

Debunking Multiform Dimensionality: *many*, Romance *tant-PL*, & morpho-syntactic opacity*

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Abstract The interpretation of *much/many* has been argued to be regulated by *Uniform Dimensionality* (Hackl 2000; Solt 2009): *much* is underspecified but *many* encodes cardinality. However, given some data where *many* denotes ‘volume’, Snyder (2021) proposes the need for *Multiform Dimensionality*: both *much* and *many* are underspecified. After reviewing the English data, and in light of novel cross-linguistic data, we argue that neither generalization is fully accurate. Instead, following Wellwood (2015, 2018), we argue for an alternative, *Abstract Uniform Dimensionality*, which we propose to be universal: MUCH always measures cardinality when it scopes over semantically interpretable plural. We derive the universal by proposing that MUCH can occupy different positions in the NP, only one of which has semantic plural in its scope. Variation is thus not semantic, but morpho-syntactic.

Keywords: Semantic universals; *much/many*; plurality; morpho-syntax-semantic interface; English; Italian; Spanish

1 Introduction

Morphemes like *much, many, more* or *most* have been referred to in the literature as Quantity Adjectives (a.k.a. QAs) since Bresnan (1973). These QAs occur cross-categorically and their syntactic distribution is very diverse (Bresnan 1973; Corver 1997; Hackl 2000; Solt 2009, 2015). For example, they can be found as modifiers of Adjective Phrases (1a), but also of Verb Phrases (1b) and Noun Phrases (1c). In a degree semantics framework (Seuren 1973, 1984; Cresswell 1976; von Stechow 1984: a.o.), it is standardly assumed that these QAs introduce a measure function.

- (1) a. {more/ the most} intelligent. (AP)
b. John doesn't run {(as) much/ more/ the most} (VP)

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- c. {(as) much/ more/ the most} coffee & {(as) many/ more/ the most} coffees (NP)

Of special interest in this paper is the distribution and interpretation of *much/many* in NPs, e.g. (1c). Inside nominals, *much* is compatible with mass NPs (2), whereas *many* is compatible with plural count NPs (3). This syntactic distribution has been observed to correlate with a different semantic interpretation: *much* is underspecified for the dimension of measurement that it introduces (2).¹ On the contrary, *many* only encodes CARD(inality) (3):

- | | | | |
|-----|---------------------------|-----|---------------------------|
| (2) | <i>much</i> + Mass NP | (3) | <i>many</i> + PL count NP |
| a. | much coffee [VOL, WEIGHT] | a. | many coffees [CARD, #VOL] |
| b. | much love [INTENSITY] | b. | many oranges [CARD, #VOL] |

This asymmetry in the syntactic distribution and semantic interpretation of *much/many* has led to the generalization in (4) which we call Uniform Dimensionality, i.e. UD, a name we borrow from Snyder (2021).

- (4) **Uniform Dimensionality (UD)** (a.o., Hackl 2000; Solt 2009, 2015)
Many unlike *much* is associated with the dimension of cardinality across all contexts.

UD captures the facts in (2) and (3) in a straightforward manner. What is more, as stated, UD correctly allows for *much* to be associated with both dense dimensions of measurement such as VOL or WEIGHT and non-dense ones, e.g. CARD, as in the case of *much furniture* (Bale & Barner 2009).

This formulation of UD is not free of challenges, though. It is a generalization based on surface forms of QAs. That is, the proponents of UD do not consider *much* and *many* to be morpho-syntactically related via suppletion (cf. Bresnan 1973; Bobaljik 2012). Instead, they treat them as independent morphemes whose surface form matches their underlying representation. Such a view presupposes that there are two separate morphemes, each with its own lexical entry and c-selectional restrictions

¹ The dimensions encoded by QAs are constrained by monotonicity (Schwarzschild 2006; Nakanishi 2007; Wellwood, Hacquard & Pancheva 2012; Wellwood 2015). That is, the dimension of measurement must preserve the part-whole structure of their domain, which can be defined as in (i) from Wellwood (2019: 49).

(i) Monotonicity Constraint (MC)

A measure function $\mu : D_\eta \rightarrow D_\delta$ is monotonic if,
 for all $\alpha, \beta \in D_\eta$ if $\alpha \prec_\eta^{\text{Part}} \beta$, then $\mu(\alpha) <_\delta \mu(\beta)$.

The MC rules out an interpretation of *much coffee* in (2a) in terms of TEMPERATURE: proper subparts of coffee do not necessarily have lesser degrees of temperature.

in the syntax:² MUCH selects mass NPs and is underspecified for the dimension of measurement; MANY selects plural count NPs and is set to encode cardinality. Wellwood (2018) provides compelling arguments against such an approach, however.

While UD seems like a robust semantic universal, it has been recently challenged by Snyder (2021), who establishes a connection between container nouns, e.g. *glass*, *bottle*, and substance-denoting plural count nouns like *oranges*:³ Both types of nouns are ambiguous between an individuating interpretation, in terms of CARD, and a measuring interpretation, in terms of dense measurement.⁴ For container nouns, the ambiguity is illustrated in (5), which can mean either (5a) or (5b) depending respectively on whether it is uttered in an *individuating context*—where individual glasses of water are relevant— or a *measuring context*—where amounts of water measured in glasses are relevant.

- (5) There are two glasses of water in the soup. (*container NPs*)
- a. A plurality of glasses consisting of 2 individual glasses, each of which is filled with water and is in the soup. [CARD]
 - b. A quantity of water which measures 2 glasses worth and is in the soup. [VOL]

Snyder claims that a similar ambiguity affects substance-denoting plural count nouns: a sentence like (6) means (6a) in an individuating context—where individual oranges are relevant—but means (6b) in a measuring context—where amounts of orange-pulp measured by taking standard-sized oranges as units are relevant.

- (6) There are four oranges in the punch. (*substance-denoting PL-count NPs*)
- a. A plurality of oranges consisting of 4 individual oranges, each of which is in the punch. [CARD]
 - b. A quantity of orange which measures 4 oranges worth and is in the punch. [VOL]

Snyder goes a step further and claims that when plural count NPs are modified by *many*, and context is controlled for, the ambiguity in (6) remains. For example, in (7) the reported judgement from Snyder is that while the cardinality interpretation is not available—5 oranges \neq 10—the sentence is true under a volume reading.

2 Throughout the paper, we are using SMALL CAPS to represent abstract or underlying forms of morphemes, and *italics* to refer to the surface forms or vocabulary items after spell-out.

3 We would like to note that the observation regarding substance-denoting plural count NPs is not really new from Snyder (2021). It had already been documented by O'Connor & Biswas (2015).

4 We will not talk about container NPs here. Though our proposal will have implications for the syntax and semantics of these constructions, we leave this issue for future research. For container NP ambiguities, see Landman (2004); Rothstein (2009, 2017); Partee & Borschev (2012).

- (7) *[Making punch. Mary squeezes 5 normal sized oranges pouring the pulp into her punch. John does the same with 10 small oranges, exactly half the size of Mary's.]*

Mary put as many oranges in the punch as John. [#CARD, VOL]

Given this reported judgment, UD as formulated in (4) is false, or at best inaccurate. Thus, in order to capture the alleged flexibility of *many*, Snyder proposes an alternative to UD. We call this generalization, as formulated in (8), Multiform Dimensionality (MD).

- (8) **Multiform Dimensionality (MD)**

Many like *much* can associate with different dimensions of measurement.

It is important to observe that just like the original formulation of UD, MD is also stated on surface forms. In addition, the judgments reported by Snyder (2021) are controversial and it is likely that not every speaker of English accepts them.⁵ However, we are going to take them at face value and report that there is variation in the VOL interpretation by using the ‘%’ symbol.

We now find ourselves in a situation in which we have two competing generalizations. Based on the reported variation, the question is where to locate such variation in the grammar. There are two possibilities:

- I. variation is located in the semantics and regulated by MD; or
- II. variation is elsewhere.

We probe these two possibilities by looking at English and Romance (Italian and Spanish) and show that variation is not located in the semantics, supporting the latter view. In fact, we argue that such variation is located in the morpho-syntax and it amounts to distinct spell-out rules for an underlying morpheme MUCH (Wellwood 2015, 2018, 2019): the fact that (the surface form) *many* can be interpreted in terms of VOL is the result of morpho-syntactic opacity. Our goal is to argue that a revised and more abstract version of UD must be maintained as a semantic universal.

Our account will follow the spirit of Wellwood’s (2015; 2018; 2019) decompositional approach to degree expressions: *much/many* are surface realizations of an underlying morpheme MUCH which introduces a measure function μ in the semantics. We propose that MUCH can occupy different syntactic positions in the NP. As

⁵ Unless otherwise noted, the VOL judgments supporting MD are Snyder’s (2021). In fact, we have interviewed 15 native speakers of English (13 from different parts of the USA; 1 from Nova Scotia, Canada; 1 from London, UK) and none of them share Snyder’s (2021) judgements. These results cast doubt on the reliability of the data.

a result, whether plural has the expected semantic effect on the resolution of that measure function depends on whether plural is in the scope of MUCH.

We begin the paper by presenting the diagnostics that motivated the original UD (§ 2.1). We then review Snyder's (2021) motivation for MD (§ 2.2) to debunk it afterwards (§ 3). We subsequently propose our revised version of UD and develop our proposal (§ 4). Next, we probe the scope of our theory by looking at two case studies: Norwegian Nominal comparatives (§ 5.1), and mass plurals (§ 5.2).

2 UD vs. MD: the Debate

2.1 Motivating UD

When assessing the syntactic distribution of *much* and *many* and their semantic interpretation, Solt (2009: 62) observes that *many* univocally measures cardinalities. Her arguments are based on degree questions and equatives involving *many*.

Degree questions such as (9) disallow non-cardinality answers: the addressee can reply to the question with a number, e.g. 5, indicating numerosity, but not with an amount such as *5lbs* which is suggestive of 'volume' or 'weight'.

(9) A: How many potatoes did you buy? B: {5/ #5lbs}

Likewise, according to Solt (2009: 62), "*as many NP as*" equatives enforce a cardinality interpretation. If *many* could be interpreted along a WEIGHT scale, the sentence in (10) should be interpretable: both Fred and John have a total of *4lbs*; however, the sentence is uninterpretable in the context provided suggesting that the only possible dimension of measurement is CARD: the number of potatoes that Fred has, i.e. 7, is not equal to the number that John has, i.e. 10.

(10) [*Fred has 7 potatoes weighing 4 pounds in total. John has 10 (smaller) potatoes weighing 4 pounds in total*]
 # John has as many potatoes as Fred

To these two diagnostics, Snyder (2021) adds a third one: anaphoric *that many* can only make reference to "that number" and thus enforce CARD. This is illustrated in (11): *that many/that number* cannot refer back to *10kgs*.

(11) [*John ate 10kgs of potatoes a year*]
 # Ash ate {that many/ that number of} potatoes a year too.

Based on these three diagnostics, UD as formulated in (4) has been endorsed, and with it the claim that *many* lexically encodes CARD.

2.2 Motivating MD

While Snyder (2021) agrees that *many* can measure cardinalities, he also claims that this is not the only possible dimension of measurement. In fact, Snyder challenges (some of) the diagnostics in § 2.1 and reports that both “*how many*” questions and “*as many NP as*” equatives can also be interpreted along a dense scale such as VOL if context is controlled for. Thus, UD should be abandoned in lieu of MD

In the case of questions, the context in (12) makes either interpretation available as a potential answer.

- (12) *[Making punch. John knows that Mary needs 5lbs of orange pulp, but she is unsure if John has purchased enough oranges to do the punch.]*
 Mary: How many oranges did you buy? John: {5 oranges / %5lbs.}

The same occurs with equatives provided a measure context: in (7), repeated below, the cardinality interpretation is not available given that the number of oranges that the participants have is not the same. The sentence has been reported to be felicitous, though, under the reading “John and Mary put the same volume of orange matter in the punch”.

- (7) *[Making punch. Mary squeezes 5 normal sized oranges pouring the pulp into her punch. John does the same with 10 small oranges, exactly half the size of Mary’s.]*
 Mary put as many oranges in the punch as John. [#CARD, %VOL]

The *many-as-VOL* interpretation does not receive as much support from anaphoric *that many*, however, even if a measuring context is provided.⁶ Consider (13), slightly adapted from Snyder (2021: 541, ex.72).

- (13) *[John and Mary both begin with 5 oranges, though her oranges are exactly half the size of his. They pulverize their oranges, pouring the resulting orange pulp into their punches.]*
 John: I put 5 oranges in my punch.

⁶ Snyder (2021: 534) reports that measuring contexts induce VOL-based interpretations of *many* in anaphoric *that many* constructions referring back to container nouns (i):

- (i) *[John fills a normal sized glass five times with water, pouring the contents each time directly into his soup. Mary does the same, though her glass is only half the size of John’s.]*
 John: I put 5 glasses of water in my soup.
 Mary: I put that {many / number of / %amount of} glasses of water too. [CARD, %VOL]

Mary: I put that {many / number of / #amount of} oranges too.
[CARD, #VOL]

It seems intuitive to interpret Mary's answer as true in the measure context provided. But such a reading cannot involve an amount-based interpretation of *many*: it is not the case that John and Mary put the same volume of orange-matter in their respective punches. Snyder (2021: 541) acknowledges this issue but claims it is not a problem if we "abandon the assumption that measure contexts always induce measure interpretations". However, this way-out undermines the motivation behind MD since the strength of the argument rests upon the alleged ambiguity of *many*.

In the next section, we outline and discuss some of the challenges that MD has to face. These challenges raise skepticism about MD as a viable alternative to UD.

3 Debunking MD

There are some serious concerns that any theory endorsing MD must address. These include (i) speaker variation, (ii) unreliable and confounded diagnostics, and (iii) cross-linguistic support. We focus on (i) and (ii) in § 3.1, and devote § 3.2 to (iii).

3.1 Speaker Variation and the Nature of the Diagnostics

The first concern is the large amount of inter-speaker variation. As formulated in (8), MD is a general statement about the interpretation of *much* and *many* and makes no reference to the potential variation in the felicity judgments. In other words, as far as we understand, the claim is that both a CARD and VOL interpretation should be accessible to every speaker of English. However, as we already mentioned in the introduction, that is far from being the case: speakers always accept the former reading, but rarely do they accept the latter one (see fn.5). Thus, we must acknowledge this variation exists and ultimately propose a theory that explains why grammars differ in this respect. Snyder (2021) does neither.

A second point of concern which we have already mentioned is the fact that not every diagnostic that supports UD also supports MD. That was the case of anaphoric *that many*, which can only make reference to 'numerosity' and not to 'amounts'. If *many* is ambiguous between a CARD and a VOL reading, this issue is unexpected.

Related to this is the fact that "*how many*" questions are not a reliable diagnostic. In fact, the VOL answer can be due to independent issues of the semantics-pragmatics of questions (Groenendijk & Stokhof 1984; Simons 2000; Abrusán 2011): speakers do not always (need to) respond to a question with a direct answer. In other words, an answer to (12) is felicitous only if John's buying a particular volume of oranges contextually entails him buying a particular number of oranges.

What is more, this issue is not only applicable to “*how many*” questions. In adverbial or adjectival degree questions in which the dimension for measurement is determined by the adverb/adjective, answers that do not strictly address what is being probed are also felicitous. An example of that is given in (14).

- (14) [Ash & Pablo are in LA] (Barry Schein, p.c.)
 Ash: How far is San Francisco? Pablo: {617 km/ 6h by car}

The adverb *far* makes reference to the dimension of DISTANCE. Thus, the question is probing for the distance between San Francisco and LA. While an answer in terms of distance is felicitous (e.g. *617km*), so is an answer that denotes duration (e.g. *6h*). And yet, we do not want to claim that adverbs like *far* are ambiguous between a DISTANCE and a DURATION interpretation. Otherwise, any *how far* question should be ambiguous. This prediction, though, is not borne out: (15).

- (15) Ash: How far does Kelly run? (Alexis Wellwood p.c.)
 Pablo: {15 km/ #15 minutes}

These data support the claim that “*how many*” questions are unreliable as a diagnostic; they can introduce pragmatic confounds independent of the grammar of measurement and the resolution of the measure function provided by MUCH.⁷

3.2 Lack of Cross-linguistic Support: Italian and Spanish

In addition to the issues in § 3.1, there are concerns of cross-linguistic variation. If MD is a genuine semantic universal, the same kind of variation in the interpretation of *many* posited by MD should surface in other languages. In this section we show that this prediction is not borne out in Spanish and Italian.⁸ In these languages, the equivalent of *many* always requires a CARD interpretation.

⁷ A more reliable diagnostic than questions is differentials, brought to our attention by Ur Shlonsky (p.c.). When *many* is the differential argument of the comparative as in (i), it can never mean ‘the volume of oranges \geq a contextually salient one by some amount’. For that interpretation to be possible, *much* is needed.

- (i) a. John used many more oranges in the punch than Mary did. [CARD, #VOL]
 b. John used much more orange in the punch than Mary did. [#CARD, VOL]

⁸ Ur Shlonsky and Hedde Zeijlstra (p.c.) point out that MD does not receive cross-linguistic support from Hebrew and Dutch either, respectively. But a detailed survey of these data is beyond this paper.

***much/many* and *tan(t)-*.** The Italian and Spanish equivalent of *much/many* is *tan(t)-*.⁹ *tan(t)-* agrees in φ -features with the NP it modifies: [GEN, NUM]. Thus, the *much-many* distinction is marked by plural agreement (cp. suppletion in English). For the VOL interpretation, *tan(t)-* must be univocally singular (16); if *tan(t)-* is plural, the only interpretation is that of numerosity, i.e. CARD, (17).

(16)	Singular <i>tant-</i> : [#CARD, VOL]	(17)	Plural <i>tant-</i> : [CARD, #VOL]
	tant-a naranj-a (SP)		tant-as naranj-as (SP)
	tant-a aranc-ia (IT)		tant-e aranc-e (IT)
	much-F orange-F		much-F.PL orange-F.PL
	‘(as) much orange’		‘(as) many oranges’

The Diagnostics in Romance. When *tant-PL* is used applying Snyder’s (2021) diagnostics for MD, the same result as in (17) obtains: *tant-PL* univocally denotes CARD.¹⁰ That is shown for plural equatives in (18) using the same context from (7).

(18)	a.	María ha puesto tant-as naranj-as como Juan (SP)
		Mary has put much-F.PL orange-F.PL as John
	b.	Maria ha messo tant-e aranc-e quante Gianni (IT)
		Mary has put much-F.PL orange-F.PL how.much John
		‘Mary has put as many oranges as John has’ [#CARD, #VOL]

Given the context from (7), the number of oranges that John has is bigger than the number of oranges that Mary has, though their amount of orange stuff is presumably the same: the volume of orange stuff in 5 normal oranges = the volume of orange stuff in 10 oranges exactly half their size. In both Spanish and Italian, CARD is infelicitous in the context ($5 \neq 10$), and the VOL interpretation is unacceptable.

Anaphoric *that many* cannot denote VOL either. Like in English, *tant-PL* is equivalent to *that number*, but not to *that amount*, (19):

(19)	[Ash and Kelly are making punch. They both begin with 5 oranges, though Ash’s oranges are exactly half the size of Kelly’. They pulverize their oranges, pouring the resulting orange pulp into their respective punches. Ash says that he has put 5 oranges in his punch, to which Kelly replies...]
	a. He puesto { (es-as) tant-as/ ese número/ #esa cantidad}. (SP)
	have put that-F.PL much-F.PL that number that amount

9 Just like English MUCH syntactically underlies the realization of certain degree constructions such as equatives, comparatives, superlatives, degree questions and AP ellipsis, so does TAN(T)- in Spanish and Italian modulo comparatives and superlatives: *más* (SP), *più* (IT) ‘more’.

10 We have consulted 8 speakers of Peninsular Spanish and 8 speakers of Italian.

- b. Ho messo { così tant-e aranc-e/ quel numero di
 have put that/so much-F.PL orange-F.PL that number of
 aranc-e/ #quella quantità di aranc-e} (IT)
 orange-F.PL that amount of orange-F.PL
 ‘I have put {that many/ that number/ *that amount} [CARD, #VOL]

Lastly, *how many* questions are the exception: they accept answers in terms of both VOL and CARD, (20).

- (20) [María wants oranges and the shopkeeper (SK) asks. . .]
 SK: cuánt-as naranj-as quieres? (SP)
 quant-e aranc-e vuole? (IT)
 how.much-F.PL orange-F.PL want
 ‘How many oranges do you want?’
 María: { 5 naranj-as/ 5lbs} (SP)
 { 5 aranc-e/ 5lbs} (IT)
 5 orange-F.PL/ 5lbs
 ‘{5 oranges/ 5lbs}’

However, just like in English, this is expected if questions introduce pragmatic confounds independent of the grammar of measurement and the resolution of the measure function.

We conclude that the cross-linguistic data, summarized in table 1, does not support MD. In fact, they reinforce the need for some version of UD. We take this as evidence that the locus of variation is not in the semantics.

	<i>How many</i>	<i>As many</i>	<i>That many</i>
EN	CARD/%VOL	CARD/%VOL	CARD
SP/IT	CARD/%VOL	CARD	CARD

Table 1 Distribution of CARD & VOL: English, Spanish & Italian

4 The Proposal

Neither UD nor MD deliver an accurate and satisfactory explanation of the variation in the interpretation of *many*. We take the shortcomings of UD and MD to arise from a common weakness: both generalizations locate the variation (or absence thereof) in the interpretation of *many* in the semantics. By assuming that *much/many* are

surface forms of MUCH (Wellwood 2015), we instead propose to reformulate the descriptive UD as the more abstract formal universal in (21), which we call *Abstract Uniform Dimensionality*:

(21) **Abstract Uniform Dimensionality (AUD)**

If MUCH has (semantic) PL in its scope, the associated dimension of measurement is cardinality.

Given AUD, the resolution of the dimension of measurement is structurally calculated and can be represented as in (22), where ‘>’ means ‘structurally higher than’: (i) what matters to determine the dimension of measurement is the syntactic position of MUCH with respect to interpretable plural information; and (ii) the interpretations where *many* appears to measure VOL arise due to morpho-syntactic opacity.¹¹

- (22) a. PL > MUCH > NP → VOL
 b. MUCH > PL > NP → CARD

4.1 Preliminaries

We begin by briefly reviewing the syntactic and semantic machinery used in our proposal. We adopt the decompositional approach to degree expressions based on Wellwood (2015, 2018, 2019): *much* and *many* are surface forms of an underlying morpheme MUCH which heads a DegP in a specifier position (Bresnan 1973; Bhatt & Pancheva 2004; Embick 2007). In the semantics, MUCH introduces a variable μ_{DIM} ranging over measure functions (23).

$$(23) \quad \llbracket \text{MUCH/TANT-} \rrbracket = \lambda d. \lambda \alpha. \mu_{\text{DIM}}(\alpha) \geq d \quad (\text{adapted from Hackl 2000})$$

A measure function is an object of type $\langle \alpha, d \rangle$, where α is an arbitrary type. Following Wellwood (2015, 2018) we take the value of μ_{DIM} to be underspecified for the dimension of measurement DIM (cardinality, volume, mass, etc.), and resolved by what is being measured. We take “what is being measured” to be what is in the scope of MUCH in the syntax. That is, the syntactic position of MUCH will determine the resolution of μ_{DIM} ’s value.

With respect to number marking, we follow Krifka (1989); Sauerland (2003); Scontras (2013, 2014) and assume the separation of morpho-syntactic number from semantically interpretable number. Morpho-syntactic number is the result of uninterpretable agreement between a probing Num head and a goal NP: Agree(Num, NP).

¹¹ Unless otherwise noted, for simplicity, we will be using the label NP to stand for *nP*; that is, a categorizing head $n + \sqrt{\text{root}}$. Explicit reference to *nPs* will be made in § 5.2 where decomposing the nominal further is necessary.

Semantic plurality, on the other hand, is a property of atoms and their sums resulting from the application of the PL operator in (25), similar to Link’s (1983) *-operator.

To construct singular count NPs from mass NPs, we make use of the individuating morpheme IND in (24), from Wellwood (2018).¹² IND is a covert atomizer: it takes an anti-atomic property P and returns a set of atoms each of which is wholly materially constituted by some portion of P -stuff. The whole material constitution relation is denoted as ‘ \triangleright ’.

$$(24) \quad \llbracket \text{IND} \rrbracket = \lambda P_{\langle et \rangle} : \text{Anti-atomic}(P) . \lambda y : \text{Atom}(y) . \exists x (P(x) \wedge y \triangleright x)$$

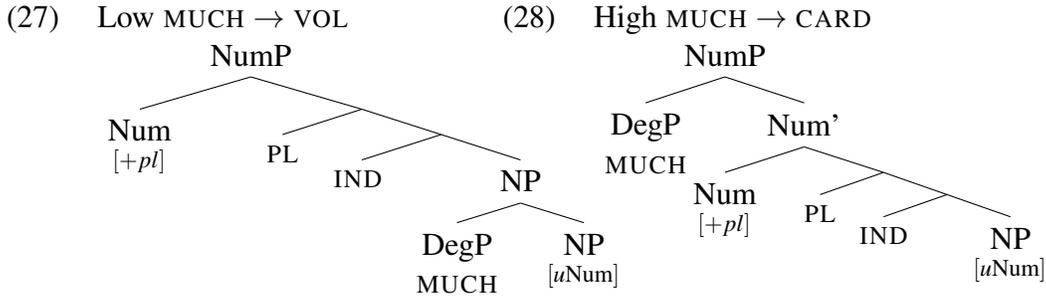
The output of IND applied to NP can then be semantically pluralized by the aforementioned PL operator in (25), also from Wellwood (2018): PL takes an atomic property P (i.e., a set of atoms) and returns pluralities of atoms of P . Here ‘ xx ’ is a plural variable and the notation ‘ $xx(x)$ ’ expresses that ‘ x is an atom of xx ’. A sample derivation of a plural individuated property from a mass property N is given in (26).

$$(25) \quad \llbracket \text{PL} \rrbracket = \lambda P_{\langle et \rangle} : \text{Atomic}(P) . \lambda xx . \forall x (xx(x) \rightarrow P(x))$$

- (26) a. $\llbracket \text{NP} \rrbracket = \lambda x . N(x)$ (The set of all portions of N)
 b. $\llbracket \text{IND NP} \rrbracket = \{a, b, c\}$ (atomized NP)
 c. $\llbracket \text{PL IND NP} \rrbracket = \{a, b, c, ab, ac, cb, abc\}$ (pluralized NP)

4.2 Explaining *Abstract Uniform Dimensionality*: the Position of MUCH

Given the above background assumptions, in order to explain *Abstract Uniform Dimensionality*, we propose that the DegP headed by MUCH can be merged in different syntactic positions in the extended projection of the Noun: a low position, Spec, NP (27); and a higher position, Spec, NumP (28).



In (27), MUCH only has the mass NP in its scope and semantic PL comes in later in the derivation. Thus MUCH is measuring portions of N-substance and μ will be

¹² This morpheme is sometimes referred to as “singulative” (Arabic, cf. Mathieu 2012).

resolved in terms of dense measurement, e.g. VOL. In (28), the NP is semantically plural before MUCH enters the derivation; and when it does, it measures pluralities which entails that μ is resolved as CARD.¹³ This is as expected given AUD in (21). On the surface, however, MUCH will be spelled-out as *many* in both positions given the presence of [ϕ : *pl*].

In the remainder of this section we provide the compositional details of the two structures (27) and (28) and explain the variation in the interpretation.

4.2.1 Low MUCH \rightarrow VOL

In the low position (27), the DegP occupies the specifier of the NP. From this position, MUCH scopes over “portions of N-stuff” (26a) and quantifies over amounts. Thus, the value of the measure function variable μ introduced by MUCH is resolved with a dense measure function such as VOL/WEIGHT (29b). To keep the derivations simple, we assume that the degree variable of MUCH is existentially closed.¹⁴

(29) *John put many oranges in the punch*

- a. $\llbracket \text{MUCH} \rrbracket = \lambda d. \lambda \alpha. \mu(\alpha) \geq d$
- b. $\llbracket \text{MUCH orange} \rrbracket = \lambda x. \exists d[\text{orange}(x) \wedge \mu_{\text{VOL}}(x) \geq d]$

After MUCH combines with the NP *orange* via Predicate Modification (Heim & Kratzer 1998), number information enters the derivation. First, IND takes the anti-atomic predicate of individuals in (29b) and makes it atomic: (30a). PL then takes this atomic predicate and adds its sums, making it semantically plural: (30b).

- (30) a. $\llbracket \text{IND MUCH orange} \rrbracket =$
 $= \lambda y. \text{Atom}(y). \exists x, d[(\text{orange}(x) \wedge \mu_{\text{VOL}}(x) \geq d) \wedge y \triangleright x]$
- b. $\llbracket \text{PL IND MUCH orange} \rrbracket = \llbracket (27) \rrbracket =$
 $= \lambda xx. \forall y: \text{Atom}(y)[xx(y) \rightarrow \exists x, d[(\text{orange}(x) \wedge \mu_{\text{VOL}}(x) \geq d) \wedge y \triangleright x]]$
‘Being a plurality every atom of which is constituted by orange-stuff whose volume is at least as large as some contextually determined standard’

Note that the resolution of μ as VOL is not affected by the semantic plural information. The value of μ is calculated based on the syntactic context upon first-merge; that is, relative to a mass domain. At PF, on the other hand, the [$+pl$] feature

13 This is at least the case for simplex measure functions. Something else might need to be said about composite ones, e.g. proportions (Partee 1989; Herburger 2000; Bale & Schwarz 2019). It is possible that if composite measure functions involve at least two μ s (i.e. $\mu(\alpha)/\mu(\beta)$), one could be resolved upon first merge and the other via a different operation, i.e. QR. We leave this for the future, though.

14 In equatives, the degree argument of MUCH is saturated by the trace of the degree quantifier *as*; and in questions, by the *wh*-degree operator.

on Num makes the whole NP plural. A Vocabulary Insertion rule (Halle & Marantz 1993) spells out MUCH as *many* under adjacency with a plural NP: (31).

$$(31) \quad \text{MUCH} \Leftrightarrow \text{many}/__ \text{ NP}_{[u\text{Num}: \text{pl}]}$$

4.2.2 High MUCH \rightarrow CARD

In the structure in (28), the DegP headed by MUCH occupies Spec,NumP. From this position, MUCH scopes over sets of pluralities. As opposed to (30), μ cannot be resolved with VOL; it must be resolved with CARD at LF: this is due to the fact that the predicate is made semantically plural before the DegP enters the semantic composition. The sample derivation is in (32).¹⁵

$$(32) \quad \text{John put many oranges in the punch}$$

- a. $\llbracket \text{IND orange} \rrbracket = \lambda y: \text{Atom}(y). \exists x(\text{orange}(x) \wedge y \triangleright x)$
- b. $\llbracket \text{PL IND orange} \rrbracket = \lambda xx. \forall y: \text{Atom}(y)[xx(y) \rightarrow \exists x[\text{orange}(x) \wedge y \triangleright x]]$
- c. $\llbracket \text{MUCH PL IND} \rrbracket = \llbracket (28)\text{orange} \rrbracket =$
 $= \lambda xx. \exists d[\mu_{\text{CARD}}(xx) \geq d \wedge \forall y: \text{Atom}(y)[xx(y) \rightarrow \exists x[\text{orange}(x) \wedge y \triangleright x]]]$
 ‘Being a plurality of oranges whose cardinality is at least as large as some contextually determined standard, and every atom of which is constituted by orange-stuff’

Again, at PF, a different Vocabulary Insertion rule determines the spell-out of MUCH as *many*. In this case, suppletion is driven by adjacency with a plural NumP (33):

$$(33) \quad \text{MUCH} \Leftrightarrow \text{many}/__ \text{ NumP}_{[+pl]}$$

4.2.3 Explaining Variation

In Spanish and Italian *tant*-PL can only denote cardinality, whereas *tant*-SG denotes dense measurement. We can explain this by holding that, in these languages, only the high merger site of the DegP is compatible with plural count NPs. The low merger site is compatible with mass NP for which morpho-syntactic (i.e. NumP) and semantic plurality are absent, and there is only one merger position available.

A similar explanation is available for the inter-speaker variability affecting the judgments reported in § 2.2. Speakers who accept the VOL interpretations of *many* have grammars where the structure in (27) and its corresponding spell-out rule are accessible. Speakers who do not accept these interpretations, on the other hand, have grammars which cannot construct the structure in (27), like Italian and Spanish.

¹⁵ There is nothing syntactically wrong with merging MUCH in Spec,INDP. However, at LF the derivation will crash: QAs cannot quantify over atomic properties due to the Monotonicity Constraint (see fn.1).

5 The Scope of the Proposal

5.1 QAs in the Norwegian NP Domain

We have proposed that the DegP containing MUCH and the measure function μ can enter the syntactic derivation in different positions based on the semantic interpretation: Spec,NP and Spec,NumP. This proposal makes the prediction that there should be languages that make a morpho-syntactic distinction at spell-out in the degree morpheme introducing μ that correlates with the semantic interpretation. In other words, a language with two different vocabulary items X and X' such that at LF X scopes over ‘portions of substance’ and X' scopes over ‘properties of pluralities’. This is precisely the case of the Norwegian comparative morpheme.

Norwegian, like English, makes a morpho-syntactic distinction between degree quantification over mass NPs and plural count NPs: *mye* ‘much’ and *mange* ‘many’, respectively. This is shown in (34).

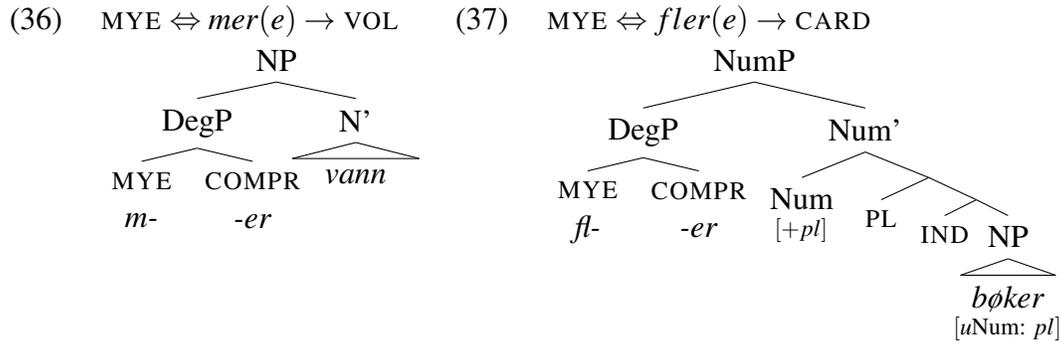
- (34) Norwegian *mye* & *mange*
- a. Det var ikke *mye* vann igjen i brønnen
 there was not much water left in well.DEF
 ‘There wasn’t much water left in the well’
 - b. Det er *mange* bøker på bordet
 there are much.PL books on table.DEF
 ‘There are many books on the table’

However, unlike English, where the *much-many* distinction is lost in comparatives, Norwegian keeps a contrast: *mer(e)* is the unmarked form used to compare mass NPs, whereas *flere* is only compatible with plural count NPs. This is illustrated in (35), adapted from Bhatt & Homer (2019: 227):

- (35) Norwegian comparative morphemes: *mer(e)* vs. *flere*
- a. Håvard drakk { *mer/* **flere* } vann enn Magnus
 Håvard drank much.COMPR much.COMPR.PL water than Magnus
 ‘Håvard drank {more/ *more_{PL}} water than Magnus’ [#CARD, VOL]
 - b. Håvard leser { **mer/* *flere* } bøker enn Magnus
 Håvard read much.COMPR much.COMPR.PL books than Magnus
 ‘Håvard read { *more/ more_{PL} } books than Magnus’ [CARD, #VOL]

Norwegian comparatives can thus receive an analogous treatment as English *many* under our theory: when *MYE* is in Spec,NP, the DegP quantifies over portions of substance. Thus, μ is resolved with the dense measurement of VOL (36). On the

contrary, when MYE is higher than the morpho-syntactic and semantic number, it contains number information in its scope and quantifies over properties of pluralities yielding an interpretation in terms of CARD, (37). At PF, spell-out of MYE is determined by the Vocabulary Insertion rules in (38):



(38) Vocabulary Insertion rules for Norwegian MYE

- a. $MYE \Leftrightarrow m - / _ \text{COMPR}]$
 $MYE \Leftrightarrow fl - / _ \text{COMPR}] \text{ NumP}_{[+pl]}$
 $MYE \Leftrightarrow mye$
- b. $\text{COMPR} \Leftrightarrow -er(e) / \text{MYE} _]$

The first rule in (38a) determines that MYE is to be pronounced as *m-* in the context of the comparative morpheme. The second rule in (38b) is more specific and states that MYE must be pronounced as *fl-* in the context of the comparative morpheme when the DegP is adjacent to a plural NumP. This last rule captures the facts and is consistent with our syntactic structure that is fed to both PF and LF. The third rule in (38c) is the elsewhere case. In (38b) the vocabulary item for the comparative is provided.

Norwegian provides strong evidence for AUD: when the syntactic output has MYE/MUCH – in whatever surface form – scoping over pluralities, the resolution of the measure function is always CARD. Moreover, this section supports the hypothesis that the resolution of μ is determined by the syntax (Toquero-Pérez 2022).

5.2 What About “Mass Plurals”?

Mass plurals in (39) are NPs which behave semantically like Mass NPs but show plural agreement morpho-syntactically, both DP internally and with the verb (cf. McCawley 1975; Gillon 1992; Acquaviva 2008): (40).

(39) *suds, mashed potatoes, brains, fumes, guts, oats*

- (40) a. Miners shouldn't breathe {*this/ these} fumes.
 b. The fumes {*was/ were} produced by the mixture of the spilled chemicals with rain and snow.¹⁶

The NPs in (39) combine with *much* rather than *many*, its interpretation being that of VOL/ WEIGHT; and they are odd with number denoting expressions: (41).

- (41) a. Too much suds pushed the door outwards. [#CARD, VOL]
 b. If one purposely sniffs gasoline or glue, or accidentally gets too much fumes while painting inside a closet... [#CARD, VOL]
 c. ?{a/ one} sud, *several fumes. (Wellwood 2019: 108)

Mass plurals are consistent with AUD. As Mass NPs, they are structurally impoverished (compared to count NPs) and do not project a NumP (Borer 2005; Caha 2022). Most importantly, they are not atomized and thus PL is absent from the structure. This entails that MUCH is never going to scope over pluralities and give rise to a cardinality interpretation (41a-b), respecting AUD.

However, mass plurals do present a *prima facie* problem for our account of spelling-out MUCH: if, as it appears, mass plurals are morpho-syntactically plural, then why is MUCH realized as *much* rather than *many* when it combines with a mass plural NP? This problem, we argue, is merely apparent.

Mass Plurals have some lexical idiosyncratic properties – e.g. *gut* vs. *guts* – and these idiosyncracies must be encoded by a head very close to the root (Acquaviva 2008). We propose, following insights from Kramer (2015), that mass plurals involve layered *n*Ps: a lower *n* is the categorizing head that is in charge of nominalizing the root, and a structurally higher *n* that carries an uninterpretable plural feature which is responsible for triggering plural agreement (40). Their structure is in (42):

$$(42) \quad [{}_{nP} n_{[+pl]}] [{}_{nP} n_{[MASS]} \sqrt{sud}] \Leftrightarrow suds \quad (\text{Mass plurals})$$

Evidence for the layered *n*P of mass plurals comes from languages like Italian. Several count Nouns that have mass plural counterparts belong to the singular masculine class ending in *-o*. But when turned into a mass plural, they involve a different inflection that triggers a change in gender (Acquaviva 2008: 126): (43).

- (43) a. cervell-o – cervell-a – cervell-i
 brain-M.SG – brain-F.PL – brain-M.PL
 ‘brain (organ) – brains (mass) – brains (organs)’
 b. mur-o – mur-a – mur-i
 wall-M.SG – wall-F.PL – wall-M.PL
 ‘wall (structure) – walls (mass) – walls (structures)’

16 <https://www.upi.com/Archives/1986/03/13/Six-treated-for-inhaling-toxic-fumes/4543511074000/>

Like other morphologically irregular plurals in Italian, these mass plurals end in *-a*, which is normally an exponent of feminine singular rather than plurality in the language. This contrasts with *-i/-e*, i.e. the canonical and regular plural markers for masculine and feminine. This is expected under Kramer’s (2015) system where pluralizing *n*’s can carry their own gender: the lower *n* has an interpretable [GEN: -FEM] restricting the class of the noun, while a structurally higher *n* head bearing [*u*GEN: +FEM] [+*pl*] is responsible for the agreement.

Back to English, the reason why MUCH is spelled-out as *much* instead of *many* is again morpho-syntax’s doing. Our account predicts that MUCH should be merged low, as is the case for mass NP-like interpretations, cp. (27). However, the presence of [*u*Num] on the Noun is contingent on the NP being countable; only count NPs contain NumP in their extended projection (Borer 2005; Caha 2022). Since mass plurals are not countable, they lack a NumP, and so in particular the feature [*u*Num] is absent. Therefore, the specification for the rules in (31) and (33) is not met, and MUCH surfaces as the elsewhere case: MUCH \Leftrightarrow *much*. That is, this is another case in which variation is located at spell-out.

6 Conclusion and Implications

We have argued that the reported variation in the interpretation of *many* does not warrant entirely abandoning UD in favor of Snyder’s (2021) MD. When properly reformulated, UD is still a robust universal and the variation is not in the semantics.

By adopting the decompositional view of degree expressions (Wellwood 2015, *et seq.*), we have proposed that the underspecified value of μ introduced by MUCH is resolved via what is in its scope in the syntax. When MUCH scopes over PL, μ cross-linguistically measures cardinalities, giving rise to our proposed universal: *Abstract Uniform Dimensionality*. AUD affords an attractive account of the reported variation in the interpretation of *many*: spelling-out MUCH depends on the morpho-syntactic context and need not correlate with a particular interpretation at LF.

We have shown how to derive the universal in a particular corner of the NP domain, and have not delved into the VP domain. There is evidence, though, that AUD also holds there under structurally similar conditions (Wellwood et al. 2012; Wellwood 2019; Toquero-Pérez 2022). That said, AUD and the theory developed have broader implications for the grammar of measurement, and in particular for the counting-measuring distinction. How the grammar distinguishes between these two abstract operations is a debated issue. AUD, paired with our theory, offers a promising and novel explanation: the distinction must be derived syntactically, via what is in the scope of μ . If this is all the distinction amounts to, counting-measuring ambiguities (in e.g. numerically modified expressions and pseudo-partitives) can be reduced to a structural ambiguity in the syntactic position of MUCH.

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