Metaphorical Measure Expressions

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We focus on a class of non-quantizing nominal measures in English that have non-literal interpretations: metaphorical measure expressions (MMEs). Our novel mereological analysis motivates their measurement properties in the abstract domain, and accounts for their morphosyntactic distributional patterns.

Data. Measure Ns, denoting either a standard (1a) or non-standard (1b) measure in concrete domains, have a quantizing function (Krifka 1989): they take a cumulative nominal argument (either mass or plural count) and return a complex measure predicate which is treated as count, and so can be pluralized, combined with numerals and govern plural verb agreement, as in (2).

(1) a. *meter*, *foot*, *liter*, *gallon*, etc.
    b. *glass*, *bucket*, *crate*, *truckload*, *pallet*, *mouthful*, etc.

(2) a. *Three crates of books (*COUNT*) were delivered to the store.*
    b. *Three crates of sand (*MASS*) were delivered to the store.*

MMEs have a non-literal measurement meaning that is neither simply count nor simply mass. Based on quantities they denote, they fall into two main subclasses: upward-entailing (UE) and downward-entailing (DE). Intuitively, in many contexts at least, if p is more informative than q, then if p counts as *an iota of information*, so does q (DE), and if q counts as *a heap of information*, so does p (UE). Some denote standard measures (in [brackets]); some are NPIs. Their non-monotonic (NM) counterparts lack non-literal uses (note the dual uses of *ounce*).

(3) a. UE: *bunch*, *heap*, *load*, *mass*, *scad*, [*ton*], *oodles**, etc.
    b. DE: *bit*, *drop*, *glimmer*, *iota*, [*ounce*], *shred*, *slither*, *sliver*, *speck*, *whiff*, etc.
    c. NM: *cup*, [*meter*], [*ounce*], etc.

MMEs do not specify quantized sets, but rather (subjectively) large/small amounts. What they measure is denoted not only by (plural) count and mass concrete Ns, whereby they needn't denote physical quantities, but also by abstract Ns, where there are no physical quantities to measure. They can be indefinite with *a(n)* or bare plurals.

(4) a. *Josie read {a heap | heaps} of books over the summer.* COUNT
    b. *Pedro drank {a heap | heaps} of water after the procedure.* MASS
    c. *Alex picked up {a heap | heaps} of knowledge in that class.* ABSTRACT (MASS)

Unlike measures for physical matter, MMEs cannot be used in counting constructions while retaining their non-literal flavor: (5) means two piles, not a doubled quantity. Apparent exceptions to this pattern seem to be conventionalized expressions that require contextually recoverable distinct (and relatively low-number) sources for individuation (*two glimmers of hope, namely...*), or involve non-literal uses of numerals (*feeling like 6 bags of shite* [ukWaC]).

(5) *Josie read two heaps of books over the summer*.

Each subclass can be intensified with a distinct syntactic construction: [X *and* X] for UE MMEs and [a(n) X of a(n) X] for DE ones, though the latter is blocked for MMEs derived from standard measures.

(6) a. *Carly found {heaps and heaps | *a heap of a heap} of information about dogs.*
    b. *Carly couldn't find {*iotas and iotas | an iota of an iota} of info about camels.*

Semantics of NPs. We assume that the interpretations of NPs have a bipartite structure (Sutton & Filip 2020, see also Landman 2016), i.e., they specify two sets: the extension and a counting base (a set of entities such that count nouns have a quantized counting base relative to a context

c and mass nouns do not where $QUA(P) \leftrightarrow \forall x, y[P(x) \wedge P(y) \rightarrow \neg x \sqsubset y]$ (Krifka 1989)). For example, ⟦books⟧ in (7) is of type $\langle c, \langle e, \langle t \times et \rangle\rangle\rangle$, a function from contexts to a pair of the extension set ($^*BOOK_c$, the upward closure of $BOOK$ under sum) and the counting base set ($BOOK_c$, the set of single books, a quantized set).

(7) $$[\![\text{books}]\!] = \lambda c.\lambda x.\left\langle\, ^*BOOK_c(x),\ \ \lambda y.BOOK_c(y)\,\right\rangle$$

We use **ext** and **cbase** as the first and second projection functions of the tuples in such lexical entries. For example:

(8) $$\mathbf{ext}([\![\text{books}]\!](c)(a)) = {}^*BOOK_c(a)$$

(9) $$\mathbf{cbase}([\![\text{books}]\!](c)(a)) = \lambda y.BOOK_c(y)$$

⟦book(s)⟧ is count, since for every context, $\mathbf{cbase}([\![\text{books}]\!](c)(x))$, i.e., $\lambda y.BOOK_c(y)$, is a quantized set.

Analysis. Chierchia 2010 proposes that expressions such as *amount (of)* and *quantity (of)* be analyzed as encoding a contextual partition operator Π_c, such that for all P, $\Pi_c(P)$ is a disjoint (and so also quantized) subset of P (see also *variants* in Landman 2011):

(10) $$[\![\text{amount}]\!] = \lambda c.\lambda P.\lambda x.\Pi_c(P)(x)$$

We propose that MMEs (e.g., *heap/iota (of)* used metaphorically) are comparable to expressions like *amount (of)* or *quantity (of)* insofar as they specify an amount of P relative to a context, but differ in two key respects: (i) measure phrases with MMEs (*MME of P*) do not specify a disjoint or quantized set of P at all contexts (hence they are not generally compatible with numeral expressions in counting constructions); (ii) downward-entailing MMEs lexically encode a small quantity of P and upward-entailing MMEs a large quantity of P relative to the context. We formalise (i) via a context-indexed operator Δ_c of type $\langle et, et\rangle$ such that:

(11) $$\forall c.\forall P.\exists X\,[\Delta_c(P) = X\ \wedge\ X \subseteq {}^*P\ \wedge\ \sqcup X = \sqcup P]$$

I.e., $\Delta_c(P)$ is a set that is akin to a cover of P (not only a minimal cover!) in the sense of Gillon 1987. For example, for $\Delta_c(\{a, b, a \sqcup b\})$, there are 5 possible outputs depending on the value for c: $\{a, b\}$, $\{a \sqcup b\}$, $\{a, a \sqcup b\}$, $\{b, a \sqcup b\}$ and $\{a, b, a \sqcup b\}$. So, Δ_c is similar to Π_c, except it outputs a subset of P that is not necessarily quantized (only a small proportion of covers are quantized). We formalise (ii) via a measure function μ of polymorphic type $\langle n, \langle \alpha t, \langle \alpha t\rangle\rangle\rangle$ such that $\mu(x, P) = n$ states that the magnitude of x with respect to P is n. The difference between UE and DE MMEs, we propose, is whether the quantity of P is specified to be above some contextually specified P-threshold $n_{c,P}$ (UE) or below $n_{c,P}$ (DE). The extension of a UE MME is a subset of the extension of P, such that the quantity of P is specified to be above some contextually specified P-threshold $n_{c,P}$. The counting base set of a UE MME is a subset of the extension of P, such that the quantity of P is specified to be above some contextually specified P-threshold $n_{c,P}$. For DE MMEs, the same holds except that the quantity of P is specified to be below some contextually specified P-threshold $n_{c,P}$. $\mathcal{P}$ is a variable of type $\langle c, \langle e, \langle t \times et\rangle\rangle\rangle$, the type for the interpretations of NPs.

(12) $[\![\text{heap}_{\text{MME}}]\!] =$
$$\lambda c.\lambda P.\lambda x.\left\langle \begin{array}{l} \Delta_c(\lambda y.\mathbf{ext}(\mathcal{P})(c)(y))(x) \wedge \mu(x, \mathbf{cbase}(\mathcal{P})(c)(x)) > n_{c,\mathcal{P}}, \\ \Delta_c(\mathbf{cbase}(\mathcal{P})(c)(x)) \wedge \mu(y, \mathbf{cbase}(\mathcal{P})(c)(x)) > n_{c,\mathcal{P}} \end{array} \right\rangle$$

(13) $[\![\text{iota}_{\text{MME}}]\!] =$
$$\lambda c.\lambda \mathcal{P}.\lambda x.\left\langle \begin{array}{l} \Delta_c(\lambda y.\mathbf{ext}(\mathcal{P})(c)(y))(x) \wedge \mu(x, \mathbf{cbase}(\mathcal{P})(c)(x)) < n_{c,\mathcal{P}}, \\ \Delta_c(\mathbf{cbase}(\mathcal{P})(c)(x)) \wedge \mu(y, \mathbf{cbase}(\mathcal{P})(c)(x)) < n_{c,\mathcal{P}} \end{array} \right\rangle$$

For example, if the interpretation of *information* is a set of (sums of) propositions (Sutton & Filip 2020), each member of the counting base set for *heap/iota of information* counts as a large/small amount of information in the context. For example, for *iota of information*:

(14) $[\![\text{iota}_{\text{MME}} \text{ of information}]\!] =$

$$\lambda x. \left\langle \begin{array}{l} \Delta_c(INFORMATION_c(x) \wedge \mu(x, INFORMATION_c) < n_{c,[\![\text{information}]\!]}, \\ \lambda y.\Delta_c(INFORMATION_c)(y) \wedge \mu(y, INFORMATION_c) < n_{c,[\![\text{information}]\!]} \end{array} \right\rangle$$

Crucially, the counting base set is not quantized (in most contexts), therefore measure phrases with MMEs are not generally felicitous in counting constructions. Furthermore, our combination of Δ_c and the restriction on the values of μ in our analysis explains why some *uses* of MMEs are upwards-entailing ($\Delta_c(P)$ and $\mu(x, P) > n_{c,P}$) and why others are downwards-entailing ($\Delta_c(P)$ and $\mu(x, P) < n_{c,P}$).

MMEs, plural morphology and indefinites: Our analysis of NPs accounts for the selectional restrictions of numeral expressions as requiring the counting base set of the argument NP to be quantized. On the further assumption that both plural morphology and the indefinite article in English select for Ns with non-cumulative extensions. ($CUM(P) \leftrightarrow [P(x) \wedge P(y) \rightarrow P(x \sqcup y)]$), we can account for their distribution across concrete and abstract domains: count Ns can be directly modified with numerals, pluralized, and used with the indefinite article, while mass Ns cannot; MMEs are somewhat in between: MMEs in measure phrases (MMPs) can be pluralized and used with the indefinite article, but resist use in counting constructions.

	Extension	C. base	Example	Indef.?	PL morph?	Num. Mod.?
SG count	$QUA, \neg CUM$	QUA	*cat, bowl of apples*	Y	Y	Y
PL count	$\neg QUA, CUM$	QUA	*cats, bowls of apples*	N	N	Y
mass	$\neg QUA, CUM$	$\neg QUA$	*mud*	N	N	N
SG MMP	$\neg QUA, \neg CUM$	$\neg QUA$	*heap/slither of courage*	Y	Y	N

As indicated by the table above, one of the reasons why these data are important for the wider theory of the count/mass distinction is that they further support the view that quantization and cumulativity relative to context are one of the keystones for modelling the wide variety of countability data, and that, furthermore, to do so, we need, minimally, two sets: extension and counting base. Put simply, given that there is a logical space between non quantization and cumulativity (a predicate can be $\neg QUA$ and $\neg CUM$), a theory of countability based on QUA and CUM should predict that some expressions fill this logical space. The data we have presented here are examples of such.

References

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