1. INTRODUCTION

Starting point: the distribution of the ‘adjectives of quantity’ many and much (also few and little):

(1) Many/few trees fell
(2) a. Much/little wine was consumed
b. The company grew too much/little
c. Fred is much/little taller than John
d. Fred is much too tall

A unified analysis: many/much/few/little are predicates of scalar intervals, i.e. type \( <dt,t> \) (Schwarzschild 2006; Rett 2006; Solt 2007a, 2007b).

Each of examples in (1)-(2) provides interval (set of degrees) to serve as argument, with degrees introduced by gradable expression (2b), degree morpheme (2c,d), or null measure function (1, 2a):

(3) a. many(\( \lambda d.\exists x [\text{tree}(x) & \text{fell}(x) & \text{MEAS}(x) \geq d] \) )\( \quad \) (1)
b. much(\( \lambda d.\exists x [\text{wine}(x) & \text{consumed}(x) & \text{MEAS}(x) \geq d] \) ) \( \quad \) (2a)
c. too-much(\( \lambda d.\text{growth}(\text{the company}) \geq d \) )\( \quad \) (2b)
d. much(\( \lambda d.\text{height}(\text{john}) < d \leq \text{height}(\text{fred}) \) )\( \quad \) (2c)
e. much(\( \lambda d.\text{maxheight} < d \leq \text{height}(\text{fred}) \) )\( \quad \) (2d)

⇒ ‘Large’ for many/much; ‘small’ for few/little

Adjectives of quantity belong to same class as degree expressions such as -er than 10; too; very (Heim 2000, 2006; Hackl 2000; Bhatt & Pancheva 2004; a.o):

(4) a. John’s good qualities are many
b. The little wine that was consumed

(5) a. Many fewer than 100 runners finished the race
b. We drank much less than a gallon of wine

(6) a. Five is too many
b. A gallon is too little

Adjectives of quantity are quantifying determiners.

2. POSSIBLE ACCOUNTS

Much/little typically taken to be mass counterparts of many/few (e.g. Higginbotham 1995)

But….

a. Occurrence outside of nominal domain (e.g. (2b-d))
  o Analysis as predicates of scalar intervals → any semantic explanation must be found in structure of domain of scales and degrees vs. domain of individuals

I will contrast three positions that could be taken:

i) Dimension: many is associated with dimension of cardinality (number); much is associated with other dimensions (Schwarzschild 2006)

ii) Dense/discrete scale structure: as a formalization of (i), many is predicated of intervals on a discrete scale (the natural numbers); much is predicated of intervals on dense scales (cf. Rett 2006; contra Fox & Hackl 2006)

iii) Agreement: many, as the plural form of much, agrees with the plural noun (Chierchia 2005)

The data in (1)-(2) yield little insight into this question, as the three properties in question coincide. It is thus instructive to examine cases where they do not.

3. THE ANALYSIS

3.1 Many and discrete vs. dense scales

Intuitively, scale involved in measurement of cardinality (as in (1)) appears to differ from other measurement scales in being discrete vs. dense:

(7) A scale \( S = \{D, >, \text{DIM}\} \) is dense if for all \( d, d' \in D \text{ s.t. } d > d', \exists d'' [d > d'' > d] \)

Volume: For any two portions of (say) water having distinct volumes \( d \) and \( d' \), there can be a third portion of water whose volume \( d'' \) falls between \( d \) and \( d' \)

Cardinality (number): For two groups of individuals numbering \( n \) and \( n+1 \), there can be no third group whose number falls between \( n \) and \( n+1 \)

* My thanks as always to Bill McClure, Marcel den Dikken and Robert Fiengo, for their advice and guidance.
Fox & Hackl (2006): Universal Density of Measurement (UDM): all scales involved in natural language measurement – including cardinality – are formally dense

(8) a. *How much doesn’t John weigh?
   b. *How many children doesn’t John have?

- Ungrammaticality of (8a): asks for the maximally informative degree d (i.e. the minimum degree d) such that John doesn’t weigh d. On the assumption that the scale of weight is dense, there is no such minimum degree.
- Explanation can only be extended to (8b) if it is assumed that the scale of cardinality is likewise dense

- Further evidence that cardinalities may be mapped to a dense scale:
  - Average values
    - (9) The average American household has 2.3 televisions
  - Nouns of measure
    - (10) The rod is 3.791 feet long
  - Counting divisible entities
    - (11) a. We ate 2½ pies / 2¼ pies / 2⅛ pies / etc.
    - b. Our firm built 3½ houses this year

- Importantly, in each of these cases the corresponding question is formed with many, not much:

(12) a. How many/*much televisions does the average American household own? 2.3
   b. How many/*much feet long is the rod?  3.791
   c. How many/*much pies did you eat?  2½

- Dense vs. discrete scale structure is not the determining factor in the many/much distinction (contra position (ii) above): many is not restricted to operating on discrete scales
- Evidence points to dimension of cardinality requiring a dense scale

3.2 Agreement

- Does the many/much distinction reflect number agreement?
  - On this view, many/much a single item (similarly for few/little); many is the plural form, much its (suppletive) singular (Chierchia 2005)

(13) a. thisSG rice/thesePL books
   b. muchSG rice/manypL books

(14) Spanish: mucho (‘much’) vs. muchos (‘many’)

3.3 Dimension vs. Agreement

Evidence from mismatches between number and dimension of measurement:

- Note that pluralities can be quantified on dimensions other than cardinality:

(15) a. I bought ten potatoes
cardinality
   b. I bought three pounds of potatoes
weight
   c. I bought two bushels of potatoes
dry volume
   d. The floor was covered by two feet of potatoes
depth

- But now consider the following scenario:

(16) John has 9 (large) potatoes weighing 3.5 pounds in total
Fred has 12 (small) potatoes weighting 2.5 pounds in total
⇒Two salient dimensions: cardinality & weight

- The only felicitous answer to (17a) is (17b) – a how many question asks for a number.

(17) a. How many potatoes does John have?
b. 9
c. #3.5 pounds

- (18) is false, despite the fact that on the dimension of weight, Fred has a lesser quantity of potatoes John does – comparisons expressed by many are comparisons of cardinality.

(18) Fred doesn’t have as many potatoes as John false

- However, replacing many with much is at best marginal (though considerable speaker variation here):

(19) a. *?How much potatoes does John have?
(20) a. *?Fred doesn’t have as much potatoes as John

- There is no completely acceptable way to describe/inquire about the weight relationship in (16)
What do these data tell us?

- Only reading available to *many* is a cardinality reading
  - *Many* itself encodes cardinality?
  - Cardinality is default dimension on which pluralities are quantified?

- Infelicity of *much*
  - Number mismatch?
  - Incompatibility with cardinality as default dimension?

- Evidence that number is not the determining factor from idiosyncratic plurals that denote substances of matter, e.g. mashed potatoes, scrambled eggs, refried beans.¹

  - Take plural agreement:
    1. a. These mashed potatoes/*this mashed potatoes
       b. The mashed potatoes are/*is cold

  - *Much* preferable to *many* (though varies by speaker and construction):
    2. a. How much mashed potatoes do you want?
       b. Don’t give me that much mashed potatoes
       c. I made too much mashed potatoes
    3. a. ??How many mashed potatoes do you want?
       b. ??Don’t give me that many mashed potatoes
       c. ??I made too many mashed potatoes

  ⇒ Presence of *much* vs. *many* not determined by same factor as presence of *this* vs. *these* (agreement)
  ⇒ Possibility of *many* suggests agreement still plays some role?

- Possibility also with some other count nouns:
  24. a. Whether you are newlyweds or a couple now finding themselves with an "empty nest", knowing how much vegetables to buy for two servings can be tricky.
     (http://www.practicalkitchen.com/cooking_for_two/buying_vegetables_for_two.shtml)
     b. If you carry just too much clothes you will end up with dirty laundry on your back all the time… (www.oldcontinent.com/tips/how_to_pack.shtml)

- Subtle difference in meaning when both *many* and *much* allowed:
  25. a. How much scrambled eggs do you want?
     b. Two scoops/a plate-full/about half the amount you gave him…
  26. a. How many scrambled eggs do you want?
     b. Two

1 I thank Greg Carlson for directing my attention to these.

- Consider again scenario (16). In this situation, (30a) arguably has a reading on which it is true, and (30b) is certainly true; by contrast (30c) is false, and (30d) is ungrammatical

  29. a. many…more than
     b. much…more than
     c. few…fewer than
     d. little…less than

  ⇒ Many and much themselves convey dimension (position (i))
  ⇒ A further test is provided by the comparative. Note that the *many/much* distinction is neutralized in the comparative, but the *few/little* distinction is not:

  30. a. John has more potatoes than Fred   true on one reading (?)
     b. John has 1 pound more potatoes than Fred  true
     c. Fred has fewer potatoes than John       false
     d. *Fred has 1 pound fewer potatoes than John  ungrammatical

  ⇒ Pluralities can be compared on dimensions other than number; it is the presence of *many/few/fewer* (which encode cardinality) that disallows this

3.4 Conclusion

- Dimension of measurement (+/- cardinality) is primary factor in selection of *many vs. much*
- Some sort of agreement as well?

4. Consequences of the Analysis

- English has degree expressions that make a distinction between the dimension of cardinality and other dimensions
- I will discuss consequences for three issues in the semantics of quantity and measurement
4.1 The Dimension of Cardinality

- *Many/few* predicated of intervals on the scale of cardinality:
  - The distinction between cardinality and other dimensions cannot be reduced to discrete vs. dense scale structure
  - There nonetheless must be some fundamental distinction between cardinality and other dimensions of measurement
- Fox & Hackl (2006): Granularity
  - Contextual parameter G that specifies a level of granularity (formalized as equivalence relation)
  - In the measurement of collections of indivisible objects, granularity assumed to be 1:
    \[(31) \quad xy \text{ iff there is a natural number } n \text{ s.t. } x \in (n, n+1] \text{ and } y \in (n, n+1] \quad (p. 569)\]
    - Presupposes existence of natural numbers
    - Only contextual?
- An alternate possibility: cardinality is distinguished from other dimensions in having a unique scale associated with it:
  \[(32) \quad \text{A scale } S \text{ is a set of points } D \text{ ordered by an ordering relationship } \succ \text{ relative to some dimension } \text{DIM}\]

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardinality:</td>
<td>1...2...3...4...5...</td>
</tr>
<tr>
<td>Weight:</td>
<td>1 pound...2 pounds...3 pounds...4 pounds...</td>
</tr>
<tr>
<td>Distance</td>
<td>1 foot...2 feet...3 feet...</td>
</tr>
</tbody>
</table>

- Put differently: points (major divisions) on scale of cardinality are non-arbitrary; dimension of cardinality has built-in granularity
- Evidence of granularity
  - *Scenario 1*: Fred has 3.3 pounds of rice; John has 3.8 pounds of rice
  - *Scenario 2*: Fred has 3.3 pounds of rice; John has 3.3 pounds of rice

\[(33) \quad \text{John has more rice than Fred True or false in both scenarios (depending on relevant level of granularity)}\]

\[\Rightarrow \text{Cardinality has natural units; volume does not}\]

- *Scenario 1*: Fred ate 3 ⅛ pies; John ate 3 ⅞ pies
  - *Scenario 2*: Fred ate 3 ¾ pies; John ate 4 ½ pies

\[(34) \quad \text{John ate more pies than Fred False in Scenario 1; potentially true in Scenario 2}\]
[(35) \quad \text{John ate more pie than Fred True or false in both scenarios (depending on relevant level of granularity)}\]

\[\Rightarrow \text{Age has conventionally defined units (cf. John is 15)}\]

- Consequence: cardinality is distinguished from other dimensions in having a non-arbitrary scale associated with it. The *many/much* distinction is sensitive to this aspect of scale structure.

4.2 Fake Mass Nouns

- Current account holds that *much/little* are predicated of intervals on a scale other than cardinality
- Prediction: Use of *much/little* entails that entities are not being counted
- Test case: ‘fake mass nouns’ (Chierchia 1998): *furniture, jewelry, mail, silverware*

\[(37) \quad \text{a. How much furniture does John have?} \quad \text{b. John doesn’t have as much furniture as Fred} \quad \text{c. John has too much furniture}\]

- On what dimension are entities such as furniture, jewelry, mail, etc. measured?
  - Barner & Snedeker (2005): fake mass nouns are cognitively count

\[(38) \quad \text{Who has more furniture?}\]
Cardinality and the many/much distinction
Stephanie Solt -- The CUNY Graduate Center

82nd LSA Annual Meeting
Stephanie Solt -- The CUNY Graduate Center
January 6, 2008

Possibility 1: Different scales (Geurts & Nouwen 2007)

- many more than operates on scales whose points differ only in cardinality
  \{ \ldots 1 \text{ beer} \ldots 2 \text{ beers} \ldots 3 \text{ beers} \ldots 4 \text{ beers} \ldots 5 \text{ beers} \ldots \} 

- much more than operates on non-cardinality scales
  \{ \ldots 1 \text{ beer} \ldots 1 \text{ martini} \ldots 3 \text{ beers} \ldots 3 \text{ beers} + 1 \text{ martini} \ldots 3 \text{ beers} + 3 \text{ martinis} \ldots \} 

Possibility 2: Two distinct structures

(45) a. [much more than [3 beers]]
   b. [[many more than [3]] [beers]]

⇒ Entails that cardinals (including complex cardinals) are constituents

5. OVERALL CONCLUSIONS

- Fundamental separation of cardinality from other dimensions of measurement (reflected in availability of degree expressions that encode cardinality)
- Further evidence of relevance of scale structure to distribution and interpretation of lexical items (cf. Kennedy & McNally 2005)

REFERENCES


