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## Modification

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### 1.1 Introduction

The term *modifier* (and modification, the function a modifier carries out) is difficult to define in intuitive terms. A first informal approximation might be, for example, to say that a modifier adds additional, non-essential descriptive content to that contributed by the expression that it combines with; in this respect, a modifier would contrast with an *argument*, which would provide descriptive content that is somehow required by the expression it combines with. For instance, one could try to argue that in (1), the content contributed by *delightful* is less essential to determining the referent of the whole nominal than that contributed by *of Susan*, and thus we could conclude that the former is a modifier, while the latter is an argument.<sup>1</sup>

(1) the delightful mother of Susan

However, this sort of reasoning has long been known to be problematic, as the large literature on the argument/nonargument distinction in the argument structure literature makes clear.<sup>2</sup> For example, consider (2):

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<sup>1</sup> Dowty (1989) argues that despite appearances, as a rule no nouns have arguments. I will not make this assumption here.

<sup>2</sup> See especially Dowty (1982), Dowty (1989), and Dowty (2003) for insightful discussion of the problem of distinguishing arguments from modifiers. In this article, the terms *argument* and *modifier* will be used to characterize expressions exclusively in terms of their compositional semantic effect. The terms *complement* and *adjunct* will be used to characterize expressions in terms of their syntactic relation to the head of a phrase. Though in most cases, (syntactic) complements are (semantic) arguments, and (syntactic) adjuncts are (semantic) modifiers, it has been argued that sometimes this parallelism breaks down; see e.g. Chung and Ladusaw (2004), Espinal and McNally (2011); see also brief comments in section 1.2.4 and 1.3.2.

- (2) the younger sister of Susan

If Susan has two sisters, the content contributed by the adjective is arguably as important as that contributed by the prepositional phrase for identifying the referent of the nominal. However, such adjectives are universally treated as modifiers, not arguments. A classic example from the verbal domain involves the verbs *buy*, *sell*, *rent*, and *lease*: Money is an essential participant in the situations these verbs describe, and yet the *for*-phrase in (3) is not treated as an argument (see e.g. Jackendoff (1972) for an early discussion of this problem):

- (3) We sold the car (to the dealer) for 2000 euros.

Syntactic obligatoriness is even more problematic as a criterion for defining modifiers, as many expressions that linguists would agree are arguments are syntactically elidable (such as *to the dealer* in (3)), and sometimes modifiers are obligatory, if arguably only for pragmatic reasons (cp. e.g. ??*a built house* vs. *a well-built house*, Goldberg and Ackerman (2001)). Consequently, in this article, *modifier* and *modification* will be defined in strictly formal terms.

The notion of modification cannot be understood without the prior assumption, at least as old as Aristotle, that language makes a distinction between the basic entities we ascribe properties to and the properties that we ascribe to them via predication. Assume that the fundamental distinction between these basic entities and properties is that the former are *saturated*, that is, semantically complete in some sense, while the latter are *unsaturated*, that is, semantically incomplete (see Frege (1997), Strawson (1959), and, for more recent discussion in the context of contemporary syntactic and semantic theory, Chung and Ladusaw (2004)). If we make this assumption, we can define *modifier* as in (4):<sup>3</sup>

- (4) **Modifier:** an expression that combines with an unsaturated expression to form another unsaturated expression of the same type.

<sup>3</sup> See Dowty (2003) for a fundamentally similar definition. This discussion assumes basic familiarity with type theory as it is generally applied to natural language semantics; see e.g. Dowty et al. (1981) and Gamut (1991) for accessible introductions, as well as Pagin, this volume. Except where crucial, all denotations are treated extensionally in this article, and the basic domain of individuals will be assumed to include entities, events, and kinds of objects and events (see e.g. Carlson (1977), Landman and Morzycki (2003)), but not properties or propositions as in e.g. Chierchia (1984), though what is said in this article could be adapted to the sort of ontology Chierchia adopted.

Modifiers can thus be contrasted with arguments, which saturate (i.e. reduce the valence of) the expressions they combine with, and (main) predicates, which as a rule combine with saturated expressions to yield expressions of a different type.<sup>4</sup>

On this view, we could conclude that the adjectives in (1) and (2) are modifiers but that *of Susan* is not, as follows. Assume that *mother* is a relational noun of type  $\langle e, \langle e, t \rangle \rangle$ . Assume that *of* is contentless and that *of Susan* denotes an entity (type  $e$ ). When *of Susan* combines with *mother*, the result, *mother of Susan*, is of type  $\langle e, t \rangle$  and thus of a lower valence, and correspondingly of a different semantic type, than *mother*. In contrast, adjectives are generally assumed to denote properties of individuals or properties of properties (that is, types  $\langle e, t \rangle$  or  $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$ , respectively). The issues involved in choosing one or the other type of denotation for the adjective will be discussed in section 1.3.1, below; for now, assume the adjective denotes a property of properties. With this denotation the adjective combines with the  $\langle e, t \rangle$ -type expression *mother of Susan*, and the result will be another  $\langle e, t \rangle$ -type expression – in other words, the adjective does not affect the valence of the expression it combines with. In the case of the *for*-phrase in (3), one need only assume (as indeed is standardly the case in the argument structure literature) that the verb *sell* denotes a three-place relation to the exclusion of the money exchanged; as a result, whatever the contribution of the *for*-phrase, it will not involve saturation.

In what follows, the definition of *modifier* in (4) is assumed, though some questions concerning its adequacy will be raised below. In order to provide a broad vision of modification, the following section presents an overview of the most important families of modifier typologies that have been proposed in the literature, with a principal (though not exclusive) focus on adjectives and adverbs. Some of the key issues raised by modification for semantic theory are then presented in 1.3.

<sup>4</sup> One sort of potential complication for this definition will be set aside here. For example, on some analyses, verbs like *seem* are analyzed as semantic type  $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$ , that is, as functions from properties to properties (see e.g. Jacobson (1990)), despite the fact that, in this instance, this semantic type is generally understood to correspond to a relation between an entity and a property, rather than a modifier of a property. Of course, whether this semantic type is really the best option for such verbs, and whether it is really correct to think that *seem* is relational in a way that other modifiers are not, are open questions.

## 1.2 Typologies of modifiers

### 1.2.1 Morphosyntactically-based typologies

Modifiers have been classified in quite different ways in the philological tradition and within formal linguistic theories, depending on the phenomena the classification was intended to explain. One well-known typology classifies modifiers according to the morphosyntactic categories they belong to and those they combine with. Perhaps the most familiar example of this sort is the characterization typically found in descriptive or pedagogical grammars of adjectives as modifiers of nominals and adverbs, as modifiers of non-nominal categories, particularly verbs, adjectives, and clauses (see e.g. Siegel (1976) and Levi (1978) on the former; and Jackendoff (1972), Thomason and Stalnaker (1973), McConnell-Ginet (1982), Ernst (1984), Wyner (1994) and Eckardt (1998) on the latter; these works also discuss the semantic correlates of morphosyntactic classifications). These definitions are intended to account, among other things, for basic facts about the distribution of the two categories, such as the contrast in (5) and (6) (though see Payne et al. (2010) and below for counterexamples).

- (5) a. the patient's complete/\*completely recovery  
 b. The patient has completely/\*complete recovered.
- (6) a. an unfortunate/\*unfortunately accident  
 b. Unfortunately/\*Unfortunate, there was an accident.

Though there is almost certainly some role for syntax in characterizing the distribution and behavior of modifiers, strictly syntactic classifications have at least two limitations. First, it is difficult to find an elegant, strictly morphosyntactic characterization of what can be a modifier and what cannot. For example, in English, nouns can be modified by expressions of almost any syntactic category, including nouns, pronouns, proper names, untensed verb phrases, and even entire clauses ((7)); perhaps the only exceptions are tensed verb phrases and determiners ((8)), which cannot function as modifiers at all.<sup>5</sup>

<sup>5</sup> With respect to determiners, the question is complicated by the complexities of the category itself. For example, numerals occur in a modifier-like position in expressions like *the/every two weeks*, but, unlike e.g. *each*, they are also sometimes argued to have an adjectival syntax and semantics. Note also that (8b) might be interpretable along the lines of (7b) as 'a situation where each of something (as opposed to some other quantity or distribution) is involved'.

- (7) a. a quality product  
 b. an all-or-nothing situation  
 c. the ‘it’ girl  
 d. a Jane Doe production  
 e. the rapidly disappearing coastline  
 f. a to die for dress  
 g. an I-told-you-so look
- (8) a. \*a rapidly disappears coastline  
 b. (?)an ‘each’ situation

Morphosyntactically, neither those expressions that can modify nor those that cannot form a natural morphosyntactic class.

Second, similar problems arise in characterizing the morphosyntactic categories that specific modifiers combine with. For example, the claim that adjectives only modify nouns is questionable. Adjectives are used as verb phrase and sentential modifiers in depictive ((9a); Dowty (1972), McNally (1994)) and absolute constructions ((9b); Stump (1985)):

- (9) a. The children came home from camp happy.  
 b. Hoarse, the instructor cancelled class.

Though it might be argued that such adjuncts and absolutes are syntactically distinct from simple adjective phrases (for example, that they are covert clauses of some sort), it is far from obvious that this is the case. It therefore does not seem possible to classify modifiers cleanly according to the morphosyntactic categories they combine with.

In addition to failing to explain these sorts of facts, the classification of modifiers in strictly morphosyntactic terms arguably emphasizes their differences over their similarities. While the morphosyntactic properties of different types of modifiers should be taken into account, the range of facts mentioned in this section points to the need to classify modifiers along other parameters.

### 1.2.2 Notionally-based typologies

What we might call notionally-based typologies classify modifiers according to aspects of their descriptive content or, loosely speaking, semantic function; such classifications can be found in descriptive grammars and the philological tradition more generally. A typical example is the typology in Picallo (2002), used specifically for adjectives (for other

typologies see e.g. Demonte (2008), Dixon (1982), Dixon and Aikhenvald (2004), and Huddleston and Pullum (2002)). Picallo divides adjectives into three classes. *Qualitative* adjectives (e.g. *male, sick, red, good*) denote properties or qualities of some entity. *Relational* adjectives (e.g. *technical, solar, molecular*; term due to Bally (1944)) are typically identified morphologically as being denominal; semantically, they contribute a property which somehow relates the individual described by the noun they modify to the sort of object described by their nominal root (for instance, a *parliamentary decision* is a decision by a parliament). The remaining adjectives are classified as *adverbial*, a heterogeneous class that Picallo divides into subclasses of modal (e.g. *possible*), aspectual (e.g. *frequent*), and circumstantial (e.g. *fast*) adjectives.

Notional typologies of adjectives have been used to account for various kinds of data.<sup>6</sup> For example, relational adjectives have among the strongest distributional identifiers of any subclass of adjectives (Boleda (2006)). Not only are they often identifiable by their denominal structure, they also stand out, for instance, as being the only class of adjectives in Spanish and Catalan that are systematically restricted to postnominal position (McNally and Boleda (2004)).

Notional typologies for adverbs and other verb phrase and sentence modifiers look superficially rather different and are equally diverse. A typical example, taken from Huddleston and Pullum (2002), sorts adverbs into 13 categories, according to whether they provide information about e.g. manner (e.g. *skillfully*), degree (e.g. *very*), modality (e.g. *necessarily*), and so on.<sup>7</sup> As is the case with notional typologies of adjectives, these adverbial subcategories are motivated both by basic semantic intuitions and, more importantly, by distributional tendencies: for instance, manner adverbs tend to appear towards the end of the verb phrase in

<sup>6</sup> In fact, they are really more about the adjectives themselves than about adjectives as modifiers, and thus they have also been used to account for phenomena not involving modification, such as what the inventory of adjectives is across languages (see e.g. Dixon (1982)), and whether or not the adjective can have a predicative use (see e.g. Levi (1978) on relational adjectives, though she does not use that term).

<sup>7</sup> Despite the traditional classification as adverbs, degree words like *very* have been argued by Kennedy (1999) not to be adjuncts/modifiers (though Kennedy and McNally (2005b) resuscitates such an analysis, and see also Katz (2005) and McNally and Kennedy (2013) for discussion of degree interpretations of manner adverbs). Instead, they have been treated as a special subcategory of word that serves as the head of a degree phrase taking a gradable adjective phrase as its complement; the degree word denotes a function from the adjective denotation, which is recast as a measure function or relation between individuals and degrees, to a property of individuals (see also Corver (1997) on DegP). See section 1.4 for further discussion.

English, whereas modal adverbs tend to appear close to the auxiliary verb, if there is one, or preceding the main verb.

Though clearly useful in predicting distributional patterns, notionally-based typologies of modifiers suffer from at least two weaknesses. First, it is difficult to determine exactly how many categories of modifiers are necessary, as attested by the lack of agreement among the different proposals. Second, as the category names themselves indicate, the specific notional categories are quite different for adjectives vs. adverbs, making such typologies less useful for capturing similarities between the two categories of modifiers. Moreover, though it remains to be demonstrated, notional typologies may prove to be superfluous, a by-product of the meanings of the roots and derivational morphemes making up the modifiers, including in particular their semantic type.

### 1.2.3 Entailment-based typologies

The most prevalent typology of modifiers in the formal semantics tradition classifies them according to the sorts of inferences they license, as accounting for inference in language is, of course, a central concern of formal semantic theories. The standard classification, originating in work by Parsons (1970) and Kamp (1975), consists of three categories, one of which in turn divides into two subcategories.<sup>8</sup>

The first category is the *intersective* modifiers. If  $\alpha$  is an expression consisting of an intersective modifier  $\beta$  and a modified expression  $\gamma$ , then for any entity  $x$ , if  $x$  is  $\alpha$ , then  $x$  is  $\beta$  and  $x$  is  $\gamma$ . This inference pattern (and the term *intersective*) reflects the fact that with such modifiers,  $\alpha$ 's satisfaction conditions amount to the intersection of  $\beta$ 's and  $\gamma$ 's satisfaction conditions. (10) illustrates:

- (10) a. Robin is a male nurse.  
 b.  $\models$  Robin is a nurse.  
 c.  $\models$  Robin is male.

Some other relatively clear examples of intersective adjectives include shape adjectives such as *circular*, so-called minimum-standard gradable adjectives such as *sick* (see Kennedy and McNally, 2005a, and below for discussion), and color adjectives such as *red*.

In contrast, when a complex expression  $\alpha$  consists of a *subsective* mod-

<sup>8</sup> As already observed by Parsons, this classification can apply to adverbs as well as adjectives, but it will be illustrated here only with adjectives.

ifier  $\beta$  and a modified expression  $\gamma$ , then for any entity  $x$ , if  $x$  is  $\alpha$ , then  $x$  is  $\gamma$ , but we cannot conclude that  $x$  is  $\beta$ . Subsective modifiers are thus so called because they serve to pick out a subset of individuals within the extension of the expression they modify, as in (11). Note that not only is  $\beta$  not entailed to hold of  $x$ , but it cannot even be meaningfully applied to  $x$  in some cases, such as (11c).

- (11) a. Andrea is a molecular biologist.  
 b.  $\models$  Andrea is a biologist.  
 c.  $\not\models$  ??Andrea is molecular.

Subsective modifiers are arguably the largest class, and the sources of the subsectivity are varied. In the case of relational adjectives such as *molecular*, subsectivity is due to the fact that the adjective establishes a relation between the kind of entity determined by the adjective's root (in (11), molecules), and the kind of entity the modified noun describes, but crucially not the entity  $x$  itself. Thus, as a rule it makes no sense to ascribe the relational adjective to  $x$  directly (though see e.g. McNally and Boleda (2004) and section 1.3.2 below for counterexamples).

Another important source of subsectivity is due to the fact that many modifiers characterize the sort of individual described by the modified expression not directly, but rather only indirectly in virtue of characterizing some event or some other individual related to it, as happens on one reading of (12) (due to Siegel (1976) and discussed extensively in e.g. Larson (1998); see also Pustejovsky (1995) for other sorts of examples).

- (12) a. Olga is a beautiful dancer (read: beautiful as a dancer).  
 b.  $\models$  Olga is a dancer.  
 c.  $\not\models$  Olga is beautiful.

On the indicated reading of (12a), *beautiful* characterizes Olga's dancing. We therefore cannot infer that Olga herself is beautiful, which is the most natural interpretation of (12c) out of context. We return to this sort of example and its implications in section 1.3.2.

A third source of subsectivity, often cited in textbooks (e.g. Chierchia and McConnell-Ginet, 2000), involves the comparison class that is used to determine whether certain gradable adjectives hold of their arguments, as illustrated in (13):

- (13) a. Lobsters are large crustaceans.  
 b.  $\models$  Lobster are crustaceans.

- c.  $\not\models$  Lobsters are large.

On the most natural reading of (13a), the sentence is true if lobsters are large taking into account the comparison class of crustaceans. In contrast, the most natural reading of (13c) out of context ascribes largeness to lobsters taking into account a more general comparison class, such as perhaps animals in general. Since these comparison classes are different, the inference from (13a) to (13c) does not automatically go through. Nonetheless, there is a strong intuition that the comparison class is easily controlled for; indeed, the comparison class can be analyzed as an argument of the adjective itself (see e.g. the discussion in Klein (1980), though Klein ultimately does not adopt such an analysis; see Solt (2011) for more recent discussion). Moreover, in contrast to what happens with relational adjectives and those like *beautiful* in (12), gradable adjectives as used in (13) are clearly directly ascribed to the individual that is the argument of the modified nominal. Thus, once the comparison class is taken into account and given a fixed value, gradable adjectives such as *large* are arguably better characterized as intersective rather than subsective.<sup>9</sup>

Continuing with the entailment-based typology of modifiers, when a complex expression  $\alpha$  consists of a *intensional* modifier  $\beta$  and a modified expression  $\gamma$ , then for any entity  $x$ , if  $x$  is  $\alpha$ , we cannot infer that  $x$  is  $\gamma$  (or, indeed, we may be able to infer that it is *not*  $\gamma$ ), nor can we conclude that  $x$  is  $\beta$ . This class includes the so-called *privative* modifiers such as *fake*, *former*, and *spurious*, which get their name from the fact that they license the inference to ‘not  $\gamma$ ’:

- (14) a. Martina is a former star athlete.  
 b.  $\models$  Martina is not a star athlete now.  
 c.  $\not\models$  ??Martina is former.

It also includes modifiers such as *alleged*, *suspected*, and *possible*, which license no entailments at all concerning whether or not  $x$  is  $\gamma$ :

- (15) a. That politician is an alleged crook.  
 b.  $\not\models$  That politician is a crook.  
 c.  $\not\models$  ??That politician is alleged.

These modifiers are termed *intensional* because they compose with and

<sup>9</sup> See Kamp, this volume, for further discussion of gradability in relation to vagueness.

operate on the noun's *intension* (understood here as a function from possible circumstances/times to sets of individuals): it is not clear how they could be given an analysis in a semantics on which there is no information about the set of individuals denoted by the unmodified nouns at different times or in different possible circumstances.

The intensional modifiers constitute a comparatively very small class, and, as Landman (2001) observes (citing unpublished work by Irene Heim), the sorts of meanings intensional adjectives can have are not random. Specifically, it seems that even if, in terms of the general schema used above, we cannot infer that  $x$  is  $\gamma$  at a given time or in a given circumstance of evaluation, it must be the case that  $x$  is  $\gamma$  at some time or in some possible circumstance of evaluation. Moreover, privative adjectives have predicative uses which would be difficult to account for if the subject were not simultaneously describable by the noun and the (predicative) adjective (see (16)).

- (16) a. This gun is fake.  
 b. The counterexample was spurious.

These facts have motivated some preliminary attempts to provide intensional adjectival modifiers with a special sort of subsective semantics (Landman (2001), Partee (2010) and Asher (2011)) or even an intersective semantics (e.g. Larson (1998), whose approach is sketched below).

It is not clear that the entailment-based typology is much more useful than the notionally-based typology for explaining linguistic phenomena such as the syntactic distribution of modifiers. In particular, it has little to say about the diverse behavior of the different subclasses of subsective modifiers, e.g. the special properties of the relational adjectives, where notionally-based typologies fare better. However, the entailment patterns motivating this typology have had important consequences for the analysis of modification in formal semantics, as will be discussed in section 1.3.

#### 1.2.4 Pragmatic/discourse-related typologies

Finally, modifiers are sometimes characterized according to pragmatic or discourse-related aspects of their interpretation. The most general, and most important, of these is the division of modifiers into those that contribute to the “at issue” content of the utterance in which they appear vs. those that do not. The latter constitute a diverse group that in-

cludes nonrestrictive relative clauses and nonrestrictively used adjectives (including expressive adjectives), and what will (somewhat loosely) be referred to as speaker-oriented adverbials, illustrated in (17a-b), (17c-d), and (17e-g), respectively.<sup>10</sup>

- (17)
- a. The candidate, who we interviewed yesterday, has a Ph.D.
  - b. (All the words were unsuitable, and) every unsuitable word was deleted. (Larson and Marušič (2004))
  - c. We visited spectacular Mount Ranier.
  - d. I left my damn keys in the car. (Potts (2007))
  - e. Unfortunately, they had to leave.
  - f. In my opinion, this is ridiculous.
  - g. Wisely, they said nothing.

Though syntactically these expressions are usually treated as adjuncts,<sup>11</sup> it is less obvious that their semantics conforms to the definition of modifier in (4). The expressions in (17a-d) have been treated as contributing a property ascribed to the entity picked out by the nominal with which they combine, resulting in a proposition independent of that denoted by the sentence in which they appear. For example, paraphrasing, an utterance of (17c) asserts that we visited Mount Ranier and contributes an additional proposition which is not, however, at issue, namely that Mount Ranier is spectacular. The expressions in (17e-g) have been given a similar treatment, on which they constitute an independent proposition “whose predicate (the adverb) evaluates the fact, event, or state of affairs denoted by S (sentence without the adverb)” (Bellert (1977), 342). However, as will be shown in section 1.3.3 below, the semantics of these expressions can ultimately be reconciled with the definition in (4).

<sup>10</sup> Each of these classes of modifier has an independent history of study, though with the exception of speaker-oriented adverbials, they have received comparatively little attention in formal semantics until recently. See Potts (2005) for the most complete overview of these modifiers and an attempt to unify their analysis in terms of the notion of at-issue content. For further discussion of the semantics of nonrestrictive relatives, see Del Gobbo (2003), Schlenker (2009), Schlenker (to appear) and references cited therein. On the semantics of expressives, see e.g. Macià (2002), Potts (2007), and Schlenker (2007). Finally, on speaker-oriented adverbials, see, in addition to the references on adverbs cited in section 1.2.1, Bartsch (1976), Bellert (1977), Mittwoch (1977), Morzycki (2008), Bonami and Godard (2008), Wyner (2008) and references cited therein. See also Schlenker, this volume.

<sup>11</sup> An exception is the analysis of adjectives in Larson and Yamakido (2008). See footnote 13.

### 1.3 Issues in the compositional semantics of modification

#### 1.3.1 Modification and modes of composition

Among the issues modification raises for semantic theory, perhaps the most basic is how best to capture the flexibility of most expressions to function both as modifiers and predicates of individuals, illustrated in (18).

- (18) a. a male nurse  
 b. The nurse was male.
- (19) a. the cookies on the table.  
 b. The cookies are on the table.

There are three general approaches to capturing this dual function.<sup>12</sup> The first and perhaps most widely assumed is to treat adjectives like *male* as ambiguous (or systematically type-shiftable) between a property of individuals denotation (type  $\langle e, t \rangle$ ) and a property of properties one (type  $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$ ); see Siegel (1976) for an early proposal. On this view, the denotation for the adjective as used in (18b) would be as in (20):

$$(20) \quad \lambda x[\mathbf{male}(x)]$$

The semantic representation for the adjective when used attributively as in (18a) would be as in (21a), which could be guaranteed via its satisfaction conditions to be equivalent to (21b); the modified nominal could thus be represented as in (21c).

- (21) a.  $\lambda P \lambda x[(\mathbf{male}(P))(x)]$   
 b.  $\lambda P \lambda x[\mathbf{male}(x) \wedge P(x)]$   
 c.  $\llbracket \text{male nurse} \rrbracket = \lambda x[\mathbf{male}(x) \wedge \mathbf{nurse}(x)]$

The second approach, advocated by e.g. Larson (1998) and Chung and Ladusaw (2006), among others, is to treat the relevant modifiers unambiguously as first-order properties and adopt the assumption that natural language uses not just functor-argument application to compose meanings, but also other modes of composition, such as the intersec-

<sup>12</sup> As elsewhere, the discussion is developed using only adjectives for illustration, though the same issues apply to other categories as well. See, for example, Davidson (1967), Parsons (1990), and Landman (2000) for relevant discussion in relation to adverbs.

tive composition operation **MODIFY**, proposed in Chung and Ladusaw (2006):<sup>13</sup>

$$(22) \quad \mathbf{MODIFY}(\lambda x[\mathbf{nurse}(x)], \lambda y[\mathbf{male}(y)]) \\ = \lambda x[\mathbf{male}(x) \wedge \mathbf{nurse}(x)]$$

On the third approach, attributed to Parsons (1970), Montague (1970), and Kamp (1975), all adjectives unambiguously denote properties of properties; in sentences like (18b), the adjective is assumed to modify a null or elided nominal rather than to be predicated directly of the subject argument. As this latter approach runs into some empirical difficulties and is not currently widely assumed in the semantics literature, it will not be discussed further here.

The choice between the other two approaches is an example of the typical trade-off that must be made in linguistic analysis: simplification in one area entails complication in another. In this case, a smaller inventory of composition rules requires more complex assumptions about lexical items; a more parsimonious lexicon requires a richer inventory of modes of composition. The ambiguity approach has the important advantage that, when developed in an intensional version, it accounts for the fact that some adjectives have only predicative uses (such as *adrift*). It also directly allows for a fully general semantics for all modification constructions, as observed in e.g. Parsons (1970), since it is not obvious how to extend the sort of intersective analysis in (22) to subjective and intensional modifiers; at least some adjectives, such as *former* and *mere*, lack predicative uses altogether and thus would seem difficult to analyze as properties of individuals. However, the second-order property analysis of modifiers has been criticized, notably by McConnell-Ginet (1982) (for adverbs) and Larson (1998) (for adjectives) on both conceptual and empirical grounds. Larson concludes that the key to understanding apparently anomalous predicative uses of adjectives, including ones like *former*, involves understanding the sortal conditions they impose on the individuals to which they can apply, an issue to which we now turn.

<sup>13</sup> Some sort of intersective analysis is also an obvious choice for restrictive relative clauses, though see Bach and Cooper (1978) for an alternative analysis on which relative clauses substitute for free property-type variables in the denotations of determiners; see Larson and Yamakido (2008) for an updated version of this analysis on which modifiers within the determiner phrase are explicitly treated as oblique arguments to the determiner. Though it is less commonly posited than the analyses discussed in this article, Larson and Yamakido present an interesting argument in favor of this analysis based on so-called *Ezafe* morphology in Persian and similar adjectival inflection in Greek and Japanese.

### 1.3.2 Subjective modification and semantic sort

Larson’s reanalysis of attributive adjectives builds on the intuition that the semantics of nouns is more complex than it initially appears, and that, in particular, nouns make available more than one variable that can be targeted by the adjective.<sup>14</sup> Larson specifically extends to nouns Davidson (1967)’s analysis of verbs as relations involving events and proposes that nouns systematically make available an event variable for adjectival modifiers, assuming a rule similar to that in (23a). Thus, the intuition is that on the subjective reading of the nominal *beautiful dancer*, *beautiful* describes events of dancing associated with the dancer; the representation for the nominal on this reading would thus be as in (23b), in contrast to the representation for the reading on which *beautiful* describes the dancer herself, as in (23c):

- (23) a. If  $\llbracket \mathbf{N} \rrbracket = \lambda x \lambda e [\mathbf{N}(x, e)]$  and  $\llbracket \mathbf{AP} \rrbracket = \lambda e [\mathbf{A}(e)]$ , then  $\llbracket \mathbf{AP} \mathbf{N} \rrbracket = \lambda x \lambda e [\mathbf{N}(x, e) \wedge \mathbf{AP}(e)]$   
 b.  $\llbracket \text{beautiful dancer} \rrbracket = \lambda x \lambda e [\mathbf{dancer}(x, e) \wedge \mathbf{beautiful}(e)]$   
 c.  $\llbracket \text{beautiful dancer} \rrbracket = \lambda x \lambda e [\mathbf{dancer}(x, e) \wedge \mathbf{beautiful}(x)]$

This analysis has the virtue of correctly predicting that subjective adjectives should also have predicative uses on the relevant readings, as in (24), assuming a variant of the rule in (23a) for copular constructions.

- (24) Olga is beautiful (as a dancer).

Moreover, as Larson suggests, this general approach can be extended to other sorts of nonintersective adjectives besides those that describe eventualities. McNally and Boleda (2004) apply it to the analysis of relational adjectives. They propose that relational adjectives generally denote properties of kinds rather than of token entities, and argue that the logical representation for the noun’s semantics contributes a variable corresponding to the kind of entity the noun describes. This kind is then related via Carlson (1977)’s realization relation  $R$  to the set of token entities in the extension of the noun and serves as the argument to the adjective, as in (25).

- (25) a.  $\llbracket \text{logistical problem} \rrbracket = \lambda x_k \lambda y_o [R(y_o, x_k) \wedge \mathbf{problem}(x_k) \wedge \mathbf{logistical}(x_k)]$

<sup>14</sup> These ideas also play a key role in Pustejovsky (1995)’s analysis of modification, but technically Pustejovsky treats adjectives as properties of properties.

The intuition behind this analysis is that one of the principal functions of relational adjectives is to form subkind descriptions from kind descriptions (e.g. *technical problem* and *logistical problem* describe subkinds of *problem*).

Among McNally and Boleda's arguments for this analysis is the fact that in the Romance languages relational adjectives have a distribution resembling that of intersective adjectives, rather than that of intensional adjectives like Catalan *presumpte* 'alleged'; for example, they only occur postnominally, a position shared by intersective adjectives, whereas intensional adjectives occur only prenominally, as the contrasts in (26) illustrate.

- (26)
- a. un presumpte assassí  
a alleged murderer  
'an alleged murderer'
  - b. \*un assassí presumpte
  - c. un problema logístic  
a problem logistical  
'a logistical problem'
  - d. \*un logístic problema

In addition, contrary to what is sometimes claimed, relational adjectives can be used predicatively not only in Romance but also in e.g. English when the predication involves classifying some individual or kind of individual to a subkind, as seen in the contrast in (27).

- (27)
- a. That problem is logistical.
  - b. ??Alex is logistical.

Such facts recast the anomaly of sentences such as (27b) as a problem of sortal incompatibility between a (first order) predicate and its argument, rather than as a problem of using a second-order predicate where it is not licensed. In fact, Larson suggests that the intersective analysis could even be used to account for intensional adjectives like *former*, a suggestion initially supported by contrasts like that in (28), discussed in Higginbotham (1985) and Bouchard (2002):

- (28)
- a. ??The thief was alleged.
  - b. His Communism was alleged.

One important concern raised by this sort of approach to subjective modification is that it can easily lead to a proliferation of variables in the

representation for the modified expression, even though there is little or no evidence that so many variables are actively available, and if they are, they cannot all have the same status (see McNally (2006) for discussion of this point). For example, while (24) suggests that the event variable in *dancer* can be targeted for predication, this is not systematically possible for the kind variable proposed by McNally and Boleda, as the unacceptability of (29b) shows.

- (29) a. a logistical specialist  
 b. ??That specialist is logistical.

Alternatively, one might try to maintain the intersective analysis for attributive modification and argue that in predications such as (24), the property contributed by the adjective is ascribed directly to the subject referent, for which it is sortally appropriate in any case, and that the way in which the property is manifested remains underspecified.

Despite this concern, the intersective approach to subsective modification is very appealing for one type of modification in particular, namely the sort of incorporation constructions discussed in e.g. Farkas and Swart (2003) for Hungarian, Chung and Ladusaw (2004) for Chamorro and Maori, and Espinal and McNally (2011) for Catalan and Spanish; see (30) for an example from Chamorro.

- (30) Man-gäi-ga' häm.  
 Agr-have-pet we  
 'We have pets.'

Though there are important differences of detail between the analyses, all of these authors argue that, in the respective languages, certain kinds of bare nominals do not saturate the verbs they cooccur with but rather effectively function as intersective modifiers. One of the various arguments offered in support of a modifier analysis is based on the fact that, in some languages, including Chamorro, the presence of the incorporated nominal is compatible with the presence of an independent "doubling" nominal with the same referent ('L' indicates linking morphology). For example, in (31), the incorporated nominal *ga'* 'pet' is doubled by *un ga'lagu* 'a dog.'

- (31) Gäi-ga' un ga'lagu ennao na patgun.  
 have-pet a dog that L child  
 'That child has a pet dog.'

If the incorporated nominal saturated the verb, Chung and Ladusaw argue, it would not be possible to semantically compose the doubling nominal with the rest of the sentence. Note the similarity between the composition rule **RESTRICT** that Chung and Ladusaw propose for combining verbs and incorporated nominals and their **MODIFY** rule, presented in (22):

$$(32) \quad \mathbf{RESTRICT}(\lambda y \lambda x [\mathbf{V}(x, y)], \lambda z [\mathbf{NP}(z)]) = \lambda y \lambda x [\mathbf{V}(x, y) \wedge \mathbf{NP}(y)]$$

Such an analysis is arguably intuitively more appealing than the alternative of treating the nominal as a second-order property of eventuality descriptions (as was proposed in de Hoop (1992) for so-called weak Case nominals). Moreover, all of the above-mentioned authors show that incorporation constructions can contain not only lexical nouns but also syntactically complex nominals, rendering implausible a lexical ambiguity analysis of the sort used by Siegel for adjectives.<sup>15</sup>

The best way to leverage sortal restrictions in order to account for cases of subsective and intensional modification remains an unresolved issue and poses important technical and conceptual challenges; see Asher (2011) for a particularly cogent discussion and a rich alternative analysis. These challenges affect not only the questions of how best to represent lexical meaning and what the inventory of composition rules should look like, but also very fundamental questions involving the semantics/pragmatics distinction, such as the possible indeterminacy of meaning in predications like (24) or the treatment of nonrestrictive, expressive, and speaker-oriented modifiers, to which we now turn.

### 1.3.3 Modification and the contribution of non at-issue content

Recall that nonrestrictive, expressive and speaker-oriented modifiers are widely claimed to contribute a proposition ancillary to the denotation of the clause in which they appear, composed of a predicate contributed by the modifier and an argument which is retrieved in one of various ways. A significant point of debate has been exactly what the semantics and

<sup>15</sup> See also Dayal (2003), who treated similar cases in Hindi as (first order) property-type arguments to the verb with the ultimate semantic effect of second-order verbal modification. This analysis constitutes another strategy for capturing the modifying effect of the nominal without treating it formally as a second-order property. See Dayal (2011) for additional discussion.

pragmatics of this ancillary proposition are – specifically, whether the proposition constitutes a presupposition, a conventional implicature, or something else, and whether or not its interpretation justifies the use of a multi-dimensional logic (see notably the debate between Potts and Schlenker in the references cited in section 1.2.4, but also the other references cited there). As this debate is addressed in Schlenker, this volume, the discussion here will focus specifically on semantics of the predicate contributed by the modifier and its implications for a general semantic theory of modification and, to a lesser degree, for a theory of natural language ontology. As the discussion must be brief, at the risk of some oversimplification, many points of detail will be glossed over in order to provide a general overview of the issues.

In this discussion it will be assumed, as the evidence suggests, that the proposition constructed from these modifiers does not form part of the at-issue content of the sentence in which they appear. For example, when someone asserts (33a), their assertion cannot be rejected on the grounds that *spectacular* does not describe Mount Ranier ((33b)) or that the fact that Mount Ranier hasn't been climbed is not surprising ((33c)):

- (33) a. Surprisingly, nobody has ever climbed spectacular Mount Ranier.  
 b. ??That's false: Mount Ranier is not spectacular.  
 c. ??That's false: It's not surprising at all.

Thus, focusing on *spectacular*, the representation of (33a) could be as in (34), setting aside the adverb for the moment; with minor modifications, the same sort of analysis extends to nonrestrictive relative clauses and at least a subset of expressives.<sup>16</sup>

- (34)  $(\text{no } x : \text{person}(x))[\exists e[\text{climb}(e, x, \text{mr})]]$   
 $\wedge \text{spectacular}(\text{mr})$

Though analyses differ on exactly how the information corresponding to the second conjunct is passed up in semantic composition to permit conjunction (or a parallel but independent interpretation) with the main clausal proposition, locally, the modifier is effectively treated as a function from entities to entities.<sup>17</sup> For example, on Potts (2005)'s analysis, when a nonrestrictive modifier is attached to an entity-denoting nomi-

<sup>16</sup> Some expressives combine compositionally with property-type nominals and behave, modulo their special pragmatic characteristics, essentially like other subsective modifiers.

<sup>17</sup> Except for certain well-defined exceptions – see e.g. Del Gobbo (2003)'s

nal, two kinds of content result: On the one hand, the entity denoted by the nominal is passed up for further semantic composition, while, on the other, the property that Potts takes as the relative clause denotation is predicated of that entity to form a proposition that constitutes conventionally implicated content, which for Potts is ontologically distinct from at-issue content. Del Gobbo (2003) does not distinguish between at-issue and non at-issue content, but treats nonrestrictive modifiers as *t*-type sisters to an *e*-type expression; the nonrestrictive modifier is eventually restructured in the syntax to form a sister to the main clause, leaving the *e*-type expression as it originally was to undergo semantic composition.

The analysis of speaker-oriented modifiers like *surprisingly* has been similar: They have generally been analyzed as functions from propositions to propositions, as in (35).<sup>18</sup>

$$(35) \quad (\mathbf{nox} : \mathbf{person}(x))[\exists e[\mathbf{climb}(e, x, \mathbf{mr})]] \\ \wedge \mathbf{surprising}((\mathbf{nox} : \mathbf{person}(x))[\exists e[\mathbf{climb}(e, x, \mathbf{mr})]])$$

Again, the differences usually involve the status of the conjoined proposition containing the adverbial. Potts (2005) adopts essentially the same approach for these adverbials as for nonrestrictive modifiers. Bonami and Godard (2008) argue for a richer model of discourse in which the distinction between at-issue and conventionally implicated content is not ontological but rather a matter of how these contents are distributed in a formal model of dialogue of the sort developed by Ginzburg (see e.g. Ginzburg (2012)). In part, then, a decision between the analyses of these modifiers involves a decision about whether or not the different sorts of content communicated in an utterance should be distinguished ontologically or through some other formal mechanism. Notably, however, as was the case for nonrestrictive modifiers, the adverbial modifier has no effect on the semantic type of the main clause.

The definition of *modifier* in (4) is not immediately reflected in the diverse semantic analyses that have been proposed for these expressions. Modifiers were defined as expressions that combine with an unsaturated expression to form another unsaturated expression of the same type.

discussion of examples due to Sells (1985) – nonrestrictive modifiers systematically combine with entity-type nominals.

<sup>18</sup> An exception is Wyner (2008), who argues that factive adverbials like *stupidly* formally denote functions from properties of events to propositions and effectively contribute a conjunctive condition on the fact described by the event predicate they combine with. Thus, for instance, Wyner’s analysis of (33a) would be paraphrased as “There is a fact that corresponds to nobody ever having climbed spectacular Mount Ranier, and that fact is surprising.”

Since entities and (at least extensionalized) propositions are not unsaturated types, on this definition they fall out of the domain of modification altogether; however, it also seems intuitively wrong that only for that reason we cannot provide additional, non-essential descriptive content about the sorts of things these types of expressions refer to. The definition was formulated this way in order to permit a clear distinction between predication and modification, which can become blurred particularly when representing sentences as the following alongside those like (33a):

- (36) It is surprising that nobody has ever climbed spectacular Mount Ranier.

The main predicate in (36) also appears to denote a function from propositions to propositions. How, then, can it be distinguished semantically from a propositional modifier? A simple way to distinguish them would be to provide the main predicate in (36) with an eventuality argument or similar, so that it would denote a relation between a proposition and the state of being surprising. If we do so, a more generalized definition of *modifier* could be formulated as in (37):

- (37) **Modifier:** an expression which combines with another expression to produce a result with the same semantic type.

This definition covers modification of entity- and proposition-denoting expressions.

It is a striking fact that entity- and propositional modifiers, i.e., modifiers of saturated expressions, systematically fail to contribute at-issue content.<sup>19</sup> Why should this generalization hold? For example, why couldn't a modifier of an entity-denoting expression, such as the relative clause in (38a), in principle have the same pragmatic status as the first clause of (38b)?

- (38) a. The candidate, who was very popular, won by a wide margin.

<sup>19</sup> Those sentence adjuncts that do contribute at-issue content make other sorts of semantic contributions, for example as sortal properties of times or locations, as in (ia), or as restrictions on sentential quantifiers, as in (ib), in which the free adjunct restricts the domain of the modal *can* (Stump (1985)).

- (i) a. Tomorrow it will rain.  
b. Standing on a chair, the child can reach the shelf.

- b. The candidate was very popular, and she won by a wide margin.

Though it does not appear to follow from any deep property of modifiers of saturated expressions, the generalization is very much in tune with the intuitive definition of modifier mentioned at the beginning of this article, namely that a modifier adds additional, non-essential descriptive content to that contributed by the expression that it combines with. For example, since a modifier of an entity-denoting expression does not play any role in determining the reference of that expression, it will play no role in determining the proposition formed when a predicate combines with the expression, either. If that proposition is what is put forward as at issue, the information contributed by the modifier will necessarily be left out.

#### 1.4 Degree modification

Within the body of research on modification, so-called degree modifiers have received particular attention and merit a section apart here. Pre-theoretically speaking, a degree modifier combines with an expression describing a gradable property and provides information about the degree to which that property holds of its argument. Typically, the gradable property is contributed by an adjective or adverb, though degree modification also appears to be possible with verbs ((39b)), prepositions ((41b)), and nouns ((43)). Examples of the varied sorts of expressions that have been claimed to serve as degree modifiers include measure phrases, intensifiers, certain manner adverbs, comparative and related constructions, and adjectives indicating some sort of extreme size. These are illustrated in (39)-(43), respectively.<sup>20</sup>

<sup>20</sup> The literature on degree modification, even just for English, to say nothing of other languages, is too large to do justice to here. A comprehensive descriptive overview of degree expressions in English is provided in Bolinger (1972). Early semantic analyses of degree modifiers of adjectives appear in Wheeler (1972) and Klein (1980); for more recent discussion of both the syntax and semantics of such modifiers see e.g. Kennedy (1999), Neeleman et al. (2004), Rotstein and Winter (2004), Kennedy and McNally (2005a), Kennedy and McNally (2005b), Katz (2005), and McNally and Kennedy (2013). Bresnan (1973) presents an early, highly detailed account of the syntax of English comparative constructions; see e.g. Bhatt and Takahashi (2011) for a recent analysis in a cross-linguistic context and extensive references. A thorough review of the classic semantic analyses of comparatives appears in von Stechow (1984); see also Klein (1991) and Beck (2011) for an updated overview. On superlatives, see e.g. Sharvit and Stateva

- (39) a. **6 feet** tall  
 b. to like **a lot**
- (40) a. **very/slightly** warm
- (41) a. **extremely/terribly/surprisingly** quickly  
 b. **well** above average
- (42) a. **bigger/more** difficult **than we expected**  
 b. **as happy as we are**  
 c. **less** necessary **than many other things**  
 d. the **newest/the most** interesting **of the bunch**  
 e. **so** tiny **that it cannot be seen**  
 f. expensive **enough that almost nobody would buy it**
- (43) a **huge/tremendous** idiot

The existing analyses of these expressions are almost as varied as the expressions themselves. Let us once again use adjectives to illustrate. Throughout this survey, adjectives have been represented as denoting simple 1-place properties of individuals, as in (44a). However, as mentioned in section 1.2.3, on some analyses gradable adjectives have been given semantic representations that include reference to extents or degrees (see Seuren (1973), Cresswell (1976) Hellan (1981), von Stechow (1984), Heim (1985), Bierwisch (1989), Kennedy (1999), *inter alia*). The implementations of this latter idea differ in detail, but (44b) will serve as a starting point. Though **tall** looks superficially similar in the two representations in (44), in (44b) it is not a property of individuals (type  $\langle e, t \rangle$ ) but rather a *measure function* (type  $\langle e, d \rangle$ ): It applies to an entity  $x$  and returns a degree  $d$ , specifically, the degree to which  $x$  is tall (or, more precisely, has height). It will be true that  $x$  is tall if the value of  $x$  on this measure function is greater than or equal to some reference degree  $d$  provided by context or linguistic material; this degree is typically referred to as the *standard*.

- (44) a.  $\lambda x[\mathbf{tall}(x)]$   
 b.  $\lambda d \lambda x[\mathbf{tall}(x) \geq d]$

(2002) and references cited there; on comparisons involving *so*, *too* and *enough*, see Meier (2003). For comparison of degree modification across different categories, see e.g. Doetjes (1997), Doetjes (2008), and Bochnak (2010); for such modification in nominals specifically, see Morzycki (2009) and Constantinescu (2011). For a typological overview of comparison constructions, see Stassen (1985). See also the references cited in all of these works.

However, the adjective is sometimes taken to contribute only the measure function to (44b). On these analyses degree morphology, instantiated either as a null positive form morpheme (usually represented as *pos*) or as an overt degree expression, typically contributes both the degree argument and the relation between the value of the measure function on  $x$  and the degree in question (see Bartsch and Vennemann (1972), Cresswell (1976), von Stechow (1984), Kennedy (1999); see Neeleman et al. (2004) for comparison of different approaches to introducing the degree). On such approaches, e.g. *6 feet* in (45a) denotes a function from measure functions, such as that denoted by *tall* (see (45b)), to properties of individuals, e.g. the property of being 6 feet tall in (45d). The representation for the entire sentence in (45a) is thus as in (45e).

- (45) a. John is 6 feet tall.  
 b.  $\llbracket \text{tall} \rrbracket = \mathbf{tall}$ , a function from individuals to degrees  
 c.  $\llbracket 6 \text{ feet} \rrbracket = \lambda G \lambda x [G(x) \geq \mathbf{6ft}]$ ,  $G$  a function of type  $\langle e, d \rangle$   
 d.  $\llbracket 6 \text{ feet tall} \rrbracket = \lambda x [\mathbf{tall}(x) \geq \mathbf{6ft}]$   
 e.  $\llbracket \text{John is 6 feet tall} \rrbracket = \mathbf{tall}(\mathbf{j}) \geq \mathbf{6ft}$

An exactly analogous treatment can be given to the (null) positive form morpheme, as illustrated in (46). The only difference involves the standard: instead of being numerically specified, either it is contextually determined by a comparison class (as is the case for *tall*) or, in some cases, it is fixed independently of a comparison class, typically as the minimum or maximum degree to which the property can be held (as is the case with e.g. *open* and *closed*, respectively).<sup>21</sup>

- (46) a.  $\llbracket \text{pos} \rrbracket = \lambda G \lambda x [G(x) \geq d_{\mathbf{s}(G)}]$ ,  $\mathbf{s}(G)$  the standard for  $G$   
 b.  $\llbracket \text{pos}(\text{tall}) \rrbracket = \lambda x [\mathbf{tall}(x) \geq d_{\mathbf{s}(\mathbf{tall})}]$

Intensifiers and other adverbs have been analyzed in a similar fashion; they differ only in the nature of the specific conditions they place on the standard for the adjective they combine with and on the standard for the resulting modified expression. For example, the standard for an

<sup>21</sup> See Kennedy (2007b) for this formulation of the semantics for *pos*; see this work and Kennedy and McNally (2005a) for detailed discussion of the standards for positive form adjectives. These works refer to adjectives whose standard is determined by a comparison class as *relative*, and to those whose standards are determined independently of a comparison class, as *absolute*. These terms are also used by extension to characterize the standards themselves. See McNally (2011) for the argument that color terms and certain other adjectives can be interpreted with a standard that is absolute but neither a minimum nor a maximum value on a scale.

adjective modified by *very* is determined by considering the comparison class of individuals that satisfy the positive form of the adjective (Wheeler (1972), Klein (1980)); the specific formulation in (47) is based on Kennedy and McNally (2005a).

$$(47) \quad \begin{array}{l} \text{a. } \llbracket \text{very} \rrbracket = \lambda G \lambda x [G(x) \geq d_{\mathbf{S}(\{y: \text{pos}(G)(y)\})}] \\ \text{b. } \llbracket \text{very tall} \rrbracket = \lambda x [\mathbf{tall}(x) \geq d_{\mathbf{S}(\{y: \text{pos}(\mathbf{tall})(y)\})}] \end{array}$$

Kennedy and McNally (2005a) show that only those interpretations of adjectives on which the standard is determined by a comparison class in the first place (as opposed to being lexically determined) are compatible with *very*. In contrast, the degree modifier *much* only combines with adjectives whose standard is a minimum degree; other degree modifiers are similarly selective.

Finally, comparatives, equatives, and similar constructions can be assigned the same general semantics, varying only in the fact that the standard is introduced by a comparative phrase or clause (e.g. *than Bill* in (48a)) and in the nature of the relation to the standard (e.g.  $>$  in (48b), rather than  $\geq$  as in previous examples):

$$(48) \quad \begin{array}{l} \text{a. } \text{taller than Bill} \\ \text{b. } \llbracket \text{-er...than Bill} \rrbracket = \lambda G \lambda x [G(x) > G(\mathbf{b})] \\ \text{c. } \llbracket \text{taller than Bill} \rrbracket = \lambda x [\mathbf{tall}(x) > \mathbf{tall}(\mathbf{b})] \end{array}$$

Note that on all of the analyses in (45)-(48), the expressions we have referred to as degree modifiers do not comply with the definitions in (4) or (37) because all of them are type changing, rather than type preserving: they turn measure functions into properties of individuals. This is a direct consequence of the proposal to treat adjectives as measure functions (or as relations between individuals and degrees) rather than as properties of individuals. This proposal, however, is not uncontroversial: see e.g. Klein (1980), Moltmann (2009), Bale (2006), van Rooij (2011); see also Kennedy (2007a) and Beck (2011) for discussion of the possibility that languages may vary in their use of degrees. Were the simple property analysis of adjectives to be maintained, an alternative analysis for degree expression on which they were type-preserving could, in theory, be pursued.

This situation naturally raises the question of whether degree expressions in fact behave like other modifiers. The preceding analyses predict that they should not. However, this prediction is only partially borne out. The most obvious difference that is predicted between degree ex-

pressions as analyzed here and other modifiers is that only the latter should be iterable. Since the result of adding a modifier to some expression is another expression of the same type, this result can, in turn, combine with additional modifiers, as illustrated in (49).

(49) long, sunny, pleasant days

In contrast, if a degree expression turns a word or phrase denoting a measure function into one denoting a property of individuals, the resulting modified phrase will not be of the appropriate type to combine with additional degree expressions. This is certainly the case for many combinations of degree expressions, as (50) illustrates.

(50) a. \*Alice is more very happy than is her brother.  
 b. \*Andrea is 6 feet very tall.  
 c. \*Alex is very 90 years old.

However, some combinations of degree expressions are possible, perhaps most notably iterations of comparison constructions as in (51a) (Bresnan (1973), Bhatt and Pancheva (2004), Kennedy and McNally (2005b)), but also the addition of measure phrases or intensifiers to comparatives to express differential degree ((51b) and (51c), respectively).

(51) a. John is (much) taller than Mary than Bill is.  
 b. John is 2 inches taller than Mary than Bill is.  
 c. John is very (much) taller than Mary than Bill is.

Whether intensifiers are genuinely iterable or not is less clear. Clearly, they can be reduplicated, as in (52a). However, some combinations of different intensifiers are odd (e.g. (52b)).

(52) a. very, very happy  
 b. ??very quite happy

Moreover, when such combinations are acceptable it can be difficult to determine whether the outermost intensifier has combined with the entire phrase, as in (53a) or just with the first intensifier, as in (53b).

(53) a. [quite [very happy]]  
 b. [[quite [very]] happy]

Uncertainties in the data notwithstanding, these sorts of facts have led to some analyses on which not all degree expressions are assigned the

same semantic type. For example, von Stechow (1984) analyzes intensifiers as modifiers of adjectives that have already combined with *pos*, while giving comparatives a (still type-changing) analysis that, unlike the analysis in (48), builds in the possibility of selection for a differential degree expression. Kennedy and McNally (2005b), taking the iterability of comparatives at face value, propose that they denote modifiers of adjectives prior to the addition of degree morphology, assigning them to type  $\langle\langle d, \langle e, t \rangle \rangle, \langle d, \langle e, t \rangle \rangle\rangle$ . The function of comparatives on this view is to manipulate the minimum or maximum degree<sup>22</sup> to which an individual can stand in relation to the relevant property. For example, while the minimum degree to which an individual can stand in the relation denoted by *tall* will be the smallest degree above zero, the minimum degree to which an individual can stand in the relation denoted by *taller than Mary* will be Mary's height. This analysis, like von Stechow's allows for the subsequent addition of measure phrases and intensifiers.

As this brief discussion should make clear, degree modification is an exceptionally complex phenomenon that requires continued research. Much of the literature on degree expressions has developed independently of the literature on modification as a whole. This is in part because of the affinities between certain sorts of degree expressions, such as measure phrases, and quantifiers, particularly determiners. However, there are also cases of degree modification, notably those involving the adverbs in (41) and the adjectives in (43), that arguably have at least as much in common with canonical modification as they do with quantification. A closer approximation between the study of degree expressions and the study of other modifiers would no doubt contribute to a better understanding of the variety of strategies human language provides for expressing the gradability, comparison, and measurement of properties.

## 1.5 Conclusion

Modification remains one of the most difficult semantic phenomena to model because it makes particularly evident the need for a sufficiently rich theory of lexical meaning and for a model that can integrate conventionalized propositional content with discourse-related aspects of meaning and, ultimately, world knowledge. The definition of a modifier as a word or phrase that combines with an expression to yield another of the

<sup>22</sup> The effect will be on the minimum for "more" comparatives and on the maximum for "less" comparatives.

same semantic type is perhaps the best definition currently available. However, a fully adequate theory of how best to explain the division of labor between the semantics of the modifier and modifiee, the semantic composition rules, and context remains to be developed.

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