

Back to basics: *more* is always *much-er*¹

Alexis Wellwood — University of Maryland

Abstract. Bresnan (1973) posited that *more* is uniformly analyzed as *much-er*, whether it appears with adjectives (*more intelligent, redder*) or nouns (*more soup*). On the earliest degree-semantic analysis of such constructions, *much* appears but is semantically inert: it serves to morphologically mark the presence of the degree argument which is introduced by adjectives and nouns (Cresswell 1976). I present an alternative analysis, one suggested by Cresswell himself: on this account, the degree argument is introduced by *much*. I first show how the interpretation of this morpheme as a structure-preserving mapping to the domain of degrees is motivated by data from nominal and verbal comparatives, and then how it extends to adjectival comparatives. To accomplish this, I argue that adjectives are predicates of *states*, and interact with degrees only in composition with *much*. The upshot is a theory in which *much* universally provides the mapping to degrees for comparison by *more*, regardless of the syntactic category it combines with.

Keywords: degree semantics, comparatives, mass nouns, atelic verbs, gradable adjectives.

1. Introduction

In Cresswell's classic (1976) paper, he offers what has become known as the degree analysis of comparatives, designed to interpret sentences like those in (1a-1b).² On his account, (1a) means that the degree to which Bill is tall is greater than the degree to which Arabella is tall, and (1b) means that the degree of volume measured by the totality of ebbing water is greater than the degree of volume measured by the totality of flowing mud.

- (1) a. Bill is **taller** than Arabella.
b. **More water** ebbs than than mud flows.

On this analysis, both adjectives like *tall* and mass nouns like *water* build in the semantics of degree. The word *more* is analyzed as the composition of *much* and *-er* (Bresnan 1973), yet the only contribution of *much* is to signal the presence of the adjective or noun's degree argument.³

At the end of his paper, however, Cresswell worries that this analysis may be on the wrong track, given that it predicts (2a,b) to be synonymous, contrary to fact.

¹Many thanks to Valentine Hacquard, Paul Pietroski, Alexander Williams, Norbert Hornstein, Jeffrey Lidz, Michael Morreau, the participants at the Konstanz workshop *Much* ado about *much*, as well as Ewan Dunbar and Michaël Gagnon, for helping me to work through the ideas I present here. Any failures of imagination or formulation are mine alone. This research was supported in part by a SSHRC doctoral award #752-2010-0499.

²He also discusses comparatives with plural noun phrases; I discuss these in the context of proposals about a covert *many* in Wellwood 2012 (cf. Hackl 2000, 2001).

³In a similar vein, Neeleman et al. 2004 and Solt 2009 interpret *much* as the identity predicate.

- (2) a. Drink **this water**.
 b. Drink **this much water**.

Assuming a single interpretation for *water*, a degree variable should be present in both (2a,b). If the only semantic role of *much* was to signal that variable's presence, (2a,b) should simply represent a case of optionality; adding *much* can't add anything to the meaning of a sentence like (2a).

Such considerations in mind, Cresswell considers an alternative in which the degree is not introduced by the noun, but is provided, somehow, by *much*. Closing the paper, he writes:

My main reason for hesitation at this point is that I find it difficult to give a clear semantics for *much*. What *much* has to do is to discover the appropriate degree of comparison for a predicate, given merely that we know what, in each world, satisfies that predicate. For this reason I feel able to do no more than indicate it as a line for further study in the semantics of mass nouns (Cresswell 1976: 290-1).

In this paper, I pursue this study, following up on recent developments in the semantics of nominal and verbal degree constructions (Hackl 2000, 2001; Nakanishi 2004, 2007; Wellwood et al. 2012). I show that consideration of the properties of these constructions requires, on any theory, a particular analysis of the "measure function" *much*. Next, I elaborate a theory in which *much* provides the mapping to degrees in comparatives with nominal, verbal, and adjectival expressions.⁴

I first consider the properties of nominal comparatives like (3a) and their verbal counterparts (3b), which motivate an analysis of *much* as a structure-preserving map from the "qualitative" domains of stuff/processes to the quantitative domain of degrees. I next show in detail that, to treat adjectival comparatives like (4) in the same manner, all we need do is adopt an analysis of gradable adjectives as predicates of states.

- (3) a. Al ate **more soup** than Bill did.
 b. Al **ran more** than Bill did.
 (4) Al is **more intelligent** than Bill is.

The resultant theory retains Cresswell's intuition (and that of many others since) that *more* states a greater-than relation between two degrees, but abandons the idea that any open class lexical item refers to degrees directly.

⁴The general flavor of the analysis has a precursor in Bale 2006, 2008's account of adjectival comparatives; our accounts differ in several respects, however for reasons of space I do not pursue a thorough comparison here.

2. Nominal and verbal comparatives

Two properties of comparatives with mass nouns and atelic verbs suggests they should be given a parallel analysis: in both cases, only predicates with “structured domains” can compose with *more*, and the mapping to degrees must be structure-preserving.⁵ These properties are encoded into an appropriately cross-categorial denotation for the measuring device *much*.

2.1. Nominal and verbal felicities and infelicities

Comparison over a mass noun like *soup* is perfectly felicitous (5a), but comparison over a count noun like *toy* is not (5b). Where (5a) describes a comparison of two portions of soup by their volume, (5b) is not interpretable.⁶ (Note: this section draws heavily on Wellwood et al. 2012, henceforth WHP.)

- (5) a. Al has **more soup** than Bill does.
b. # Al has **more toy** than Bill does.

Similarly, comparison over an atelic verb like *run* is perfectly felicitous (6a), but comparison over a telic verb like *die* is not (6b). Where (6a) describes a comparison of two events of running by the amount of time they took,⁷ (6b) is uninterpretable.⁸

- (6) a. Al **ran more** than Bill did.
b. # Al **died more** than Bill did.

Interestingly, the felicitous nominal comparatives show a remarkable property (as Schwarzschild 2002, 2006 pointed out): they only give rise to a particular subset of dimensions for measurement. Comparing over *soup* allows for comparison by volume, but not by temperature or degree of tastiness—despite the fact that any portion of soup will have some degree of temperature (even if it’s cold) and some degree of tastiness (even if it’s not that good).

⁵I focus here on non-plural nouns and verbs, but Wellwood et al. 2012 and Wellwood 2012 discuss similar parallels but between plural NPs and VPs. The punchline of that discussion is that independently observed parallels between nominal number and verbal aspect have parallel effects when they figure in comparatives.

⁶That is, it is uninterpretable if we insist that *toy* in all instances is a singular count noun. Odd, coercive interpretations are possible, in which cases *toy* is treated like a mass noun.

⁷Other dimensions for measurement are possible, but all respect the constraints discussed below. I ignore questions of variability in the choice of dimension for measurement until §5.

⁸The usual caveats apply: (6b) is only uninterpretable if we interpret *die* as picking out momentaneous dying events that can only happen once per individual. Coercive interpretations require interpreting *die* quite differently.

- (7) $\llbracket \textit{more soup} \rrbracket \approx$ by volume, *by temperature, *by tastiness

Similar facts obtain with verbal comparatives. Comparing over *run* as in (6a) allows for comparison by temporal duration, but not by speed or degree of effort expended—again, despite the fact that any running event will have some associated degree(s) of speed, and effort expended.

- (8) $\llbracket \textit{run more} \rrbracket \approx$ by time, *by speed, *by effort

WHP analyzed such facts as suggesting a particular interpretation of the measure function *much* that appears in such constructions: it only combines with “structured” predicates, and it preserves structure in the mapping to degrees. In the next section, I elaborate on and refine this analysis, showing how it derives the distribution and interpretation of nominal and verbal comparatives.

2.2. Measuring masses and atelics

The notion of “structure” I employ distinguishes predicates that have an ordering on their domain from those that do not. With respect to nominal and verbal comparatives, this tracks a distinction familiar from the mass/count and atelic/telic literature. While the extensions of mass and atelic predicates are ordered by the part-of relation, the extensions of count and telic predicates have no linguistically accessible ordering; while mass and atelic predicates are “structured”, count and telic predicates are “unstructured”. In this section, I show that an analysis of *much* which tracks this distinction can explain the data from the preceding section.

By assumption, mass nouns and atelic verbs do not encode the semantics of degree. Bare nouns are one-place predicates of portions of matter or individual objects (Cartwright 1975; Link 1983; Bunt 1985; Krifka 1989; Higginbotham 1994; Bale and Barner 2009, among many others), and their verbal counterparts are similarly analyzed, in this case as one-place predicates of parts of processes or individual events (Taylor 1977; Mourelatos 1978; Bach 1986; Landman 2000, among others). In what follows, I represent structured sets as those containing (non-atomic) *parts*, α , α' , and their sums, $\alpha \oplus \alpha'$; non-structured sets contain only atoms, α_{AT} , α'_{AT} .⁹

The mass term *soup* has the denotation in (9a), and an extension like that in (9b).¹⁰ Correspondingly, the atelic term *run* has the denotation in (10a), and an extension like that in (10b).¹¹

⁹ α is a wildcard variable over primitive types, e.g. those referred to in the first position of individual $\langle e, t \rangle$, event $\langle v, t \rangle$, and state types $\langle s, t \rangle$.

¹⁰I leave the functional representation of the meaning of *soup* underspecified for its massness, as I do not assume that the proper place for determining the domain of a mass term is in the logic (e.g., in terms of superplurals, Nicolas 2008; Linnebo and Nicolas 2008).

¹¹I adopt the neodavidsonian analysis (Parsons 1990; see also Schein 1993; Pietroski 2005; among others).

- (9) a. $\llbracket \textit{soup} \rrbracket = \lambda x[\text{SOUP}(x)]$
 b. $\rightsquigarrow \{x_{\text{SOUP}}, x'_{\text{SOUP}}, \dots, x_{\text{SOUP}} \oplus x'_{\text{SOUP}}, \dots\}$

- (10) a. $\llbracket \textit{run} \rrbracket = \lambda e[\text{RUN}(e)]$
 b. $\rightsquigarrow \{e_{\text{RUN}}, e'_{\text{RUN}}, \dots, e_{\text{RUN}} \oplus e'_{\text{RUN}}, \dots\}$

Following WHP, I propose that a covert *much* provides the mapping to degrees when mass and atelic expressions appear in the comparative. On my implementation, *much* is interpreted as in (11), where μ is a homomorphic map from the ordering on the domain of the α s to the domain of degrees (see Krifka 1989, Nakanishi 2007 for similar appeals). The latter domain is, I assume, the structure corresponding to the real numbers and their ordering by \geq .

- (11) $\llbracket \textit{much} \rrbracket = \lambda d \lambda \alpha [\mu(\alpha) = d]$,
 where D_α is ordered, and μ is a homomorphism from $\langle D_\alpha, \succcurlyeq_\alpha \rangle$ to $\langle D, \geq \rangle$.

Appeal to homomorphisms ensures that the mapping to degrees is structure preserving. This analysis allows us to see why volume but not temperature is permitted with mass comparatives (12a,b): two arbitrary proper subportions of soup will necessarily measure less by volume than their sum, but this is not necessarily or even likely so for measurement by temperature.¹²

- (12) If x and x' are distinct portions of some soup, and $x \oplus x'$ is their sum:
- Volume is structure preserving:**
 Measures $\mu_{\text{vol}}(x)$ and $\mu_{\text{vol}}(x')$ are necessarily less than the measure $\mu_{\text{vol}}(x \oplus x')$.
 - Temperature is not structure preserving:**
 Measures $\mu_{\text{temp}}(x)$ and $\mu_{\text{temp}}(x')$ are **not** less than the measure $\mu_{\text{temp}}(x \oplus x')$.

The same appeal explains why measurement by temporal duration but not by speed is permitted with atelic comparatives (13a,b): two arbitrary subportions of some running event necessarily measure less than that of the whole event, but this is not necessarily or even likely so for speed.

- (13) If e and e' are distinct subevents of some running, and $e \oplus e'$ is their sum:
- Time is structure preserving:**
 Measures $\mu_{\text{time}}(e)$ and $\mu_{\text{time}}(e')$ are necessarily less than the measure $\mu_{\text{time}}(e \oplus e')$.

¹²On this analysis, it is necessary to assume that, for a predicate to count as “structured”, the ordering on its domain is non-trivial. Note that I use subscripts on μ to indicate the dimension as a convenience at present, and return to the issue of variable dimensions in §5.

- b. **Speed is not structure preserving:**
 Measures $\mu_{speed}(e)$ and $\mu_{speed}(e')$ are **not** less than the measure $\mu_{speed}(e \oplus e')$.

Dimensions like temperature and speed are not structure-preserving on domains ordered by the part-of relation on portions of matter or parts of events: there is no homomorphism for *much* to pick out to measure such domains along such dimensions.

Notice that, on the present analysis, if an expression is *not* associated with a (non-trivial) ordering, it will not combine with *much*. This accounts for the infelicity observed with count nouns and telic verbs. In contrast to its mass counterpart, a count noun like *toy* has the denotation in (14a), and an extension like that in (14b). It is satisfied only by atomic toys.

- (14) a. $[[toy]] = \lambda x[TOY(x)]$
 b. $\rightsquigarrow \{x_{AT_{TOY}}, x'_{AT_{TOY}}, x''_{AT_{TOY}}\}$

Correspondingly, the telic verb *die* has the denotation in (15a), and an extension like that in (15b). It is satisfied only by atomic dying events.

- (15) a. $[[die]] = \lambda e[DIE(e)]$
 b. $\rightsquigarrow \{e_{AT_{DIE}}, e'_{AT_{DIE}}, e''_{AT_{DIE}}\}$

We have analyzed nominal and verbal comparatives without appealing to degrees in the denotation of these expressions directly. Mass nouns and atelic verbs are one-place predicates over different primitive types which, when they compose with *much*, are related to degrees in a structure-preserving way. In the next section, I extend this analysis to adjectival comparatives.

3. Adjectival comparatives

Only “gradable” adjectives combine with *more*. In adjectival comparatives, dimensions for measurement are *not* restricted to those that preserve the properties of the NP putatively predicated of by the adjective. I propose that, in these cases, it is not the extension of NP that is measured, but that of the adjective itself. This analysis requires the innovation that APs are interpreted as predicates of *states* (as in Fults 2006), in which case measurement with *much* can be seen as structure preserving.

3.1. Adjectival felicities and infelicities

While comparison over adjectives like *red* is perfectly felicitous (16a), comparison over adjectives like *dead* is not (16b). Where (16a) describes a comparison of two qualities of redness along some dimension, which I will assume is *saturation*, (16b) is uninterpretable.^{13,14}

- (16) a. Al is **more red/redder** than Bill is.
 b. # Al is **more dead/deader** than Bill is.

Usually, adjectives are taken to predicate directly of their subject, which in comparative constructions means that the subjects are measured for their degree of Adj-ness. The consequences of this assumption can be seen by considering the sentences in (17a-17b). In both, the extension of *Al's soup* and *Bill's soup* would be measured in the matrix and *than*-clauses respectively.

- (17) a. Al's soup is **hotter** than Bill's soup.
 b. Al's soup is **more red** than Bill's soup.

Considering Al's soup, it is not necessary or even likely that arbitrary subparts are less hot or less red than the total (modulo granularity), so measurement by temperature or redness do not track the part-whole structure of soup. The standard analysis thus derives a fundamental difference between "measurement" in the nominal and verbal domains, and that in the adjectival: adjectival measurement is seen as not, in general, structure-preserving.

On one fairly standard formulation, *red* is interpreted as a function from degrees to individual predicates, and *dead* as simply an individual predicate, with the denotations in (18).¹⁵ On this view, a direct descendant of Cresswell's original analysis, gradable adjectives have the semantics of degree 'built in', and the target of their measurement is the subject of their clause.

- (18) a. $[[red]] = \lambda d \lambda x [RED(x) = d]$
 b. $[[dead]] = \lambda x [DEAD(x)]$

¹³(16b) cannot be read as a comparison of relative quality of deadness, as this property is apparently absolute. Coercion may invoke ancillary dimensions that may somehow be related to being dead (amount of time spent being dead, the gruesomeness of the death, etc), or a plurality of deaths (as in a videogame). The former are coercive; I discuss the plural readings in some detail in Wellwood 2012.

¹⁴Note that, on Bresnan's 1973 analysis, the reduced form *redder* is still, underlyingly *much-er red*. Her proposal is that *much* deletes in the environment of an adjective.

¹⁵Note I am using the formulation given by Heim 1985 for the denotation of a gradable adjective, rather than Kennedy 1997's formulation. The specific points made in this section would have to be made differently if addressing Kennedy, but the conclusion is the same.

In this way, the standard analysis encodes the fact that only gradable adjectives are felicitous with *more*: only these adjectives introduce the degrees required for the evaluation of that expression. Adjectives like *dead*, since they do not build in the semantics of degree, are infelicitous with *more*.

On this account, *more red* cannot be understood as a comparison along a dimension like “greenness”, or “attractiveness to the subject”, because red degrees fail to encode such information.

- (19) $[[\textit{more red}]] = \text{by saturation, *by greenness, *by attractiveness}$

I propose instead that gradable adjectives do not measure their NP subject, but instead *much* measures the extension of AP. Fults (2006), arguing from very different concerns, concludes that adjectives are predicates of states, not degrees *or* individuals. The most striking data he provides, for my purposes, are adjectival comparatives with some or many layers of modification.¹⁶ Gradable adjectives may appear with arbitrarily many modifiers, all of which must be interpreted within the scope of the comparative operator. (20a) compares Al’s and Bill’s degrees of patience temporally located in the morning, (20b) their degrees of redness in response to a particular kind of emotional state, and (20c) degrees of upsetness in situations yet more elaborately identified.

- (20) a. Al is **more patient in the morning** than Bill is
 b. Al turns **redder when she’s embarrassed** than Bill does.
 c. Al is **more upset with Carl in the late morning on Mondays from arguments about the Sunday night football game** than Bill is. (A. Williams, p.c.)

To account for such data, Fults invokes Davidsonian arguments to the effect that gradable adjectives are interpreted as one-place predicates of *states*. On this view, modifiers like *in the morning* are interpreted as conjunctive predicates of eventualities.¹⁷

In the next section, I show how the felicitous and infelicitous cases can be captured in the state analysis of adjectives, by showing how the formulation of gradable adjectives as structured, and non-gradable adjectives as non-structured emerges on this view. I then show how making this distinction in the state analysis allows for a general characterization of the distribution and interpretation of adjectival comparatives in terms of structure-preserving *much*.

¹⁶Fults offers a number of specific syntactic and semantic arguments for the conclusion that the mapping to degrees with gradable adjectives proceeds via a separate functional head that he calls Deg. One of his major goals was to eliminate reference to degrees in positive constructions, which doesn’t concern us here.

¹⁷Other hypotheses face various issues. The one that offends Davidsonian sensibilities would posit a new time variable in the denotation of the adjective for each temporal expression that can be shown to modify AP directly. An alternative would posit that the adjective always has a time variable, which modifiers can conjoin with; such an account faces difficulty with closure of that variable before composition with the subject. The same obtains for an analysis that simply adds a state argument to the denotation of the adjective. In contrast, extending the neodavidsonian theory to these cases recruits technology we already need for eventive predications without further stipulation.

3.2. Measuring states

On the standard approach to gradable adjectives, these morphemes encode two distinct bits of information: *quality*, the fact that *redness* and not *greenness* is being predicated of, and *quantity*, or *how much* of the property is predicated. In this section, I explore how these two bits of information can be encoded separately; the qualitative information is provided by the state argument, and the quantitative information extracted in degree constructions by *much*.

I posit that the gradable adjective *red* has the denotation in (21a), and an extension like that in (21b). Here, *red* is associated with an ordering on its domain, \succ_{red} . As above, structured sets are those containing non-atomic parts (α, α') and their sums $(\alpha \oplus \alpha')$, and non-structured sets contain only atoms $(\alpha_{AT}, \alpha'_{AT})$.¹⁸

- (21) a. $\llbracket red \rrbracket = \lambda s[\text{RED}(s)]$
 b. $\rightarrow \{s_{\text{RED}}, s'_{\text{RED}}, \dots, s_{\text{RED}} \oplus s'_{\text{RED}}, \dots\}$

My analysis of *much* is repeated as (22) below. As before, μ can invoke no dimensions for measurement which do not track the ordering associated with its α argument; if *red* is a predicate of red states ordered by something like increasing intensity, this serves to explain why *more red* cannot describe comparisons like *red that is more green*.

- (22) $\llbracket much \rrbracket = \lambda d \lambda \alpha [\mu(\alpha) = d]$,
 where D_α is ordered, and μ is a homomorphism from $\langle D_\alpha, \succ_\alpha \rangle$ to $\langle D, \geq \rangle$.

As we've seen, whenever an expression is *not* associated with an ordering, it will not combine with *much*. On the state analysis, non-gradable adjectives like *dead* are such predicates: *dead* has the denotation in (23a), and an extension like that in (23b). The difference here is that, rather than appealing to the fact that *dead* doesn't have a degree argument to explain its infelicity with *more*, I appeal to the fact that it predicates only of atomic states.

- (23) a. $\llbracket dead \rrbracket = \lambda s[\text{DEAD}(s)]$
 b. $\rightarrow \{s_{AT_{\text{DEAD}}}, s'_{AT_{\text{DEAD}}}, \dots\}$

This analysis retains the intuitions underlying the degree-based analysis of adjectives, only in a slightly different way. When gradable adjectives are analyzed as degree predicates, an ordering on

¹⁸The sum notation will have to be taken with a grain of salt, as it is not altogether clear at present what the parts or ordering principles may be for state predicates.

their domains is invoked, however implicitly. The intended notion of ‘degrees’ on this account is quite specific, and strictly richer than that which I adopted above: the degrees associated with *red* are particular to that adjective.¹⁹ So the set of degrees associated with the meaning of *red* (24a) might look as in (24b) on such approaches.

- (24) a. $\llbracket red \rrbracket = \lambda d \lambda x [\text{RED}(x) = d]$
 b. $\rightsquigarrow \{d_{\text{RED}1}, d_{\text{RED}2}, d_{\text{RED}1} \oplus d_{\text{RED}2}, \dots\}$

Adjectival degrees are not numbers, but equivalent to something like numbers bound up with a dimension. The net result is that such degrees encode both the qualitative information about the kind of thing they describe, as well as the quantitative values they possess, derivative on the position they occupy in the degree ordering. This stipulation makes it possible for a straightforward account of apparent ‘incommensurability’: the purported infelicity of (25) arises because the degrees named by *red* and those named by *tall* are simply not orderable with respect to one another.

- (25) # Al is **redder** than Bill is tall.

These intuitions can be maintained in the state analysis by assuming that adjectives like *red* and *tall* are predicates of things which are not orderable with respect to one another, i.e. there is no one *qualitative* \succ that orders both types of states. Further, if we assume that one and the same μ has to measure in both clauses of a comparative like (25), the same infelicity can be derived: there is no single \succ that μ can map to \geq .

I have analyzed adjectives without appeal to degrees in any adjectival denotation. Gradable adjectives are one-place predicates over a primitive type which, when they compose with *much*, are related to degrees in a structure-preserving way. The primitive type in this case is that of *states*. In the next section, I present the compositional details of cross-categorial comparatives in which *much* universally provides the mapping to degrees.

4. Composition with *much*

The semantic theory presented in this section provides a perfect parallel to the syntactic analysis of comparatives which decomposes *more* into *much-er*, but differs from Cresswell’s proposal in that here, *much* plays a critical semantic role. I first present the theory, and then show how the compositional details work when applied to comparatives with mass, atelic, and adjectival predicates.

I assume the modern syntax argued for by Bhatt and Pancheva (2004) (and references therein). On my account, the morpheme *-er* QRs from the complement position of *much* in the matrix clause,

¹⁹Beck 2011 attributes this view to von Stechow 1984; cf. Bale 2008’s ‘universal scale’ which has dimensionless degrees like those I assume.

leaving behind a degree variable. The expression *much d* is conjoining with its XP sister, and *much*'s α argument is identified with the more specifically typed argument of XP. Thus, the basic analysis of mass, atelic, and gradable adjective expressions composed with *much* is as in (26).

- (26) a. $\llbracket \llbracket \llbracket \text{much } d \rrbracket \text{ soup} \rrbracket \rrbracket = \lambda x[\text{SOUP}(x) \ \& \ \mu(x) = d]$
 b. $\llbracket \llbracket \llbracket \text{much } d \rrbracket \text{ run} \rrbracket \rrbracket = \lambda e[\text{RUN}(e) \ \& \ \mu(e) = d]$
 c. $\llbracket \llbracket \llbracket \text{much } d \rrbracket \text{ red} \rrbracket \rrbracket = \lambda s[\text{RED}(s) \ \& \ \mu(s) = d]$

In the *than*-clause, a *wh*- operator merges with *much*, which raises to the top of that clause and creates what is understood as a degree abstraction structure. The tail of this abstraction structure, the variable *d*, is first applied to the meaning of *much*, and then this expression conjoins with the meaning of the (elided) NP. So the *than*-clause contains expressions identical to the matrix expressions in (26).²⁰

An account of *-er* that invokes QR in the matrix is motivated by interpreting it as a generalized quantifier over degree predicates, as in (27).²¹ The first degree predicate is that denoted by the *than*-clause, and the second that created by QRing *-er* from the complement position of *much* in the matrix clause. In what follows, I provide compositional details only for the final LF, which is an expression headed by *-er* that takes both the matrix and *than*-clauses as arguments.²²

- (27) $\llbracket \text{-er} \rrbracket = \lambda D \lambda D' [\text{max}(D') > \text{max}(D)]$

Consider the derivation of a comparative with the mass noun *soup*. The sentence in (28) has the structure in (28a), and the two degree clauses the interpretations in (28b-28c), ignoring tense. In the neodavidsonian account of verbs, all arguments (internal and external) are introduced by thematic predicates.²³ Thematically-bound expressions are conjoined with the meaning of the verb, and *much* is conjoined with the meaning of the measured XP.

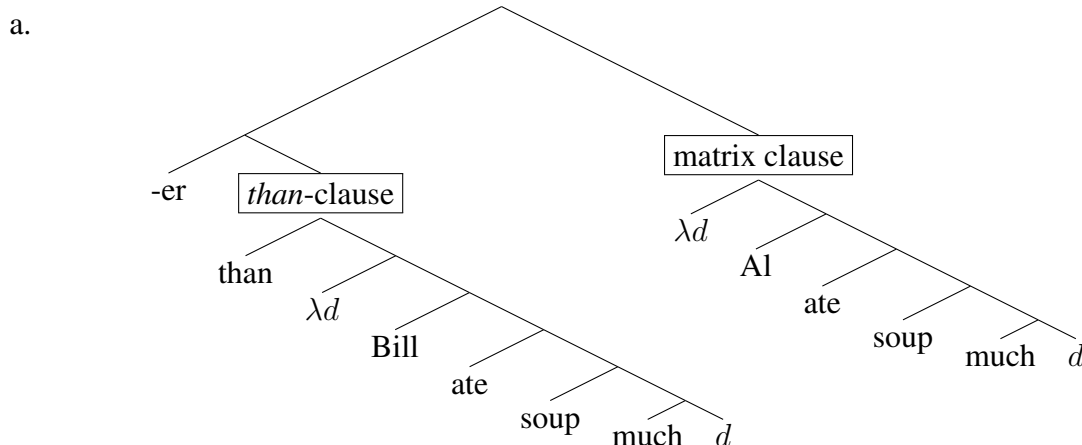
- (28) Al ate **more soup** than Bill did.

²⁰Of course, only when the measured XP is the same under ellipsis. In cases like *Al drank more wine than Bill did water*, only the [*d much*] portion is identified between the matrix and *than*-clauses.

²¹While there are many, many live possibilities for the formulation of a degree-based interpretation of *-er*, I ignore such possibilities here; my interest is only in specifying where that morpheme gets its degrees from.

²²In the full story of how comparative clauses are derived, the *than*-clause is merged countercyclically as complement to *-er* at the top of the matrix clause, comparative ellipsis applies to it, and dummy *do* is inserted to support tense.

²³For reasons of space, I do not go through all of these steps individually; and, I do not attempt to make a stand on the content of these thematic predicates. It has become fairly standard to introduce the external argument of an action verb like *run* or *eat* as 'Agent'. For adjectives, the relation may be 'Instantiates', 'Possessor' (see Kratzer 2006 for attitude verbs), or 'Bearer'. The matters are complex, and likely philosophical; as such, I do not take a stand on these issues here.



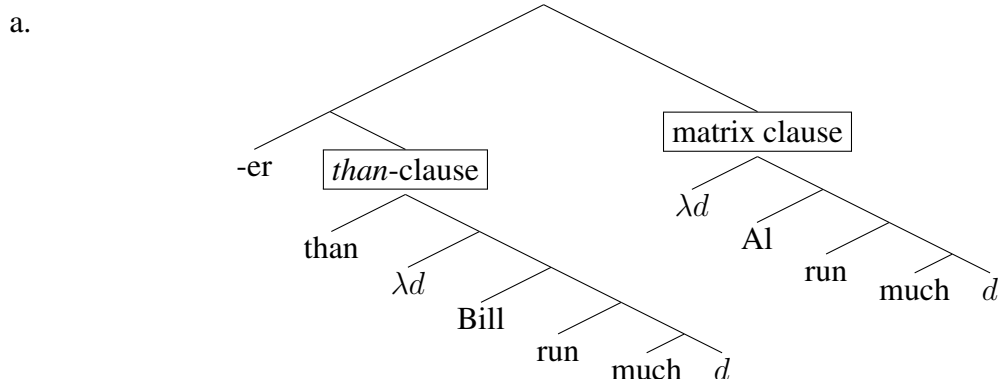
- b. $\llbracket \text{than-clause} \rrbracket =$
 $\lambda d[\exists e[\text{EAT}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Bill}) \ \& \ \exists x[\text{SOUP}(x) \ \& \ \Theta_{\text{obj}}(e, x) \ \& \ \mu(x) = d]]]$
- c. $\llbracket \text{matrix clause} \rrbracket =$
 $\lambda d[\exists e[\text{EAT}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Al}) \ \& \ \exists x[\text{SOUP}(x) \ \& \ \Theta_{\text{obj}}(e, x) \ \& \ \mu(x) = d]]]$

Altogether, the interpretation of (28) is given in (29), where these two degree predicates have been applied to the meaning of *-er*. The meaning is paraphrased: the maximal degree associated with a soup part that Al ate is greater than the maximal degree associated with a soup part that Bill ate. In this case, (28) compares degrees of *of volume*, which is determined by the choice of mapping, μ . (I discuss this idea in detail in the next section.)

$$(29) \quad \text{max}(\lambda d[\exists e[\text{EAT}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Al}) \ \& \ \exists x[\text{SOUP}(x) \ \& \ \Theta_{\text{obj}}(e, x) \ \& \ \mu(\mathbf{x}) = d]]]) \\
> \text{max}(\lambda d[\exists e[\text{EAT}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Bill}) \ \& \ \exists x[\text{SOUP}(x) \ \& \ \Theta_{\text{obj}}(e, x) \ \& \ \mu(\mathbf{x}) = d]]])$$

The derivation of a comparative with the atelic verb *run* proceeds in exactly the same fashion, except here *much* conjoins with the verbal predicate and μ measures *e*. The sentence in (30) has the structure in (30a), and the two degree clauses the interpretations in (30b-30c).

(30) Al ran more than Bill did.



- b. $\llbracket \text{than-clause} \rrbracket = \lambda d[\exists e[\text{RUN}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Bill}) \ \& \ \mu(e) = d]]$
 c. $\llbracket \text{matrix clause} \rrbracket = \lambda d[\exists e[\text{RUN}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Al}) \ \& \ \mu(e) = d]]$

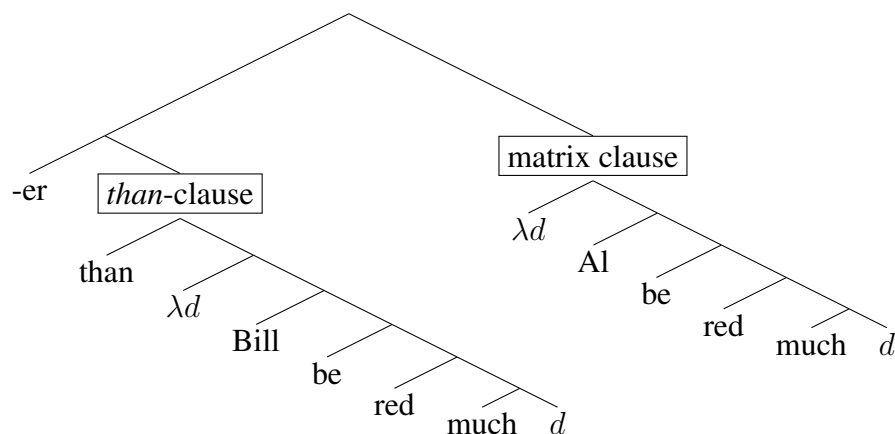
The two degree predicates are applied to the meaning of *-er*, delivering the complete meaning in (31). This meaning is paraphrased: the maximal degree associated with a subpart of Al's running is greater than the maximal degree associated with a subpart of Bill's running. The most natural interpretation of (30) is that the compared degrees are measurements by temporal duration.

$$(31) \quad \begin{aligned} & \max(\lambda d[\exists e[\text{RUN}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Al}) \ \& \ \mu(e) = d]]) \\ & > \max(\lambda d[\exists e[\text{RUN}(e) \ \& \ \Theta_{\text{subj}}(e, \text{Bill}) \ \& \ \mu(e) = d]]) \end{aligned}$$

Finally, deriving the adjectival case is once again exactly parallel, except here *much* conjoins with the adjectival predicate, and μ measures *s*. Note that, as usual, the main verb (*be*) is uninterpreted. In this case, the sentence in (32) has the structure as in (32a), and the two degree clauses the interpretations in (32b-32c).

(32) Al is **more red** than Bill is.

a.



- b. $\llbracket \text{than-clause} \rrbracket = \lambda d[\exists s[\text{RED}(s) \ \& \ \Theta_{\text{subj}}(s, \text{Bill}) \ \& \ \mu(s) = d]]$
 c. $\llbracket \text{matrix clause} \rrbracket = \lambda d[\exists s[\text{RED}(s) \ \& \ \Theta_{\text{subj}}(s, \text{Al}) \ \& \ \mu(s) = d]]$

These two degree predicates are applied to the meaning of *-er*, with the resultant interpretation in (33). The interpretation may be paraphrased: the maximal degree associated with a red state Al is in is greater than the maximal degree associated with a red state Bill is in. I am assuming that the compared degrees are measurements by saturation.

$$(33) \quad \begin{aligned} & \max(\lambda d[\exists s[\Theta_{\text{subj}}(s, \text{Al}) \ \& \ \text{RED}(s) \ \& \ \mu(s) = d]]) \\ & > \max(\lambda d[\exists s[\Theta_{\text{subj}}(s, \text{Bill}) \ \& \ \text{RED}(s) \ \& \ \mu(s) = d]]) \end{aligned}$$

Across the NP, VP, and AP domains, the same mechanism for measurement is employed, and differ only in *what exactly* is measured and correspondingly what dimensions for measurement are used. *much* contributes the predicate μ , which selects a structure-preserving map from the material, process, or stative domains (depending on what it combines with) to the domain of degrees. In the next section, I discuss how to understand cases in which multiple dimensions are available for measurement, and the following section concludes.

5. On dimensions

One of the concerns Cresswell raised for an analysis in which *much* provides the mapping to degrees was that that expression would somehow have to know which degrees were appropriate in any given case. On the analysis presented here, we have said that if the extension of XP is “structured”, μ provides a homomorphic map from its structure to degrees. As I assume there is only one set of degrees—the set of real numbers—I here recast Cresswell’s concern as a question about how the dimension for measurement, or the homomorphic map, is selected.

Above, I supposed only that *more soup* was a comparison of measures by volume, *run more* by measures of temporal duration, and *more red* by measures of saturation. However, (34) plainly suggests that this can only be part of the picture.

- (34) If there is **as much** water **by volume** in one bucket as there is, say, sand in another bucket, presumably there is **not as much** water as sand **by weight**.
(Cartwright 1975: 158; my emphasis)

To make the matter clearer, consider a simpler version of (34), my (35). The mass terms *water* and *sand* may each give rise to measurement by volume *or* weight, and in some cases the value assigned to the sentence in a context will differ depending on the dimension chosen. In some situations, an utterance of (35) will be true if the dimension chosen to measure along is volume, and false in the same situation if weight is chosen.

- (35) Al has **more water** than Bill has **sand**.

The same pattern obtains when we consider comparatives with atelic verbs. Both *run* and *swim* allow measures both by temporal duration or by distance travelled; an utterance of (36) may be true or false in a context depending on which dimension is chosen. However, it appears that the *same* dimension must be invoked in each clause; (35-36) may not describe comparisons where the matrix picks out volume/temporal duration and the *than*-clause weight/distance, respectively.

- (36) Al **ran more** than Bill **swam**.

Furthermore, the same pattern appears to obtain with adjectives. I have been assuming the natural interpretation for color adjectives in comparatives is measurement by saturation, but perhaps hue, brightness, or others are possible; (37) suggests that however dimensionality is resolved, it must be the same dimension in both clauses.

(37) Al turned **redder** than Bill turned **green**.

The same goes for more familiar examples. The use of the adjectives *tall* and *wide* are commensurable, as tallness and width are both compatible with measures by something like line length (38a). And so for the more exotic (38b): intelligence and beauty may be comparable as both give rise to measures by subjective value (cf. Bale 2006, 2008).

(38) a. Al is **taller** than Bill is **wide**.
b. Al is **more beautiful** than Bill is **intelligent**.

These data suggest two ideas about the role of *much*. First, the possibility of volume *or* weight with *soup* and the like could suggest that the relationship between μ and the measures it picks out is one-to-many, so long as the measures are structure-preserving. Second, the available selection may depend not on the properties of the measured predicate alone, but more derivatively on the properties defined over the *class* of predicates to which it belongs. This could suggest that, whenever there appears to be distinct classes of expressions (e.g., concrete mass nouns, action-based atelic verbs, color adjectives), all in the class should be restricted to the same set of possible measures, and members in a class should always be comparable.

There is a non-trivial relationship between independently-motivated properties of predicates, and their interpretation in the comparative. While there is some variability in the dimensions invoked to measure a given predicate, it is not possible to invoke dimensions that are not structure-preserving on its domain. Finally, it may be that the choice of dimensions is limited by what ordering principles inhere to different classes of predicates.

6. Conclusion

I began with a discussion of Cresswell's classic paper, in which the degree analysis of morphemes like *more* was first proposed. There, he developed an analysis (which gave rise to what is, by now, the standard) in which the semantics of degree was encoded directly into gradable adjectives and mass terms (as well as plurals, which I haven't discussed). In the closing of his paper, he suggested an alternative to which I have attempted to give substance.

The data that led to Cresswell's suggesting this alternative was the difference in meaning between *this water* and *this much water*. The difference appears to lie in the fact that the former phrase

indicates a demonstration of a particular type of substance (water), and the latter a demonstration of a particular amount of that substance. This difference can be derived in an analysis in which *water* is a simple predicate, but *much* introduces a degree variable; that variable may be bound by demonstrative *this* just as it may be by the more obvious degree operators *so*, *too*, and *how* (39).

- (39) a. Drink **this much** water.
 b. He drank **so much/too much** water.
 c. **How much** water did he want?

When *this* appears with *much*, it demonstrates a degree by binding the *d* introduced by *much*, and when it appears bare with *water*, it demonstrates a substance by binding the *x* introduced by *water*.

In sum, the theory I advance, in which *much* is semantically active, provides a general explanation for what can and cannot appear with *more*, where explanations offered by theories pursuing Cresswell's original proposal have different explanations for different cases: only certain adjectives can denote measure functions, and only certain NPs and VPs can combine with *much*. In the present work, a heterogeneous account is replaced with a homogeneous one: universal restrictions on the measure function *much* are responsible for both felicitous and infelicitous compositions with *more*.

Most importantly, the proposal has some features that make it interesting given wider theoretical concerns. For one, it serves to drive a larger wedge between the "contentful" vocabulary (those of type $\langle \alpha, t \rangle$, α a primitive type) and the "functional". On the present theory, no noun, verb, or adjective lexicalizes a measure function, but each may be quantified by the measure function *much* provided their domains are "structured". The account also supports an extension of the neodavidsonian theory to gradable adjectives, providing a straightforward account of adjectival modification in comparative constructions.

The account also raises some questions. First, if an adjective like *red* is a predicate of states, can it be that any occurrence of that adjective is truly intersective (40)? And second, if the available measures depend on what is measured and how its ordered, what explains the facts in (41)?

- (40) Al likes **red apples**.
 a. ?? $\llbracket \text{red apples} \rrbracket = \lambda x[\text{RED}(x) \ \& \ \text{APPLES}(x)]$
 b. ?? $\llbracket \text{red apples} \rrbracket = \lambda s[\text{RED}(s) \ \& \ \text{APPLES}(s)]$

- (41) a. Al is **more patient** than Bill is. \checkmark *patience*, **events*
 b. Al is **patient more** than Bill is. \times *patience*, \checkmark *events*

I leave these questions for future research.

References

- Bach, E. (1986). The algebra of events. *Linguistics and Philosophy* 9(1), 5–16.
- Bale, A. (2006, April). *The universal scale and the semantics of comparison*. Ph. D. thesis, McGill University, Montreal, Quebec.
- Bale, A. (2008). A universal scale of comparison. *Linguistics and Philosophy* 31, 1–55.
- Bale, A. and D. Barner (2009). The interpretation of functional heads: Using comparatives to explore the mass/count distinction. *Journal of Semantics* 26, 217–252.
- Beck, S. (2011). Comparison constructions. In C. Maienborn, K. von Stechow, and P. Portner (Eds.), *Semantics: An international handbook of natural language meaning*, Volume 2, Chapter 53, pp. 1341–1390. Mouton de Gruyter. In preparation.
- Bhatt, R. and R. Pancheva (2004). Late merger of degree clauses. *Linguistic Inquiry* 35(1), 1–46.
- Bresnan, J. (1973). Syntax of the comparative clause construction in English. *Linguistic Inquiry* 4(3), 275–343.
- Bunt, H. C. (1985). *Mass terms and model-theoretic semantics*. Number 42 in Cambridge Studies in Linguistics. Cambridge, UK: Cambridge University Press.
- Cartwright, H. (1975). Amounts and measures of amount. *Noûs* 9(2), 143–164.
- Cresswell, M. J. (1976). The semantics of degree. In *Montague Grammar*, pp. 261–292. New York: Academic Press.
- Fulst, S. (2006). *The structure of comparison: an investigation of gradable adjectives*. Ph. D. thesis, University of Maryland, College Park.
- Hackl, M. (2000). *Comparative Quantifiers*. Ph. D. thesis, Massachusetts Institute of Technology.
- Hackl, M. (2001). Comparative quantifiers and plural predication. In K. Megerdooomian and L. A. Bar-el (Eds.), *Proceedings of WCCFL XX*, Somerville, Massachusetts, pp. 234–247. Cascadilla Press.
- Heim, I. (1985). Notes on comparatives and related matters. Unpublished manuscript, University of Texas, Austin.
- Higginbotham, J. (1994). Mass and count quantifiers. *Linguistics and Philosophy* 17(5), 447–480.
- Kennedy, C. (1997). *Projecting the Adjective: The Syntax and Semantics of Gradability and Comparison*. Ph. D. thesis, University of California, Santa Cruz.
- Kratzer, A. (2006, July). Decomposing attitude verbs. Talk given at The Hebrew University of Jerusalem.

- Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In R. Bartsch, J. van Benthem, and P. van Emb de Boas (Eds.), *Semantics and contextual expression*, pp. 75–115. Stanford, CA: CSLI Publications.
- Landman, F. (2000). *Events and Plurality*. Norwell, MA: Kluwer Academic Publishers.
- Link, G. (1983). The logical analysis of plurals and mass terms: A lattice-theoretical approach. In R. Baeuerle, C. Schwarze, and A. von Stechow (Eds.), *Meaning, Use and Interpretation of Language*, pp. 302–323. Berlin, Germany: DeGruyter.
- Linnebo, O. and D. Nicolas (2008). Superplurals in English. *Analysis* 68(3), 186–97.
- Mourelatos, A. (1978). Events, processes, and states. *Linguistics and Philosophy* 2, 415–434.
- Nakanishi, K. (2004). On comparative quantification in the verbal domain. In R. B. Young (Ed.), *Proceedings of SALT XIV*, Cornell University, Ithaca, NY, pp. 179–196. CLC Publications.
- Nakanishi, K. (2007). Measurement in the nominal and verbal domains. *Linguistics and Philosophy* 30, 235–276.
- Neeleman, A., H. van de Koot, and J. Doetjes (2004). Degree expressions. *The Linguistic Review* 21, 1–66.
- Nicolas, D. (2008). Mass nouns and plural logic. *Linguistics and Philosophy* 31, 211–244.
- Parsons, T. (1990). Events in the semantics of English: A study in subatomic semantics. In *Current Studies in Linguistics Series no. 19*, pp. 334. Cambridge, Massachusetts: MIT Press.
- Pietroski, P. (2005). *Events and semantic architecture*. Oxford, UK: Oxford University Press.
- Schein, B. (1993). *Plurals and events*. Cambridge, Massachusetts: MIT Press.
- Schwarzschild, R. (2002). The grammar of measurement. In B. Jackson (Ed.), *Proceedings of SALT XII*, Cornell University, Ithaca, NY, pp. 225–245. CLC Publications.
- Schwarzschild, R. (2006). The role of dimensions in the syntax of noun phrases. *Syntax* 9(1), 67–110.
- Solt, S. (2009). *Much* support and *more*. In M. Aloni, H. Bastiaanse, T. de Jager, and K. Schulz (Eds.), *Proceedings of the 17th Amsterdam colloquium*, pp. 446–455.
- Taylor, B. (1977). Tense and Continuity. *Linguistics and Philosophy* 1(2), 199–220.
- von Stechow, A. (1984). Comparing semantic theories of comparison. *Journal of Semantics* 3(1), 1–77.
- Wellwood, A. (2012, November). A matter of degrees. University of Maryland, m.s.
- Wellwood, A., V. Hacquard, and R. Pancheva (2012). Measuring and comparing individuals and events. *Journal of Semantics* 29(2), 207–228.