

Measure Terms and Classifiers

1 Schwarzschild's new analysis

The data we have been considering:

- (1) *Adjunct MPs*
 - a. *2 liter water
 - b. *2 kilo sand
 - c. 9 chili hot sauce
 - d. 9 degree water

- (2) *Partitive MPs*
 - a. 2 liters of water
 - b. 2 kilos of sand
 - c. *9 chilis of hot sauce
 - d. *9 degrees of water

In his NU talk, Roger Schwarzschild presented a new analysis of these facts, which combined his old claims about syntax and some new claims about the semantics of the nominal projection.

- (3) *Schwarzschild's syntactic claims*
 - a. MPs in (pseudo-)partitives are specifiers in the functional projection of the NP.
 - b. MPs in 'compounds' are adjuncts at the N' level.

Both of these claims seem pretty reasonable. The first is uncontroversial, and RS presented some new data from morphology and prosody for the second one.

- (4) *Schwarzschild's semantic claim about N' meanings*

N's are always dissective; this is a (universal?) fact about noun (phrase) meanings.

- (5) *Dissectivity*

P is dissective iff $\forall x, y [(P(x) \wedge y \subset x) \rightarrow P(y)]$

- Every proper part of a quantity of 9 degree water is 9 degree water.
- No proper part of a 2 liter quantity of water is 2 liter(s of) water.

The bigger picture here involves an analysis of noun meanings whereby every noun comes with both a standard denotation (a set or characteristic function) and a part-whole relation.

- (6) $[[N]]^c = \langle S_N, \subset_N \rangle$

- (7)
 - a. mass nouns: $x \subset_N y = x$ is a material part of y
 - b. plural count nouns: $x \subset_N y = x$ is an *atomic* individual part of y
 - c. singular count nouns: *don't have part structure*

Assumption (7c) accounts for the examples in (8); here dissectivity is vacuously satisfied.

- (8) a. a 2 liter quantity of water
b. a 2 kilo pile of sand
c. a 3 kilo baby

Why are the following bad?

- (9) a. *9 degrees of water
b. *9 chilis of hot sauce

According to RS, nothing is wrong with the semantics here. He's assuming that the partitive and adjunct constructions have the same semantics; presumably something like (10a-b).

- (10) a. $\llbracket [N' \text{ MP } N] \rrbracket = \lambda x. \llbracket MP \rrbracket(x) \wedge \llbracket N \rrbracket(x)$
b. $\llbracket [QP \text{ MP } NP] \rrbracket = \lambda x. \llbracket MP \rrbracket(x) \wedge \llbracket NP \rrbracket(x)$

Instead, the problem with (9a-b) is one of syntax:

- (11) *Avoid Syntax*
If S_1 and S_2 are semantically equivalent syntactic representations but S_1 is less complex (has fewer functional projections?) than S_2 , then S_2 is ungrammatical.

I am not opposed to the idea of economy constraints in syntax (though this sort of constraint does come at a potentially big theoretical cost; cf. Fox 2000), but it is not clear to me that this is the right take on these facts.

My biggest concern is an empirical one: it is generally true that ungrammatical but *interpretable* structures 'make sense':

- (12) a. the train rapidly approaching from the east
b. a man proud of his children
- (13) a. *the rapidly approaching from the east train
b. *a proud of his child man
- (14) a. I heard Kim's claim that Lee saw Arnold.
b. I was angry that Kim refused to talk to Arnold.
- (15) a. *Who did you hear Kim's claim that Lee saw?
b. *Who were you angry because Kim refused to talk to?

This problem is particularly severe for the 'nonmonotonic' MPs. Consider (16a-b).

- (16) a. *If you have 106 degrees of baby, you should call the doctor.
b. ??Pat gave birth to 3 kilos of baby.

In (16b), we are able to coerce a sensible (if grotesque) interpretation by treating *baby* as a mass noun. Why can't we do some sort of similar coercion in (16a)? Why don't we interpret it the right way, even though the syntax is wrong?

My conclusion: RS’s analysis of noun meaning and the adjunct construction is compelling and thought-provoking, and leads to a very insightful story about the count-mass distinction, but we should look for a more satisfying analysis of the partitives.

2 Classifier constructions

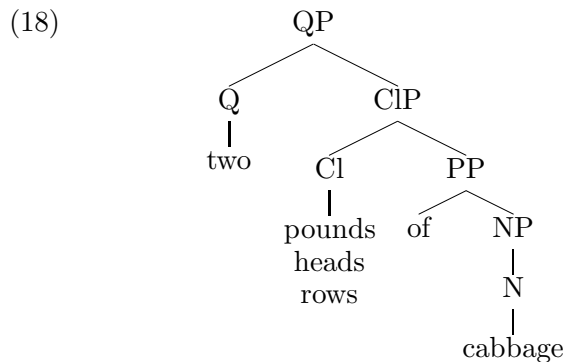
2.1 A taxonomy of classifiers

Lehrer 1986 discusses seven types of classifier construction:

- (17)
- a. unit counters: *piece of equipment*
 - b. fractional classifiers: *3 quarters of the pie*
 - c. number set classifiers: *many hundreds of people*
 - d. collective classifiers: *two clumps of grass*
 - e. varietal classifiers: *two kinds of flowers*
 - f. measure classifiers: *two pounds of cabbage*
 - g. arrangement classifiers: *two rows of beans*
 - h. (metaphorical classifiers: *a warm spring rain of a man*)

Lehrer obviously assumes that measure terms are classifiers. Indeed, according to her, a defining feature of classifiers is that they “designate quantities, implicitly, if not explicitly”.

Is this semantic similarity enough to justify the sort of syntax we were considering last time?



There is one clear sense in which this class does not have a uniform syntax: the ‘head’ can be either a DP or a NP.

Do we have a mixture of ‘true’ partitives and other things here? I suspect so, though if the idea we were considering last time is right — that we always have ‘partitive *of*’ — then really these are all partitives. We’ll reevaluate this below.

More generally, even if we decide that all of the constructions in (17) represent a natural semantic class, are we justified in assuming a uniform syntax as well?

2.2 Relation between classifier and head

Even though there are restrictions on some classifier/noun combinations *pride of lions*, *gaggle of geese*, etc., there is clear evidence of productivity and, in particular, semantic content to the classifier term:

- (19) a. a flock of philosophers
b. a swarm of philosophers

The classifier term has an independent meaning beyond its ‘quantizing’ function, which interacts with noun meaning in a systematic way.

Moreover, this effect is independent of the upstairs numeral/determiner, suggesting that the constituency we were considering last time is the correct one.

- (20) a. a ball/wad/cube/sheet of yarn/dough/litter/mud/paper
b. a pound/ton/meter³ of yarn/dough/litter/mud/paper

An important difference between the classifiers in (20a) and the measure terms in (20b), however, is that the former seem to require that the substance named be in the relevant form.

- (21) a. a cup of soup
b. a bowl of rice
c. a ball of dough
d. a line of cocaine
e. a row of cabbage

Is this an actual entailment or just a pragmatic convention, though?

- (22) a. I’d like a cup of soup served in a bowl.
b. I’d like a bowl of rice served on a plate.
c. [Looking at a big batch of dough]
This is easily seven balls of dough. (*seven pizzas (worth) of dough*)
d. This bag contains at least 10 lines of cocaine.
e. There’s at least four rows (worth) of cabbage in this tray.

It seems that particularly when it’s clear that we’re interested in amounts, the ‘shape inferences’ can be overridden. Or perhaps this is just another indication that just about anything can be understood as a measure term, if the context is right?

Lehrer makes a distinction between ‘exact’ and ‘inexact’ measures. The former is a closed class of terms corresponding to conventionalized amounts; the latter is an open class of terms corresponding to (relatively) vague amounts.

- (23) *Exact measures*
a. two pounds of potatoes
b. ten miles of interstate
c. two feet³ of helium
d. two cups of flour

- (24) *Inexact measures*
a. two cups of tea
b. a packet of detergent
c. a mouthful of food
d. a treeful of fruit

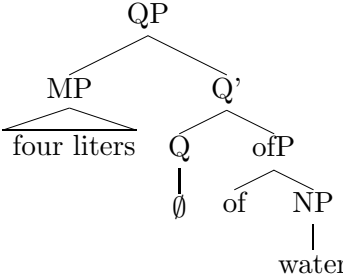
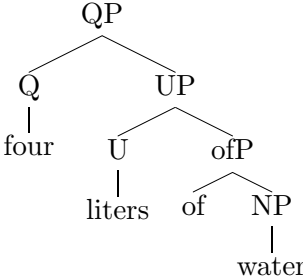
The morpheme *-ful* can be used to indicate measure status. Not surprisingly, it is infelicitous with exact measures, and obligatory with non-(standard) containers.

- (25) a. a liter(*ful) of milk
 b. a gallon(*ful) of oil
 c. a ton(*ful) of coal
- (26) a. a mouth*(ful) of meat
 b. a hand*(ful) of sand
 c. a beak*(ful) of fish

Maybe the examples in (25) provide some evidence for the idea that ‘exact’ measures incorporate a measure function into their meanings?

2.3 Syntax

Can we find syntactic evidence that measure terms show up in the same structural configuration as other classifiers? Here again are the structures under consideration:

- (27) a. 
- b. 

Coordination facts support the analysis in (27b), though this sort of argument is a little weak.

- (28) a. This recipe calls for two [cups of water] and [teaspoons of sugar].
 b. This recipe calls for two [bunches of parsley] and [liters of water].

Ellipsis data is pretty clear:

- (29) a. We need six crates of wine, but I only found five ~~crates of wine~~.
 b. We need six liters of oil, but I only found five ~~liters of oil~~.
- (30) a. *We need some 3 liter bottles, but I only found some 2 ~~liter bottles~~.
 b. *We need 100 degree water, but I was only able to heat up 50 ~~degree water~~.

Modification data also provides an argument, though here the facts are a bit tricky.

- (31) a. three cubes of frozen meat
 b. three frozen cubes of meat
- (32) a. three pounds of rancid meat
 b. ?three rancid pounds of meat

- (33) a. three tubs of boiling water
b. ?three boiling tubs of water

- (34) a. three liters of boiling water
b. ?three boiling liters of water

Presumably the odd ones are odd because of the semantic contribution of the classifier term itself. Crucially, there's a clear contrast with adjuncts:

- (35) a. six ounces of wormy apple
b. ?six wormy ounces of apple

- (36) a. a six ounce wormy apple
b. *a six wormy ounce apple

We could look further, but these facts provide a good initial indication that we're on the right track in treating measure terms and classifiers in the same way wrt syntactic structure.

2.4 Semantics

Is there a uniform semantics for classifiers? The standard view on classifiers is that they make noncountable terms countable. But what about the partitive/pseudopartitive distinction?

- (37) a. *two cocaine(s)
b. two lines/bags/grams of cocaine
c. two lines/bags/grams of this cocaine

And what about plurals? They're countable already, so why bother with classifiers?

- (38) a. two carrots
b. two bushels/rows/kilos of carrots
c. two bushels/rows/kilos of these carrots

The answer, presumably, is that the sort of semantics we need to make mass terms countable can be extended to have a similar 'classifying/measuring' effect on plurals and partitives because the latter have meanings very similar to the former:

- (39) a. mass nouns: material parts of stuff
b. plural nouns: individual parts of sums
c. partitive phrases: material parts of objects or individual parts of sums

According to RS, then, all of these predicates are 'non-countable' in the sense that they have 'parts with parts'. To make them countable, we need 'partless parts' (or atoms). The main semantic contribution of a classifier term is to add an extra restriction to the meaning provided by the nominal/partitive predicate, such that the whole complex generates a set of atoms: parts of the noun/partitive denotation of some measure/shape/class.

Here's a stab at what we want. D_{prt} is supposed to identify the domain of predicates that have 'non-trivial' part-whole structures (so everything but count nouns), though perhaps this doesn't have to be stipulated.

$$(40) \quad \llbracket \text{Cl} \rrbracket = \lambda P \in D_{prt} \lambda x. \text{class}(x) \wedge P(x)$$

Here *class* is a predicate that imposes the (possibly vague) classification restriction on the individual argument of the predicate. For example:

- (41) a. kilo: $\text{class} = \lambda x. \mathbf{weight}(x) = \mathbf{k}$
 b. cube: $\text{class} = \lambda x. \mathbf{shape}(x) = \mathbf{cube}$
 c. gaggle: $\text{class} = \lambda x \in \llbracket \text{geese} \rrbracket. \mathbf{number}(x) \succeq \mathbf{n}$

So *kilo of sand* will be true only of parts of sand whose weight is a kilo, *cube of that tuna* will be true only of material parts of that tuna whose shape is a cube, and *gaggle of geese* will be true only of sums of geese whose number is greater than some vague value **n**.

If this is the right story, then Roger is probably right in saying that pseudopartitive *of* really is a dummy element. That is, we don't need it to contribute anything semantically — the meaning of a mass noun or plural is enough.

- (42) a. 2 heads cattle
 b. 2 heads lettuce
 c. 2 kilos lettuce

- (43) a. *mot the catle
 b. *2 heads the lettuce
 c. *2 kilos the lettuce

In contrast, we still do need partitive *of* when the head of the predicate is individual denoting in order to get the right input to the classifier term. In some sense, then, the use of classifiers with partitives is 'parasitic' on the role they play in making non-countable basic predicates countable. (Cf. Ladusaw's discussion of the function of the partitive construction.)

3 Constraints on measure classifiers

Given our observations about the semantic function of classifiers, we might generalize to the following hypothesis:

- (44) The semantics of the functional projections of the noun — or at least the classifier projection — is in a crucial sense the opposite of the semantics of N'. Whereas N' must be dissective, ClP must not be. More to the point, it must be *quantized*.

- (45) A predicate *P* is quantized iff: $\forall x, y [(P(x) \wedge y \subset x) \rightarrow \neg P(y)]$

Quantization has the effect of generating atoms, so we can certainly make sense of the constraint in (44) as a by-product of the basic function of classifiers. Whether there is a deeper explanation for this constraint is an issue we'll have to think more about.

If this is right, it seems to derive the results we want. First, and most importantly, we seem to get the right cut on which measure terms can show up in the classifier construction:

- (46) a. $\llbracket \text{liter of water} \rrbracket = \lambda x. \mathbf{vol}(x) = \mathbf{l} \wedge \text{water}(x)$
 b. $\llbracket \text{degree of water} \rrbracket = \lambda x. \mathbf{temp}(x) = \mathbf{d} \wedge \text{water}(x)$

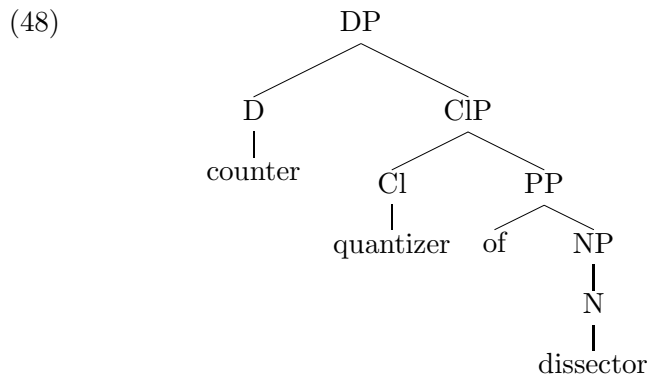
(46a) is quantized: it is true of liter quantities of water and not true of subparts. (46b) is not quantized: if it is true of some part of water that its temperature is a degree, it may also be the case that subparts of that water have temperatures of a degree.

This result is quite general: whenever the measure term is monotonic for the head, the denotation of *CL of head* is going to be quantized, and when it's not monotonic, the predicate denotation won't be quantized.

Note that we don't have to stipulate anything about which measure terms encode measure functions. This is good, because when we come back to examples in which the head names a scale, we get exactly the result we want.

- (47) a. $\llbracket \text{liter of volume} \rrbracket = \lambda x. \mathbf{l}. \mathbf{vol}(x) = \mathbf{l} \wedge \text{volume}(x)$
 b. $\llbracket \text{degree of temperature} \rrbracket = \lambda x. \mathbf{d}. \mathbf{temp}(x) = \mathbf{d} \wedge \text{temperature}(x)$

Unlike (46b), (47b) *is* quantized: if x is a degree unit of temperature, then subparts of x will not count as degree units. (Ditto for (47a).)



There's more to say about the relation between classifiers and nouns, and about the variety of classifiers, but I need to stop here.

4 Last thoughts

- (49) a. flower*(s)
 b. 3 flowers
 c. 3 of (*the) flowers
 d. 3 rows of (the) flowers
 e. 3 m³ of (the) flowers

References

Fox, Danny. 2000. *Economy and semantic interpretation*. Cambridge, MA: MIT Press.
 Lehrer, Adrienne. 1986. English classifier constructions. *Lingua* 68:109–148.