

Measure words and countability: same form, different meanings

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1 Syntactic categories and dimensions of measurement

With gradable adjectives, the lexical semantics of the adjective determines the dimension of measurement. (e.g. Cresswell 1976; von Stechow 1984; Heim 2001)

- (1) a. Gasol is tall, but I wonder how much so.
b. I know Gasol is taller than Messi, but I wonder how much more.
- (2) *tall* $\rightsquigarrow$ HEIGHT

With verbs, the dimension of measurement is not lexically determined.

Figure 1: If this is a stretch of some running (Mary)

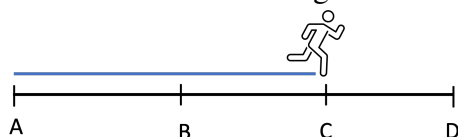


Figure 2: If this is a stretch of some running (John)



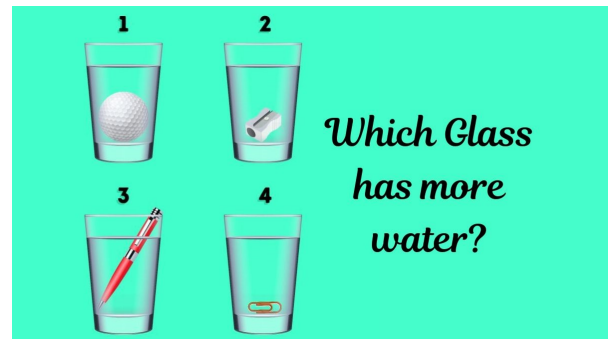
- (3) a. John ran more than Mary.
b. Mary didn't run as **much** as John.

We can understand (3) in terms of CARDINALITY, DISTANCE, DURATION but not SPEED.¹

¹Languages might differ in this respect. See Toquero-Pérez (2022).

This is also the case with nouns.

Who has more??



- (4) a. Messi has more ballon d'ors than Ronaldo does.
b. Nobody has as **many** ballon d'ors as Messi does.
- (5) a. Glass 4 has more water than any other glass does.
b. No glass has as **much** water as glass 4.

The dimension of measurement differs: CARDINALITY in (4), but VOLUME in (5).

A dimension of measurement (e.g. DURATION, DISTANCE, SPEED, VOLUME etc.) is a kind of property that provides a basis for ordering the things it applies to.

Part-whole relations also provide a basis for ordering.

→ Plural count nouns and mass nouns have part-whole structure.

Dimensions that reflect the part-whole structure of the domain of objects(/events) they apply to are **monotonic**:

- (6) Monotonic dimension

A dimension is monotonic if for two objects/events that stand in a part-whole relation, the measure of the part is smaller than that of the whole.

VOLUME, WEIGHT, CARDINALITY are monotonic when they apply to objects.

The interpretation of measure words with NPs and VPs has been argued to be constrained to monotonic measures.

(Schwarzschild 2006; Wellwood et al. 2012)

Call this the **Monotonicity Constraint (MC)**.

Going back to the NP cases, notice the following generalization:

- (7) **Cardinality Generalization** (e.g. Bale and Barner 2009; Wellwood et al. 2012)
Comparatives with some mass nouns (e.g. *furniture, jewelry, footwear, baggage* etc.) and all plural count nouns permit only cardinality-based interpretations.

Why can't the following happen?

- *many/more* combine with the remaining mass nouns and measure cardinality?
- *much/more* combine with plural count nouns and measure volume/weight?

The hypothesis in (8) has been proposed:

(e.g. Solt 2009)

(8) **Uniform Dimensionality (UD)**

Many is associated with cardinality, while *much* is associated with other dimensions.

(9) **Surface Form Underlying Form Dimension of Measurement**

<i>much</i>	$\Leftrightarrow \sqrt{\text{MUCH}}$	$\leftrightarrow$ WEIGHT, VOLUME...
<i>many</i>	$\Leftrightarrow \sqrt{\text{MANY}}$	$\leftrightarrow$ CARDINALITY

The Cardinality Generalization follows if we assume that the surface forms of comparatives are underlyingly different: (10). (e.g. Bresnan 1973; Hackl 2000)

(10)	Surface form		Underlying form		Dimension of measurement
	<i>more</i>	$\Leftrightarrow$	$\sqrt{\text{MUCH}+\text{COMPR}}$	$\leftrightarrow$	WEIGHT, VOLUME...
	<i>more</i>	$\Leftrightarrow$	$\sqrt{\text{MANY}+\text{COMPR}}$	$\leftrightarrow$	CARDINALITY

Predictions of UD

- If the dimension of measurement is cardinality, *many* is used. Otherwise, *much* is.
- There is no relationship between plural-marking and the surface form of the measure word (i.e. MW).
- If (8) is a property of MWs more generally, the same contrasts will be observed cross-linguistically.

Goals today: we will ...

- test the predictions of UD and show that they are not borne out, in English and across languages;
- demonstrate that the alternation in the surface forms of MWs is driven by the presence/absence of plural-marking.
- propose a more general version of (7).
- CARDINALITY is enforced when the part-whole structure of the constituent being measured is generated from the set of atoms.

2 Diagnosing the rest of the asymmetries in English

Plural mass nouns

(11) *[There are two small heaps of suds in the bathtub, whereas there is a single large heap of suds in the sink.]*

A: Where are there more suds?

B: There are more suds in the sink than in the bathtub. #CARDINALITY, VOLUME

C: There aren't as { %**much**/ %**many** } suds in the bathtub as in the sink. #CARDINALITY, VOLUME

Plural mass nouns are measured in terms of VOLUME.

There is variation in the surface form of the measure word. (also e.g. Smith 2021)

Object mass nouns

(12) [John has 4 small rings and a bracelet. Mary has 2 large necklaces and a tiara.]

A: who has more jewelry?

B: John has more jewelry than Mary does. CARDINALITY, #VOLUME

C: Mary doesn't have as { **much**/ *many } jewelry as John does. CARDINALITY, #VOLUME

Object mass nouns are measured in terms of CARDINALITY.

The surface form of the measure word is always *much*.

A preliminary generalization:

(13) *many* is restricted to contexts in which plural-marking is available.

No plural, no *many*

much but not *many* appears with imperfective telic predicates, which roughly correlate with count nouns and are measured in terms of cardinality. (Wellwood et al. 2012)

(14) Barney ran to the store as { *much*/ *many } as Ted did.

much and not *many* surfaces in cases of adjectival ellipsis. (e.g. Corver 1997)

(15) These boys are persistent; in fact, they are too { *much*/ *many } so.

much and not *many* can modify adjectives that lexically invoke cardinalities.

(16) The benefits are { *much*/ *many } more numerous.

3 Beyond English: Greek

3.1 Count, mass and number marking

Greek makes a distinction between count and mass nouns. Only count nouns can make singular/plural contrasts and be modified by cardinal numerals: (17) vs. (18).²

²Mass nouns are only acceptable in these contexts under a shifted interpretation, i.e. a container reading, which indicates a count syntax:

- (i) Tere tria ner-a
bring three water-NT.PL
'Bring three waters'

- (17) Count nouns
- | | |
|-----------------------|--------------------|
| a. periodik{ -o/ -a} | b. dio periodik-a |
| magazine -NT/ -NT.PL | two magazine-NT.PL |
| ‘magazine/ magazines’ | ‘two magazines’ |
- (18) Unmarked mass nouns
- | | |
|-------------------|---------------------------------------|
| a. ner{ -o/ #-a} | b. # dio ner-a |
| water -NT/ -NT.PL | two water-NT.PL |
| ‘water(#-s)’ | ‘two waters (#two water substances)’ |

Some nouns can be pluralized giving rise to an ‘abundance’ interpretation. They trigger plural agreement, but disallow numeral modification.³ (e.g. Tsoulas 2009; Alexiadou 2011)

- (19) a. (**Ta**) ner-a trexun apo to tavani
the.NT.PL water-NT.PL run.3PL from the ceiling
‘A lot of water drips from the ceiling’
- b. * Dio ner-a trexun apo to tavani
two water-NT.PL run.3PL from the ceiling
‘Two waters drip from the ceiling’

Greek also has object mass nouns. Like in English, they allow size adjective modification but resist plural-marking and numeral modification. (Alexiadou 2015)

- (20) a. I epiplosi sto domatio ine strogili
the.F furniture.F in.the room is round.F
‘the furniture in the room is round’
- b. * Oi epiplos-eis sto domatio einai strogila
the.F.PL furniture-F.PL in.the room are round.F.PL
‘the furnitures in the room are round’
- c. * Dio epiplosi
two furniture.F
‘Two furnitures’

3.2 Adding measure words

Measure words in Greek agree in gender, number and case with the noun they modify.

When the noun is a plural, either count or mass, the measure word agrees with it in plural number: (21a) and (21b).

- (21) Den exo ksana-di
NEG have.1SG again-seen
‘I have never seen ...’

³Kouneli (2019) describes the interpretation as ‘substance scattered/spread over a surface in a disorderly way’. As Alexiadou (2011) notes, this ‘abundance’ interpretation is more salient with verbal predicates like *spray*, *fall*, *drip*, *run* or *gather*, as illustrated in (19).

- a. perissoter-**a** periodik-**a** sto patoma
more-NT.**PL**.ACC magazine-NT.**PL**.ACC in.the floor
‘... more magazines on the floor’ CARDINALITY, #ABUNDANCE, #VOLUME
- b. perissoter{ -**a**/ *-o } ner-**a** sto patoma
more -NT.**PL**.ACC/ -NT.ACC water-NT.**PL**.ACC in.the floor
‘... more water on the floor’ #CARDINALITY, ABUNDANCE

When the noun is mass and unmarked for number, so is the measure word: (22).

- (22) a. Ipia perissoter-o ner-o
drank.1SG more-NT.ACC water-NT.ACC
‘I drank more water’ #CARDINALITY, VOLUME
- b. Agorasa perissoter{ -**i**/ *-es } epiplos-i
bought.1SG more -F.ACC -F.PL.ACC furniture-F.ACC
‘I bought more furniture’ CARDINALITY, #VOLUME

Object mass nouns and plural count nouns are measured in terms of CARDINALITY.

The marked surface form of the measure word depends on the availability of plural.

4 Summary

4.1 what we have learned

Many is not exclusively used in environments where the interpretation is cardinality.

Many seems to be limited to environments in which plural is available.

Plural-marking need not entail countability or atomic reference.

The mapping between surface forms of MWs and their interpretation is not one-to-one.

(23) *The MW-markedness Generalization*

The (plural-)marked forms of measure words (e.g. *many*, *few*, *perissotera*, etc.) are restricted to contexts in which the expression (e.g. the noun) is marked plural.

Table 1: Plural, MW form and interpretation (small cross-linguistic survey)

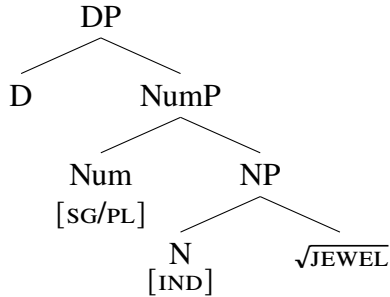
Type of N	Langs.	Agr.		MW form		Dim.	
		SG	PL	Unmarked	Marked	CARD.	OTHER
Umarked Mass	<i>English</i>	✓	*	✓	*	*	✓
	<i>Greek</i>	✓	*	✓	*	*	✓
	<i>Spanish</i>	✓	*	✓	*	*	✓
	<i>Telugu</i>	✓	*	✓	*	*	✓
Object Mass	<i>English</i>	✓	*	✓	*	✓	*
	<i>Greek</i>	✓	*	✓	*	✓	*
	<i>Spanish</i>	✓	*	✓	*	✓	*
PL Mass	<i>English</i>	*	✓	∅	∅	*	✓
	<i>Greek</i>	*	✓	*	✓	*	✓
	<i>Spanish</i>	*	✓	*	✓	*	✓
	<i>Telugu</i>	*	✓	*	✓	*	✓
PL Count	<i>English</i>	*	✓	*	✓	✓	*
	<i>Greek</i>	*	✓	*	✓	✓	*
	<i>Spanish</i>	*	✓	*	✓	✓	*
	<i>Telugu</i>	*	✓	*	✓	✓	*

4.2 What we already knew about object mass and plural count nouns

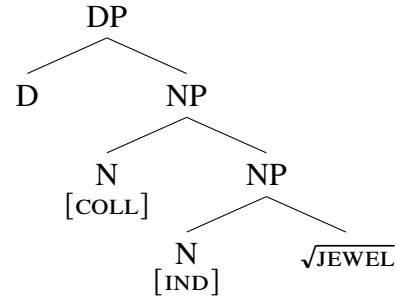
We proposed that both object mass and count nouns are marked for [INDIVIDUATED], but differ in terms of

- [SG/PL]-marking on Num → count nouns;
- [COLL]-marking on a layered N → object mass nouns.

(24) (a) *jewel, jewels*



(25) *jewelry*



4.3 The morpho-syntax of MWs

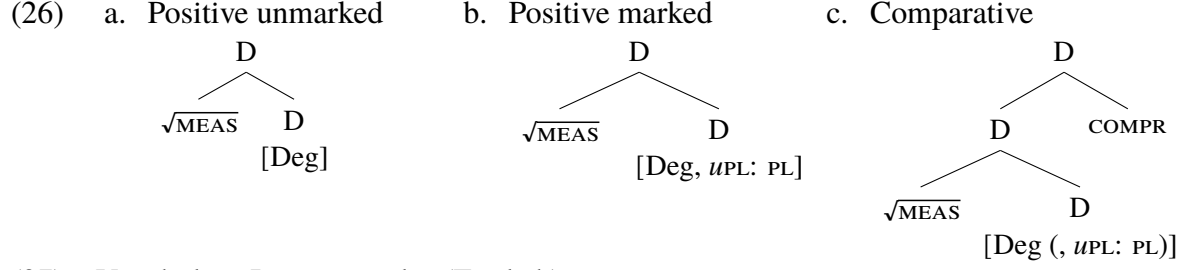
MWs are structurally complex:

(Bresnan 1973; Bobaljik 2012; Dunbar and Wellwood 2016)

- in the positive, they consist of a root and a functional head.⁴

⁴We are going to call it D, and treat MWs as determiner-like. Nothing crucial hinges on this. Their categorial status could be a relabelled DEG(ree) (Abney 1987), Q(uantifier) (Bresnan 1973) or A(adjective).

- comparative (and subsequently superlative) morphemes are added to the positive.



(27) Vocabulary Insertion rules (English)

- a. $\sqrt{\text{MEAS}} \Leftrightarrow \text{many} / _D[\text{Deg}, u\text{PL}: \text{PL}]$
 b. $\sqrt{\text{MEAS}} \Leftrightarrow \text{much}$

In English, impoverishment applies before VI deleting the plural feature on D: (28).

(28) $D[\text{Deg}, u\text{PL}: \text{PL}] \rightarrow D[\text{Deg}] / _ N_{[\text{PL}]}$

Those speakers who have this rule as part of their grammar will apply (28) after the plural feature has been copied, which will bleed the VI rule in (27a): Table 2.

Table 2: Variation in $\sqrt{\text{MUCH}}$ -exponence

Grammar	Agree(D, PL)	Impoverishment	VI rule
G1	✓	*	(27a) = <i>many</i>
G2	✓	✓	(27b) = <i>much</i>

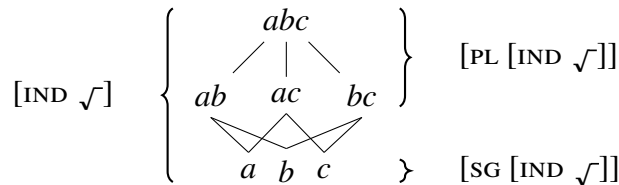
5 The semantics of NPs (again)

5.1 The meaning of terminal nodes

(29) Extension of root+N node

- a. $\llbracket \sqrt{\text{ROOT}} N_{[\text{IND}]} \rrbracket = \{x: x \text{ is an atomic root or sum of atomic roots} \} = \{a, b, c \dots abc\}$
 b. $\llbracket \sqrt{\text{ROOT}} N \rrbracket = \{x: x \text{ is a portion of root or sum of portions of root} \} =$
 e.g. $\{a_s, b_s, c_s \dots abc_s\}$

The extension of $\llbracket \sqrt{\text{ROOT}} N_{[\text{IND}]} \rrbracket$, where a, b, c are atoms, is an individuated semi-lattice.



- (30) a. $\llbracket [\text{SG}] \rrbracket = \lambda P. \lambda x. P(x) \wedge \text{atom}(x)$
 e.g. $\{a, b, c, ab, ac, bc, abc\} \rightarrow \{a, b, c\}$
 b. $\llbracket [\text{PL}] \rrbracket = \lambda P. \lambda X. \forall x [X(x) \rightarrow (P(x) \wedge \neg \text{atom}(x))]$

- ‘[PL] maps P to a property of pluralities, of which every sum of atoms satisfies P ’
 e.g. $\{a, b, c, ab, ac, bc, abc\} \rightarrow \{ab, ac, bc, abc\}$
 c. $\llbracket [\text{COLL}] \rrbracket = \lambda P. \lambda X. \forall x [X(x) \rightarrow \exists y [P(y) \wedge \text{atom}(y) \wedge y \neq x \wedge R(x, y)]]$
 ‘For every x among the X s, there is an atom y in P which is different from x and stands in the relation R with x ’

5.2 The extension of NPs

- (31) $\llbracket \text{jewels} \rrbracket = \lambda X. \forall x [X(x) \rightarrow \text{jewel}(x) \wedge \neg \text{atom}(x)]$
 ‘a plurality of (just sums of) jewels’
 (32) $\llbracket \text{jewelry} \rrbracket = \lambda X. \forall x [X(x) \rightarrow \exists y [\text{jewel}(y) \wedge \text{atom}(y) \wedge y \neq x \wedge R(x, y)]]$
 ‘a plurality of an atomic jewel-related item and their sums’
 (33) $\llbracket \text{water} \rrbracket = \{x: x \text{ is a portion of water or sum of portions of water}\}$
 ‘a property of a portion or sums of portions of water’

6 MWs and The Cardinality Generalization redux

Measure roots (i.e. $\sqrt{\text{MEAS}}$) introduce a variable ranging over measure functions μ , which associates entities (of any type) with degrees.

μ does not have a fixed value; it will be provided by the assignment function A : (34a).

- (34) a. $\llbracket \sqrt{\text{MEAS}} \rrbracket^A = A(\mu)$ (Wellwood 2015, 2018, 2019)
 b. $\llbracket D_{[\text{Deg}]} \rrbracket = \lambda \mu_{\langle \alpha, d \rangle}. \lambda d. \lambda \alpha. \mu(\alpha) \geq d$ (adapted from Hackl 2000)
 c. $\llbracket \sqrt{\text{MEAS}} D_{[\text{Deg}]} \rrbracket = \lambda d. \lambda \alpha. A(\mu)(\alpha) \geq d$

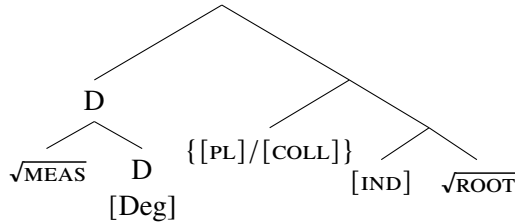
The value of μ is resolved by the syntactic position of $[\sqrt{\text{MEAS}} D]$ in tandem with the semantic properties of the NP.

We can reformulate the Cardinality Generalization in (7) as (35).

(35) The Cardinality Generalization Redux

When a measure word, i.e. $[\sqrt{\text{MEAS}} D_{[\text{Deg}]}]$, has an individuated plurality in its scope, the associated dimension of measurement is cardinality.

- (36) Structural description for $A(\mu)$ as CARDINALITY



- (37) A CARDINALITY measure function is defined for properties of individuated semi-lattices: when defined, $\text{CARDINALITY}(\alpha) = 1$ iff

- a. α is an atom in P ; or
- b. for every member/part of α there is an atom in P ;
- c. and $|\alpha| \geq d$.

Only the NPs in (31) and (32) are generated from the set of atoms.

- (38) $\llbracket \text{many jewels} \rrbracket = \llbracket (34c) \rrbracket \llbracket (31) \rrbracket =$
 $= \lambda X. \exists d [\forall x [X(x) \rightarrow (\text{jewel}(x) \wedge \neg \text{atom}(x))] \wedge A(\mu)(X) \geq d]$
 $A(\mu)(X) = A(\mu)(\text{a plurality of (just sums of) jewels})$
 $A(\mu) \rightarrow \text{CARDINALITY}$
- (39) $\llbracket \text{much jewelry} \rrbracket = \llbracket (34c) \rrbracket \llbracket (32) \rrbracket$
 $= \lambda X. \exists d [\forall x [X(x) \rightarrow \exists y [\text{jewel}(y) \wedge \text{atom}(y) \wedge y \neq x \wedge R(x, y)]] \wedge A(\mu)(X) \geq d]$
 $A(\mu)(X) = A(\mu)(\text{a plurality of an atomic jewel-related item and their sums})$
 $A(\mu) \rightarrow \text{CARDINALITY}$

7 Implications

A good candidate for a language universal: object mass and plural count nouns are interpreted in terms of cardinality when modified by MWs. (e.g. Lima 2014; Deal 2017)

By correlating surface forms and interpretation, UD

- misses said generalization, and
- fails to capture the relationship between (plural-)markedness and the surface forms of MWs, e.g. (23).

A more abstract alternative: The Cardinality Generalization Reux.

The dimension of cardinality is predictable by the syntactic context in concert with the semantic properties of the measured constituent.

- (40) a. $[_D \sqrt{\text{MEAS}} D_{[\text{Deg}]}] > N \rightarrow \# \text{CARDINALITY}$
 b. $[_D \sqrt{\text{MEAS}} D_{[\text{Deg}]}] > N_{[\text{PL}]} \rightarrow \# \text{CARDINALITY}$
 c. $[_D \sqrt{\text{MEAS}} D_{[\text{Deg}]}] > \text{Num}_{[\text{PL}]} > N_{[\text{IND}]} \rightarrow \text{CARDINALITY}$
 d. $[_D \sqrt{\text{MEAS}} D_{[\text{Deg}]}] > N_{[\text{COLL}]} > N_{[\text{IND}]} \rightarrow \text{CARDINALITY}$

Surface forms of MWs may be sensitive to syntactic terminals, but not semantic interpretation.

This is in turn compatible with a modular view of the grammar: the morpho-phonological system and the semantic system are non-overlapping.

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