A matter of degrees: Composing cross-categorial comparatives

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Every matter, or virtually every matter, is mod (is a matter that admits of differences in degree).


Selections from the intellectual history of [more]

Adjectives

Cresswell’s treatment of sentences like (1) initiates the “degree analysis”

(1) Al is more red than Bill is

* Gradable adjectives provide a mapping from individuals to degrees along a particular dimension (e.g. degrees of redness)
→ more describes a greater-than relation over degrees

Plural nouns & verbs

Hackl extends the degree analysis to comparatives with plural nouns

(2) Al ate more cookies than Bill did

* Plural noun phrases don’t provide a mapping to degrees
→ Covert many maps pluralities to degrees (of cardinality)

Wellwood, Hacquard, & Pancheva (WHP) consider plural verb phrases

(3) Al jumped up and down more than Bill did

* Plural verb phrases don’t provide a mapping to degrees either
→ Cross-categorial many does (∼ Nakanishi’s analysis of Japanese excessives)
Mass nouns & atelic verbs

Finally, the degree analysis is extended to comparatives with mass nouns (suggested by Hackl, elaborated by WHP)

(4) Al has more soup than Bill does

* Mass nouns do not provide a mapping to degrees
* Mass nouns don’t count here (so it can’t be many measuring)
→ Covert much provides the mapping to degrees

WHP consider atelic verb phrases

(5) Al ran more than Bill did

* Atelic verbs don’t reference degrees, and take mass-like dimensions
→ Cross-categorial much measures here, too

∼ Possible comparatives:

▷ This theory thus provides three ways more can get degrees

(6) i. [-er RED] ii. [-er MANY] cookies] iii. [-er MUCH] soup]

Gradable adjectives like red combine directly with more
With nouns and verbs, a covert adjective combines with more

Not everything goes, though:

(7) a. # Al is deader/more dead than Bill is non-gradable A
b. # Al has more toy than Bill does count N
c. # Al died more than Bill did telic V

How does the theory rule out bad comparatives?
~ Impossible comparatives:

▷ The theory has three ways more can fail to get degrees

(8)  i. #[-er DEAD]   ii. #[-er MANY] toy   iii. #[-er MUCH] toy

Non-gradable adjectives can’t combine directly with more

Count nouns and telic verbs fail to license a covert adjective

Today: How would this picture be different, if the theory had been developed in the reverse order, starting with masses and atelics?

Present day: stressing much

MUCH has properties that make it a good candidate for a universal measurer

— MUCH, unlike RED, is structure preserving

Given redder soup and more soup, on the “standard” view RED measures [soup] as surely as MUCH does, but

(9)  a. red saturation doesn’t track part-wholes in [soup] red
    b. volume does track part-wholes in [soup] much

What if RED doesn’t measure [soup] at all?
What if MUCH measures [red]?

— MUCH, like MANY, is structure preserving

Given more rocks, on the standard view MANY measures [rocks]

(10) number does track part-wholes in [rocks] many

What if [many] is just MUCH plus the plural?
My idea: Exploit much to reconfigure the degree analysis
   * Introduce the notion of “measurability” that crosscuts domains
   * Give a semantic analysis paralleling Bresnan’s syntactic analysis

The promise: A general theory of possible/impossible comparatives!

Four theses to be developed

— much is the only measurer in comparatives
— NPs, VPs, and APs are one-place predicates (of different sorts)

\[
\begin{align*}
(11) & \quad \text{a. } \llbracket \text{soup} \rrbracket = \lambda x[\text{SOUP}(x)] \\
     & \quad \text{b. } \llbracket \text{run} \rrbracket = \lambda e[\text{RUN}(e)] \\
     & \quad \text{c. } \llbracket \text{red} \rrbracket = \lambda s[\text{RED}(s)]
\end{align*}
\]

— The nature and structure of their domains limits the possible dimensions

\[
\begin{align*}
(12) & \quad \text{a. } \llbracket \text{more soup} \rrbracket \approx ... \text{ by volume, *temperature, *tastiness} \\
     & \quad \text{b. } \llbracket \text{run more} \rrbracket \approx ... \text{ by time, *speed, *effort} \\
     & \quad \text{c. } \llbracket \text{redder} \rrbracket \approx ... \text{ by saturation, *blueness, *attractiveness}
\end{align*}
\]

— Infelicities reflect combining much with unstructured predicates

The rest of the hour:

§I    Understanding much
   Setting up the “standard” theory
   Structure preservation with Ns & Vs
   The requirement for structure

§II    The analysis of much
§III  many is redundant

The standard picture
many is much+PL

§IV  Adjectives do not measure

The standard picture
Adjectives need a state variable
Adjectives do not need a degree variable

§V  Putting the pieces together

Composing cross-categorial comparatives

§VI  many readings of stative comparatives

I Understanding much

much is the default measurer for mass and atelic expressions
much is curiously restricted: it requires structured domains for measurement, and only permits structure-preserving dimensions for comparison

I.i Setting up the “standard” picture

Compatibility with words like more motivated the introduction of degrees, with the paradigmatic cases involving adjectives

(13)  Al is more intelligent than Bill is

more compares the maxima of two sets of degrees

(14)  \[\text{max}(D) > \text{max}(D')\]  (Bhatt & Pancheva)

\footnote{There are many live possibilities for the exact denotation of more, but these do not matter for present purposes.}
**Gradable adjectives** introduce degrees\(^2\)

\[(15) \quad [\text{intelligent}] = \lambda d \lambda x [\text{INTELLIGENT}(x) = d] \quad \text{(Heim)}\]

Abstracting over the degrees in each clause forms degree predicates

\[(16) \quad [\text{more}] (\lambda d [\text{Bill is } d\text{-INTELLIGENT}]) (\lambda d [\text{Al is } d\text{-INTELLIGENT}])\]

**Mass nouns** like soup do not reference degrees, yet appear here

\[(17) \quad \text{Al has more soup than Bill does}\]

Their denotation is, I assume, comparatively impoverished\(^3\)

\[(18) \quad [\text{soup}] = \lambda x [\text{SOUP}(x)]\]

\(x\) ranges over portions of matter that count as soup

Similarly, **atelic verbs** like run do not reference degrees

\[(19) \quad \text{Al ran more than Bill did}\]

And their denotation, in a neodavidsonian world, is fairly simple

\[(20) \quad [\text{run}] = \lambda e [\text{RUN}(e)]\]

\(e\) ranges over portions of events that count as running

For **mass nouns and atelic verbs**, much provides the mapping to degrees  
\((\approx \text{Hackl; Nakanishi; WHP; cf. Neeleman et al; Solt})\)

\[(21) \quad [\text{much}] = \lambda d \lambda \alpha [\mu(\alpha) = d]\]

\(^2\)I use von Stechow’s 1984, Heim’s 1985 type \(<d,<e,t>>\) denotations for gradable adjectives, cf. Kennedy’s type \(<e,d>: [\text{intelligent}] = \lambda x [\text{INTELLIGENT}(x)].\) These differences don’t affect the present discussion.

\(^3\)Modulo ideas that the proper place for determining the domain of a mass term is in the logic (e.g. superplural logic, see Nicolas; Linnebo & Nicolas).
α is a ‘wildcard’—much doesn’t distinguish between individuals and events

(22) a. \([\text{more}] (\lambda d[\text{Bill ate } d\text{-MUCH soup}]) (\lambda d[\text{Al ate } d\text{-MUCH soup}])\)

b. \([\text{more}] (\lambda d[\text{Bill ran } d\text{-MUCH}]) (\lambda d[\text{Al ran } d\text{-MUCH}])\)

µ is a homomorphism from the αs to degrees, which are abstracted over in composition with more (≈ Nakanishi; WHP)

I.ii Structure preservation with Ns and Vs

Only structure-preserving dimensions are available for comparing over mass and atelic expressions

(Below, I represent a structured set as one which contains both entities (e.g. \(x, x'\)) and their sums (\(x \oplus x'\)))

Mass nouns denote part-of structures\(^4\) (Cartwright; Link; Bunt)

(23) \([\text{soup}] = \lambda x[\text{SOUP}(x)] \leadsto \{x_{\text{SOUP}}, x'_{\text{SOUP}}, \ldots, x_{\text{SOUP}} \oplus x'_{\text{SOUP}}, \ldots\}\)

Mass entities are portions or parts, and sums are larger portions comprised of smaller ones

Atelic verbs, too, denote part-of structures (Bach; Landman; Mourelatos; Taylor)

(24) \([\text{run}] = \lambda e[\text{RUN}(e)] \leadsto \{e_{\text{RUN}}, e'_{\text{RUN}}, \ldots, e_{\text{RUN}} \oplus e'_{\text{RUN}}, \ldots\}\)

Atelic entities are subevents or parts of events, and sums are larger events comprised of smaller ones

With mass nouns, more only recruits dimensions tracking part-of relations! (Schwarzschild)

\(^4\)I do not assume atomic extensions for for mass and atelic XPs. I submit to the difficulty of representing continuous sets.
(25) \( \text{more soup} \approx \ldots \text{by volume, } *\text{temperature, } *\text{tastiness} \)

Volume preserves part-whole relations, temperature or tastiness do not

Proper subparts of some soup necessarily measure less in volume than the whole, this is not likely so for temperature

If \( x \) and \( x' \) are distinct portions of soup, and \( x \oplus x' \) is their sum:

(26) Volume is structure preserving:
The measures \( \mu_{\text{vol}}(x) \) and \( \mu_{\text{vol}}(x') \) are necessarily less than the measure \( \mu_{\text{vol}}(x \oplus x') \).

(27) Temperature is not structure preserving:
The measures \( \mu_{\text{temp}}(x) \) and \( \mu_{\text{temp}}(x') \) are not less than the measure \( \mu_{\text{temp}}(x \oplus x') \).

With atelic verbs, more only recruits dimensions tracking part-of relations! (WHP)[5]

(28) \( \text{run more} \approx \ldots \text{more by time, } *\text{speed, } *\text{effort} \)

Temporal duration preserves part-wholes, speed or effort don’t

Proper subparts of some running necessarily measure less time than the whole running event, not so for speed, or quantity of effort expended

If \( e \) and \( e' \) are distinct subevents of running, and \( e \oplus e' \) is their sum:

(29) Time is structure preserving:
The measures \( \mu_{\text{time}}(e) \) and \( \mu_{\text{time}}(e') \) are necessarily less than the measure \( \mu_{\text{time}}(e \oplus e') \).

(30) Speed is not structure preserving:
The measures \( \mu_{\text{speed}}(e) \) and \( \mu_{\text{speed}}(e') \) are not less than the measure \( \mu_{\text{speed}}(e \oplus e') \).

much tracks structure in the mapping to degrees
Next, we will see that much requires structure

I.iii The requirement for structure

Not all nouns and verbs can appear (bare) in the comparative
What doesn’t occur is informative for understanding much
(Below, unstructured domains are those that only contain entities (e.g. $x, x'$) but not their sums)

Count nouns are not felicitous here

(31) # Al has more toy than Bill does
And, they are unstructured (or, only trivially structured)

(32) a. $\text{[toy]} = \lambda x[\text{TOY}(x)] \leadsto \{x_{\text{TOY}}, x'_{\text{TOY}}, x''_{\text{TOY}}\}$
The extension of toy has no relevant part-whole structure, neither mass-like nor plural – it contains atomic entities and nothing else

Telic verbs are not felicitous here

(33) # Al died more than Bill did
And, they too are unstructured (or, only trivially structured)

(34) $\text{[die]} = \lambda e[\text{DIE}(e)] \leadsto \{e_{\text{DIE}}, e'_{\text{DIE}}, e''_{\text{DIE}}\}$
The extension of die has no relevant part-whole structure, neither atelic-like (process) nor plural – it contains atomic events and nothing else

WHP suggested these data can be uniformly captured by the analysis of much
II The analysis of much

The data from §I is captured by added felicity conditions on $[[\text{much}]]$

$$\text{(35) } [\text{much}] = \lambda d \lambda \alpha [\mu(\alpha) = d],$$

where $\alpha$ is structured by $\succeq_\alpha$ and $\mu$ tracks $\succeq_\alpha$

(Note: this analysis refines and expands that of WHP, and refs therein)

If a predicate combines with much, it must have an associated ordering, and such orderings determine what measurements are possible

Now in much we have a measurer that is:

— Cross-categorial: $\alpha$ is a wildcard variable over primitive types

— Requires structure: the $\alpha$s must be ordered, $\succeq_\alpha$

— Preserves structure: $\mu$ tracks $\succeq_\alpha$

Depending on what you’re talking about, and how it’s ordered, you are restricted to particular classes of measures:

A domain of masses won’t be measured by temporal duration, and its ordering by part-of won’t lead to measures by temperature

More formally, $\mu$ maps the $\alpha$s to the $d$s only if the $\alpha$s are ordered, and the mapping preserves that ordering

$$\text{(36) } \text{For all } \alpha, \text{ and all } d, \mu(\alpha) = d \text{ just in case:}$$

a. The $\alpha$s are ordered; there is a $<D_\alpha, \succeq_\alpha>$;

b. $\mu$ is a homomorphism $h$ from $<D_\alpha, \succeq_\alpha>$ to $<D_d, \geq_d>$ s.t.:

i. For all $x, y$ in $D_\alpha$, there exists $h(x), h(y)$ in $D_d$;

ii. $x \succeq_\alpha y$ iff $h(x) \geq_d h(y)$; and,

iii. For some $z$ in $D_\alpha$, $h(z) = d$. 
The degree structure is just the number line (cp. Benacerraf). Mapping to degrees permits **quantitative talk** about a **qualitative** domain.

With **mass nouns**, \(\succsim\alpha\) is the part-of relation over portions of matter. If \(x\) and \(x'\) are distinct portions of soup, and \(x \oplus x'\) is their sum:

\[
\{x, x', x \oplus x'\} \xrightarrow{\mu} \{d, d', d \oplus d'\}
\]

a. **Volume**: \(\mu_{vol}(x) = d\) and \(\mu_{vol}(x') = d'\), then necessarily \(\mu_{vol}(x \oplus x') = d \oplus d'\)
   e.g., \(\mu_{vol}(x) = .2\) and \(\mu_{vol}(x') = .2\), \(\mu_{vol}(x \oplus x') = .4\)

b. **Temperature**: \(\mu_{temp}(x) = d\) and \(\mu_{vol}(x') = d'\), then not likely \(\mu_{temp}(x \oplus x') = d \oplus d'\)
   e.g., \(\mu_{temp}(x) = 20\) and \(\mu_{temp}(x') = 20\), \(\mu_{temp}(x \oplus x') \neq 40\)

With **atelic verbs**, \(\succsim\alpha\) is the part-of relation over parts of events. If \(e\) and \(e'\) are distinct subevents of running, and \(e \oplus e'\) is their sum:

\[
\{e, e', e \oplus e'\} \xrightarrow{\mu} \{d, d', d \oplus d'\}
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b. **Speed**: \(\mu_{speed}(e) = d\) and \(\mu_{speed}(e') = d'\), then not likely \(\mu_{speed}(e \oplus e') = d \oplus d'\)
   e.g., \(\mu_{speed}(e) = 20\) and \(\mu_{speed}(e') = 20\), \(\mu_{speed}(e \oplus e') \neq 40\)

In this framework, we can define a notion of **measurability**

\[
\text{(39)} \quad \text{A predicate is } \textbf{measurable} \text{ iff its domain is } \textbf{ordered.}
\]

\(\rightarrow\) Only **measurable** predicates appear with more
Mass and atelic domains are thought to be ordered, but (singular) count/telic not. Indeed, only the former are compatible with more

<table>
<thead>
<tr>
<th>Measurable</th>
<th>Non-measurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>mass NP</td>
<td>count NP</td>
</tr>
<tr>
<td>atelic VP</td>
<td>telic VP</td>
</tr>
</tbody>
</table>

Table 1: Measurable and non-measurable predicates

This table summarizes possible/impossible comparatives so far
Can [much] be the measurer in a wider set of data?

~ A predicate P appears with more if [P] is non-trivially structured

Plural expressions denote something like plural part-of structures
Gradable adjectives are thought to range over an ordered set of degrees

~ Mapping to degrees in comparatives is accomplished by much

Can much+PL guarantee comparison by number?
Are adjectives actually measurers (i.e., do they introduce degrees)?

~ [much] is a homomorphism from [P] to degrees

Do plural and adjectival comparatives suggest structure preservation?

Plural comparisons only lead to comparisons by number
Adjectival comparisons lead to comparisons along a number of dimensions

We will consider many-comparatives first (§III), then adjectival (§IV)
III many is redundant

many has been posited as the default measurer for plural XPs
many is curiously restricted: it requires plural domains for measurement, and only permits cardinality-based comparison

Could many just be the spell-out of much+PL?
As we saw, much provided a mapping to degrees with masses/atelics

\[
[\text{much}] = \lambda d \lambda \alpha [\mu(\alpha) = d]
\]
where \( \alpha \) is structured by \( \succeq_\alpha \) and \( \mu \) tracks \( \succeq_\alpha \)

This mapping was seen to be structure-dependent, and structure-preserving

III.i The standard picture

Plural expressions are not assumed to reference degrees
Yet, plural nouns occur felicitously in the comparative

\[
\text{Al ate more cookies than Bill did}
\]
Their denotation is, I assume, quite simple\(^6\)

\[
[\text{cookies}] = \lambda x [\text{COOKIE}(x) \& \text{PL}(x)]
\]
x here ranges over pluralities of entities that count as cookies

Plural verb phrases occur felicitously in the comparative

\[
\text{Al jumped (up and down) more than Bill did}
\]
Their denotation is, I assume, fairly simple

---

\(^6\)For simplicity, I am agnostic about whether the conceptual contribution of PL needs to be more explicit in the logic.
A matter of degrees: Composing cross-categorial comparatives

(44) \[[\text{jump} \text{ PL}] = \lambda e[\text{JUMP}(e) \& \text{PL}(e)]\]

e ranges over pluralities of events that count as jumpings

Note: English doesn’t grammatically mark plurality in the verbal domain overtly, but comparatives with telics have to be interpreted plurally

(45) \# Al jumped (once) more than Bill did

WHP: English has an optional covert verbal plural, on a par with overt pluractionals in other languages

To account for comparatives with plural nouns, Hackl posited that a covert many provides the mapping to degrees; WHP extended it to plural verbs

(46) a. more cookies \(\approx\) [[-er MANY] [cookie PL]]
b. jump more \(\approx\) [[-er MANY] [jump PL]]

many’s job is to measure the cardinality of pluralities

Its restrictions are coded into its (cross-categorial) denotation (\(\approx\) Nakanishi, WHP)

(47) \[[\text{many}] = \lambda d\lambda \alpha[\#(\alpha) = d]\]

where \(\alpha\) is structured by the plural part-of relation \(\geq_{PP}\)

\# is a function from pluralities to their cardinalities

III.ii many is much+PL

\[[\text{many}]\] looks suspiciously like much...

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\[[\text{many}]\] looks suspiciously like much...
Could simply *adding* more structure (the plural) result in an obligatorily numerosity-based comparison, but via structure-preserving *much*?

**Plural nouns** may only be compared by counting (Bale & Barner)

\[(48) \ [\text{more cookies}] \approx \ldots \text{more by number, } *\text{weight, } *\text{tastiness}\]

The same for **plural verbs** in the comparative (WHP)

\[(49) \ [\text{jumped more}] \approx \ldots \text{more by number, } *\text{distance, } *\text{effort}\]

No other likely properties of cookies or of jumping events matter

Comparison by number **reflexively** tracks the presence of a plural operator

\[(50) \ a. \ \text{Al found more rock than Bill did} \quad *\text{number, weight} \\
\quad b. \ \text{Al found more rocks than Bill did} \quad \text{number, } *\text{weight}\]

Is this opportunistic *many*, or *much*-like structure preservation?

If we take the plural morpheme to have semantic import many is redundant → The plural ensures that only *certain kinds of things* can satisfy Pl(α), and those kinds of things (pluralities) have a purely numerical dimension

Construing plurals as sets for a moment...

\[(51) \ a. \ \text{If } [\text{cookies}] = \{\{a\}, \{a, b\}\}, \text{measurement of its elements (sets) can only deliver the numerical dimension—} \text{the only property of this sort they have} \text{ is cardinality} \\
\quad \rightarrow \ \text{Measurement by } \text{number} \text{ tracks } \text{plural part-of structure!}\]

With *much*, what is measured/how it’s ordered determines dimensionality

*For different sorts of worries about this, see Krifka; Schein; Borer; Sauerland, Anderssen, & Yatsushiro.
Here, *what is measured* is different: we’re measuring *pluralities* rather than masses or processes.

Adding structure changes what you’re talking about, a thought familiar from the mass/count literature.

The novel hypothesis here: what you’re talking about determines how you measure. More on this in §VI.

**Interim summary**

So much for the nominal and verbal domains:

We have seen positive and negative data, which we subsumed under a generalization about *measurability*

(52) A predicate is measurable iff its domain is ordered.

The possibility of felicity in the comparative was pinned on this notion: a predicate appears with *more* just in case it is measurable.

Positively, this generalization covered mass and atelic expressions

(53) a. Al ate *more soup* than Bill did
    b. Al *ran more* than Bill did

These predicates’ domains were assumed to be ordered by the part-of relation.

Negatively, the generalization excluded count and telic expressions

(54) a. # Al had *more toy* than Bill did
    b. # Al *died more* than Bill did

These domains were assumed to be unstructured.
Finally, **only dimensions tracking structure** were permitted

(55)  
\[ \text{[more soup]} \approx \text{by volume, *temperature, *tastiness} \]
\[ \text{[run more]} \approx \text{by time, *speed, *effort} \]

**Felicity conditions** on much captured these data

(56)  
\[ \text{[much]} = \lambda d \lambda a [\mu(\alpha) = d], \]
\[ \text{where } \alpha \text{ is structured by } \succeq_\alpha \text{ and } \mu \text{ tracks } \succeq_\alpha \]

Only structured predicates combine with much, and \( \mu \) is a homomorphism.

Next, we considered that plural **count and telic** XPs occur felicitously

(57)  
\[ \text{a. } \text{Al had more toys than Bill did} \]
\[ \text{b. } \text{Al jumped up and down more than Bill did} \]

Here, **only** comparisons by number are permitted

\[ \rightarrow \text{Here, we have measurement by much, with a privileged contribution from } \]
\[ \text{the (nominal or verbal) plural} \]

The facts so far, in terms of measurability, are summarized as

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Table 2: Measurable and non-measurable predicates

Last but not least, how might **adjectival comparatives** fit in?
IV Adjectives do not measure

If gradable adjectives are to combine with much, they have to be predicates of something whose structure can be preserved in measurement

\[(58) \quad \text{[much } d\text{]} = \lambda \alpha[\mu(\alpha) = d] \quad \text{where } \alpha \text{ is structured by } \succcurlyeq_\alpha \text{ and } \mu \text{ tracks } \succcurlyeq_\alpha\]

Are the domains of gradable adjectives structured? What about non-gradable adjectives?
Can there be structure preservation in adjectival comparatives?

IV.i The standard picture

On the standard picture, when adjectives measure, the structure of the measurand is irrelevant

\[(59) \quad \text{Ice cream is more tasty than soup}\]

Arbitrary subparts of some ice cream are not likely less tasty than the whole, yet the mass term \([\text{ice cream}]\) is measured for its tastiness

Under this view, you are measuring the subject, and the measurement has nothing to do with the structure of the subject’s extension

APs saturated with some \(d\) combine with individual predicates\(^9\)

\[(60) \quad \text{[tasty } d\text{]} = \lambda x[\text{TASTY}(x) = d]\]

Usually, this is the subject (by function application)

\[(61) \quad \text{[Ice cream is more tasty than soup]} = \text{MORE}(\lambda d[\text{TASTY}(\text{soup}) = d])(\lambda d[\text{TASTY}(\text{ice-cream}) = d])\]

\(^9\)I am using Heim’s type \(<d, e, t>\), formulation of degree predicates here, rather than Kennedy’s type \(<e, d>\) analysis. Some points have to be made differently for the different approaches, but this is immaterial for present purposes.
Two types of data militate against this view: thematic and temporal modification of gradable adjectives

IV.ii Adjectives need a state variable

Independently, thematic with-phrases raise issues for the standard view

(62) Al is more patient with Carl than Bill is

(62) means that Al’s degree of patience directed at Carl is greater than Bill’s degree of patience directed at Carl

(Fults)

Assuming with Carl is a predicate of individuals (arguably an odd assumption to begin with), this is not the meaning we get

(63) a. \[[[\text{patient } d]] = \lambda x[\text{PATIENT}(x) = d]\]

b. ?? \[[[\text{with Carl}]] = \lambda x[\text{WITH}(x, \text{Carl})]\]

c. ?? \[[[\text{patient } d][\text{with Carl}]] = \lambda x[\text{PATIENT}(x) = d \& \text{WITH}(x, \text{Carl})]\]

d. ?? \[[[\text{Al }[[\text{patient } d][\text{with Carl}]]]] = \exists s[\text{PATIENT}(\text{Al}) = d \& \text{WITH}(\text{Al, Carl})]\]

This means that Al is patient to some degree and Al is with Carl, two independent conjuncts that, when combined, do not give the meaning of (62)

Further, gradable adjectives admit a range of clearly temporal modifiers

(64) a. Al is more patient in the morning than Bill is

b. Al is more patient during a long session than Bill is

Here, we do not compare degrees of patience simpliciter, but degrees of patience that differ in their temporal frame of reference

Maybe such phrases just fill an optional time argument slot? (Lin)
But, we can get temporal phrases that no one wants to say are arguments

(65)  \( \text{Al turns red\textcolor{red}{er} when she's embarrassed} \) than Bill does

And, even less likely arguments: reason clauses (T. Grano, p.c.)

(66)  \( \text{Al is happier because Carl won the lottery} \) than Bill is

Barring a more complex analysis than is generally proposed for VP modifiers, in which they are predicates of eventualities

(67)  a.  \( \text{Al ran in the morning} \) and again in the afternoon
    b.  \( \exists e[\text{run}(e) \& Ag(e, \text{Al}) \& \text{in-the-morning}(e) \& ...] \)

The simplest hypothesis is a denotation for patient like\(^{10}\)

(68)  \( \text{[patient]} = \lambda d \lambda s[\text{PATIENT}(s) = d] \)

Here, all we’ve done is replaced the individual variable with a state variable

Now, the subject is introduced by a thematic predicate

(69)  \( \text{[Al [be patient]]} = \lambda s[\text{PATIENT}(s) \& \Theta_{subj}(s, \text{Al})] \)

and with-phrases themselves introduce thematic predicates

(70)  \( \text{[patient [with Carl]]} = \lambda s[\text{PATIENT}(s) \& \Theta_{target}(s, \text{Carl})] \)

(Any puzzle here is just that found with neodavidsonian analyses more generally: how should we understand these thematic predicates exactly?)

Temporal modifiers simply conjoin, to form predicates like

(71)  \( \text{[[patient d] [in the morning]]} = \lambda s[\text{PATIENT}(s) = d \& \text{IN-THE-MORNING}(s)] \)

\(^{10}\)An alternative is \( \text{[patient]} = \lambda d \lambda s \lambda x[\text{PATIENT}(s, x) = d] \), which faces difficulties with closure of the state variable before composition with the subject. Yet another is \( \text{[patient]} = \lambda d \lambda x \lambda s[\text{PATIENT}(s, x) = d] \), which is challenged to compose with modifiers and the subject in the expected order.
And the interpretation is right: measured states of patience that are temporally located in the morning

**Modifiers restrict which states you’re measuring**, which helps derive the fact that the (a) and (b) sentences can simultaneously be true:

(72) **Context**: Al is quite patient with his kids (unlike Bill), but totally not patient otherwise (unlike Bill).

a. Al is *more patient with his kids* than Bill is
b. Bill is *more patient* than Al is

Unmodified, the ‘generic’ patient state is measured; with modifiers, the ‘generic’ state w.r.t. a certain class of situations is measured

### IV.iii Adjectives don’t need a degree variable

Now that adjectives are predicates of states, can we abandon the hypothesis that they also introduce degree variables?

**Gradable adjectives** are now analyzed on a par with:

(73) \[ [\text{red}] = \lambda d \lambda s [\text{RED}(s) = d] \]

The adjective first combines with a degree, and then a state argument

Now in **adjectival comparatives**, we have measurement of states

(74) \[
[\text{Al is more red than Bill is}] = \\
max(\lambda d [\exists s [\text{Al is in } s \& \text{RED}(s) = d]]) \\
> max(\lambda d [\exists s [\text{Bill is in } s \& \text{RED}(s) = d]])
\]

→ It is an open question whether the mapping is structure-preserving!
It’s generally thought that red associates with an ordering of degrees of redness (cp. Beck, att. to von Stechow)

\[(\text{red}) = \lambda d \lambda x [\text{RED}(x) = d] \rightsquigarrow \{ d_{\text{RED}1}, d_{\text{RED}2}, d_{\text{RED}1} \oplus d_{\text{RED}2}, \ldots \}\]

d_{\text{RED}1} \oplus d_{\text{RED}2} is read like: \(d_{\text{RED}1} \oplus d_{\text{RED}2}\) is as much redness as \(d_{\text{RED}1}\) plus \(d_{\text{RED}2}\)

These ds are **proprietary** to RED

This hypothesis allows for a straightforward account of incommensurability:

\[(\text{76}) \quad \# \text{Al is taller than Bill is red} \quad \#\text{commensurable}\]

Degrees of tallness and redness are not orderable w.r.t. one another

We can preserve this intuition **without reference to degrees** by positing instead that RED’s satisfiers are ordered *states*

\[(\text{77}) \quad [\text{red}] = \lambda s [\text{RED}(s)] \rightsquigarrow \{ s_{\text{RED}}, s'_{\text{RED}}, \ldots, s_{\text{RED}} \oplus s'_{\text{RED}}, \ldots \}\]

\(s \oplus s'\) is read like: \(s \oplus s'\) is as red as \(s\) plus \(s'\), etc[11]

→ Incommensurability is a consequence of the fact that there is no \(\succ_{\alpha}\) that orders both tall states and red states!

**Gradable adjectives**, then, are **structured predicates**

If much can measure them, they needn’t recapitulate the degree argument

\[(\text{78}) \quad \begin{align*}
\text{a.} & \quad \text{more red} = [[[\text{-er much}] \text{ red}]} \\
\text{b.} & \quad \Box[[[d \text{ much}] \text{ red}]] = \lambda s [\text{RED}(s) \& \mu(s) = d]
\end{align*}\]

The normal functioning of \(\mu\) ensures an orderly mapping to degrees

---

[11]: I am using \(\oplus\) to be contiguous with the rest of the paper. However, one may want to pursue a stativized version of Bale’s proposal, where the ordering is derived from a binary relation. His specific proposal, that this relation is defined over individuals, faces the same adjetival modification problems discussed above.
The standard theory rules out **non-gradable adjectives** like *dead*

(79)  # Al is dead/more dead than Bill is  #sg state

By stipulating that they don’t denote measure functions

(80)  a. ✓ $\lambda[x][\text{DEAD}(x)]$

b. $\times [\text{dead}] = \lambda d \lambda s [\text{DEAD}(s) = d]$

We can rule them out as not possessing the relevant structure

(81)  $[\text{dead}] = \lambda s [\text{DEAD}(s)]$  \[\rightsquigarrow \{s_{\text{DEAD}}, s'_{\text{DEAD}}, \ldots\}\]

If being dead is all-or-nothing, there is no structure to measure

Finally, we find evidence for **structure preservation**

(82)  $[\text{redder}] \approx \ldots$ by saturation, *blueness, *attractiveness

“How close to blue”, and “how attractive” are not natural orderings of red states, even while both are imaginable properties of instances of redness

At the level of “measurability”, gradable/non-gradable adjectives represent an instance of the more general pattern

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<tr>
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</table>

Table 3: Measurable and non-measurable predicates

(Non-)measurability unifies the formal properties of these predicates, and captures felicity with **more**
V Putting the pieces together

We have seen arguments that much is the only measurer in comparatives. Now we can see the compositional details.

The syntactic analysis that makes parallels of adjectival, nominal, and verbal comparatives (Bresnan)

\[(83)\]

\[\text{a. } \text{more soup} \approx [\text{much -er soup}]\]
\[\text{b. } \text{run more} \approx [\text{much -er run}]\]
\[\text{c. } \text{more red} \approx [\text{much -er red}]\]

Is reflected in the semantic analysis

\[(84)\]

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

The “contentful” expressions combine with much by conjunction

many-type readings are just the same, but for the presence of the plural

With the plural noun toys,

\[(85)\]

\[\text{a. } \text{more toys} \approx [\text{much -er}[\text{toy -s}]]\]
\[\text{b. } \llbracket [\text{much d}][\text{toy -s}] \rrbracket = \lambda x[\text{TOY}(x) & \text{PL}(x) & \mu(x) = d]\]

So with the plural verb jump (up and down)

\[(86)\]

\[\text{a. } \text{jump (up and down) more} \approx [\text{much -er}[\text{jump PL}]]\]
\[\text{b. } \llbracket [\text{much d}][\text{jump PL}] \rrbracket = \lambda e[\text{JUMP}(e) & \text{PL}(e) & \mu(e) = d]\]

(Note: without the plural, these predicates would be uninterpretable)
The best part is, -er can still mean whatever it means

\[(87) \quad [-er] = \lambda D \lambda D'[\max(D') > \max(D)] \quad \text{(Bhatt & Pancheva)}\]

The main difference: all of -er’s degree predicates are formed by much

Mass noun comparatives

First, we compose the comparative over soup
We construct the than-clause, QR -er, and arrive at

\[(88) \quad \text{Al has more soup than Bill does}\]

\[\begin{array}{c}
\text{-er} \\
\text{than-clause} \\
\text{than} \\
\text{Bill} \\
\text{has} \\
\text{soup} \\
\text{much} \\
\text{d} \\
\end{array} \quad \begin{array}{c}
\text{matrix clause} \\
\text{Al} \\
\text{has} \\
\text{soup} \\
\text{much} \\
\text{d} \\
\end{array}\]

b. \[\llbracket\text{than-clause}\rrbracket = \lambda d[\exists s[\text{have}(s) & \Theta_{\text{subj}}(s, \text{Bill}) & \exists x[\text{soup}(x) & \Theta_{\text{obj}}(s, x) & \mu(x) = d]]]\]

c. \[\llbracket\text{matrix clause}\rrbracket = \lambda d[\exists s[\text{have}(s) & \Theta_{\text{subj}}(s, \text{Al}) & \exists x[\text{soup}(x) & \Theta_{\text{obj}}(s, x) & \mu(x) = d]]]\]

Each clause is a predicate of degrees that \(\mu\) maps soup parts to

-er takes the maximal degrees in each set, and compares them

\[(89) \quad \max(\lambda d[\exists s[\text{have}(s) & \Theta(s, \text{Al}) & \exists x[\text{soup}(x) & \Theta_{\text{obj}}(s, x) & \mu(x) = d]])] > \max(\lambda d[\exists s[\text{have}(s) & \Theta(s, \text{Bill}) & \exists x[\text{soup}(x) & \Theta_{\text{obj}}(s, x) & \mu(x) = d]])]\]

Interpretation: the maximal degree associated with a soup part of Al’s is greater than the maximal degree associated with a soup part of Bill’s
Atelic verb comparatives

The very same process applies to the comparative with run. We construct the than-clause, QR -er, and arrive at

\[(90)\quad \text{Al ran more than Bill did}\]

\[\text{a.}\]

\[
\begin{array}{c}
\text{matrix clause} \\
\text{than-clause} \\
\text{-er}
\end{array}
\]

\[
\begin{array}{c}
\text{Bill}
\end{array}
\]

\[
\begin{array}{c}
\text{run}
\end{array}
\]

\[
\begin{array}{c}
\text{much}
\end{array}
\]

\[
\begin{array}{c}
d
\end{array}
\]

\[\text{b.} \quad [\text{than-clause}] = \lambda d[\exists e[\text{RUN}(e) \& \Theta_{subj}(e, \text{Bill}) \& \mu(e) = d]]
\]

\[\text{c.} \quad [\text{matrix clause}] = \lambda d[\exists e[\text{RUN}(e) \& \Theta_{subj}(e, \text{Al}) \& \mu(e) = d]]
\]

Each clause is a predicate of degrees that \(\mu\) maps parts of some running to

-er takes the maximal degrees from each set, and compares them

\[(91) \quad \text{max}(\lambda d[\exists e[\text{RUN}(e) \& \Theta(e, \text{Al}) \& \mu(e) = d]]) > \text{max}(\lambda d[\exists e[\text{RUN}(e) \& \Theta(e, \text{Bill}) \& \mu(e) = d]])
\]

Interpretation: the maximal degree of any subpart of Al’s running is greater than the maximal degree of any subpart of Bill’s running.

Adjectival comparatives

And finally, the same process for comparing over red. After constructing the than-clause, QRing -er, we arrive at

\[(92) \quad \text{Al is more red than Bill is}\]
Each clause is a predicate of degrees that $\mu$ maps red states to

-er takes the maximal degrees, and compares them

\[(93) \quad max(\lambda d[\exists s[\text{RED}(s) & \Theta_{\text{subj}}(s, \text{Al}) & \mu(s) = d]]) > max(\lambda d[\exists s[\text{RED}(s) & \Theta_{\text{subj}}(s, \text{Bill}) & \mu(s) = d]])\]

I.e., 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.

Plural XPs are just the same, except Pl combines with XP before much

**VI many readings of stative comparatives**

We have seen how the cases of interest compose, now I want to discuss a few cases that are more challenging but, I think, suggestive

We noted a contrast between comparisons over bare mass nouns, and their plural counterparts in the comparative

\[(94) \quad \text{a. Al has} \, \text{more} \, \text{rock} \, \text{than} \, \text{Bill} \, \text{does} \]
b. Al has **more rocks** than Bill does  *weight, number

The idea was that the addition of the plural restricted the available measures

**The question is:** Can adjectives be pluralized?

**A partial answer:** they at least can give rise to comparisons by number

To see this, **imagine the following context:**

There are two boxes, A and B, that flash red light at different saturation levels of red light at different frequencies

**Adjectival comparatives** allow AP-specific dimensions

(95) (Just now) A was **more red** than B was  *saturation, *number

But, **post-adjectival** more only allows the numerical dimension

(96) (For 5 min) A was **red more** than B was  *saturation, number

(96) requires counting occasions on which a particular state holds!

“Moving” more resulted in a radically different interpretation!

Indeed, in such cases we are able to distinguish between **S-level and I-level adjectives**:

While patient and intelligent are **gradable**, and so compose with more

(97) a. Al is **more patient** than Bill is

b. Al is **more intelligent** than Bill is

(Here, we compare degrees of patience and intelligence, simpliciter)
There is a difference between them when more is post-adjectival

(98) a. Al is patient more than Bill is
b. # Al is intelligent more than Bill is

The S-level adjective patient happily invites counting occasions
The I-level adjective intelligent does not

There is a complementarity between the stative/eventive or temporal reading, and the position of more—what could get us this distinction? (Maienborn?)

Indeed, adding structure changes the interpretation (recall rock/rocks)
However, one and the same string can support both types of readings!

Context: Imagine everyday it’s either pizza or hamburgers for lunch
Gradable VPs like want  allows AP and VP type

(99) (On Friday) Al wanted pizza more than Bill did
(100) (Last week) Al wanted pizza more than Bill did

On “AP” type, degrees of desire are compared
On “VP” type, counts of top choices for each boy are compared

Not unsurprisingly, non-gradable VPs are infelicitous

(101) # Al knew this answer more than Bill did

However, it has not been observed that such strings lack two readings

But, we access a comparison by number if we manipulate the properties of the direct object in a familiar way

12Note that Villalta and Lassiter analyze such VPs as measure functions, in the Heim and Kennedy styles respectively. Such accounts will face similar difficulties to those described in the next section.
(102) Al knew the answers more than Bill did

(102) can only be compared by counting occasions!

Questions for the future: Must you first convert stative predicates into event/time predicates, and then count? What does this imply for rock/rocks?

VI Conclusions

We considered a new way of thinking about comparatives

We introduced the notion of “measurability” across categories, resulting in:

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<td>sg non-gradable VP</td>
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Table 4: Measurable and non-measurable predicates

much, the universal measurer, combines with measurable but not non-measurable predicates—and meeting the conditions on much means felicity with more

The proposal has some interesting features:

- Further division of “contentful” vocabulary from “functional”
- Extension of the neodavidsonian theory to gradable adjectives
- Capture of structure dependence/preservation across categories
The biggest question, one that is not faced under the standard approach: where do differences in dimensionality (for a single predicate) come from?

It seems that *one and the same thing* can be compared on different dimensions

(103) a. Al has **more coffee grounds** than Bill does volume, weight
    b. Al **ran more** than Bill did time, distance

If the structure of a predicate determines the measurement, does this mean there are multiple part-of structures?

And how many dimensions can adjectival comparatives be compared along?

(104) Box A turned **more red** than Box B did

Could this be compared by saturation, brightness, purity...?

**Option 1: Polysemy.** Predicates have multiple senses. Once one is decided on (often given surrounding linguistic context), \( \mu \) applies blindly

**Option 2: Lexical prespecification.** Part of \( \mu \)'s application is picking from the available menu of prespecified qualitative orderings

There are more questions here, but... Thanks!

**Appendix: Conjunctive modifiers and complexity**

Analyzing gradable adjectives as one-place predicates of states allowed us to handle cases of comparative modification straightforwardly

But it raises an issue: How do **attributive adjectives** compose with nouns? Or **conjunctive adverbs** with verb phrases?

\(^{13}\)See the Appendix for others.
In particular, if sorts are so important, how can \([\text{red}]\) and \([\text{barns}]\) be true of the same things?

(105) a. \([\text{red barns}] = \lambda x [\text{RED}(x) \& \text{BARN}(x)]\)
b. \([\text{red barns}] = \lambda s [\text{RED}(s) \& \text{BARN}(s)]\)

Roger Schwarzschild has recently been advocating the view that nouns, indeed, are predicates of states, to some success.

But regardless, on my view, no thing can be both a barn and a red state.

Depending on whether more combines with AP or NP, radically different dimensions are possible:

(106) a. Al saw \([\text{more red barns}]\) than Bill did \(\text{saturation, } \ast\text{number}\)
b. Al saw \([\text{more [red barns]}]\) than Bill did \(\ast\text{saturation, number}\)

If dimensionality is a consequence of what you measure, and how it is ordered—RED and BARN can’t be true of the same things!

Measuring by “redness” means measuring red states, and counting means measuring pluralities.

(107) a. \([\text{red d-much barns}] = \lambda x [\text{BARN-S}(x) \& \exists s [\text{RED}(s) \& \Theta(s, x) \& \mu(s) = d]]\)
b. \([\text{red [d-much barns]}] = \lambda x [\text{BARN-S}(x) \& \exists s [\text{RED}(s) \& \Theta(s, x)] \& \mu(x) = d]\)

The same issue arises with conjunctive adverbials.

We can easily construct and interpret:

(108) a. Al \([\text{ran [more quickly]}]\) than Bill did \(\text{speed, } \ast\text{time}\)
b. Al \([\text{[ran quickly] more]}\) than Bill did \(\ast\text{speed, time}\)

Measuring speed is \textbf{measuring states}, and temporal duration is \textbf{measuring running}.
(109) a. $[[\text{quick d-much run}]] = \lambda e[\text{RUN}(e) \& \exists s[\text{QUICK}(s) \& \Theta(s, e) \& \mu(s, d)]]$

b. $[[\text{quick [ d-much run ]}]] = \lambda e[\text{RUN}(e) \& \exists s[\text{QUICK}(s) \& \Theta(s, e)] \& \mu(e, d)]]$

Interestingly, though, this would represent a straightforward semanticization of Larson’s syntactic analysis of *quickly*:

- *ly* is a head that merges with *quick*, which could be analyzing as a transformation of stative *quick* into an event predicate by *-ly*

Are these the right conclusions?

**REFERENCES**


