. What John cooked was exactly/approximately fifty tapas.

b. #What John cooked was exactly/approximately Beef Stroganoff.[19]

---

[18]They claim:

> The term *imprecision* in work by Pinkal (1995), Kennedy (2007) partially overlaps with what we refer to as scalar vagueness, but not completely so. For example, *bald* is usually regarded as vague rather than imprecise.

However, since *bald* is an absolute gradable adjective and Kennedy characterizes absolute gradable adjectives as imprecise, one would imagine that he would consider *bald* imprecise.

[19]Sauerland and Stateva do not consider coerced-scalar readings and so mark these uses of *beef stroganoff* as infelic-

c. What John cooked is maybe/definitely Beef Stroganoff.[20]

They find further support for this analysis in the way different approximators can and cannot combine. In the case of scalar approximators, the infelicity is due to the vacuity of the second approximator (the first sets the granularity function, leaving the second with nothing to do).

(34) a. #John is exactly/precisely approximately 30. (Sauerland and Stateva 2007, p. 235)
b. #John is approximately exactly/precisely 30.

In this dissertation, I will assume for ease of explication a framework like Lasersohn (1999) where a sentence like (25) is technically false if Mary arrived slightly after three o'clock.[21] However, my focus will be on lexical means that allow for imprecision, which can be adapted to either approach.

Below is a diagram of the different vague expressions discussed above, further dividing the space from (24). My focus will be largely on the branches in 1.1, and by the time this tree is revisited again in Chapter 5, we will have explored the way various modifiers interact with these branches.

---

itous. When I return to these sentences, I *will* consider coerced-scalar readings and treat sentences like this as felicitous.

[20]Here, it is the meaning of *Beef Stroganoff* that is under discussion, not what John actually cooked.

[21]I am not suggesting that Lasersohn (1999) is more or less correct than Krifka (2009). Indeed, neither makes much in the way of testable predictions. Lasersohn (1999), however, allows me to write more concisely explicit formulations.

(35)

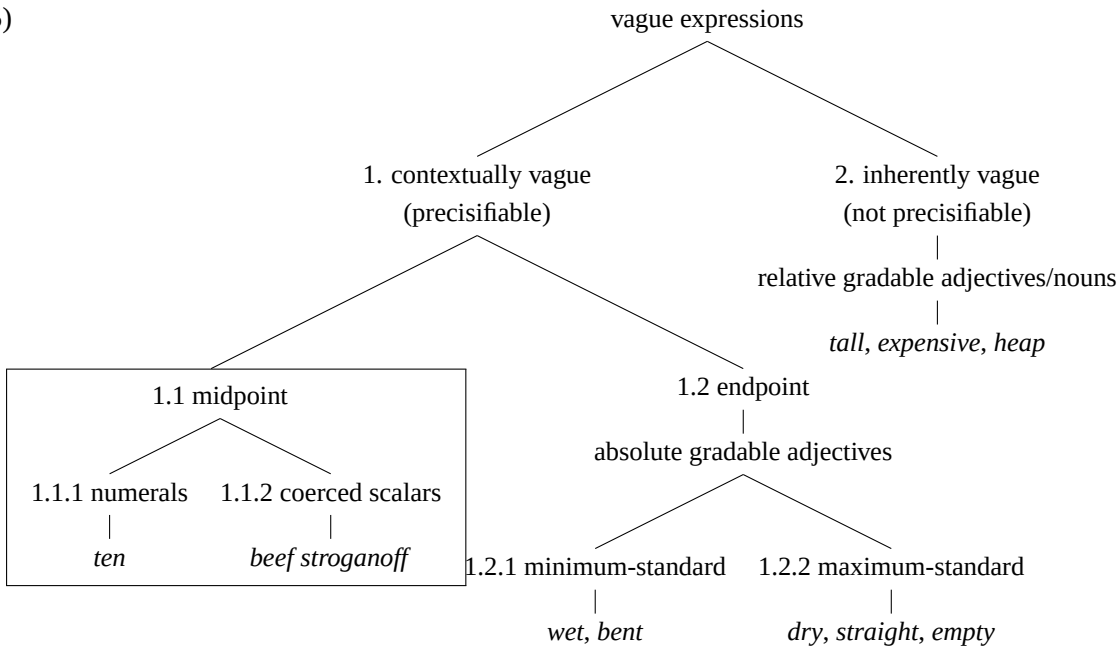

Table 1 provides a list of modifiers that will be discussed. The vertical split between modal and non-modal modifiers will be the focus of Chapters 2-3. The horizontal split will be addressed in Chapter 4 in the context of quantifier composition.

	felicitous with coerced scalars	**infelicitous with coerced scalars**
modal	*maybe* *like*	*about* *a good*
non-modal	*approximately* *exactly* *roughly* *just about* pragmatic slack/halos/roundness	*around*

Table 1: Summary of modifier categorization by modal status and ability to modified coerced scalars

1.2 Modality

As mentioned above, I will focus primarily on vague readings that arise through interactions with modals. This section provides a brief overview of modality and the framework I will be using.

Modality is generally treated as quantification over possible worlds with respect to the truth of some proposition (Kratzer 1981, 1991). Modals convey both a 'force' and a 'flavor', where force ranges from 'possibility' (true in at least one possible world) to 'necessity' (true in all possible worlds). Flavor describes how possible worlds are organized – a sampling of different flavors that can be associated with the modal *have to* are demonstrated below (von Fintel and Gillies 2007, p. 34).

(36) a. Epistemic (knowledge)

e.g. Given all those wet umbrellas, it has to be raining.
'In all worlds consistent with my knowledge (including the knowledge that many people are carrying wet umbrellas), it is raining.'

b. Deontic (requirements)
e.g. According to the hospital regulations, visitors have to leave by six p.m.
'In all worlds consistent with what is required (including the rules imposed by the hospital), visitors leave by six p.m.'

c. Bouletic (desires)
e.g. According to my wishes as your father, you have to go to bed in ten minutes.
'In all worlds that satisfy my desires (as your father), you go to bed in ten minutes.'

d. Circumstantial (relevant circumstances)
e.g. Given the current state of my nose, I have to sneeze.
'In all worlds consistent with the relevant facts of this situation (including the current state of my nose), I sneeze.'

e. Teleological (goals)
e.g. Given the choices of modes of transportation and their speeds, to get home in time, you have to take a taxi.
'In all worlds that satisfy my goal (of getting home on time), I take a taxi.'

Modality can be contributed by a variety of expressions (a sampling, again from von Fintel (2006), is given in (37)), though auxiliaries and adverbs have received the most theoretical attention.

(37) a. Modal auxiliaries
e.g. Sandy must be home.

b. Semimodal verbs
e.g. Sandy has to be home.

c. Adverbs
e.g. Perhaps, Sandy is home.

d. Nouns
e.g. There is a slight possibility that Sandy is home.

e. Adjectives
e.g. It is far from necessary that Sandy is home.

f. Conditionals
e.g. If the light is on, Sandy is home.

g. Infinitivals
e.g. Sandy is to be home by curfew.

Some important areas of study within modality include those listed in (38).

(38) 1. Determining the set of possible modal meanings

e.g. {epistemic possibility, deontic necessity, . . . }

2. Determining the set of possible modality-bearing expressions
   e.g. {*must*, *probably*, . . . }
3. Determining which modal meanings are available for which modal terms in which modal contexts
   e.g. *Sandy has to be home.* $\rightarrow \begin{cases} \text{epistemic necessity} \\ \text{deontic necessity} \\ \dots \end{cases}$
4. Using the above to build an adequate theory of modality

In what follows I will focus on the second and third of these, expanding the set of recognized modal expressions and tying these new expressions to epistemic interpretations.

1.2.1 Modals with scalars

The main contribution of this dissertation comes through investigating the interaction of modals with scalars, as in (39), repeated from above.

(39) There were maybe 20 people at the party.

More specifically it is the interaction between epistemic possibility modals (e.g. *might*, *maybe*, *perhaps*, *possibly*) and scalars that I focus on, showing that this interaction produces behavior that is surprising though consistent with modality.

Summarized in (40) and (41) are two behaviors that I argue in Chapter 2 are characteristic of modally-modified scalars: giving rise to approximative readings and licensing discontinuous alternatives.

(40) **Uncertain approximation:** When uncertainty is interpreted as approximation, where the exact value is not known, but the approximate value is (e.g. *I've been to that restaurant maybe ten times already.*)

(41) **Licensing discontinuous alternatives:** When a range expression is interpreted as referring to a proper subset of that range (e.g. *We bought maybe 60 rolls for the cookout.* [referring to rolls that come in packs of six, where the speaker perhaps actually bought 54 or 66, but not, say, 59])

Similar behavior can be seen when scalars appear with modifiers that are not traditionally treated as modal, including the discourse particle *like* and rising intonation. On the basis of this similarity in behavior, I argue that these items are modal, as opposed to the non-modal analyses in Siegel (2002) and Gunlogson (2003, 2008) respectively.

Included among my proposed modal expressions is the quantifier *about*, and while the distribution of *about* can be explained in part by its modal content, I argue in Chapter 4 that a decomposition analysis of quantifiers is needed to provide an adequate account of the distribution of these modals.

1.2.2 Intonation and modality

Just as epistemic possibility adverbs like *maybe* can mark our uncertainty, so can rising intonation. Consider the responses to the following question.

(42) A: How many people came to the party?
B:
a. Twenty.
b. Twenty?

The response in (42a) gives the appearance of a much more confident speaker than (42b), and the analysis of rising intonation in Gunlogson (2001, 2008) helps us see why.

Gunlogson analyses declaratives with falling intonation as making speaker commitments, so a speaker who utters *Twenty people came to the party* with falling intonation commits himself to that proposition. Rising intonation, on her analysis, marks the speaker's commitment as contingent, so a speaker who utters *Twenty people came the the party?* with rising intonation will not commit to that proposition unless it is confirmed by some other discourse agent.

In Chapter 3, I build on this analysis to allow it to explain novel data on the interaction of rising intonation with epistemic possibility modals. For example, in (43a) rising intonation indicates the speaker's contingent commitment to the proposition that blue is John's favorite color, but (43b) does not express that the speaker is contingently committed to the proposition that blue *might* be John's favorite color, counter to what Gunlogson's analysis predicts.

(43) A: What's John's favorite color?
B:
a. Blue?
b. Maybe blue?

To account for such data, I introduce a different analysis of rising intonation which treats it on par with epistemic possibility modals. This allows the attested interpretation of (43b) to be derived through modal concord.

1.3 Quantification

Quantifiers have also provided a rich area of study for linguists and philosophers, highlighted in works such as Barwise and Cooper (1981) and Keenan (1996). These authors (among others) focus on *Generalized Quantifiers* (GQs) such as *every student* and *no librarians*. These are second-order

functions[22] which map from properties to truth values (i.e. are of type $\langle\langle et\rangle t\rangle$).

Under a GQ-theory, a wide variety of quantificational determiners are treated the same, i.e. as irreducible functions from properties to sets of properties ($\langle\langle et\rangle\langle\langle et\rangle t\rangle\rangle$). These include such diverse terms as *every*, *no*, *fewer than five*, *all but two*, *the ten*, and *neither*. An advantage of this uniform treatment is that it allows for a number of insightful generalizations across quantifiers, such as Extension, which states that if a generalized quantifier is true of some set in the universe, it remains true if the universe is expanded. This generalizability, however, comes at a cost, as demonstrated in Hackl (2000).

Hackl focuses on comparative determiners, those that involve a both a measure function (e.g. 5) and a comparative relation (e.g. $>$, =) in their truth conditions. Quantificational determiners in general are quite heterogeneous, and even limiting himself to comparative determiners, Hackl identifies at least six classes (Hackl 2000, p. 24). But this does not include all comparative determiners (e.g. it may exclude *more than zero*). Perhaps more importantly, a GQ theory does does not give us a way to relate *three* and *more than three*, etc. Furthermore, GQ theory has been shown to make incorrect predictions. Hackl (2000) notes that GQ theory treats the sentences in (10) as truth-conditionally equivalent, despite the fact that speakers find (44a) to be considerably worse than (44b).

(44) a. ?? More than one student is meeting. (Hackl 2000, p. 62)
(MORE THAN ONE)(*student***)(***is-meeting***) = T** iff $|student \cap is\text{-}meeting| > 1$

b. At least two students are meeting.
(AT LEAST TWO)(*student***)(***is-meeting***) = T** iff $|student \cap is\text{-}meeting| \geq 2$

This analysis will be addressed in greater detail in Chapter 4.

In this dissertation I adopt Hackl's decompositional approach to quantifiers and expand on it such that it can be used to explain the behavior of quantifiers in a variety of syntactic contexts when they appear with coerced scalar arguments. In particular, I allow it to explain contrasts like those in (45)-(46) below.

(45) a. John served approximately 50 sandwiches.
b. What John served was approximately 50 sandwiches.

(46) a. *John served approximately beef stroganoff.
b. What John served was approximately beef stroganoff.

I adjust the framework to handle non-numeral scalars, as in (46), and I give an explicit account of copular type-shifts to handle contrasts like (46a) vs. (46b). In doing so, I demonstrate that patterns

[22] Second-order functions range over individuals (1st) AND sets of individuals (2nd).

like the one shown in (45)-(46) follow from a decompositional quantifier system.

1.4 Organization

The structure of the dissertation, including the ways in which I investigate the questions outlined above, are broken down by chapter below.

Ch 2: Chapter 2 accounts for how typical markers of uncertainty, like the modal *maybe*, can be used as approximators in expressions like *There were maybe twenty people at the meeting*. I then show the approximative readings produced by these uncertainty markers to differ from those of other approximators like *approximately*, and I identify characteristic behavior of modal-scalar interactions. In particular, I highlight modals' ability to license discontinuous alternatives, shown in sentences like *It's Susan's birthday today, and she's maybe/#approximately thirty*. I demonstrate that certain other modifiers, including *about*, show similar characteristically modal behavior, and I use this behavior to argue that these modifiers are modal. I use these differences in behavior between modal and non-modal modifiers to support a heterogeneous view of vagueness.

Ch 3: Chapter 3 investigates the use of rising intonation in indicating speaker uncertainty. I focus on the interaction between rising intonation and the modifiers discussed in Chapter 2, introducing novel data that is problematic under Gunlogson (2008)'s framework: in responses to questions like *What's John's favorite color?*, rising intonation indicates a speaker's uncertainty (e.g. *Blue.* vs.*Blue?*), but adding an additional uncertainty marker (e.g. *Maybe blue?*) does not contribute an independent layer of uncertainty. I use this data to argue instead for a treatment of rising intonation as an operator with epistemic modal content that participates in modal concord with other epistemic modal elements. By establishing modal content in rising intonation, I not only provide an additional diagnostic for identifying modal content in other expressions (via evidence of modal concord). I also demonstrate that rising intonation shows modal patterns of approximation (e.g. licensing discontinuous alternatives) and strengthen the modal/non-modal split established in Chapter 2.

Ch 4: Chapter 4 examines the distribution of *approximately* and *about* under a decompositional analysis of quantifiers. In particular, I focus on contrasts involving the quantified element (scalar/non-scalar, e.g. *John served approximately {50 sandwiches/beef stroganoff}*) and the syntactic structure it appears in (copular/non-copular, e.g. *{What John served was/#John served} approximately beef stroganoff*). I provide a decompositional analysis to account for these and other patterns. This chapter further explores a modal quantifier marking high, not low, certainty – *a good* – demonstrating that modal scalar modifier need not be epistemic *possibility* operators. I use the distribution of *a good* with other quantifiers to argue both for its epistemic-more-certain status and for its status as a Hackl-style degree function. I show these modifiers to exemplify two classes, split in their ability to appear with coerced scalars, that cross-cut the modal distinction highlighted in Chapter 2.

Ch 5: Chapter 5 concludes.

2 Vagueness amid approximation and uncertainty

2.1 Introduction

Language provides means to express an idea with varying degrees of precision (i.a. Lakoff 1973; Lasersohn 1999; Krifka 2009, 2007). Some terms have a precise meaning but can be used imprecisely, where context allows, such as in (1). The numeral *twenty* can be used to refer to something that costs $20.00 exactly, but in a sufficiently imprecise context a speaker can round and use *twenty* to refer to something that cost, for example, $19.50.

(1) [Casually describing a book that costs $19.50]
This book costs twenty dollars.

Some words like *expensive* lack a precise meaning altogether.

(2) This book is expensive.

Additionally, there are countless modifiers that affect precision, such as *roughly*, *more-or-less*, and *exactly*.

As discussed in Chapter 1, various authors have highlighted these different types of vague expressions in their analyses. Here I will focus on Sauerland and Stateva (2007), who distinguish forms with a precise meaning (also called imprecise or contextually vague, e.g. *twenty*, *full*) from those which lack a fixed precise meaning (also called vague or inherently vague, e.g. *tall*). This separates the numeral *twenty*, which has a precise meaning of $20.\overline{0}$, from the adjective *tall*, which has no such meaning.

In this chapter I further support this heterogeneous view of vagueness. In particular, I draw on Sauerland and Stateva (2007) in highlighting the contrast in vagueness that arises from modal approximators to that that arises from non-modal modifiers. I then build on my previous analysis in Zaroukian (2011a) and explore novel differences in the behavior of these expressions (which will further be contributed to in Chapter 3) and show how these follow from a regular heterogeneous view of vagueness that distinguishes modal vagueness from non-modal vagueness.

The remainder of the chapter is organized as follows. Section 2.2 sets the stage by exploring how modals can act as approximators. I argue that when an epistemic possibility operator like *maybe* combines with a vague predicate, it quantifies over epistemically-accessible worlds where the vague predicate has different extensions (as in Sauerland and Stateva 2007), and this can lead to an approximative reading if these extensions are clustered in an approximative way. Section 2.4 examines traditional, non-modal approximators like *approximately* and introduces ways in which they differ from modal approximators. I argue that the modal/non-modal status of approximators manifests in contexts where approximative alternatives are contextually blocked. Section 2.5 takes these contrasts between modal and non-modal approximators and discusses them in the context of Pragmatic Halos as a theory of vagueness. I argue that this supports a heterogeneous view of vagueness. I further argue, contrary to Sauerland and Stateva (2007), that a Pragmatic Halos

approach adequately captures the readings associated with modifiers like *approximately* and *exactly*. Pragmatic Halos, however, cannot be the sole mechanism that gives rise to vagueness, as it fails to capture the contrasts between modal and non-modal vagueness discussed in Section 2.4.

2.2 Uncertainty and approximation

An approximative reading can arise when scalars are marked as uncertain. This can be seen most clearly with scalar numerals modified by the modal *maybe*, as is (3).

(3) There were $\underbrace{\text{maybe}}_{\text{modal}}$ $\underbrace{20}_{\text{scalar}}$ people at the party.

I will discuss the patterns of approximation that arise from this type of modification in Section 2.2.1, and I will then explain these patterns in the context of Sauerland and Stateva (2007) in Section 2.2.2.

2.2.1 Uncertain numerals

When we use words like *maybe* to mark our uncertainty with respect to an item, our interlocutor might entertain alternatives to this uncertain item. For example, consider the exchange in (4), where Ann asks Bill who won the race. Bill cannot remember, but he thinks it may have been John, which he expresses through his response *maybe John*.

(4) a. Ann: Who won the race?
Bill: Maybe John.
b. reading: {John, Mary, Peter}

As a result of Bill's uncertainty, Ann may entertain other likely winners (who in this context I assume to be Mary and Peter), represented in (4b).[23]

When the uncertain item is a numeral, there is a strong tendency for the set of alternatives to resemble approximation, as in (5).

(5) a. Ann: How many people competed?
Bill: Maybe twenty.
b. reading: {18, 19, 20, 21, 22}

This approximation becomes even more salient if we consider a similar response Bill could have made, namely *approximately twenty*, where the alternatives entertained by Ann in (6b) look like (5b).

[23]The bracket notation I use in these examples is meant to represent the alternatives considered in a particular scenario. These alternatives are the result of complex interactions between multiple representations that may be non-discrete (see Section 2.4.3) or have internal structure (see Sections 2.3.2 and 2.4.1).

(6) a. Ann: How many people competed?
Bill: Approximately twenty.
b. reading: {18, 19, 20, 21, 22}

Approximation, however, does not occur with all uncertain numerals, as demonstrated in (7). Here Bill gives the jersey number of the player he believes to have the most fouls, and he indicates his uncertainty with *maybe*, again uttering *maybe twenty*.

(7) a. Ann: Which player has the most fouls?
Bill: Maybe twenty.
b. reading: {20, 6, 77, 15}

Here, this uncertain numeral is unlikely to give rise to approximation. Instead, Ann may consider other players likely to have numerous fouls, independent of their jersey number. Intuitively, these numerals function not like numerals, but rather like names.

Additionally, when this approximation effect occurs, the range of alternatives depends on the numeral. For example, if *twenty* in (5) is replaced with *twenty-seven*, the range of alternatives tends to be smaller.

(8) a. Ann: How many people competed?
Bill: Maybe twenty-seven.
b. reading: {26, 27, 28}

In summary, uncertain numerals here lead to three puzzles: why uncertain numerals give rise to approximative readings, as in (5), why some uncertain numerals fail to give rise to approximative readings, as in (7), and why some uncertain numerals give rise to more approximate readings than others, as in (5) vs. (8). These puzzles will be addressed by expanding on the non-monistic view of vagueness in Sauerland and Stateva (2007). This expansion of Sauerland and Stateva (2007) will also bring into focus a number of questions, importantly: Should approximation be described through multiple scale granularities or as a probability distribution over a single continuous scale? Additionally, by addressing a variety of uses, both approximative and non-approximative, I argue for a unified standard analysis of *maybe* as an epistemic possibility operator, a la Kratzer (1991).

2.2.2 Uncertain numerals explained

I will begin by discussing Sauerland and Stateva (2007)'s explanation for how *maybe* leads to approximative readings with what they call epistemically-vague terms, as well as their explanation for how *approximately* leads to approximative readings of what they call scalarly-vague terms. I then explore the combination of *maybe* with scalarly-vague terms and *approximately* with epistemically-vague terms. Throughout I expand on Sauerland and Stateva (2007) to explain the data presented in Section 2.2.1.

***Maybe* as an epistemic approximator**

Sauerland and Stateva (2007) put forward an explanation for how *maybe* can lead to approximative readings. They claim that *maybe* (also *more or less*, *definitely*, *certainly*, etc., or what they term *epistemic approximators*) combines with predicates that are *epistemically vague*, or which have no precise meaning available to the speaker. For example, *heap* is epistemically vague, even in a context where the speaker knows the exact shape and size of the pile in question, as in (9) (cf. if there were a precise definition of heap, e.g. perfectly cone-shaped and containing 20-25 objects, the speaker could say whether or not this pile qualified).

(9) This perfectly cone-shaped pile of 17 sand-grains on the table in front of us is maybe a heap. (Sauerland and Stateva 2007, p. 235)

I provide definitions for epistemic vagueness and epistemic approximators, extrapolated from Sauerland and Stateva (2007), in (10)-(11).

(10) **Epistemic vagueness:** vagueness that results from lack of availability of a precise meaning for a term

(11) **Epistemic approximator:** an epistemic quantifier used in an epistemically-vague context

Epistemically-vague terms, Sauerland and Stateva (2007) propose, have different extensions in different worlds, even across worlds where physical object properties are constant. For example, a context compatible with (9) is given in (12), where the epistemically-vague predicate *heap* describes different piles of sand across different worlds, even though the piles and their size are constant across worlds. Following Kratzer (1991), *maybe* in this context existentially quantifies over these epistemically-accessible worlds. So, for (9), there exists at least one world (w_1, w_2) in which $pile_2$ is a heap.

(12) Example context for (9)

In all epistemically accessible worlds w_1, w_2, w_3, w_4:
$pile_1$ contains exactly 15 grains of sand
$pile_2$ contains exactly 17 grains of sand
$pile_3$ contains exactly 20 grains of sand
$[\![\textbf{heap}]\!]^{w_1} = \{pile_1, pile_2, pile_3\}$
$[\![\textbf{heap}]\!]^{w_2} = \{pile_2, pile_3\}$
$[\![\textbf{heap}]\!]^{w_3} = \{pile_3\}$
$[\![\textbf{heap}]\!]^{w_4} = \emptyset$

From Sauerland and Stateva (2007)'s discussion, however, it is not clear why this should result in an approximative reading.

First, note that epistemically-vague predicates need not give approximative readings with *maybe*. This can be seen in an example like (13).

(13) [The speaker feels strongly about several movies and is unsure which is his favorite.]
This is maybe my favorite movie.

Shown in (14), in epistemically-accessible worlds where physical properties are constant, the extension of *my favorite movie* differs, but there is nothing obviously approximative about the extensions of these films.

(14) Example context for (13)

In all epistemically accessible worlds w_1, w_2, w_3, w_4:

$movie_1$ = Schindler's List

$movie_2$ = Borat

$movie_3$ = Star Wars: Attack of the clones

$movie_4$ = Six String Samurai

$[\![\textbf{my favorite movie}]\!]^{w_1} = \{movie_1\}$

$[\![\textbf{my favorite movie}]\!]^{w_2} = \{movie_2\}$

$[\![\textbf{my favorite movie}]\!]^{w_3} = \{movie_3\}$

$[\![\textbf{my favorite movie}]\!]^{w_4} = \{movie_4\}$

To achieve an approximative reading, Sauerland and Stateva (2007)'s *heap* example relies on possible heap sizes varying in an approximative way such that things that are *maybe a heap* fall within some small contiguous range. For example, if piles of less than 15 grains are not heaps in any world, piles of 15 to 20 grain are heaps in some worlds, and piles of more than 20 grains are heaps in all worlds, then if you refer to something as *maybe a heap*, it can be inferred to have between 15 and 20 grains (i.e. to be close to the border of accepted heap-dom). As we saw in (14), however, this is not the only reading available. I differentiate two relevant uncertainty interpretations of epistemically vague predicates, readings which are conflated in Sauerland and Stateva (2007). I term these readings *unknown-standard* interpretations and *gray-area* interpretations.

(15) **Unknown-standard uncertainty:** Uncertainty resulting from not knowing the relevant standard for an uttered expression and therefore not knowing whether said standard has been met.

(16) **Gray-area uncertainty:** Uncertainty resulting from knowing that the referent of some expression falls within an indeterminate, or 'gray' area for that expression.

Unknown-standard interpretations are demonstrated in (17) and (18) below, where the standard for 'tallness' and 'heap-dom' are unknown. This can lead to approximative readings if the possible standards are in close proximity to each other, as shown in the (b) examples.

(17) John is maybe tall.

a. ‘John is tall for a jockey, but compared to the average man, he is not tall.’ (not approximative)
b. ‘John is tall according to your standard of tallness, but if we are using my slightly stricter standard, then he is not.’ (approximative)

(18) This is maybe a heap.

a. ‘This is a heap to a neat freak, but not to a slob.’ (not approximative)
b. ‘This is a heap to you, but according to my slightly-different standards, it is not a heap.’ (approximative)

Again, the idea is that if the possible standards are clustered, an approximative reading results. If the possible standards are far enough apart, the resulting reading is not approximative.

Gray-area interpretations are demonstrated in (19) and (20), where the relevant measurement is known to fall within the gray area of the epistemically-vague predicate. Since this is necessarily restricted to scalarly-close alternatives, an approximative reading results.

(19) John is maybe tall.

‘John is borderline tall.’ (approximative)

(20) This is maybe a heap.

‘This is a marginal heap.’ (approximative)

While Sauerland and Stateva (2007) are correct in that invoking possible worlds can make approximation possible, it does not *entail* approximation. Under the account I develop here, epistemic approximation in *maybe a heap* can be viewed as arising in at least two ways: under a uncertain-standard reading as in (18b), where the possible standards of heap-dom are minimally different from each other, or under a gray-area reading as in (20).

Numerals as scalarly vague

In contrast to epistemically-vague (cf. inherently-vague) predicates like *heap*, Sauerland and Stateva (2007) claim that numerals are *scalarly vague* (cf. contextually vague/imprecise), a term that describes expressions that denote a point on a scale but which can be expressed with multiple granularities (simplifying from Krifka 2009).

(21) **Scalar vagueness:** vagueness that results from the availability of multiple granularities

The numeral *twenty*, for example, can denote the point $20.\overline{0}$ on an infinitely-precise scale, but it can also denote, say, 19.5–20.5 on an integer scalar or 17.5–22.5 only a scale with increments of 5. Sketches of three granularities are shown in (22).

(22) a. $[\![\textbf{twenty}]\!] = 20$ Scale: $\cdots - 19.999 - \cdots - 20.\overline{0} - \cdots - 20.001 - \cdots$

b. $[\![\textbf{twenty}]\!] = 20$ Scale: $\cdots - 19.\overline{9} - 20.\overline{0} - 20.\overline{01} - \cdots$

c. ⟦**twenty**⟧ = 19.5–20.5 Scale: $\cdots - 19 - 20 - 21 - \cdots$

d. ⟦**twenty**⟧ = 17.5–22.5 Scale: $\cdots - 15 - 20 - 25 - \cdots$

Sauerland and Stateva (2007) propose that scalarly-vague terms have a granularity parameter that can be manipulated by scalar approximators like *approximately* and *exactly*. So in a context where the possible granularities for *twenty* are as given in (22), *approximately* sets the granularity parameter to the coarsest option (e.g. ⟦**twenty**⟧ = 17.5–22.5), and *exactly* sets it to the finest option (e.g. ⟦**twenty**⟧ = 20).

(23) **Scalar approximator:** a term that sets the granularity parameter of an item to its coarsest granularity

I will show with greater precision how this happens.

For the following, I will adopt an analysis in the spirit of Krifka (2009) and treat numerals as ranges across a normal distribution (Dehaene 1997, a.o.).[24] For example *twenty* optimally represents 20, less optimally 19 and 21, even less optimally 18 and 22, and so forth. For simplicity, I will assume strict cut-offs at one standard deviation (σ) from the uttered numeral (μ). In Figure 2, σ is set at 2 such that *twenty* represent the range $[18-22]$, where 20 is the most probable value and 18 and 22 are the least probable, though still possible, values.[25]

Importantly for our purposes, Krifka's framework includes an explanation for relative range effect of round numbers, why you will give someone more slack if they said *twenty* than *twenty-seven* (e.g. if an item cost $23.50, it is generally more acceptable to refer to this as costing $20 than to refer to it as costing $27 dollars, even though these are equally 'incorrect' in that they are both off by $3.50). Krifka's explanation is formulated via game theory and competing pressures to use simple expressions and to communicate successfully.

To see this through an example, imagine that the speaker utters *twenty*, and the context allows a variety of levels of precision (σ values). The hearer is biased to interpret *twenty* with the roundest reading available to maximize his chances of correct interpretation (if speaker meant 20 exactly, it is within your range, so you have interpreted them 'correctly'; if they meant e.g. 18, it is still within your range, and you have still interpreted them correctly). Now imagine that the speaker had uttered

---

[24] While the normal distributions is a continuous distribution, I will be discussing it often with reference to discrete data. This can be viewed, innocuously I hope, as binning on the side of language, where continuous data is mapped to discrete linguistic representations of that data.

[25] Krifka chooses instead to explicate with intervals as follows:

(i) *i*: value strictly denoted by a number word (e.g. ⟦**thirty-nine**⟧ $= 39.\overline{0}$)
r: level of precision
$[i \pm r]$:range represented by numeral denoting *i* with precision of *r*

Here, if *twenty* appears with a precision level $r = 1/10$, it will be interpreted as $[20 \pm 2]$, or $[18-22]$, with uniform probability.

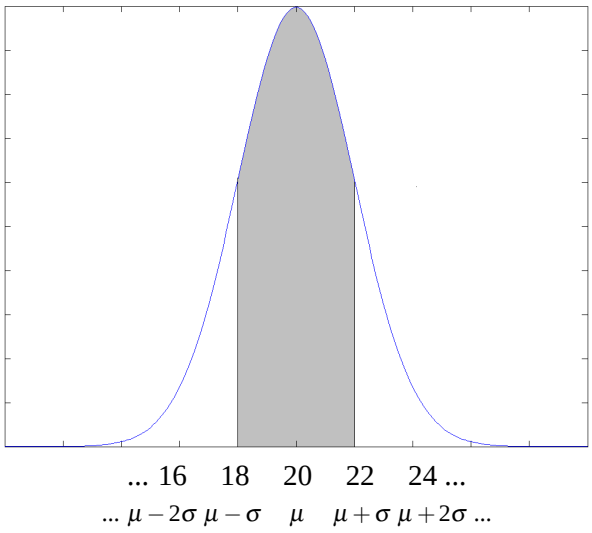

Figure 2: A normal distribution centered at 20 with $\sigma = 2$

nineteen, again with a variety of precision levels available in the context. Here the hearer will be biased to interpret *nineteen* under a more precise reading because if the speaker intended a wide range around 19, they would have used the simpler expression *twenty* to accomplish this, so *twenty* blocks rounder interpretations of *nineteen*.

This round number effect is built into Sauerland and Stateva (2007)'s granularity parameter. Rounder numbers have wider granularities available. For example, the granularity shown in (22d) would not be available to *nineteen* (due to blocking by *twenty*), because I assume no scale like that (e.g. ... – 12 – 17 – 22 – ...) exists.[26]

In explaining approximators, I must decide between an approach like Sauerland and Stateva (2007) which assumes that numerals can be defined with respect to multiple scales (where approximative readings pick a coarse-grained scale), or an approach like Lasersohn (1999) which assumes that numerals are always defined with respect to a precise scale (where approximative readings are computed on top of the precise scale, with (approximately) normal distribution).

While both approaches can handle the data I will be discussing, I adopt a precise approach. Following Lasersohn (1999), I will assume that numerals are true only under a precise reading (for reasons that will be made clear later, I will assume that either a real or natural number scale is used, depending on what is being quantified over). So, numerals are associated with this σ, but σ does not enter into truth conditions without some appropriate modifier (*approximately*, *maybe*).

Next, I will build on this exegesis to explain the puzzles from Section 2.2.1.

[26] See Krifka (2009) for a discussion of why such scales may not exist. He draws on factors such as pressure to reduce average scale complexity (e.g. the average number of syllables in {12, 17, 22} is 3.5 vs. 2.5 for {10, 15, 20}).

Epistemic approximators with scalarly-vague terms

Returning to epistemic approximators (e.g. *maybe*, *definitely*), Sauerland and Stateva (2007) note that they can be used with numerals to specify the speaker's certainty with respect to a particular level of granularity (or σ, in our parlance). A paraphrase of their example is given in (24) (Sauerland and Stateva 2007, p. 230, fn. 3).

(24) [John agreed to cook fifty tapas. In the end, he produced only forty-nine. The speaker wants to argue that John meant *fifty* in an imprecise way, such that cooking forty-nine tapas satisfies his promise.]
The number of tapas John cooked is definitely fifty.

In their framework, (24) expresses that, in all epistemically-accessible worlds, the level of granularity is such that $[\![\textbf{fifty}]\!]$ includes 49. This would be true in a context like (25), in which worlds where $\sigma = 0$ are crucially not epistemically accessible.

(25) Example context for (24)

In all epistemically accessible worlds w_1, w_2, w_3:
The number of tapas cooked by John is 49
In w_1, $\sigma = 5$
In w_2, $\sigma = 2$
In w_3, $\sigma = 1$
$[\![\textbf{fifty}]\!]^{w_1} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$
$[\![\textbf{fifty}]\!]^{w_2} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$
$[\![\textbf{fifty}]\!]^{w_3} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$

Conversely, a sentence like *The number of tapas John cooked is maybe fifty* in the same context should express that, in at least one epistemically-accessible world, the level of granularity is such that $[\![\textbf{fifty}]\!]$ includes 49. I achieve this in (26) where I alter (24) in to include w_4.

(26) In all epistemically accessible worlds w_1, w_2, w_3:
The number of tapas cooked by John is 49
In w_1, $\sigma = 5$
In w_2, $\sigma = 2$
In w_3, $\sigma = 1$
In w_4, $\sigma = 0$
$[\![\textbf{fifty}]\!]^{w_1} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$
$[\![\textbf{fifty}]\!]^{w_2} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$
$[\![\textbf{fifty}]\!]^{w_3} = \{[\![\textbf{The number of tapas cooked by John}]\!]\}$
$[\![\textbf{fifty}]\!]^{w_4} = \emptyset$

In this way, it is possible to get approximative readings of numerals with *maybe* the same way we get round number readings (in the absence of *maybe*) – by interpreting them with a non-zero σ value.

I add numerals to the two categories of uncertain readings discussed above, first for unknown-standard readings (27) (cf. (17)-(18)), then for gray-area readings (28) (cf. (19)-(20)).

(27) This is maybe twenty people.

a. 'It is twenty if speaking very loosely, but not if being super precise.' (approximative)

b. 'It is twenty according to my standards, but not to yours, which I know to be slightly stricter.' (approximative)

(28) This is maybe twenty people

'I'm speaking loosely, but I'm not sure if I can call this twenty.' (approximative)

In the contexts like (26) and (12), the element being described (*the number of tapas John cooked*, *this cone-shaped pile of 17 sand-grains*, etc.) is known precisely (Sauerland and Stateva (2007) highlight these contexts to show that the (un)certainty they are interested in is associated with *heap*, etc., not what is being described as a heap). In the examples I opened with like (5), this element was not known precisely. [27]

For the epistemic numeral cases discussed above, I quantified over worlds with different granularities/σs. In (5), we want something that looks like Figure 3. Here we will consider alternatives (along the lines of Sauerland and Stateva (2007)) to be sets of possible worlds (i.e. worlds consistent with the epistemic modal base (Kratzer 1991)). These sets of worlds will be ordered in terms of their plausibility by an ordering source, as sketched in Figure 3. We can do this by quantifying over granularity levels/σs. For example, if I consider integers, 20 will be in the denotation of *twenty* in the most worlds ($\sigma = 0 - \infty$), then 19 and 21 ($\sigma = 1 - \infty$), then 18 and 22 ($\sigma = 2 - \infty$), etc.

This range information can be expressed in possible world semantics as the propositions p_σ in (29), which picks out worlds where the value intended by the speaker (y) falls within one standard deviation (σ) of the uttered numeral (μ), and a family of functions p_x in (30), which picks out worlds where the intended value (y) falls within $\sigma - x$ of that number (μ) for $0 < x < \sigma$.[28] I will let

[27] Note that this approximation is available even when granularity appears set, suggesting that all cannot be as Sauerland and Stateva (2007) describe, i.e. differing extensions. In (i), the speaker may be expressing approximate with a σ of 0, such that the plausible alternatives are 79.0, 81.0, etc.

(i) [Trying to recall data that was recorded to one decimal place.]
The temperature of the water was maybe 80.0.

I'll put aside where exactly approximation comes from in these cases, and I will move on to provide a formalization.

[28] As described here, this results in a linear probability curve, not the Gaussian one described above, a problem which will not be addressed here.

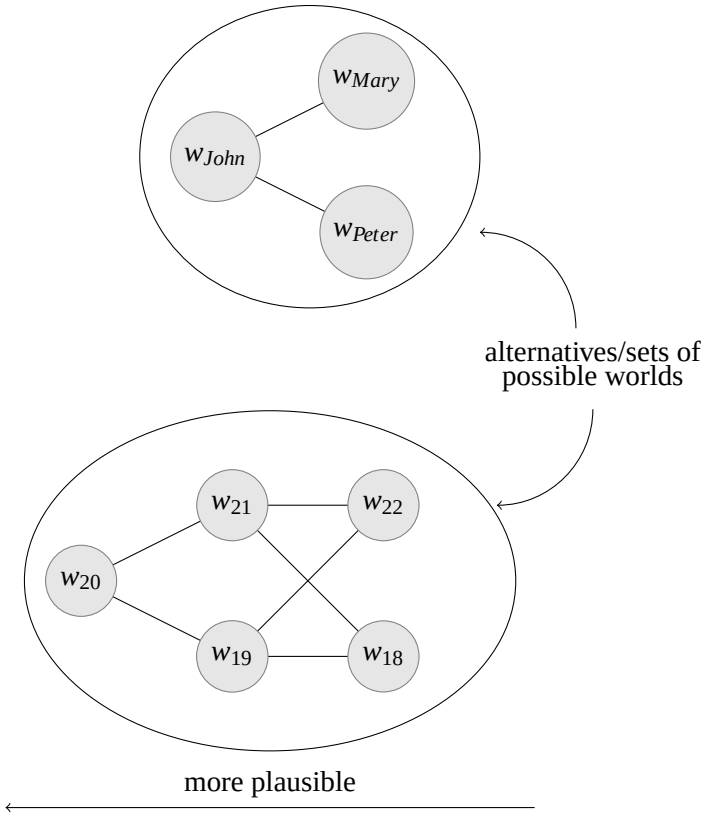

Figure 3: Circles represent alternatives as sets of worlds, ordered according to a modal base; lines represent accessibility relations. Here, for example, w_{John} represents the set of worlds where John won the race, and w_{20} represents the set of worlds where twenty people competed.

y assign to any world the numeric value intended by the speaker in that world, representing public uncertainty about what value the speaker intends (e.g. the speaker may have said 20 but intended 19, i.e. knew the exact value but used a round number).

(29) $p_\sigma = \lambda w.y(w) \in \{[\![\mu - \sigma]\!], ..., [\![\mu + \sigma]\!]\}$

(30) $p_x = \lambda w.y(w) \in \{[\![\mu - x]\!], ..., [\![\mu + x]\!]\}, 0 < x < \sigma$

We can see how this works in the example sentence from above *This book cost twenty dollars* with $\mu = 20$ and $\sigma = 2$. Here $p_\sigma = \lambda w.y(w) \in \{[\![20-2]\!], ..., [\![20+2]\!]\}$ (i.e. picks out set of worlds where the value *y* intended by the speaker in that world is between 18 and 22) and $p_x = \lambda w.y(w) \in \{[\![20-x]\!], ..., [\![20+x]\!]\}, 0 < x < 2$.

Treating *maybe* as involving an epistemic modal possibility operator, I will assume that for uncertain numerals (e.g. *maybe twenty*), the modal base will contain only the sets of worlds consistent with p_σ (i.e. worlds within σ of μ) and the ordering source will contain the worlds consistent with the propositions in p_x for $0 < x < \sigma$ (i.e. will order more closely worlds where the value is closer to μ). Now, if we take the uncertain numeral *maybe twenty* from (5), with $\mu = 20$ and

again assuming and $\sigma = 2$, we see that $p_\sigma = \lambda w.y(w) \in \{[\![20-2]\!], ..., [\![20+2]\!]\}$ (i.e. picks out the set of worlds where the value *y* intended by the speaker in that world is between 18 and 22) and $p_x = \lambda w.y(w) \in \{[\![20-x]\!], ..., [\![20+x]\!]\}, 0 < x < 2$ (i.e. worlds where the value *y* is closer to 20 are more likely).

This leads us to an explanation for why approximation does not always occur with uncertain numerals: this effect only happens with numerals that are scalarly vague, like in (5), not with numerals acting in a non-scalar labeling capacity, as in (7), which do not represent ranges and are therefore not associated with p_σ and p_x like scalars are.

And we have an explanation for why the range of alternatives depends on the numeral, as we see when *maybe twenty* in (5) leads to a wider range of alternatives than *maybe twenty-seven* in (8). Pragmatic preference for simple expressions leads more complex numerals like *twenty-seven* to represent smaller ranges (i.e. induce smaller σs) than simpler numerals like *twenty*, as discussed above. Since *twenty-seven* has a smaller σ, its p_σ allows a smaller range of possible worlds, leading to its narrower interpretation as an uncertain numeral (for details, see Krifka 2009).

To summarize the explanations offered here, first, uncertain numerals give rise to approximative readings because the numeral contributes range information (formalized here in p_σ and p_x) to the modal base and ordering source, so possible worlds are those in which the numeral is close to the uttered numeral. Some uncertain numerals fail to give rise to approximative readings because they are not scalar and therefore are not associated with ranges. Some uncertain numerals give rise to more approximate readings than others because they are associated with larger ranges (here, σs), so p_σ allows a wider range of possible worlds.

Scalar approximators with epistemically-vague terms

The final configuration to complete this paradigm is scalar approximators with epistemically-vague terms. This approximation effect can be seen with any item that is used scalarly, including such an unlikely term as *beef stroganoff*. To see this, consider a scalar interpretation of *beef stroganoff*, like the one required in the sentence in (31).

(31) What John served was only approximately beef stroganoff.

Sauerland and Stateva (2007) provide a different take on this kind of construction. They consider *approximately beef stroganoff* infelicitous in (32) because scalar approximators (*exactly*/*approximately*) can only combine with scalar items (i.e. items with a granularity parameter that they can set).

(32) Judgments from Sauerland and Stateva (2007)

a. What John cooked was definitely/maybe beef stroganoff.

b. # What John cooked was exactly/approximately beef stroganoff.

While I will return to this data in Chapter 4, here I am considering the coerced scalar reading of *beef stroganoff*, which gives a similar type of scalar approximation in *approximately beef*

stroganoff and *maybe beef stroganoff*. This is much like the similarity between *maybe twenty* and *approximately twenty* discussed above.[29]

2.2.3 Summary

So far we have seen a variety of cases of approximation involving *maybe*, where this approximation was explained by drawing on Sauerland and Stateva (2007). The approximative (and non-approximative) readings addressed here utilize *maybe*, an epistemic possibility operator. When *maybe* combines with a vague predicate, it quantifies over epistemically-accessible worlds where the vague predicate has different extensions (Sauerland and Stateva 2007), and this can lead to an approximative reading if these extensions are clustered in an approximative way (e.g. though a gray-area interpretation). And though these approximative readings can vary in a number of ways (directionality, labeling readings, etc.), these readings can all be derived from the epistemic possibility operator denotation of *maybe*.

Next, I will contrast that with more typical approximators like *approximately*.

2.3 Uncertain approximation vs. other approximation

In the previous section I noted that any expression used scalarly can give rise to approximation when marked as uncertain. There are, however, a number of other readings that can arise as well. I discuss these readings below to highlight other ways in which *maybe* differs from *approximately*, and I discuss possible analyses for these uses. While I postpone thorough discussion of *approximately* until Section 2.4, I show that these various uses of *maybe* can all be derived through treating it as an epistemic possibility operator.

2.3.1 Uncertain labels

Maybe

A reading which I term the *uncertain-label* reading was previously discussed in the context of (7), repeated in (33) below.

(33) a. Ann: Which player has the most fouls?
Bill: Maybe twenty.
b. reading: {20, 6, 77, 15}

[29] This scalar coercion occurs with many scalar adjectives, e.g. *73 is more prime than 2* (see also Armstrong, Gleitman, and Gleitman (1983) for judgments on *odd* and *even*).

Here the word modified by *maybe* is acting as a label, not a scalar. It should be kept in mind that, given the right context, this type of label reading is available for all the examples above and can cause them to lose their approximate reading, which again is only available when they are interpreted as scalars.

For example, if (5), repeated in (34) below, occurred in a context where both Ann and Bill knew that four races had occurred that year such that one had 20 participants, one had 6, one had 77, and one had 15, but Bill did not know which participant count corresponded to the race Ann was asking about, the set of alternatives may then be that in (34c).

(34) a. Ann: How many people competed?
Bill: Maybe twenty.
b. reading: {18, 19, 20, 21, 22}
c. reading: {20, 6, 77, 15}

Approximately

A similar labeling reading does not appear to be available for *approximately*. This means that, in an example like (35), *approximately twenty* can only have an approximative reading.

(35) a. Ann: How many people competed?
Bill: Approximately twenty.
b. reading: {18, 19, 20, 21, 22}
c. # reading: {20, 6, 77, 15}

Likewise, *approximately* is degraded when combining with a non-scalar, as in (36).

(36) Ann: Which player has the most fouls?
Bill: Maybe twenty.
Bill′: ??Approximately twenty.

I will return to the degradedness of *approximately* in these examples in Section 2.4.1. There I describe *approximately* as operating strictly over scales, and the infelicity of the reading in (35c) is likely due to the unavailability of a scale over those alternatives.

Analysis

Labeling readings can be derived using the same machinery as the approximative ones, with the difference that non-scalar labels do not have numerically-approximative alternatives (i.e. do not contribute p_σ and p_x like scalars do). Figure 4 demonstrates this, showing the approximative ({18, 19, 20, 21, 22}, (34b)) and non-approximative ({20, 6, 77, 15}, (34c)) readings of *Maybe twenty* in (34) above.

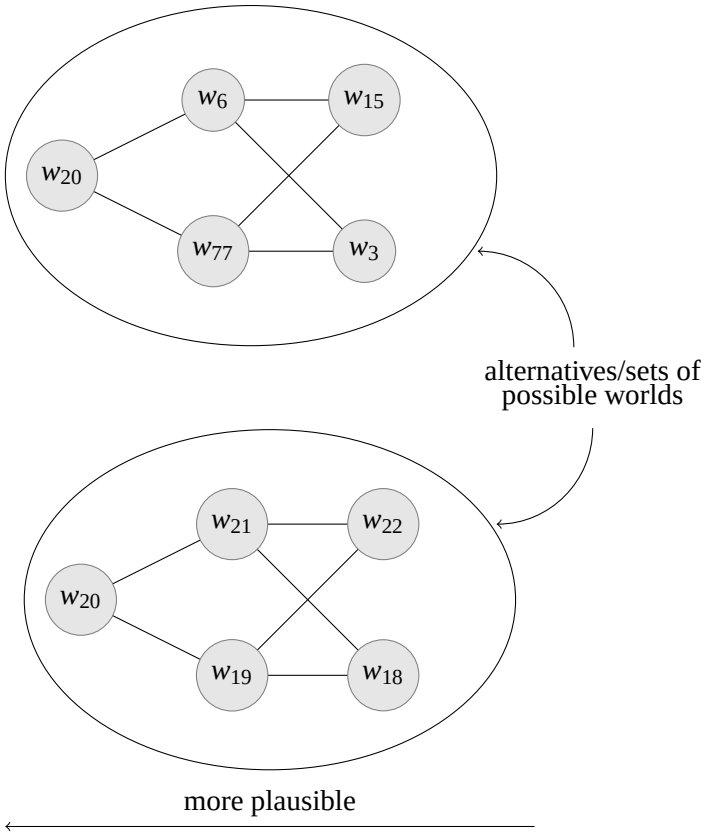

Figure 4: Circles represent alternatives as sets of worlds, ordered according to a modal base; lines represent accessibility relations.

2.3.2 Alternatives as approximation

Maybe

Considering the similarity in interpretation between *maybe twenty* and *approximately twenty* pointed out in (5) and (6) (as well as between *maybe beef stroganoff* and *approximately beef stroganoff* in (32a) and (31)), we might want to push further than the labeling analysis suggested above and consider that the interpretation of *maybe John* in (4), repeated below, could be thought of as approximation too.

(37) a. Ann: Who won the race?
Bill: Maybe John.
b. reading: {John, Mary, Peter}

This seems quite possible, provided that we are able to determine the appropriate scales to range over. Recall that epistemic approximation results when scale information is incorporated into the modal base/ordering source to yield an approximative reading. For (37), we can think of John as representing a point on some set of scales which contribute to the modal base/ordering source.

Alternatives to John then are like John in certain relevant respects (e.g. speed, predisposition to race, and susceptibility to performance anxiety) and represent points on these relevant scales that fall close enough to John to be considered likely.[30]

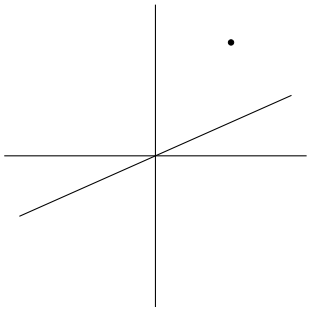

Figure 5: Representation of the entity John in a space defined by speed, susceptibility to performance anxiety, and predisposition to race

Approximately

Note that even when conceiving of *maybe John* as approximation, as suggested above, it still contrasts sharply with *approximately John* in (38), further emphasizing their different means of approximating.

(38) Ann: Who won the race?
Bill: Maybe John.
Bill′: #Approximately John.

This will be addressed in Section 2.4.3. There I will analyze *approximately John* as quantifying over alternatives that are hypothetical (i.e. non-real) people differing slightly from John. The degradedness of *approximately John* in (38) stems largely from the fact that hypothetical people do not win races.

Analysis

We can once again consider this in terms of p_σ/p_x, with the relevant scale (or scales) being some non-cardinality scale. Taking (37) and using our modal base to restrict our 'values' to persons, p_σ picks out worlds where the person intended by the speaker falls within σ of the uttered person John on the relevant scale (or scales).

[30] Cf. The type-shifting operation in (78) in Section 2.4.2.

I will not go into detail on how multiple scales should be implemented, but this idea draws on multidimensionality highlighted in work such as Alrenga (2007) and Sassoon (2010). Alrenga (2007) discusses comparatives like *same* and *different* as comparisons of locations on a scale in some dimension or set of dimensions (e.g. *x and y are the same color* compares the locations of *x* and *y* on a scale of color). When the dimension is left unspecified, *same* involves quantification over all (relevant) dimensions, whereas *different* involves quantification over at least one (relevant) dimension, as shown in (39).

(39) a. *x and y are the same* – $\forall$ relevant dimensions of comparison, $x \approx y$ in that dimension
b. *x and y are different* – $\exists$ relevant dimension of comparison s.t. $x \not\approx y$ in that dimension

From a similar perspective, Sassoon (2010) discusses certain gradable adjectives and their antonyms, like *healthy* and *unhealthy*, where the positive form (*healthy*) involves quantification over all (relevant) dimensions and the negative form (*unhealthy*) involves quantification over at least one (relevant) dimension, as shown in (40).

(40) a. *x is healthy* – $\forall$ relevant dimensions, *x* is healthy in that dimension
b. *x is unhealthy* – $\exists$ relevant dimension s.t. *x* is not healthy in that dimension

Paralleling these analyses, the use of *maybe* in examples like (4) (*The winner is maybe John*) can be likened to a loose *same* (i.e. *similar*).

(41) *x is maybe y* – $\forall$ relevant dimensions, *x* is similar to *y* in that dimension

In (4), the alternatives are people who are close to *John* on all relevant dimensions. Note that this approximative reading is again arrived at by using a unified *maybe* as an epistemic possibility operator.

2.3.3 Directional *maybe*

Maybe

Another case of uncertainty, as pointed out by Stephanie Solt (p.c.), is seen in (42) where *maybe* acts like the directional modifier *at most*.

(42) [Context: Ann organized, but did not attend, a party last night and hopes it had a high turn-out of around 75. Bill attended the party and does not know exactly how many people were there, but believes the number to be 40, give or take 10.]

Ann: How many people were at the party?
Bill: Maybe fifty.

Here, it seems that Bill chose his response to best fit Ann's expectations rather than to reflect the number he really thought was most likely, 40. Below I will explore three possible analyses of this directionality. I will subscript *maybe* with $\leq$ or $\geq$ when referring to its directional use. While all

three of these analyses account for the data at hand, I assume Analysis 3 on the grounds that it provides the most thorough formalization of the source and use of directionality.

Approximately

Unlike *maybe*, *approximately* is degraded when modifying an upper/lower bound. For example, in (43) where fifty is the absolute largest value believes possible, *approximately fifty* is marked as a response, as it seems to suggest that values both below and above fifty are possible.

(43) [Context: Ann organized, but did not attend, a party last night and hopes it had a high turn-out of around 75. Bill attended the party and does not know exactly how many people were there, but believes the number to be 40, give or take 10.]

Ann: How many people were at the party?
Bill: ?Approximately fifty.

It appears, then, that *approximately* has no directional reading on par with *maybe*.

Analysis 1 – Directionality as label on maximum/minimum possible value

The first analysis I consider for directional *maybe* is one that treats it as another case of labeling, as discussed in Section 2.3.1 above. In (42), Bill chose the highest likely value, 50, to minimize Ann's disappointment; he had several answers he could have given, and for pragmatic reasons he chose the one called *fifty*. Note that this analysis predicts that Bill could have chosen the smallest (or any other) likely value if it had been more in line with his communicative goals, and this is indeed true. This is demonstrated in the examples in (44), where Bill picks the lowest likely value in (44a) to satisfy Ann and the highest likely value in (44b) to satisfy Charlie.

(44) [Bill thinks that the temperature is around freezing (32° F).]

a. Ann: I hope it's cold enough to go ice skating. How cold is it?
   Bill: Maybe$_{\geq}$ 30.
b. Charlie: I hope it's too warm to go ice skating. How warm is it?
   Bill: Maybe$_{\leq}$ 35.

This analysis, while it can can account for the data at hand, has little predictive power, particularly given that I have not imposed any formal constraints on label generation. In light of this, I examine other possible, stronger, analyses below.

Analysis 2 – Directionality as implicature

The second possible analysis comes from Geurts and Nouwen (2007), who liken *maybe* to the directional superlative modifiers *at most*/*least*, noting that they have similar distributions and inter-

pretations, as in (45). Here they both provide an upper/lower bound (like *more/fewer than*), and they can be dislocated (unlike *more/fewer than*).

(45) a. Betty had three martinis {at most/maybe/*fewer than}.
b. {At least/Maybe/*More than}, Betty had three martinis.

The directional superlatives *at most*/*least*, however, have a more restricted distribution than *maybe*, as shown in (46).

(46) Superlative vs. *maybe* (Geurts and Nouwen 2007, p. 26)
a. a restaurant with {*at most/maybe} as many as thirty tables
b. a restaurant with {*at most/maybe} thirty table or even more

I assume that this restriction is due to directionality. 'Positive' directed modifiers like *a few* and *at least* contrast with 'negative' directed modifiers like *few* and *at most* (Moxey and Sanford 2000; Sanford, Williams, and Fay 2001; Sanford, Dawydiak, and Moxey 2007, a.o.) in contexts like (47). Assume that the speaker wants to maximize the number of trees saved, *fortunately* is felicitous with positive modifiers and *unfortunately* is felicitous with negative modifiers.

(47) a. Fortunately/#Unfortunately, a few trees were saved. (positive mod)
b. #Fortunately/ Unfortunately, few trees were saved. (negative mod)
c. Fortunately/#Unfortunately, at least forty trees were saved. (positive mod)
d. #Fortunately/ Unfortunately, at most forty trees were saved. (negative mod)

Returning to (46), the modifiers *as many as* and *or even more* appear to be positive, patterning like other positive modifiers.

(48) a. Fortunately/#Unfortunately, as many as forty trees were saved. (positive mod)
b. Fortunately/#Unfortunately, forty trees were saved or even more. (positive mod)

The incompatibility between *at most* and *as many as*/*or even more* in (46), then, appears to be a result of referring to thirty tables positively and negatively at the same time (i.e. as saying that it is both a small and a large quantity).

(49) a. *a restaurant with $\underbrace{\text{at most}}_{negative}$ $\underbrace{\text{as many as}}_{positive}$ thirty tables
b. *a restaurant with $\underbrace{\text{at most}}_{negative}$ thirty table $\underbrace{\text{or even more}}_{positive}$

Geurts and Nouwen suggest that *maybe* differs from superlatives in that it lacks a semantically-specified direction, allowing it to remain felicitous with positive modifiers in (46). We have seen, however, that *maybe* can have a directional meaning, cf. (42). This suggests that *maybe*'s direction is pragmatically, not semantically, supplied, allowing it to have a $\leq$, $\geq$, or neutral reading, depending on the context.

Directional uses of *maybe* pattern much like superlative modifiers, demonstrated by the paraphrases in (50).

(50) Context: Bill thinks that the temperature is around freezing (32° F).

a. Ann: I hope it's cold enough to go ice skating. How cold is it?
Bill: Maybe$_{\geq}$ 30.
Bill': At least 30.

b. Charlie:I hope it's too warm to go ice skating. How warm is it?
Bill: Maybe$_{\leq}$ 35.
Bill': At most 35.

The similarity begins to fade when considering (51). These sentences show the directional version of *maybe*, which is unexpectedly more felicitous than the superlative modifier *at most* in (51a).

(51) a. a restaurant with {*at most/maybe$_{\leq}$} as many as thirty tables

b. a restaurant with {*at most/*maybe$_{\leq}$} thirty tables or even more

The degradedness of *maybe*$_{\leq}$ with positive modifiers in (51b), then, cannot be given the same explanation as that for the degradedness of *at most*. As shown in (52), *maybe*$_{\leq}$ does not pattern like a negative modifier, and in fact patterns like a positive modifier.[31] Similarly to (42), it provides an optimistic flavor.

(52) Fortunately/?Unfortunately, maybe$_{\leq}$ forty trees were saved. (positive mod)

Maybe$_{\geq}$'s degradedness in (51b) cannot be due to a polarity conflict with the positive modifiers, since it itself is positive. Rather, I proposed that *maybe*$_{\leq}$ is degraded in (51b) because it is semantically incompatible with (*even*) *more*. The same is true of *at most*. *At most* and *maybe*$_{\leq}$ set the upper limit at thirty, and while *as many as* merely contributes positive flavor, *or even more* semantically contradicts the established upper limit, leading to infelicity (the number cannot be both *at most thirty* and *more than thirty*). This conflict, along with the conflicts in directionality, are shown in Table 2.

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[31] *Maybe*$_{\geq}$ also patterns like a positive modifier, though this is less surprising given that *at least* is a positive modifier.

(i) Context: Bill thinks that the temperature is around freezing (32° F).

a. Ann: I hope it's cold enough to go ice skating. How cold is it?
Bill: ?Fortunately/Unfortunately it's maybe$_{\geq}$ 30 (but probably warmer).
Bill': ?Fortunately/Unfortunately it's at least 30 (but probably warmer).

b. Charlie: I hope it's too warm to go ice skating. How warm is it?
Bill: Fortunately/?Unfortunately it's maybe$_{\geq}$ 35 (but probably warmer).
Bill: Fortunately/?Unfortunately it's at least 35 (but probably warmer).

	directionally compatible	semantically compatible
at most + *as many as*	×	✓
at most + *or even more*	×	×
maybe$_{\leq}$ + *as many as*	✓	✓
maybe$_{\leq}$ + *or even more*	✓	×

Table 2: Semantic and directional compatibility of pairs of directional modifiers.

At most, which always conflicts semantically and/or directionally with the modifiers in (51), is consistently infelicitous. *Maybe*$_{\leq}$, which conflicts with *or even more* is infelicitous with *even more* only.

While this analysis covers the data in question, it does not provide a formal account of the source of *maybe*'s directionality, similar to Analysis 1 above. Therefore, I will explore one more analysis below.

Analysis 3 – Directionality from contextually-supplied min/max

Hackl (2000) and Nouwen (2010) discuss another class of modals with directional readings. These directional readings result from the relative scope of the modal and a minimality or maximality operator supplied by a comparative or superlative operator. In (53), for example, where a possibility modal is involved, an upper-bound reading results when the maximality operator (supplied by the comparative *fewer than*) out-scopes the possibility operator (supplied by *allowed*), and an unbound reading results when the possibility operator out-scopes the maximality operator.

(53) a. Jasper is allowed to read fewer than 10 books.
b. $max_n(\diamond\exists x[\#x = n \,\&\, book(x) \,\&\, read(j,x)]) < 10$ (upper-bound)
c. $\diamond[max_n(\exists x[\#x = n \,\&\, book(x) \,\&\, read(j,x)]) < 10]$ (unbound)

I propose, based on examples like (54) and (55), that the minimality/maximality operator can be contextually supplied. The upper-bound reading in (54) is provided by scoping the contextually-supplied maximality operator over the possibility operator, and the lower-bound reading is (55) is provided by scoping the contextually-supplied minimality operator over the possibility operator.

(54) a. [Context: The building is always chilly.]
You are allowed to turn the thermostat to 70.
b. $max_n(\diamond\exists x[\#x = n \,\&\, turnThermTo(x)]) = 70$ (upper-bound)

(55) a. [Context: The building is always too warm.]
You are allowed to turn the thermostat to 70.
b. $min_n(\diamond\exists x[\#x = n \,\&\, turnThermTo(x)]) = 70$ (lower-bound)

Provided that the minimality/maximality operator can be contextually supplied, this analysis can easily be applied to *maybe* to account for its directional readings. The upper-bound reading in (42) is simply a case where the maximality operator out-scopes the modal possibility operator, shown

in (56a). Note that the reverse scope unbound reading, shown in (56b), is attested ('it is possible that maximally 50 people were at the party'), but it is not the same as the non-directional readings like (5), which makes no reference to minimality/maximality (i.e. has no contextually-supplied operator).

(56) Maybe 50 people were at the party.

a. $max_n(\diamond\exists x[\#x = n \;\&\; people(x) \;\&\; atParty(j,x)]) = 50$ (upper-bound)

b. $\diamond[max_n(\exists x[\#x = n \;\&\; people(x) \;\&\; atParty(j,x)]) = 50]$ (unbound)

Under this analysis, the main difference between $maybe_{\geq/\leq}$ and *at most*/*least* is that the latter have a fixed *max* operator while the former has a *max* (or *min*) only as supplied by the context.

(57) a. $\text{maybe}_{\geq/\leq}$ 10
$max_n/min_n(\diamond\ldots) = 10$

b. at most 10
$max_n(\ldots) \leq 10$

This provides us with directional readings of *maybe* without requiring additional machinery (given that contextually-supplied *min*/*max* are independently motivated). This also provides a straightforward explanation for the data in (51), as in Analysis 2 above: Both *at most* and $maybe_{\leq}$ are infelicitous in (51) because they are semantically incompatible with *even more* in (51b). Only *at most* is infelicitous in (51a), however, because neither *at most* nor $maybe_{\leq}$ conflict semantically with *as many as*, and only *at most* conflicts with it in directionality.

As this provides the most spelled-out account of directionality, I will assume Analysis 3. Nothing that precedes or follows, however, crucially relies on this particular analysis. Furthermore, each of these analyses allows a standard epistemic-possibility-operator treatment of *maybe*, regardless of its (lack of) directionality.

2.3.4 Summary

Above I discussed three different uses of *maybe* (*maybe* with uncertain labels, alternatives as approximation, and *maybe*'s directional uses), and I compared these to the uses of *approximately*, a comparison that will be expanded upon in Section 2.4. I provided analyses for these different uses of *maybe*, and of which allowed a common core epistemic-possibility-operator analysis of *maybe*.

2.4 Non-(un)certain approximators

We saw in Section 2.2 that uncertain numerals can give rise to approximation, and in Section 2.3 we began to consider the use of *approximately*. In this section I shift focus from *maybe* to *approximately*, using my analysis of uncertain numerals here to inform my analysis of *approximately*. In Section 2.4.1 I propose an analysis of *approximately* as a non-modal approximator, differing in important ways from modals like *maybe*, and in Section 2.4.2 I demonstrate that this analysis provides

attested readings for a variety of co-occurring approximators. In Section 2.4.3 I discuss and resolve a potential complication for this analysis.

2.4.1 *Approximately*

As was hinted at in Section 2.3, *approximately* does not give rise to approximate readings in the same way that *maybe* does. I analyzed *maybe* as an epistemic possibility operator that can express that its complement is from some set of (sufficiently-close) alternatives. Here I claim that *approximately* marks no such uncertainty and expresses rather that something falls within a range. For example, in *John is approximately 20*, John's age must falls within some range around twenty. The lack of uncertainty I propose for *approximately* is supported by data like (58), where *approximately*, though not *maybe* is consistent with the speaker knowing that John is 19 and not 20.

(58) A: John is 20.
B: No, he's 19, though that means he's *approximately*/#*maybe* 20.

Building on Hackl (2000)'s treatment of *exactly*, I propose that *approximately* is a degree modifier as shown in (59).[32]

(59) $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}$ & $D(m)$

Here *approximately* takes a degree n and a partially-saturated parameterized determiner[33] D and asserts that D holds of some degree m that is sufficiently close (as determined by a contextually-supplied distance metric σ) to n. The relevant parameterized determiner here is a null *many*, adapted from Hackl (2000) and given in (60), which takes a degree n and plural predicates $*f$ and $*g$ and asserts that there is some x such that both $*f$ and $*g$ are true of x and the cardinality of x is n.

(60) $[\![\textbf{many}]\!] = \lambda d \in D_{Card}.\lambda *f \in D_{\langle et\rangle}.\lambda\ *g \in D_{\langle et\rangle}.\exists x *f(x) = *g(x) = 1$ & x has d-many atomic parts in f (Hackl 2000, p. 244)

A sentence like (61) would then be derived as shown in (62), which asserts that there is some degree m that is sufficiently close to 20 and there is some entity x such that x is a plurality of people, x arrived, and the cardinality of x is m.

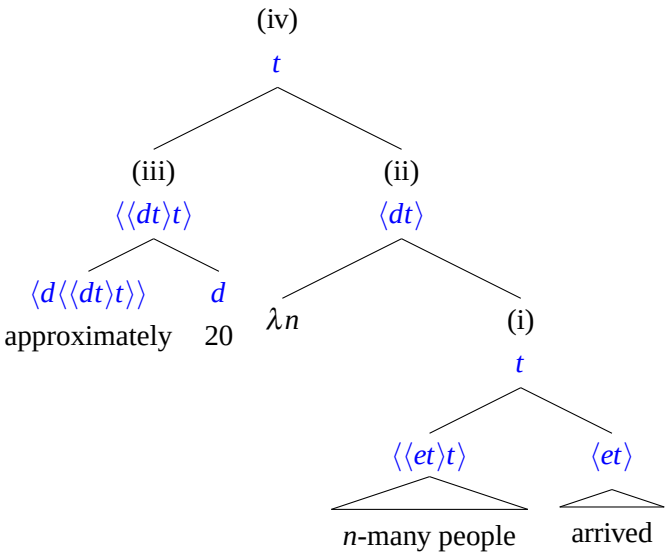
(61) Approximately twenty people arrived.

---

[32] Cf. the denotation he provides for *exactly n*: $[\![\textbf{exactly n}]\!] = \lambda D_{\langle dt\rangle}.D(n) = 1$ & $\neg\exists[d > n$ & $D(d) = 1]$, (Hackl 2000, p. 126). This framework will be discussed extensively in Chapter 4.

[33] A parameterized determiner is of type $\langle d\langle\langle et\rangle\langle\langle et\rangle t\rangle\rangle\rangle$. In (59), all its argument positions except for the degree argument have been saturated prior to this point.

(62) a.



b. $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\} \wedge D(m)$
$[\![\textbf{20}]\!] = 20$
$[\![n\textbf{-many people}]\!] = \lambda\ {}^*g \in D_{\langle et\rangle}.\exists x\ people(x) = {}^*g(x) = 1$ & x has n-many atomic parts in *person*
$[\![\textbf{arrived}]\!] = \lambda z.arrived(z)$
$[\![\textbf{(i)}]\!] = \exists x.people(x) = arrived(x) = 1$ & x has n-many atomic parts in *person*
$[\![\textbf{(ii)}]\!] = \lambda n.\exists x.people(x) = arrived(x) = 1$ & x has n-many atomic parts in *person*
$[\![\textbf{(iii)}]\!] = \lambda D_{\langle dt\rangle}.\exists m_d \in \{y | 20-\sigma \leq y \leq 20+\sigma\}$ & $D(m)$
$[\![\textbf{(iv)}]\!] = \exists m_d \in \{y | 20-\sigma \leq y \leq 20+\sigma\}$ & $\exists x.people(x) = arrived(x) = 1$ & x has m-many atomic parts in *person*

Approximately shows the same range effects as *maybe*, as can be seen by replacing *maybe* with *approximately* in (63) (cf. (5), (6)), as shown below.

(63) a. Ann: How many people competed?
Bill: Maybe twenty.
Bill′: Approximately twenty.
b. reading: {18, 19, 20, 21, 22}

Note that *approximately* cannot replace *maybe* in (7) to give rise to a reading like (5b), since *twenty* here is not appropriately scalar (cf. (36)).

(64) Ann: Which player has the most fouls?
Bill: Maybe twenty.
Bill′: ??Approximately twenty.

These approximative effects are captured in the denotation in (59), which incorporates σ to determine its range.

This denotation also captures an important difference, shown in (65).

(65) a. It's Susan's birthday today, and she's maybe thirty.
b. #It's Susan's birthday today, and she's approximately thirty.

Approximately in (65b) is infelicitous because it is unable to accommodate the fact that it is Susan's birthday (i.e. that Susan cannot be, e.g., 28 and three months old on her birthday). With *maybe* in (65a), on the other hand, this information can easily be accommodated in the modal base, excluding incompatible ages from consideration. This difference is reflected in the denotation above in (59), where m is drawn from a continuous range ($\{y|n-\sigma \leq y \leq n+\sigma\}$), one that includes impossible ages like 28 and three months. While *approximately* is consistent with it being Susan's birthday, in drawing from this continuous decimal range it suggests that intermediate values are possible. This requires extra effort on hearer's behalf in order to fit the utterance to the context, resulting in degradedness. In (65a), alternatives are again drawn from a decimal scale, but here with *maybe* the modal base acts as a filter, removing impossible ages from consideration.

Note that (65b) is acceptable in a very precise context like (66).

(66) It's Susan's birthday today, though she's only *approximately* thirty right now. She won't really turn 30 for another seven minutes.

The acceptability of *approximately* in (66) is predicted by the account developed here. As discussed above, m can be drawn from a continuous range centered around thirty. If σ is small enough (e.g. 10 hours) that it does not conflict with the date being Susan's birthday, as it is in (66), the utterance should be felicitous. In what follows, however, I do not entertain such readings. In fact, such reading are difficult to arrive at, as discussions of adult ages tend bias readings that are less precise readings than what is required in (66).

Note also that hearers are often tempted to paraphrase (65b) as (67), but this paraphrase obscures the contrast between *maybe* and *approximately*.

(67) It's approximately Susan's 30th birthday.
a. = it's 3 days before her 30th birthday
b. = it's her 29th, 30th, or 31st birthday

Unlike (65b), (67) has a reading that is felicitous in a context where it is Susan's birthday. This reading is given in (67b), where quantification ranges over birthdays, not ages, such that no intermediate values exist. This is the same kind of quantification seen in (68), which ranges over tournaments, and in (69), which ranges over people, neither of which have intermediate values.

(68) This is approximately Susan's 5th LPGA tour.

(69) Approximately 20 people competed.

I return to this quantification pattern in Section 2.4.3.

So, through associating scalars with range information as described by Krifka (2009), the similarities between *maybe* and *approximately*, as well as their differences, can be captured. These are

summarized briefly in (70).

(70) a. *approximately*
   (i) non-modal
   (ii) does not accommodate contextual information
   (iii) uses σ for range
   b. *maybe*
   (i) modal
   (ii) accommodates contextual information
   (iii) uses σ for modal base

Since *approximately* is not modal it is unable to accommodate contextual information, but since it draws on σ in determining range it gives rise to the same roundness effects as *maybe*.

2.4.2 Modifier stacking

Sauerland and Stateva (2007) treat *approximately* and *exactly* differently from what was proposed in (59). According to their analysis, scalar approximators function to restrict granularity parameters in the following way: *approximately* specifies a course-grained scale (cf. large σ) and *exactly* specifies a fine-grained scale (cf. small σ). Thus, *approximately x* picks out a wider section of a scale than *exactly x*.

(71) a. $[\![\textbf{exactly}]\!]^{gran}(G) = G(\{\text{finest}(gran)\})$ (Sauerland and Stateva 2007, p. 233)
   b. $[\![\textbf{approximately}]\!]^{gran}(G) = G(\{\text{coarsest}(gran)\})$

According to this analysis, scalar approximators cannot be felicitously stacked, as shown as in (72), because the first approximator sets the granularity parameter, leaving the second vacuous.[34]

(72) a. # John is exactly approximately 30 (Sauerland and Stateva 2007, p. 235)
   b. # John is approximately exactly 30

While Sauerland and Stateva do not address coerced readings, these readings are in fact available for the sentences in (72). First consider *John is approximately 30*, and imagine that there is some

[34] If the second approximator were truly vacuous, one might expect (72a) to be more or less equivalent, awkwardness of vacuity aside, to *John is exactly 30* and (72b) should be similarly equivalent to *John is approximately 30*.

(i) Prediction from Sauerland and Stateva (2007)
   a. #John is exactly approximately 30 $\rightsquigarrow$ John is exactly 30
   b. #John is approximately exactly 30 $\rightsquigarrow$ John is approximately 30

This, however, does not seem quite right. Vacuity alone may make this predicted reading (i.e. (i)) unavailable, so Sauerland and Stateva (2007) may be accurate so far, but we need not stop here.

prototype for approximately-30-ness; if John reflects this prototype, he might be referred to as *exactly approximately 30*, or (72a). The counterpart *approximately exactly 30* in (72b) has a reading where the speaker acknowledges the ideal of exactly-30-ness, and asserts that John is near this ideal. In both cases, the (linearly) first modifier is modifying a coerced scalar, i.e. both *approximately 30* and *exactly 30* need to be re-conceived as points on a scale (of approximately/exactly-30-ess) in order to be modified by another degree modifier. Possible contexts are provided below.

(73) a. [To participate in a study, subjects must be approximately 30, satisfied by being less than 345 days from their 30th birthday. John turned 364 days ago]
John is exactly approximately 30.

b. [To participate in a study, subjects must be within one day of their 30th birthday. John turned 30 two days ago.]
John is approximately exactly 30.

The denotations developed in Sections 2.2.2 and 2.4.1, repeated in (74)-(75) below, stack in a way that provides a more satisfying analysis. To complement *approximately*, I include a new denotation of *exactly* in (77), which is identical to (59), repeated in (76) below, except it is only defined for values of σ that are smaller than some contextually-defined standard σ_c (i.e. the degree m must be very close to n).[35] [36]

(74) $p_\sigma = \lambda w.y(w) \in \{[\![\mu - \sigma]\!], ..., [\![\mu + \sigma]\!]\}$

(75) $p_x = \lambda w.y(w) \in \{[\![\mu - x]\!], ..., [\![\mu + x]\!]\}, 0 < x < \sigma$

(76) $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt \rangle}.\exists m_d \in \{y | n - \sigma \leq y \leq n + \sigma\}$ & $D(m)$

(77) $[\![\textbf{exactly}]\!] = \lambda n_d.\lambda D_{\langle dt \rangle}.\exists m_d \in \{y | n - \sigma \leq y \leq n + \sigma\}$ & $D(m)$, defined if $\sigma < \sigma_c$

Further, I introduce a shifting operation that can take nouns from non-scalar to scalar readings. This is shown in (78), which maps some x (of any type) onto something of type d which corresponds to that original x on some relevant scale.[37]

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[35] Hackl's denotation of *exactly*, which will be discussed in Chapter 4 asserts that the proposition was true of the uttered numeral but not of any larger number. My denotation rather asserts that the proposition is true of some number very close to the uttered numeral (but which could be slightly larger or smaller).

[36] In support of this denotation, note that *exactly* can still be used imprecisely, e.g. you can most likely utter *Mary arrived at exactly three o'clock* if her official arrival time is 3:00:00.1. And note that (76) and (77) are manipulating granularity, similar to (71), though here through the use of σ. See Pinkal (1995) for an in-depth discussion of these concerns.

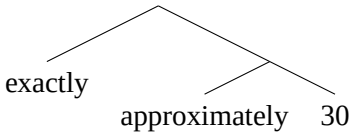
[37] See Burnett (2012) for an alternative pragmatic account of this shift wherein non-scalar adjectives (e.g. *atomic*, *geographical*, *dead*) are degree expressions (specifically, absolute gradable adjectives) subject to a precision constraint. Under most circumstances, this precision constraint causes them to appear non-scalar, but the constraint can be pragmatically removed in contexts like *73 is more prime than 2*. The scale is presumably one of prototypicality, though what

(78) Degree type-shift
$\lambda x_{\tau}.x_d$

By employing the type-shifting operation in (72), I can provide a satisfactory account of the coerced interpretations in (72). This type-shift converts ⟦**approximately 30**⟧ in (72a) and ⟦**exactly 30**⟧ in (72b) into scalars so that they can be modified again by the first approximator. Thus ⟦**approximately 30**⟧ will represent $approximately30_d$ (the point corresponding to *approximately 30*, or perhaps the 'ideal' represented by *approximately 30* on some scale of 'approximately 30'-ness), and similarly for ⟦**exactly 30**⟧.

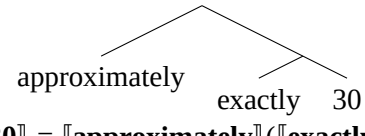
Using this degree shift (indicated below with "$\rightarrow d$"), *exactly approximately 30* now means something that is very close to the ideal of 'approximately 30', shown in (79), and *approximately exactly 30* means that something is reasonably close to the ideal of 'exactly 30', shown in (80). This seems much more in line with intuitions of what the sentences in (72) mean, when interpretable.

(79) a.



b. ⟦**exactly approximately 30**⟧ = ⟦**exactly**⟧(⟦**approximately**⟧(⟦**30**⟧))
$= [\lambda n_d.\lambda D_{\langle dt\rangle}.\exists x_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(x)$, defined if $\sigma < \sigma_c]$
$([\lambda n_d.\lambda D_{\langle dt\rangle}.\exists x_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(x)](30))$
$\overset{\rightarrow d}{=} [\lambda n_d.\lambda D_{\langle dt\rangle}.\exists x_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(x)$, defined if $\sigma < \sigma_c](approximately30_d)$
$= [\lambda D_{\langle dt\rangle}.\exists x_d \in \{y|approximately30_d - \sigma \leq y \leq approximately30_d + \sigma\}\ \&\ D(x)]$,
defined if $\sigma < \sigma_c]$

(80) a.



b. ⟦**approximately exactly 30**⟧ = ⟦**approximately**⟧(⟦**exactly**⟧(⟦**30**⟧))
$= [\lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)]$
$[\lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)$, defined if $\sigma < \sigma_c](30)$
$\overset{\rightarrow d}{=} [\lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y|n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)](exactly30_d)$
$= [\lambda D_{\langle dt\rangle}.\exists m_d \in \{y|exactly30_d - \sigma \leq y \leq exactly30_d + \sigma\}\ \&\ D(m)]$

Intuitions about *exactly* in combination with *maybe* are generally murky, but they provide another test case. *Maybe exactly 30* seems to indicate that it is possible that the quantity in question is

exactly this means is not obvious. These adjectives might encode multiple (perhaps infinite) scales (e.g. *more pregnant* as closer to due date, larger belly, etc.). This is further complicated by the fact that coerced scalars do not pass all tests for maximum-standard absolute adjectives (e.g. absolute adjectives are felicitous in resultative constructions, but coerced scalars are not, cf. *He pounded the metal flat/#hexagonal*) .

very close to 30 (*It's around 30, maybe even exactly 30*). Using the shift in (78), an interpretation predicted by the analysis developed here is that the plausible alternatives are those close to the ideal of *exactly thirty*, which would presumably involve values close to 30 (though, since it's not entirely clear what the relevant scale is, it's not entirely clear what the nearby alternatives would be).

(81) $[\![\textbf{maybe}]\!]([\![\textbf{exactly}]\!]([\![\textbf{30}]\!]))$
$= \diamond[\lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)$, defined if $\sigma < \sigma_c](30) \overset{\rightarrow d}{=} \diamond[exactly30_d]$
$f : p_{\sigma_{exactly30_d}}\ g : p_x$

Without the shift, there would ultimately be no scalar to introduce p_σ and p_x, so it seems that an approximative reading would not be guaranteed in this case.

(82) $[\![\textbf{maybe}]\!]([\![\textbf{exactly}]\!]([\![\textbf{30}]\!]))$
$= \diamond[\lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)$, defined if $\sigma < \sigma_c](30)$
$= \diamond[\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | 30-\sigma \leq y \leq 30+\sigma\}\ \&\ D(m)$, defined if $\sigma < \sigma_c]$

It seems, then, that this analysis predicts the availability but not the necessity of scalarly-close alternatives for utterances like *maybe exactly 30*, which accords with intuition. A similar prediction is made for *maybe approximately 30*.

Overall, the analyses of *approximately* and *exactly* developed here predict interpretations that line up well with hearer intuitions. Note that Sauerland and Stateva's denotations in (71), when provided with a shift operation like (78), act much like the denotations in (59) and (77) (i.e. give readings like those in (79) and (80)). Additionally, they express range and their granularity could be parameterized to σ such that they would show the round number effects and infelicity with discontinuous alternatives (e.g. (65)) described above. The denotations in (59) and (77), however, have the advantage of avoiding the unattested vacuous-second-approximator readings that Sauerland and Stateva claim for the sentences in (72). These denotations in (59) and (77) also have the advantage of according with the analysis of degree modifiers in Hackl (2000), which helps to account for certain distributional asymmetries, which I will return to in Chapter 4.

2.4.3 Atomicity in approximation

This discussion of *approximately* brings up a new question: why is *approximately twenty people* as a response to *How many people competed?* in (83) less offensive than *approximately thirty* in (84)? More specifically, why does *approximately twenty people* not express that there may have been, say, 21.7 people?

(83) Ann: How many people competed?
Bill: Approximately twenty.

(84) # It's Susan's birthday today, and she's approximately thirty (years old).

The solution here, I propose, is atomicity of the quantified phrase. People are considered atomic[38], and since they are not divisible, only whole-person increments are considered in (6). Years, on the other hand, are readily divisible, so non-integer increments are considered in (84). The modifier *approximately*, I propose, is able to respect this atomicity and does not induce non-integer alternatives in (6) because it quantifies over an integer, not a decimal scale. This contrasts with the availability of non-integer alternatives when *approximately*'s complement is non-atomic, as in (84), where *approximately* quantifies over a decimal scale. Recall also that (67), repeated below in (85), gives the reading demonstrated in (85b) which is felicitous when it is Susan's birthday and does not introduce intermediate values. This is because quantification here ranges over birthdays, which are atomic, much like *people* in (83).

(85) It's approximately Susan's 30th birthday.

a. = it's 3 days before her 30th birthday

b. = it's her 29th, 30th, or 31st birthday

The modifier *maybe* likewise respects atomicity, but recall that, unlike *approximately*, *maybe* can also accommodate contextual information (e.g. the fact that it is Susan's birthday in (65)). Thus, (65b) is still felicitous because the modal accommodates the context to rule out intermediate values.

(5) Ann: How many people competed?
Bill: Maybe twenty.

(65a) It's Susan's birthday today, and she's maybe thirty (years old).

Atomicity can conflict with contextual information. As we saw in (65), the context can require discontinuous alternatives, while non-atomicity of the quantified phrase calls for continuous alternatives. A similar case can be seen in (86).[39]

(86) ? approximately two people

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[38]Note that I am talking about people, not bodies.

[39]Examples like (86) are often felicitous when *approximatively* is used correctively, as in (i).

(i) A: I hear we'll be interviewing two people for the position.
B: Eh, *approximately* two. There's one person we're not quite sure about yet.

I assume B's use of *approximately* is felicitous here because B faces a stronger pressure to agree with A to the furthest extent possible (i.e. B is saying *Yes, we are interviewing two people, but in a rough interpretation of 'two'*).

The numeral *two* is typically used relatively precisely, i.e. with a small σ.[40] Here *approximately* begins to sound strange because of a conflict between atomicity and what I will term non-vacuity of alternatives, a pragmatic constraint that requires sets of alternatives to have a size greater than one.[41] [42] Here I say that the set of alternatives exclusive of the item itself should not be empty. Conversely, though less relevantly here, it should not contain the entire universe.

(87) Non-vacuity of alternatives: for a set of alternatives α, $|\alpha| > 1$

Since the quantified unit *people* is atomic and the range (e.g. $\pm.5$)[43] contains only the uttered value, as shown in (88), this violates non-vacuity of alternatives.

(88) a. approximately two people
b. {2}

---

[40] Subitization may also be a factor here; if you saw two people, you would know there were (exactly) two people. A mass reading escapes this problem (*approximately two people's-worth of parts, approximately two pounds of people*).

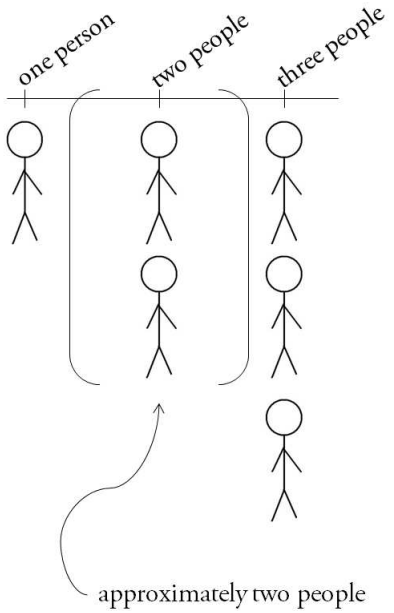
[41] I consider this primarily a consequence of the Maxim of Manner ('Be brief'). This constraint is presumably in effect in other domains that make use of alternatives. For example, contrastive focus cannot be used unless alternatives can be computed (Rooth 1992), and questions are infelicitous if they trivially partition the domain (e.g. *Does John own the computer that he owns?*) (Groenendijk and Stokhof 1984a).

[42] This is similar to the Non-vacuity principle, (Kamp and Partee 1995, p. 161)

(i) (NVP) Non-vacuity principle: In any given context, try to interpret any predicate so that both its positive and negative extension are non-empty.

For example, if knives are by definition sharp, the utterance *This is a sharp knife* would have only a positive extension. This, however, is not how the sentence is interpreted. Instead, *sharp* is reinterpreted more strictly to allow both a positive and a negative extension.

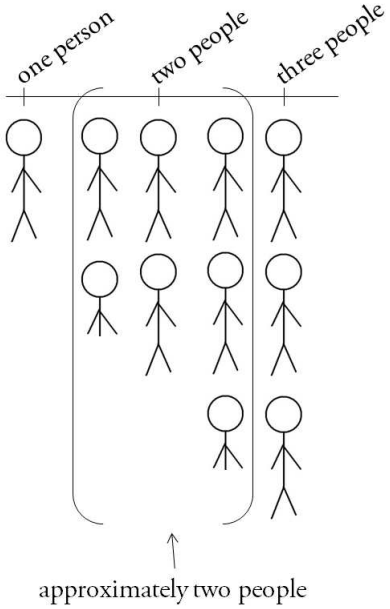
[43] While σ need not be .5, is will likely be quite small, since 2 is a relatively unround number (cf. 100).



To allow for more than one item to be in the range of *approximately two people*, I am tempted to coerce a somewhat disturbing non-atomic reading of people, as shown in (89).[44]

(89) a. approximately two people

b. reading: {1.5, ..., 2, ..., 2.5}



[44]For simplicity, this illustration shows only 1.5, 2, and 2.5 people as alternatives, but with $\sigma = .5$, all values between 1.5 and 2.5 are possible alternatives.

The infelicity of (86), then, follows from the impossibility of simultaneously respecting atomicity and non-vacuity of alternatives. If the quantified phrase is instead non-atomic, as in (90), non-vacuity of alternatives is no longer a problem and the utterance is (ceteris paribus) felicitous.

(90) a. approximately two people's worth of weight
b. approximately two cadavers

Note that *maybe*, on the other hand, can respect non-vacuity of alternatives and as well as atomicity by giving a labeling (non-approximative) reading, as discussed in Section 2.3.1.

Relatedly, we can see that the alternatives arising from *maybe John* do not tend to be the same as the items that fall within the denotation of *approximately John*, as alluded to in Section 2.3.2. *Approximately John* seems to point to some (probably hypothetical) person who differs from John only slightly. *Maybe John* gives a more macroscopic reading, allowing for (probably non-hypothetical) alternatives that differ more sharply from John. This difference may be due to contextual information accommodation: you are presumably searching for actual people, not hypothetical John-like people, so for *maybe John* the range (σ) needs to be wider if it is to include any alternatives not already ruled out by world knowledge. For *approximately John*, on the other hand, the range will contain entities even without widening, since there is no modal base to exclude purely hypothetical John-like people.

Now that I have introduced atomicity as information that can be accommodated by modifiers like *approximately*, my split between *approximately* and *maybe* (i.e. *maybe* can accommodate contextual information, *approximately* cannot, as shown in (65)) might seem suspect. Here I would like to emphasize that atomicity is distinct from the contextual information I have been dealing with (e.g. whether or not it is your birthday).

Atomicity is about the quantified phrase, not the context, and is thus more local. The scale to be quantified over is determined locally by the quantified phrase. If the quantified phrase is atomic, the scale will be an integer scale. If not, it will be a decimal scale. Context can then operate over this scale to rule out decimal alternatives.

In (65), the quantified phrase *years* sets a decimal scale, and the context (in which it is Susan's birthday) rules out intermediate non-integer values as alternatives. In (91), the quantified phrase *people* sets an integer scale.

(91) Approximately 30 people were invited to the party.

2.4.4 Summary

This section introduced a Hackl-style analysis of *approximately* which contrasts with *maybe* in its ability to accommodate contextual information. This behavior was demonstrated in examples like (65), where *approximately*, but not *maybe* is marked due to the contextual need for discontinuous alternatives. I analyzed this ability to accommodate contextual information as resulting from a modifier's modal status: the modal *maybe* can accommodate contextual information, while the non-modal *approximately* cannot.

I then demonstrated that the denotations I provide for non-modal *approximately* and *exactly* combine to produce attested readings, with the aid of the degree type-shift in (78). Finally, I discussed the effect of a quantified expression's atomicity. Atomicty explained how the reading *it's Susan's 29th, 30th, or 31st birthday today* is available for (92b), but degraded for (92a).

(92) a. # It's Susan's birthday today, and she's approximately 30.
b. It's approximately Susan's 30th birthday.

This is because (92a) quantifies over a non-atomic scale of time (which allows for Susan to be non-integer ages on her birthday) while (92b) quantifies over atomic birthdays.

Finally, note that, unlike *maybe* (Section 2.3.3), there is no directional *approximately*. In (93), Bill′'s response is roughly equivalent to Bill's, but Bill″'s is not.

(93) Context: Bill thinks that the temperature is around freezing (32° F).
a. Ann: I hope it's cold enough to go ice skating. How cold is it?
Bill: Maybe$_{\geq}$ 30.
Bill′: At least 30.
Bill″: Approximately 30.
b. Charlie:I hope it's too warm to go ice skating. How warm is it?
Bill: Maybe$_{\leq}$ 35.
Bill′: At most 35.
Bill″: Approximately 30.

2.5 Approximators and theories of vagueness

Sauerland and Stateva (2007) argue that scalar vagueness and epistemic vagueness arise from separate mechanisms: scalar vagueness arises from a granularity parameter (in our version $\sigma > 0$), whereas epistemic vagueness results from quantification over epistemically-accessible worlds. Having (at least) two different mechanisms that give rise to vagueness requires a heterogeneous theory of vagueness. The homogeneous theory they target to argue against is Lasersohn (1999)'s pragmatic halos. Below I will describe this theory and demonstrate how it alone is not sufficient to account for the data I have presented. I will argue, however, contrary to Sauerland and Stateva (2007), that pragmatic halos are not *wrong*, they are simply insufficient.

I will then discuss two additional modifiers, *like* and *about*, using the diagnostics developed here to determine what mode of vagueness they appeal to. I will show that *about* shows some unusual behavior, but behavior that can still be accounted for using the two uncertainty mechanisms discussed so far, epistemic possiblity operators (seen through *maybe*) and range-denoting expressions (seen through *approximately*).

2.5.1 Pragmatic halos

The analysis of approximation from uncertainty presented above is reminiscent of Lasersohn (1999)'s pragmatic halos. Lasersohn proposes that a numeral, among other phrases, has a precise denotation, and the referent of that denotation is surrounded by a halo of elements which differ from it in pragmatically ignorable ways. Under this theory, vague readings result not from the denotation itself, but from the elements in the halo being treated as if they were true. I argue that while pragmatic halos are not *wrong* (contra claims by Sauerland and Stateva (2007)), they are not sufficient for the data I discuss. In particular, the theory as is predicts no difference between modal and non-modal modifiers.

In the characterization Lasersohn provides of pragmatic halos, some element α is surrounded by a halo of elements which differ from α in pragmatically ignorable ways, as illustrated in Figure 6.[45] For example, in (1), repeated below in (94), $\alpha = 20$, and α's halo includes 19.5, allowing the

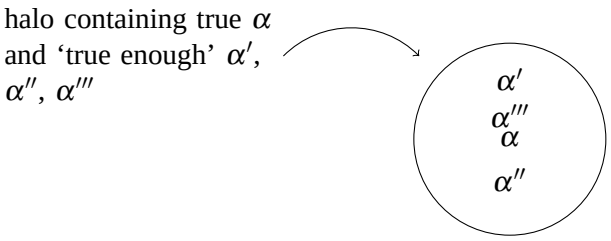


Figure 6: α with its halos, containing α', α'', and α''', which differ from α only in pragmatically ignorable ways.

speaker to describe the book as costing twenty dollars.

(94) [Casually describing a book that costs $19.50]
This book costs twenty dollars.

Slack regulators like the hedges *roughly* and *loosely speaking* are terms that manipulate pragmatic halos, functioning to more-or-less expand $[\![\alpha]\!]$ to include its halo[46]. For example, while $[\![$**twenty**$]\!]$ is only true for 20 exactly, $[\![$**roughly twenty**$]\!]$ is true for values that differ from twenty in pragmatically ignorable ways. Other slack regulators like *precisely* and *exactly* function to narrow the halo around α, such that the halo around $[\![$**exactly** $\alpha]\!]$ is smaller than that around $[\![\alpha]\!]$.

[45] Lasersohn writes: "Given an expression α denoting some object x, I like to think of the set the context associates with x as arrayed around x in a sort of circular cluster, so I will call this set,together with its ordering relation, the PRAGMATIC HALO of x, or, extending the terminology, as the pragmatic halo of α", (Lasersohn 1999, p. 527) and "$H_C(\alpha)$ is understood to be a set of objects which differ from $[\![\alpha]\!]^{M,C}$ only in ways which are pragmatically ignorable in C; $\leq_{\alpha,C}$ is an ordering of $H_C(\alpha)$ according to similarity to $[\![\alpha]\!]^{M,C}$", (Lasersohn 1999, p. 548).

[46] E.g. $[\![$**loosely speaking** $\Phi]\!]^{M,C} = \bigcup H_C(\Phi) - [\![\Phi]\!]^{M,C}$ (Lasersohn 1999, p. 545)

Another way to view this, employed by Sauerland and Stateva (2007), is shown in Figure 7, where the area of the scale denoted by α is shaded black, and the area of the scale included in α's halo is shaded gray. Here the slack regulator *exactly* functions to narrow the halo around α, while the slack regulator *approximately* functions to include halo values in the denotation.[47]

Figure 7: Depiction of denotation (black) and halo (gray) of *twenty*, with and without slack regulators.

Inadequacy of pragmatic halos

For our treatment of numerals in a pragmatic-halos framework, it would seem that the propositions p_σ and p_x, introduced in Section 2.2, are the same as the information structuring these pragmatic halos (i.e. the information used to determine what is pragmatically ignorable and how to order items based on similarity). However, one difference soon becomes apparent, which is seen most clearly through slack regulators.

To see how the information used in the possible worlds account developed here differs from one using pragmatic halos, compare the use of *maybe* with the hedge *roughly* in (95).

(95) a. It's Susan's birthday today, and she's maybe thirty.
b. #It's Susan's birthday today, and she's roughly thirty.

As in (65)/(95a), *maybe* can readily accommodate the fact that it is Susan's birthday, but with *roughly*, this information does not seem to enter into halo construction, leading to infelicity.[48] And this behavior is not specific to the term *roughly*. Recall that *approximately* showed the same behavior in (65). Even round numbers do not accommodate this kind of outside information, as shown in (96). Here, the speaker can utter (96a) to pick out a possible value from a set of discontinuous alternatives, but (96b) is unable to do so (i.e. (96b) cannot effectively convey that this person may be 35 or 23 or 47, etc. but not an intermediate age). Similarly, using a round number in (96c) can

[47] According to Lasersohn, this would exclude *20*, but I will ignore this here.

[48] Note that *roughly* (like *approximately*) is acceptable in a very precise context. For example, you can be pedantic and insist that Susan is only roughly thirty if she was born at noon and it is currently only 9am.

convey that the speaker believes this person to be approximately thirty, but not that he is one of a set of discontinuous values around thirty (e.g. 23 or 35).

(96) [You're talking to an acquaintance, and she tells you her brother was born in the year of the ox, which for present purposes means he's 11, 23, 35, 47, 59, 71, or 83 years old. This acquaintance is in her thirties, so your best guess would be that her brother is 35 (as opposed to 11, 23, etc.).]

a. maybe thirty-five
b. #approximately thirty-five
c. #thirty

So, while there is overlap in the information structuring pragmatic halos and the information structuring possible worlds, the overlap is not complete. Halos deal with precision (such as the information contributed by p_σ, p_x in (29) and (30)) only, while modals accommodate precision as well as additional contextual information.

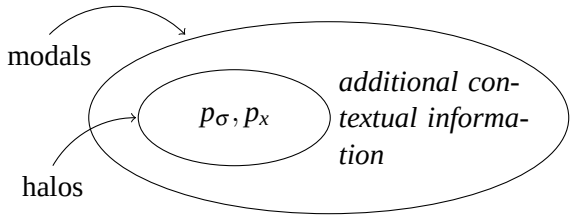


Figure 8: Information accommodated by modals (e.g. *maybe*) vs. halos/halo-widening terms (e.g. *roughly*, *approximately*)

Using Sauerland and Stateva (2007)'s distinction between epistemic and scalar approximation, it becomes apparent that the epistemic *maybe thirty* accommodates contextual information, while scalar *roughly thirty* does not (parallels scalar *approximately*). Figure 8 can then be redrawn as Figure 9.

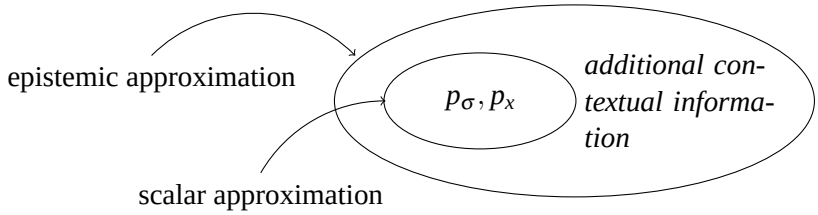


Figure 9: Information accommodated by modals (e.g. *maybe*) vs. halos/halo-widening terms (e.g. *roughly*, *approximately*)

Sauerland and Stateva (2007)'s objection to pragmatic halos

Sauerland and Stateva (2007) discuss the following data, discussed previously in Section 2.4.2, as an objection to halos as a theory of vagueness.

(97) a. # John is exactly/precisely approximately 30. (Sauerland and Stateva 2007, p. 235)
b. # John is approximately exactly/precisely 30.

They argue that Lasersohn (1999)'s theory predicts that (97b) should be felicitous, contrary to the judgments they report in (97). Following Lasersohn (1999), Figure 10 below (replicated from Sauerland and Stateva (2007, p. 236)) shows the denotations of *30*, *exactly 30*, *approximately 30*, *approximately exactly 30*, and *exactly approximately 30* are represented in black along a number line, with pragmatic halos shown in gray.

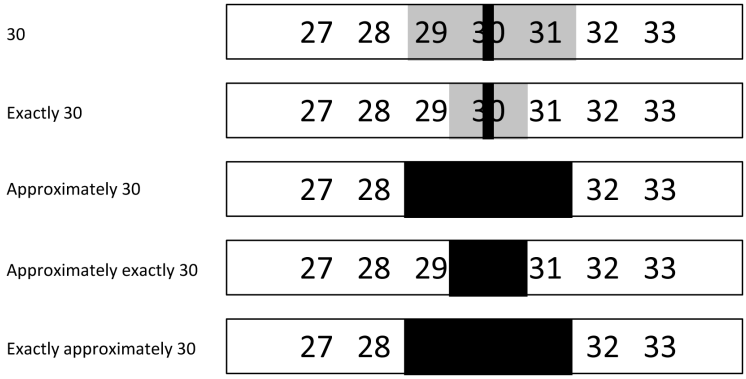


Figure 10: Deriving *approximately exactly 30* and *exactly approximately 30* from first-order-vague expressions

Sauerland and Stateva claim that *approximately exactly 30* in (97b), is 'incorrectly' predicted to be felicitous under a pragmatic halos account, which would to alter the narrowed halo around 30 such that those values evaluate to true (instead of merely being treated as if they were true).[49] Sauerland and Stateva claim that their theory 'correctly' predicts (97b) to be infelicitous because "A second scalar approximator in the scope of the first is vacuous", since the first has already restricted the granularity parameter such that the second cannot alter it, (Sauerland and Stateva 2007, p. 235).

Counter to Sauerland and Stateva, however, many speakers find examples like (97b) to be felicitous in an appropriate context, such as (98).

(98) A: Is John exactly 30?
B: Yes, or if he's not *exactly* 30, then he's *approximately* exactly 30

[49]They also claim that the reverse word order *exactly approximately 30* in (97a) is likewise 'correctly' predicted to be infelicitous under a pragmatic halos account. This time, however, the reason is that, while *exactly* acts to narrow halos, *approximately 30* has no halo. This vacuity, they claim, leads to infelicity.

This is supported by its attested use in the examples in (99).[50]

(99) a. What happens in approximately exactly a month? (-2 days)
b. This is approximately exactly what happened yesterday after lunch. Give or take.
c. Sooner or later each of the shoes and boots ended up approximately exactly the same size and it became a concern to help type socks along with T-shirts to their rightful seller.

Additionally, when second-order vagueness is taken into consideration, Lasersohn makes the correct predictions for these sentences. This is shown in Figure 11, where second-order vagueness[51] widens the halo of a first-order-vague expression.

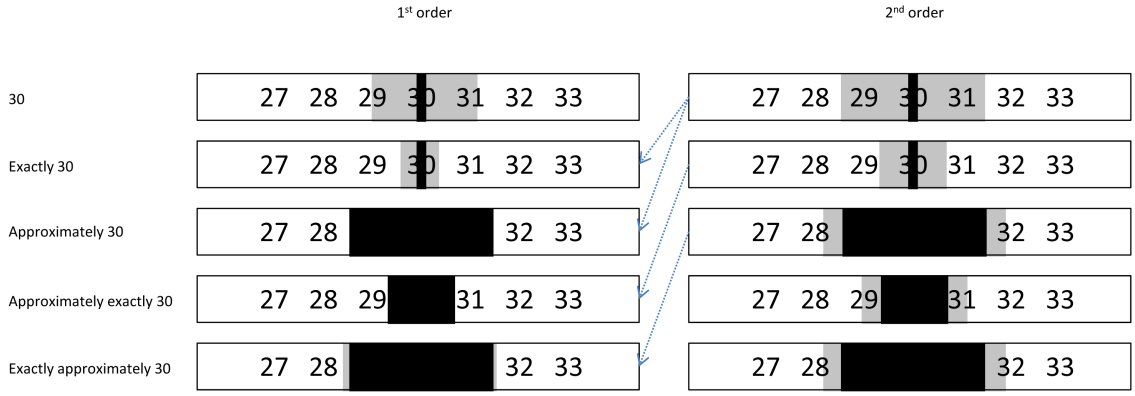


Figure 11: Deriving *approximately exactly 30* and *exactly approximately 30* from second-order-vague expressions

I maintain that, while halos may not be *wrong*, they are not sufficient to describe patterns like that in (65).[52] That is, this theory does not provide a means to appropriately alter the content of the halo based on the identity of the modifier.

2.5.2 The hedge *like*

Now that this distinction between modal (e.g. *maybe*) and non-modal (e.g. *approximately*) approximators has been noted, we may expect to find modal items like *maybe* which have been mis-

[50] From http://www.formspring.me/bdill, http://andresmax.com/post/7807129432/brianfranco-this-is-approximately-exactly-what, respectively.

[51] Second-order vagueness is the vagueness associated with determining boundaries between borderline and non-borderline areas. Generally, there is no clear delineation between the two.

[52] It is also worth bearing in mind that Lasersohn set out to address *pragmatic slack*, not to create a new theory of vagueness. Though see Burnett (2012) for an argument to subsume pragmatic slack as a subtype of vagueness.

classified as slack regulators (i.e. act merely to make the items in the halo evaluate to true). And indeed this seems to be the case for Siegel's (2002) *like*. In her analysis, *like* α denotes a variable corresponding either to α or an element within α's halo.[53] As can be seen in (100), however, *like* can accommodate outside information, just like *maybe* in (65) and (95).

(100) It's Susan's birthday today, and she's, like, thirty.

This can also be seen in an example like (96), repeated below with the addition of *like* in (101b). Here again, *like* can accommodate outside information, and (101b) can refer to one of a discontinuous set of alternatives.

(101) [You're talking to an acquaintance, and she tells you her brother was born in the year of the ox, which for present purposes means he's 11, 23, 35, 47, 59, 71, or 83 years old. This acquaintance is in her thirties, so your best guess would be that her brother is 35 (as opposed to 11, 23, etc.).]

a. maybe thirty-five
b. like thirty-five
c. #approximately thirty-five
d. #thirty

As these examples show, *like*, like *maybe* and unlike *approximately*, is felicitous in contexts which require discontinuous sets of alternatives. This cannot be explained by halos as described by Laserson and suggests that there is some modal semantic component to *like* such that outside information can be accommodated in its modal base, explaining the felicity of (100).

2.5.3 The hedge *about*

On the surface, the hedge *about* seems to mean something very similar to *approximately*, but subtle differences can be observed which suggest that *about* may be modal. Consider (102), where *about* is often judged to be not quite as degraded as *approximately*.

(102) a. It's Susan's birthday today, and she's maybe thirty.
b. #It's Susan's birthday today, and she's roughly/approximately thirty.
c. ?It's Susan's birthday today, and she's about thirty.

A similar pattern holds in (103).

[53] Siegel: If $[\![\alpha]\!]^{MC}$ represents the denotation of α relative to a model M and context C, and v_i is a variable over denotations of the same logical type as $[\![\alpha]\!]^{MC}$, then $[\![\textbf{like } \alpha]\!]^{MC}$ is $(v_i : v_i = [\![\alpha]\!]^{MC} \vee v_i \in \bigcup H_c(\alpha))$. (Siegel 2002, p. 62)

(103) [You're talking to an acquaintance, and she tells you her brother was born in the year of the ox, which for present purposes means he's 11, 23, 35, 47, 59, 71, or 83 years old. This acquaintance is in her thirties, so your best guess would be that her brother is 35 (as opposed to 11, 23, etc.).]

a. maybe thirty-five
b. like thirty-five
c. ?about thirty-five
d. #approximately thirty-five
e. #thirty

To explain this difference between *about* and *approximately* in (102)-(103), I propose that *about* is modal, similar to *like* and *maybe*. I interpret the remaining contrast between *about* and *maybe*/*like*, however, as indication that *about* is also range-denoting, like *approximately*.

Below I present additional evidence for modal content in *about* based on the differential behavior of *approximately* and *about* with epistemic predicates and different patterns of intonation. I then support my decision to treat the epistemic component of *about* as semantic, not pragmatic.

Evidence from epistemic predicates

Support for treating *about* as having some modal component comes from its interaction with epistemic predicates. First consider Matushansky (2002)'s account of the verb *seem*. While both *approximately* and *about* are felicitous in the complement of propositional *seem*, shown in (104b) and (105b), only *about* is felicitous in the complement of non-propositional *seem*, shown in (104a) and (105a).

(104) a. John seems about six feet tall.
b. John seems to be about six feet tall.

(105) a. ?John seems approximately six feet tall.
b. John seems to be approximately six feet tall.

Matushansky argues that a non-propositional complement of *seem* must be a scalar or contain an overt degree operator (see also Morzycki 2011). This might suggest that *about*, but not *approximately*, is an appropriate degree operator, pointing toward a difference in their syntax such that *about*, but not *approximately*, would form a DegP complement and thus be licensed as the complement of non-propositional *seem*. It is not independently clear, however, why *about* but not *approximately* should pattern with overt degree modifiers.

Given the lack of independent evidence for the syntactic account above, I propose that this contrast between *about* and *approximately* stems from epistemics. Matushansky describes the non-propositional form of *seem* I am discussing as 'perceptual' (as opposed to propositional *seem*). This can be seen in the sentences below. To utter (106a), direct evidence is needed, whereas to utter (106b), the speaker must be making an epistemic deduction ("for example, one cannot enter a room,

look at Kleenexes and medicine bottles strewn all over the floor, and utter [(106a)]," (Matushansky 2002, p. 225)). Matushansky paraphrases (106a)-type sentences as *I perceive that P holds* and (106b)-type sentences as *from what I see I conclude that P holds*, given in (107).

(106) a. The squire seems sick. (Matushansky 2002, p. 225)
b. The squire seems to be sick.

(107) Matushansky paraphrases
a. Non-propositional: *I perceive that P holds*
b. Propositional: *from what I see I conclude that P holds*

There seems to be another nuance to (106a), though. It may be better paraphrased as *I believe, based on perception, that P holds*, such that it has a (non-deductive) epistemic component.

(108) Revised Matushansky paraphrases
a. Non-propositional: *I believe, based on perception, that P holds*
b. Propositional: *from what I see I conclude that P holds*

Note also the contrast between (106a) and (109), where (109) appears much stronger than (106a).

(109) The squire is sick.

Now the lower felicity of *approximately* in (105a) may be due to the uncertainty conveyed by non-propositional *seem* conflicting with the precision and certainty pragmatically associated with *approximately*. On the other hand, the uncertainty conveyed by non-propositional *seem* is consistent with the uncertainty associated with *about*.

In support of this, consider the use of *approximately* and *about* in the scope of the modal auxiliary *might* below, with the relevant paraphrases given in italics.

(110) a. John might be about six feet tall.
John is somewhere in the ballpark of six feet
b. John might be approximately six feet tall.
It is possible that John is approximately six feet tall

In (110a), *about* can give rise to something like a modal concord reading (*might* does not add any additional epistemic meaning), whereas in (110b) *approximately* cannot and instead seems to require some specialized context to be felicitous. A similar pattern is seen with *seem* (*seem* does not add any additional epistemic meaning), suggesting that both *seem* and *about* have some epistemic modal component that can act in concord, shown in (111) and (112).

(111) [The speaker is inspecting the construction of a model airplane]
a. That seems about right.
As far as I can tell, that seems right. or more literally
I believe, based on perception, that that is right.

b. That seems approximately right.
As far as I can tell, that's not quite right, but it's close. or more literally
I believe, based on perception, that that is approximately right.

(112) a. John seems about six feet tall.
As far as I can tell, John is six feet tall. or more literally
I believe, based on perception, that John is six feet tall.
b. John seems approximately six feet tall.
As far as I can tell, John is close to six feet. or more literally
I believe, based on perception, that John is approximately six feet tall.

Its behavior with discontinuous alternatives in (102) and (103), as well as its behavior in the complement of *seem*, point toward *about* having some modal component.

Evidence from intonation

Another context which may help us pinpoint the meaning of *about* is the comparison between (113) and (114). In both these contexts, rising intonation (indicated here by *?*) is used to mark speaker uncertainty (following Gunlogson 2008). In (113b), rising intonation and *maybe* give a modal concord reading, while *maybe* alone in (113c) appears uncooperative.[54] This uncooperativity results from *maybe*'s marking a lack of speaker commitment in conjunction with falling intonation's failure to elicit a source for the commitment the speaker has failed to make (for full analysis, see Zaroukian 2011b). This contrasts with (114), where (114c) remains cooperative without rising intonation.

(113) Amy: How many books did John bring?
Ben:
a. 10?
b. Maybe 10?
c. #Maybe 10.

(114) Amy: How many books did John bring?
Ben:
a. 10?
b. About 10?
c. About 10.

[54]Bear in mind that this uncooperativity is largely restricted to (fragment) answer contexts. In previous examples like *It's Susan's birthday today, and she's maybe thirty* are felicitous without rising intonation.

This pattern is predicted under a modal account of *about* where the speaker does not commit 10 but *does* commit to some range around 10, as suggested by the degradedness of *about* compared to *maybe*/*like* in (102) and (103), repeated below.

(115) a. It's Susan's birthday today, and she's maybe thirty.
b. #It's Susan's birthday today, and she's roughly/approximately thirty.
c. ?It's Susan's birthday today, and she's about thirty.

(116) [You're talking to an acquaintance, and she tells you her brother was born in the year of the ox, which for present purposes means he's 11, 23, 35, 47, 59, 71, or 83 years old. This acquaintance is in her thirties, so your best guess would be that her brother is 35 (as opposed to 11, 23, etc.).]
a. maybe thirty-five
b. like thirty-five
c. ?about thirty-five
d. #approximately thirty-five
e. #thirty

About with rising intonation gives rise to a concord-like reading in (114b), but *about* with falling intonation is not infelicitous since the speaker expresses commitment to a range around 10 (i.e. it is still a helpful discourse move). Notice that here *about* patterns more like *approximately* in (117), again supporting the idea that *about ten* also expresses commitment to a range around 10.

(117) Amy: How many books did John bring?
Ben:
a. 10?
b. Approximately 10?
c. Approximately 10.

Locus of modality

Here I would like to justify my decision for treating *about* as semantically modal, rather than simply being pragmatically associated with uncertainty. The semantics I propose for *about* are given in (118), with *approximately* repeated below.

(118) $[\![\textbf{about}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)\ \&\ \diamond D(n)$

(119) $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)$

In (118) and (119), *about* and *approximately* differ in that *about* expresses 'I don't know exactly, I do know approximately', whereas *approximately* expresses something more like 'I know approximately'.

I offer two arguments for treating *about*'s uncertainty component as semantic. First, I showed that *about* participates in modal concord, and modal concord has been treated as a semantic and/or syntactic, not pragmatic, phenomenon (Geurts and Nouwen 2007; Anand and Brasoveanu 2010; Huitink 2012; Zeijlstra 2008). Second, we can see in examples like (120) that this uncertainty component is not defeasible. In (120), the speaker is presumed to know her own age and can describe it as being within some range around 25 (i.e. (120a)), but cannot use expressions that indicate that she may be 25 ((120b) and (120c)). If uncertainty in *maybe* and *about* were defeasible, they should be felicitous in this context.

(120) [Speaker is 27 years old]

a. I'm approximately 25.
b. ?I'm about 25.
c. #I'm maybe 25.

These arguments are summarized in (121).

(121) Data consistent with semantic uncertainty:

- Allows modal concord – due to $\diamond D(n)$ ($\diamond\diamond D(n)$)
  - with *seem*, (112)
  - with *might*, (110)
  - with *?*, (102)
- The uncertainty is not defeasible, (120)

2.5.4 Summary

In the account I have developed, modals and non-modals approximate through different mechanisms, capturing approximative readings and the differing abilities to license discontinuous alternatives in (122).

(122) a. It's Susan's birthday today, and she's maybe/like thirty.
b. ?It's Susan's birthday today, and she's about thirty.
c. #It's Susan's birthday today, and she's approximately/roughly thirty.

Each of these modifiers approximates by using range information associated with *thirty* which I formalized through p_σ and p_x, but through different mechanisms. Modals like *maybe* and *like* license discontinuous alternative by quantifying over a modal base wherein alternatives can be ruled out. Non-modals like *approximately* quantify over continuous ranges and have no mechanism for ruling out alternatives within that range of quantification.

Pragmatic halos are similar to the present analysis in the way they determine the range of alternatives/approximation, but halos involve precision only. An additional dimension, modality, is required to capture the differences highlighted in (122), arguing for a heterogeneous approach to vagueness. The means of approximation discussed here are divided as shown in Table 3.

modal	*maybe*
	like
	about
non-modal	*approximately*
	exactly
	roughly
	pragmatic slack/halos/roundness

Table 3: Summary of modal split

A summary of the diagnostics used to arrive at this classification is given in below in Table 4. Here modals are divided between '−range' (e.g. *maybe*) and '+range' (e.g. *about*) and are compared with non-modals (e.g. *approximately*).[55] These diagnostics are exemplified in (122)–(125).

	+modal −range	+modal +range	−modal +range
contextual information accommodation, (122)	✓		
interactions with modals			
– felicitous with *seem*, (123)	✓	✓	
– concord with *might*, etc., (124)	✓	✓	
– concord with rising intonation, (125)	✓	✓	
– infelicitous answer w/o rising intonation, (125)	✓		

Table 4: Summary of behavior under diagnostics

(123) a. ??John seems six feet tall.
b. John seems maybe six feet tall.
c. John seems about six feet tall.
d. ??John seems approximately six feet tall.

(124) a. John might be about six feet tall.
John is somewhere in the ballpark of six feet
b. John might be about six feet tall.
It is possible that John is approximately six feet tall
c. John might be approximately six feet tall.
It is possible that John is approximately six feet tall

(125) Amy: How many books did John bring?

[55] I do not explore the −modal −range modifiers here, which are not of interest here.

Ben:

a. (i) 10?
   (ii) Maybe 10? ≈10?
   (iii) #Maybe 10.

b. (i) 10?
   (ii) About 10? ≈10?
   (iii) About 10.

c. (i) 10?
   (ii) Approximately 10? ≉10?
   (iii) Approximately 10.

2.6 Conclusion

By examining constructions like *maybe twenty* I have shown that information associated with numerals can be incorporated into a possible worlds semantics, which has the desirable result of accurately describing their approximating behavior as well as their divergence from constructions like *approximately twenty*, notably in contexts with discontinuous sets of alternatives like that in (126).

(126) a. It's Susan's birthday today, and she's maybe/like thirty.
   b. ?It's Susan's birthday today, and she's about thirty.
   c. #It's Susan's birthday today, and she's approximately/roughly thirty.

Under this analysis, scalars represent ranges, with closer values being more probable. In modal contexts (e.g. *maybe twenty*), this information is incorporated into the modal base and ordering source such that plausible alternatives are those scalarly close, resembling approximation. It can also be seen that, while this same information may be used in pragmatic halos, use of contextual information sets these types of approximation apart and suggests that certain hedges contain modal components. The approximators with a modal component can then accommodate contextual information, while non-modal approximators cannot, and I showed that this allowed us to reclassify *like* and *about* as modal. This partition is repeated in 5, building up to the table presented in the introduction on page 13.

modal	*maybe*
	like
	about
non-modal	*approximately*
	exactly
	roughly
	pragmatic slack/halos/roundness

Table 5: Summary of modal split

This analysis supports a heterogeneous view of vagueness beyond the split between inherent vs. contextual vagueness, one that systemically distinguishes readings generated from modal and non-modal modifiers.

This analysis has an interesting cross-linguistic application in Approximative Inversion, a phenomenon in East Slavic languages like Russian whereby a noun and a numeral can reverse order to yield an approximative interpretation.

(127) a. Ivan pročital dvadcat' knig.
Ivan read twenty books
'Ivan read twenty books.'

b. Ivan pročital knig dvadcat'.
Ivan read books twenty
'Ivan read approximately twenty books.'

While my interest in Approximative Inversion here is semantic, see Zaroukian (2012) for a novel syntactic analysis which incorporates modality to derive approximation.

Despite typically being translated as 'approximately' (Yadroff and Billings 1998; Pereltsvaig 2006, a.o.), Approximative Inversion marks speaker uncertainty and functions much like the uncertain numerals discussed above. Notably, it is felicitous with discontinuous alternatives, like *maybe* is in (126).

(128) Birthday example: (Pereltsvaig 2006, p. 284)
[Masha is going to a colleague's birthday party and is asked how old that colleague is. Since she doesn't know him very well, she is guessing his age from his looks, etc. ...]

a. let tridcat'
years thirty

b. #priblizitel'no tridcat' (let)
approximately thirty years

c. #30-35 let
30-35 years
'approximately thirty years'

Here, approximative inversion is felicitous, shown in (128a), but *priblizitel'no* 'approximately' or providing an interval are not. Unlike English uncertain numerals, however, Approximative Inversion does not seem to allow a labeling reading. Its infelicity in examples like (129), then, is due to the inability of 35 to provide a large enough σ for the set of alternatives to contain any value but 35 itself, violating non-vacuity of alternatives.

(129) Zodiac example:
[You're talking to an acquaintance, and she tells you her brother was born in the year of the ox, which for present purposes means he's 11, 23, 35, 47, 59, 71, or 83 years old. This acquaintance is in her thirties, so your best guess would be that her brother is 35 (as opposed to 11, 23, etc.).]

a. #let tridcat’ pjat’
years thirty five
‘approximately thirty-five years’

While this ostensible inability to bear a label reading is somewhat mysterious, it roughly parallels the behavior of English *about*, as will be shown in Chapter 4. Overall, the patterns seen in Approximative Inversion provide striking support for this analysis of English uncertain numerals.

3 Uncertainty, prosody, and their interaction

3.1 Introduction

In Chapter 2, we saw intonation used as evidence for modal content in *about* (Section 2.5.3). In this chapter, I supply the analysis that allows us to account for such patterns, wherein I treat rising intonation as a quantifier over possible worlds which can participate in modal concord with modals like *about* and *maybe*. In developing this analysis, I focus on rising intonation in declarative responses[56] to questions.

When responding to a question, a speaker can use rising intonation to indicate uncertainty, as demonstrated in (1a). The speaker can also include an epistemic possibility adverb like *maybe* in (1b). Surprisingly, though, an epistemic possibility adverb alone appears curt and uncooperative (indicated with #), shown in (1c)[57].

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue? ≈(1a)
c. #Maybe blue.

Also surprising is the near-equivalence in meaning between (1a) and (1b); despite (1b) containing twice the uncertainty markers as (1a), they both express that the speaker is not certain that blue is John's favorite color.

Note that other epistemic adverbs like *probably* do not show this near-equivalence.

(2) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Probably blue? ≉(2a)
c. Probably blue.

Similar to (1a)-(1b), (2a) seems to indicate speaker uncertainty with respect to the truth of the proposition that John's favorite color is blue. (2b), on the other hand, seems to indicate that the speaker thinks John's favorite color is most likely blue, and the speaker expresses this with rising

[56] Throughout I use the word "response" for an utterance that is intended to address the Question Under Discussion. This is more liberal than a complete/partial "answer" in the sense of Groenendijk and Stokhof (1984b).

[57] These responses can be improved with inferential continuations such as ... *I feel like he always wears blue shirts, so it would make sense for blue to be his favorite color.* I am assuming there is no such continuation in these examples.

intonation because he is uncertain that he has understood the question properly (e.g. believes Amy already knows John's favorite color and does not understand why she would ask him).

When using non-fragment responses, the pattern again changes. Observe that the full-sentence response (3a) is not equivalent to its adverb-containing counterparts in (3b) or (3c). Instead, similar to (2b), (3b) favors a trick-question reading. And, similar to (1c), (3c) appears uncooperative.

(3) Amy: What is John's favorite color?
Ben:

a. It's blue?
b. Maybe it's blue? $\not\approx$(3a)
c. #Maybe it's blue.

In this chapter I provide explanations for these patterns, drawing from Gunlogson (2003, 2008) on rising intonation and Anand and Brasoveanu (2010) on modal concord. Gunlogson analyses rising intonation as marking a speaker's commitment to their utterance as contingent (see Section 3.2.1). Following Gunlogson's analysis, we expect the following paraphrases for the responses in (1):

(4) Predicted interpretations

(1a) Blue?
'It's blue, but don't believe me that it's blue unless someone can verify.'

(1b) Maybe blue?
'It's possible that it's blue, but don't believe me that it's possible that it's blue unless someone can verify.'

(1c) Maybe blue.
'It's possible that it's blue.'

In actuality, as described above, (1b) means approximately the same as (1a), and (1c) is relatively infelicitous. I propose that the similarity between (1a) and (1b) is a result of concord between the two uncertainty markers in (1b). Because of the mechanics of concord I adopt, rising intonation can only participate in concord with adverbs that match it in strength, which includes *maybe*, but not stronger adverbs like *probably*, preventing (2b) from giving a concord reading equivalent to (2a).

Infelicity of responses like (1c) is, I propose, a matter of cooperativity. Rising intonation, per Gunlogson's analysis, invites another discourse agent to confirm the proposition uttered with rising intonation. By using *maybe* with falling intonation, the speaker is making only a weak commitment and is not providing an opening for any other agent to help answer the question.

The difference between fragment and full-declarative responses is suggested to belie the fact that these fragments are declaratives. The ostensible lack of concord in (3b) is due to biases in interpreting the locus of uncertainty, and when these are compensated for, a concord reading results.

Section 3.2 provides an overview of Gunlogson (2008) on rising intonation. Section 3.3 provides an analysis of (1) and (2) by expanding on Gunlogson and treating rising intonation as an

epistemic possibility marker that participates in modal concord with epistemic possibility adverbs. Section 3.4 addresses the data in (3) by exploring two cases in which concord between *maybe* and rising intonation does not appear to be available, followed by a discussion of whether fragments responses as in (1)-(2) can be assumed to be underlyingly declarative. Section 3.5 concludes.

3.2 Rising intonation

3.2.1 Gunlogson on rising declaratives

Gunlogson (2003, 2008) discusses the use of declaratives as questions, as in (5b). While a typical question looks like (5a) and utilizes rising intonation along with interrogative syntax, sentences like (5b) can function as questions as well, using rising intonation with declarative syntax (cf. (5c))(Gunlogson 2003, p. 8).

(5) a. Is it raining? (rising polar interrogative)
b. It's raining? (rising declarative)
c. It's raining. (falling declarative)

Gunlogson demonstrates that though both polar interrogatives and rising declaratives can function as questions, rising declaratives have a more restricted distribution. In particular, they are infelicitous in out-of-the-blue contexts like (6) (Gunlogson 2008, p. 104).

(6) [Robin is sitting in a windowless computer room with no information about current weather conditions when another person enters from outdoors.] Robin to newcomer:
a. Is it raining?
b. #It's raining?
c. #It's raining.

With the proper contextual support, however, a rising declarative is licensed, as demonstrated in (7) (Gunlogson 2008, p. 104).

(7) [Robin is sitting, as before, in a windowless computer room when another person enters. The newcomer is wearing a wet raincoat and boots.] Robin to the newcomer:
a. Is it raining?
b. It's raining?
c. (I see that/So/Oh) It's raining.

Gunlogson's analysis in a nutshell is that a declarative introduces a commitment, and rising intonation on a declarative marks that commitment as contingent. If the commitment is contingent on ratification by the addressee, the utterance is interpreted as a question. As such, rising declarative questions require a context that supports the speaker as having adequate evidence to make a (contingent) commitment ('Speaker Evidence') and the addressee as being more authoritative that

the speaker so than the addressee may ratify the speaker's contingent commitment ('Addressee Authority') (Gunlogson 2008, p. 114).

(8) a. **'Speaker Evidence':** the speaker is perceived as having adequate evidence to commitment to p

b. **'Addressee Authority':** the addressee is perceived as being more authoritative than the speaker so that the addressee may ratify the speaker's contingent commitment

Gunlogson formalizes this through a framework similar to Hamblin (1971), where a discourse context C contains, for each discourse participant, their discourse commitments (within their commitment set, or *cs*) and the commitments for which they are a source (their source set, or *ss*).

(9) $C_d = \langle \sigma_\alpha, \sigma_\beta, ... \rangle$, where each σ_χ is a triple $\langle cs, ss, \chi \rangle$, with χ as agent in d, and:

a. $cs = \{w \in W$: all discourse commitments of agent χ in discourse d are true in $w\}$

b. $ss = \{w \in W$: all commitments of agent χ in discourse d for which agent χ is a source are true in $w\}$

Declaratives express speaker commitment, where if agent α declares p, p will be 'added' to α's *cs* and *ss*, where 'adding' p to a *cs* or *ss* means eliminating all worlds not compatible with p within the *cs* or *ss* (i.e. $cs' = cs \cap p, ss' = ss \cap p$).

Rising intonation on a declarative marks the speaker's commitment to the content of that declarative as contingent on some discourse condition obtaining, as defined in (10).

(10) A discourse move μ by an agent α is *contingent* upon a discourse condition δ if:

a. δ does not obtain at the time of μ

b. It is inferable in the discourse context that the update effected by μ is to be retained only if δ obtains after the discourse move immediately succeeding μ

If the discourse condition it is contingent on is ratified by the addressee, as defined in (11) (with β as the addressee), it is interpreted as a question, as defined in (12).

(11) A discourse move μ committing an agent α to ϕ is *contingent* upon ratification by an agent β, $\alpha \neq \beta$, if:

a. β is implicitly authoritative with respect to ϕ at the time of μ

b. It is inferable in the discourse context that α's commitment to ϕ will be withdrawn unless the discourse move immediately succeeding μ has the effect of committing β to ϕ as a source

(12) An utterance of a declarative with content ϕ is *questioning* to the extent that the speaker's commitment is understood as contingent on the addressee's ratification of ϕ.

The contrast between (6b) (*It's raining?* without evidence) and (7b) (*It's raining?* with evidence) is due primarily to the speaker's ability to act as a source for the expressed proposition. In

both cases, the addressee has just come in from outside and is thus more authoritative with respect to the weather than the speaker is, so the rising declarative can be felicitously contingent on ratification by the addressee (i.e. interpreted as a question). And in (7b), the speaker has some weaker evidence (from the addressee's appearance) that it is raining. In (6b), however, the speaker has no such evidence and cannot felicitously commit to rain (even contingently). This is summarized in terms of Speaker Evidence and Addressee Authority below.

(13)
#(6b)	−Speaker Evidence, +Addressee Authority
(7b)	+Speaker Evidence, +Addressee Authority

In the following section, we will examine the success of this framework on explaining examples like (1).[58]

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue? ≈(1a)
c. #Maybe blue.

3.2.2 Rising declarative responses

Moving beyond rising declarative questions, this section focuses on rising intonation in responses, as in (1). Following Gunlogson (2008), rising intonation marks an utterance as contingent, so in a rising declarative like (1a) the speaker's commitment to the proposition that blue is John's favorite color is contingent on some discourse condition. In order for this to be interpreted as a question, the addressee must be a potential source for that commitment (Addressee Authority). However, in asking the question, the addressee implied ignorance, making him an implausible source. Therefore, a rising declarative like (1a) does not receive a question interpretation. It simply conveys a lack of speaker commitment without being contingent on ratification by the addressee. If someone can corroborate the response, it can be added to the discourse, but corroboration is not necessarily expected.

The responses in (1), however, do not have the interpretations that would be expected in Gunlogson's framework. These expected interpretations are given in (14), repeated from (4).

(14) Predicted interpretations
(1a) Blue?
'It's blue, but don't believe me that it's blue unless someone can verify.'

[58] While I assume that such examples are underlyingly declarative, I explore alternatives in 3.4.

(1b) Maybe blue?
'It's possible that it's blue, but don't believe me that it's possible that it's blue unless someone can verify.'

(1c) Maybe blue.
'It's possible that it's blue.'

(1a) should express that blue is John's favorite color, but only contingently, due to the rising intonation. (1b) should make the rather weak claim that blue might be John's favorite color, but only contingently, due to the rising intonation. (1c) should express that it is possible that John's favorite color is blue, non-contingently.

In reality, however, (1a) and (1b) seem equivalent in meaning, and (1c) seems infelicitous.

(15) Actual interpretations

(1a) ≈ (1b) ≈ *It's blue, but don't believe me that it's blue unless someone can verify.*
(1c) = #

I propose that the solution to the equivalence between (1a) and (1b) is a consequence of modal concord, and the infelicity of (1c) is due to the uncooperative use of *maybe* without rising intonation. These solutions will both be explored in the following section, in which I provide a novel concord analysis where a modal adverb in combination with rising intonation gives rise to modal concord. This will draw on Gunlogson (2003, 2008), but will provide motivation for a revised analysis of rising intonation as quantifying over the speaker's *cs*.

3.3 Concord in rising declarative responses

This section begins with an overview of modal concord, which is then applied to the data in (1) to explain the equivalence between (1a) and (1b). Finally, we address (1c), whose infelicity is unrelated to modal concord but stems from the uncooperativity of underinformative statements uttered with falling intonation.

3.3.1 The phenomenon of modal concord

Modal concord occurs when multiple modal items give rise to the reading of just a single modal item, as in (16).

(16) a. John might possibly be home by curfew.
(i) 'It's possible that it's possible that John is home by curfew.' (no concord)
(ii) 'It's possible that John is home by curfew.' (concord)

b. John must mandatorily be home by curfew.
(i) 'It's mandatory that it's mandatory that John is home by curfew.' (no concord)
(ii) 'It's mandatory that John it home by curfew.' (concord)

Here, the modal elements can unite in meaning as in the paraphrases in (ii). Such concord can occur when a modal auxiliary (e.g. *might*, *must*) and a modal adverb (e.g. *possibly*, *mandatorily*) have the same (or similar) flavor (i.e. modal base) and quantificational force. In (16a), we can note that the auxiliary and adverb share epistemic flavor and existential force, and in (16b) they share deontic flavor and universal force. A concord reading is not available if there is a mismatch between force (17b) or flavor[59] (17c). (In what follows, E = epistemic, D = deontic; $\exists$ = existential, $\forall$ = universal.)

(17) a. John perhaps$_{E,\exists}$ might$_{E,\exists}$ be home. (concord)
b. John perhaps$_{E,\exists}$ must$_{E,\forall}$ be home. (no concord)
c. John legitimately$_{D,\exists}$ might$_{E,\exists}$ be home. (no concord)

3.3.2 An analysis of modal concord

For an analysis of modal concord, I draw on Anand and Brasoveanu (2010), who suggest that modal concord occurs when a modal adverb takes a modal argument and causes both to share the same modal base. They provide denotations for modal auxiliaries and adverbs as in (18). (In what follows f is the modal base. The ordering source is omitted for clarity. I use overbraces to highlight quantificational force.)

(18) a. Modal aux: (Anand and Brasoveanu 2010, pp. 23-24)

(i) $[\![\textbf{must}]\!] = \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} . \overbrace{\bigcap f(w)}^{\forall} \subseteq p$

(ii) $[\![\textbf{may}]\!] = \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} . \overbrace{\bigcap f(w)}^{\exists} \cap p \neq \emptyset$

b. Modal adverb: (Anand and Brasoveanu 2010, p. 24)

(i) $[\![\textbf{obligatorily}]\!] = \lambda M_{\langle s\langle s\langle\langle st\rangle t\rangle\rangle\langle\langle st\rangle t\rangle\rangle} \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} : f$ is deontic .

$M(w)(f)(p) \wedge \overbrace{\bigcap f(w)}^{\forall} \subseteq p$

(ii) $[\![\textbf{legitimately}]\!] = \lambda M_{\langle s\langle s\langle\langle st\rangle t\rangle\rangle\langle\langle st\rangle t\rangle\rangle} \lambda w \lambda f_{\langle s\langle\langle st\rangle t\rangle\rangle} \lambda p_{\langle st\rangle} : f$ is deontic .

$M(w)(f)(p) \wedge \overbrace{\bigcap f(w)}^{\exists} \cap p \neq \emptyset$

---

[59] Flavor mismatch is allowed with an epistemic adverb, according to Anand and Brasoveanu (2010).

(i) a. John must$_{E,\forall}$ obligatorily$_{D,\forall}$ be home. (no concord)
b. John definitely$_{E,\forall}$ must$_{D,\forall}$ be home. (concord)

(ii) a. John might$_{E,\exists}$ allowably$_{D,\exists}$ be home. (no concord)
b. John possibly$_{E,\exists}$ must$_{D,\exists}$ be home. (concord)

It is through presupposition that the modal adverb ensures that the adverb and auxiliary share the same modal flavor (e.g. *obligatorily* only composes with deontic auxiliaries). An example derivation for the combination of the deontic auxiliary *must* and the deontic adverb *obligatorily* is given in (19).

(19) must$_{D,\forall}$ obligatorily$_{D,\forall}$ (concord)

a. $\underbrace{[\lambda M \lambda w \lambda f \lambda p : f \text{ is deontic } . M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}]}_{\textit{obligatorily}} \underbrace{(\lambda w \lambda f \lambda p . \overbrace{\bigcap f(w) \subseteq p}^{\forall})}_{\textit{must}}$

b. $\underbrace{\lambda w \lambda f \lambda p : f \text{ is deontic } . \underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{\textit{must}} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{\textit{obligatorily must}}$

Anand and Brasoveanu (2010) claim that agreement in force is required as a result of a non-cancellable $\neg\forall$ implicature generated from $\exists$-force modals.[60] Thus, if a $\exists$-force modal occurs with a $\forall$-force modal, there will be a clash between the latter and the $\neg\forall$-implicature of the former. This is demonstrated in (20) and (21), where the auxiliary and adverb are mismatched in force (for clarity, (b) shows the conflicting implicature in gray).[61]

(20) must$_{D,\forall}$ legitimately$_{D,\exists}$ (no concord)

a. literally: $\underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{\textit{must}} \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$ (*legitimately*)

b. w/ implicature: $\underbrace{\overbrace{\bigcap f(w) \subseteq p}^{\forall}}_{\textit{must}} \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg[\bigcap f(w) \subseteq p]}^{\neg\forall}$ (*legitimately must*)

(21) may$_{D,\exists}$ obligatorily$_{D,\forall}$ (no concord)

---

[60] Anand and Brasoveanu (2010) only discuss this implicature within modal adverbs, but presumably it applies to modal auxiliaries as well, (21).

[61] Anand and Brasoveanu (2010) argue that cancellation in these contexts is not available for a simple assertion (e.g. (i), where a generic operator cannot cancel not-all implicature of *most*), but can be accomplished during a subsequent discourse update (e.g. (ii)).

(i) *Most dolphins are dolphins. (Anand and Brasoveanu 2010, p. 25)

(ii) We can legitimately deny your request. In fact, we have to. (Anand and Brasoveanu 2010, p. 25)

a. literally: $\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$

may

obligatorily

b. w/ implicature: $\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg[\bigcap f(w) \subseteq p]}^{\neg\forall} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}$

may

obligatorily may

3.3.3 A modal-concord analysis for rising intonation

Returning to rising declarative responses, we want to determine why (1a) and (1b) are equivalent.

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue?
c. #Maybe blue.

To do so, I propose a revised analysis of rising intonation which treats it as a possibility operator, and I introduce an Epistemic Commitment Principle in (24) which relates rising intonation to other epistemic possibility operators. This will then allow a modal-concord reading of (1b).

I assume that *maybe* involves existential quantification over epistemically accessible worlds, as shown in (22).

(22) $[\![\textbf{maybe}]\!] = \lambda M \lambda w \lambda f \lambda p : f \text{ is epistemic } .M(w)(f)(p) \wedge \overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists}$

Gunlogson characterizes rising intonation as marking an utterance as contingent, and I will further formalize this as existential quantification over worlds epistemically accessible from the speaker's *cs*.

(23) $[\![\textbf{?}]\!] = \lambda w \lambda f \lambda p . \overbrace{\bigcap f(w) \cap \{w' | p \subseteq cs \text{ in } w'\} \neq \emptyset}^{\exists}$

Note that here I have relativized the *cs* to possible worlds. Rising intonation now, instead of merely marking a commitment as contingent, also expresses that the set of words where p is consistent with the speaker's *cs* (here, intersected with the set of epistemically-accessible worlds) is non-empty. This is similar to the *reduction set*, or set of contexts accessible from some given context

(Gunlogson 2001).[62]

Using rising intonation as the argument of *maybe*, composition progresses as follows:

⟦**maybe ?**⟧

$$= \llbracket \textbf{maybe} \rrbracket (\llbracket \textbf{?} \rrbracket) \quad \text{(i)}$$

$$= \underbrace{\left[\lambda M \lambda w \lambda f \lambda p.\, f \text{ is epist.} M(w)(f)(p) \wedge \bigcap f(w) \cap p \neq \emptyset\right]}_{\textit{maybe}} \underbrace{\left(\lambda w \lambda f \lambda p. \bigcap f(w) \cap \{w' | p \subseteq cs_s \text{ in } w'\} \neq \emptyset\right)}_{?} \quad \text{(ii)}$$

$$= \underbrace{\lambda w \lambda f \lambda p : f \text{ is epist.} \overbrace{\underbrace{\bigcap f(w) \cap \{w' | p \subseteq cs_s \text{ in } w'\} \neq \emptyset}_{1}}^{\exists_{cs}} \wedge \overbrace{\underbrace{\bigcap f(w) \cap p \neq \emptyset}_{2}}^{\exists}}_{\textit{maybe ?}} \quad \text{(iii)}$$

If *maybe+?* (read: *maybe* with rising intonation) allows modal concord, we expect concord between the underlined items 1 and 2 above, which match in (epistemic) flavor and (existential) force. These two items, however, quantify over different sets: item 2 quantifies over epistemically accessible worlds where p is true, while item 1 quantifies over epistemically accessible worlds where p is in the speaker's *cs*. However, if someone is possibly committed to p, we can assume that they consider p epistemically possible, which I codify in the Epistemic Commitment Principle.[63]

(24) **Epistemic Commitment Principle:** $\diamond_{cs} p \models \diamond_{epist} p$

If an agent is possibly(/contingently) committed to p, it can be assumed that that agent believes p is possible.

This reduces to treating a speaker's *cs* as their epistemic modal base. (It assumes the $cs \subseteq \bigcap f(w)$, i.e. *cs* is stricter)

Following the Epistemic Commitment Principle, the contribution of *maybe* is entailed by *?*, and we can see why (1a) and (1b) are equivalent: ⟦**maybe ?**⟧ evaluates to ⟦**?**⟧.

$$= \left[\lambda w \lambda f \lambda p : f \text{ is epist.} \bigcap f(w) \cap \{w' | p \subseteq cs_s \text{ in } w'\} \neq \emptyset\right] \quad \text{(iv)}$$

$$= \llbracket \textbf{?} \rrbracket \quad \text{(v)}$$

---

[62] The reductions set of C is defined as $\mathfrak{R}$ = {<C,C'> such that <C,C'>$\in$ R}. R is defined below, where $\wp$ is the powerset operator.

(i) Let R be an accessibility relation between contexts C, C' such that <C,C'>$\in$ R iff $cs_A(C') \in \wp(cs_A(C))$ and $cs_B(C') \in \wp(cs_B(C))$ and C' is not empty (Gunlogson 2001, p. 48)

[63] This resembles the epistemic step, by which a speaker can infer *Ben thinks it isn't red* from *Ben doesn't think it's red*. Sauerland (2004) formalizes this as $\neg K\phi \rightarrow K\neg\phi$, where ϕ is a proposition and K is Gazdar (1979)'s epistemic certainty operator. The Epistemic Step (i.e. $\diamond K\phi \rightarrow K \diamond \phi$) allows us to infer *Ben is committed to it possibly being blue* from *Ben is possibly committed to it being blue.*

So, by treating rising intonation as quantifying over the speaker's *cs*, as in (23), and by assuming the Epistemic Commitment Principle, we can account for the concord reading in (1b).

Note that this Epistemic Commitment Principle applies in other cases of possible commitment. It is not restricted to modal-concord contexts and can be inferred from utterances like *Blue?* in (1a). This is demonstrated in (25), where a continuation contradicting this assumption has a contradictory feel, and a continuation reiterating the assumption has a redundant feel.

(25) a. #Blue? By the way, I don't think it could be blue. (contradictory)
b. #Blue? By the way, I think it could be blue. (redundant)

The same pattern can be seen in other cases of entailment, as demonstrated in (26).

(26) a. #John has a laptop. By the way, I don't think John has a computer. (contradictory)
b. #John has a laptop. By the way, I think John has a computer. (redundant)

Additionally, the Epistemic Commitment Principle can also be seen in Gunlogson's examples of rising declarative questions like *It's raining?* (5b).

(27) a. #It's raining? By the way, I don't think it could be raining. (contradictory)
b. #It's raining? By the way, I do think it could be raining. (redundant)

3.3.4 Rising intonation with other modal adverbs

Below I demonstrate that the analysis above makes correct predictions about the interpretation of rising intonation in combination with other modal adverbs. First, observe that the analysis predicts concord readings with all epistemic possibility adverbs, not just *maybe*, since they are all subject to the Epistemic Commitment Principle. And, as demonstrated in (28), this prediction is met.

(28) Amy: What is John's favorite color?
Ben:
a. Maybe blue? (≈ Blue?)
b. Possibly blue? (≈ Blue?)
c. Perhaps blue? (≈ Blue?)

On the other hand, universally-quantifying adverbs like *definitely* are predicted to not lead to modal concord, since an appropriate entailment relation is lacking.[64]

[64] Or, similarly, according to Anand and Brasoveanu, *definitely*, *absolutely*, etc. are flavor- and force-neutral and act to strengthen the force of the auxiliary.

(29) *definitely+?*

$\diamond_{cs} p \not\models \Box_{epist} p$

Or, if we treat a speaker's *cs* as their epistemic modal base, the lack of concord would be due to a conflict between the universal force of *definitely* and the non-universal implicature of *?*.

(30) $[\![\textbf{Definitely } p\textbf{?}]\!] = \overbrace{\underbrace{\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg[\bigcap f(w) \subseteq p]}^{\neg\forall}}_{?} \wedge \overbrace{\bigcap f(w) \subseteq p}^{\forall}}^{definitely\ ?}$

This prediction holds for other universally-quantifying adverbs like *undoubtedly* and *certainly*. And, as predicted, the concord reading is not attested.

(31) a. Definitely blue? ($\not\approx$ Blue?)
b. Undoubtedly blue? ($\not\approx$ Blue?)
c. Certainly blue? ($\not\approx$ Blue?)

Likewise, the adverb *probably* is predicted to not lead to modal concord, again due to its quantificational force (which here I call MOST, somewhere near universal force) being too strong for the appropriate entailment relation to hold.

(32) *probably+?*

$\diamond_{cs} p \not\models \text{MOST}_{epist} p$

Or, if we treat a speaker's *cs* as their epistemic modal base, the lack of concord would be due to a conflict between the near-universal force of *definitely* and a non-*most* implicature of *?* (*m* is some threshold).

(33) $[\![\textbf{Probably } p\textbf{?}]\!] = \overbrace{\underbrace{\overbrace{\bigcap f(w) \cap p \neq \emptyset}^{\exists} \wedge \overbrace{\neg\left[\frac{|\bigcap f(w) \cap p|}{|\bigcap f(w)|} > m\right]}^{\neg\text{MOST}}}_{?} \wedge \overbrace{\frac{|\bigcap f(w) \cap p|}{|\bigcap f(w)|} > m}^{\text{MOST}}}^{probably\ ?}$

This prediction holds for other near-universally-quantifying adverbs like *likely*. And again, as predicted, the concord reading is not attested.

(34) a. Probably blue? ($\not\approx$ Blue?)
b. Likely blue? ($\not\approx$ Blue?)

Instead, with (near-)universally-quantifying adverbs, rising intonation seems to convey *is this the kind of answer you're looking for?*[65], not the speaker's level of certainty about blue being John's favorite color. So, with other epistemic modal adverbs, this analysis makes the correct predictions.[66]

3.3.5 Cooperativity and (1c)

We have seen that the near equivalence between (1a) and (1b) can be accounted for through modal concord. The final step in accounting for the data in (1) is to address the infelicity of (1c).

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue? ≈(1a)
c. #Maybe blue.

In this response Ben is neither answering the question under discussion nor opening the door for anyone else to do so. In other words, Ben's *cs* contains the proposition that John's favorite color might be blue, but Ben does not provide an opening for anyone to step in as a source for this actually being John's favorite color. And this uncooperativity seems to be exactly the kind of infelicity this utterance suffers from.[67]

---

[65] This reading will be discussed below and referred to as QUD-uncertainty.

[66] A potential objection to the discussion above is that it presupposes that epistemic modal concord even exists. Geurts and Huitink (2006) and Huitink (2012) argue that no special machinery is needed to derive concord readings from epistemic modals, since the entailment relations in (i) are considered to hold in the epistemic domain (though not in other domains, e.g. deontic).

(i) a. $\Diamond\Diamond\phi \rightarrow \Diamond\phi$
'If it is possible that it is possible that ϕ, then it is possible that ϕ'
b. $\Box\Box\phi \rightarrow \Box\phi$
'If it is necessary that it is necessary that ϕ, then it is necessary that ϕ'

Since cases of epistemic concord can be derived through logical means without any special concord machinery, and since there does not seem to be e.g. deontic intonation to check whether this phenomenon is more general, these cases may not be relevant for arguing for/against any particular theory of modal concord (for other analyses see Geurts and Nouwen (2007); Zeijlstra (2008); Huitink (2012)). Accordingly, such arguing is absent in this paper. Bear in mind, however, that not requiring special concord machinery does not make these modal concord readings any less real.

[67] Note that similar responses in the form of exclamatives are felicitous, as in (i).

(i) Amy: What is John's favorite color?
Ben: Hey, maybe it's blue! That would be great, because I have a blue shift I could give him!

One reason for the felicity is that they carry emotive content (Gutiérrez-Rexach 1996, a.o). So, while Ben is neither answering the question in (i) nor providing an opening for anyone else to, he is expressing what he would like the answer to be.

3.3.6 Summary

In this section we accounted for the pattern in (1) using modal concord and drawing on Gunlogson (2008)'s analysis of rising intonation. We amended the analysis by treating rising intonation as existential quantification over speaker's *cs*, and we introduced the Epistemic Commitment Principle to show how, though they do not quantify over the same set, *maybe* is redundant under rising intonation. This also allowed us to explain the behavior of other adverbs with rising intonation: adverbs like *probably* in (2) have a quantificational force that is too strong to allow them to participate in modal concord with (existential) rising intonation. In the next section we will look more closely at predictions generated by this proposal and address the data in (3).

(3) Amy: What is John's favorite color?
Ben:
a. It's blue?
b. Maybe it's blue? $\not\approx$(3a)
c. #Maybe it's blue.

3.4 Concord in a range of rising configurations

Our analysis has assumed that fragment responses, like those in (1), were declarative.

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue? $\approx$(1a)
c. #Maybe blue.

These responses, however, can be ambiguous between declarative and interrogative fragments, as shown by the paraphrases in (35).

(35) Amy: What is John's favorite color?
Ben:
a. Blue?
= It's blue?
= Is it blue?
b. Maybe blue?
= It's maybe blue?
= Is it maybe blue?

Furthermore, recall that in Section 3.1 we introduced full declaratives (3), repeated below, and we noted that (3a) and (3b) do not seem equivalent. This contrasts with the equivalence of their fragment counterparts in (1a) and (1b).

(3) Amy: What is John's favorite color?
Ben:
a. It's blue?
b. Maybe it's blue? $\not\approx$(3a)
c. #Maybe it's blue.

The lack of equivalence between (3a) and (3b) might suggest that rising intonation in full declaratives does not participate in modal concord, an exception unexplained in the current analysis. Additionally, if the fragments in (1) are underlyingly declarative, it is unexpected that they should pattern differently from the full declaratives in (3), casting doubt on the assumption that these fragments are declarative.

In this section, we will examine rising intonation in a variety of configurations, some of which will show an ostensible lack of concord reading between rising intonation and *maybe*, as in (3b). This will be shown to be an artifact of 1) mismatched uncertainty readings, or 2) infelicitous pragmatic weakening. We will conclude by returning to the question of whether these fragments are declarative or interrogative.

3.4.1 Different uncertainty readings

At first blush, the lack of equivalence between (3a) and (3b) could be interpreted as indicating a lack of concord in (3b). I argue below that (3b) allows a concord reading, and that its lack of equivalence with (3a) is due instead to (3a) and (3b) each favoring a different uncertainly reading.

To see the two different uncertainty readings mentioned above, observe that the fragment response in (36a) and full-sentence declarative response in (36c) do not seem equivalent. (36a) does, however, seem equivalent to the full-sentence interrogative response in (36c).

(36) Amy: What is John's favorite color?
Ben:
a. Blue? (p)
b. It's blue? $\not\approx$(36a) (QUD)
c. Is it blue? $\approx$(36a) (p)

The difference, I propose, is that the rising intonation in (36a) and (36c) favors what I term an 'uncertain-p' reading, where the speaker's uncertainty is with respect to the truth of the proposition expressed (here, the speaker is not certain that blue is John's favorite color). On the other hand, the rising intonation in (36b) favors what I term an 'uncertain-QUD' reading, where the speaker's uncertainty is with respect to the identity of the question under discussion, or *QUD* (here, Ben is not sure that Amy is asking what John's favorite color, perhaps because Ben believes that Amy already knows John's favorite color).

(37) a. **Uncertain-p reading:** Reading where a speaker's uncertainty is with respect to the truth of the expressed proposition

b. **Uncertain-QUD reading:** Reading where a speaker's uncertainty is with respect to the identity of the question under discussion

Where relevant, I notate rising intonation's preferred uncertainty reading to the right of each example.

Observe that when *maybe* is present, fragment, full-declarative, and full-interrogative responses seem comparable, all preferring an uncertain-*p* reading.

(38) Amy: What is John's favorite color?
Ben:

a. Maybe blue? (*p*)
b. It's maybe blue? ≈(38a) (*p*)
c. Is it maybe blue? ≈(38a) (*p*)

On the other hand, when *probably* is present, an uncertain-QUD reading is biased, though not for full-sentence interrogatives.

(39) Amy: What is John's favorite color?
Ben:

a. Probably blue? (QUD)
b. It's probably blue? ≈(39a) (QUD)
c. Is it probably blue? ≉(39a) (*p*)

These readings are summarized in Table 6.

modifier	sentence form	favored interpretation
–	fragment	uncertain-*p*
–	full declarative	uncertain-QUD
–	full interrogative	uncertain-*p*
maybe	fragment	uncertain-*p*
maybe	full declarative	uncertain-*p*
maybe	full interrogative	uncertain-*p*
probably	fragment	uncertain-QUD
probably	full declarative	uncertain-QUD
probably	full interrogative	uncertain-*p*

Table 6: Attested readings from (36)-(39)

So, while it appears that rising intonation can have either uncertainty reading, interrogative structure seems to force an uncertain-*p* reading, as do weak epistemic adverbs (e.g. *maybe*), while strong epistemic adverbs (e.g. *probably*) force an uncertain-QUD reading. In this way, fragments and full-declarative responses pattern alike in their interactions with epistemic adverbs, unlike full interrogatives.

In support of this, notice that when fragment *Blue?* and full-declarative *It's blue?* occur in a

context that strongly biases a particular reading, they appear equivalent. We see this first in (40), where the context establishes that Ben does not know John's favorite color, biasing an uncertain-*p* reading of the rising intonation.

(40) [Uncertain-*p* context: As part of a party game, Ben is answering trivia questions about John. He doesn't know John very well but is trying his best.]
Amy: What is John's favorite color?
Ben:

a. Blue? (*p*)
b. It's blue? ≈(40a) (*p*)
c. Is it blue? ≈(40a) (*p*)
d. It's maybe blue? ≈(40a) (*p*)

In this context, now (40a) and (40b) appear equivalent. Note that (40d) is also equivalent to (40a) (and (40b)), indicating that full declaratives allow a concord reading between *maybe* and rising intonation.

A similar pattern can be seen in (41), where the context establishes that Amy is aware that Ben knows John's favorite color (ruling out an uncertain-*p* reading), biasing an uncertain-QUD reading of the rising intonation.

(41) [Uncertain-QUD context: Amy and Ben were recently discussing John's favorite color and established that they are both sure that it is blue.]
Amy: What is John's favorite color?
Ben:

a. Blue? (QUD)
b. It's blue? ≈(41a) (QUD)
c. #Is it blue? $\not\approx$(41a)
d. #It's maybe blue? $\not\approx$(41a)

In this context, now (41a) and (41b) appear equivalent. As mentioned above, however, interrogative structure and the adverb *maybe* both force an uncertain-*p* reading, and this uncertain-*p* reading is incompatible with the context where Ben know's what John's favorite color is, so (41c) and (41d) are infelicitous.

We are now in a position to give a full explanation of (3), repeated below, and its ostensible lack of concord reading.

(3) Amy: What is John's favorite color?
Ben:

a. It's blue? (QUD)
b. Maybe it's blue? $\not\approx$(3a) (*p*)
c. #Maybe it's blue.

In a neutral context without an epistemic adverb, full declaratives appear to bias an uncertain-QUD reading, so (3a) receives an uncertain-QUD reading ($\diamond_{cs}$QUD)[68]. With *maybe*, an uncertain-*p* reading is preferred, so (3b) receives an uncertain-*p* reading ($\diamond_{cs}p$). Importantly, even though (3b) is not equivalent to (3a), (3b) can still give a concord reading ($\diamond_{cs}p \models \diamond_{epist}p$). We saw this already in (40), where we used a context that biases an uncertain-*p* reading in the full-sentence declarative. Furthermore, note that (3b), while not equivalent to (3a), is equivalent to the fragment *Blue?* (e.g. (1a)), which likewise favors an uncertain-*p* reading.

Thus we see that rising concord is available between rising intonation and *maybe* so long as rising intonation receives an uncertain-*p* reading. Concord then follows from the Epistemic Commitment Principle ($\diamond_{cs}p \models \diamond_{epist}p$). Lack of equivalence between responses like *Maybe it's blue?* and its *maybe*-less counterpart *It's blue?* does not indicate lack of concord but rather a difference in uncertainty readings.

3.4.2 Pragmatic weakening

The second case in which concord readings appear to be absent arises when we consider rising declarative questions. Consider the example in (42) (adapted from Gunlogson 2008, p. 104), where, counter to our prediction, a concord reading does not appear to be available.

(42) [Robin is sitting in a windowless computer room when another person enters. The newcomer is wearing a wet raincoat and boots.] Robin to the newcomer:

a. It's raining?

b. #It's maybe raining? $\not\approx$(42a)

The questions in (42a) and (42b) are not equivalent, but this time it is not due to a discrepancy between uncertain-*p* and uncertain-QUD readings[69]. The utterance in (42b) sounds more like a suggestion than a question and is relatively bizarre out of the blue, particularly directed at someone who just came in from outside and knows whether or not it is raining.

To see why (42b) is infelicitous, first consider the case where (42b) receives a cumulative (i.e. non-concord) reading. Here the speaker contingently commits to the proposition that it is possible that it is raining. The speaker has adequate evidence for this, but the speaker also has adequate evidence for the stronger proposition *It's raining* and so is not expected to choose the weaker proposition. This is that much more unexpected given that the addressee is in a position to make the stronger commitment (that it is or is not raining) as well. So, assuming cooperative conversationalists, (42b)

[68]This uncertain-QUD may be biased in full-declarative responses since they can be seen as a repetition of the perceived QUD (*It/John's favorite color is X*). Fragment responses, on the other hand, provide no such repetition.

[69]Note that uncertain-QUD readings should not be at play here, since Robin is introducing the QUD.

is infelicitous.[70]

Note that the felicity improves in a context where the addressee is not authoritative with respect to whether or not it is raining, but is authoritative with respect to whether or not it **might** be raining. For example, if, instead of arriving from outdoors, the addressee just checked the weather report in the paper and saw the probability of rain for the present time of day, (42b) is felicitous.

Given that a cumulative reading is infelicitous, why can't a concord reading rescue (42b)? I propose that a concord reading of (42b) is infelicitous due to the pragmatic effect of concord. As Zeijlstra (2008) describes it, to achieve a single-modal reading, only a single modal item is necessary, so the presence of a second modal item in modal concord contexts is pragmatically marked (cf. Grice's Maxim of Manner, specifically "Be brief", (Grice 1975)) and gives an emphatic effect. When two possibility modals are used where only one is needed, this leads to a weakening effect (more remote possibility). So, just as (43b) is weaker than (43a), the single-modal *It's maybe raining?* in (42b) is weaker than its single-modal counterpart *It's raining?* in (42a), even under a concord reading.

(43) a. John might be home by curfew.
b. John might possibly be home by curfew.

In statements like those in (43) this pragmatic effect does not affect felicity, but I will argue below that it has a noticeable effect on the felicity of declarative questions and answers like (i) where the weakening effect of modal concord conflicts with discourse requirements.

This emphatic effect is not limited to modal concord and has been explored in depth for emphatic double negation, where an emphatic reading of multiple negation can occur when Negative Concord is not obligatory (Zeijlstra 2008), as in (44).

(44) a. Dat heb ik nooit neit gezien (Dutch) (van der Wouden 1994, p. 147)
that have I never not seen
'I never saw that'
b. Sij is nooit nie beskikbaar nie (Afrikaans) (Zeijlstra 2008, p. 322)
she is n-ever neg available neg
'She is never ever available'

[70]Note that if only possibility is relevant, i.e. *It's maybe raining* is at the right level of informativity, (42b) is still not felicitous because the rain gear alone is sufficient to conclude that rain is possible, obviating rising intonation, cf. (i).

(i) [Robin is sitting in a windowless computer room with no information about current weather conditions when another person enters from outdoors.] Robin to newcomer:
a. #There's evidence pointing toward it being rainy right now?
b. There's evidence pointing toward it being rainy right now.

A similar emphatic effect can be seen in (45), where redundant 'strong' expressions (e.g. *very*, *often*) lead to a strengthening effect, and redundant 'weak' expressions (e.g. *occasionally*, *sort of*) lead to a weakening effect.

(45) a. Miss Tox was often in the habit of assuring... (Fowler and Fowler 1906, p. 342)

b. We are very, very happy with the result. (van der Wouden 1994, p. 145)

c. Lord Roseberry has not budged from his position–splendid, no doubt–of lonely isolation. (Fowler and Fowler 1906, p. 342)

d. Klein huisje (Dutch) (van der Wouden 1994, p. 145)
small house-DIM
'Small little house'

e. Ben sometimes occasionally attended mass.

f. David was somewhat slightly annoyed.

Returning to the concord reading of (42b), the use of two uncertainty markers where only one is required leads to pragmatic weakening, here marking heightened uncertainty. This heightened uncertainty implies that the speaker does not have adequate evidence for the commitment they are making (e.g. they do not realize the correlation between rain and wet raingear). And if the speaker does not have adequate evidence, they cannot felicitously make the commitment. Thus (42b) is infelicitous under a concord reading due to an inference of lack of Speaker Evidence.

Now we see that modal concord readings may be technically possible for rising declarative questions like (42b), but they express a heightened lack of certainty incompatible with the use of a declarative. Note that this contrasts with rising declarative responses, as in (46).

(46) Amy: What's the weather like right now?
Ben:

a. It's raining?

b. It's maybe raining? $\approx$ (46a)

There the speaker faces pressure to provide an answer to the current QUD, making a declarative felicitous though the speaker's evidence may not be sufficient. In (42), the speaker faces no pressure to assert that it's raining. And while concord is infelicitous with rising declarative questions like (42), this does not reflect a failure in the theory proposed above but rather a conflict between the pragmatic effect of concord and the requirement of declaratives that speakers have adequate evidence for their commitments.

So far we have seen two cases where concord readings appear to be unexpectedly absent. These were shown to be due to differences in uncertainty readings and pragmatic weakness, which are orthogonal to and compatible with the analysis developed in Section 3.3. Next, we will use evidence from here and elsewhere to address the question of whether examples like (1) are declarative.

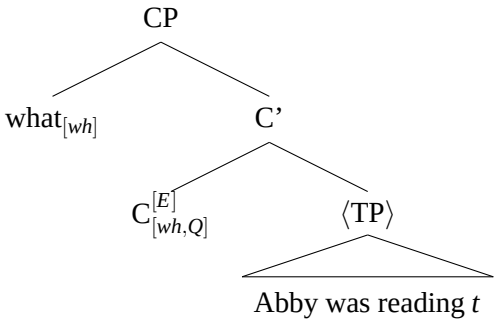
3.4.3 The syntactic status of fragments

We have assumed, but not verified, that the fragments in, e.g., (1) are rising declaratives, not interrogatives. In this section we will attempt to verify that this is appropriate.

In determining whether these fragments are declarative or interrogative, I will assume the analysis of fragments in Merchant (2004). This builds off of his analyses of sluicing as involving an unpronounced TP, which is licensed by an [E] feature in C/F, as demonstrated in (47).

(47) a. Abby was reading something, but I don't know what ⟨Abby was reading *t*⟩.

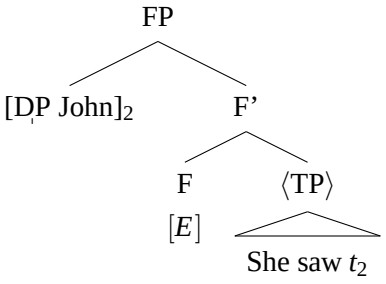
b.



Merchant (2004) proposes a similar analysis for fragment responses, where the fragment is moved to the left periphery and TP is deleted (Merchant 2004, p. 675).

(48) a. A: Who did Mary see?
B: John.

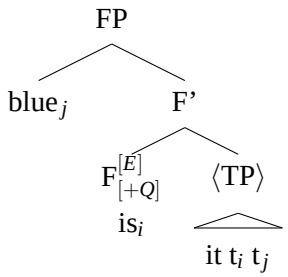
b.



Given this analysis of fragments, what behavior can we look for to determine whether they are underlyingly declarative or interrogative?

Moved Q material For one, we can look to see if auxiliaries can appear in fragments. In an interrogative with auxiliary inversion, the auxiliary should move outside of the deleted TP and thus be pronounced. Thus, if an auxiliary appears in a fragment, that would suggest that that fragment is interrogative.

(49)



However, Merchant (2001) argues that there is no I/T-to-C/F movement in constructs with TP ellipsis, as evidenced in (50)-(52).[71]

(50) Max has invited someone, but I don't know who (*has).

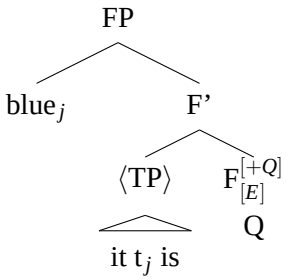
(51) Max has invited someone, but who (*has)?

(52) A: Max has invited someone. (Merchant 2001, p. 63)
B: Really? Who (*has)?

Auxiliary inversion, then, does not appear to be able to diagnose declarative/interrogative structure in fragments.

***In-situ* Q material** But perhaps question particles can provide a reliable diagnostic. If fragments with interrogative syntax have a structure like (53), the presence of a question particle in rising fragments would indicate that they have interrogative syntax. The absence of a question particle would suggest that they are declarative/not interrogative.

(53)



In Japanese, a question particle appears, as expected, in full interrogative responses, shown below.

(54) A: John-wa nani-o katta-no?
John-TOP what-ACC bought-Q
'What did John buy?'

[71] Merchant argues that IP/TP is deleted prior to I/T-to-C/F movement, so ellipsis bleeds verb movement; see also van Craenenbroeck and Lipták (2008).

B: Kare-wa hon-o katta-no?
he-TOP book-ACC bought-Q
'Did he buy a book?'

B′ Kare-wa hon-o katta (yo).
he-TOP book-ACC bought (PARTICLE)
'He bought a book.'

Now consider the Japanese fragment responses in (55). B's response demonstrates a particle with falling intonation, and B′'s response demonstrates a particle with rising intonation, marking the B′'s uncertainty. Importantly, note that while particles can appear in fragment responses, as in B″'s, a question particle (*ka* or *no*), shown in B‴'s response, is ungrammatical.

(55) A: John-wa nani-o katta-no?
John-TOP what-ACC bought-Q
'What did John buy?'

B: Hon (da yo).
book (copula particle)
'A book.'

B′: Hon?
book
'A book?'

B″: Hon-kana?
book-PARTICLE
'A book?'

B‴:*Hon-ka/no?
book-Q
'A book?'

Note that there is no general constraint against question particles appearing with elided material: the question particle *-ka* appears in pseudo-sluicing structures like (56) (Merchant 1998) and sluicing structures like (57) (Takita to appear).

(56) Abby-ga dareka-o mi-ta ga, watashi-wa dare ka wakaranai.
Abby-NOM someone-ACC see-PAST but I-TOP who Q know.not
'Abby saw someone, but I don't know who.'

(57) Taroo-wa dono zyaanaru-ni ronbun-o das-oo ka kimeta ga, Hanako-wa dono zyaanaru-ni ka kimekaneteiru.
Taroo-TOP which journal-to paper-ACC submit-inf Q decided but Hanako-TOP which journal-to Q cannot.decide
'(lit.) Though Taroo decided to which journal to submit a paper, Hanako cannot decide to which journal (to submit a paper).'

This diagnostic, then, points toward the possibility of rising fragments with declarative syntax.

NPIs Negative polarity items (NPIs) are licensed by interrogative structure, as well as by negation, as demonstrated in (58)-(59) for the NPIs *anything* and *ever*.

(58) a. %John read anything. (no licenser)
b. Did John read anything? (interrogative)
c. John didn't read anything. (negation)

(59) a. *John has ever read War and Peace. (no licenser)
b. Has John ever read War and Peace? (interrogative)
c. John hasn't ever read War and Peace. (negation)

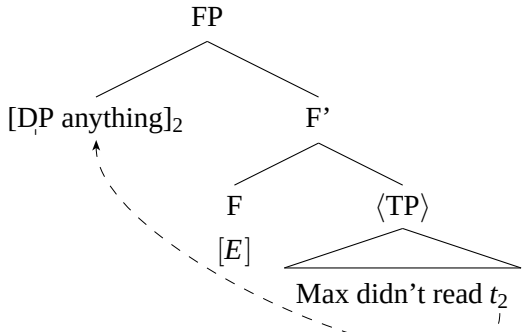
Therefore, if NPIs can occur in fragments (in the absence of any other NPI licensers), this suggests that fragments can be interrogative. On the other hand, if NPIs cannot occur in fragments (in the absence of any other NPI licensers), this suggest that fragments cannot be interrogative.

Unfortunately, NPIs cannot occur in fragments in English, rising or not (Merchant 2004, p. 691). This is shown in (60), where elided negation is unable to license the NPI *anything*.

(60) A: What didn't Max read?
B: *(Max didn't read) anything.

According to Merchant, this is due to English NPIs' inability to be left-dislocated (62), and since fragments (under Merchant's analysis) are left-dislocated material, these NPIs cannot occur in fragments.

(61)



(62) a. Max didn't read anything. (Merchant 2004, p. 691)
b. *Anything, Max didn't read.

Fortunately, English provides us with some (relatively-)left-dislocatable NPIs. For instance, while *anything* cannot be easily left-dislocated, *any*+NP can (Marcel Den Dikken, p.c.).[72]

[72]The more complex the DP, the more felicitous these become (e.g. *anything* < *any book* < *any book by Chomsky* < *any book by Chomsky that referenced left-dislocation*), but this may have more to do with memory constraints (specifically, the ability to remember that the gap-filler was an NPI) than grammar.

(63) a. #Anything, Max didn't read.
b. ?Any book, Max didn't read.

Correspondingly, these left-dislocatable NPIs can appear (relatively) in fragments.

(64) A: What didn't Max read?
B: *(Max didn't read) anything.
B': ?(Max didn't read) any books.

These NPIs (both *any*+NP and *anything*) are even better with rising intonation, where they appear to be licensed by interrogative structure, not negation.

(65) A: What did Max read?
B: ?(Did Max read) anything?
B': (Did Max read) any books?

Overall, then, it appears that fragments can be both interrogative (evidenced by their licensing left-dislocatable NPIs) and declarative (evidenced by the absence of Q markers). But are all the fragments we discussed above interrogative? We saw evidence in (55) to suggest that this is not the case in Japanese. Furthermore, recall that fragments pattern like full declaratives, not full interrogatives, in their interactions with epistemic adverbs, as was summarized in 6. While we are not yet able to address this issue definitively, the data we have seen is at least consistent with the fragments in examples like (1) having an underlyingly-declarative syntax.

3.5 Conclusion

By implementing Gunlogson (2008)'s analysis of rising intonation semantically, we were able to explain the pattern of data in (1) through modal concord (such that (1a) is equivalent to (1b)) and cooperativity (such that falling intonation on an underinformative statement like (1c) is uncooperative).

(1) Amy: What is John's favorite color?
Ben:
a. Blue?
b. Maybe blue? $\approx$ (1a)
c. #Maybe blue.

The lack of equivalence between (2a) and (2b), where a stronger epistemic adverb appears, is due to the clash in strengths between the adverb (near-necessity) and rising intonation (possibility), which blocks modal concord.

(2) Amy: What is John's favorite color?
Ben:

a. Blue?
b. Probably blue? $\not\approx$ (2a)
c. Probably blue.

The lack of equivalence between the full-sentence responses in (3a) and (3b) was due to conflicting uncertainty readings, where (3a) biases an uncertain-QUD reading, while (3b) (and (1a) and (1b)) biases an uncertain-*p* reading.

(3) Amy: What is John's favorite color?
Ben:
a. It's blue?
b. Maybe it's blue? $\not\approx$ (3a)
c. #Maybe it's blue.

A number of innovations were introduced in explaining these patterns, which we will briefly revisit. First, allowing modal concord between adverbs required giving semantic content to intonation. This semantic content was formalized as existential quantification over the speaker's *cs*, such that rising intonation took on an epistemic possibility operator. This is unconventional, but it allows an explanation for the data puzzles examined in this paper via modal concord.

While this modal analysis remains largely consistent with Gunlogson (2008)'s (summarized here on page 71), she cautions against linking rising intonation directly with epistemic states. She discusses counterfactuals, where a speaker's current (temporary) commitment set may contradict their epistemic commitments (Gunlogson 2001, p. 43, fn. 4). An example of such a context is given in (66)-(67), where Ben adds the proposition that the moon is made of cheese to his commitment set without actually believing that the moon is made of cheese.

(66) Amy: We both know the moon isn't made of cheese, but let pretend that it is for a moment.
Ben: Okay, the moon is made of cheese.

(67) Amy: We both know the moon isn't made of cheese, but let pretend that it is for a moment.
Now ask me if the moon is made of cheese.
Ben: Is the moon is made of cheese?
Amy: Yes.
Ben: Okay.

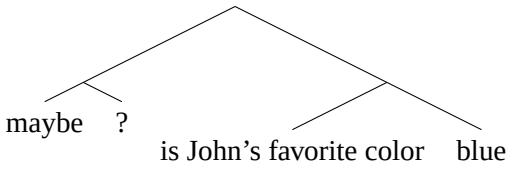
It is clear, however, that this commitment that the moon is made of cheese is separate from any earlier *cs*s (otherwise their *cs*s would be the empty set since this new commitment conflicts with the earlier commitment that they know the moon is not made of cheese) and will not last beyond the scope of the hypothetical. Why, then, should we not have separate temporary epistemic states as well? Such states seem necessary in an exchange like (68), where Ben is referring to his separate temporary set of beliefs (without which, he would be forced to reply to Amy's question in the negative).

(68) Amy: I know the moon isn't made of cheese, but let pretend that it is for a moment. Now, do you believe the moon is made of cheese?
Ben: Of course, everyone knows that.

Gunlogson's apprehension, then, appears unnecessary. So long as epistemic commitments are given the same treatment as discourse commitments in these contexts, conflicts between actual commitments and commitments within counterfactuals will not arise.

A consequence of attributing modal semantic content to rising intonation is that accomplishing concord between adverbs and rising intonation requires a semantic configuration like that in (69), where the adverb composes directly with rising intonation. While epistemic adverbs are generally considered to appear in a high position, I must locate them at the same level as illocutionary elements.

(69)



Similar compositional interactions between prosodic items and syntactic constituents are not uncommon. For example, the comma intonation the (70a), as described in (Potts 2003, a.o.) causes the relative clause to yield propositions that are independent of the main clause (and here infelicitous, cf. *The linguist is taller than the linguist and the linguist works of presuppositions and the linguist works on vowel harmony*).

(70) a. #The linguist, who works on presuppositions, is taller than the linguist, who works on vowel harmony.
b. The linguist who works on presuppositions is taller than the linguist who works on vowel harmony. (Potts 2005, p. 130)

In (70b), without comma intonation, the relative clauses restrict the domain of the determiner (here, felicitously, since they restrict each use of *linguist* in different, an presumably unique, ways). Similar interactions have been argued for in Steedman (2007), where boundary tones compose with other syntactic constituents, and in Biezma and Rawlins (2012), where falling pitch contour in alternative questions composes with syntactic constituents.

The analysis I present crucially relies on the Epistemic Commitment Principle, repeated in (71).

(71) **Epistemic Commitment Principle:** $\diamond_{cs} p \models \diamond_{epist} p$

If an agent is possibly committed p, it can be assumed that that agent believes p is possible.

This principle predicts a number of concord readings, which we saw to be complicated by the fact that (at least) two different uncertainty readings are possible (uncertain-p and uncertain-QUD), and concord only occurs when both modals share the same type of uncertainty reading. And while

maybe biases an uncertain-p reading of rising intonation, stronger adverbs like *definitely* and *probably* bias **against** an uncertain-p reading. Furthermore, while rising intonation allows both an uncertain-p reading and an uncertain-QUD reading, epistemic adverbs appear to only allow an uncertain-p reading.

The possible configurations of these readings are sketched out in (72). For rising intonation in the absence of another epistemic marker, both an uncertain-p and an uncertain-QUD reading are available (modulo context). For rising intonation with an epistemic possibility adverb like *maybe*, a concord reading is available (via the Epistemic Commitment Principle) under the uncertain-p reading of rising intonation, but not under the uncertain-QUD reading. For rising intonation with an epistemic necessity adverb like *definitely*, a concord reading is **not** available under the uncertain-p reading of rising intonation, which is presumably due to the fact that $\diamond_{epist}\, p$, the reading that would be arrived at through the Epistemic Commitment Principle, would generate the implicature that $\neg\Box_{epist}\, p$, which conflicts with the contribution of the adverb. Under the uncertain-QUD reading, concord is not available. This account naturally extends to near-necessity adverbs like *probably*.

(72) a. *?*

(i) $\diamond_{cs} p \rightarrow \diamond_{epist} p$ (p context)

(ii) $\diamond_{cs} QUD \rightarrow \diamond_{epist} QUD$ (QUD context)

b. *maybe?*

(i) $\diamond_{cs} \diamond_{epist}\, p \rightarrow \diamond_{epist} p$ (p context)

(ii) $\diamond_{cs} QUD \diamond_{epist}\, p$ (QUD context)

c. *definitely?*

(i) $*\Box_{cs} \diamond_{epist}\, p \rightarrow \diamond_{epist} p$ (p context)

w/ implicature: $\Box_{cs} \diamond_{epist}\, p \rightarrow \diamond_{epist} p \wedge \neg\Box_{epist}\, p$

(ii) $\Box_{cs} QUD \diamond_{epist}\, p$ (QUD context)

d. *probably?*

(i) $*\text{MOST}_{cs} \diamond_{epist}\, p \rightarrow \diamond_{epist} p$ (p context)

w/ implicature: $\text{MOST}_{cs} \diamond_{epist}\, p \not\rightarrow \diamond_{epist} p \wedge \neg\text{MOST}_{epist}\, p$

(ii) $\text{MOST}_{cs} QUD \diamond_{epist}\, p$ (QUD context)

The readings available remain consistent with the Epistemic Commitment Principle.

Finally, given this discussion, it may be interesting to note the interaction between rising intonation and different approximators.

(73) Amy: How old is Chris?

Ben:

a. Ten?

b. About ten? $\approx$ (73a)

c. Approximately ten? $\not\approx$ (73a)

Here, *about* appears to give rise to a concord reading, whereas *approximately* does not. A similar pattern can be seen in (74), where *about* appears to give a concord reading with *might*, but *approximately* does not.

(74) a. John might be about six feet tall.
‘John is somewhere in the ballpark of six feet’
b. John might be approximately six feet tall.
‘It is possible that John is approximately six feet tall’

This suggests that approximators like *about* have a modal component that can participate in modal concord with other modal possibility markers like *might* and rising intonation, which then further supports our treatment of rising intonation as a modal possibility marker.

4 The distribution of scalar modifiers

4.1 Introduction

In the preceding chapters we saw modifiers like *approximately* modifying numerals, as in (1).

(1) What John served was approximately fifty sandwiches.

We also saw glimpses of these modifiers modifying other categories, as in (2), where *approximately* modifies the coerced scalar noun phrase *beef stroganoff*.

(2) What John served was only approximately beef stroganoff.

In this chapter I lay out more carefully what these modifiers are and how their cross-categorial behavior (cf. numeral modification in (1), nominal modification in (2)) can be accounted for within existing theories of quantification. I do this by identifying and explaining asymmetries in the distribution of *approximately* and its near-synonym *about*, particularly those exhibited below in (3)-(4).

(3) a. John served approximately/ about 50 sandwiches.
b. John served #approximately/#about beef strognaff.

(4) a. What John served was approximately/ about 50 sandwiches.
b. What John served was approximately/#about beef stroganoff.

The analysis I provide finds the distribution of *approximately* to be a direct result of composition and argument types, and the narrower distribution of *about* is a result of its inability to coerce a scalar reading from its complement. This behavior exposes two classes of modifiers, those that pattern like *approximately*, and those with a more limited distribution like *about*. These classes are summarized in (5).

The remainder of the chapter proceeds as follows. Section 4.2 provides an overview of a leading theory of quantifiers, Generalized Quantifier Theory, highlights objections that have been made against Generalized Quantifier Theory in the literature, and presents Hackl (2000)'s decompositional alternative. Section 4.3 builds on this decompositional theory of quantifiers to account for the use of *approximately* as a modifier of both numerals and coerced scalars as in (3)-(4). Section 4.4 addresses *about* and its relative lack of cross-categorial behavior. Section 4.5 investigates *a good*, a modifier that, like *about*, fails to show cross-categorial behavior. Section 4.6 concludes.

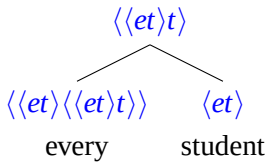
4.2 Quantifiers

4.2.1 Generalized Quantifier Theory

Quantifiers frequently interact with scalars and have provided a rich area of study for linguists and philosophers, highlighted in works such as Barwise and Cooper (1981) and Keenan (1996). These authors (among others) focus on *Generalized Quantifiers* (GQs) such as *every student* and *no*

librarians. These are second-order functions which map from properties to truth values ($\langle\langle et\rangle t\rangle$). They are composed of a quantificational determiner like *every* or *no* ($\langle\langle et\rangle\langle\langle et\rangle t\rangle\rangle$) and a noun like *student* or *librarians* (i.e. are of type $\langle et\rangle$).

(5)



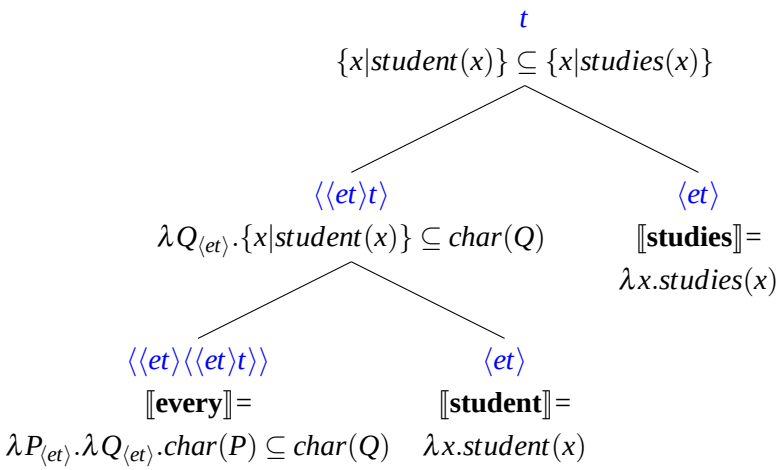
Under a GQ-theory, a wide variety of quantificational determiners (e.g. *every*) are treated the same, i.e. as irreducible functions from nominal predicates to GQs ($\langle\langle et\rangle\langle\langle et\rangle t\rangle\rangle$). These include such diverse expressions as *every*, *no*, *fewer than five*, *all but two*, *the ten*, and *neither*.

(6) A sampling of GQs from Keenan (1996, pp. 42-43)

a. **EVERY(*A*)(*B*) = T** iff $A \subseteq B$
b. **NO(*A*)(*B*) = T** iff $A \cap B = \emptyset$
c. **(FEWER THAN FIVE)(*A*)(*B*) = T** iff $|A \cap B| < 5$
d. **(ALL BUT TWO)(*A*)(*B*) = T** iff $|A - B| = 2$
e. **(THE TEN)(*A*)(*B*) = T** iff $|A| = 10$ & $A \subseteq B$
f. **NEITHER(*A*)(*B*) = T** iff $|A| = 2$ & $A \cap B = \emptyset$
g. **MOST(*A*)(*B*) = T** iff $|A \subseteq B| > |A - B|$

For example, *every student studies* is true if the set of students is a subset of the set of studiers. This composition is demonstrated using lambda notation in (7).[73]

(7)



[73] In (7) I use *char* to represent the *characteristic function*, which takes a function of type $\langle et\rangle$ and return the set of entities that are true of that function (i.e. $\lambda f_{\langle et\rangle}.\{x|f(x)=1\}$).

An advantage of this uniform treatment is that it helps explain a number of generalizations across quantifiers, such as those enumerated in (8).[74]

(8) **Conservativity:** For all $A, B \subseteq M, Q_M(A)(B) \leftrightarrow Q_M(A)(A \cap B)$

Domain Independence: For all $A, B \subseteq M$, if $M \subseteq M'$, then $Q_M(A)(B) \leftrightarrow Q_{M'}(A)(B)$

Licensing of Negative Polarity Items

This generalizability, however, comes at a cost, as demonstrated in Hackl (2000) and reviewed below.

4.2.2 Limits of Generalized Quantifier Theory

Hackl focuses on comparative determiners, or quantificational determiners that he characterizes as requiring a measure function (e.g. *five*) and a comparative relation (e.g. $>$, =) in their truth conditions. Quantificational determiners in general are quite heterogeneous, and even limiting himself to comparative determiners, Hackl identifies at least six classes (Hackl 2000, p. 24).

(9) Comparative determiners

a. Cardinal determiners
   e.g. *three*, *more than three*
b. Indefinite, vague, and intensional determiners
   e.g. *(a) few*, *many*, *approximately ten*, *about ten*
c. Proportional determiners
   e.g. *two out of (every) three*, *less than one third of the*
d. Indefinite, vague, and intensional proportional determiners
   e.g. *few out of every ten*, *a lot of the*
e. Two place (comparative) determiners
   e.g. *more... than...*, *the same number of... as...*
f. Boolean combinations of the above
   e.g. *three or four of the*, *either fewer than five or else more than a hundred*

This variety is not predicted under a theory like GQ theory. Additionally, by treating quantificational determiners as opaque wholes, a GQ theory does does not provide means for relating *three* and *more than three*, etc.

[74] Conservativity states that for any quantifier Q and sets A and B, $[\![Q(A)(B)]\!]$ is not effected by any items in B that is not also in A (e.g. you can evaluative $[\![$**All dogs bark**$]\!]$ without looking beyond the set of dogs (A)). Similarly, Domain Independence states that $[\![Q(A)(B)]\!]$ is unchanged by any expansions or contractions of the universe that do not change A or B (e.g. $[\![$**All dogs bark**$]\!]$ is unchanged by removing some cats from the universe). See Chapter 5 of Szabolcsi (2010) for a nice overview of these generalizations.

More problematically, GQ theory has been shown to make incorrect predictions about the interpretations of quantificational sentences. Hackl (2000) notes that such incorrect predictions are made with Minimum Number of Participants verbs, such as *meet*, *gather*, *separate*, and *disperse*. This is shown in (10). GQ theory treats both sentences in (10) as truth-conditionally equivalent.

(10) a. ?? More than one student is meeting. (Hackl 2000, p. 62)
(MORE THAN ONE)(*student*)(*is-meeting*) = T iff $|student \cap is\text{-}meeting| > 1$

b. At least two students are meeting.
(AT LEAST TWO)(*student*)(*is-meeting*) = T iff $|student \cap is\text{-}meeting| \geq 2$

While native speakers find (10a) to be considerably worse than (10b), GQ theory does not offer an explanation for this.[75]

4.2.3 A decompositional alternative to Generalized Quantifier Theory

To address these issues, Hackl introduces a decompositional analysis of quantifiers. His account decomposes comparative quantificational determiners into three parts: 1) a degree function, 2) a degree quantifier, and 3) a measure phrase. The decomposition of *more than three* is given below.[76]

(11) *more than three*

a. degree function: $[\![\textbf{\textit{MANY}}]\!] = \lambda d \in D_{Card}.\lambda\, {}^*f \in D_{\langle et\rangle}.\lambda\, {}^*g \in D_{\langle et\rangle}.\exists x\, {}^*f(x) = {}^*g(x) =$ 1 & x has d-many atomic parts in f (Hackl 2000, p. 213)

b. degree quantifier: $[\![\textbf{-er than n}]\!] = \lambda D_{\langle dt\rangle}.max(\lambda d.D(d) = 1) > n$

c. measure phrase: $[\![\textbf{three}]\!] = 3$

The degree function *MANY* is a phonologically-null function that takes a cardinality (provided by the measure phrase) and two plural predicates and asserts that there is some x which is true of both predicates and which has the specified cardinality in the domain of the first predicate.[77] The degree quantifier *-er than* modifies *MANY* such that the cardinality of x is greater than the specified cardinality, yielding the form *more than*. This composition is shown for *More than three people came to the party* in (12). The resulting truth conditions, $[max(\lambda d.\exists x\ students(x)\ \&\ cttp(x)\ \&\ x$ has d-many atomic parts in $student) > 3]$, assert that among the cardinalities d such that there is some x where x is a plurality of students, x is a plurality that came to the party, and x is made up

[75] Hackl refers to this as the Minimal Number of Participants Generalization. Winter (1998) discusses similar cases.

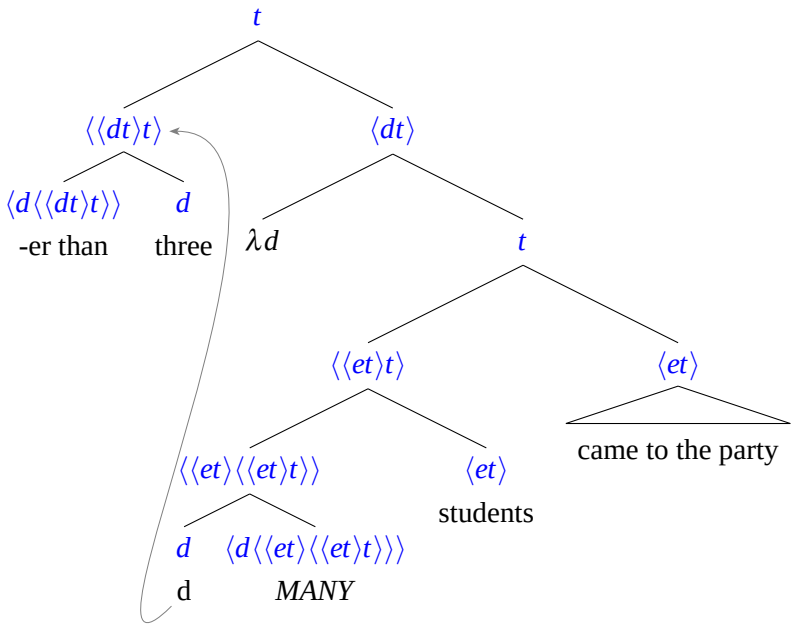
[76] This roughly parallels the decomposition of other comparative constructions like *taller than six feet* (comparative *more* + measure function *tall* + measure phrase *six feet*), (Kennedy 2007; Cresswell 1976, a.o).

[77] Hackl counts *atomic* parts to deal with counting over individual people in e.g. *twin brothers* (where atoms are individual people) and pairs of people with *couples* (where atoms are pairs of individuals). See (Hackl 2000, p. 213) for a treatment of *atomic*.

of *d*-many students, the largest such *d* is larger than the cardinality 3 (See Section 4.B for this and other derivations).

(12) a. More than three people came to the party.

b.

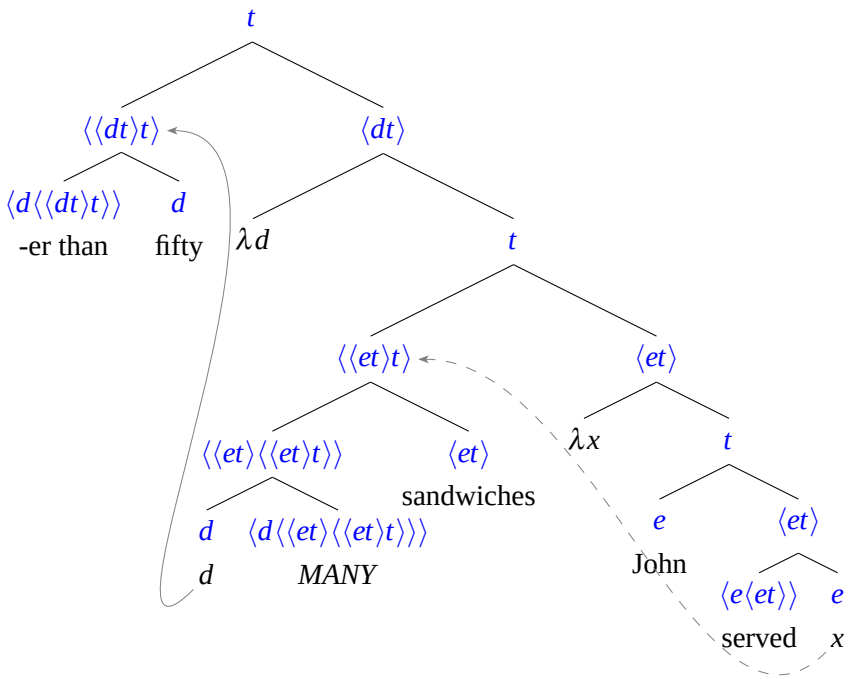


Notice in (12) that the quantificational determiner (the degree quantifier and the measure phrase) raises to a higher position where it is interpretable.[78] When the quantifier is in object position, as in (13), yet more movement is necessary. The $\langle\langle et\rangle t\rangle$ generalized quantifier cannot be interpreted in situ and QR's to a higher position, shown by the dotted line.

(13) a. John served more than fifty sandwiches.

[78]Hackl notes that this could be handled by a type-shift instead of by movement, but a movement account helps Hackl account for the Minimal Number of Participants Generalization (MNPG) exemplified in (10) – this gives the quantificational determiner a "clausal source", see (17).

b.



Bare numerals like *three* are also considered comparatives, but they involve no degree quantifier and are interpreted in situ (i.e. without moving to a "clausal node") (Hackl 2000, p. 128).

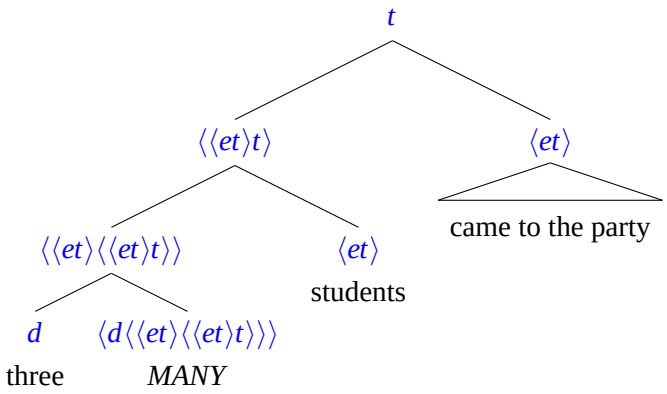
(14) *three*

a. degree function: *MANY*
b. degree quantifier: NA
c. measure phrase: *three*

The sentence ⟦**Three students came to the party**⟧ asserts, $[\exists x.students(x) = ctt\,p(x) = 1$ & x has 3-many atomic parts in *student*$]$, that there is some x that is a plurality of students, that is a plurality of entities who came to the party, and that is made up of 3 students.

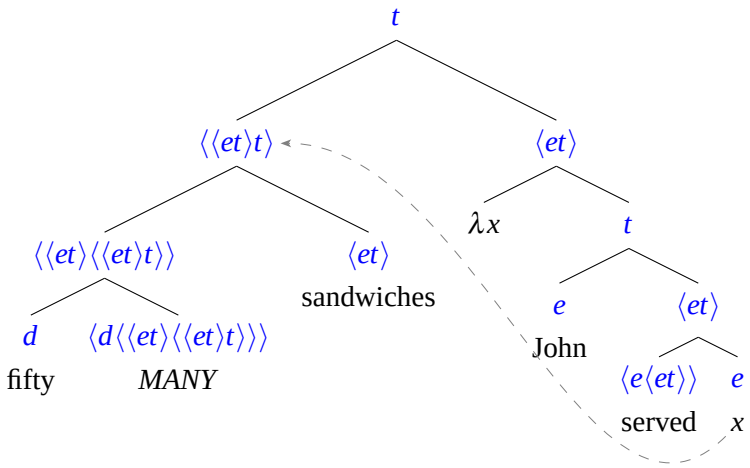
(15) a. Three students came to the party.

b.



Again, in object position we see that the generalized quantifier QR's to a higher position where it is interpretable.

(16) a. John served fifty sandwiches.

b. 

Immediately, we see that this decompositional approach readily allows us to relate *three* and *more than three*, etc. In each of these cases, *three* acts as a measure phrase, and the presence/identity of the degree quantifier is the differentiating element.

	three	*more than three*	*at least three*	*exactly three*
degree function:	*MANY*	*MANY*	*MANY*	*MANY*
degree quantifier:	NA	*-er than*	*at least*	*exactly*
measure phrase:	*three*	*three*	*three*	*three*

Table 7: Decomposition of several quantifier phrases

Perhaps more importantly, explains Hackl, this decomposition account also helps explain the contrast in (10), repeated below in (17). Comparative quantifiers like *more than one* contain two quantificational elements, the degree quantifier (*-er than*) and the degree function (*MANY*), such that the matrix VP is interpreted inside the comparative[79]. In sentences like (17a), this leads to a clash between the Minimum Number of Participants verb, which requires a plural argument, and the singular argument it is given.

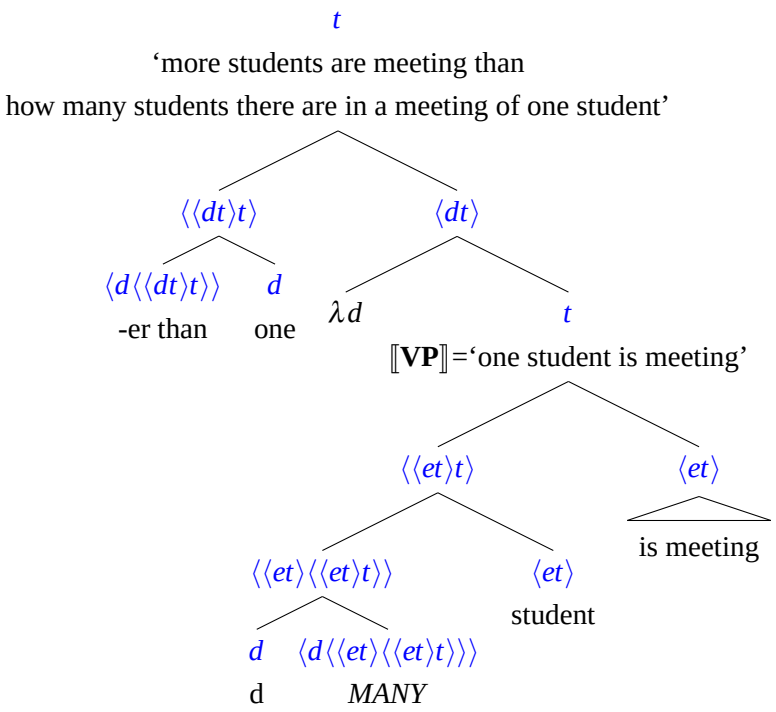
(17) a. ??More than one student is meeting.
'More students are meeting than how many students there are in a meeting of one student.'
(cf. 'The number of students meeting is more than one')

b. No fewer than two students are meeting.
'No fewer students are meeting than how many students there are in a meeting of two students.'

[79]The measure phrase is base generated as sister of the degree function, as seen in examples like (15). To be modified by a degree quantifier, as in (12), the measure phrase must move to matrix position where the resulting function can find its required function of type $\langle dt \rangle$. Thus, claims Hackl, the measure phrase is interpreted both within the quantified DP and in the matrix DP.

This infelicitous interpretation within the VP is shown in (18). Where the measure phrase is interpreted in the low position, it leads to the infelicitous *one student is meeting*, which then leads to an infelicitous interpretation of the sentence as a whole.

(18) a. More than one student is meeting.

b. 

Given the success of this decompositional approach, I will adopt it. Furthermore, a decompositonal approach will be important here, as I focus on interactions between items within the quantificational determiner, which is beyond the scope of GQ theory. In the following two sections I show that the account I provide of *approximately*/*about* fits into this type of decompositional framework.[80] I will further introduce machinery to handle coerced scalars and account for the contrasts introduced in (3)-(4).

4.3 *Approximately*

4.3.1 Introduction

To see how modifiers like *approximately* fit into a decompositional theory of quantifiers, I will first concentrate on their distribution. *Approximately* can appear in constructions like (19) and (20), where it modifies the number phrase *50 sandwiches*.

[80] Though see Section 4.A for how it might fit into a GQ theory.

(19) John served approximately 50 sandwiches.

(20) What John served was approximately 50 sandwiches.

Approximately can even modify non-scalars that have been coerced into a scalar reading, as *beef stroganoff* has in the examples below. With these scalars, however, *approximately* is more restricted in its distribution. Of the two examples below, only (22) is acceptable.

(21) ??John served approximately beef stroganoff.

(22) What John served was approximately beef stroganoff.

Below I investigate this asymmetry. Specifically, I will address a) how *approximately* is able to modify categories other than numeral and b) why coerced-scalar nouns pattern differently from numerals ((21),(22) v. (19),(20)). I will show that by following a decompositional analysis, an approximator in combination with any scalar (e.g. *approximately beef stroganoff*) requires more arguments than are supplied in (21). The requirement is obviated in copular constructions like (22) by a copula-specific type-shift.

4.3.2 Modified numerals

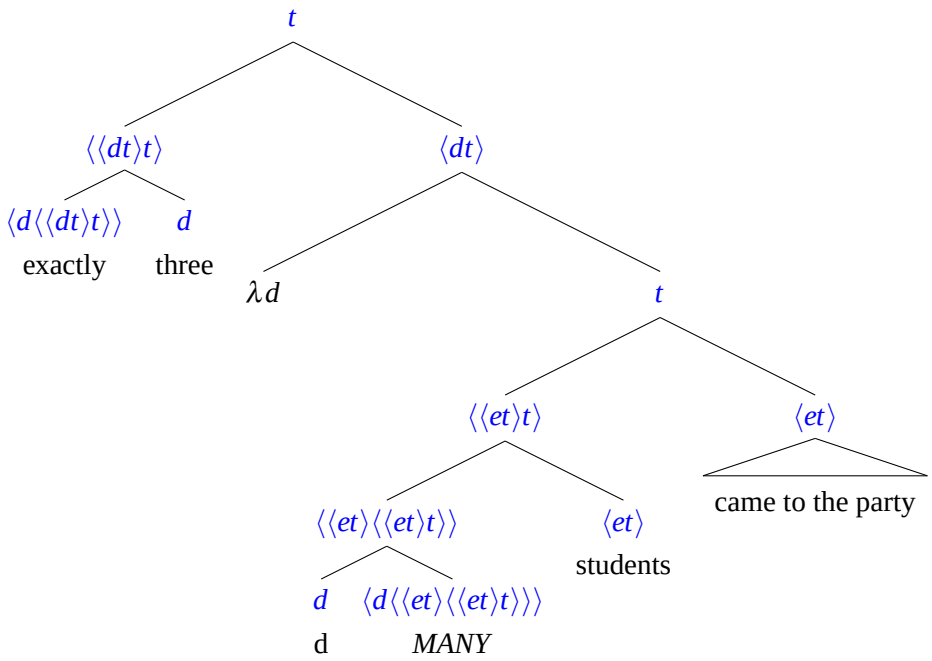
To provide an analysis for the data in (19)-(20), I adopt the treatment of quantifiers in Hackl (2000) described above. To get us started, Hackl provides the following denotation for *exactly n*, which composes as in (24)-(25).

(23) $[\![\textbf{exactly n}]\!] = \lambda D_{\langle dt \rangle}.D(n) = 1 \;\&\; \neg\exists d[d > n \;\&\; D(d) = 1]$ (Hackl 2000, p. 126)

In (24), *exactly* functions to assert that the number of students who came to the party is three and no more than three.

(24) a. Exactly three students came to the party.

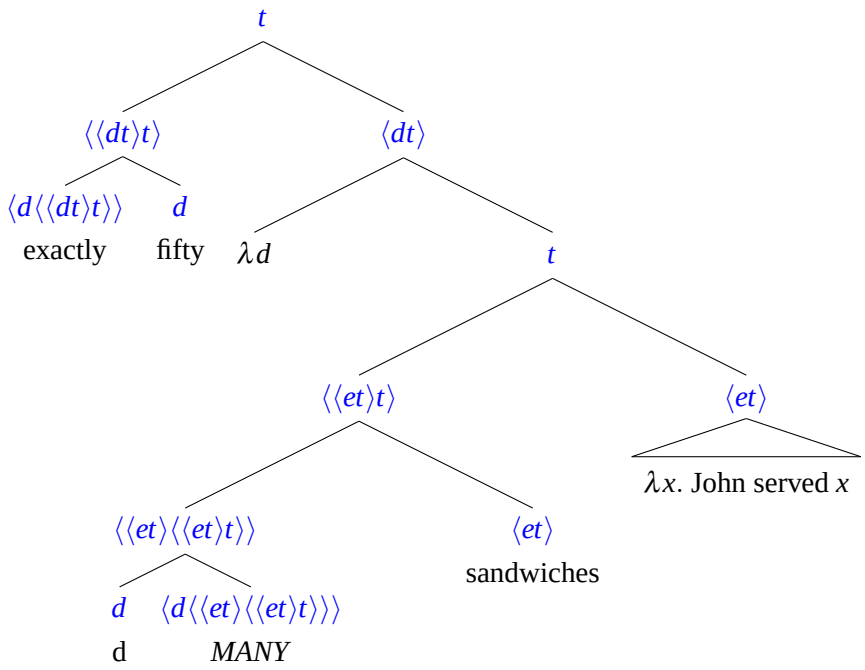
b.



Similarly, in (25), *exactly* functions to assert that the number of sandwiches that John served is fifty and no more than fifty.

(25) a. John served exactly fifty sandwiches.

b.



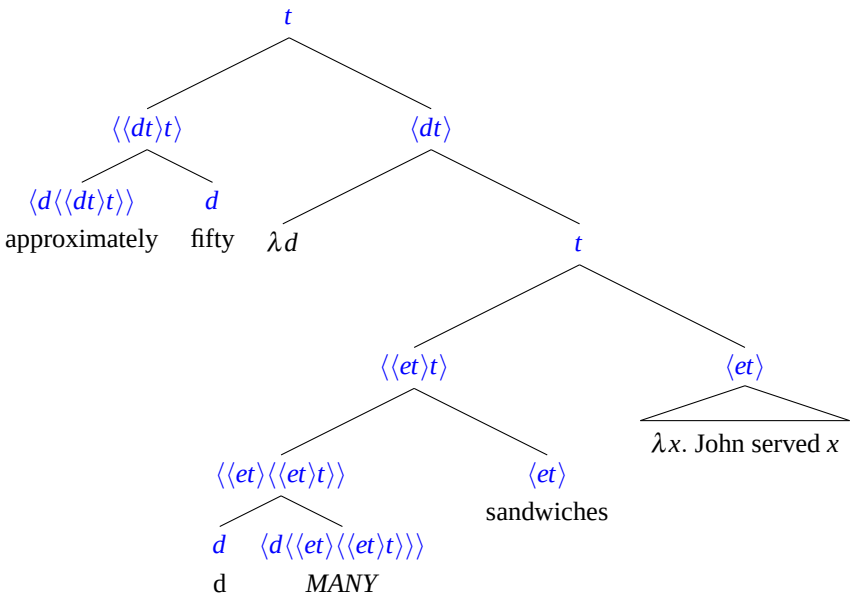
Like *exactly*, I treat *approximately* as a degree quantifier. This degree quantifier feeds *MANY* a degree that falls within some contextually-determined distance σ of n.[81]

(26) $[\![\textbf{approximately n}]\!] = \lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n+\sigma \geq y \geq n-\sigma\}$ & $D(m)$

This gives for (19), shown in (27), the truth conditions $[\exists m_d \in \{y|50+\sigma \geq y \geq 50-\sigma\}$ & $[\exists x.sandwiches(x)$ & $served(j,x)$ & x has m-many atomic parts in *sandwich*$]]$, or there is some cardinality m within a contextually-supplied distance from fifty such that there is some x such that x is a plurality of sandwiches, x was served by John, and x is made up of m sandwiches.

(27) a. John served approximately fifty sandwiches. = (19)

b.



Before I address the sentence in (20), observe that Hackl notes a restriction on *MANY*: unlike other degree functions like *tall*, *MANY* can only be used attributively.[82] This is apparent in the complements of *look* and *consider*, which require predicative ($\langle et\rangle$) arguments (Partee 2008, p. 361).

(28) a. John looks tall. (Hackl 2000, p. 97)

[81] This is the same denotation used in Section 2.4.1 on page 42.

[82] Note that Hackl treats the lexical item *many* as the combination of *MANY* with a contextually-supplied degree, parallel to the treatment of positive forms of gradable adjectives (e.g. *tall* in *John looks tall*). The pattern of infelicity holds for all uses of *MANY*, including the ones illustrated above, cf. (i).

(i) a. *The guests look ({more than/exactly/approximately}) 20 (people).
b. *I consider the guests ({more than/exactly/approximately}) 20 (people).

b. *The guests look many.

(29) a. Mary considers John tall. (Hackl 2000, p. 98)

b. *Mary considers the guests many.

Compare (28)-(29) with (30), where both *tall* and *MANY* can appear in attributive constructions.

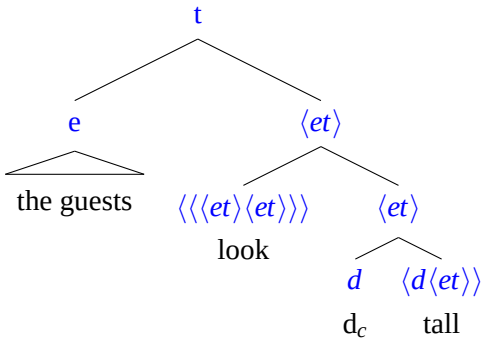
(30) a. Tall men

b. Many guests

The difference, Hackl proposes, is that *MANY* cannot be type-shifted to behave predicatively, whereas *tall* can. The composition for the sentences in (28) are shown below. In (31), *tall* is shifted to its predicative version (Hackl 2000, p. 81) and combines with a contextually-supplied degree.

(31) a. The guests look tall.

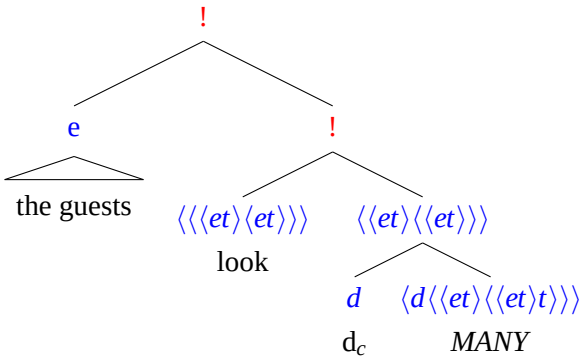
b.



In (32), no comparable type-shift is available for *MANY* and the derivation fails.

(32) a. *The guests look many.

b.



A possible objection to this can be seen in (33), where *MANY* occurs in what might appear to be a predicative post-copular position.[83]

(33) The guests were many women. (Hackl 2000, p. 97)

Hackl, however, claims copular constructions do not provide reliable tests for predicate status.[84] To account for this felicity in copular constructions, I will assume that these copular constructions involve a type shift, shown in (35).[85]

I follow Heycock and Kroch (1999) in assuming that specificational pseudoclefts like (20) are equative constructions where the copula joins two elements of type e or two elements of type $\langle et \rangle$ ((22) is simply predicative). I further follow them in assuming that only quantifier phrases that introduce an individual or group referent can appear in post-copular position. (See Beghelli (1995) for discussion of these different quantifier phrase types.)

(34) a. What John served was a/one sandwich. (individual)
b. What John served was {some/several/five/most of the} sandwiches. (group)
c. ??What John served was {less than five/more than five} sandwiches.

The individual/group quantifier phrase contributes a referent of type e in these constructions.[86] I assume that this is accomplished via the copular type-shift in (35). Essentially, this type-shift serves to saturate one of $[\![\textbf{\textit{MANY}}]\!]$'s $\langle et \rangle$ arguments.

(35) $[\![\textbf{be}]\!] = \lambda f_{\langle\langle et\rangle t\rangle}.\lambda x.\iota y[f(\lambda z.z = y)] = x$

(36) a. What John served was approximately fifty sandwiches. = (20)

---

[83] Again, this pattern holds for all uses of *MANY*, including the ones illustrated above, cf. (i).

(i) *The guests were ({more than/exactly/approximately}) 20 (people).

[84] For example, as Williams (1983) notes, predicates and generalized quantifiers alike can appear in copular constructions like (i). See also Partee (2008)'s BE operator, which shifts generalized quantifiers to predicates.

(i) This house has been $\{\underbrace{\text{red}}_{\langle et\rangle} / \underbrace{\text{every color}}_{\langle\langle et\rangle t\rangle}\}$.

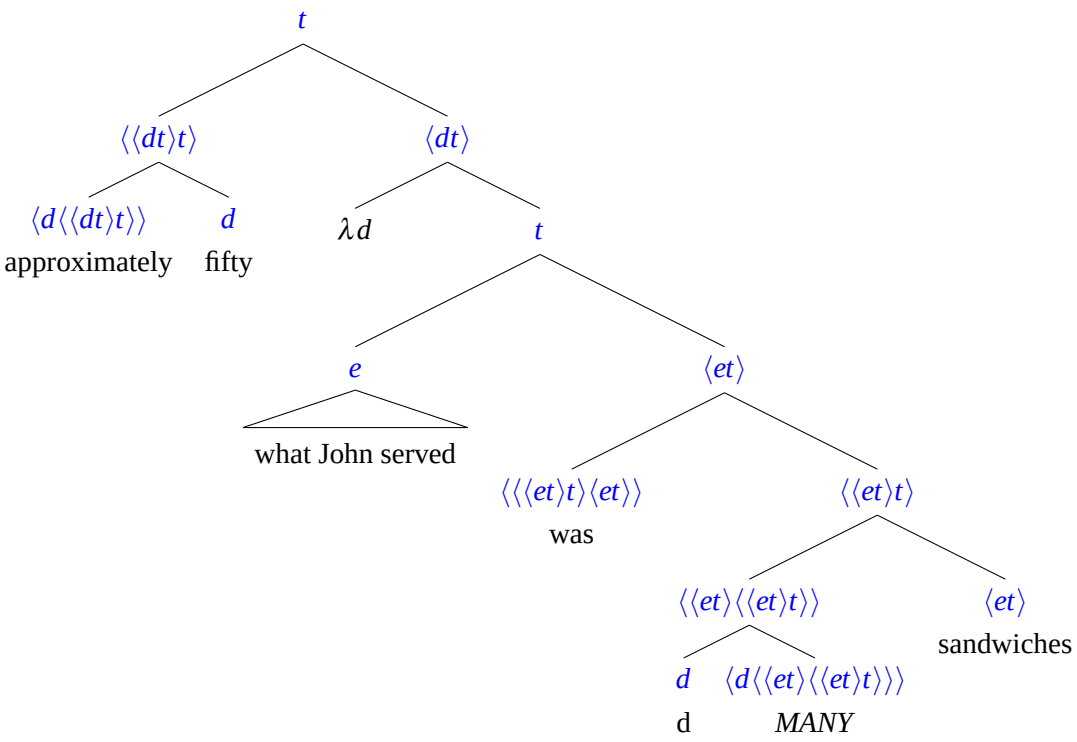
Additionally, equative and specificational copular constructions as in (ii) appear to take referential expressions.

(ii) a. Clark Kent is $\underbrace{\text{Superman}}_{e}$. (equative)
b. The winner is $\underbrace{\text{John}}_{e}$. (specificational)

[85] Section 4.3.4 on page 118 will entertain the possibility of *approximately* et al. modifying the verb, not the degree.

[86] See, e.g. Devlin (1997); Moxey and Sanford (1993), for discussion of how this referent is introduced. In Discourse Representation Theory, this class of quantifiers introduces a discourse referent that can be referred to anaphorically.

b.



4.3.3 Coerced scalars

While the account above only handles degrees of cardinality, modifiers like *exactly* and *approximately* can modify other scalars, as in (37).

(37) a. You're exactly right.
b. His solution is approximately correct.
c. Their revenue was exactly halved by the merger.
d. The dough approximately tripled in volume.
e. They told exactly the same story.

They can also modify expressions that have been coerced into scalars, as in (38).

(38) a. What John served was approximately beef stroganoff.
b. They knew exactly the point I was trying to make.
c. Mary's explanation was approximately my reasoning as well.
d. It was exactly what a scone should be.

Hackl's analysis requires some expansion before it can be applied to sentences like these. First, I will treat coerced scalars as degrees, much like *fifty*. As for their scale, I will assume it to be one of prototypicality (cf. prototypicality modifiers like *real* and *true* in Morzycki (2012)). Scalar *beef stroganoff* then will denote a degree on a scale of beef stroganoff-ness.

Second, we cannot use *MANY* with these constructions, since it requires plural predicates and involves counting over atomic parts. Instead I assume another phonologically-null degree function

MUCH along the lines of *MANY*, but which references scale degrees instead of cardinalities.[87] In fact, *MUCH* could replace *MANY* if we consider cardinalities to be degrees on a cardinality scale (which would presumably be the relevant scale for numerals). This would probably be advantageous for several reasons. First, since *MUCH* can do all the work of *MANY*, including only *MUCH* in the lexicon would be more parsimonious. Further, maintaining two separate degree functions emphasizes a deep split between count and mass nouns, but this distinction is not present in all languages.

Note that, similar to the plurality requirement in *MANY*, *MUCH* should contain a requirement that f have more than d=0. Also, *MUCH* can be used for non-numeral non-coerced scalars, like *dry*.

(39) $[\![\textbf{\textit{MUCH}}]\!] = \lambda d \in D_d.\lambda f \in D_{\langle et\rangle}.\lambda g \in D_{\langle et\rangle}.\exists x : f(x)$ & $g(x)$ & x falls at d on the scale associated with d

As with *MANY*, *MUCH* can only be used attributively. Thus it cannot appear in the complement of *look* or *consider*, which require predicative ($\langle et\rangle$) arguments.[88]

(40) a. John looks tall.
b. *The guests look many.
c. *The water looks much.

(41) a. Mary considers John tall.
b. *Mary considers the guests many.
c. *Mary considers the water much.

Finally, sentences like *What John served is approximately beef stroganoff* appear to be predicative, not specificational, constructions (cf. *What John served was tasty*). Higgins (1979) demonstrates the difference between predicational and specificational pseudoclefts with examples like (42), which are ambiguous between a predicational and a specificational reading. The predicational reading is given in (42a), where *food for the dog* describes the things that John didn't eat. The specificational reading is given in (42b), where *food for the dog* IS the thing he that failed to eat (and still would have been had John eaten it).

(42) What John didn't eat was food for the dog.

---

[87] I am using degrees instead of intervals primarily to be maximally parallel to Hackl.

[88] Some speakers report that *much* is felicitous in the complement of *consider* in negative contexts like (i), perhaps due to interference from the reading where *much* quantifies of over *consider* events, cf. *often*.

(i) %John doesn't consider salary offer much.

a. predicational: ‘the thing(s) John did not eat served to feed the dog’
b. specificational: ‘John did not eat the following: dog food’

In (43), note that the predicational reading is preferred over the specificational reading.

(43) What John served was approximately beef stroganoff.
a. ✓ predicational: ‘the thing John served served as (approximately) beef stroganoff’
b. × specificational: ‘John served following: (approximately) beef stroganoff’

In (44), the situation is reversed.

(44) What John served was approximately 50 sandwiches.
a. × predicational: ‘the thing John served served as (approximately) 50 sandwiches’
b. ✓ specificational: ‘John served following: (approximately) 50 sandwiches’

Sentences like (42) can be disambiguated through conjunction. When *food for the dog* is conjoined with a predicative item, like *high in protein* in (45), the predicational reading of the sentence is preferred.

(45) What John didn’t eat was (both) high in protein and food for the dog.
a. ✓ predicational: ‘the thing(s) John did not eat served to be high in protein and feed the dog’
b. × specificational: ‘John did not eat the following: high in protein, dog food’

When conjoined with a referential noun phrase, the specificational reading is preferred.[89]

(46) What John didn’t eat was (both) the spoiled milk and food for the dog.
a. × predicational: ‘the thing(s) John did not eat served as the spoiled milk and feed the dog’
b. ✓ specificational: ‘John did not eat the following: spoiled milk, dog food’

I argued above that *approximately beef stroganoff* is predicative, while *approximately 50 sandwiches* is not, and this is further suppored by conjunction patterns. The predicate *approximately beef stroganoff* can conjoin with predicates to give a richer description, as in (47), where *delicious* and *approximately beef stroganoff* describe the dish that John served.

(47) What John served was (both) delicious and approximately beef stroganoff. (predicational pseudocleft)

[89]Note that a non-referential interpretation is possible for *the milk* (e.g. *The food that John didn’t eat served as a stand-in for the spoiled milk and dog food in the tableau Sydney was painting.*)

a. ✓ predicational: 'the thing John served served as delicious and (approximately) beef stroganoff'
b. × specificational: 'John served following: delicious, (approximately) beef stroganoff'

Sentences like (48), where *approximately beef stroganoff* combines with a non-predicate are degraded.[90]

(48) ?What John served was (both) the spoiled milk and approximately beef stroganoff. (predicational pseudocleft)

When a non-predicate is conjoined with *50 sandwiches*, however, no such degradation occurs.

(49) What John served was (both) spoiled milk and 50 sandwiches.

Note further that these conjoined non-predicate expressions, instead of describing the same item, describe two independent components of what John served. In (50), for example, a cooperative speaker expresses that John served (approximately) 100 items, not 50.

(50) What John served was (both) 50 hoagies and 50 sandwiches. (specificational pseudocleft)
a. × predicational: 'the thing John served served as (approximately) 50 hoagies and (approximately) 50 sandwiches'
b. ✓ specificational: 'John served following: (approximately) 50 sandwiches, (approximately) 50 sandwiches'

Finally, observe that when *50 sandwiches* is conjoined with a predicate, the sentence is degraded.

(51) ?What John served was (both) delicious and 50 sandwiches.

Overall, this data unequivocally argues for treating *approximately beef stroganoff*, but not *approximately 50* predicatively.

To fit *approximately beef stroganoff* into a predicative construction, I employ the shift in (52), where a generalized quantifier is shifted to a predicate of type $\langle et \rangle$. Essentially, this type-shift serves to saturate both of $[\![\textbf{\textit{MUCH}}]\!]$'s $\langle et \rangle$ arguments.

(52) $[\![\textbf{be}]\!] = \lambda q_{\langle\langle et\rangle\langle\langle et\rangle t\rangle\rangle}.\lambda y.q([\lambda x.x = y])([\lambda x.x = y])$

This shift is built into the copula in the derivations below.

In (21), *much* can take *beef stroganoff* (type d) and $[\lambda x.$ John served $x]$ (type $\langle et \rangle$) as arguments, but it is still missing an argument of type $\langle et \rangle$ and is therefore unacceptable. This is illustrated

[90] Again, a predcative interpretation is possible for *the milk* (e.g. *The food that John served functioned as both the spoiled-milk course and the approximately-beef-stroganoff course*), but I am ignoring such readings.

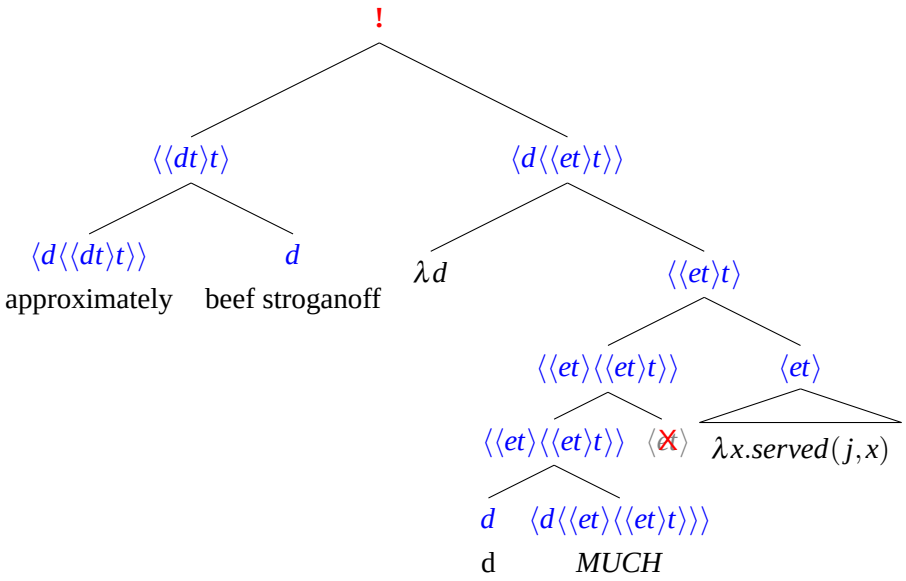
below, where *MUCH*'s (missing) $\langle et \rangle$ arguments are underlined.

(53) ??John served approximately beef stroganoff *MUCH* ____. = (21)

The failed composition is shown in (54), with X in place of the missing argument of type $\langle et \rangle$.

(54) a. ??John served approximately beef stroganoff.

b.

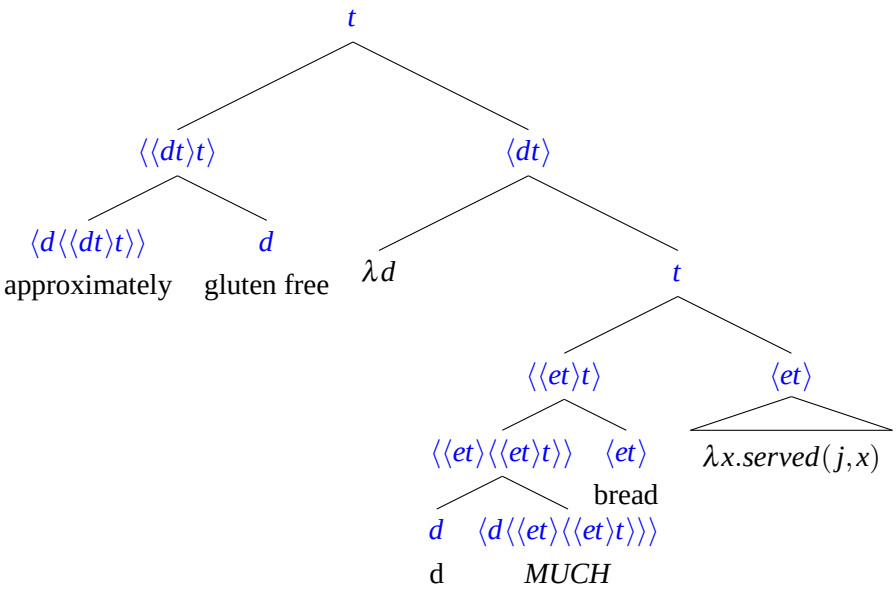


Note that when this 'missing' argument is present, the sentence is grammatical. This can be seen with coerced scalar adjectives, as in (55) where an additional NP argument (*bread*) is present.[91]

(55) a. John served approximately gluten-free bread.

[91] Providing an additional argument in (21) (e.g. *John served an approximately beef stroganoff dish*) does not result in a grammatical sentence, presumably because the coerced scalar is an NP, and NPs typically do not take such arguments.

b.

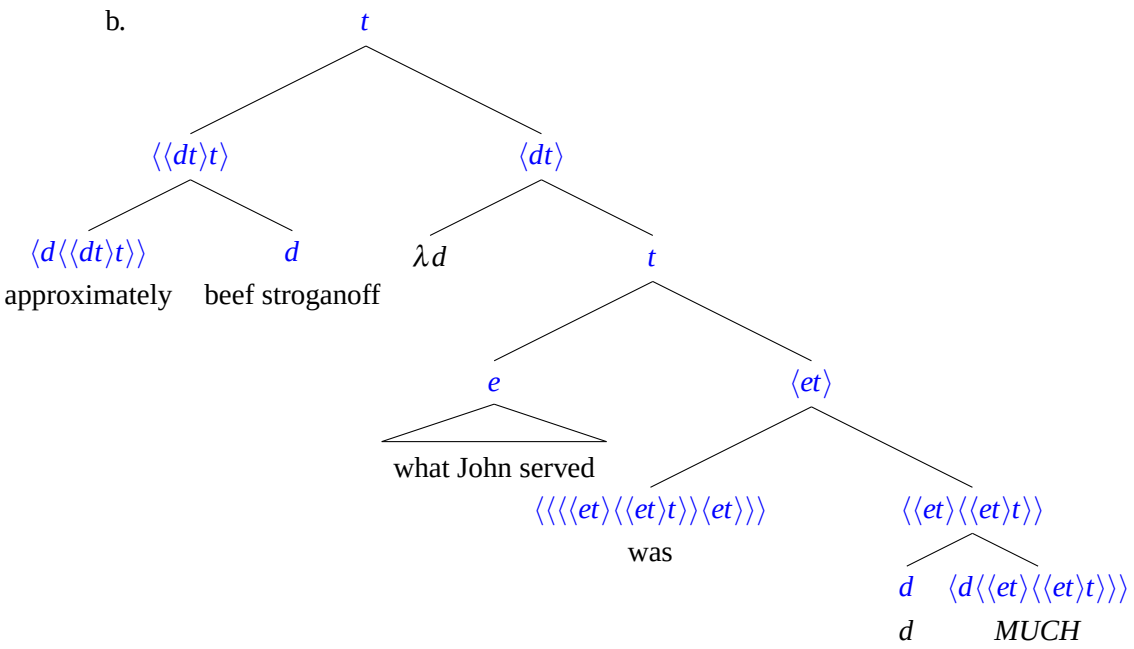


Given this explanation for the unacceptability of (21), the acceptability of (22), repeated below, may seem mysterious, since it too seems to be missing an argument of type $\langle et \rangle$.

(56) What John served was approximately beef stroganoff *MUCH* ____. = (22)

Recall, however, that Hackl does not consider post-copula positions to be strictly $\langle et \rangle$. Correspondingly, I employ the copula-specific type-shift from (52). Using this shift, the sentence in (22) has as its truth conditions $[\exists m_d \in \{y | bs + \sigma \geq y \geq bs - \sigma\}$ & $\exists x : x = wjs$ & x falls at m on the scale associated with $m]$, asserting that there is some degree m within a contextually-supplied distance from the prototype of beef stroganoff such that there is some x such that x is what John served and x falls at m on the scale associated with m.

(57) a. What John served was approximately beef stroganoff.



Expectedly, *approximately* with a coerced scalar is unacceptable as the complement of *look* and *consider*, mirroring the behavior of *many* in (28) and (29). This supports the idea that this type-shift is tied to the copula such that *many* cannot behave predicatively without a copula.[92]

(58) *That dish looks approximately beef stroganoff.

(59) *I consider that dish approximately beef stroganoff.

Note that coerced scalars are felicitous in other copular expressions, not just pseudoclefts.

(60) This dish is approximately beef stroganoff. (predicational)

In particular, they are felicitous in predicational copular constructions. They are not felicitous in equative ones like (61) or specificational ones like (62).[93] This is consistent with the type-shift proposed in (52) above, which outputs a predicate (⟨*et*⟩), while equative and specificational

[92] While nouns are unacceptable as the complement of *look* and *consider* in (58)-(59) (this is also true for gradable nouns like *idiot*), adjectives show a different pattern.

(i) That glass looks (approximately) full.

(ii) I consider that glass (?approximately) full.

While I leave this to future work, this again appears to be a case where measure-phrase category does matter, as I hypothesized in *John served an approximately {#beef stroganoff/gluten free} dish*.

[93] Examples of each of these copular constructions from Geist (2008) are given below, with the semantic type of the underlined argument given in parentheses.

constructions require an individual (*e*).

(61) #Grandma's casserole is (the same thing as) approximately beef stroganoff. (equative)

(62) #The winner of the competition is approximately beef stroganoff. (specificational)

In sum, I assume that *approximately* is a Hackl-style degree quantifier which combines with *MUCH* and requires two arguments of type $\langle et \rangle$. The unacceptability of (21), repeated in (63), is due to a missing argument of *MUCH*. The acceptability of (22), repeated in (64) is due to a copula-specific type-shift such that *MUCH* is no longer missing an argument.

(63) ??John served approximately beef stroganoff.

(64) What John served was approximately beef stroganoff.

Approximately's cross-categorial behavior, modifying both natural and coerced scalars, is accounted for by adding *MUCH* to the inventory of degree functions, allowing modifiers to combine with degrees beyond those of cardinality.

4.3.4 A note on adverbs

The analysis above introduced the type-shift in (52) to handle coerced scalars. A potential alternative which avoids introducing this type-shift is to treat *approximately* in these cases as modifying not the noun (*beef stroganoff*), but rather the verb (*be*).

Consider (65) and (66), where the comparison with *allegedly* highlights the adverbial status of *approximately* in the sentences we have been considering.

(65) a. What John served was allegedly/approximately beef stroganoff.
b. What John served ?allegedly/?approximately was beef stroganoff.

(66) a. John served ??allegedly/??approximately beef stroganoff.
b. John allegedly/??approximately served beef stroganoff.
c. John allegedly/approximately doubled his income.

(i) predicational
John is a teacher. ($\langle et \rangle$)

(ii) equative
Mark Twain is Samuel Clemens. (*e*)

(iii) specificational
The murderer is John. (*e*)

In English, adverbs typically follow a light verb, as *allegedly*/*approximately* do in (65a). Adverbs typically precede a lexical verb, as they do in (66b). This is particularly clear with scalar verbs like *double*, as in (66c). Given this pattern, *approximately*'s acceptability in (65a) and unacceptability in (66a) may simply fall out from the general structural position of adverbs, without requiring an additional copula-specific type-shift. This suggests that *approximately* does not combine with coerced scalars. Sentences like (65a) are only available through *approximately* combining with verbs like copular *be*.

This account, which I will refer to as the Adverb Account, can thus explain the contrast between (65a) and (66a) without introducing an additional type-shift like (52), and this cause it to appear preferable. Note, however, that the Adverb Account is still forced to introduce an extra type-shift or multiple lexical items to account for uses as in (67), where *approximately* modifies a non-eventive scalar.

(67) a. Approximately 20 people came to the party.
b. The glass looks approximately full.

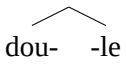
This alone does not fatally complicate the Adverb Account, but I will uncover a larger problem below.

If *approximately* is acting adverbially, what might it look like? Consider *approximately*'s effect on *doubled* in sentences like (66c). The verb *doubled* itself seems to convey that something increased until it reached twice its original measure. Accordingly, I assume that ⟦**double**⟧ takes an entity x and an event e and returns true if the size of x (along some relevant dimension[94]) becomes twice its original value by the end of e.

(68) $\llbracket \textbf{double} \rrbracket = \lambda x_e.\lambda e_v.size(x)$ increases in e s.t. $\frac{size(x) \text{ at } e_1}{size(x) \text{ at } e_0} = 2$

When *approximately* modifies *double*, it targets *double*'s 'twice' component (not its 'increase' component), suggesting that *approximately* modifies degree arguments. To allow this, I will decompose *double* as shown in (69), where ⟦**-le**⟧ combines with ⟦**dou-**⟧ to yield (68).

(69)



(70) $\llbracket \textbf{dou-} \rrbracket = 2$

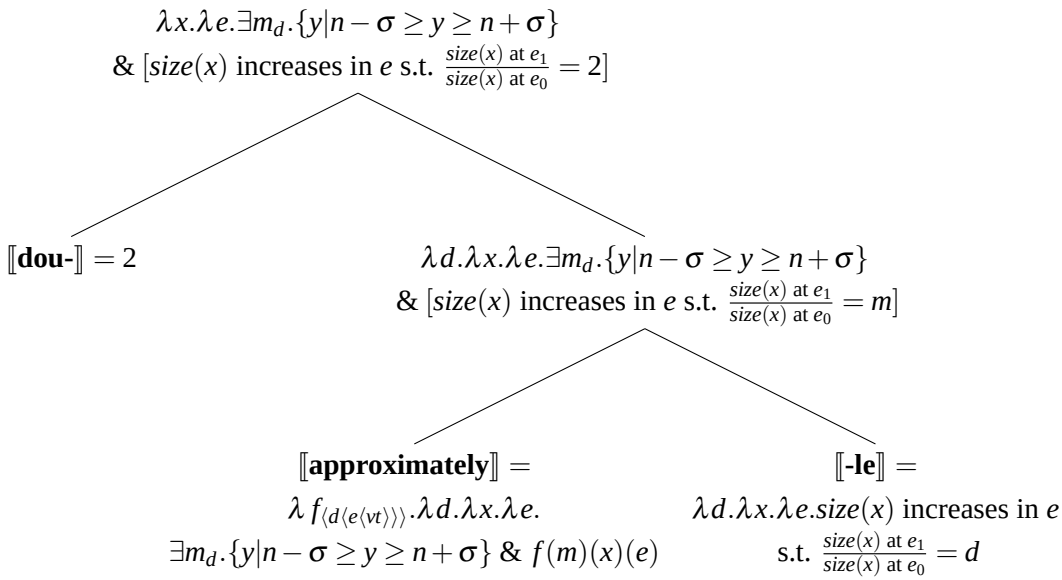
(71) $\llbracket \textbf{-le} \rrbracket = \lambda d.\lambda x.\lambda e.size(x)$ increases in e s.t. $\frac{size(x) \text{ at } e_1}{size(x) \text{ at } e_0} = d$

Now *approximately* can target the degree component of *double* through a denotation like (72), shown in (73).

[94] cf. *double in height/weight/*etc.

(72) $[\![\textbf{approximately}]\!] = \lambda f_{\langle d\langle e\langle vt\rangle\rangle\rangle}.\lambda d.\lambda x.\lambda e.\exists m_d.\{y|n-\sigma \geq y \geq n+\sigma\}$ & $f(m)(x)(e)$

(73)



In (73) we see that *approximately double* takes an entity x and an event e and returns true if the size of x becomes within σ of twice its original value by the end of e.

These appear to be satisfactory truth conditions for a sentence like (66c) but complications arise when applying the $[\![\textbf{approximately}]\!]$ in (72) to the copula. Most importantly, I know of no independent reason to believe that such verbs have degree arguments. If (72) is on track, then adverbial *approximately* cannot modify copulas, so quantifier *approximately* is required in sentences like (65a). The adverbial account, then, cannot account for the pattern in (65)-(66), and I maintain the analysis developed in 4.3.2-4.3.3 above wherein *approximately* is a degree quantifier that combines with a degree function (*MANY*, *MUCH*) and avails itself of type-shifts in copular constructions.

4.3.5 Summary

In this section I accounted for the cross-categorial behavior of *approximately* by introducing the degree function *MUCH*, which allows *approximately* to quantify over degrees other than degrees of cardinality. I also explained the contrast between (74)-(75) vs. (76)-(77) as being an issue of missing arguments. In (76)-(77), the coerced scalar *beef stroganoff* serves as a degree argument (like *50* in (74)-(75)), but a propositional argument (*sandwiches* in (74)-(75)) is missing. This is compensated for in (75) by a copula-specific type-shift, while (76), with no copula to provide a shift, is degraded.

(74) John served approximately 50 sandwiches.

(75) What John served was approximately 50 sandwiches.

(76) ??John served approximately beef stroganoff.

(77) What John served was approximately beef stroganoff.

4.4 *About*

Unlike *approximately*, *about* is not acceptable in either sentence types in (78)-(79).

(78) ??John served about beef stroganoff.

(79) ??What John served was about beef stroganoff.

The explanation I propose is simply that *about* cannot coerce scalar readings out of non-scalar predicates.[95] I then relate this to the analysis of *about* in Sauerland and Stateva (2007) and argue further for the epistemic account of *about* developed in Chapter 2.

4.4.1 Coercion

Like *approximately*, *about* is felicitous with a variety of non-numeral scalars.

(80) a. You're about right.
b. His solution is about correct.
c. Their revenue was about halved by the merger.
d. The dough about tripled in volume.
e. They told about the same story.

Unlike *approximately*, however, *about* appears to be infelicitous with scalars that require coercion, as in (81).

(81) a. ??What John served was about beef stroganoff.
b. ?That is about the point I was trying to make.
c. ?Mary's explanation was about my reasoning as well.
d. ?It was about what a scone should be.

The difference between *approximately* and *about*, I propose, is that unlike *approximately*, *about* does not coerce scalar readings. *About*, therefore, cannot combine with non-inherently-scalar terms like *beef stroganoff*.[96] Why this is the case is not immediately clear but may be related to the

[95] Recalling the discussion from Section 4.3.4, an alternative analysis based on adverb syntax is available for *about*. While *approximately* can modify scalar verbs, we might suggest that *about* cannot, leading to the contrast above.

(i) John served approximately/about 50 sandwiches. (num mod)

(ii) a. What John served was approximately/#about beef stroganoff. (verb mod)
b. John approximately/?about served 50 sandwiches. (verb mod)
c. What John served was approximately/about 50 sandwiches. (either)

[96] The same can be seen for other prepositions like *around* and *near*.

availability of non-scalar forms of *about*[97]:

(82) a. It's about to rain.
b. It's about time.
c. Tom moved about the room.
d. John talked about Mary.

These forms might contribute to a blocking effect; when *about* modifies a non-numeral, it may be interpreted as one of the above uses of *about* rather than allowing a coerced-scalar reading.

Asymmetry in the distribution of *approximately* and *about* has been noted before. Sauerland and Stateva (2007) claim that *approximately* freely combines with non-endpoint scalars, while *about* can only combine with non-endpoint scalars in the form of numerals and temporal expressions, as shown in (83) and (84) below (Sauerland and Stateva 2007, 241-2).

(83) a. #approximately dry/pure/white
b. approximately three/north/the same
c. #approximately beef stroganoff/a heap of wood

(84) a. about three, at about noon, at about midnight, at about the same time
b. #about clean/open/north

Note that Sauerland and Stateva intentionally avoid coerced scalar readings, so for their purposes *approximately beef stroganoff* is infelicitous. If we assume that *beef stroganoff* in (22) is coerced into a non-endpoint scalar reading, this distinction would account for the asymmetries in question: *beef stroganoff* as a non-endpoint scalar should be felicitous with *approximately*, but it is neither a numeral nor a temporal expression and therefore should be infelicitous with *about*, as is indeed the case. A sketch of a non-endpoint scalar reading of *beef stroganoff* is given in Figure 12.

4.4.2 Additional restrictions

Sauerland and Stateva's characterization of *about* as combining only with numerals and temporal expressions, however, is both too inclusive and too restrictive. There are many temporal expressions

---

(i) ??What John served was around/near beef stroganoff.

(ii) ??The towel John brought was around/near dry.

[97]To be clear, I do not assume that all uses of *about* involve the same lexical item. Instead, I suggest that the presence of non-scalar lexical entries with the same phonological form as scalar *about* causes us to resist forcing a scalar reading out of a non-scalar modified by *about*.

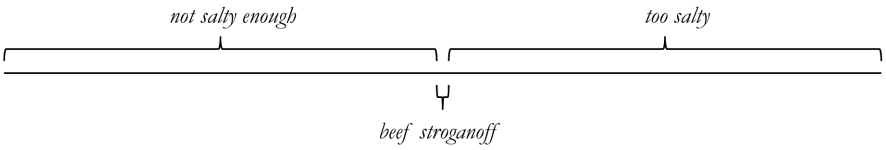


Figure 12: An example of *beef stroganoff* as a non-endpoint scalar, where position on the scale indicates amount of salt, an arbitrary dimension of variation

that *about* cannot modify.[98] In (85), for example, *about* is degraded when modifying temporal expressions like *Tuesday*, *Thanksgiving*, and *2010*.

(85) a. ?He'll arrive on about Tuesday.
b. ?It's about Thanksgiving.
c. ?The year is about 2010.

Additionally, there are non-numeral non-temporal expressions that *about* can occur with, particularly certain gradable adjectives like *full*, *empty*, and *straight* (recall also the data in (80)).

(86) a. about full/empty/straight/?dry/?certain/?closed/#invisible/#pure
b. about #wet/#visible

The data in (85), I propose, follow from *about*'s epistemic content. The data in (86), I propose, contain an independent form of *about* that acts similarly to *almost* and *just about*.

Epistemic content limiting distribution

Recall the evidence from Chapter 2 used to argue that *about* is an uncertainty marker. First, *about* is infelicitous when context establishes knowledge as shown in (87), where *about* (like fellow modal *maybe* but unlike near-synonym *approximately*) is infelicitous when the speaker is assumed to know his own age.[99]

(87) [The speaker is 26 years old, and the addressee is seeking a 25-year-old]

[98]Thanks to Gregory Ward (p.c.) for bringing these to my attention, as well as the fact that scale matters for felicity (cf. *I'm about {at the boarder/# in New York}*).

[99]This contrast with (i), where the speaker may not know his own age, and *about* is now felicitous.

(i) [The speaker is 26 years old but is suffering from amnesia such that he does not know his age, and the addressee is seeking a 25-year-old]
a. I'm approximately 25.
b. I'm about 25.
c. I'm maybe 25.

a. I'm approximately 25.
b. ?I'm about 25.
c. #I'm maybe 25.

Additionally, *about* interacts epistemically with epistemic predicates *might* and *seem*. For example, in (88) *about* (but not near-synonym *approximately*) gives rise to modal concord readings (Geurts and Nouwen 2007, a.o.).

(88) John is about six feet tall.
a. ≈ John might be about six feet tall.
b. ≈ John seems about six feet tall.

(89) John is approximately six feet tall.
a. $\not\approx$ John might be approximately six feet tall.
b. $\not\approx$ John seems approximately six feet tall.

About also interacts epistemically with rising intonation (following Chapter 3 and Zaroukian 2011b). For example, in (91) *about* (but not near-synonym *approximately*) gives rise to modal concord readings.

(90) Amy: How many books did John bring?
Ben:
a. 10?
b. About 10? ≈(90a)
c. About 10.

(91) Amy: How many books did John bring?
Ben:
a. 10?
b. Maybe 10? ≈(113a)
c. #Maybe 10.

(92) Amy: How many books did John bring?
Ben:
a. 10?
b. Approximately 10? $\not\approx$(92a)
c. Approximately 10.

Can *about*'s epistemic content explain (85)? Note that *about* improves when the context supports speaker uncertainty, and it worsens when context supports certainty. In the following examples, we will see that these sentences are infelicitous when they conflict with speaker knowledge, and they are improved if *about* is replaced with *approximately*, which has no epistemic component

(97), (94), (101a). We also see that the felicity of *about* improves when it appears in a context that supports speaker uncertainty in (98), (95), and (101a).

We begin with (85a), repeated below.

(93) ?It's about Thanksgiving.

Here, where the context is incompatible with speaker uncertainty, *about* is infelicitous, unlike *approximately*, as demonstrated in (94).

(94) You think today is Thanksgiving? It's November 30th, but I guess...
   a. today is *approximately* Thanksgiving.
   b. ?today is *about* Thanksgiving.

In (95), where the context is compatible with speaker uncertainty, *about* improves.

(95) a. Since it was right around the time my brother was born, I'd say it was about Thanksgiving.
   b. ?Since it was right around the time my brother was born, I'd say it was approximately Thanksgiving.

The same pattern can be seen for *Tuesday* and *2010* in (96) and (99).

(96) ?He'll arrive on about Tuesday.

(97) You think he'll arrive on Tuesday? He'll actually arrive on Monday, but I guess...
   a. he'll arrive on *approximately* Tuesday.
   b. ?he'll arrive on *about* Tuesday.

(98) a. John is stopping by our house on his cross-country bike ride. His schedule depends heavily on the weather, but he thinks he'll arrive on about Tuesday.
   b. ?John is stopping by our house on his cross-country bike ride. His schedule depends heavily on the weather, but he thinks he'll arrive on approximately Tuesday.

(99) ?The year is about 2010.

(100) You think the year is 2010? It's actually 2012, but I guess...
   a. the year is *approximately* 2010.
   b. ?the year is *about* 2010.

(101) a. Since it was right around the time my brother was born, I'd say it was about 2010.
   b. ?Since it was right around the time my brother was born, I'd say it was approximately 2010.

This epistemic behavior is captured in (103) and (102), where *about* and *approximately* differ in that only *about* directly expresses that the uttered numeral is epistemically possible, implicating

lack of speaker certainty.

(102) $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}$ & $D(m)$
'asserts that D is true of some degree m that falls within some contextually-determined distance σ from the uttered degree n'

(103) $[\![\textbf{about}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}$ & $D(m)$ & $\diamond D(n)$
'asserts that the D is true of some degree m that falls within some contextually-determined distance σ from the uttered degree n AND that the D is possibly true of n'

Just about

Returning to (86), maximum-standard adjectives (Kennedy and McNally 2005; Kennedy 2007), shown in (86a), seem more felicitous with *about* than minimum-standard adjectives do, shown in (86b). This may be because approximating a minimum-standard adjective results in something relatively trivial. That is, if any non-zero amount of water will cause something to be 'wet', the laxer *about wet* could be true of everything; a similar pattern holds for *approximately* and *exactly*.[100] This is sketched in Figure 13.[101]

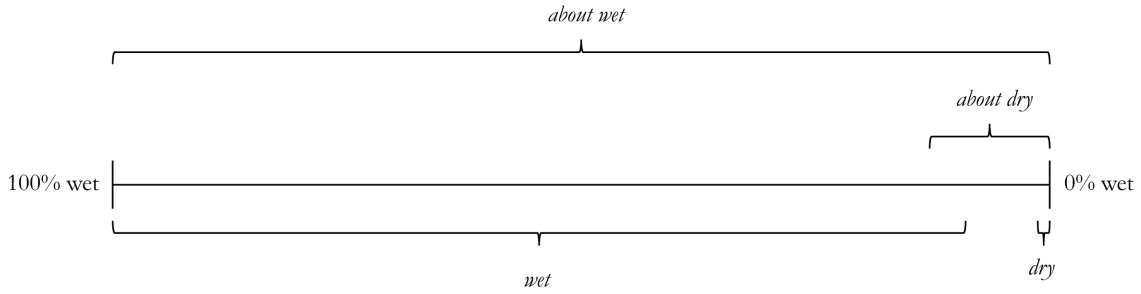


Figure 13: A scale of wetness, where the area covered by *about* can be seen to include the entire scale.

Still, not all maximum-standard adjectives are acceptable with *about* (e.g. *pure*).

(104) a. about full/empty/straight/?dry/?certain/?closed/#invisible/#pure
b. about #wet/#visible

[100]Note also that maximum-standard adjectives are more punctuated and precisifiable, like numerals and (acceptable, see previous footnote) temporal expressions.

[101]See also Burnett (2012), where she argues that minimum-standard adjectives are potentially vague (e.g. have borderline cases in some contexts) in their positive form (e.g. *dry*), while maximum-standard adjectives are potentially vague only in their negative form (e.g. *not wet*).

The explanation I pursue here involves comparison with similar *just about* forms. Note that with the addition of *just*, *about* has a wider distribution.

(105) a. just about full/empty/straight/dry/certain/closed/?invisible/pure
b. just about ?wet/?visible

Below I will refer to those maximum-standard adjectives acceptable with bare *about* as AFMs (*about*-felicitous maximum-standard adjectives, e.g. *full*), and I will refer to those maximum-standard adjectives not acceptable with bare *about* as AIMs (*about-in*felicitous maximum-standard adjectives, e.g. *pure*).

Given the wider distribution of *just about* compared with bare *about*, I pursue the idea that when bare *about* appears with an AFM, it is a conventionalized abbreviation of *just about*. If *about* appears with an AIM, no such conventionalized form is available. I argue for this in two ways below. First, I show that the interpretation of *about* with AFMs mirrors that of *just about* and not that of numeral-/temporal-expression-modifying *about*. Second, I bring in corpus data to suggest that *just about* occurs more often with AFMs than with AIMs, and I argue that such use is consistent with the conventionalization of a *just*-less form of *just about* for AFMs but not for AIMs.

Conventionalization and the interpretation of *about*

Just about is, as described by Morzycki (2001), an '*almost* modifier', a class that includes terms such as *almost*, *virtually*, *nearly*, *damn near*, *pretty much*, *not quite*, and *just about*. We can begin by observing that this class of modifiers is generally felicitous with maximum-standard adjectives.

(106) a. almost full/empty/straight
b. almost dry/certain/closed/invisible/pure

(107) a. virtually full/empty/straight
b. virtually dry/certain/closed/invisible/pure

(108) a. nearly full/empty/straight
b. nearly dry/certain/closed/invisible/pure

(109) a. damn near full/empty/straight
b. damn near dry/certain/closed/invisible/pure

(110) a. pretty much full/empty/straight
b. pretty much dry/certain/closed/invisible/pure

(111) a. not quite full/empty/straight
b. not quite dry/certain/closed/invisible/pure

(112) a. just about full/empty/straight
b. just about dry/certain/closed/invisible/pure

Almost, as described by Nouwen (2006), has both a proximal and a polar component, which can be seen in the sentence in (113). This sentence expresses that Travis came close to dying (proximal), but that he did not die (polar).

(113) Travis almost died.

a. Travis came close to dying (proximal)
b. Travis did not die (polar)

This polar component, while present, is backgrounded, as can be seen in the infelicity of (114a), particularly in comparison with (114b).

(114) a. #Fortunately, Travis almost died.
b. Fortunately, Travis did not die

Returning to AFMs, we see that bare *about* patterns with *almost* modifiers in expressing proximity. This is unsurprising, since *about* expresses proximity when combining with numerals and temporal expressions as well.

(115) a. almost full
b. just about full
c. about full
d. (about ten)

More interestingly, these uses of *about* continue to pattern with *almost* modifiers with respect to polarity: *about full* seems to express *not full*. Note that this polarity is not expressed with numerals/temporals.

(116) a. almost full $\rightarrow$ not full
b. just about full $\rightarrow$ not full
c. about full $\rightarrow$ not full
d. (about ten $\not\rightarrow$ not ten)

Additionally, this polar component is not prominent with this use of *about*.

(117) a. #Fortunately, the glass was almost full when it fell.
b. #Fortunately, the glass was just about full when it fell.
c. #Fortunately, the glass was about full when it fell.

Overall, this use of *about* patterns with *almost* modifiers instead of with numeral/temporal *about*. This supports the idea that this use of *about* is an *almost* modifier with a phonologically

null *just*. [102]

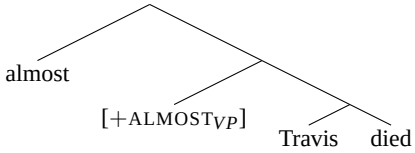
[102] Morzycki provides the following denotation for *almost*, which combines with the *almost*-licensing feature in (ii) (Morzycki 2001, p. 321).

(i) $[\![\textbf{almost}]\!] = \lambda w \lambda w'.\textsc{close}(w)(w')$

(ii) $[\![[\textbf{ALMOST}_{VP}]]\!] = \lambda P \lambda R \lambda e \lambda w.\neg P(e)(w) \wedge \exists w'[P(e)(w') \wedge R(w)(w') \wedge \forall w''[[w'' \leq_w w' \wedge P(e)(w'')] \rightarrow w'' =_w w']]$

The structural configuration of these items is given in (iii). Morzycki assumes, following Cinque (1999), that adverbs are licensed by a functional head and appear in the specifier of that head.

(iii)

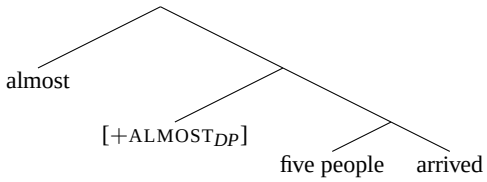


A sentence like *Travis almost died* evaluates as $\exists e.\neg died(Travis)(e)(w) \wedge \exists w'[died(Travis)(e)(w') \wedge close(w)(w') \wedge \forall w''[[w'' \leq_w w' \wedge died(Travis)(e)(w'')] \rightarrow w'' =_w w']]$, asserting that Travis did not die in the actual world, but there is some world w' in which he did die that is close to the actual world, and for all worlds w'' that are at least as close to the actual world as w' and where Travis died, then all the propositions true in both w'' and in the actual world are also true in w'.

Morzycki provides the following feature for DP-modifying *almost*:

(iv) $[\![[\textbf{ALMOST}_{DP}]]\!] = \lambda Q \lambda R \lambda P \lambda w.\neg Q(P)(w) \wedge \exists w'[Q(P)(w') \wedge \lambda x[P(x)(w)] = \lambda x[P(x)(w')] \wedge R(w)(w') \wedge \forall w''[[w'' \leq_w w' \wedge Q(P)(w'')] \rightarrow w'' =_w w']]$

(v)



Almost 5 people arrived evaluates to $\exists w'[5 - people(arrived)(w') \wedge \lambda x[arrived(x)(w)]] = [\lambda x[arrived(x)(w')]] \wedge close(w)(w') \wedge \forall w''[[w'' \leq_w w' \wedge 5 - people(arrived)(w'')] \rightarrow w'' =_w w']$, or there exists a world w' in which five people arrived and the set of people who arrived in the actual world is the same as the set of people who arrived in w', and for all worlds w'', if w'' is at least as close to the actual world as w' and 5 people arrived in w'', then all the propositions true in both w'' and in the actual world are also true in w'.

Morzycki's analysis of *almost* can most easily be extended to *just about* by assigning them identical denotations.

(vi) $[\![\textbf{almost}]\!] = [\![\textbf{just about}]\!] = [\![\textbf{about}]\!] = \lambda w \lambda w'.\textsc{close}(w)(w')$

To yield non-directional *about*, we can combine the denotation in (vi) with a new non-polar licensing feature, provided in (vii).

(vii) $[\![[\textbf{ABOUT}_{DP}]]\!] = \lambda Q \lambda R \lambda P \lambda w.\exists w'[Q(P)(w') \wedge \lambda x[P(x)(w)] = \lambda x[P(x)(w')] \wedge R(w)(w') \wedge \forall w''[[w'' \leq_w w' \wedge Q(P)(w'')] \rightarrow w'' =_w w']]$

This is not so different from the analysis of *about* developed in this chapter, as it likewise results in an epistemic possibility marker. It is not immediately clear that this lexical decomposition is desirable for *about*, and for the remainder I will maintain the analysis presented in this chapter and in Chapter 2.

Summary

In order to explain the behavior of *approximately*, I have provided a decompositional analysis of *approximately* such that, in the absence of a copula, it can only act attributively. The complete paradigm is repeated below.

(118) a. John served approximately 50 sandwiches.
b. John served about 50 sandwiches.

(119) a. What John served was approximately 50 sandwiches.
b. What John served was about 50 sandwiches.

(120) a. ??John served approximately beef stroganoff.
b. ??John served about beef stroganoff.

(121) a. What John served was approximately beef stroganoff.
b. ??What John served was about beef stroganoff.

The sentence in (120) is unacceptable because *MUCH* remains unsaturated, while the sentence in (22) is felicitous due to a copula-specific type shift that obviates this 'missing' argument. *Approximately* and *about* pattern differently with coerced-scalar nouns but not with numerals because *approximately* can coerce scalar readings out of non scalars, but *about* cannot.

This analysis provides new support for a decompositional approach to quantification. It also extends Hackl's approach to numerals, which (among other things) treats them as degrees modified by a possibly-null degree function, by extending it to coerced scalars like *beef stroganoff*. This analysis, however, raises a number of questions.

For instance, one might wonder whether separate *many*/*much* operators are necessary. On some level, they both relate degrees (of cardinality, beef-stroganoff-ness, etc.), so perhaps one unifying operator could be posited. Note, however, that *many* is restricted to pluralities and atomic counts of items, not degrees (e.g. sandwiches, not cardinalities), while *much* is restricted to degrees (e.g. of beef-stroganoff-ness), not items (e.g. things John served).

Perhaps more interesting is the question of *why* modifiers like *approximately* can appear with coerced scalars while modifiers like approximative *about* cannot, as in (122).

(122) What John served as approximately/#about beef stroganoff.

Furthermore, why do maximum standard adjectives pattern like coerced scalars in their ability to be modified?

(123) What John dropped as approximately/#about full.

This data provides an interesting avenue for future work on nominal/adjectival coercion, as well as theories of quantification.

4.4.3 Summary

In this section, I discussed a number of distributional asymmetries between different uses of *approximately* and *about*. Asymmetries in the use of *approximately* are reflective of its status as a degree function, and its cross-categorial behavior was attributed to its ability to combine with degrees other than those of cardinality via *MUCH*. *About* showed a different distribution due to a) its inability to coerce scalar readings and b) its ability to surface as a phonologically-reduced form of *just about*.

I also revisited the surprising way *about* interacts with modals (*might*) and *seem*, patterning differently from *approximately*. This builds on the discussion of *about* in Section 2.5.3 (p. 59) which argued that *about* is an epistemic possibility modal, which I formalized in this chapter in (103).

Approximately and *about* are not unusual in displaying the asymmetries targeted in this chapter; rather, they represent two classes of modifiers. The first class, represented by *approximately*, can appear with coerced scalars. This is demonstrated in (125).

(124) John served / What John served was { approximately, exactly, (roughly), just about, almost, maybe, etc. } 50 sandwiches.

(125) ??John served / What John served was { approximately, exactly, (roughly), just about, almost, maybe, etc. } a sandwich.

While these modifiers can all all appear with coerced scalars, they are by no means a homogeneous group. For example, there are both modal and non-modal modifiers, as we can see from the diagnostics from Chapter 2. In (126), these non-modal modifiers do not appear to allow a concord reading, unlike the modal modifiers in (127).

(126) a. John might be {approximately/exactly/almost/just about} six feet tall.
b. John seems {approximately/exactly/almost/just about} six feel tall.

(127) a. John might be {maybe/like} six feet tall.
b. John seems {maybe/like} six feel tall.

Similarly, from earlier in this chapter we see that the non-modal modifiers are consistent with the

modified scalar being impossible, while modal modifiers are not:

(128) A: John is 20.
B: No, he's 19, though that means he's {*approximately*/*almost*/*just about*} 20.
B′:#No, he's 19, though that means he's {*maybe*/*like*/*about*} 20.

The second class, represented by *about*, does not appear with coerced scalars, as demonstrated in (130).

(129) John served / What John served was { about / around / (near) / less than / etc. } 50 sandwiches.

(130) ??John served / ??What John served was { about / around / near / less than / etc. } a sandwich.

This class likewise appears to contain both modal and non-modal modifiers. In the following diagnostic from Chapter 2, these modal modifiers in (131) appear to allow a concord reading, while the non-modal modifiers in (132) do not.

(131) a. John might be about six feet tall.
'John is somewhere in the ballpark of six feet.'
b. John seems about six feel tall.
'As far as I can tell, John is six feet tall.'

(132) a. John might be around six feet tall.
'It is possible that John is approximately six feet tall'
b. John seems around six feel tall.
'As far as I can tell, John is close to six feet.'

However, both modal and non-modal modifiers are inconsistent with the modified scalar being impossible.[103]

[103]This does not seem to be about an inability to bear contrastive stress.

(i) A: Twenty people came.
B: Twenty *exactly*, or do you mean *around*/*about* twenty?

	felicitous with coerced scalars	**infelicitous with coerced scalars**
modal	*maybe* *like*	*about*
non-modal	*approximately* *exactly* *roughly* *just about* pragmatic slack/halos/roundness	*around*

Table 8: Summary of modifier categorization by modal status and ability to modified coerced scalars

(133) A: Ben is 20.
B: No, he's 19, though that means he's ??*around*/??*about* 20.

These two classes of modifiers (those that appear with coerced scalars and those that do not) are shown cross-cutting the modal/non-modal distinction in Table 8.

In the next section I will discuss another modifier that, like approximative *about*, only appears with numerals.

4.5 *A good* measure

Here we will discuss a more-certain modifier that has received little attention[104], *a good*, which appears with measure phrases as in (134).

(134) John read a good ten books.

Here I propose that *a good* conveys two evaluations: a) that the speaker thinks the quantity under discussion is 'a lot', b) that the speaker thinks that quantity is likely. This allows us to account for its felicity in combination with other modifiers and allows us to draw parallels with other evaluative modifiers.

The analysis I provide follows a decompositional approach to quantifiers, as above, lending further support to this approach. Moreover, this illustrates another modifier that, like *about*, does not appear with coerced scalars. Unlike *about*, however, *a good* is best classified as a degree function (a la *MANY*), not a degree quantifier.

[104]Though see Bolinger (1972, pp. 37, 54, 150n), where he suggests that *good* refers to sufficiency, fullness, or intensification.

4.5.1 Distribution

To begin, let us assume a naive theory of *a good*, namely, one where *a good X* is roughly equivalent to *at least X* ($\geq X$). That has some intuitive appeal, but it quickly runs into problems when *a good* is used in combination with other modifiers, shown in (135).

(135) a. John read about a good ten books.
b. John read at least a good ten books.
c. #John read at most a good ten books.
d. ?John read more than a good ten books.
e. #John read less than a good ten books.

Comparing (135) to (136), the $\geq X$ meaning of *a good* is supported by its relative felicity with *about* and infelicity with *at most*/*more than*/*less than*. It is surprising, however, that (135b) does not appear redundant, while (136b) does, indicating that *a good* does not merely mean *at least*.

(136) a. John read about at least ten books.
b. ??John read at least at least ten books.
c. #John read at most at least ten books.
d. ?John read more than at least ten books.
e. #John read less than at least ten books.

There are other ways in which *a good* has a similar distribution to *at least*, as shown in (137).

(137) a. David is a good 6 feet tall(er than Kate).
b. David is at least 6 feet tall(er than Kate).

However, *a good* requires a quantity to directly modify, while *at least* is more flexible. In (138), we see that *a good* cannot directly modify the adjective *tall*, while *at least* can[105].

(138) a. *David is a good tall.
b. %David is at least tall.

In (139), we see that *a good* cannot be stacked on top of another modifier like *about*, while *at least* can.

(139) a. *John read a good about ten books.
b. John read at least about ten books.

[105]Here, however, the comparison appears to be metalinguistics and is not height-specific, e.g. *David isn't a skilled basketball player, but he's at least tall*.

Contrastingly, in (140) we see that *about* can modify *a good*, while it cannot modify *at least*.

(140) a. John read about a good ten books. = (135a)
b. *John read a good at least ten books.

To account for the data in (135), I propose that *a good* carries two evaluative components which conflict with the modifiers in (135c)-(135e), but not with the modifiers in (135a)-(135b). To account for the data in (137)-(140), I propose that *a good* is a degree function a la *many* (Hackl 2000) and therefore requires a degree argument and it can be modified by degree quantifiers (e.g. *at least*, *about*) but it cannot modify them.

4.5.2 Analysis

As mentioned above, I claim that the pattern in (135) is due to a conflict between the evaluative content in *a good* and the directionality of the modifiers in (135c)-(135e). I express this evaluative content in the form of two presuppositions.[106]

(141) Evaluative content of *a good*
a. 'certainty component'– the speaker believes the quantity expressed is likely
presupposition: $\boxdot \#x = d$ (quantities is true in all closest worlds)
b. 'sufficiency component' – the speaker believes the quantity expressed is 'a lot'
presupposition: $\#x \geq d_s$ (quantity meets some salient threshold)

These presuppositions allow us to explain the pattern in (135). To see this, let us first look more closely at the other modifiers in (135).

It has been argued that some quantifiers are 'directed', with some like *a few* being 'positive' and some like *few* being 'negative' (Moxey and Sanford 2000; Sanford et al. 2001, 2007, a.o., see also discussion in Section 2.3.3). This can be seen in examples like those in (142) from Sanford et al. (2007).

(142) a. In the autobahn pile-up, a few people were seriously injured, which is a *good/bad thing.
b. In the autobahn pile-up, few people were seriously injured, which is a good/*bad thing.

The quantifiers *a few* and bare *few* seem to represent roughly the same quantity, but as (142) demonstrates, they have different felicity conditions. *A few* is taken to highlight its positive extent (more than zero), while *few* is taken to highlight its negative extent (less than many). Taking for granted

[106] This content does not pattern straightforwardly as either presupposition or conventional implicature. For simplicity, I assume that it forms presuppositions.

that we seek to minimize injury to others, in (142) the positive extent (more than zero) of injured people is highlighted (which is a bad thing), while in (142b) the negative extent (less than many) of injured people is highlighted (which is a good thing).

This same contrast can be seen with the modifiers in (135). *At most* and *less than* require 'minimizing' contexts, while *at least* and *more than* require 'maximizing' contexts (*about* is neutral). (The contexts below assume that we want to maximize the number of trees saved and minimize the number of trees lost.)

(143) Max. context

a. #Fortunately, at most five trees were saved. (negative)

b. Fortunately, at least five trees were saved. (positive)

(144) Max. context

a. #Fortunately, less than five trees were saved. (negative)

b. Fortunately, more than five trees were saved. (positive)

(145) Min. context

a. Fortunately, at most five trees were lost. (negative)

b. #Fortunately, at least five trees were lost. (positive)

(146) Min. context

a. Fortunately, less than five trees were lost. (negative)

b. #Fortunately, more than five trees were lost. (positive)

The patterns in (135) reflect the fact that the modifiers in (135c)-(135e) have a prominent directed component (> 10 or < 10, i.e. $\neq 10$), which conflicts with the certainty component of *a good* ($\boxdot \#x = 10$). *At most* and *less than* are negative and highlight < 10, so for *at most*, 10 is the least likely quantity, and for *less than*, 10 is not even possible. And while 10 is entailed by the positive *more than*, exactly 10 is impossible.

This pattern holds for other modifiers as well. The prominently negative modifiers *barely* and *few* are infelicitous with *a good*, as in (147) and (148).

(147) #barely a good ten (cf. Fortunately, John is barely sick)

(148) #a good few

Non-prominently negative modifiers like *almost* (Nouwen 2006) are felicitous, as in (149).

(149) almost a good ten (cf. #Fortunately, John is almost sick)

Positive modifiers like *many* are likewise felicitous, as in (150).

(150) a good many (positive)

This certainty component, then, begins to predict the pattern in (151), repeated below with the polarity of the modifier given in parentheses.

(151) a. John read about a good ten books. (positive)
b. John read at least a good ten books. (positive)
c. #John read at most a good ten books. (negative)
d. ?John read more than a good ten books. (positive)
e. #John read less than a good ten books. (negative)

If, as I claim, *a good* highlights the expressed quantity through its certainty component, its infelicity pattern with negative modifiers in (135) is expected. The negative modifiers highlight < 10, which conflicts with this certainty components predicting the infelicity of (135c) and (135e). The positive modifiers highlight > 10 and thus are predicted to be felicitous, so then why is (135d) infelicitous? After all, both *at least ten* and *more than ten* entail ten. If, as I claim, *a good* highlights the expressed quantity through its certainty component, its infelicity pattern with negative modifiers in (135) is expected. The negative modifiers highlight < 10, which conflicts with this certainty components predicting the infelicity of (135c) and (135e). The positive modifiers highlight > 10 and thus are predicted to be felicitous, so then why is (135d) infelicitous? After all, both *at least ten* and *more than ten* entail ten.

To see more clearly the difference between *at least* and *more than*, I will assume the analysis given by Geurts and Nouwen (2007). They propose that the 'superlative' modifiers *at most* and *at least* are modal, while the 'comparative' modifiers *less than* and *more than* are not.[107]

At least in (152) expresses that the speaker is certain that John read ten books, and it is possible that he read more.

(152) a. John read at least ten books.
b. $\Box\exists x[10(x) \wedge \mathit{book}(x) \wedge \mathit{read}(j,x)] \wedge \Diamond\exists x[\#x > 10 \wedge \mathit{book}(x) \wedge \mathit{read}(j,x)]$

At most in (153) expresses that the speaker thinks it is possible that John read ten books, and it is not possible that he read more.

(153) a. John read at most ten books.
b. $\Diamond\exists x[10(x) \wedge \mathit{book}(x) \wedge \mathit{read}(j,x)] \wedge \neg\Diamond\exists x[\#x > 10 \wedge \mathit{book}(x) \wedge \mathit{read}(j,x)]$

Less than in (154) simply expresses that the quantity of books that John read is less than ten.

(154) a. John read less than ten books.
b. $\exists n[n < 10 \wedge \#\mathit{books} = n]$

[107] Cummins and Katsos (2010) argue that this effect is pragmatic, not semantic. Nouwen (2010) argues that the contrast is in whether a modifier can express relations to definite amounts.

Similarly, *more than* in (155) simply expresses that the quantity of books that John read exceeds ten.

(155) a. John read more than ten books.
b. $\exists n[n > 10 \wedge \#books = n]$

Returning to (135b) and (135d), we can now see that *at least* and *a good* are working in harmony (they both assert $\Box 10$). *More than* and *a good*, however, are not ($\Box 10$ v. > 10), so it is not surprising that (135d) should be less felicitous that (135b).

I believe the patterns in (137)-(140), repeated in (156)-(159), reflect the fact that *a good* is a Hackl-style degree function. As such, it directly takes a cardinality as an argument and can be modified by degree modifiers like *at least* and *about*, but it cannot modify degree modifiers.

All of these are met in (156).

(156) a. David is a good 6 feet tall(er than Kate).
b. David is at least 6 feet tall(er than Kate).

In (157), the modifier does not directly combine with a cardinality, so we predict that *a good* will be unacceptable. (It's harder to say why *at least* is acceptable in (157), but this example may have to do with *at least*'s ability to combine with ostensibly non-scalar terms.)

(157) a. *David is a good tall.
b. %David is at least tall. (At least David is tall.)

A good cannot modify other degree functions like *about*, though the degree quantifier *at least* can.

(158) a. *John read a good about ten books.
b. John read at least about ten books.

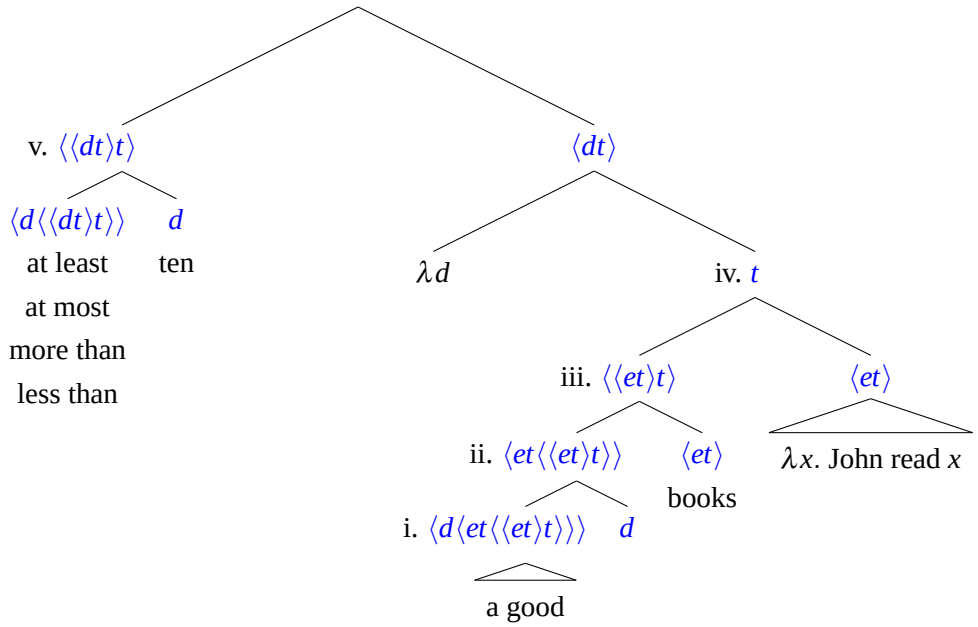
And *a good* can be modified by (otherwise compatible) degree quantifiers like *at least* and *about*, as in (135a)/(159) and (135b). *At least*, as a degree modifier, cannot be modified by other degree modifiers as in (159).

(159) a. John read about a good ten books.
b. *John read a good at least ten books.

The composition of the examples in (135) can be seen below in (161), where the degree function *a good* combines with a degree (*ten*), two predicates (*books* and *John read*), and a degree quantifier (*at least, at most, more than, less than*).

(160) $[\![\textbf{a good}]\!] = \lambda d_{Card}.\lambda f_{\langle et\rangle}.\lambda g_{\langle et\rangle}.\exists x : \#x \geq d_s \;\&\; \boxdot\#x = d\; [f(x) \;\&\; g(x) \;\&\; x$ has d-many parts in $f]$

(161)



i. $[\![\textbf{a good}]\!] = \lambda d_{Card}.\lambda f_{\langle et\rangle}.\lambda g_{\langle et\rangle}.\exists x : \#x \geq d_s$ & $\boxdot\#x = d$ $[f(x)$ & $g(x)$ & x has d-many parts in $f]$

ii. $[\![\textbf{a good } d]\!] = \lambda f_{\langle et\rangle}.\lambda g_{\langle et\rangle}.\exists x : \#x \geq d_s$ & $\boxdot\#x = d$ $[f(x)$ & $g(x)$ & x has d-many parts in $f]$

iii. $[\![\textbf{a good } d \textbf{ books}]\!] = \lambda g_{\langle et\rangle}.\exists x : \#x \geq d_s$ & $\boxdot\#x = d$ $[book(x)$ & $g(x)$ & x has d-many parts in $book]$

iv. $[\![\textbf{John read a good } d \textbf{ books}]\!] = \exists x : \#x \geq d_s$ & $\boxdot\#x = d$ $[book(x)$ & $read(j,x)$ & x has d-many parts in $book]$

v. $[\![\textbf{at least ten}]\!] = \lambda D_{\langle dt\rangle}.\Box D(10)$ & $\Diamond[\exists m > 10 : D(m)]$ (cf. Geurts and Nouwen 2007)

$[\![\textbf{at most ten}]\!] = \lambda D_{\langle dt\rangle}.\Diamond D(10)$ & $\neg\Diamond[\exists m > 10 : D(m)]$

$[\![\textbf{more than ten}]\!] = \lambda D_{\langle dt\rangle}.\#(\lambda n.D(n)) > 10$

$[\![\textbf{less than ten}]\!] = \lambda D_{\langle dt\rangle}.\#(\lambda n.D(n)) < 10$

vi. $[\![\textbf{(135b)}]\!] = \Box[\exists x : \#x \geq d_s$ & $\boxdot\#x = 10$ $[book(x)$ & $read(j,x)$ & x has 10-many parts in $book]]$ &
$\Diamond[\exists m > 10[\exists x : \#x \geq d_s$ & $\boxdot\#x = m$ $[book(x)$ & $read(j,x)$ & x has m-many parts in $book]]]$

$[\![\textbf{(135c)}]\!] =$ $\Diamond[\exists x : \#x \geq d_s$ & $\boxdot\#x = 10$ $[book(x)$ & $read(j,x)$ & x has 10-many parts in $book]]$ &
$\neg\Diamond[\exists m > 10$ $[\exists x : \#x \geq d_s$ & $\boxdot\#x = m$ $[book(x)$ & $read(j,x)$ & x has m-many parts in $book]]]$

$[\![\textbf{(135d)}]\!] = \#(\lambda n.[\exists x : \#x \geq d_s$ & $\underline{\boxdot\#x = n}$ $[book(x)$ & $read(j,x)$ & x has n-many parts in $book]])\underline{> 10}$

$[\![\textbf{(135e)}]\!] = \#(\lambda n.[\exists x : \#x \geq d_s \ \& \ \boxdot\#x = n \ [book(x) \ \& \ read(j,x) \ \& \ x \text{ has } n\text{-many parts in } book]]) < 10$

Evaluativity

Above, *a good* was treated as an evaluative modifier that signifies that the speaker considers its argument to be 'certain' and 'sufficient'. Instead, one may have expected *a good* to signify that the speaker evaluates the argument positively. Sentences like (162) suggest that *a good* indeed lacks this meaning (though, in sentences without a gradable adjective, intersective readings are possible, such that (137) would mean John read a set of things that were both good and books, but not necessarily 'certain' or 'sufficient').

(162) I've been sick a good two weeks now, and I've hated every second.

Other adjectives, however, can be substituted for *good* as in (163a) and contribute predictable meaning (e.g. *astonishing* – high on 'astonishing'-scale) instead of committing to the modified quantity being high, or even low (though see *a measly/piddling/*etc.). This parallels evaluative adverbs, as in (163b).

(163) a. The game was an astonishing four minutes/hours long.
b. The game was astonishingly long/short.

Even in a somewhat similar construction *good and* which carries a 'sufficient' ('thoroughly') meaning, the *good* here is contentful, indicating that the speaker is pleased.

(164) {Our prank made Chris/#That prank made me} good and irritated.

The role of *good* in *a good* is rather special in that it conveys the speaker's attitude about a quantity with respect to some notion of 'certainty'/'sufficiency' instead of conveying the speaker's attitude about 'goodness'.

In certain syntactic contexts, *well* can fill a similar role, indicating 'a lot' without indicating 'goodness'.[108]

(165) He got here well/a good while after ten o'clock. (Bolinger 1972, p. 37)

Modality

In previous chapters, I highlighted the modal components of modifiers though modal concord and discontinuous alternatives, and here I examine the modal component of *a good*. Because of the

[108]These are somewhat comparable to sufficiency readings (*well acquainted/equipped/read*) (Kennedy and McNally 2005, p.375) as well as to the spectrum in *well beyond/after/past/.../before/.../#near/#close*.

nature of *a good*, these diagnostics are less straightforward, but below we will see that they do support *a good*'s modal status.

First, sentences like (166) which require that any alternatives be discontinuous are felicitous with *a good*, but this is uninteresting in that (166) seems to lack alternatives completely (i.e. only allow exactly 30, presumably because it expresses certainty, not uncertainty).

(166) It's Susan's birthday today, and she's a good thirty years old.

Some speakers report that (166) allows 31 and possibly 32 as alternatives, evidencing modal behavior by licensing discontinuous alternatives. The fact that they are restricted to being greater than or equal the uttered numeral is consistent with the sufficiency component of the denotation I provide for *a good*.

If we choose a rounder number, alternatives seem possible, and the felicity of (167) suggests that *a good* does indeed allow discontinuous alternatives (in all the closest worlds, they would have been married $\sim$200 years minus intermediates).

(167) a. Today would have been my great-great-great-great-great-great-grandparents' anniversary. They would have been married for a good 200 years now.

b. #Today would have been my great-great-great-great-great-great-grandparents' anniversary. They would have been married for approximately 200 years now.

As with *about*, concord readings with *a good* are complicated by the fact that it is not purely a modal operator. This can be seen in (168), where (168a) and (168b) are not identical in semantic content (which is sketched below), but the semantic content of (168c) is very similar (presumably due to concord) to that of (168a).

(168) a. John read a good ten books.
$\exists x : \#x \geq d_s$ & $\boxdot \#x = 10$ [$book(x)$ & $read(j,x)$ & x has 10-many parts in $book$]

b. John definitely read ten books.
$\Box \exists x :$ [$book(x)$ & $read(j,x)$ & x has 10-many parts in $book$]

c. John definitely read a good ten books.
$\Box \exists x : \#x \geq d_s$ & $\boxdot \#x = 10$ [$book(x)$ & $read(j,x)$ & x has 10-many parts in $book$]

Additionally, *a good* is relatively infelicitous with uncertainty-expressing terms like *possibly*.

(169) a. John definitely read a good ten books.

b. ?John probably read a good ten books.

c. ??John possibly read a good ten books.

A similar pattern can be seen in (170), where *a good* (along with other certainty-expressing modifiers) are infelicitous uncertainty-expressing rising intonation.

(170) Amy: How many books did John read?
Ben:

a. #Definitely ten?
b. #At least ten?
c. #(He read) a good ten?
d. Definitely ten.
e. At least ten.
f. (He read) a good ten.

4.5.3 Summary

While previous discussion has focused on epistemic possibility modifiers like *maybe*, this section has presented a case of epistemic-necessity modal modification through *a good* and has highlighted some other components (particularly evaluativity) that can be involved in scalar modifiers. I have proposed that *a good* comments on the speaker's certainty as well as evaluation of the largeness of the quantity. This is of particular interest because the evaluation here is one strictly about certainty and quantity, not about goodness. Also, we saw that the distribution of *a good* with other (un)certainty markers supports idea of modality-sensitivity in vagueness. The distribution of *a good*, particularly in (137)-(140), likewise supports a decompositional analysis of quantifier where *a good* is a degree function, like *MANY* and *MUCH*.

I have left a few points about *a good*'s distribution unexplained. For example, like *approximately*, *a good* can modify nominals in addition to numerals[109], but unlike *approximately*, a nominal modified by *a good* must be quantificational (cf. *#a good beef stroganoff*), and may be to some degree conventionalized.[110]

(171) a. a good number of people
b. a good amount of coverage
c. a good sum of money
d. a good deal of time
e. a good length of time
f. a good dose of humility
g. a good chunk of resources

A troublesome offshoot of the data above is that, though I claim they are both degree functions, null *MANY* and *a good* are far from interchangeable, as demonstrated in (172).

[109]This is not surprising, given the presence of *a* and the adjectival status of *good*. More surprising is that *a good* can combine with numerals (cf. **John read a ten books*). In fact, some adjectives like *fair* can combine with nominals to give a quantificational reading (*a fair number of people*) but not numerals (**a fair ten people*) (though cf. *mediocre*).

[110]Note that *many* in phrases like *a good many of them* is most likely not the same as Hackl's null *MANY*, which should not co-occur with fellow degree function *a good*. Instead, this seems to be the non-comparative *many* as in *Many people came*.

(172) a. *at least *MANY* number of people (cf. *at least a good number of people*)
b. *approximately *MANY* amount of coverage
c. *about *MANY* sum of money
d. *more than *MANY* deal of time
e. *exactly *MANY* length of time
f. *less than *MANY* dose of humility
g. *at most *MANY* chunk of resources

This, however, seems largely to do with the lack of a necessary determiner, as shown by the improved acceptability of the data in (173). They are perhaps not fully acceptable due to these quantities being too vague to modify in these ways.

(173) a. ?at least a number of people (a number of people)
b. ??approximately an amount of coverage (?an amount of coverage)
c. ??about a sum of money (a sum of money)
d. ?more than a deal of time (a deal of time)
e. ??exactly a length of time (?a length of time)
f. less than a dose of humility (a dose of humility)
g. at most a chunk of resources (a chunk of resources)

This brings up the the matter of the internal structure of *a good*. I have treated this as a single unit, and in a number of ways it does act as an idiom. Notably, *a good* cannot be replaced with similar expressions, demonstrated in (174).

(174) a. John read a good ten books.
b. ?John read the good ten books. (intersective reading only)
c. ?John read every good ten books. (intersective reading only)
d. ?John read those good ten books. (intersective reading only)

In these examples where *a* is replaced with a different functional item, only an intersective reading is possible (i.e. the books were good, as opposed to bad).

The details, however, I leave to future research.

4.6 Conclusion

In this chapter I provided a decompositional analysis of *approximately* and *about* that accounted for the (lack of) cross-categorial behavior of these modifiers in (175)-(176).

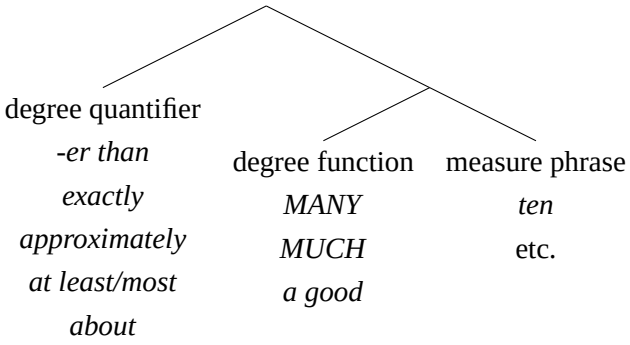
(175) a. John served approximately/ about 50 sandwiches.
b. John served #approximately/#about beef stroganoff.

(176) a. What John served was approximately/ about 50 sandwiches.
b. What John served was approximately/#about beef stroganoff.

Approximately is able to modify non-numerals (e.g. *beef stroganoff*, *correct*) by coercing them into appropriately scalar expressions. The distribution of *approximately* also reflects its argument structure (*approximately 50/beef stroganoff* requires an additional argument, e.g. *sandwiches*, before combining with the remained of the sentence) and the availability of a copular type-shift (which obviates the need for this additional argument). The narrower distribution of *about* is a result of its inability to coerce scalar readings.

As hypothesized in Chapter 1, this analysis involves a fixed set of parts that combine in various ways: a degree function (*MANY*, *a good*), a measure phrase (*ten*, *three*, etc.), and optionally a degree quantifier (*-er than*, *exactly*, *approximately*, etc.), shown in (177).

(177)



However, do these parts combine in predictable ways? Where *MANY* is involved, these terms combine in predictable ways (i.e. any combination of *MANY* + measure phrase + degree quantifier is licit).

(178) a. *MANY*-er than ten (more than ten)
b. exactly ten-*MANY*
c. approximately ten-*MANY*
d. at least/most ten-*MANY*
e. about ten-*MANY*

MUCH also seems to combine in predictable ways when modifying a (non-coerced) scalar term like *full*. While *full* is a maximum-standard adjective, note that it is being used as a midpoint expression (like numberals and other coerced scalars) in these examples. Note, also, that when *about* combines with these scalars, it is the directional, not the approximative *about* (e.g. *about full* $\rightarrow$ not full).

(179) a. *MUCH*-er than full (more than full)
b. exactly full-*MUCH*
c. approximately full-*MUCH*
d. at least/most full-*MUCH*
e. about full-*MUCH* (directional *about* only)

This pattern changes when *MUCH* combines with a coerced scalar. I tie this to their using a closed prototype scale, not allowing for an open one (or imprecision).

(180) a. #*MUCH*-er than beef stroganoff (more than beef stroganoff)
b. exactly beef stroganoff-*MUCH*
c. approximately beef stroganoff-*MUCH*
d. #at least/#most beef stroganoff-*MUCH*
e. ??about beef stroganoff-*MUCH*

When we consider *a good*, which I claim is likewise a degree function, judgments become more complicated.

(181) a. *a good-er than ten (a better than ten) (! cf. more than a good)
b. exactly a good ten (syn fine)
c. approximately a good ten (syn fine)
d. at least/most a good ten (syn fine)
e. about a good ten (syn fine)

Most of the examples above seem syntactically fine (though may contain conflicting semantic/pragmatic information, as discussed in Chapter 4), except when comparative morphology is applied directly to *a good*.

The degree quantifier *-er than* picks out the maximal element and asserts that it is greater than the supplied measure phrase.

(182) $[\![\textbf{-er than n}]\!] = \lambda D_{\langle dt \rangle}.max(\lambda d.D(d) = 1) > n$

When it applies to *a good*, it does the same, but with added presuppositions. Though sentences like *John read a better than ten books* do not seem to be grammatical, very similar forms are attested in the Corpus of Contemporary American English (Davies 2008) and appear to have the meaning predicted by the analysis presented in this dissertation (i.e. 'more than' plus presuppositions of certainty and sufficiency).[111]

(183) "We are delivering better than 95 percent of the time," he added.

(184) The wind quickly decreased by continued blowing at better than 20 knots for another three hours, and visibility remained near nil.

(185) And with all the modifications I just made, I should be able to get better than 100 miles

[111] Possibly even the negative counterpart is attested. While there is no *a bad*, (i) seems to mean 'less than'. However, it doesn't seem to have a certainty or sufficiency component. Therefore, this is probably more along the lines of *a score that is worse than 75* (note that the *better than* examples appear to lose their certainty and sufficiency components when given a similar paraphrase).

(i) Never mind that no one has ever won the Masters after opening with a score worse than 75.

per gallon.

(186) Since 1980, only seven NBA teams have shot worse than 70 percent from the line during the regular season, and none made it beyond the first round of the playoffs.

While the picture is somewhat more complicated with *a good* (perhaps due to its grammaticalization), these components so far appear to combine as expected, supporting the compositional approach to quantifiers pursued here.

Generally, this chapter has served to a) support a decompositional analysis of quantifiers and b) identify a split among approximators regarding their ability to appear with coerced scalars. This split, which can be handled under a decompositional approach, as demonstrated above, makes new demands of any alternative proposal.

4.A Coerced scalars under GQ Theory

While I have emphasized the strengths of a decompositional theory like Hackl (2000), the data I have presented are not necessarily fatal to a GQ theory. The denotation for *approximately* in (26) can be written in a Keenan (1996)-style, shown in (187) and applied in (188).

(187) **(APPROXIMATELY FIFTY)(*A*)(*B*) = T** iff $|A \cap B| \in \{y | 50 + \sigma \geq y \geq 50 - \sigma\}$

(188) John served approximately fifty sandwiches.
(APPROXIMATELY FIFTY)([$\lambda x.sandwiches(x)$**],[**$\lambda x.served(j,x)$**]) = T** iff
$|[\lambda x.sandwiches(x)] \cap [\lambda x.served(j,x)]| \in \{y | 50 + \sigma \geq y \geq 50 - \sigma\}$

In (189), GQ theory exposes the same missing-argument problem that we saw in a decompositional theory (here I assume $||$ operates over degrees other than those of cardinality).

(189) ??John served approximately beef stroganoff.
(APPROXIMATELY BEEF STROGANOFF)(?,[$\lambda x.served(j,x)$**]) = T** iff
$|? \cap [\lambda x.served(j,x)]| \in \{y | bs + \sigma \geq y \geq bs - \sigma\}$

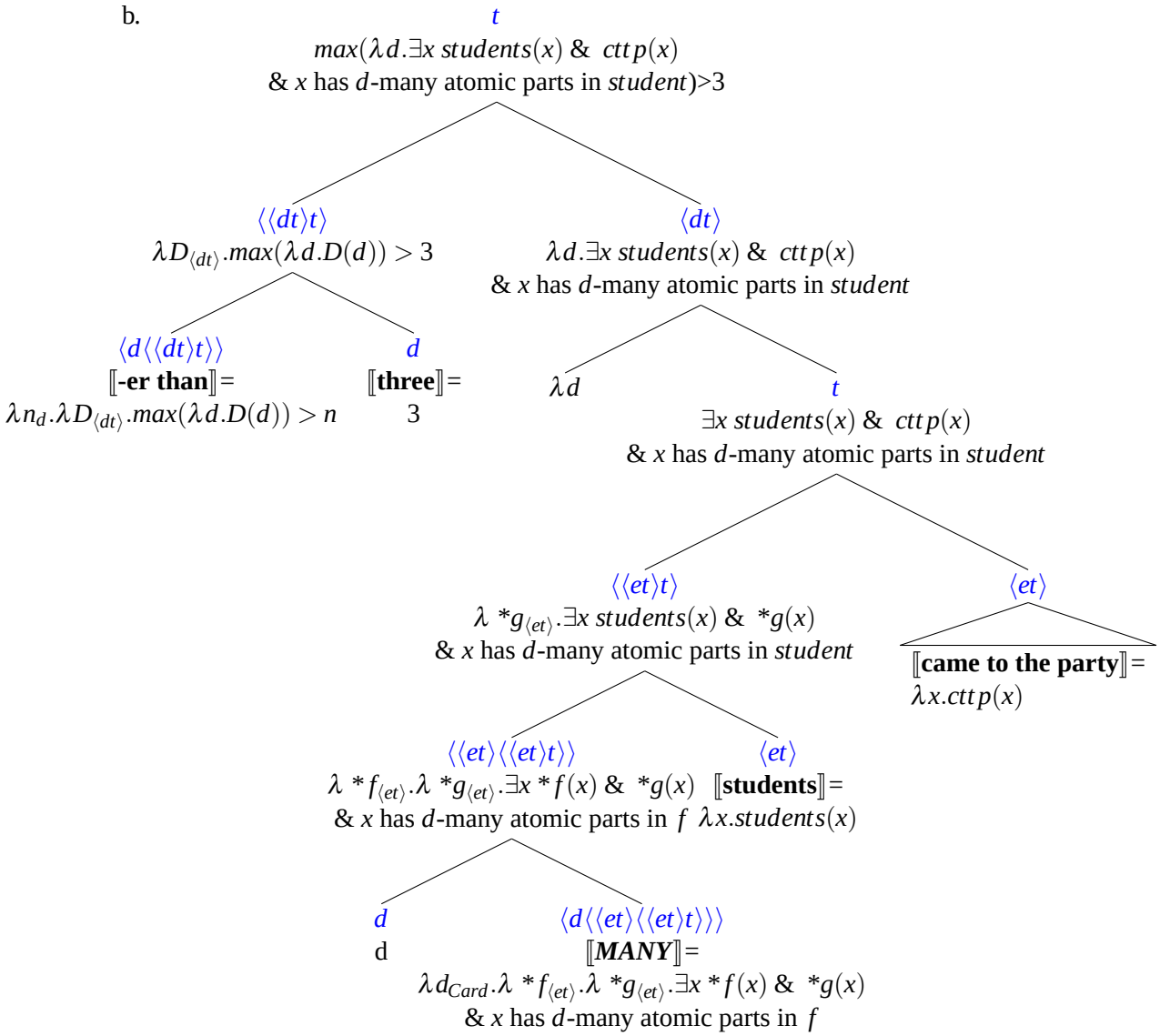
The ameliorating effect of the copula, might be accomplished in GQ theory using a similar type-shift (yielding something like **(APPROXIMATELY BEEF STROGANOFF)(A) = T** iff $|A| \in \{y | bs + \sigma \geq y \geq bs - \sigma\}$), though I know of no such independently-proposed GQ shifts.

(190) What John served was approximately beef stroganoff.
Shifted: **(APPROXIMATELY BEEF STROGANOFF)(**$\lambda x.served(j,x)$**) = T** iff
$|\lambda x.served(j,x)| \in \{y | bs + \sigma \geq y \geq bs - \sigma\}$)
Unshifted: **(APPROXIMATELY BEEF STROGANOFF)(?,[**$\lambda x.served(j,x)$**]) = T** iff
$|? \cap [\lambda x.served(j,x)]| \in \{y | bs + \sigma \geq y \geq bs - \sigma\}$

4.B Derivations

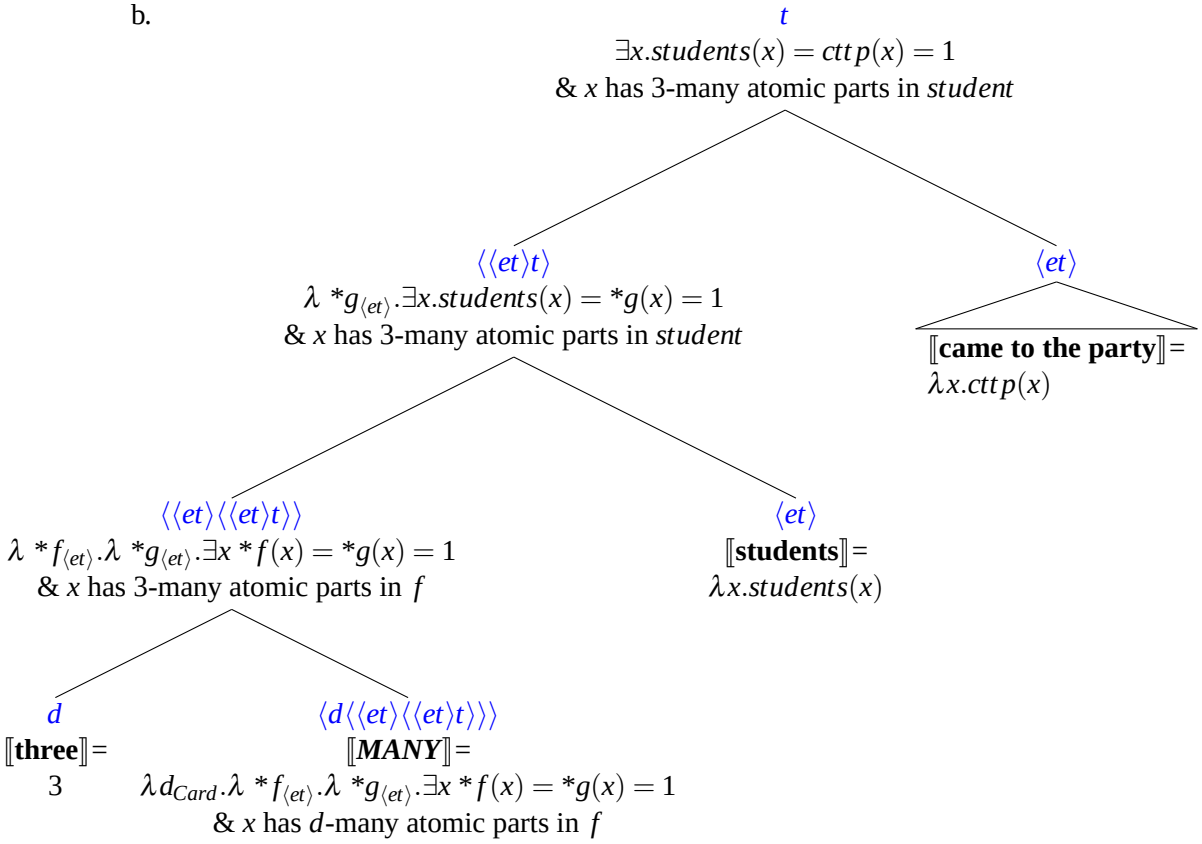
(191) a. More than three people came to the party. (cf. (12))

b.



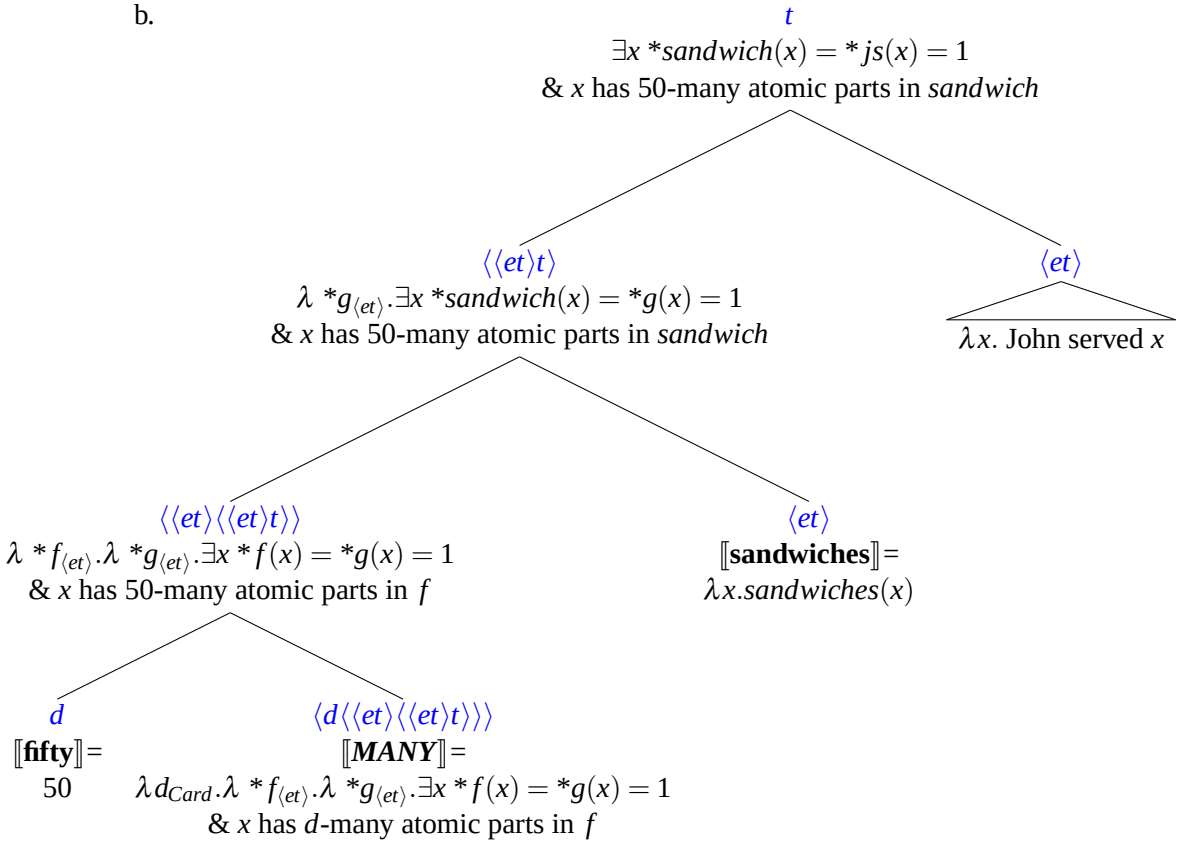
(192) a. Three students came to the party. (cf. (15))

b.



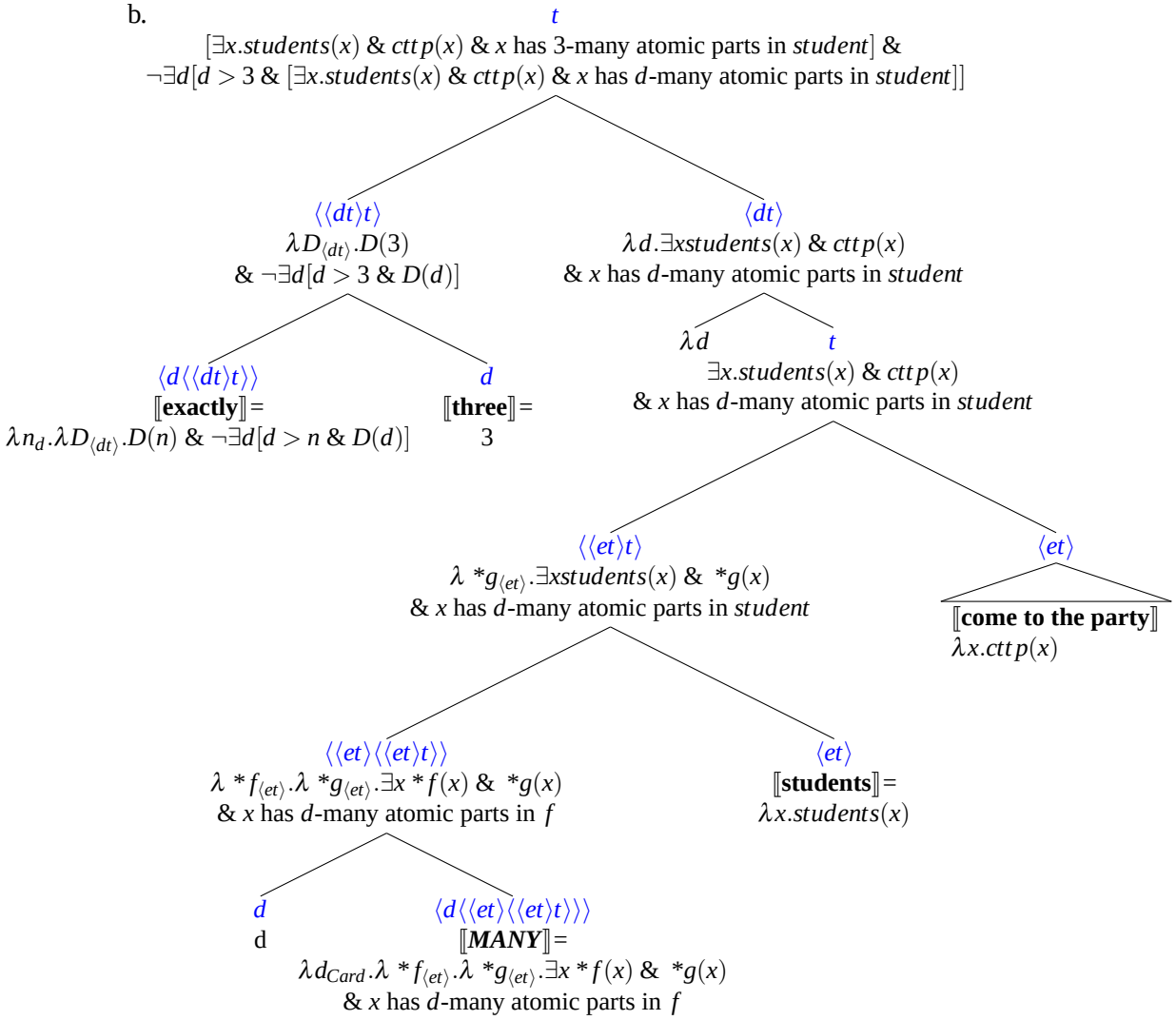
(193) a. John served fifty sandwiches. (cf. (16))

b.



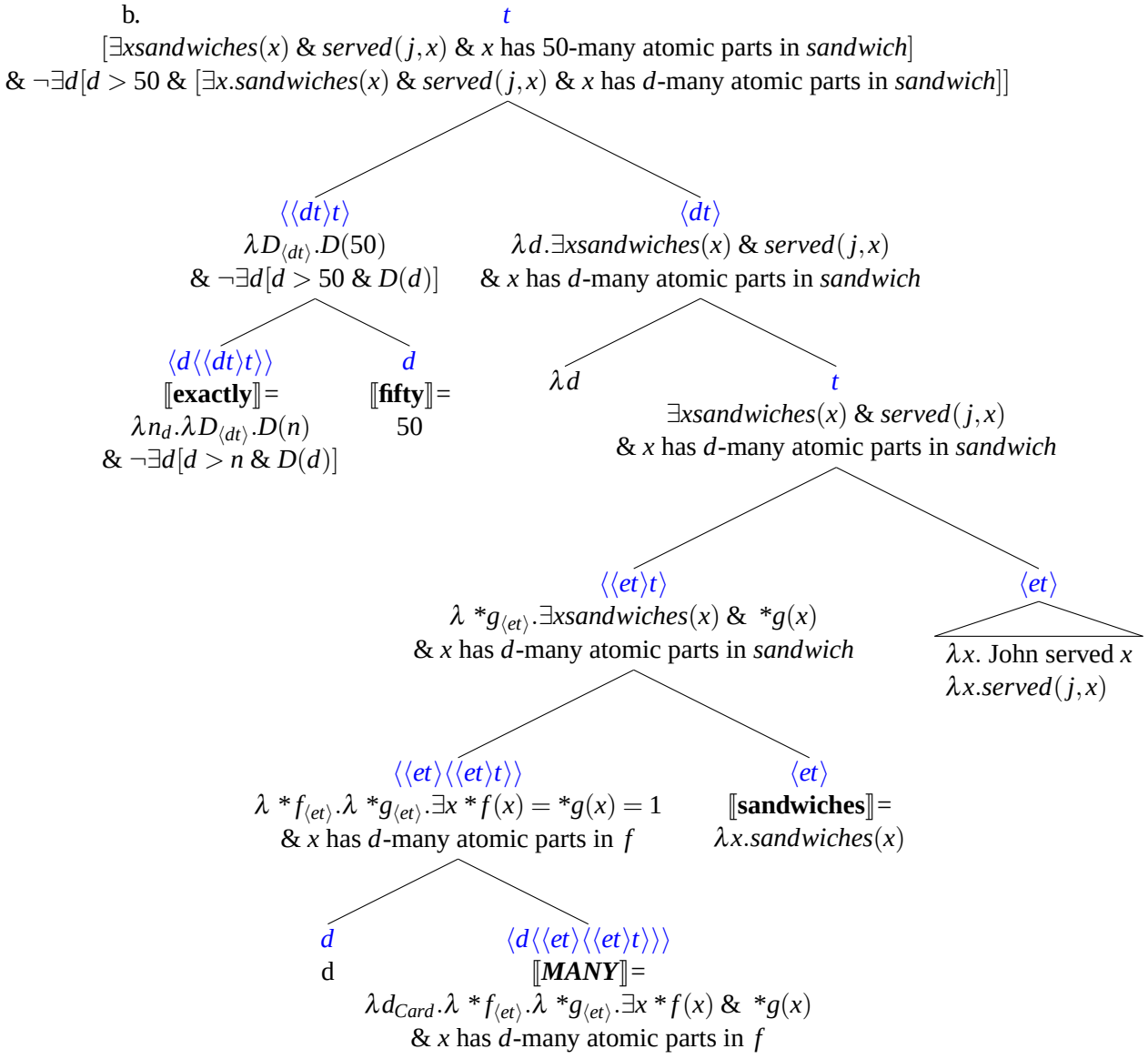
(194) a. Exactly three students came to the party. (cf. (24))

b.



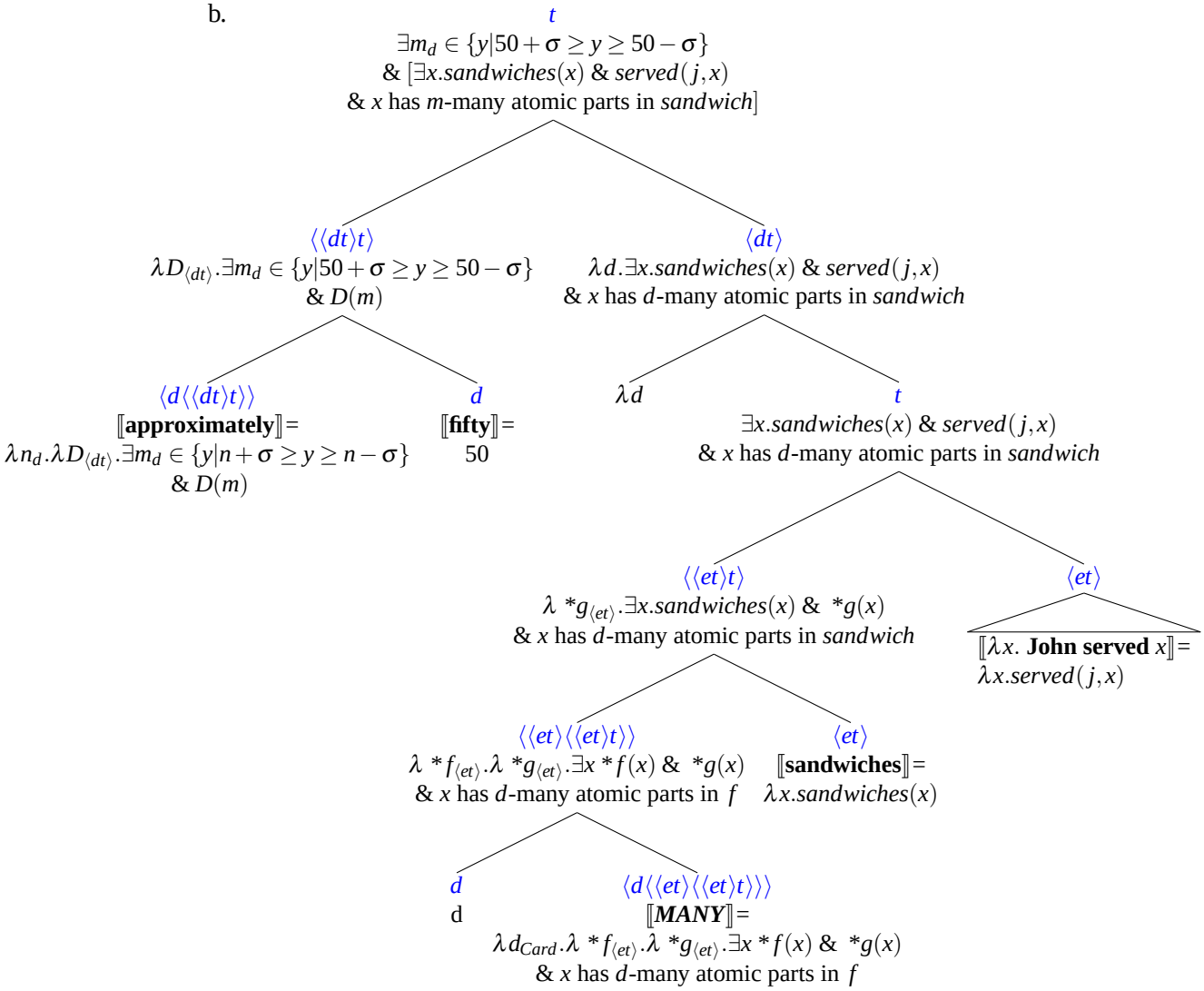
(195) a. John served exactly fifty sandwiches. (cf. (25))

b.



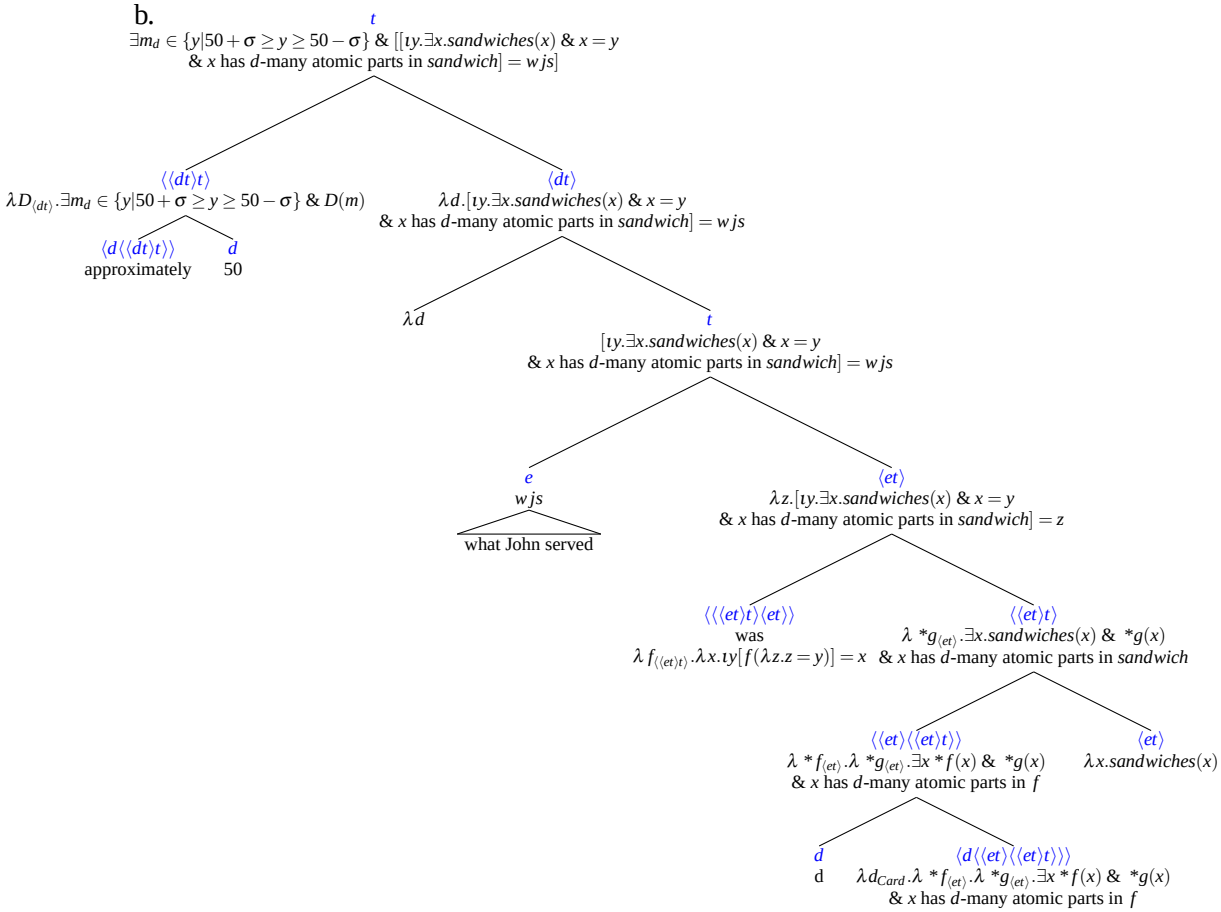
(196) a. John served approximately fifty sandwiches. = (19) (cf. (27))

b.



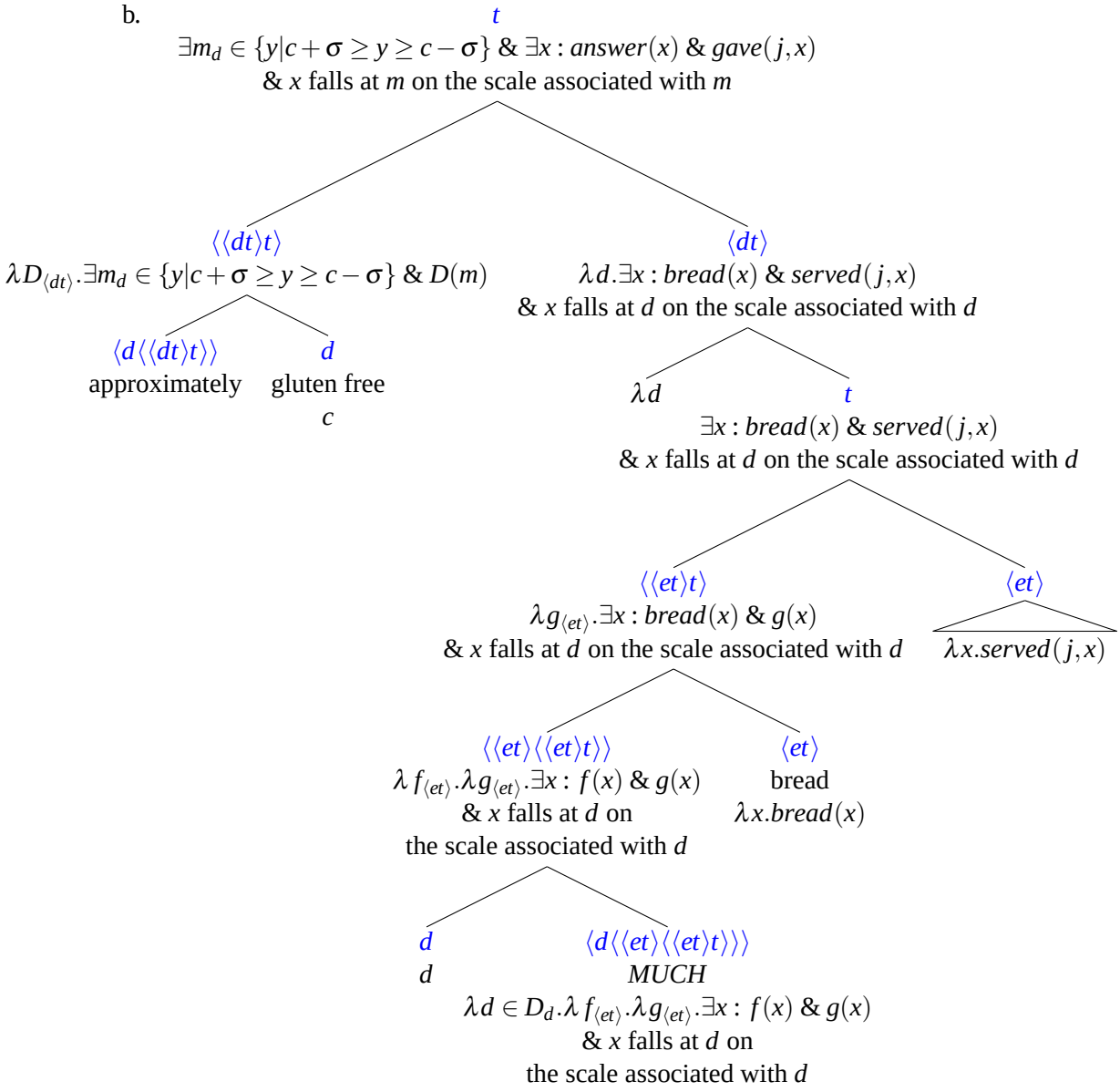
(197) a. What John served was approximately fifty sandwiches. = (20) (cf. (36))

b.



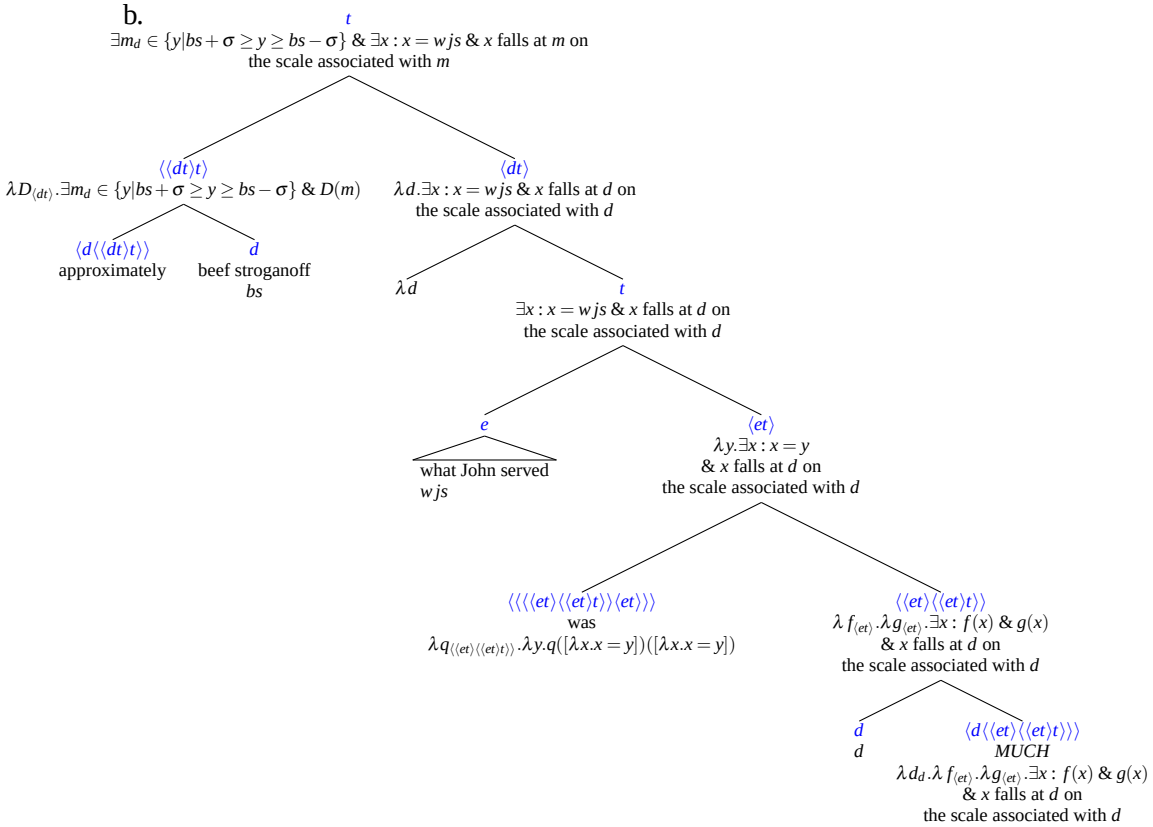
(198) a. John served approximately gluten-free bread. (cf. (55))

b.



(199) a. What John served was approximately beef stroganoff. (cf. (57))

b.



5 Conclusion

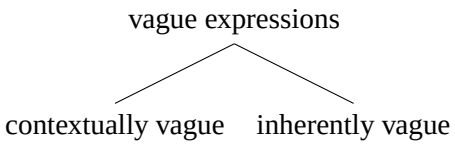
This dissertation was framed around following questions:

(1)

1.What is the nature of vagueness?
2.How should quantifiers be analyzed?

What is the nature of vagueness? Throughout this dissertation I have supported a heterogeneous view of vagueness, one that makes a high-level distinction between what I have referred to as contextually-vague and inherently-vague expressions.

(1)



Within contextually vague expressions, I have further argued that the distinction between modal- and non-modal-generated vagueness is crucial for understanding a wide range of phenomena linked to vagueness. To do so, I built on the distributional asymmetries noted in Sauerland and Stateva (2007) between epistemic modal modifiers like *maybe* and non-modal modifiers like *approximately*. I expanded on this work by providing formal accounts of how modal modifiers lead to approximative readings. For the four modifiers that received the most attention here, I provided the following denotations.

(2) $[\![\textbf{approximately}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)$

(repeated from page 42)

(3) $[\![\textbf{about}]\!] = \lambda n_d.\lambda D_{\langle dt\rangle}.\exists m_d \in \{y | n-\sigma \leq y \leq n+\sigma\}\ \&\ D(m)\ \&\ \diamond D(n)$

(repeated from page 63)

(4) $[\![\textbf{maybe}]\!] = \lambda w\lambda f\lambda p.\bigcap f(w) \cap p \neq \emptyset$ (semi-repeated from page 77)

(5) $[\![\textbf{?}]\!] = \lambda w\lambda f\lambda p.\bigcap f(w) \cap \{w' | p \subseteq cs \text{ in } w'\} \neq \emptyset$ (repeated from page 77)

Following these, $[\![\textbf{approximately}\ x]\!]$ expresses that degree in question falls within some contextually-determined range of (degree) x. $[\![\textbf{about}\ x]\!]$ expresses the same, though also that it is epistemically possible that x itself is the degree in question. $[\![\textbf{maybe}\ x]\!]$ entails no such range restriction, expressing only that (proposition) x is epistemically possible. Similarly, rising intonation in $[\![x\textbf{?}]\!]$ expresses that x epistemically possible but also that the speaker is possibly committed to x.

I proposed that, along the lines of Krifka (2009), scalars are associated with range information that allows for their round interpretations, and I formalized this through two (families of) functions, p_σ and p_x, introduced in Chapter 2, page 30. When modified by a modal, scalars shape the modal base and ordering source with this information such that, ceteris paribus, the possible alternatives to the scalar are items that are scalarly close to it, and the closer the alternative, the more likely that

alternative is. I referred to this approximative reading as *uncertain approximation*, a characteristic behavior of modal-induced vagueness. A second characteristic behavior is *licensing discontinuous alternatives*, and these repeated below from Chapter 1 page 15.

(6) **Uncertain approximation:** When uncertainty is interpreted as approximation, where the exact value is not known, but the approximate value is

(7) **Licensing discontinuous alternatives:** When a range expression is interpreted as referring to a proper subset of that range

Both of these were seen, for example, in sentences like those in (8) and (9). These have approximative readings where context rules out intermediate ages (e.g. thirty years and eleven days; 203 years), and we see that only modal approximators are felicitous.

(8) a. It's Susan's birthday today, and she's maybe thirty.
b. #It's Susan's birthday today, and she's roughly/approximately thirty.

(9) a. Today would have been my great-great-great-great-great-great-grandparents' anniversary. They would have been married for a good 200 years now.
b. #Today would have been my great-great-great-great-great-great-grandparents' anniversary. They would have been married for roughly/approximately 200 years now.

This licensing of discontinuous alternatives follows from the account I provided of uncertain approximation. Namely, uncertain approximation approximates by means of a modal base, and this modal base also contains propositions that can rule out alternatives. This contrasts with non-modal range expressions like *approximately*, which have no such mechanism for ruling out in-range alternatives.

I further showed that some expressions that have traditionally not received a modal analysis (e.g. *like*, *about*) demonstrate modal behavior. In sentences like (10), they appear more felicitous than non-modals like *approximately*. I use the contrast between *like* and *about* here to argue for both a modal and a range component to *about*.

(10) a. It's Susan's birthday today, and she's like thirty.
b. ?It's Susan's birthday today, and she's about thirty.

I also show both *like* and *about* to give expected modal concord readings with epistemic predicates and rising intonation. Through this behavior, I argued that these should be included in the typology of modal expressions.

A summary of the typology developed in Chapter 2 is repeated in Table 9. The diagnostics developed in Chapter 2 for determining this categorization are repeated in Table 10.

Several of these diagnostics look for modal concord between the modifier and some other modal element (*seem*, *might*), but I also uncover what appear to be concord readings between modal modifiers and rising intonation. This is shown in examples like (11), where *maybe* does not contribute

modal	*maybe* *like* *about*
non-modal	*approximately* *exactly* *roughly* pragmatic slack/halos/roundness

Table 9: Summary of modal split developed in Chapter 2

	+modal −range	+modal +range	−modal +range
contextual information accommodation	✓		
interactions with modals			
– felicitous with *seem*	✓	✓	
– concord with *might*, etc.	✓	✓	
– concord with rising intonation	✓	✓	
– infelicitous answer w/o rising intonation	✓		

Table 10: Summary of behavior under diagnostics developed in Chapter 2

its own independent layer of epistmic modality.

(11) Amy: What is John's favorite color?
Ben:

a. Blue?
b. Maybe blue?

In Chapter 3 I developed an analysis of rising intonation to account for these. I proposed that rising intonation has semantic epistemic modal content such that it can participate in concord with other epistemic modals. Specifically, I proposed that rising intonation existentially quantifies over worlds that are epistemically accessible from the speaker's commitment set (page 77), and this interacts with epistemic possibility adverbs via the Epistemic Commitment Principle I propose (page 78), which allows a reader to conclude that if an agent is possibly committed to a proposition (i.e. if that proposition is accessible from their commitment set), then the agent believes that that proposition is possible.

How should quantifiers be analyzed? In Chapter 4 I provided support for a decomposition approach to quantifiers through examining the broader distribution of modifier like *approximately* and *about*, focusing on the differing felicities of these modifiers with coerced and non-coerced scalars in sentences like those in (12)-(13).

(12) a. John served approximately/ about 50 sandwiches.
b. John served #approximately/#about beef stroganoff.

(13) a. What John served was approximately/ about 50 sandwiches.
b. What John served was approximately/#about beef stroganoff.

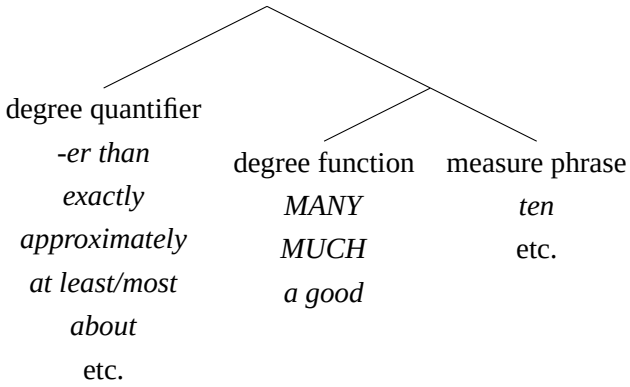
I derived the patterns above by building on the decompositional approach in Hackl (2000). I provided machinery to handle coerced scalars, where coerced and non-coerced scalars alike cannot be used attributively (i.e. no attributive type-shift exists for quantifiers, per Hackl), and I introduced a new copula-specific type-shift to account for the ability of coerced scalars to appear in copular constructions, but not in other constructions. I also proposed that certain modifiers, including *about*, cannot appear with coerced scalars. This ability provides a further split among the modifiers I discuss, repeated in 11.

	felicitous with coerced scalars	**infelicitous with coerced scalars**
modal	*maybe* *like*	*about* *a good*
non-modal	*approximately* *exactly* *roughly* *just about* pragmatic slack/halos/roundness	*around*

Table 11: Summary of modifier categorization by modal status and ability to modified coerced scalars

Hackl's decompositional framework provided three items for composing a quantifier: a degree quantifier, a degree function, and a measure phrase.

(14)



I contributed a new item *MUCH* to the inventory of degree functions, allowing this framework to handle non-cardinal measure phrases like *full* and (coerced-scalar) *beef stroganoff*. This then required that these items, as measure phrases, be uniformly of type *d*(egree) in these constructions. This was facilitated by the type-shift repeated in (15), which takes some item and returns the degree on the appropriate scale represented by that item.

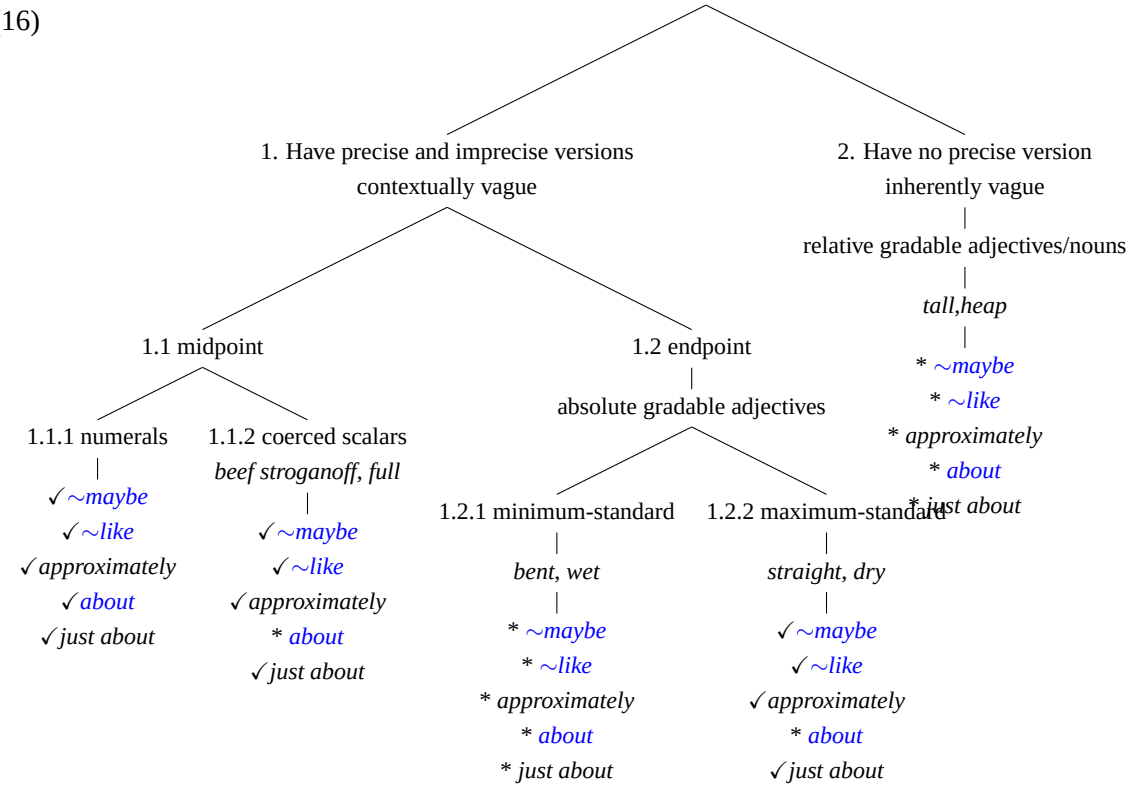
(15) Degree type-shift
$\lambda x_{\tau}.x_{d}$

The inner workings of this type-shift, however, remain an important omission.

While this dissertation has taken the first steps in understanding the relation between epistemic modality and approximation, much work remains to be done. While some of the expressions examined here (including *maybe* and *a good*) have similar effect cross-linguistically, others (including Approximative Inversion and rising intonation) do not. At present, the exact process behind the grammaticalization of the epistemic component of these expressions is not well understood.

Despite the differences between modal and non-modal approximators, in many ways they pattern the same. This can be seen in (16) where *approximately* fits right in among modal terms across a variety of classes of vague expressions (below ∼*maybe* refers to approximative uses of *maybe*, similarly for ∼*like*).

(16)



Each of these modifiers is felicitous with midpoint scalars like numerals, but none are felicitous with relative gradable scalars. Similarly, none are felicitous with minimum-standard scalars, but all are felicitous with maximum-standard scalars minus *about* (also other prepositions like *near*, *around*). It appears that while each modifier is subtly different, they nonetheless comprise a unified class of hedges, allowing us to communicate, if not precisely, then at least truthfully.

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Vita

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