Universals in superlative semantics

Elizabeth Coppock, Elizabeth Bogal-Allbritten and Golsa Nouri-Hoss

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Abstract

This paper establishes a linguistic universal regarding the interpretation of quantity words such as *many* in the superlative. While some languages use such a form to express both a relative reading (as in *Gloria has visited the most continents*) and a proportional reading (as in *Gloria has visited most continents*), the vast majority do not allow the latter, and all allow the former. Absolute readings for the superlatives of ordinary gradable adjectives, in contrast, are universal. Existing potential explanations for these results (in terms of DP layer, cardinal vs. proportional readings for *many*, and underlying pseudopartitive structures) are shown to suffer from certain limitations. We offer a semantic explantion, centered around the claim the quantity words denote predicates of degrees rather than individuals.

Keywords: quantity words, comparison, superlatives, measurement, universals, typology, fieldwork, semantics

1 Introduction

Superlative constructions have been observed to be ambiguous between two interpretations, called *absolute* and *relative*. For a sentence like (1), the absolute reading can be paraphrased, 'Mary climbed the mountain that was taller than all other mountains', and the relative reading can be paraphrased, 'Mary climbed a taller mountain than anyone else climbed.'[1]

[1]We thank all language consultants and linguists who helped us to gather and understand the data presented here. [Names to be included in de-anonymized version.]

We use the following abbreviations in glosses: ABL: ablative, ACC: accusative, ADD: additive, ADV: adverbializer, AREAL: areal (Navajo), ATTRIB: attributive (Aymara), AUX: auxiliary, CL: classifier, CMPR: comparative, DECL: declarative, DEF: definite, DEM: demonstrative, DL: delimitative (Aymara), ERG: ergative, EVID: evidential, EZ: ezafe (Persian), FEM: feminine, FOC: focus, GEN: genitive, INCL: inclusive (Aymara), INDEF: indefinite, INT: intensifier, IPFV: imperfective aspect, LOC: locative, MASC: masculine, NEG: negation, NMLZ: nominalizer, NOM: nominative,

(1) Mary climbed the tallest mountain.

The absolute reading simply involves reference to a mountain that is taller than all other (salient) mountains. The relative reading is focus-sensitive. In (1), the only natural placement of focus is on *Mary*. In (2), with emphasis on *yesterday*, the relative reading is that Mary climbed a taller mountain yesterday than any other day.

(2) Mary climbed the tallest mountain *yesterday*.

The relative interpretation is remarkable for its ability to obviate constraints on definite noun phrases (Szabolcsi, 1986). For example, relational *have* is typically restricted to indefinite noun phrases:

(3) a. John has a sister.
b. *John has the sister.
c. John has the smartest sister.

Drawing on evidence from Hungarian, where focus is syntactically marked, Szabolcsi (1986) shows that the superlative-containing definite noun phrases that are exempt from constraints on ordinary definites require there to be a focus or a *wh-* phrase in the sentence to license them. Thus, focus-sensitivity goes along with behavior as an indefinite; these are both are properties of relative readings.[2]

The superlatives of quantity words such as *many* have also been observed to be ambiguous between two interpretations, called *relative* and *proportional* (Hackl, 2009). These are exhibited in (4-a) and (4-b), respectively.

(4) a. Gloria has visited the most continents.
b. Gloria has visited most continents.

Example (4-a) could be true in a situation where Gloria has visited only three of the continents, as long as everyone she is being compared to has visited fewer. (4-b) could not be true in such a situation, given that there are seven continents. On

OBJ: object, OM: object marker (Persian), PAST: past, PERF: perfective aspect, PL: plural, POSS: possessive, PRES: present, REL: relativizer, SBJV: subjunctive, SIM: simple tense (Aymara), SG: singular, SPRL: superlative, SUBJ: subject, TOP: topic.

[2]The contrast between absolute and relative readings was discussed early on by Szabolcsi (1986) with reference to Hungarian, and has been taken up in a fair amount of recent cross-linguistic research, mainly focussed on English (Gawron, 1995; Heim, 1999; Hackl, 2000; Sharvit & Stateva, 2002; Hackl, 2009; Teodorescu, 2009; Krasikova, 2012; Szabolcsi, 2012; Bumford, 2016; Wilson, 2016), but also with reference to German (Hackl, 2009), Swedish (Coppock & Josefson, 2015), other Germanic languages (Coppock, to appear), Hungarian (Farkas & É. Kiss, 2000), Romanian (Teodorescu, 2007), Spanish (Rohena-Madrazo, 2007), Arabic (Hallman, 2016a), and Slavic languages including Macedonian, Czech, Serbian/Croatian and Slovenian (Pancheva & Tomaszewicz, 2012).

the other hand, (4-b) is felicitous in a situation in which Gloria is the only person in the domain of discourse, while (4-a) requires that there be others in the domain of discourse who have visited some number of continents, i.e., that there be salient focus-alternatives to *Gloria*.

Some theories analogize the proportional readings of quantity words to the absolute readings of ordinary gradable adjectives, most notably that of Hackl (2009). A decompositional analysis of proportional *most* as the superlative of MANY is significant in light of Barwise & Cooper's (1981) argument from *most* that first-order logic is not sufficient to represent meaning in natural language, motivating the introduction of generalized quantifiers as semantic primitives. If all that is necessary to model proportional *most* is degrees and pluralities, then the key motivation for introducing generalized quantifiers is threatened.

However, certain asymmetries between the proportional readings of quantity superlatives and the absolute readings of ordinary gradable adjectives have been observed. Among Germanic languages, the superlatives of quantity words show different definiteness-marking and phi-feature agreement patterns from the superlatives of quality words (Coppock, to appear). And although we know of no languages in which the superlatives of ordinary gradable adjectives lack absolute readings, it has been observed that there are languages in which the superlatives of quantity words do lack proportional readings. For example, in Slovenian, the superlative of MANY has only a relative reading (Živanović, 2007b):

(5) **Naj-več** ljudi pije pivo.
SPRL-many people drink beer
Relative: 'More people drink beer than any other beverage.'
(*Proportional unavailable:* 'More than half the people drink beer.')
(Slovenian)

The study described in §2 shows that this asymmetry holds quite broadly among the languages of the world, and that it is very much the rule rather than the exception that the superlative of *many* lacks a proportional reading. Based on data from around 90 languages from 27 different language families, drawn from every continent, we conclude that the markedness of proportional readings is indeed universal:

(6) **Universal: Proportional implies relative**
If a language has a superlative of MANY or MUCH, then it has a relative interpretation, but not necessarily a proportional interpretation.

In fact, something even stronger holds: Any language that has a superlative of MUCH or MANY uses it to express relative readings. Moreover, proportional readings appear to be quite rare, and we found no evidence for them among non-European languages (although there are some borderline cases).

In §3, we consider several possible explanations for this universal. Boškovic &

Gajewski (2008) tie the availability of proportional readings to Boškovic's (2008) NP/DP parameter, according to which some languages have a DP while others only have an NP. On this view, proportional readings require a DP layer. Observing that there are DP-languages that nevertheless lack proportional readings for the superlative of *many*, Dobrovie-Sorin & Giurgea (2015) and Pancheva (2015) propose alternative views. According to Dobrovie-Sorin & Giurgea (2015), proportional readings are not compositionally derived as the superlative of *many*; they are monomorphemic generalized quantifiers as originally proposed by Barwise & Cooper (1981). Pancheva (2015) proposes that relative and proportional readings realize different kinds of pseudopartitive structures, and languages differ as to which of these structures is available.

We argue in §3.3 that the markedness of proportional readings is due to the following default principles: First, quantity words like *many* denote gradable predicates of degrees rather than individuals by default. In order for proportional readings to arise in the manner envisioned by either Hackl (2009) or Hoeksema (1983) – to our knowledge the only two existing proposals for how proportional readings arise compositionally as the superlative of MANY – a quantity word must denote a gradable predicate of individuals rather than degrees. This is a marked option.

However, this assumption alone—that quantity words by default denote gradable predicates of degrees—does not guarantee that proportional readings could not arise for quantity superlatives by another means. A further constraint is needed in order to force a focus-sensitive reading. We propose that the following is at work: Superlative constructions by definition involve comparison *among* (as opposed to *between*) some set of entities, and it turns out that comparison *among* any set of entities must involve comparison among some set of *individuals*. Adding this constraint guarantees that quantity superlatives will always have focus-sensitive readings, for reasons we will explain in detail in §3.3.

We speculate that analogical pressure from other quantifiers in the lexicon may be a force that drives the development of proportional readings, allowing these hindrances to be overcome. Some evidence for this comes from the range of strategies for forming superlatives that underlie proportional readings. In our sample, languages with proportional MOST predominantly use a morphological superlative. All of the potential counterexamples to this generalization (Hausa, Wolof, Georgian, Aymara) are unclear or borderline cases.

Our proposal avoids the difficulties that previous proposals face and sheds light on some subtle agreement-marking patterns. Coppock (to appear) establishes the following generalizations:

1. On relative readings, if there is disagreement between the quantity superlative and the noun, then the quantity superlative shows default agreement (neuter singular).

2. If a given morphosyntactic pattern is a possible for adverbial superlatives in a

given language, then that pattern is also possible with quantity superlatives.

3. On proportional readings, quantity superlatives never disagree in number with the noun (although they may disagree in other features, such as definiteness).

These generalizations hold up quite well across our broader sample as well. They can be understood under Coppock's (to appear) *target-domain hypothesis*, according to which the agreement features that appear on a quantity superlative reflect the nature of the entity that it describes. Degree- and event-type entities are associated with default neuter singular agreement. This leads us to expect default neuter singular agreement with adverbial and ordinary quantity superlatives. When the quantity word denotes a gradable predicate of individuals, on the other hand, we expect plural agreement in the case of a plural discourse referent.

Stepping back, the picture that emerges is broadly in line with the one painted by Hackl (2009), insofar as it involves a decompositional treatment of proportional MOST, including a MANY element and a superlative element (at least historically). We also adopt the same strategy for achieving the expressive power necessary for modelling the truth conditions of proportional MOST, namely the introduction of pluralities and degrees. But the compositional route to proportional *most* is full of obstacles, very much unlike the straightforward route to absolute readings for the superlatives of ordinary gradable adjectives.

2 Typological study

To prove the universal in (6), we undertook a broad cross-linguistic study, covering around 90 languages from 27 different language families, drawn from every continent. The languages in our sample were also diverse with respect to their strategies for forming superlatives. Our method of data collection is described in detail in §2.1, and the results are presented thereafter.

2.1 Method and language sample

Descriptive grammars generally include examples of constructions that might be described as quality superlatives. However, there is substantially less description of the structure and, in particular, semantic interpretation(s) of quantity superlatives, with the exception of a relatively small number of European languages. In order to address gaps in the existing descriptive account, we employed a method that we term TARGETED COMPARATIVE FIELDWORK. This method is characterized by the study of a targeted issue (here, quantity superlatives) through elicitation on a broad sample of languages. We discuss below our methodology and the sample of languages that inform our typological conclusions.

2.1.1 Methodology

To determine what readings were available for the superlative of MANY in a given language, we first asked several native speakers to translate a short story into their native language. Then, using published resources such as grammars and dictionaries, we did our best to decode the responses. Finally, building on this information, we carried out follow-up interviews.

Our main elicitation tool was a questionnaire structured as a short story consisting of 17 sentences designed to elicit particular structures and meanings of interest, including relative and proportional quantity superlatives, relative and absolute quality superlatives, comparatives, and quantity words. Appendix A gives the full story and instructions seen by participants. The sentences in (7) and (8) were among those intended to elicit proportional and relative quantity superlatives, respectively.

(7) a. **Most of the kids who go to my school** like to play music.
[For example, there are 100 kids in my school and 65 of them like to play music.]

b. Mom baked cookies yesterday and I ate **most of them**.
[For example, she baked 20 cookies and I ate 14.]

(8) a. Of all the kids in my school, I'm the one who plays **the most instruments**.
[For example, I play 7 instruments, two of my friends play 6 instruments, and lots of people play one or two instruments, but nobody else plays more than 4.]

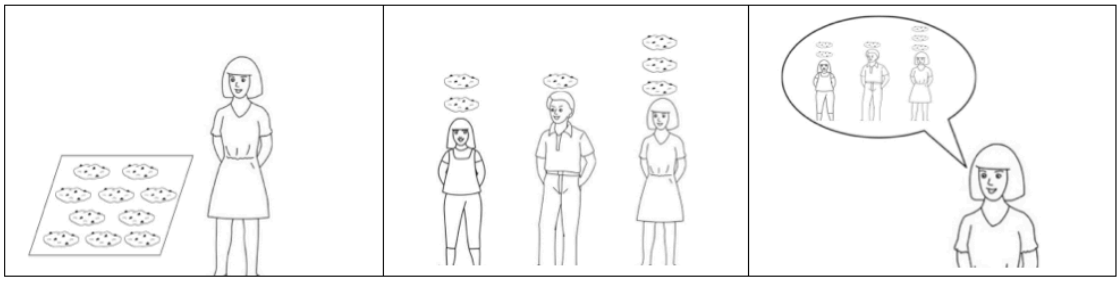
b. But I am also the member of our family who eats **the most cookies**.
[For example, I eat on average 5 cookies per day, and other members of my family eat on average 4 or fewer cookies per day.]

The number of questionnaire respondents varied from language to language; we aimed for five, but the actual number varied between one and 15. The vast majority of participants completed the questionnaire online with English prompt sentences.[3] The online format allowed us to gather data efficiently from languages that were not represented in previous work and which would have otherwise been hard to access.

Translation questionnaires do not provide negative evidence: The absence of some structure from the translation of a particular prompt does not necessarily indicate its impossibility. It is also not guaranteed that the participants are familiar enough with English to perceive the distinctions of interest in the given text. Therefore, we conducted brief follow-up elicitation sessions. In cases where the superlative of MANY was used for relative readings but not proportional reading, this allowed us to determine whether their omission reflected the absence of proportional readings for superlatives.

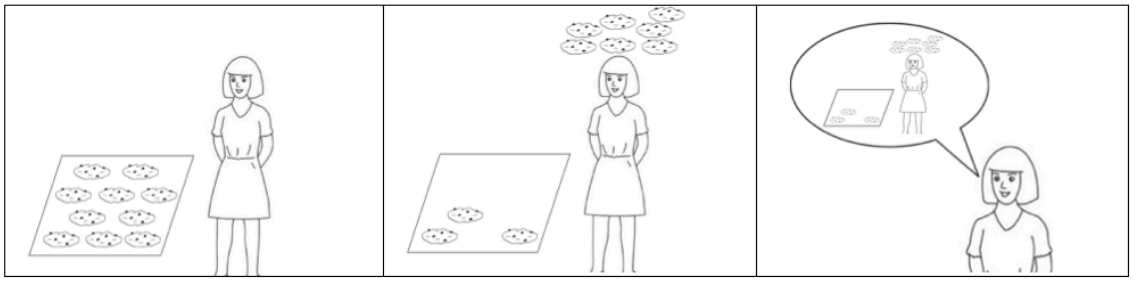
[3] A subset of participants saw the questionnaire in Swedish, Swahili, Persian, or Spanish.

The exact follow-up materials used with particular languages varied depending on what issues required clarification. Some of these materials are described as they become relevant in the discussion below. The following pair of visual contexts were used frequently, however. These contexts were constructed to determine whether a given language's superlative structure admitted both proportional and relative readings. Each context only admits one reading: Figure 1 admits a relative, but not proportional, reading. Figure 2 admits a proportional, but not relative, reading. Speakers were asked whether a superlative structure volunteered in Figure 1 could also be used in Figure 2.



You bake 10 cookies to share with your siblings. You eat three cookies, your little sister eats two, and your older brother eats one. Later you tell me what you did.

Figure 1: Relative quantity superlative



You are home alone one weekend and you bake 10 cookies. You are extremely hungry, so you eat 7 of them. Only three are left. Later you tell me what you did.

Figure 2: Proportional quantity superlative

2.1.2 Languages and coding of superlative strategies

We collected data from 29 language families and about 90 languages distributed across all continents. Table 1 lists one language from each subfamily that we investigated, organized by continent.

Macro-area	Family	Subfamily	(Language)
Eurasia	Austroasiatic	Vietic	Vietnamese
Eurasia	Basque	Basque	
	Dravidian	South Dravidian	Tamil
	Indo-European	Albanian	
		Balto-Slavic	Macedonian
		Celtic	Irish
		Germanic	Swedish
		Greek	
		Indo-Iranian	Persian
		Italic	French
	Japonic	Japanese	
	Kartvelian	Georgian-Zan	Georgian
	Koreanic	Korean	
	Nakh-Daghestanian	Daghestanian	Lezgian
	Sino-Tibetan	Bodic	Tibetan
		Mahakiranti	Newar
	Tai-Kadai	Kam-Tai	Thai
	Turkic	Common Turkic	Turkish
	Uralic	Finnic	Finnish
		Hungarian	
Africa	Afro-Asiatic	Cushitic	Somali
		Semitic	Arabic
		West Chadic	Hausa
	Atlantic-Congo	North-Central Atlantic	Wolof
		Volta-Congo	Yoruba
	Eastern Sudanic	Nubian	Kenuzi-Dongola
	Mande	Western Mande	Vai
	Nilotic	Western Nilotic	Lango
Papunesia	Austronesian	Nuclear Austronesian	Javanese
		Malayo-Polynesian	Indonesian
	Gunwinyguan	Marne	Kunbarlang
North America	Algic	Algonquian	Passamaquoddy
	Iroquoian	Cherokee	
	Mayan	Core Mayan	Kaqchikel
	Na-Dene	Athabaskan-Eyak	Navajo
	Otomanguean	Eastern Otomanguean	Chatino (San Juan Quiahije)
		Western Otomanguean	Chinanteco (San Antonio Analco)
	Salishan	Interior Salish	Okanagan Salish
	Siouan	Core Siouan	Lakota
	Uto-Aztecan	Southern Uto-Aztecan	Huasteca Nahuatl
South America	Aymaran	Central-Southern Aymara	Aymara
	Quechuan	Quechua II	Cochabamba Quechua

Table 1: Language sample

We coded each language in the database for basic information about the morphosyntactic strategy used to translate superlative prompts. The coding scheme in (9) combines categories from Bobaljik (2012) and Gorshenin (2012). We illustrate each code with one language. The specific codes assigned to each language were generally consistent with previous typological literature, but were in some cases overridden by our own fieldwork. The code assigned to each language is further intended to represent the language's *primary* manner of translating superlative prompts. The primary code corresponds to the structure discussed in descriptive work on the language and/or most frequently volunteered by consultants. For languages like Russian with multiple ways of translating superlative prompts, the 'primary' label is somewhat arbitrary. But this does not affect the diversity of our sample or our conclusion. What is important is that the strategy assigned to a language is the one whose application to quantity words is assessed for relative and proportional readings.

(9) **Structures used in translations of superlative prompts**

a. **M:** Morphological superlative marker.
English: *tall-**est*** [*tall*-SPRL]

b. **PERIPH:** Analytic (periphrastic) superlative marker.
Indonesian: ***paling*** *tinggi* [SPRL tall]

c. **CMPR+DEF:** Combination of definiteness marker and a comparative.
French: ***le plus*** *fine* [DEF CMPR thin]

d. **CMPR:** Comparative structure.
Wolof: ***gën*** *gaaw* [surpass$_{\text{CMPR}}$ fast]

e. **CMPR+ALL:** Comparative with universal standard of comparison.
Georgian: ***q'vela-ze*** *maγali* [all-on$_{\text{CMPR}}$ tall]

f. **CMPR+ANY:** Comparative with existential standard of comparison.
Navajo: ***'a-láah-go*** *'áníłnéézˊ* [INDEF.OBJ-beyond$_{\text{CMPR}}$-ADV tall]

g. **OTHER:** Some other strategy is used.
Vietnamese: Superlative indicated by combination of comparative and aspect marker (Gorshenin, 2012)

h. **VERY:** Gradable expression modified by intensifier.
Kagulu: *ikulu-**si*** [big-INT]

Because material from the comparative construction is often implicated in superlative constructions, languages were also coded according to their strategy for forming comparatives.[4] These codes again reflect the range of strategies recognized

[4]For languages without an overt comparative element associated with the gradable predicate, or with an optional comparative element, one might either posit a covert comparative element or claim that comparative meaning is solely encoded by the standard marker. Our categorizations rely solely on the overt morphosyntax, and are neutral with regard to whether there are such covert elements. We use the code CMPR$_{\emptyset/STND}$ to classify languages of these types.

by Bobaljik (2012) and Stassen (1985).

(10) **Comparative strategies**

a. **M/STND:** Morphological expression of comparative marker on gradable predicate (e.g. English *-er*). Standard marker indicates standard of comparison.

b. **PERIPH/STND:** Comparative is expressed analytically (periphrastically) with a free element associated with gradable predicate. Standard marker indicates standard of comparison.

c. **∅/STND:** Comparative is not marked on gradable predicate. Comparative meaning is overtly indicated by standard marker.

d. **EX** Comparative relation is expressed with a verb translating as 'exceed' or 'surpass.'

e. **CNJ** Comparative relation is expressed via conjunction.

For languages in which the strategy for forming superlatives involves a comparative, such as in CMPR+DEF languages, we sometimes specify the strategy for forming superlatives as a subscript, e.g. $\text{CMPR}_{M/STND}$+DEF.

2.1.3 What counts as a quantity superlative?

All languages that we considered seem to have at least one strategy for translating questionnaire prompt sentences with superlatives, reflected by the codes in (9). However, in order to evaluate the markedness universal as stated in (6), it is necessary to make a determination as to whether a translation from a given language counts as the 'superlative of MANY'. We adopt the definitions in (11).

(11) a. **Superlative strategy:** A construction that conveys that a gradable property holds of an entity to a uniquely high extent, when comparison is made among all entities within a relevant set that may be explicit or implicit.[5]

b. **Quantity superlative:** A construction involving (only) a superlative strategy that stands in the same paradigmatic relation to a word for MANY or MUCH as a quality superlative stands in to its positive form.

The definition of 'superlative strategy' frames superlatives in terms of a 'comparative concept' in the sense of Haspelmath (2010), such that we appeal to broadly applicable semantic concepts (gradability, uniqueness) instead of specific structural criteria. Doing so allows us to test the proposed typological universal against languages whose superlative structures differ from English or other well-studied languages. For instance, our set of superlative strategies includes both structures where the

[5]See Gorshenin (2012, 58-60) for a similar operational definition of superlatives that also takes uniqueness as one of the semantic components crucial to superlative meaning.

superlative forms a constituent with the noun as in French (12) as well as probable adverbial superlatives as in Navajo (13).[6]

The definitions in (11) allow us to include languages whose quantity superlatives lack an overt realization of MANY. In French and Navajo, the same structures characterize quantity and quality superlatives: CMPR+DEF in French (12) and CMPR+ANY in Navajo (13). But only quality superlatives contain an overt predicate that indicates the dimension along which comparison is made (e.g. size, quantity). However, the expressions we categorize as quantity superlatives in these languages contain the morphosyntactic indicators of a superlative construction, and occupy the superlative cell in the positive-comparative-superlative paradigm for MANY. Crucially, the comparative forms of MANY also lack an overt MANY; cf. (12-c) and (13-c).

(12) a. Jean a lu **le** **plus** de livres.
Jean has read DEF CMPR of book.PL
'John has read the most books.'

b. Je ne suis pas celui de la famille qui a la taille **la** **plus** **fine**.
1SG NEG be NEG that.one of DEF family REL has DEF waist DEF CMPR thin
'I'm not the one in the family with the thinnest waist.'

c. Jean a lu **plus** de livres que moi.
Jean has read CMPR of books than 1SG
'John has read more books than me.'
(French; CMPR$_{PERIPH/STND}$+DEF)

(13) a. Anna bááh łikaní **'a-láah-go** yiyííyą́ą́'.
Anna cookie INDEF.OBJ-beyond-ADV 3OBJ.3SUBJ.eat.PERF
'Anna ate the most cookies.'

b. Anna tsin **'a-láah-go** **'áníłnéézí**-ígíí yaah
Anna tree INDEF.OBJ-beyond-ADV 3SUBJ.tall-NMLZ 3OBJ.up

[6]In some cases, we also lacked a principled and feasible way of reliably distinguishing adverbial from adnominal uses. The status of Finnish *eniten* '(the) most', for example, is unclear to us. Relative superlatives are often morphosyntactically similar to adverbial superlatives (Coppock, to appear; Coppock & Strand, to appear), so there tend to be few surface clues to go on. In fact, we question whether it is even possible in principle to sever the two types of cases cleanly apart. We therefore do not distinguish between these two types.

From the perspective of the current study, one reason to exclude adverbial structures is that, given that it is not in construction with a noun, there is no reason to expect that it might give rise to a proportional reading. If the question is how proportional readings are constructed on the basis of superlative constructions, then these cases are not particularly relevant. Since we ultimately decided to include both adnominal and adverbial strategies in our final count, our estimation of the rate at which proportional readings arise should therefore be read with the understanding that adverbial cases are included.

haas'na'.
3OBJ.3SUBJ.climb.PERF
'Anna has climbed up the tallest tree.'

c. Anna bááh łikaní **shi-láah-go** yiyíiyą́ą́'.
Anna cookie 1SG.OBJ-beyond-ADV 3OBJ.3SUBJ.eat.PERF
'Anna ate more cookies than me.'
(Navajo; CMPR$_{\varnothing/STND}$+ANY)

The definitions in (11) excluded certain structures from the set of quantity superlatives. First, structures like (14) used to translate proportional prompts in French do not count as quantity superlatives because this construction does not involve *only* a superlative strategy. Instead, there is additional material (*part*) which is not otherwise part of the relevant superlative strategy.

(14) La **plupart** des cygnes sont blancs.
DEF majority of.DEF.PL swans 3PL.be white
Prompt: 'Most swans are white.'

The definitions in (11) also exclude languages that employ Bobaljik's (2012) VERY translation strategy for superlative prompts. In Kagulu, for instance, both quality and quantity superlative prompts were translated with an intensifying 'augmentative' suffix *-si* (Petzell, 2008).

(15) a. Hachiwendaga kutega samaki ing'hulu-**si**.
PAST.1PL.want catch fish big-INT
Prompt: 'I wanted to catch the biggest fish.'

b. Ikaka hakadiya ubwabwa mwingi-**si**.
1POSS.brother PAST.eat rice many-INT
Prompt: 'My brother ate the most rice.'
(Kagulu; VERY)

The Kagulu *-si*-construction does not count as a superlative strategy according to (11) because it does not necessarily convey that the gradable property holds to a *uniquely high extent*. We found that *si* was felicitous in contexts where the marked property does not hold of the subject to a uniquely high extent. The Kagulu consultant volunteered the following *si*-construction in response to a visual context in which the character speaking in (16) picks a mango which is equally large as the one picked by the addressee. Each character can describe her respective mango as *ikulu-si* 'big-INT'.

(16) Aniye nani nibawa iyembe ikulu-**si**!
1SG also 1SG.pick mango big-INT
'I also picked a very big mango!' (cf. #'I also picked the biggest mango!')
(Kagulu; VERY)

Finally, there is uncertainty as to whether languages employing a CMPR strategy are languages that exhibit superlative meaning as defined above. In such languages, no morphological distinction reliably distinguishes between comparative and superlative meaning, as reflected by the multiple translations available for Wolof sentences like (17) (Diop, 2012). When the comparison set is left covert, it is unclear whether the sentence expresses superlative meaning — comparison *among* members of an implicit set including Kofi — or comparative meaning — comparison *between* Kofi and members of the implicit set.

(17) Kofi mo (len) **gën** gaaw.
Kofi FOC 3PL surpass be.fast
'Kofi is the fastest' or 'Kofi is faster.'
(Wolof; CMPR_{EX})

Similarly, Zimmermann (2008) cites the following Hausa example from Jaggar (2001), in which the sequence of the verb *fìi* 'exceed' and quantity expression *yawàa* permits both comparative and superlative translations.

(18) màasu zàngà-zangà ma-**fìi** **yawàa**
demonstrators NMLZ-exceed quantity
'more/most demonstrators'
(Hausa; CMPR_{EX})

Data from languages that use the CMPR strategy are only relevant to our proposal for quantity superlative meaning if the CMPR strategy counts (or can count) as a true superlative strategy. Our uncertainty about such cases is preserved in the presentation of our results below.

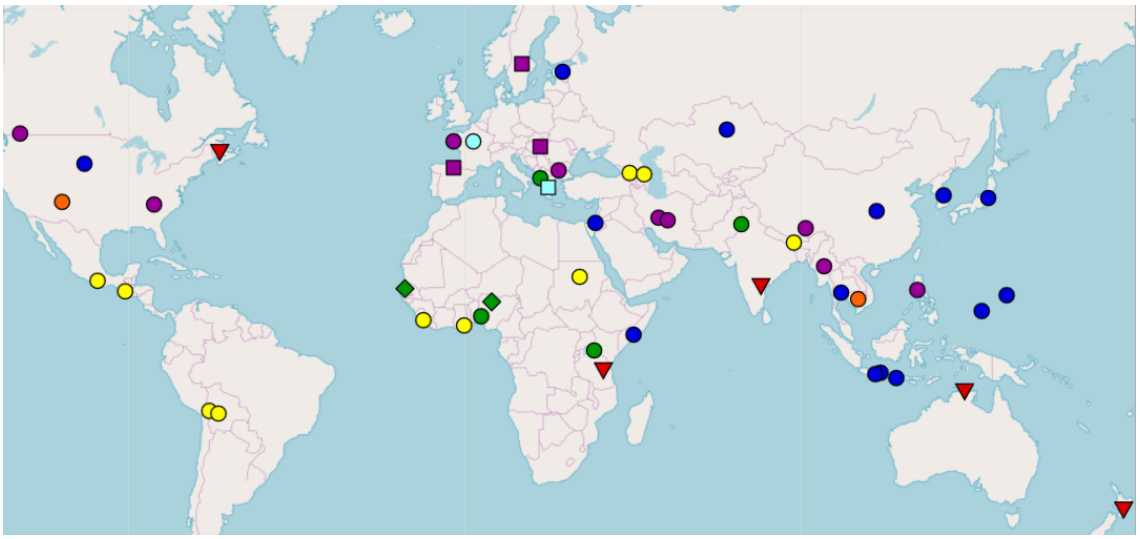
2.2 Results

2.2.1 Universal: Proportional implies relative

Languages were classified as to whether quantity superlatives express (i) a proportional interpretation and (ii) a relative interpretation. For both questions, there were four possible values: YES, NO, NA, and ?. The value 'NA' indicates that the language lacks quantity superlatives. The value '?' indicates that it is impossible to tell whether a superlative construction is being used.

Our findings are summarized in Figure 3, which gives a representative sample of the languages that we investigated. Not all of the languages investigated are shown in this map; the map is limited to one language per genus, as categorized by WALS (Dryer & Haspelmath, 2013). The colors in the map represent different strategies for forming superlatives, and the shapes represent the available interpretations for quantity superlatives. A square represents the case in which quantity superlatives have both relative and proportional readings (YES-YES). A circle indicates that

quantity superlatives do not have proportional readings but do have relative readings (NO-YES). An upside-down triangle indicates that quantity superlatives do not exist in the language (NA-NA). A diamond indicates that it is not possible to tell whether a superlative or comparative strategy is being used (?-?).



Legend for primary superlative strategy (colors)

- M: Morphological superlative marker
- PERIPH: Periphrastic superlative marker
- CMPR+DEF: Comparative plus definiteness marker
- CMPR: No formal distinction between comparative and superlative
- CMPR+ALL: Comparative plus 'of/than all'
- CMPR+ANY: Comparative plus 'of/than some/any'
- VERY: Intensifier
- OTHER/NONE

Legend for quantity superlative interpretations (shapes)

- ■ YES-YES: **Both** relative and proportional readings available
- ● NO-YES: Proportional readings are **not** available but relative readings **are** available
- ▼ NA-NA: Quantity superlatives do not exist in the language
- ◆ ?-?: Unable to distinguish superlative and comparative

Figure 3: Representative sample of languages investigated. One language per genus.

Let us consider examples of each of the four shapes used in the map. The set of YES-YES languages (square) consisted of Greek, Romanian, Basque, Hungarian, and all Germanic languages. We illustrate with Greek:

(19) Éfaga **ta** **perissotera** biskóta.
ate.1SG DEF much.CMPR cookies

Proportional: 'I ate most of the cookies.'
Relative: 'I ate the most cookies.'
(Greek; CMPR$_{M/STND}$+DEF)

The vast majority of languages surveyed were NO-YES languages (circle). We illustrate the NO-YES pattern with Persian, a representative of the M superlative strategy. The set of NO-YES languages included representatives of every superlative strategy, however; representative examples are given in the next subsection.

(20) Man **biš-tar-in** cookie ra khord-am.
1SG much-CMPR-SPRL cookie OM eat.PAST-1SG
Relative: 'I ate the most cookies.'
(*Proportional unavailable:* 'I ate most of the cookies.')
(Persian; M)

Proportional superlative prompts in these languages were translated by a variety of non-superlative structures, including phrases translated as 'almost all,' bare MANY/MUCH, nominal expressions translated as 'majority', and comparative structures. Persian speakers employed the last of these strategies, as shown:

(21) Man biš-**tar**-e cookie-ha ra khord-am.
1SG much-CMPR-EZ cookie-PL OM eat.PAST-1SG
'I ate most of the cookies.'
(Persian)

The set of NA-NA languages (upside-down triangle) consists of VERY languages, including Kagulu (15). All VERY languages are categorized as NA-NA languages because, as discussed earlier, intensifiers do not pattern like true superlative structures: intensifiers do not necessarily convey that the gradable property holds to a uniquely high extent. Because VERY languages lack a true superlative structure, these languages do not bear on the distribution of proportional and relative readings.

Finally, the set of ?-? languages (diamond) is a subset of the set of CMPR languages. As discussed above, CMPR structures can be translated both as comparatives and superlatives, so it is difficult to say with certainty that such structures should be called 'superlatives.' For instance, while speakers of both Wolof (22) and Hausa (not shown) were able to use CMPR structures in translations of both relative and proportional prompts (22), the uncertain status of CMPR led us to characterize both languages as ?-? languages rather than YES-YES.

(22) a. Ci xale yu nekk sama ekkol yép, man ma ci tëgg lu
LOC child REL be 1POSS all school 1SG 1SG LOC play REL
gën bëre ci sabar.
surpass be.many LOC drum
'Of all the kids in my school, I'm the one who plays the most drums.'

b. Xale yu **gën** **bëre** ci sama ekkol bëgg na ñu tëgg
child REL surpass be.many LOC 1POSS school like PERF 3PL play
mízik.
music
'Most of the kids who go to my school like to play music.'
(Wolof; CMPR_{EX})

For some CMPR languages, including Albanian (23) and Yoruba (not shown), it was possible to determine that the superlative of MANY is certainly not used to convey a proportional reading. We put these in the 'NO-YES' category, although a slightly more accurate designation for these languages would be 'NO-?'.

(23) Unë jam ai që i bie **më** **shumë** instrumenteve.
1SG 1SG.be 3SG REL of play CMPR many instruments
Relative: 'I am the one who plays the most instruments.'
(*Proportional unavailable:* 'I am the one who plays most of the instruments.')
(Albanian; CMPR)

Crucially, no shape is needed to represent hypothetical YES-NO languages, in which the quantity superlative is used for proportional but not relative readings. The absence of such languages from our sample means that the universal in (24) is *supported* by our results. Proportional readings indeed appear to be typologically marked: any language that uses the superlative of MANY for a proportional reading also uses it for a relative reading.

(24) **Universal: Proportional implies relative**
If a language has a superlative of MANY or MUCH, then it has a relative interpretation, but not necessarily a proportional interpretation.

We also did not find any NO-NO languages, where a superlative strategy exists but is not used to express either proportional or relative readings. The absence of NO-NO languages from our sample also supports an even stronger generalization: if a language has a superlative of MUCH or MANY at all, then that superlative is used for (at least) a relative interpretation. So not only are proportional readings typologically marked, relative readings are in some sense universal.

We can also give a very rough estimate of the approximate rate at which quantity superlatives have proportional readings. We cannot merely count up the number of YES-YES languages and then divide by the total number of languages, because we had a significant over-representation of, for example, Germanic languages, which all have the property in question. Such a method would greatly over-estimate the natural rate at which this occurs. Instead, we can calculate a coarse estimate by dividing the number of language families in which proportional readings are found

by the number of language families containing at least one language with quantity superlatives. Out of 27 language families in which quantity superlatives are attested, the YES-YES pattern is exhibited in 4 language families. By this coarse estimate, 14.8% of the language families surveyed exhibit proportional readings in at least one language.

For a more accurate estimate, we calculate the rate at which YES-YES languages are found within a given language family. To calculate the rate within a particular family, we look at each subfamily and determine whether the YES-YES pattern is attested. For example, we find the YES-YES pattern in 2 of the 7 Indo-European subfamilies surveyed, so the rate of proportional reading occurrence within Indo-European is 2/7. By this method, we find that the probability of proportional readings is as low as 7.5% across the entire language sample.

Note that there is a very great amount of uncertainty surrounding both estimated rates because there are approximately 400 language families but only 27 are represented in our sample. Nevertheless, these findings indicate that YES-YES languages are relatively rare crosslinguistically.

The rarity of proportional readings stands in sharp contrast with the ubiquity of absolute readings for quality superlatives. We found no language in which a quality superlative construction permitted a relative reading but lacked an absolute reading. The examples below show the availability of absolute and relative readings for Persian and Navajo quality superlatives, both of which were shown above to lack proportional readings. Both examples were elicited using a pair of pictures that depicted trees of different heights in a garden. The male character fails to climb the absolute tallest tree in the image ((25-a), (26-a)). However, he succeeds in climbing the second tallest tree, while the two female characters only manage to climb shorter trees ((25-b), (26-b)).

(25) a. Un aval say kard az **boland-tar-in** deraxt-e baq
3SG first effort do.PAST.3SG from tall-CMPR-SPRL tree-EZ garden
bala bere vali un xeili boland bud.
up SBJV-go.3SG but 3SG be.PAST.3SG very tall.3SG
Absolute prompt: 'First he tried to climb the tallest tree in the garden, but it was too tall.'

b. Bein-e se ta bache un barande shod chon
among-EZ three CL kid 3SG winner become.PAST.3SG because
un az **boland-tar-in** deraxt-e bala raft.
3SG from tall-CMPR-SPRL tree-EZ up go.PAST.3SG
Relative prompt: 'Among the three kids, he was the winner because he climbed the tallest tree.'
(Persian, M)

(26) a. 'Ałtsé tsin **'a-láah-go** **'áníłnéézí**-ígíí yaah
first tree INDEF.OBJ-beyond-ADV 3SUBJ.tall-NMLZ 3OBJ.up

haa'nééh ńt'éé 'ayóo 'áníłnéézlá
3OBJ.3SUBJ.climb.IPFV PAST very 3SUBJ.tall EVID
Absolute prompt: 'First he tried to climbed the tallest tree, but it was too tall.'

b. 'Áłchíní táalt'ée-go, 'anaaígíí honeesná, tsin
children three-ADV competition AREAL.OBJ.3SUBJ.win.PERF tree
'a-láah-go **'áníłnéézí**gíí yaah
INDEF.OBJ-beyond-ADV 3SUBJ.tall-NMLZ 3OBJ.up
haas'na'.
3OBJ.3SUBJ.climb.PERF
Relative prompt: 'Among the three kids, he was the winner because he climbed the tallest tree.'
(Navajo, CMPR$_{\emptyset/STND}$+ANY)

Comparable examples that demonstrate the availability of both relative and absolute quality superlative readings exist for all other NO-YES languages in our sample.

Any explanation for the universal must therefore distinguish between absolute quality and proportional quantity superlatives. It must rely on some factor that distinguishes them, such that languages can have absolute quality meanings but lack proportional meanings. Before we consider what this theory might be, however, we first remark on other generalizations that emerged from our sample.

2.2.2 Distribution of proportional readings by strategy

In addition to support for the proposed universal, our sample yielded several further generalizations about the distribution and realization of proportional superlative readings. We observe first that the distribution of proportional readings for the superlative of MANY is limited with respect to superlative strategy. The majority of languages with proportional readings (coded as YES-YES) exhibit a morphological (M) superlative strategy, as in e.g. Greek (19). Proportional readings were generally missing for superlative strategies involving more complex structures based on comparative markers. The only clear exceptions were Greek and Romanian, both of which employ CMPR+DEF superlative structures in proportional and relative contexts. We illustrate with Romanian (27). See Coppock & Strand (to appear) for extensive discussion of these cases.

(27) a. Eu sunt cel care canta la **cele mai multe** instrumente.
1SG 1SG.be DEF REL 3SG.play to DEF CMPR many instruments
'I am the one who plays the most instruments.'

b. **Cele mai multe** lebede sunt albe.
DEF CMPR many swans 3PL.be white
'Most swans are white.'
(Romanian; CMPR$_{PERIPH/STND}$+DEF)

By contrast, the set of NO-YES languages manifests a diverse array of superlative strategies. Indeed, the set of NO-YES languages included representation from every clear superlative strategy. Representatives of each strategy are given below.

(28) Jas izedov **naj-mnogu** kolači.
1SG 1SG.SUBJ.eat.PERF.PAST SPRL-many cookies
Relative: 'I ate the most cookies.'
(*Proportional unavailable:* 'I ate most of the cookies.')
(Macedonian; M)

(29) Saya makan kue **paling banyak**.
1sg eat cake SPRL many
Relative: 'I ate the most cakes.'
(*Proportional unavailable:* 'I ate most of the cakes.')
(Indonesian; PERIPH)

(30) Jean a lu **le** **plus** de livres.
Jean has read DEF CMPR of books
Relative: 'John has read the most books.'
(*Proportional unavailable:* 'John read most of the books.')
(French; CMPR$_{PERIPH/STND}$+DEF)

(31) Ichaqa ñuka **tukuy** familia-y-**manta** **astawan** **ashka**-ta galletas
but 1SG all family-1POSS-from CMPR many-ACC cookies
mikhu-ni.
eat-1SG
Relative: 'I am also the member of our family who eats the most cookies.'
(*Proportional unavailable:* '...who eats most of the cookies.')
(Quechua; CMPR$_{PERIPH/STND}$+ALL)

(32) (Shí) bááh łikaní **'a-láah-go** yíyą́ą́'.
1SG cookie INDEF.OBJ-beyond-ADV 3OBJ.1SG.SUBJ.eat.PERF
Relative: 'I ate the most cookies.'
(*Proportional unavailable:* 'I ate most of the cookies.')
(Navajo; CMPR$_{\varnothing/STND}$+ANY)

We note two potential challenges to the generalization that proportional readings are absent in languages with more structurally complex superlative strategies. First, Georgian. Georgian speakers readily employ the CMPR$_{\varnothing/STND}$+ALL strategy in translations of all quality superlative prompts (relative, absolute) as well as in translations of relative quantity superlative prompts.[7]

[7]Gorshenin (2012) describes CMPR+ALL strategy as potentially co-primary with a synthetic morphological strategy, where the adjective is marked by the circumfix *u...es*, as in *u-lamaz-es-i* [*u*-pretty-*es*-NOM]. But while such expressions are sometimes translated into English as superlatives ('prettiest'), authors also describe them as expressing simply high degree ('very pretty') (Aronson,

(33) a. Mari **q'vela-ze maγal-i** gogo-a.
Mari all-on tall-NOM girl-3SG.be
'Mari is the tallest girl.'

b. **Q'vela-ze met'-i** nacxvr-eb-i me ševčame.
all-on many.CMPR-NOM cookie-PL-NOM 1SG 1SG.SUBJ.ate.3OBJ
'I ate the most cookies.' (*Context:* Fig. 1)
(Georgian; $\text{CMPR}_{\varnothing/STND}$+ALL)

However, the situation is complicated when we consider proportional prompts. All but one consultant rejected a proportional interpretation ('I ate most of the cookies') for the CMPR+ALL structure in (33). By contrast, a CMPR+ALL structure was volunteered and accepted by the majority (all but one) of consultants in the following context, which specified that 75% of milk comes from cows.

(34) **Qvela-ze met'** rʒe viγebt ʒrox-eb-is-gan.
all-on many.CMPR milk.NOM 1PL.SUBJ.get.3OBJ cow-PL-GEN-from
Prompt: 'Most milk comes from cows.'
Lit: 'We get most milk from cows.'

We conclude, albeit somewhat tentatively, that the CMPR+ALL structure in (34) only superficially appears to have a proportional reading: in fact, it is receiving a kind of relative reading with focus on *cows*, similar to the interpretations discussed by Hackl (2009, p. 76) for German sentences like *Die meisten Studenten sind MÄNNLICH* 'Most of the students are MALE'. For now, Georgian remains a NO-YES language.

Aymara also initially appears to be a language in which a structurally complex superlative strategy is used to express both proportional and relative meanings. Proportional and relative prompts were translated using the expression *jil(a)-pach(a)*, where *jila* is the comparative marker and *pacha* is referred to by Coler (2014) as an 'inclusive' marker. *Pacha* can be used with quantifiers, numerals, and other expressions to convey a notion of totality or precision, among other meanings.

(35) a. Na-w **jil(a)-pach(a)** manq'antawj-t.
1SG-DECL CMPR-INCL eat-1SIM
'I ate the most (cookies).'

b. Na-ki-w **jil(a)-pach(a)** manq'antawj-t.
1SG-DL-DECL CMPR-INCL eat-1SIM
'I ate most (of the cookies).'
(Aymara)

1990; Hewitt, 1995; Harris, 2000). Further elicitation confirmed that the *u...es* circumfix does not convey the uniqueness that characterizes true superlative meaning (N. Amiridze, p.c.).

However, we are skeptical that *jil(a)-pach(a)* is the true Aymara superlative strategy. When asked for free translations of quality superlative prompts, consultants volunteered sentences like (36-a), with the universal quantifier *taqi* in addition to *jil(a)* and *pach(a)*.

(36) a. Isawila-x **taqi**-ni-t-s **jil(a)-pach(a)** jach'a-w.
Isabel-TOP all-ATTRIB-ABL-ADD CMPR-INCL big-DECL
'Isabel is the tallest.'

b. Isawila-x **taq(i)-pacha**-t **jila** jach'a-w.
Isabel-TOP all-INCL-ABL CMPR big-DECL
'Isabel is the tallest.'
(Aymara, CMPR+ALL)

Taqi was also volunteered in relative quantity superlative contexts (37), but was not volunteered in proportional contexts; we expect it to be rejected in such contexts.

(37) Hansu-w(a) kaphiy-x(a) **taqi**-ni-t(a)-s **jil(a)-pach(a)**
Hans-DECL coffee.ACC-TOP all-ATTRIB-ABL-ADD CMPR-INCL
umantaway-pacha.
drink-EVID
'Hans probably drank the most coffee.'
(Aymara, CMPR+ALL)

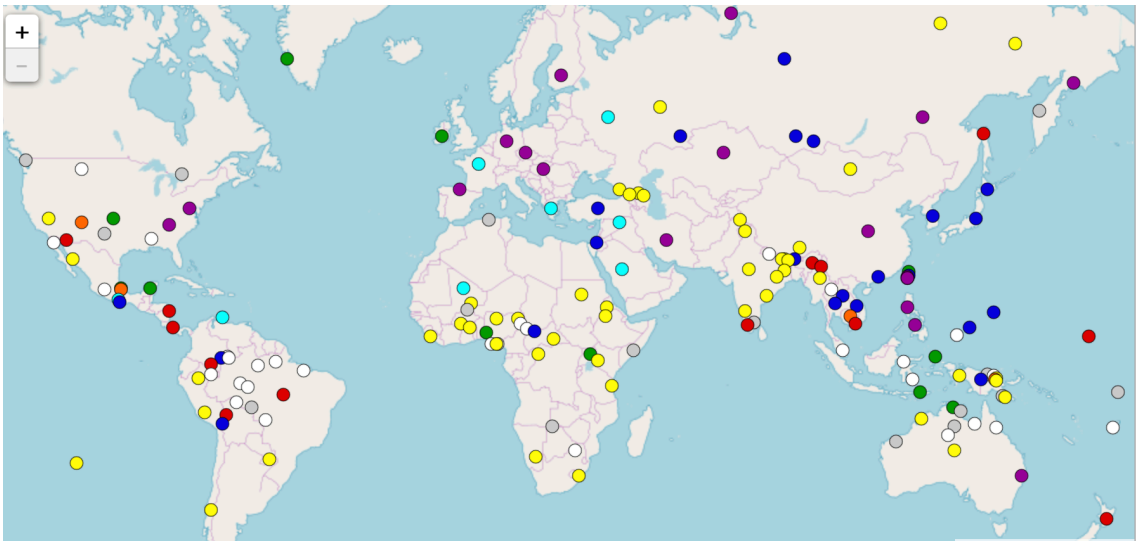
In sum, we tentatively classify our two boundary cases, Georgian and Aymara, as NO-YES languages. The generalization that emerges from the data, then, is that proportional readings for quantity superlatives are largely restricted to languages that employ a morphological (M) superlative strategy.

2.2.3 Geographical distribution of proportional readings

The languages in which proportional readings are clearly available for the superlative of MANY are not only limited in terms of their superlative strategy, but also have a restricted geographic distribution. All clear cases are languages from Europe, with the single exception being Arabic. Speakers of Standard Arabic express proportional superlative meaning by means of *ʔakθar*, which is the result of combining the quantity adjective *kaθīr* with superlative templatic morphology *ʔaCCaC* (Hallman, 2016b). The same expression can also have a relative quantity superlative meaning, as evidenced by our questionnaire results and supported by Hallman (2016a). However, we note that Arabic is in relatively close proximity to other YES-YES languages, so it does not constitute a particularly surprising exception to the apparent geographic generalization.

We note that these two factors – morphological strategy and geography – are

not independent; the morphological strategies for forming superlatives are unevenly distributed across the globe. Figure 4 shows the geographical distribution of superlative strategies used with ordinary gradable adjectives (data combined from Gorshenin (2012) and Bobaljik (2012)).[8] As the reader may verify, the geographical distribution of strategies among the sample we have investigated is representative of the geographical distribution of strategies for ordinary superlatives, and there are relatively few languages with morphological superlatives outside of Europe.



Legend

- M: Morphological superlative marker
- PERIPH: Periphrastic superlative marker
- CMPR+DEF: Comparative plus definiteness marker
- CMPR: No formal distinction between comparative and superlative
- CMPR+ALL: Comparative plus 'of/than all'
- CMPR+ANY: Comparative plus 'of/than some/any'
- VERY: Intensifier
- OTHER/NONE

Figure 4: Geographical distribution of superlative strategies

2.2.4 Proportional readings and the number-marking generalization

A final generalization emerges on closer examination of proportional readings in languages where they exist:

(38) **Number-marking generalization**

[8]The dataset underlying this map is published at Harvard Dataverse (Coppock, 2016).

Quantity superlatives never disagree in number with the associated noun on proportional readings, but they often do on relative readings.

This was observed for Germanic by Coppock (to appear). In Germanic, agreement mismatches involving relative readings involve default (neuter singular) agreement on the superlative and accompanying determiner. For example, relative 'the most cookies' is expressed in Faroese as *flest køkur*, the determiner is neuter singular and the noun is feminine plural, so there is a mismatch in both number and gender. Similarly, in Swedish, we have the historically neuter singular form *flest kakor*, where the superlative lacks plural agreement despite the presence of plural agreement on the noun *kakor* 'cookies'.

Proportional readings in Swedish can involve an agreement mismatch between the superlative and the noun, but not in number, rather in definiteness. Proportional *most cookies* can be translated into Swedish as *de flesta kakor* or *de flesta kakorna*, in both cases involving a plural definite determiner and a superlative bearing a weak ending, which is compatible with plural agreement. In the former, the noun does not bear a definite suffix, so there is a mismatch in definiteness between the superlative and the noun. However, this mismatch does *not* involve number.

Further south, in German, *am meisten Bücher*, with neuter singular *am*, is unambiguously relative. With a proportional reading, the determiner must be plural, as in *die meisten Bücher*. According to Roelandt (2016), in Flemish Dutch, *het meeste bergen*, with the neuter singular definite determiner *het* against the masculine plural *bergen* 'mountains' can be used to mean 'the most mountains' (relative reading), but on a proportional reading, it is always *de meeste bergen*, with a determiner that agrees in number.

This generalization extends beyond Germanic to our larger sample. The Basque sentence in (39) with plural marker *-ak* on the quantity word receives a proportional interpretation.

(39) Amak gaileta-k egin zituen atzo eta ni-k **gehi-en-ak** jan
mom cookie-PL make AUX yesterday and 1SG-ERG much-SPRL-PL ate
nituen.
AUX
'Mom baked cookies yesterday and I ate most of them.'
(Basque; M)

By contrast, a relative reading arises when the quantity word lacks plural marking:

(40) Baina familian gaileta **gehi-en** jaten dituena naiz.
but family cookie much-SPRL eat AUX 1SG.be
'But I am also the member of our family who eats the most cookies.'
(Basque; M)

The proposal we offer in §3.3 will help to explain this generalization.

3 Toward an explanation

Let us now consider how to explain this universal. To begin, we review the compositional routes through which they have been proposed to arise in §3.1. Following this, we consider alternative possible theories.

3.1 How do proportional readings arise?

As far as we know, only two such routes have been proposed, one due to Hackl (2000, 2009), and one due to Hoeksema (1983). We discuss these in turn.

3.1.1 Deriving proportional readings à la Hackl

Hackl's theory is based on the following assumptions. First, *-est* picks up a contextually-given comparison class of individuals $\mathbf{C}$, and takes as arguments a gradable predicate G of type $\langle d, et\rangle$ and an individual x, presupposed to be a member of $\mathbf{C}$, and returns 'true' if and only if the maximal degree to which G holds of x exceeds the maximal degree to which G holds of any *non-overlapping* individual y in $\mathbf{C}$. (Two plural individuals are *non-overlapping* if they have no common sub-individuals.) We use the symbol ∂ from Beaver & Krahmer (2001) to represent presupposition, so $\partial(\mathbf{C}(x))$ is a formula that returns the 'undefined' truth value unless $\mathbf{C}(x)$ is true. We use the symbol $\asymp$ with infix notation to represent the non-overlap relation.[9]

(41) $\textit{-est} \rightsquigarrow \lambda G_{\langle d,et\rangle}\lambda x\,.\,[\partial[\mathbf{C}(x)] \wedge \forall y[[\mathbf{C}(x) \wedge x \asymp y] \rightarrow \max d[G(x,d)] > \max d[G(y,d)]]]$

Second, Hackl assumes that *-est* may occupy one of two different scope positions at LF, one inside the DP and one outside the DP. For *Gloria visited most continents*, on a proportional reading, *-est* occupies an LF position within the DP, as in (42), and the DP is interpreted with a null existential quantifier, notated $\exists$.

(42) *Gloria visited* [$_{\text{DP}}$ $\exists$ [*-est* λd [*d-many continents*]]]

On a relative reading, *-est* moves to be adjacent to the focus, which is *Gloria* in this case, out of the DP. The definite article which is present in the DP cannot be interpreted, so it is deleted at LF, as indicated by the strikeout notation in (43).

[9] Hackl (2009) actually treats the non-overlappingness condition as part of the interpretation of the $\neq$ symbol, and a deeper hypothesis about what it means for two entities to be distinct. In this discussion, we find it useful to distinguish between non-equality and non-overlap, so we use two different symbols for the two concepts.

(43) *Gloria* [*-est* λd *visited* [$_{\text{DP}}$ ~~*the*~~ [*d-many continents*]]]

Third, MANY accepts a degree argument. Hackl (2000) treats MANY as a 'parameterized quantificational determiner' of type $\langle d, \langle et, \langle et, t\rangle\rangle\rangle$; Hackl (2009) treats it as a gradable predicate of type $\langle d, et\rangle$, relating a plural individual to the number of atomic individuals making it up. We will present the latter version and use the non-logical constant many to represent this concept.

The logical translation that is compositionally derived for (42) specifies truth conditions whereby Gloria visited some entity x such that x is a more numerous continent-plurality than all y in the comparison class C which *do not overlap with* x.

(44) $\exists x[\mathsf{visit}(\mathsf{g}, x) \wedge \partial(\mathbf{C}(x)) \wedge \forall y[[\mathbf{C}(y) \wedge y \prec x]$
$\rightarrow \max d[{*}\mathsf{cont}(x) \wedge \mathsf{many}(x, d)] > \max d[{*}\mathsf{cont}(x) \wedge \mathsf{many}(y, d)]]]$

For example, consider a $\mathbf{C}$ made up of the elements a, b, c, and all sums thereof, including ab (the sum of a and b), ac (the sum of a and c), and abc (the sum of all three), illustrated in Figure 5. Among the elements which satisfy the condition imposed on x is ab, because the only y in $\mathbf{C}$ that does not overlap with ab is c, and c has fewer atoms than ab. This means that this particular x is more numerous than all y in $\mathbf{C}$ which do not overlap with it, so it satisfies the description. Similar reasoning holds for ac and bc and of course abc. So this theory predicts that any plurality which constitutes more than half of the atoms in the domain will satisfy the condition, correctly capturing the 'more than half' condition. And because there are multiple xs that can satisfy this condition, it is correctly predicted for English that proportional *most* will not license a definite article, though proportional *most* does license definite articles in other languages, as discussed in the next section.

3.1.2 Deriving proportional readings à la Hoeksema

Hoeksema (1983) gives a compositional analysis of cases like Dutch *de meeste boeken*, lit. 'the most books' which is ambiguous between a relative reading and a proportional reading.

(45) Anton heeft de **meeste** boeken gelezen.
Anton has DEF many.SPRL books read
'Anton has read {the most, most of the} books.'
(Dutch; M)

According to Hoeksema's analysis, on the proportional reading, two groups of books are compared with respect to size, those that Anton has read, and those that Anton has not read. Thus the contextually-provided comparison class must consist of these two groups of books. If $\mathbf{C}$ is not assumed to be constituted by a sum lattice, but rather a set of non-overlapping pluralities, then it is not necessary to assume that

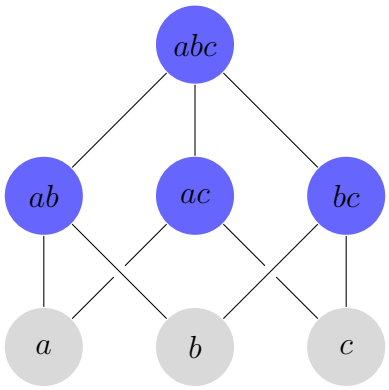


Figure 5: Hasse diagram for a sum lattice exemplifying a possible comparison class. Colored nodes are elements of the comparison class that are more numerous than all non-overlapping elements.

-est quantifies only over non-overlapping elements, so '$x \neq y$' can replace '$x \asymp y$' in the lexical entry for *-est*:[10] If **C** consists of two non-overlapping pluralities of books, those that Anton read and those that Anton did not read, then this *-est* combined with 'many' and 'books' denotes, relative to **C**, a predicate that holds of the larger of the two.

See the discussion in §3.3.2 for tentative arguments in favor of Hoeksema's strategy. It may be that both of these routes are used, in different languages, or under different circumstances more broadly. Moreover, these may not be the only two routes to proportional readings, and it is possible that neither one adequately captures how proportional readings are derived. But what is clear is that any theory that predicts that allows one of these routes predicts that proportional readings should be available. Thus under ordinary circumstances, both should be disallowed.

3.2 Previous views

Having established that proportional readings of quantity superlatives are typologically marked, and rare, let us consider why this might be the case. There are several potential explanations already in the literature, all of which contribute valuable insights but do not cover all of the data. We consider them in turn.

[10]Hoeksema's actual analysis is formulated in terms of a superlative predicate that takes a comparison relation such as *taller than* or *more* as an argument. This is in line with Bobaljik's (2012) findings suggesting that superlatives contain comparatives, as well as the diverse range of strategies for forming superlatives, but it is not immediately relevant to our point here.

3.2.1 DP layer?

Building on Boškovic's (2008) division of languages into those that have a DP layer above NP and those that lack one, Boškovic & Gajewski (2008) explain the (non-)availability of proportional readings based on the presence or absence of a DP layer in the noun phrase. Boškovic & Gajewski assume that MANY has a type that is incompatible with -EST (unlike ordinary gradable adjectives, which may remain *in situ*). This type-incompatibility forces -EST to move and take scope. A DP layer provides a DP-internal landing spot for -EST, giving rise to a proportional reading. Without a landing spot within DP, -EST must seek higher ground; hence a relative reading.

(46) **DP layer hypothesis**
A DP layer provides a landing spot for -EST, enabling a proportional reading to arise.

Evidence for this proposal is adduced by the authors from Živanović's (2007b) finding that, among the languages he studied, languages that have what he calls a 'majority superlative determiner' also have a definite determiner. (ivanovi calls the proportional reading the 'majority' reading and the relative reading the 'plurality' reading.) Živanović (2007a) claims that the opposite direction holds as well: Languages having a definite determiner and what he calls a 'plurality superlative determiner' also have what he calls a 'majority superlative determiner'. The former corresponds roughly to a superlative of MANY with a relative reading; the latter corresponds roughly to a superlative of MANY with a proportional reading, although the distinction is slightly different, as we will discuss shortly. Boškovic & Gajewski (2008) build their analysis on the claim that the implication is bidirectional; they write, "English, German, Macedonian, Dutch, Bulgarian, Norwegian, Hungarian, and Romanian have articles and allow the majority reading; SC, Slovenian, Czech, Turkish, Polish and Punjabi lack articles and do not allow the majority reading". So the claim is:

(47) a. Every language that has a 'majority superlative determiner' has a definite determiner.
b. Every language that has a definite determiner and a 'plurality superlative determiner' has a 'majority superlative determiner'.

It is worth clarifying what these authors mean by 'plurality superlative determiner'. Based on Živanović's (2007b) summary at the end of his paper, it appears that Hebrew and Catalan are not languages that have "plurality superlative determiners", even though they do have what we would call a superlative of MANY. These cases are relevant because both Hebrew and Catalan have definite determiners, and yet the superlative of MANY does not have a proportional reading in these languages,

as Živanović (2007b) himself points out.

Boškovic & Gajewski (2008) predict that in any language with overt definite determiners (hence a DP layer), the superlative of MANY should have a proportional reading. This prediction is not borne out by the facts: we find languages with overt definite determiners which nevertheless lack proportional readings.[11]

In Hebrew (Semitic, Afro-Asiatic), there is a proportional quantifier *rov* 'most', shown in (48), which is morphologically distinct from the superlative of MANY, namely *haxi harbe* 'SPRL many', shown in (49). Example (50) shows the same superlative element *haxi* in combination with *few*.

(48) **rov** ha-yelad-im she-holx-im le-beyt ha-sefer
most DEF-child-PL.MASC REL-go.PRES-PL.MASC to-house DEF-book
Sel-i ohav-im li-Smoa musika
of-1SG like-PL.MASC to-hear music
'Most of the kids who go to my school like to play music.'
(Hebrew)

(49) mi-kol ha-yelad-im be-beyt ha-sefer shel-i, ani (hi)
of-all DEF-child-PL.MASC in-house DEF-book of-1SG 1SG be.FEM
zot Se-menagen-et be-**haxi harbe** kley negina
DEM.FEM REL-play.PRES-FEM.SG at-SPRL many instruments
'Of all the kids in my school, I'm the one who plays the most instruments.'
(Hebrew; M)

(50) mi Se-menagen be-**haxi me'at** kley negina b-a-miSpaxa
who REL-play.PRES.MASC.SG at-SPRL few instruments in-DEF-family
Sel-i zo axot-i Karin
of-1SG be sister-1SG Karin
'The member of my family who plays fewest instruments is my sister Karin.'
(Hebrew; M)

[11] There is another possible counterexample in the opposite direction: a language that *lacks* a determiner, in which proportional readings *are* available for quantity superlatives. As mentioned above, Georgian is a potential case where the superlative of MANY has a proportional reading. If indeed Georgian allows proportional readings, then this case is problematic for Boškovic & Gajewski (2008) given that Georgian seems to lack a DP layer. Georgian has neither definite nor indefinite overt articles (Gil, 1982), an attribute that when found in other languages is taken by Boškovic (2008) to indicate the absence of a DP layer. While the mere absence of overt definite articles may not be sufficient to show that a given language lacks a DP layer (see e.g. Syed & Simpson (2017) on Bengali), we observe that apart from proportional readings, Georgian patterns in all other respects like a language lacking articles, according to Boškovic's (2005) criteria: it allows left branch extraction (Polinsky, 2016), permits scrambling (Schäfer, 2008; Skopeteas & Fanselow, 2010), and lacks superiority effects in multiple *wh*-questions (Amiridze, 2003; Erschler, 2015). Thus all available evidence suggests that Georgian lacks a DP, and yet proportional readings are available in this language, which is unexpected for Boškovic & Gajewski (2008).

It is not clear if *rov* is morphologically decomposable, but in any case it is not the regular superlative of *harbe* (Hadas Kotek, p.c.). The regular superlative of MANY, *haxi harbe*, cannot be used with a proportional interpretation. Hebrew thus shows that there are languages with definite determiners that lack proportional readings for the superlative of MANY. Romance languages, including the case of Catalan that Živanović mentions, also fall into this category.

Why don't Hebrew and Catalan count as having 'plurality superlative determiners'? Apparently the superlative of MANY does not count as a determiner in these languages, due to the fact that it is not formed using a morphological strategy, but rather periphrastically (Hebrew) or with the help of a definite article (Catalan). Indeed, Živanović (2007a, 13-20) goes to some length to characterize what it means to be a determiner, including being the sort of thing that can occupy the D position of a DP. If Živanović's (2007a) generalization is limited to those languages in which the superlative of MANY happens to be formed morphologically, then it has a much more limited scope than the universal we have given evidence for here. Any explanation for this more narrow generalization may not extend to the full range of cases we have considered.

But even this more narrow generalization is challenged by languages with morphological (M) quantity superlatives that could plausibly be treated as determiners, but which still lack proportional readings. Pancheva (2015) observes that Bulgarian has a definite determiner but quantity superlatives lack a proportional reading, which is unexpected for Boškovic & Gajewski (2008).

(51) Maria pročete **naj-mnogo**(-to) statii.
Maria read SPRL-many(-DEF) articles
Relative: 'Maria read the most articles.'
(*Proportional unavailable:* 'Maria read most of the articles.')
(Bulgarian; CMPR+DEF)

Parallel results obtain for other Slavic languages including Macedonian,[12] and Kurdish Sorani, which exhibits definiteness-marking but lacks a proportional interpretation for its regular quantity superlative (52). Proportional readings are expressed by the alternative quantity expression *zorba* (53).

(52) La nevaan tawaw-i mndalaan-i qutaabxaan-aka-m mn taaqe
from between whole-EZ kids-EZ school-DEF-my 1SG only
kas-eka-m Ka **zor-tar-in** aamer-i musiqaa
person-INDEF-1SG REL much-CMPR-SPRL instrument-EZ music

[12]Macedonian signals proportional readings by means of *poveḱe*. It is unclear why Živanović (2007b) refers to *poveḱe* as a 'superlative determiner' given its lack of superlative marker *naj-*. The prefix *po-* found in *poveḱe* is generally classified as a comparative marker (Bobaljik 2012, 127, Liljana Mitkovska, p.c.)

dazaan-em wa dajan-em.
know.PRES-1SG and play.PRES-1SG
'Of all the kids in my school, I'm the one who plays the most instruments.'
(Kurdish Sorani; M)

(53) **Zorba**-i mndalaan awanái va dena qutaabxaana-i mn pe-yan
most-EZ kids those such come.PRES school-EZ 1SG to-them
Xosh-a musiqa bezhan-in.
pleasant-is musik play.PRES-3PL
'Most of the kids who go to my school like to play music.'
(Kurdish Sorani)

Even if Živanović's (2007b) more narrow generalization were correct, Boškovic & Gajewski's (2008) explanation for it would seem to *predict* a somewhat broader generalization, one that is blind to whether superlatives are formed analytically or synthetically. As long as there is an -EST element to undergo movement, presumably, the same factors should be at play. And thus Boškovic & Gajewski (2008) would appear to predict that proportional readings should be available at least in languages that use a periphrastic superlative construction, such as Hebrew, if not among a broader set. So Bulgarian, Macedonian, Kurdish Sorani, and Hebrew would all seem to be puzzling under this account. Assuming these languages have DPs, then it is not the absence of a DP layer that explains the absence of proportional readings in these languages.

Albanian, which also has definiteness-marking, is another potential counterexample, but in this language, there is no morphological distinction between comparative and superlative; periphrastic *më* is consistently used to express both comparative and superlative meaning. For proportional 'most', the form *shumicës* is used, while *më shume* 'more many' is used for relative 'most'. It is unclear to us what Boškovic & Gajewski (2008) would predict for this case; it depends whether an -EST element is to be posited. If there is no such element, then the predictions of their theory are not falsified by this case. The more restricted the scope of the theory, however, the less potential it has to explain a broad cross-linguistic universal, though.

To summarize: There are quite a number of counterexamples to the claim that every language that has a definite determiner has a proportional reading for the superlative of MANY. Some are cases in which the language uses a morphological strategy to form superlatives (Bulgarian, Macedonian, and Kurdish); these are counterexamples to Živanović's (2007a) original claim, which was limited to 'superlative determiners'. These also present a puzzle for Boškovic & Gajewski's (2008) view. Additional challenges come from cases like Hebrew and possibly Albanian, where superlatives are formed periphrastically.

Before moving on, let us briefly note one additional problem with the DP layer hypothesis, which is more of a conceptual nature. In every language where proportional readings of *many* are blocked, absolute readings of ordinary gradable adjec-

tives like *tall* are available. So it is crucial on this view that a DP-internal reading of *many* may be blocked while a DP-internal reading of an ordinary gradable adjective like *tall* is not. In order to ensure a difference in type between *many* and *tall*, Boškovic & Gajewski (2008) propose that *many* has a modificational meaning (type $\langle d, \langle \langle e, t \rangle, \langle e, t \rangle \rangle \rangle$) while ordinary gradable adjectives like *tall* are of type $\langle d, \langle e, t \rangle \rangle$:[13]

(54) $many \rightsquigarrow \lambda d \lambda P \lambda x \,.\, P(x) \wedge \mathsf{many}(x, d)$

(55) $tall \rightsquigarrow \lambda d \lambda x \,.\, \mathsf{tall}(x, d)$

Thus, while Boškovic & Gajewski's (2008) account posits a type difference between *many* and *tall*, the difference is not deep; it amounts to a common shift between the two types that does not alter the basic conceptual meaning of *many* or *tall*. In other words, the derivation of absolute and proportional readings is still fundamentally similar. If this were all that stood in the way of proportional readings, we would expect to find them far more often.

3.2.2 Cardinal vs. proportional *many*?

Another possibility explored in the literature is to place the blame on the quantity word, building on the observation that languages can differ with respect to the focus-sensitivity of their quantity words. English *many* has been claimed to have multiple readings (Milsark, 1977; Westerståhl, 1985; Löbner, 1987; Partee, 1989; Büring, 1996; Herburger, 1997; Cohen, 2001; Solt, 2009; Krasikova, 2011; Krasikova & Champollion, 2011). For instance, Partee (1989) claims that (56) is ambiguous between 'cardinal' and 'proportional' readings:

(56) Many aspens died.
Cardinal reading: A large number of aspens died.
Proportional reading: A large proportion of aspens died.

The classic example of the so-called 'reverse' reading, first discussed by Westerståhl (1985), is the following:

(57) Many Scandinavians have won the Nobel Prize in Literature.

This sentence can be felt to be true on grounds that Scandinavians make up a large proportion of the winners, even though the absolute number of Scandinavians who have won and the proportion of Scandinavians who have done so are both very small.

Not all quantity words exhibit all of these readings. Krasikova & Champollion (2011) show that Russian exhibits a distinction between cardinal and proportional

[13] This is presented as Hackl's (2000) view, but is actually slightly different; Hackl's 'parameterized quantificational determiner' account treats MANY as an expression of type $\langle d, \langle et, \langle et, t \rangle \rangle \rangle$. As far as we can see, the difference is crucial; we do not see how to derive proportional readings DP-internally using the $\langle d, \langle et, \langle et, t \rangle \rangle \rangle$ analysis.

MANY (*mnogie* vs. *mnogo*), where the former is focus-sensitive and the latter is not. Could it be that languages differ with respect to their inventory of quantity words, and this is what drives the availability of proportional readings in a language?

Pancheva (2015) considers and rules out this possibility. It would be the non-focus-sensitive MANY that underlies proportional readings, rather than the focus-sensitive one. As she points out, given the broad availability of proportional, non-focus-sensitive uses of MANY in languages that lack proportional readings for quantity words, it is not clear how the detailed semantics of MANY could be leveraged to explain the universal.

3.2.3 Underlying pseudopartitive structure?

Pancheva (2015) proposes an alternative explanation for missing proportional readings: Quantity superlatives always derive from an underlying pseudopartitive structure containing an abstract measure noun, but different interpretations emerge depending on whether a *measure* or *individuating* pseudopartitive is involved. This distinction can be illustrated with the following contrast:

(58) a. John broke two glasses of water. [individuating]
b. John added two glasses of water to the soup. [measure]

In *individuating* pseudopartitives, as in (58-a), the container or measure noun (*glass*) is the head, whereas in *measure* pseudo-partitives, as in (58-b), the substance noun (*water*) is the head (Doetjes, 1997; Landman, 2004; Rothstein, 2009; Alexiadou et al., 2007). Pseudopartitive structures may contain an abstract noun meaning 'number' or 'amount', as in the following example from Italian, which gives rise to a relative reading, but not a proportional reading.

(59) **il maggior numero** di articuli
DEF large.CMPR number of articles
Relative: 'the most articles'
(*Proportional unavailable:* 'most of the articles')

Pancheva proposes that in Slavic-type languages, the superlative of MANY spells out a combination of a special degree-oriented form of *large* ($large_d$) and an abstract NUMBER noun specialized for individuating pseudopartitives (NUMBER_i) as in (59), along with -EST. (This is the underlying structure only for the *superlative* of MANY, as positive and comparative forms of MANY in Slavic are compatible with measure pseudopartitives as well.) Pancheva posits a different abstract NUMBER noun (NUMBER_m) for measure pseudopartitives. In languages where the superlative of MANY spells out the measure structure (such as English), both relative and proportional interpretations are available, because the comparison class turns out to consist of individuals. We refer the reader to Pancheva's paper for further details.

One attractive aspect of this proposal it that it is consonant with the tendency for quantity superlatives with relative readings to take singular agreement, discussed above on p. 5. These effects can be explained under Coppock's (to appear) target-domain hypothesis, assuming that the target argument is a degree in the case of relative readings, in combination with Pancheva's proposal. The target argument would be a degree in the case of relative readings under Pancheva's proposal, as the superlative modifies an abstract NUMBER noun.

But we are not convinced that this proposal actually derives the universal, even given the (rather strong) assumption that languages must select among individuating and measure pseudopartitive constructions to serve as their underlying structures for the superlative of MANY. Pancheva claims that in those languages that allow only the individuating pseudopartitive, only relative readings will arise. But we fail to see a principled reason why a proportional reading could not arise under her assumptions about the individuating pseudopartitive. Suppose that the comparison class consisted of two degrees, the cardinality of the set of swans that are white, and the cardinality of the set of swans that are not white. If the comparison class is constituted in just this way, then a 'more than half' interpretation will arise for *The most swans are white*. Nowhere in the paper is it made explicit what would rule out this sort of interpretation.

Furthermore, under Pancheva's proposal, quantity superlatives arise through the spell-out of an underlying structure involving the adjective LARGE and the noun NUMBER. Yet there is no trace of this underlying structure on the surface; they are not morphologically related to either LARGE or NUMBER (by definition).

Relatedly, Wilson (2016, 17), who advocates a similar idea to Pancheva's, points out that if there is a silent NUMBER noun in combination with LARGEST, then we might expect just LARGEST to realize a structure excluding NUMBER, yielding a reading for something like 'He ate the largest (of) cookies' as 'He ate the largest number of cookies.' (Wilson's example is *He ate the smallest almond tarts.*)

Moreover, Pancheva stipulates that MANY is the spell-out of 'LARGE NUMBER' *only in the context of superlatives*. It is hard to see how this could be grounded in universal principles. Moreover, it is not clear why -EST could not combine with non-superlative MANY in the presumed measure pseudopartitive structure, when this is possible for positives and comparatives.

Another problem is that the substance noun in relative-only quantity superlatives is not always marked the way pseudopartitives are (although they do pattern distinctively alike in some languages, such as Polish, where both appear with genitive case). In Italian, pseudopartitives are marked with *di* (e.g. *il magggior numero di articuli* (59)). By contrast, quantity superlatives do not contain this marker (de Boer, 1986).[14]

[14]Note that there is no morphological distinction between comparatives and superlatives in Italian: *più* can mean either 'more' or 'the most'. The same is true for Ibero-Romance, e.g.

(60) Dei nostri amici Luigi è quello che ha **più** (***di**) **soldi**.
of.DEF 1PL.POSS friends Luigi 3SG.be the.one REL has CMPR of money
'Of our friends, Luigi is the one who has **the most money**.'
(Italian)

Similar facts hold for Spanish (*un kilo de manzanas* 'a kilo of apples'; *Soy el que come **más galletas** en mi familia* 'I am the one who eats **the most cookies** in my family').

Mandarin is another language in which the behavior of quantity superlatives does not match the behavior of measure pseudopartitives. The substance noun in Mandarin pseudopartitives sometimes occurs with *de*, and this has the effect of disambiguating between individuating and measure readings. Rothstein (2017, 156) writes: "As Cheng & Sybesma (1998) show, *de* forces a measure reading, and is infelicitous in a context which requires the individuating interpretation. (61-a) requires the individuating interpretation (and *de* is out); (61-b) requires the measure interpretation (and *de* is in)."

(61) a. #Wo kai le san ping **de** jiu.
1SG open ASP three CL_{bottle} DE wine
Intended: 'I opened three bottles of wine.'
b. Wo de wei neng zhuangxia san ping **de** jiu.
1SG.POSS stomach can hold three CL_{bottle} DE wine
'My stomach can hold three bottles of wine.' (Rothstein, 2017, 156)
(Mandarin)

The Mandarin superlative structure (62) only permits a relative interpretation. In this structure, *de* is permitted, although not obligatory (Hsin-Lun Huang, p.c.).

(62) Wo chi le **zui duo de** binggan.
1SG eat ASP SPRL many DE cookie
'I ate the most cookies.'
(Mandarin; PERIPH)

This means that superlatives on relative readings can reflect an underlying measure pseudopartitive structure, rather than an individuating one as predicted by Pancheva.

It is even more problematic to assume that proportional readings involve pseudopartitive structures. As Dobrovie-Sorin has emphasized in her work (Dobrovie-Sorin, 2013, 2015; Dobrovie-Sorin & Giurgea, 2015), proportional readings often involve true partitive structures, while relative readings do not. True partitives are

Spanish *más*. The difference between superlatives and comparatives can be detected with the presence of an overt comparison class, as we have in (60) (*dei nostri amici* 'of our friends'). As Luigi is considered a member of this group, the interpretation is clearly superlative rather than comparative.

quite distinct from pseudopartitives, with respect to a number of syntactic behaviors, including extraposition, adjectival modification, stranding, and fronting (Stickney, 2009, 45). And they are not interchangeable: Dobrovie-Sorin (2013) points out that mass substance nouns often require partitive constructions on proportional interpretations, while count nouns prefer non-partitive constructions. This is borne out throughout a range of Germanic languages as Coppock (to appear) shows. This sort of difference is not possible to explain under the assumption that all proportional readings involve pseudopartitive structures.

Finally, when the putative underlying pseudopartitive structure is made overt, *it has only a relative reading*:

(63) Kate wrote the greatest number of articles.

Given this, how could such a structure be the underlying structure for a quantity superlative on a proportional reading?

This last point brings out a deep fact: *When quantities are compared, a relative reading arises.* It is important to consider why this might be. If we can understand why (63) has only a relative interpretation, we may be in a position to understand why quantity superlatives are typically restricted in the same way, if we can also assume that quantity superlatives are fundamentally similar to these kinds of constructions in some way. Our proposal, presented in §3.3, explains this.

3.3 Proposal

3.3.1 Ruling out proportional readings

Both of the routes discussed in §3.1 involve a quantity word that is a gradable predicate of individuals, type $\langle d, et \rangle$. We propose that quantity words by default denote gradable predicates of *degrees* instead (e.g. type $\langle d, dt \rangle$). The superlative of a quantity word characterizes a degree that is greater than all other degrees in the context. Such an expression combines semantically with a noun in a manner similar to how a measure phrase like *two liters* combines in a phrase like *two liters of milk*, with the help of some compositional 'glue' that ties the nominal predicate with a degree-denoting phrase.

Under these assumptions, neither Hackl's route nor Hoeksema's route is available, as both depend on a $\langle d, et \rangle$-type meaning for MANY. But these assumptions still do not suffice to rule out proportional readings entirely, because there is another way a proportional reading for the superlative of *many* could be derived. In principle it could characterize the degree that is the greatest of the salient set of degrees in the context, and there could be two contextually-salient degrees, one which corresponds to the number of individuals that satisfy a given predicate, and another which corresponds to the number of individuals that do not. (A similar problem was raised above for Pancheva's account.) This would yield a proportional

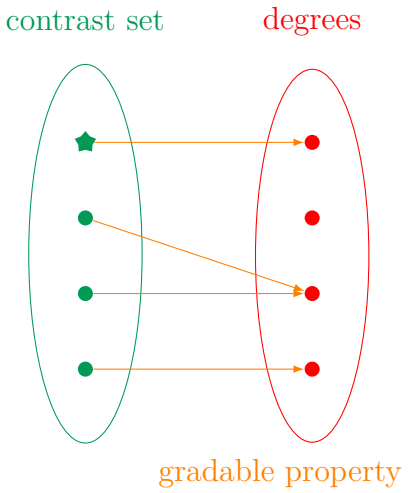


Figure 6: Anatomy of a simple superlative scenario

interpretation. In order to rule this out, an additional assumption is necessary.

Stating this additional assumption requires us to introduce a bit of terminology for talking about the meaning of superlatives. Given the number of languages to cover, the number of different constructions to take into consideration even within a given language, and the diversity of languages with respect to the morphosyntactic details of how superlatives are formed, it is convenient to express this assumption at a certain level of abstraction.

Generally, superlatives involve comparison along some dimension, among some set of entities. In English, the set of entities among which this comparison is made can be indicated using an *among*, *out of*, or *of* phrase. We call this set of entities the CONTRAST SET.[15]

The semantics of a superlative construction can be characterized in terms of situations in which the members of the contrast set are all associated with degrees via some gradable property such as height. A schematic representation of such a situation is given in Figure 3.3.1. The star represents the target argument of the superlative.

In the case of a relative reading, the gradable property that associates the contrast set with the degrees is not expressed by the predicate to which superlative

[15]The contrast set may be explicitly identified, or it may be invoked implicitly. In languages like Wolof, where no morphosyntactic distinction is made between comparative and superlative, it may well be the case that a contrast set is sometimes implicitly invoked, although it is hard to tell. But crucial to being a superlative use is that a contrast set is invoked. Merely saying *Ann is taller than Bill* does allow one to infer that Ann is tallest among some set of entities, but it does not *invoke* a contrast set in the intended sense, implicitly or explicitly. *Who are you comparing among?* is not a reasonable thing to say in response to such an assertion, for example.

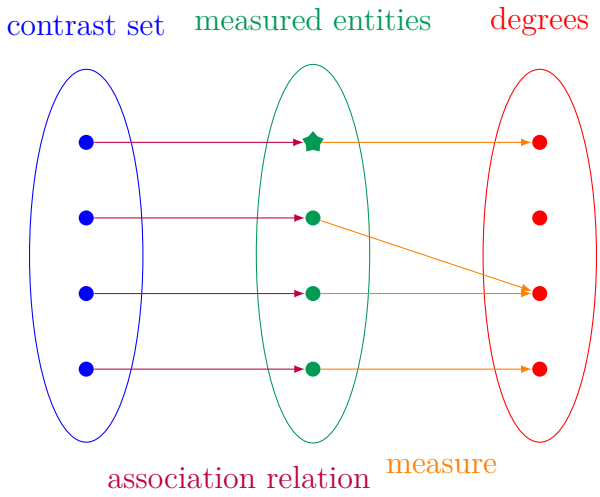


Figure 7: Anatomy of a relative-superlative scenario

morphology applies. Rather, the members of the contrast set are associated with degrees indirectly, via a set of entities measured by that predicate. For example, on a relative reading of *Gloria climbed the tallest mountain*, Gloria and the other climbers constitute the contrast set, and they are indirectly associated with degrees of mountain height on the basis of the mountains that they climb. Following Coppock & Beaver (2014), we call the relation between the climbers and the mountains an ASSOCIATION RELATION, and we call the gradable property that is expressed by the predicate to which superlative morphology attaches, namely *tall* in this case, the MEASURE.[16] Such a situation might look as in Figure 3.3.1.

The members of the contrast set are associated with degrees through the relational composition of the association relation with the measure. Just as in the simple case, a superlative construction in the case of a relative reading requires that there be a single member of the contrast set that is associated with the highest degree. The target argument for the superlative is the measured entity associated with that member of the contrast set; this is indicated with the star in Figure 3.3.1.

In fact, absolute readings can be seen as an instance of this latter schema, where the association relation is identity. In that case, the contrast set and the measured entities collapse. So this latter, more complex schema may be seen as definitional for superlative constructions, with the simpler schema as a special case.

We cannot specify in full detail how these components are morphosyntactically realized in every language; indeed, these questions are controversial even for English. But we do assume certain constraints. The MEASURE is the gradable predicate

[16]The association may or may not be identical to Szabolcsi's 'frame of comparison'; we are unsure exactly what this term was meant to encompass.

to which superlative morphosyntax attaches (e.g. *tall*). The MEASURED ENTITIES constitute the range of the association relation, and the entities to which the measure applies. The CONTRAST SET is identified with the set of measured entities when the association relation is identity; otherwise it is identified by an appropriate licensor.

With this conceptual framework in place, let us posit two general constraints that will allow us to derive the universal:

1. **Compare Individuals:** The contrast set consists of (possibly plural) individuals.

2. **Measure Quantities:** Quantity words denote gradable predicates of degrees.

Together, these two constraints force a focus-sensitive reading for quantity superlatives, because together, they imply that the contrast set must be distinct from the set of measured entities. The measured entities must be quantities (degrees), given that they are measured by quantity words, which are gradable predicates of quantities; since the contrast set is made up of individuals, the association relation cannot be identity. The only other option is for the association relation to be determined by an appropriate licensor, such as focus. Hence quantity superlatives will always have focus-sensitive readings.

We now sketch one compositional implementation of our theory, for a language with a superlative morpheme. Quantity words denote gradable predicates of degrees; they are type $\langle d, dt\rangle$ (cf. $\langle d, et\rangle$). The simplest quantity word is MUCH:[17]

(64) MUCH $\rightsquigarrow \lambda d \lambda d' \,.\, \mathsf{size}(d') = d$

(MANY has an additional presupposition that d' is a cardinality.) The size of a degree is arguably the degree itself; on this view, the denotation is the identity relation over degrees.

Superlative constructions characterize the measured entity that is associated with the member of the contrast set corresponding to the highest degree. Let us use $\mathsf{sup}(x, G, C)$ to denote the proposition that x is most G in C. Then $\mathsf{sup}(x, R \circ M, C)$ denotes the proposition that x is greatest in C with respect to the composition of R with M. Similarly to Coppock & Beaver (2014), we take a superlative morpheme, given a measure M, to characterize a measured entity y that is associated via R with some x such that $\mathsf{sup}(x, R \circ M, C)$, for appropriate R, M, and C. We assume that these variables are free and fixed via constraint satisfaction. This yields the following lexical entry for *-est*:

[17] Of prior proposals for quantity words, ours most resembles those of Solt (2009, 2015) and Rett (2008), where quantity words are type $\langle d, \langle dt, t\rangle\rangle$ and $\langle dt, dt\rangle$, respectively. Rett does not apply her analysis to superlatives; Solt offers a treatment using a modification of her 2015 theory in her 2011 paper but under that analysis the target of a quantity superlative is still always an individual rather than a degree.

(65) -EST$\rightsquigarrow$
$\lambda M_{\langle d,\langle\tau,t\rangle\rangle}\lambda y_\tau\,.\,\partial(\mathbf{C}(\mathbf{x}) \wedge \mathbf{R}(\mathbf{x}, y)) \wedge \mathsf{sup}(\mathbf{x}, \mathbf{R} \circ M, \mathbf{C})$

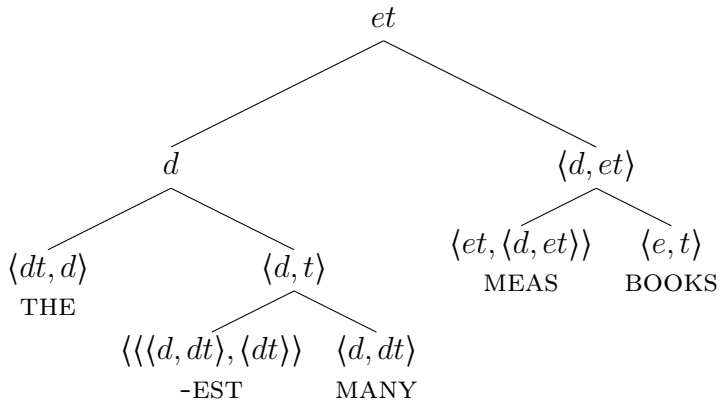
Here, τ can be type e, d or v. $\mathbf{C}$ must consist of individuals (type e) and $\mathbf{R}$ relates individuals in $\mathbf{C}$ to things of type τ. Combined with a gradable predicate like *many* or *much*, the result is a predicate of type $\langle d, t\rangle$.

To compose a quantity expression with a noun, we adopt the assumption that there is a silent measure head; see for example Rett 2014 and Solt 2015 and references cited therein. Here, we adopt Rett's (2014) M-Op, which we write MEAS:

(66) MEAS $\rightsquigarrow \lambda P \lambda d \lambda x\,.\,P(x) \wedge \mu(x) = d$ (where μ is a salient measure function)

The combination of MEAS with the noun is a predicate that is expecting a degree argument. This degree argument can be saturated by the quantity superlative directly if an IOTA type shift applies to *many* + *est*. For English, we might assume that the definite article is a verbal instantiation of this shift, so that *the* forms a constituent with *most*, but this is not crucial.[18] The structure of the derivation for English *the most books*, then, is given in (67).

(67) Structure of a relative reading



Crucially, the target argument of the superlative is a degree. This rules out proportional readings, given the constraint that $\mathbf{C}$ must consist of individuals. That constraint forces $\mathbf{C}$ to be distinct from the set of measured entities, which forces it to become focus-sensitive.

This theory also explains the number agreement generalization. Recall that on Coppock's (to appear) target-domain hypothesis, the agreement features of a superlative reflect the domain from which the target argument is drawn (degrees, individuals, events, etc.). On this view, the domain of plural individuals corresponds

[18]This analysis of superlatives under relative readings is similar to Krasikova's (2012) proposal for relative readings in general insofar as the comparison class involves degrees (or sets thereof, or intensions of sets thereof), but it overcomes Krasikova's problem with ties, discussed by Bumford (2016).

to plural agreement, while the domains of degrees and events correspond to default (neuter singular) agreement. Since the measure is a gradable predicate of degrees, the measured entities are always degrees, so the target of the superlative will be a degree. Thus our assumptions predict that quantity superlatives on relative readings will exhibit default (neuter singular) agreement, a prediction that is generally borne out, as discussed above on p. 5. (There are cases of relative quantity superlatives on relative readings in which full agreement is displayed, such as Greek, so either this is a mere tendency rather than a hard-and-fast rule, or relative quantity superlatives in languages such as Greek involve a MANY that is actually a gradable predicate of individuals rather than degrees. This is a question for future research.)

In Romance languages as well, quantity superlatives mirror adverbial superlatives in their morphosyntax (Coppock & Strand, to appear). For example, in Italian, along with other Ibero-Romance languages, quantity superlatives lack definiteness-marking, despite the fact that these languages generally form superlatives with the help of a definite article:

(68) Di tutti i ragazzi della mia scuola io sono quello che
of all DEF kids in.the 1POSS school 1SG 1SUBJ.be the.one REL
suona **più strumenti**.
3SUBJ.play CMPR instruments
'Of all the kids in my school, I'm the one who plays the most instruments.'
(Italian)

Adverbial quantity superlatives also lack definiteness-marking:

(69) ... uno che lavora **più** di tutti e parla **meno** di
... one REL 3SUBJ.work CMPR of all and 3SUBJ.speak little.CMPR of
tutti.
all
'... one who works **most** of all and speaks **least** of all'
(Italian)

Generally, among Romance languages, there is a perfect correlation between whether adverbial superlatives are marked definite in the language and whether quantity superlatives are (Coppock & Strand, to appear). This commonality can be explained under the assumption that both quantity and adverbial superlatives differ from the superlatives of ordinary gradable adjectives in their semantic type.[19]

Before moving on to how proportional readings arise, let us briefly note one more advantageous prediction of these assumptions. Adverbial superlatives, as in *John ran the fastest* are always focus-sensitive, i.e., have only relative reading. A sentence like *John ran the fastest* requires that there is at least one alternative to John that

[19]Greek is an exception to this generalization: Adverbial superlatives obligatorily lack definiteness-marking, but quantity superlatives always have it.

ran at some speed. Suppose that *fast* relates events to degrees; letting v be the type for events, it is of type $\langle d, vt \rangle$. If the target in such cases is an event, then our theory predicts the contrast set must be distinct from the measured entities in the case of adverbial superlatives, and hence requires them to be focus-sensitive, correctly.

3.3.2 Proposal for proportional readings

What happens in languages that *do* have proportional readings? We suggest that a precondition for the development of proportional readings is that the quantity word be construed as a predicate of individuals.

Such a predicate may in principle give rise to a proportional reading either through Hackl's route or through Hoeksema's, although Hackl's route would require a change to our definition of sup so that quantification is over non-overlapping pluralities rather than distinct pluralities. On the surface, a Hoeksema-style derivation seems more appropriate for languages in which proportional readings are marked with definite morphology such as Dutch, German, Swedish, and Faroese. As there is only one satisfier of the description, it is correctly predicted for these languages that a definite article will be licensed. On the other hand, it appears that definiteness-marking does not accompany the quantity word on a proportional interpretation in English, Icelandic, or Elfdalian (Coppock, to appear). But if the quantity superlatives in these languages are treated as quantifiers rather than as attributive modifiers, then they might not be expected to co-occur with definiteness-marking, so Hoeksema's analysis is compatible with these languages as well.

The idea that proportional readings involve a binary partition over the extension of the noun also resonates with the fact that proportional readings often involve comparative rather than superlative morphology, even in languages where superlatives are available, such as Persian. Persian expressions of proportional meaning as in (70) contain the comparative marker *-tar* but not the superlative marker *-in*.

(70) Man biš-**tar**-e cookie-ha ra khord-am.
1SG much-CMPR-EZ cookie-PL OM eat.PAST-1SG
'I ate most of the cookies.'
(Persian)

By contrast, the superlative marker *-in* is found in addition to comparative marker *-tar* in Persian sentences expressing relative quality superlative meaning:

(71) Man biš-**tar-in** cookie ra khord-am.
1SG much-CMPR-SPRL cookie OM eat.PAST-1SG
'I ate the most cookies.'
(Persian; M)

A similar structure is found in Hindi, where proportional meaning is expressed with

zyaadaatar, which can be decomposed into the Hindi comparative marker *zyaadaa* and an archaic comparative marker *-tar* taken from Persian (Bhatt & Takahashi, 2011; Gorshenin, 2012). In Slavic languages including Bulgarian and Macedonian, a comparative marker combines with a nominalizer to express proportional meaning, as in Macedonian *poveќeto* (Liljana Mitkovska, p.c.). Romance languages give further support to a Hoeksema-style decomposition of proportional readings into a comparative and two partitions, since they include a noun translated as 'part' in addition to a comparative, as in Spanish *la mayor parte* or French *la plupart*.

We are therefore inclined to believe that Hoeksema's route is the main one, or possibly the only one, through which proportional readings are derived. This route requires a number of oddities: the quantity word must be a gradable predicate of individuals, the contrast set must contain only two elements, and the contrast set must be determined on the basis of a predicate that is determined by the sentence, and not given by prior context. So there are quite a number of obstacles to proportional readings along this route.

We conjecture that the violations of these defaults is offset by the benefit of having a quantifier-like item that can stand in a paradigmatic relation to words like *all*, *some*, and *no*. Evidence that this conjecture is on the right track comes from the distribution of proportional readings among strategies for forming superlatives. As shown above, all of the languages with unambiguous and unproblematic proportional readings for the superlative of *many* use a morphological strategy for forming superlatives.

Moreover, as mentioned above, all of the languages in which we found a proportional reading for the superlative of MANY were in Europe, with the exception of Arabic. This raises the possibility that the development of such readings is affected by language contact. This lends further support to the idea that proportional readings do not arise on their own, but require extra help.

4 Summary and conclusion

To summarize, we have supported the proposed universal, repeated in (72).

(72) **Proposed Universal: Proportional ⇒ Relative**
If a superlative form of MANY or MUCH has a proportional interpretation, then it also has a relative interpretation.

In more concrete terms, we found languages where the superlative of MANY or MUCH had a relative reading but no proportional reading, and languages where both readings were attested, but no languages where the superlative of MANY or MUCH had a proportional reading but no relative reading. As we have seen, there exists great diversity in the morphosyntactic strategies used to express superlative meanings crosslinguistically, and quantity superlatives are even more richly diverse.

It is remarkable that in the midst of all of this diversity, a linguistic universal could emerge. But this appears to be what we have found. Relative readings appear not to require any extra ingredients beyond a quantity word and a way of indicating a superlative interpretation, while proportional readings require something more.

We have proposed to explain the markedness of proportional readings on the basis of two main assumptions: That contrast sets must consist of individuals, and quantity words denote gradable predicates of degrees. This forces the contrast set to be distinct from the measured entities, and the association relation to be determined by a licensor such as focus, yielding a relative interpretation. In combination with the target-domain hypothesis, these assumptions explain certain subtle facts about agreement: quantity superlatives exhibit neuter singular agreement, and often mirror adverbial superlatives in their morphosyntax. We hypothesize that proportional readings arise when (i) quantity words denote gradable predicates of degrees, and (ii) the comparison class is construed as a binary partition over the domain, determined on the basis of a predicate identified in the sentence.

This analysis takes elements from much of the previous literature on the topic. From Hackl (2009) and Hoeksema (1983) we take that proportional readings are a species of absolute reading, a notion that is realized here by having the association relation be identity. From Pancheva (2015) we take that relative readings involve measurement of degrees (numbers) rather than individuals. From Dobrovie-Sorin & Giurgea (2015) we take that grammaticalization is involved. The key feature of our analysis that differentiates it from these prior views is the claim that quantity superlatives by default denote gradable properties of degrees. This assumption encapsulates the fundamental difference between ordinary gradable adjectives and quantity words driving the difference in their behavior.

Where does all of this leave us with respect to the question of what sorts of logics are necessary to capture proportional quantifiers? Barwise & Cooper showed that first order logic does not suffice, and proposed Generalized Quantifier Theory. Hackl (2009) argued that a different remedy was preferable on the grounds that MOST is MANY plus -EST, as Bresnan (1973) suggested. Our results show that proportional readings do not arise straightforwardly as a combination of the meanings of these two elements, and suggest that a process of lexicalization may be at work in their development. But the meaning that has been solidified is the composition of a number of pieces that are not generalized quantifiers; the complex can be described in a logic that has degrees and pluralities and does not use generalized quantifiers. So even if proportional quantifiers arise through a historical process of lexicalization, the result does not require generalized quantifiers as semantic primitives. Thus, in terms of this larger discussion, while our findings do appear to require a softening of Hackl's specific proposals, they are consistent with his larger claim, that proportional MOST does not motivate the introduction of generalized quantifiers as semantic primitives.

A Appendix: Translation questionnaire

Instructions. Please translate the sentences below into your native language. More literal translations are preferred, but only as long as they sound natural. Give as many translations as you like, and comments are welcome but not required. (No need to translate the parts in parentheses; they are just supposed to help explain what is meant.)

1. Most of the kids who go to my school like to play music. (For example, there are 100 kids in my school, and 65 of them like to play music.)
2. Of all the kids in my school, I'm the one who plays the most instruments. (For example, I play 7 instruments, two of my friends play 6 instruments, and lots of people play one or two instruments, but nobody else plays more than 4.)
3. I don't like most of the music they play on the radio.
4. My brother Hans also plays many instruments, but not more than me.
5. The member of my family who plays fewest instruments is my sister Karin.
6. During most of the summer we have played music every day.
7. I don't know how much coffee we've drunk and how many cookies we've eaten during the summer.
8. But it is probably Hans who has drunk the most coffee. (For example, Hans drank three cups every day, and the rest of us drink one or two cups every day.)
9. Mom says that he ought to drink less coffee.
10. I am the one who drinks the least coffee.
11. But I am also the member of our family who eats the most cookies. (For example, I eat on average 5 cookies per day, and other members of my family eat on average 4 or fewer cookies per day.)
12. Mom baked cookies yesterday and I ate most of them. (For example, she baked 20 cookies and I ate 14.)
13. I drank most of the milk too. (For example, there were two liters of milk and I drank 1.5 liters.)
14. I'm not the one in the family with the thinnest waist.
15. I ought to eat fewer cookies.
16. But it's hard since mom bakes the yummiest cookies in the whole world.
17. Many try, but few can resist mom's cookies!

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