Comparatives and Superlatives at the Syntax/Semantics Interface

Roumyana Pancheva
University of Southern California

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Goal of the course

- A very fast introduction to the core grammar of comparison and an overview of some of the main results and outstanding questions in this corner of language.

1. Ann is taller than Bill is.
2. Ann is the tallest of all.

Questions concerning the core grammar of comparatives and superlatives:

- The **lexical meaning** of the relevant functional elements: -er, -est, (than, of), any null elements
- The **lexical meaning** of the predicates with which -er and -est compose
- **Syntax**: what merges with what; what, if anything, moves where; is there hidden structure; timing; linearization
- **Logical semantics**: interaction with quantifiers, modals, focus, NPIs
- **Cross-linguistic variation**: syntax, lexical semantics

The general picture

- Clearly, there is no time to provide detailed answers to all of these questions (even if we knew them all).
- The answers we will suggest (some firmer than others):
- **Lexical semantics**:
  - -er and -est are degree heads introducing null degree quantifiers. They appear in AP, NP and VP comparatives.
  - Gradable predicates like *tall* are relations between degrees and individuals

2. \[ [[tall]] = \lambda d \lambda x \ [\text{HEIGHT}(x) \geq d] \]
- Functional adjectives like *many* and *much* turn NPs and VPs into gradable predicates

Syntax:

- The degree quantificational determiners COMP/SUPER combine first with the standard (the than/of expression); the degree quantifier undergoes QR

3. 

4. A *wh*-degree operator binds the degree variable in the *than*-clause
1. Comparison across categories: The cast of characters

The major syntactic categories can express comparison using similar means.

(5) a. Boris is taller than Nina
   b. Ann is a quicker athlete than Kate
   c. Mimi visits more often than Sasha
   d. Peter has fewer bikes than Vanja
   e. Sonia drinks less than Irina

(6) a. Boris is (the) tallest
   b. Ann is the quickest athlete
   c. Mimi visits most often
   d. Peter has the fewest bikes
   e. Sonia drinks the least

1.1 Degree morphemes: Deg and ‘Q’-As

Synthetic comparatives: specialized comparative and superlative inflection for adjectives and adverbs, and not for nouns or verbs

(7) a. Adjective: tall
    b. Adverb: quickly

(8) a. more/most handsome
    b. more/most importantly
    c. more/most doctors
    d. drink more/the most

Decomposition of more and most (Bresnan 1973, a.o.) into Deg and Q- adjectives/adverbs

(9) a. -er + many/much = more
    b. -est+ many/much = most

Outline of the class

Sept 14, Friday
- Functional elements for comparison across categories
- Cross-linguistic variation in comparative types
- The semantics of gradability, measurement and comparison
- Parallels between NP and VP comparatives

Sept 15, Saturday
- ‘Classical’ and ‘Deg’-headed approaches to the architecture of comparison
- Evidence for QR of COMP and SUPER
- Superlative ambiguities, degree quantifier scope and focus
- Refining the architecture of comparatives and superlatives

Sept 16, Sunday
- Direct and reduction analyses of phrasal comparatives and their implications
1.1.1 Other ‘Q’-As

- No dedicated inflection for comparative or superlative of inferiority; these are analytic for all categories

10) ‘Lesslessness’ Bobaljik (to appear)
   No language has a synthetic comparative of inferiority.

11) a. less/least tall
    b. less/least quickly
    c. fewer/fewest doctors
    d. drink less/the least

12) a. po-/naj-malko knigi
    -er/-estfew books
    ‘fewer/fewest books’
    b. pija po-/naj-malko
    drink -er/-est-little
    ‘drink less/the least’

In English, the analytic/synthetic distinction with respect to adjectives and adverbs is morpho-phonological.

17) a. more/most interesting
    * interesting -er/-est
    b. ? more/most tall
    more/-er/-est
    c. ?? drive more/ (the) most fast
    drive fast -er/-est

This suggests that much in such cases is not interpreted

- ‘Much Deletion’ (Bresnan 1973)

18) a. [-er much] tall
    -er ? tall
    b. [-er much] handsome
    ‘more handsome’

- ‘Much support’: Deg and A cannot form a single head through head-movement or post-syntactic merger, so much is inserted to support Deg (Corver 1997, Embick and Marantz 2008, Solt 2010, Bobaljik to appear)

19) We will also see that there is semantic evidence for such a uniform cross-categorial analysis of comparison
• In other languages, the analytic-synthetic forms of adjectives and adverbs exist side by side. The semantic role played by *much* in such cases seems to do with norm-relatedness
  • claimed in Matushansky (2001), Krasikova (2009) for Russian; but note that many but not all speakers agree
(20) **Russian** (Krasikova 2009)
  a. Katja ne vyšokaya no ona vyš-e čem Sergej
      Katja neg tall but she tall-er than Sergej
      ‘Katja isn’t tall but she is taller than Sergej.’
  b. Katja ne vyšokaya *no ona bol ee* vyšokaya čem Sergej
      Katja neg tall but she much-er tall than Sergej
      ‘Katja is not tall, but she is taller than Sergej.’
  • Reported by some Hindi speakers (not in Bhatt 2012), similar facts for Bangla
(21) **Hindi-Urdu** (Bhatt 2012)
      John Bill-se (zyaadaa) lambaa hai
      John Bill-than (much/more) tall is
      ‘John is taller than Bill.’

Questions (that will not be necessarily fully answered here):
• What is the syntax and semantics of the two Degs *-er* and *-est*? What is their common component? How are they different?
• What is the role of ‘Q’-As *many/much/few/little*? When and how are they associated with norm-relatedness?
• Do all languages have these degree morphemes? Are there other ways to express comparison?

1.1.3 Other Degs
• A family of ‘degree’ morphemes
(22) a. **as** (+ many/much) as tall, as often, as many books, as much salt, drink as much
    b. **too** (+ many/much) too tall, too often, too many books, too much salt, drink too much
    c. **enough** tall *enough*, often *enough*, *enough* books, *enough* salt, drink *enough*
    d. **so** (+ many/much) so tall, so often, so many books, so much salt, drink so much
    e. **how** (+ many/much) how tall, how often, how many books, how much salt, drink how much
    f. **that** (+ many/much) *that* tall, *that* often, *that* many books, *that* much salt, drink *that* much
    g. **POS** (+ many/much) *POS* tall, *POS* often, *POS* many books, *POS* much salt, drink *POS* much

1.2 Degree clauses
• Selectional restrictions exist between Deg and its associated clause yet the two are discontinuous, obligatorily so
    • An additional argument that *more* decomposes to *-er + many/much*
(23) a. *-er* tall [than Bill is], *-er much* interesting [than the movie is]
    b. **as** tall [as Bill is]
    c. **too** tall [to go on this ride]
    d. tall *enough* [to go on this ride]
    e. **so** tall [that he cannot go on this ride]
(24) a. *-er* (+ many/much/little/few) ... *than* + finite clause
    b. **as** (+ many/much/little/few) ... *as* + finite clause
    c. **too** (+ many/much/little/few) ... non-finite clause
    d. **enough** ... non-finite or finite clause
    e. **so** (+ many/much/little/few) ... *that* + finite clause
Questions:
- Does the degree morpheme first combine with its associated clause? If so, why the obligatory extraposition of the degree clause? Where does the degree clause extrapose to?
- Or does the degree morpheme first combine with the gradable predicate? If so, how are the selectional restrictions determined? When and where does the degree clause merge?
- What is the role of the markers for the standard (the clause–introducers)? Are they complementizers, prepositions, conjunctions? Do they have a meaning or are they playing a purely syntactic role?
- What is the internal syntax of the degree clause? What is its meaning?
- Is there cross-linguistic variability in the overall architecture, the internal syntax of the degree clause, or the role of the clause-introducer?

1.3 Degree phrases
- Both phrases and clauses can appear as complements of than

(25) taller than [he is / him]

(26) Russian
  a. Anna sil′nee čem (byl) Ivan.
     Anna strong-er than-wh (was) Ivan Nom
     ‘Anna is stronger than Ivan (was)’
  b. Anna sil′nee Ivana.
     Anna strong-er Ivan Gen
     ‘Anna is stronger than Ivan’

(27) Bangla (Priyanka Biswas, p.c.)
  a. jOn bil′er theke lOmba
     John bill′er from tall
     ‘John is taller than Bill.’
  b. bil jOtO lOmba, jOn tar theke (beSi) lOmba
     bill how tall john that beSi from more lOmba
     ‘John is taller than Bill is.’

1.4 Summary
- The basic building blocks of comparatives and superlatives

(28) a. X has property P -er than Y has property P
  b. X has property P -est of all

(29) Deg: -er, -est

(30) ‘Q,’ As: much/many/few/little

(31) gradable P:
  a. [ [Q AdjP / AdvP ]
  b. [ Q NP / VP ]

(32) comparison >> measurement >> lexical predicate
2. Cross-linguistic variation in comparatives

2.1 Types of comparatives

- Not all languages have a counterpart of -er. The absence of an overt -er may have very different sources:
  - “Implicit comparison” vs. “explicit comparison” (Kennedy 2007)
  - Explicit comparatives: ‘exceed’-comparatives and ‘-er’-comparatives
  - In an ‘-er’-comparative the -er (and its associated COMP) may be covert

(33) comparatives
    implicit
    explicit
    ‘exceed’ ‘-er’ covert ‘-er’ overt ‘-er’

(see Ultan 1972, Stassen 1985, Beck et al 2009)

- ‘Exceed’ comparatives (cf. (34))

(34) Hausa (Stassen 1985)
  Doki ya-fi rago girma
  Horse it-exceed goat bigness
  ‘A horse exceeds a goat in height.’

(35) Yoruba (Beck et al 2009)
  a. Kathy fi esebata kan ga ju Sandra lọ.
    Kathy with foot one is-tall exceed Sandra go (st.marker)
    ‘Kathy is one foot taller than Sandra.’
  b. Owó osù rè ju ti e lọ money month her exceed that your go (st.marker)
    ‘Her income exceeds your income.’

- Null –er (“Explicit comparison” (Kennedy 2007))

(36) a. Javanese (Kennedy 2007)
  Enak daging karo iwik
  is-good meat than fish
  ‘Meat is better than fish.’
    Nihongo-wa doitsgo yori muzukashi
    Japanese-TOP German from difficult
    ‘Japanese is more difficult than German.’
  c. Hindi-Urdu (Bhatt and Takahashi 2011, Bhatt 2012)
    John Bill-se (zyaadaa) lambaa hai
    John Bill-than (much) tall is
    ‘John is taller than Bill.

- “Implicit comparison” (Kennedy 2007): absolute, not comparative, form of the adjective; English (37), possibly Samoan (38) as well.

(37) John is tall, compared to Bill.

(38) Samoan (Kennedy 2007)
  Ua tele le Queen Mary, ua la’itiiti le Aquitania.
  is big the Queen Mary, is small the Aquitania
  ‘The Queen Mary is bigger than the Aquitania.’

(39) Hixkaryana (Stassen 1985)
  Kaw-ohra naha Waraka kaw naha Kaywerye
tall-not he-is Waraka tall he-is Kaywerye
  ‘Kaywerye is taller than Waraka.’
Kennedy’s (2007): 3 tests for distinguishing between implicit and explicit comparison (cf. Fults 2006)

- Contexts of very slight difference

(40) A 600 word essay and a 200 word essay
   a. This essay is longer than that one.
   b. Compared to that essay, this one is long.

(41) A 600 word essay and a 597 word essay
   a. This essay is longer than that one.
   b. Compared to that essay, this one is long.

- Minimum standard gradable adjectives: open, bent, impure

(42) Rod A: Rod B: 
   a. # Compared to A, B is bēnē.
   b. B is more bent than A.

- Measure phrases

(43) a. * Compared to Lee, Kim is 10cm tall.
   b. Kim is 10 cm taller than Lee.

2.2 (Even) less clear cases

- No overt clause-introducer, possibly paratactic constructions (cf. (46), (38)) – yet what is the role of more in (46), cf. the absence of more in (38)?

(46) a. Motu (Stassen 1985)
   Ina na namo herea una na dia namo
   This is good more that is not good
   ‘This is better than that is.’
   b. Miskito (Stassen 1985)
   Yan kau tuktä, man almuk
   I more young he old
   ‘I am younger than he is.’

- While the than-clause is typically taken to be a complement of -er, some have proposed that it is (also) a conjunct to the main clause (Lechner 2004, Moltmann 1992)

2.3 High and low -er

- Old Slavic has two types of synthetic comparative adjectives (e.g. Duridanov 1993)

  a. In Type I comparatives, the comparative suffix is added to the root.
  b. In Type II comparatives, the comparative suffix is added to a projection of the adjective.

(47) (cf. Latin jus)
2.4 Summary

- The main types of comparatives, cross-linguistically
  - Explicit comparison

X has property P -er than Y has property P

X exceeds Y in property P

- Implicit comparison

X has property P and not Y has property P

X has property P, compared to Y

There’s further variation within ‘-er’-comparatives, e.g., height of merge
There is need for informed fieldwork to understand the possible variation.
But even for the better studied languages there is still a lot to be done.

3. Brief overview of the semantics of gradable adjectives, measurement and comparison

3.1 Gradable vs. non-gradable adjectives

- Adjectives differ in whether or not they express properties that naturally yield orders of individuals. Adjectives that don’t are odd in the various comparative constructions.

Different types of gradable adjectives

(56) a. tall, old, long, heavy, wide, fast
    b. smart, handsome, interesting
    c. dirty, wet, bent
    d. closed, straight


- Questions:
  - What does the gradability property suggest about the lexicon/syntax distinction? Are some adjectives specified in the lexicon asgradable, whereas others aren’t? If so, how?
  - To the extent that non-gradable adjectives can appear with degree morphology, how is that accomplished? Type-shifting? A family of meanings?
3.2 Two approaches to the semantics of adjectives

- One approach (cf. McConnell-Ginet 1973, Klein 1980) treats both tall and Bulgarian as predicates of individuals:

\[(57)\]

a. \( \llbracket \text{tall} \rrbracket = \lambda x \{ x \text{ is tall} \} \)

b. \( \llbracket \text{Bulgarian} \rrbracket = \lambda x \{ x \text{ is Bulgarian} \} \)

- The domains of gradable adjectives are partially ordered sets, where the ordering is with respect to some property (e.g., height for tall, (58a)). No such ordering is imposed on the domains of non-gradable adjectives, (58b).

\[(58)\]

a. \( D_{\text{tall}} = \{ \text{John, Mary, Bill, Sue ...} \} \)

b. \( D_{\text{Bulgarian}} = \{ \text{John, Mary, Bill, Sue ...} \} \)

- The domain of gradable adjectives is further partitioned into positive and negative extensions (and possibly an undefined extension; cf. Klein 1980) according to a contextually determined standard value.

\[(59)\]

a. \( D_{\text{tall, pos}} \subseteq D_{\text{tall}} \& D_{\text{tall, pos}} = \{ \text{Bill, Sue ...} \} \)

b. \( D_{\text{tall, neg}} \subseteq D_{\text{tall}} \& D_{\text{tall, neg}} = \{ \text{John, Mary,...} \} \)


- A scale is a set of degrees, which represent measurement values, ordered along a dimension, which indicates the property being measured (height, weight, length, cost, temperature, speed, volume, etc.).

- long, tall, wide all relate to spatial distance, but have different, though commensurate, dimensions. The ordering relation determines the difference between polar opposites (e.g. tall/short).

\[(60)\]

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3.3 The ‘classical’ degree-based analysis


\[(61)\]

a. \( \llbracket \text{tall} \rrbracket = \lambda d \lambda x \{ x \text{ is height } \geq d \} \)

b. \( \llbracket \text{Bulgarian} \rrbracket = \lambda x \max \{ d : x \text{ is d-tall} \} \)

- Scales are suitable for cross-categorial measurement and comparison. Roughly, for the situation in (62) we can say (63)-(64):

\[(62)\]

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\[(63)\]

a. A is 2-units X (e.g., A is 2-years old / 2-meters tall /...)

b. B is 6-units X
c. B is 4-units X-er than A
d. C is the X-est

\[(64)\]

a. A has 2 Xs (e.g., A has 2 children / 2 cars /...)

b. B has 6 Xs
c. B has 4-units more Xs than A
d. C has the most Xs

- On this approach, a new kind of abstract entity is posited—degrees—alongside individuals, events, times, possible worlds, and the lexical semantics of adjectives makes reference to it.

\[(65)\]

a. \( \llbracket \text{tall} \rrbracket = \lambda d \lambda x \{ x \text{'s height } \geq d \} \)

b. \( \llbracket \text{Bulgarian} \rrbracket = \lambda x \max \{ d : x \text{ is d-tall} \} \)

\[(66)\]

\[(67)\]

\[DP \xrightarrow{\text{AP}} \text{A tall} \]

\[DP \xrightarrow{\text{DegP}} \text{A Bulgarian} \]
The question of the exact semantics for -er is not settled. The current contenders are in (70).\(^6\)

\[ \begin{align*}
(70) & \quad a. \lambda E \lambda R \lambda Q \text{max}(Q) > \text{max}(P) \\
& \quad b. \lambda E \lambda R \lambda Q \exists d \{ \text{max}(Q) \land \forall d' \text{max}(Q) \land \forall d' \to d' \leq d \}
\end{align*} \]

On the ‘classical’ approach in (68), DegPs are quantifiers over degrees.

Deg -er as a quantificational degree determiner that takes two degree predicates as its arguments. The first argument of –er is the degree clause.

The two form a quantifier that undergoes QR. (In (69), the QR-ed DegP is shown as adjoined to the left of TP – this is just a shorthand for the claim that the than-clause needs to be linearized to the right)

\[ \begin{align*}
(71) & \quad A \text{ is more expensive than } B \text{ is.} \\
& \quad a. \lambda d \{ \text{d} \text{ is } d\text{-expensive} \} > \lambda d \{ \text{d} \text{ is } d\text{-expensive} \} \\
& \quad b. \exists d \{ \text{expensive}(A,d) \land \neg \text{expensive}(B,d) \}
\end{align*} \]

3.4 The ‘Deg-headed’ degree-based analysis

A semantic implementation in Kennedy (1999): gradable adjectives denote measure functions (type \(<e,d>\)); degree morphemes have three arguments: a measure function, denoted by the adjective, a degree and an individual.

\[ \begin{align*}
(72) & \quad a. \lambda x \{ \text{x's \ \text{HEIGHT}} \} > d \\
& \quad b. \lambda G_e, d \lambda x \{ G(x) > d \}
\end{align*} \]

This approach is compatible with an in-situ Deg-headed analysis (see Abney 1987, Larson 1988, Corver 1990, 1993, Kennedy 1999, for variants on this structure)

\[ \begin{align*}
(73) & \quad \lambda x [G(x) > d]
\end{align*} \]

4. Semantic parallels between NP and VP comparatives

Languages with ‘-er’-comparatives require many/much in nominal and verbal comparatives.

Technically, these are comparatives of attributive functional adjectives (nominal) and of functional adverbs (verbal)

\[ \begin{align*}
(74) & \quad a. \lambda x [\text{ADJ } -er \text{ much } \text{coffee}] \\
& \quad b. \lambda x [\text{ADJ } -er \text{ many } \text{books}] \\
& \quad c. \lambda x [\text{ADJ } -er \text{ much } \text{drove more}] \\
& \quad \text{Is the same more, or rather -er and much, many involved in NP and VP comparatives? (Wellwood, Hacquard and Pancheva 2012) }
\end{align*} \]

- More doesn’t compose with sg. count nouns or perfective telic predicates
- Plural NPs and imperfective-habitual VPs are compared on a scale of cardinality, whereas mass NPs and perfective (atelic) VPs are compared along non-cardinal scales, as long as these are monotonic on the part-whole structure of the predicate.
4.1 Adnominal *much/many*

- **Semantic plurality**: Adnominal *more* requires semantically plural count arguments (Hackl 2000, 2001).
  
  (75)  
  a. There were more students than professors at the party.  
  b. * There was more student than professor at the party.

- *Many* incorporates a measure function, mapping (sums of) individuals to degrees of cardinality (Hackl 2000).^3^  
  
  (76) \[[many]] = \lambda d \lambda x \ [ |x| = d \]

- If *many* were to combine with singular NPs, the measure function would map all individuals in the NP denotation to the degree of one, failing to yield a non-trivial order, unlike what happens in the adjectival domain.

- Adnominal *much* incorporates a measure function too, relating individuals to non-cardinality degrees. Order-preservation is satisfied by mass structure.  
  
  (77) \[[much]] = \lambda d \lambda x \ [ \mu(x) = d \]

4.2 Adverbial *much*

- Extensive measure function *much* in the verbal domain as well (cf. Nakanishi 2004, 2007). The comparative quantifier [-er than...] combines with this measure function in verbal comparatives (Wellwood et al 2012)

- We should see the distribution of adverbial *more* as parallel to that of determiner *more*, and aspectual properties should conspire to determine the scale of comparison (Wellwood et al 2012)

  + Comparisons of **singular events** (i.e. episodic PFV, PROG) should only be possible with an atelic VP and the comparison should be along some quantity dimension

  + Comparison of **plural events** (i.e. habitual) should be possible with both telic and atelic VPs, and the comparison should be in terms of cardinality

- **Monotonicity**: the dimension of partitive measure phrases and ‘Q’ adjectives must be monotonic on the part-whole relation given by the NP (Schwarzschild 2002, 2006)

  (78)  
  a. two pound cherries (attributive, non-monotonic)  
  b. two pounds of cherries (partitive, monotonic)  
  c. too much cherries (partitive, monotonic)

- Comparison by cardinality satisfies monotonicity.

- Mass NPs vary considerably more in their dimension of measurement. However, this variety is constrained to dimensions that are (still) monotonic with respect to the part-whole structure of the NP.

  (79)  
  a. I have more coffee than Mary does. weight/volume/*temperature/*price cardinality (servings/kinds/...)  
  b. I have more coffees than Mary does. cardinality (objects)  
  c. I have more toys than John does. cardinality (objects)

- **Cardinality comparison**: the scale of comparison for plural NPs is always in terms of cardinality, whereas for mass NPs it varies (Bale and Barner 2009)

  (80)  
  a. Yesterday, John ran more than Mary did.  
  b. [ \lambda d [John ran-PFV d-MUCH ]] [-er \ [ than \ [ \lambda d [Mary ran-PFV d-MUCH ]]]]  
  c. The amount that John ran is greater than the amount that Mary ran

  (81)  
  a. In those days, John ran more than Mary did  
  b. [ \lambda d [John ran-IMPFV d-MANY (times) ]] [-er \ [ than \ [ \lambda d [Mary ran d-MANY-IMPFV (times) ]]]]  
  c. The number of running events by John is greater than the number of running events by Mary.

  (82)  
  a. # Once yesterday, Mary reached the top more than John did  
  b. [ \lambda d [John reached-PFV the top d-MANY (times)]] [-er \ [ than \ [ \lambda d [Mary reached-PFV the top d-MANY (times)]]]]

  (83)  
  a. In those days, Mary reached the top more than John did  
  b. [ \lambda d [John reached-IMPFV the top d-MANY (times)]] [-er \ [ than \ [ \lambda d [Mary reached-IMPFV the top d-MANY (times)]]]]  
  c. The number of events of John reaching the top is greater than the number of events of Mary reaching the top
In sum (from Wellwood et al 2012)

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<tr>
<th>Generalizations - determiner <em>more</em></th>
<th>Generalizations - adverbial <em>more</em></th>
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<tbody>
<tr>
<td>I. Singular count NPs do not combine with determiner <em>more</em></td>
<td>I. Perfective telic predicates do not combine with adverbial <em>more</em></td>
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<tr>
<td>II. The scales of comparison for NPs are necessarily monotonic (in terms of cardinality or otherwise)</td>
<td>II. The scales of comparison for VPs are necessarily monotonic (in terms of cardinality or otherwise)</td>
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<td>III. The scale for comparison of non-plural marked mass NPs is variable</td>
<td>III. The scale for comparison of progressive-marked atelic predicates is variable</td>
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<td>IV. The scale for comparison of NPs marked with plural morphology is in terms of cardinality only</td>
<td>IV. The scale for comparison of VPs with IMPF-HAB morphology is in terms of cardinality only</td>
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Endnotes

1. Little may itself be further decomposed into negation and much (see Heim 2006)
2. Bulgarian may seem to contradict this generalization. Verbal comparatives may sometimes appear without an overt much, e.g. (ia) is possible alongside (ib), but its distribution is restricted.
   (i) a. po-običam kafe
   b. po-veče običam kafe
   ‘I love coffee more.’
4. Heim’s semantics is closely related to that of von Stechow (1984), as in (i).
   \[ \lambda [\text{er}] \lambda Q \exists d [Q(d) \land d > \text{max}(P)] \]
5. This formalization is found in Hackl (2000), who later (and in Hackl 2001) adopts a ‘degree determiner’ analysis for many, such that it takes the NP and VP as arguments in addition to a degree variable, but this is not important for our purposes.