Comparative Constructions:

Addendum to the Paper "Gradable Comparatives"

Iddo Lev

June 18, 2005

1 Introduction

In (Lev, 2005), I explored comparative constructions that are based on gradable adjectives. The aims of the present paper are:

1. Extending the analysis to cover non-gradable comparatives (such as *different* and *similar*), nominal comparatives, and adverbial comparatives.

2. Addressing the open questions there.

3. Investigating the interaction of comparative constructions with an independently-motivated analysis for ellipsis.

4. Investigating the interaction of comparative constructions with an independently-motivated analysis for reciprocals.

5. Extending the analysis to the superlative cases.

Throughout this paper, a reference GC(n)efers to the numbered item (n) in (Lev, 2005).

2 Non-Gradable Comparatives

2.1 Overview

The meaning of *different*, *same*, *similar*, *identical*, *equivalent*, etc. typically relies on some salient dimension in the context of utterance, as indicated by its interpretation in (1). This contextually salient feature may be the item's identity, its type, etc. (Nunberg, 1984).

(1) a. $\mathit{diff}[f](x, y) \equiv f(x) \neq f(y)$, for some salient feature f.

b. • This book is different from that book.
• $\mathit{diff}[f](\mathit{this\text{-}book}, \mathit{that\text{-}book})$
• for example, $f = \lambda x.\mathit{author\text{-}of}(x)$

Non-gradable comparative constructions are closely related to gradable ones, and the parallels can be seen in the following table:

(2)

gradable case	non-gradable case
order relation $<$	equivalence relation: $=, \neq, \approx, \equiv, \ldots$
a scale S, ordered by $<$	an unordered set V of values
a measure function from entities to degrees in S	a salient feature function from entities to values in V
comparators (on degrees from S): *more ... than*, *as ... as*	comparators (on values from V): *different ... than*, *similar ... to*

There are two interesting differences between the cases. The first is that S is ordered on a scale, while the set of values V in the non-gradable case is only divided into equivalence classes. So instead of a table like GC(11), we have the following:[1]

(3)

the comparator	operator	meaning
different	DIFF	$\neq$
same	SAME	$=$
similar	SIMIL	$\approx$ (some similarity relation)
equivalent	EQUIV	$\equiv$ (some equivalence relation)
...		

Since S is ordered, a gradable comparator can be modified by an explicit value from S that signifies the *distance* on the scale between the two compared values, whereas this is usually unavailable for the non-gradable case (except in a looser sense as in (5)):

(4) a. John is [2 inches] taller than Bill.
b. John is ??? different than Bill.

(5) a. John is much taller than Bill.
b. John is very similar to Bill.

The second difference is that the measure function is always explicitly mentioned in the gradable case (e.g. "more expensive" utilizes a mapping from entities to their price), whereas the salient feature function is never explicitly mentioned in the non-gradable case as part of the construction itself (thus, "different" could mean "different w.r.t. height, name, author, etc.). If we tried to force parallelism explicitly between the two cases, we would get something like this:

(6) (make explicit the salient feature:)
a. This present is more expensive than that present.
b. This present is *diff* *f* than that present.

Moreover, the value in S may be expressed explicitly, whereas the value in V may never be so expressed. Continuing the forced parallelism, we would get something like this:

[1]Of course, the set V *could* be ordered, but the point is that non-gradable comparatives would not utilize this ordering. For example, the salient feature function in (1) could be *length-of*, but *different* would only compare the lengths using equality and not '$<$'.

(7) a. John is [6 feet] tall.
b. John is v f.
(where f is the salient feature, and $f(john) = v \in V$)

It is easier to see this point by noticing that while phrasal comparatives and comparative deletion exist for both gradable and non-gradable comparatives (8), (9), comparative subdeletion only exists for the gradable case (10), (11):

(8) (predicative, phrasal)
a. John is taller than Bill.
b. John is different than Bill.

(attributive, phrasal)
c. John read a longer book than Bill.
d. John read a different book than Bill.

(9) (predicative, deletion)
a. John is taller than Bill was.
b. John is different than Bill was.

(attributive, deletion)
c. John read a longer book than Bill wrote.
d. John read a different book than Bill wrote.

(10) (predicative, subdeletion)
a. John is taller than Bill is wide.
b. * John is different than Bill is ???.

(11) (attributive, subdeletion)
a. John read a longer book than Bill wrote an interesting one.
b. * John read a different book than Bill wrote a ??? one.

There is no word that could stand for the '???' here ("different" won't do because it already includes the comparator, and putting it there would be parallel to saying: * John is taller than Bill is wider.)

2.2 Syntax-Semantics Interface

Modulo these differences, we would expect to see the same behavior in the gradable and non-gradable cases, and this indeed seems to be true (see e.g. (Alrenga, 2005) for a long list of parallel behaviors between gradable and non-gradable comparatives). Here is an example for the predicative phrasal case. We simply take GC(35) and do nothing more than replace the comparator MORE with the comparator DIFF, and specify that the salient feature function $\boxed{5}$ comes from the context.

(12) "different" (as in: "John is different than Bill")

$$\begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & {}_{adj}[\text{PRD } +] \\ \text{SUBJ} & \langle \text{NP:}\boxed{1} \rangle \\ \text{COMP} & \langle\ \rangle \end{bmatrix} \\ \text{SEM-R} & [\text{HEAD-R } \boxed{2},\ \text{VAL-R } \boxed{4}] \\ \text{GLUE} & \left\langle \begin{array}{l} \boxed{5} : \boxed{1}^e \rightarrow \boxed{4}^d, \\ \lambda G \lambda y \lambda x.\text{DIFF}(G(x), G(y)) : (\boxed{1}^e \rightarrow \boxed{4}^d) \rightarrow \boxed{3}^e \rightarrow \boxed{1}^e \rightarrow \boxed{2}^t \end{array} \right\rangle \\ \text{CONTEXT} & [\text{SAL-FEATURE-FUNC } \boxed{5}] \end{bmatrix} \\ \text{NONLOCAL|INHER|EXTRA} & \{\text{PP}[than]\text{:}\boxed{3}\} \end{bmatrix}$$

If the salient feature function is for example $\lambda x.name\text{-}of(x)$, the final semantics we would obtain for "John is different than Bill" is $\textsc{diff}(name\text{-}of(john), name\text{-}of(bill))$.

The three other versions of "different" (predicative deletion, and the two attributive cases) are obtained from their gradable counterparts in exactly the same way.

2.3 Comparison to Other Work

Heim (1985) discusses in brief non-gradable comparatives, and although her analysis of them parallels her analysis for the gradable case, both analyses suffer from the same problems as discussed in (Lev, 2005, sec.7.3).

Alrenga (2005) notices the many similarities in the distribution of gradable and non-gradable adjectives. However, he does not propose a uniform analysis for both, as was done here. Instead, he proposes that while gradable comparatives express relations between sets of degrees, *different*, *same*, and *like* express relations between sets of contextually relevant properties. Thus, the meaning of (13)a is (13)b.

(13) a. I am different than I used to be.
b. There is some difference between the properties that I used to possess and those that I currently possess. (set non-identity)

This analysis is a special case of my proposal, since one can take the salient feature function f to be a function that returns the contextually relevant set of properties of an individual. Then *different* and *same* express non-equality and equality between such sets, *similar* expresses non-empty intersection between such sets, and so on. It's not clear yet whether restricting our view to sets of contextually relevant properties is the right analysis in all cases. Moreover, my analysis showed that the semantics of gradable and non-gradable comparatives have the same structure, except that the relevant feature function is not expressed in the latter case. Other than that, Alrenga (2005) does not at all address the syntax-semantics interface of the comparatives, i.e. how the semantics is actually obtained from the syntax.

3 Nominal Comparatives

3.1 Background: Determiners and Quantifiers

Here is an example of a simple quantifier determiner:

(14) "every":

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & {}_{det}\begin{bmatrix} \text{SPEC N'}:\boxed{3}:\boxed{1}\rightarrow\boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{GLUE} & \left\langle \lambda P \lambda S.every(P,S) : \forall H^t.\ (\boxed{1}^e \rightarrow \boxed{2}^t) \rightarrow (\boxed{3}^e \rightarrow H^t) \rightarrow H^t \right\rangle \end{bmatrix}$$

Recall the abbreviations from Figure 1 in (Lev, 2005, sec. 3.2): the expression N':$\boxed{3}$:$\boxed{1}$→$\boxed{2}$ is simply a shorthand for N' that has in it:

(15) $\begin{bmatrix} \text{SEM-R} & [\text{HEAD-R } \boxed{3},\ \text{VAR-R } \boxed{1},\ \text{RESTR-R } \boxed{2}] \end{bmatrix}$

According to the SPEC principle in (Pollard and Sag, 1994, p.51), the SPEC value of the determiner will be identified with the synsem of the noun. Thus, (14) can combine with GC(25) to produce:

(16) "every student":

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \textit{noun} \\ \text{SPR} & \langle\ \rangle \end{bmatrix} \\ \text{SEM-R} & \begin{bmatrix} \text{HEAD-R} & \boxed{3}[\textit{3rd,sing}] \\ \text{VAR-R} & \boxed{1} \\ \text{RESTR-R} & \boxed{2} \end{bmatrix} \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda P \lambda S.every(P,S) : \forall H^t.\ (\boxed{1}^e \to \boxed{2}^t) \to (\boxed{3}^e \to H^t) \to H^t, \\ \lambda x.student(x) : \boxed{1}^e \to \boxed{2}^t \end{array} \right\rangle \end{bmatrix}$$

And this can further participate in a larger sentence:

(17) "John saw every student":

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBJ} & \langle\ \rangle \end{bmatrix} \\ \text{SEM-R} & \boxed{4} \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda P \lambda S.every(P,S) : \forall H^t.\ (\boxed{1}^e \to \boxed{2}^t) \to (\boxed{3}^e \to H^t) \to H^t, \\ \lambda x.student(x) : \boxed{1}^e \to \boxed{2}^t, \\ \lambda x \lambda y.saw(x,y) : \boxed{5}^e \to \boxed{3}^e \to \boxed{4}^t, \\ john : \boxed{5}^e \end{array} \right\rangle \end{bmatrix}$$

The glue derivation will combine *john* with *saw* and *every* with *student* to produce:

(18) $\lambda y.saw(john, y) : \boxed{3}^e \to \boxed{4}^t$,
$\lambda S.every(\lambda x.student(x), S) : \forall H^t.\ \to (\boxed{3}^e \to H^t) \to H^t$

We can now explain what H^t means. This is a piece of representation that is written as you just saw above as part of the statements inside GLUE features. This variable has absolutely no interaction with the syntactic feature structures, and plays no role during the construction of those structures. When the glue statements are taken to the side for the purpose of finding glue derivations, the boxed numbers are now treated as constants in the logical language, whereas H^t is treated as a variable that can range over such constants. Thus, if H^t is instantiated to $\boxed{4}^t$, we get:

(19) $\lambda S.every(\lambda x.student(x), S) : (\boxed{3}^e \to \boxed{4}^t) \to \boxed{4}^t$

This is a quantifier of type $(e \to t) \to t$, as expected, that can combine correctly with the first statement of (18) to produce the correct result:

(20) $every(\lambda x.student(x), \lambda y.saw(john, y)) : \boxed{4}^t$

Notice that only after all of the sentence's GS statements are collected together do we start looking for ways to combine them. Therefore, the order of their combination is completely independent of the fact that in the syntax, VP's combined with their subjects last. Thus, the glue derivation combined *john* with $\lambda x \lambda y.saw(x, y)$ first to get $\lambda y.saw(john, y) : \boxed{3}^e \to \boxed{4}^t$, and then "every student" combined with this. This approach can create the effect of the quantifier storage in (Pollard and Sag, 1994), but it is much more general and flexible: it works not only for determiners but for any other semantic operator whose combination with the rest of the semantic material is underspecified by the syntax, including negation, modals, tense, floating quantifiers, polyadic quantifiers, etc.

3.2 Type $\langle 1, 1 \rangle$ Quantifiers

(21) a. (No) more/less than three students attended the party.
b. At least/most three students attended the party.

More/less/at-least/at-most simply expect a number on their COMPS list. *No* is a determiner modifier. This is straightforward and has no extraposition:

(22) * More students attended the party than three.

(23) "more" (as in: "More than three students laughed")

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & {}_{det}\begin{bmatrix}\text{SPEC N'}:\boxed{3}:\boxed{1}\!\to\!\boxed{2}\end{bmatrix} \\ \text{COMPS} & \langle \text{PP}[\mathit{than},\text{PRD-},\text{COMPS}\langle\text{NumP}\rangle]:\boxed{4}\rangle \end{bmatrix} \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda n \lambda P \lambda S.\text{MORE}(|P \cap S|, n) : \\ \forall H^t.\ \boxed{4}^n \to (\boxed{1}^e \to \boxed{2}^t) \to (\boxed{3}^e \to H^t) \to H^t \end{array} \right\rangle \end{bmatrix}$$

3.3 Type $\langle 1, 1, 1 \rangle$ Quantifiers

Recall that one of the options for gradable comparatives was direct degree comparison, where a degree was explicitly specified, against which the measure of the individual was compared – see (Lev, 2005, sec. 4.2). This parallels the type $\langle 1, 1 \rangle$ case we showed in the previous subsection. In both cases, there is no extraposition.

All the other options for comparatives had indirect descriptions of this degree using various complements, which could be extraposed. The same occurs with numerical determiners. Instead of specifying a direct number, some complement phrase includes an indirect description of this number.

The first case is of a type $\langle 1, 1, 1 \rangle$ quantifier, as shown in (24)a. The complement may extrapose to the right, as shown in (24)b.

(24) a. More students than teachers laughed.
b. More students laughed than teachers.

So now, *more* is a determiner that modifies the N' as usual, and also expects on its EXTRA list another noun:

(25) "more" (as in: "More students than teachers laughed")

$$\begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CAT} & \begin{bmatrix}\text{HEAD}_{det}\begin{bmatrix}\text{SPEC N'}:\boxed{3}:\boxed{1}\to\boxed{2}\end{bmatrix}\end{bmatrix} \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda Q\lambda P\lambda S.\text{MORE}(|P\cap S|,|Q\cap S|): \\ \forall H^t.\ (\boxed{4}^e\to\boxed{5}^t)\to(\boxed{1}^e\to\boxed{2}^t)\to(\boxed{3}^e\to H^t)\to H^t\end{array}\right\rangle \end{bmatrix} \\ \text{NONLOCAL|INHER|EXTRA} & \{\text{PP}[\textit{than},\text{PRD}-,\text{COMPS}\langle\text{N'}[\textit{pl}]:\boxed{4}\to\boxed{5}\rangle]\}\end{bmatrix}$$

The NP "teachers" lacks a determiner, so it's easier to treat it as N'. The resulting semantics for the sentence would come out as:

(26) $\text{MORE}(|\textit{student} \cap \textit{sneezed}|, |\textit{teacher} \cap \textit{sneezed}|)$.

The same entry would also work for "More students laughed than teachers". However, the extraposition rule GC(37) would have to be revised to account for the possibilities here. Perhaps a feature on the extraposed element which is selected for by the comparator could help the rule determine where the element can be discharged.

Many cases could be accounted for along these lines. The case shown in (27) (which some have claimed involves a type $\langle 1, 1, 1, 1\rangle$ quantifier operating on the four sets of students, attending-party, teachers, and attending-reception), would have a similar entry to (25) except that it would expect a complement which is a sentence marked with *than* and missing a numeric quantifier. We also get the three attributive cases in (28), where the sentence complement in (28)a is missing a numeric quantifier, in (28)b an NP, and (28)c should have a parallel solution to (28)b as discussed for attributive phrasal comparative in (Lev, 2005, sec. 6.5).

(27) More students attended the party than teachers attended the reception.

(28) a. John read more books than Mary read magazines. (comp. subdeletion)
b. John read more books than Mary read. (comparative deletion)
c. John read more books than Mary. (phrasal comparative)

Pollard (1990) reviews more cases, however he conflates those that have and those that lack ellipsis phenomena. The interaction of ellipsis, gapping etc. with nominal comparatives here – e.g. (29) – should be the same as their interaction with the other comparative constructions.

(29) More consultants work at H-P than (consultants work) at PARC.

4 Adverbial Comparatives

Each of the major families of comparatives we've seen so far – gradable, non-gradable, and quantitative – have adverbial versions:

(30) a. John ran faster than Mary / than Mary ran. (gradable)
b. John spoke differently than Mary / than Mary spoke. (non-gradable)
c. John danced more than Sue / than Sue danced. (quantitative)

In this section, we analyze such cases. In order to do that, we first need to discuss the syntax-semantics interface of adverbs, and for that we need events semantics. We import the treatment of events in glue semantics from (Fry, 1999a,b) into HPSG.

4.1 Events in Glue Semantics

A verb's semantics, after all its arguments are combined with it, is a property of events. For example, "John greeted Mary" describes the property of events: $\lambda e.greet(e) \wedge past(e) \wedge agent(e, john) \wedge patient(e, mary)$. VP modifiers contribute conjuncts to this property. The entire property is eventually closed off by an existential quantifier $\exists e$ at the sentential level.

To account for that, we revise the semantics of verbs from GC(22):

(31) "greeted":

$$\left[\begin{array}{ll} \text{CAT} & \left[\begin{array}{ll} \text{HEAD} & [\text{VFORM } \textit{fin}] \\ \text{SUBJ} & \langle \text{NP}[\textit{nom}]{:}\boxed{2}[\text{PER } \textit{3rd}, \text{ NUM } \textit{sing}] \rangle \\ \text{COMP} & \langle \text{NP}{:}\boxed{3} \rangle \end{array}\right] \\ \text{SEM-R} & [\text{HEAD-R } \boxed{1}, \text{ EVENTP-R } \boxed{4}] \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda x \lambda y \lambda v.greet(v) \wedge past(v) \wedge agent(e, x) \wedge patient(e, y) : \boxed{2}^{e} \rightarrow \boxed{3}^{e} \rightarrow \boxed{4}^{ep}, \\ \lambda Z.\exists v.Z(v) : \boxed{4}^{ep} \rightarrow \boxed{1}^{t} \end{array} \right\rangle \end{array}\right]$$

The difference here is that we introduce a new resource EVENTP-R, of type *ep*, and use it in the semantics. *ep* stands for "event predicate", and is effectively a shorthand for the type $ev \rightarrow t$, where ev is the type of events. The first item in GLUE is a bit unusual compared to all we have seen so far, because while $\boxed{2}^{e}$ is associated with x and $\boxed{3}^{e}$ with y, $\boxed{4}^{ep}$ is associated not with v but with the entire result $\lambda v.[\ldots]$. (We use v for the event variable rather than the conventional e so as not to cause confusion with the type e).[2]

When this verb combines with its two arguments using Schemas 1 and 2, we get the following GLUE:

(32)
$$\left\langle \begin{array}{l} john : \boxed{2}^{e}, \\ mary : \boxed{3}^{e}, \\ \lambda x \lambda y \lambda v.greet(v) \wedge past(v) \wedge agent(e, x) \wedge patient(e, y) : \boxed{2}^{e} \rightarrow \boxed{3}^{e} \rightarrow \boxed{4}^{ep}, \\ \lambda Z.\exists v.Z(v) : \boxed{4}^{ep} \rightarrow \boxed{1}^{t} \end{array} \right\rangle$$

The first three statements combine to $\lambda v.[greet(v) \wedge \ldots \wedge patient(v, mary)] : \boxed{4}^{ep}$, and this combines with the fourth statement to $\exists v.[greet(v) \wedge \ldots \wedge patient(v, mary)] : \boxed{1}^{t}$.

4.2 Gradable Absolutive Adverbs

The separation of the existential closure from the event property in the GLUE of (31) is necessary in order to be able to "stick in" between them things like VP modifiers

[2] There is a general issue in the syntax-semantics interface of glue semantics, whether to allow semantic resources of such higher types, or whether to always spell out such types explicitly and only use semantic resources of atomic types. For example, in the semantics of nouns and adjectives (see e.g. GC(25) and GC(26)), we could use just one semantic resource, PRED-R, of type *et*, which is a shorthand for $e \rightarrow t$, instead of the two resources VAR-R and RESTR-R of types e and t respectively. If higher types are allowed, then after all the GLUE statements are collected, they may need to undergo a step of conversion (to open up such shorthands) before they are combined in derivations, although that depends on how the derivations are calculated. In any case, this issue is orthogonal to the main points of this paper and (Lev, 2005).

and tense modifiers contributed by auxiliaries to non-finite verbs. However, negation, modals, and quantifiers modify the HEAD-R resource of type t.[3] Here is an entry for a gradable absolutive adverb:

(33) "quickly"

$$\begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{mod VP}\begin{bmatrix}\textsc{sem-r}\ \begin{bmatrix}\textsc{eventp-r}\ \boxed{4}\end{bmatrix}\end{bmatrix}\end{bmatrix}_{adv} \end{bmatrix} \\ \textsc{sem-r} & \begin{bmatrix}\textsc{event-r}\ \boxed{5},\ \textsc{val-r}\ \boxed{6}\end{bmatrix} \\ \textsc{glue} & \left\langle \begin{array}{l} \lambda v.quickly(v) : \boxed{5}^{ev} \to \boxed{6}^{d}, \\ \lambda z \lambda G \lambda P \lambda v.P(v) \land \textsc{abs}(G(v), z) : \boxed{7}^{d} \to (\boxed{5}^{ev} \to \boxed{6}^{d}) \to \boxed{4}^{ep} \to \boxed{4}^{ep} \end{array} \right\rangle \\ \textsc{context} & \begin{bmatrix}\textsc{sal-values}\ \ \{\langle quickly, \boxed{8} : \boxed{7}\rangle\}\end{bmatrix} \end{bmatrix}$$

This entry is very similar to the entry for an absolutive attributive adjective in GC(72), with the following differences: (a) Instead of having a measure function from individuals to degrees ($e \to d$), we have a function from events to degrees ($ev \to d$) – thus *quickly* returns the speed of events; (b) the last two items on the GLUE list in GC(72) are combined here to one statement for simplicity; and (c) the degree ($\boxed{7}$ here, $\boxed{6}$ in GC(72)) is taken from a salient context value here, rather than from the COMPS list, because it can never be specified explicitly:

(34) * John ran 2mph fast/quickly.

This adverb may combine with a VP by the head-adjunct schema.[4] The sentence "John greeted Mary quickly" will have a GLUE consisting of (32) and the GLUE from (33), and this yields (35), for some salient degree d.

(35) $\exists v.[greet(v) \land past(v) \land agent(v, john) \land patient(v, mary) \land \textsc{abs}(quickly(v), d)])$

4.3 Gradable Comparative Adverbs

It is easy to give an entry when there is a direct comparison to a degree:

(36) "faster" (as in: "John ran faster than 3mph"):

$$\begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{head} & \begin{bmatrix}\textsc{mod VP}[\textsc{sem-r}|\textsc{eventp-r}\ \boxed{6}]\end{bmatrix}_{adv} \\ \textsc{comps} & \langle \textsc{pp}[than, \textsc{pre-}, \textsc{comps}\langle \textsc{np}[\textsc{degree+}]{:}\boxed{4}^{d}\rangle]\rangle \end{bmatrix} \\ \textsc{sem-r} & \begin{bmatrix}\textsc{event-r}\ \boxed{7},\ \textsc{val-r}\ \boxed{8}\end{bmatrix} \\ \textsc{glue} & \left\langle \begin{array}{l} \lambda v.fast(v) : \boxed{7}^{ev} \to \boxed{8}^{d}, \\ \lambda G \lambda z \lambda P \lambda v.[P(v) \land \textsc{more}(G(v), z)] : \\ (\boxed{7}^{ev} \to \boxed{8}^{d}) \to \boxed{4}^{d} \to \boxed{6}^{ep} \to \boxed{6}^{ep} \end{array} \right\rangle \end{bmatrix}$$

This will produce the semantics: $\exists v.ran(v) \land agent(v, john) \land \textsc{more}(fast(v), 3mph)$.

Now, suppose we have the following sentence:

[3] Thus, the correct semantics for "John didn't run" is $\neg\exists v.ran(v) \land agent(v, john)$ and not when the negation is within the existential. Similarly with modals and quantifiers.

[4] An unresolved question: How is an adverb allowed to appear both to the left and the right of the VP? E.g.: "John quickly greeted Mary."

(37) John ran faster than Mary ran.

The desired semantics is (38)a (which is logically-equivalent to (38)b).

(38) a. $\exists v.[ran(v) \wedge agent(v, john) \wedge$
$\qquad \textsc{more}(fast(v), \iota z.\exists u.[ran(u) \wedge agent(u, mary) \wedge \textsc{abs}(fast(u), z)])]$

b. $\exists v.[ran(v) \wedge agent(v, john) \wedge$
$\qquad \exists u.[ran(u) \wedge agent(u, mary) \wedge$
$\qquad\qquad \textsc{more}(fast(v), fast(u))]]$

The entry for *faster* here should be along the lines of attributive comparative deletion GC(74). It should expect on its EXTRA list a sentence which is missing an adverb phrase that describes a degree. For attributive comparative deletion GC(74) we could easily say that a lexical extraction rule moves the AP argument of the clause's main verb (e.g. *be*) from the COMP list to the SLASH. But here, since adverbs are usually not required arguments and do not appear on a COMP list, we need to assume that we can have a phonologically-null feature structure standing for an empty adverb, and acting similarly to a "trace" – notice that $\boxed{3}$ is the LOCAL and is also on the SLASH set:[5]

(39) A feature structure for a trace of an adverb:

$$\begin{bmatrix} \text{LOCAL} & \boxed{3}\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & {}_{adv}\begin{bmatrix} \text{MOD VP}\begin{bmatrix}\text{SEM-R} & [\text{EVENTP-R } \boxed{1}]\end{bmatrix}\end{bmatrix}\end{bmatrix} \\ \text{SEM-R} & [\text{EVENTP-R } \boxed{2}] \\ \text{GLUE} & \left\langle \lambda Q \lambda P \lambda v.P(v) \wedge Q(v) : \boxed{2}^{ep} \rightarrow \boxed{1}^{ep} \rightarrow \boxed{1}^{ep} \right\rangle \end{bmatrix} \\ \text{NONLOCAL}|\text{INHER}|\text{SLASH} & \{\boxed{3}\} \end{bmatrix}$$

Now, this feature structure can combine with a verb just like a normal adverb, and we get:

(40) "than Mary ran $_{-(adv)}$"

$$\begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & verb[fin] \\ \text{MARKING} & than \\ \text{SUBJ} & \langle\ \rangle \end{bmatrix} \\ \text{SEM-R} & [\text{HEAD-R } \boxed{4},\ \text{EVENT-P } \boxed{1}] \\ \text{GLUE} & \left\langle \begin{array}{l} mary : \boxed{5}^{e}, \\ \lambda x \lambda v.run(v) \wedge past(v) \wedge agent(v, x) : \boxed{5}^{e} \rightarrow \boxed{1}^{ep}, \\ \lambda Z.\exists v.Z(v) : \boxed{1}^{ep} \rightarrow \boxed{4}^{t}, \\ \lambda Q \lambda P \lambda v.P(v) \wedge Q(v) : \boxed{2}^{ep} \rightarrow \boxed{1}^{ep} \rightarrow \boxed{1}^{ep} \end{array} \right\rangle \end{bmatrix} \\ \text{NONLOCAL}|\text{INHER}|\text{SLASH} & \left\{ \boxed{3}\text{S}[\text{SEM-R}|\text{EVENTP-R } \boxed{2}] \right\} \end{bmatrix}$$

Intuitively, if we combine the GLUE statements here, we get:

[5] Technically, to avoid such phonologically-null feature structures, we could have a rule that can modify a verb by adding to its SLASH the LOCAL of the adverb feature structure.

(41) $\lambda Q.\exists v.[run(v) \wedge past(v) \wedge agent(v, mary) \wedge Q(v)] : \boxed{2}^{ep} \rightarrow \boxed{4}^{t}$

i.e. a property that, given a property Q of events, returns a truth value of whether the event of Mary running has the property Q. And now, the adverb *faster* expects such a structure on its EXTRA list:

(42) "faster" (as in: "John ran faster than Mary ran"):

$$\left[\begin{array}{ll} \text{LOCAL} & \left[\begin{array}{ll} \text{CAT} & \left[\text{HEAD}_{adv}\left[\text{MOD VP}[\text{SEM-R}|\text{EVENTP-R } \boxed{6}]\right]\right] \\ \text{SEM-R} & [\text{EVENT-R } \boxed{7},\ \text{VAL-R } \boxed{8}] \\ \text{GLUE} & \left\langle \begin{array}{l} \lambda v.fast(v) : \boxed{7}^{ev} \rightarrow \boxed{8}^{d}, \\ \lambda G \lambda Z \lambda P \lambda v.[P(v) \wedge \text{MORE}(G(v), \iota z.Z(\lambda u.\text{ABS}(G(u), z)))] : \\ (\boxed{7}^{ev} \rightarrow \boxed{8}^{d}) \rightarrow (\boxed{2}^{ep} \rightarrow \boxed{4}^{t}) \rightarrow \boxed{6}^{ep} \rightarrow \boxed{6}^{ep} \end{array} \right\rangle \end{array}\right] \\ \text{NL}|\text{INHR}|\text{EXTRA} & \left\{ \text{S}\left[\begin{array}{l} \text{MARKING } than, \\ \text{NL}|\text{INHR}|\text{SLSH } \left\{\text{ADVP:}[\text{SEM-R}|\text{EVENTP-R } \boxed{2}], \ldots\right\} \end{array}\right] : \boxed{4} \right\} \end{array}\right]$$

So after combining (42) with (40), we have:

(43) $Z = \lambda Q.\exists v.[run(v) \wedge past(v) \wedge agent(v, mary) \wedge Q(v)] : \boxed{2}^{ep} \rightarrow \boxed{4}^{t}$
Z is applied on:
$Q = \lambda u.\text{ABS}(fast(u), z) : \boxed{2}^{ep}$
Therefore we get as the second argument to MORE in (42):
$\iota z.\exists v.[run(v) \wedge past(v) \wedge agent(v, mary) \wedge \text{ABS}(fast(v), z)]$,
i.e. the z such that Mary ran z-fast.

The subdeletion case, as in (44)a, will be analyzed along the same lines, in parallel to the adjective case GC(76). The analysis of the phrasal case, as in (44)b, has the same issues that were raised in (Lev, 2005, sec. 6.5) regarding the phrasal case for gradable adjectives, and the solution should be along the same lines.

(44) a. Mary spoke more enthusiastically than John spoke angrily.
b. John ran faster than Mary.

4.4 Non-gradable Comparative Adverbs

differently, *similarly*, etc. [TBD]

4.5 Quantitative Comparative Adverbs

[TBD]

(45) John danced more than Sue walked.

Need a more sophisticated semantics that quantifies over events:

(46) $\text{MORE}(|\lambda v.danced(v) \wedge agent(v, john)|, |\lambda v.walked(v) \wedge agent(v, mary)|)$

This is very interesting, because *more* here must prevent the existential closure in both the main sentence and the complement clause from connecting with the event predicates. It has to absorb them and "discard" them. Moreover, as a quantifier, it may have scope ambiguity. Happily, all this is easily expressible in the syntax-semantics framework we have here.

References

Alrenga, Peter. 2005. Comparisons of similarity and difference. Handout at TREND, Stanford University, April 16.

Fry, John. 1999a. Resource-logical event semantics for LFG. Talk given at the LFG'99 conference.

Fry, John. 1999b. Resource-logical event semantics for LFG. Unpublished draft.

Heim, Irene. 1985. Note on comparatives and related matters. Ms., University of Texas, Austin.

Lev, Iddo. 2005. Gradable comparatives: Syntax and syntax-semantics interface. Paper for Ling221B, Stanford University.

Nunberg, Geoffrey. 1984. Individuation in context. In *Proceedings of WCCFL 3*, 203–217.

Pollard, Carl. 1990. Notes on the syntax and semantics of comparatives. Unpublished ms.

Pollard, Carl, and Ivan Sag. 1994. *Head-driven phrase structure grammar*. Studies in Contemporary Linguistics. The University of Chicago Press.