1. Quantizers: Measure phrases and Quantity Nouns

This talk is going to address two closely related phenomena, measure phrases, illustrated in (1a) of your handout:

(1a) Mary bought two gallons of wine.

and quantity nouns, illustrated in (1b) and (1c):

(1b) Mary bought a lot of wine.
(1c) Mary bought a number of bottles of wine.

where *lot* and *number* are quantity-nouns.

I'm going to argue that both depart from the basic right branching structure of English and that *two gallons*, *a lot* and *a number* are all constituents.

These constituents perform a basic determiner-like semantic function I'll call quantizing, following Krifka, which differs both from ordinary noun modification and from quantification. This is going to lead to a somewhat unconventional $\overline{\mathrm{D}}$ node that dominates phrases like *a number*, *a lot*, and *a gallon*, which in turn supports the idea that determiners do not find their restrictors in a fixed phrase structural position.

2. A puzzle

I'm going to begin with measure phrases, I want to argue that measure phrases have some unusual syntactic properties, which I'll illustrate by way of the interesting syntactic puzzle in (2).

(2) Barry Bonds hit a career-best 73 home runs.

There are three anomalies in (2):

1. First, there is a singular article, *a* with a plural noun *home runs.*
2. Second, there is a nominal modifier to the left of a cardinal number, a marked occurrence in English, as illustrated in (4):

   (4) *There were early three flights that day
3. Third, semantically *career-best* is modifying not *home runs* but *73* or *73 home runs*, as illustrated by the unacceptability of (5):

   (5) * Barry Bonds hit a career-best home runs.

I'm going to argue that all three anomalies can be explained by the fact that *73 home runs* is a measure phrase.

1. First, the **measure phrase** is singular due to peculiar syntactic and semantic properties of measure phrases, illustrated below.
2. Second the cardinal number *73* may have modifiers attached to the left because it is part of a measure phrase and not functioning as a count adjective.

3. Third, the adjective career-best semantically requires a measure argument, and a measure is semantically **incomplete** without a number argument. So (5) is out.

3. Syntactic and Semantic Arguments

Figure 1a shows the basic structure of the analysis I'll argue for. It makes reference to the category CL (for 'Classifier'). These are simply nouns differing from other nouns by some feature. Here I've somewhat tentatively adopted the feature +F (for functional).

Figure 1 also illustrates an analogy between measure nouns and count adjectives which is descended from Krifka's classifier-like analysis of count adjectives. The two structures are isomorphic with CL standing in place of A[+Q] and $\overline{\overline{\mathrm{P}}}$ standing in place of $\overline{\overline{\overline{\mathrm{N}}}}$. The idea is that the empty count adjective performs the same semantic function as the measure noun *gallons*, to be illustrated shortly in the semantics.

Both can be characterized as quantizers, modifiers that make a noun denotation bounded in quantity, either because it is bounded on the lower side (*at least 3 men* or one the upper side (*at most three men*). These ideas are spelled on pages 2 and 3. I'm going to skip over the details in the interest of time.[1]

Example (7) shows some more examples of quantity nouns:

(7)

a. *A number of people* left.

b. *A herd of antelope* appeared.

c. *A lot of squeegees* were on loan.

And (8) shows that these fit the semantic definition of quantity-bounding.

(8)

$$\begin{aligned}\text{a lot of people}(g) \rightarrow \exists g'[&\text{a lot of people}(g')\wedge\\ &\neg\text{a lot of people}(g \sqcap g')\end{aligned}$$

Example (9) shoiws the basic syntactic pattern separating nominal quantizers like *number* and adjectival *quantizers* like *many*. Nominal quantizers welcoime what Selkirk (1977) calls the **pseudopartitive** construction:

(9)

a. A number of men left.

and adjectival quantizers do not:

[1] Emphasizing a semantic analogy between count adjectives and measure phrases is a feature of both Krifka (87) and Nerbonne (95).

(9)

c. * Many of men left.

On page 5, there is a list of topics showing the plan for the rest of this talk.

1. I present some arguments for the structure in Figure 1a, some quite old, some new.
2. Then I extend the analysis to quantity nouns. After that I return to example (2) and show how its apparent anomalies are all resolved.
3. Finally I'll talk about the general consequences of the analysis for DP structure.

4. Syntactic and Semantic Arguments

Figure 2 on p. 3 shows competing analyses of *two gallons of wine*. THe analysis in Figure 2a is called the **measure specifier analysis** because the number *2* is a lexically attached specifier of the measure noun. The analysis in Figure 2b is called the **count adjectives analysis** because the number *2* is functioning as a count adjective.

I'm argueing **for** the measure specifier analysis, not **against** the count adjective analysis. It turns out both structures are necessary to handle the peculiar syntactic properties of measure phrases.

4.1. Arguments that Measure phrases are constituents

Section 3.1 presents four arguments that measure phrases are constituents.

First we have well-known basic distributional facts of the sort shown in (13).

(13)

a. a lot of milk
b. a lot tougher
c. sixty yards of silk
d. sixty yards long
e. sixty yards from the goal line

Measure and quantity noun phrases occur as units throughout the grammar, (13 b) and (13d) show measure phrases functioning as adjectival specifiers, *a lot tougher* and *sixty yards long.* (13e) shows a measure phrase functioning as a PP specifier (*sixty yards from the goal line*).

(14) shows that measure phrases may be antecedents to the anaphoric phrase 'that much'.

(14) Fred may have drunk **two liters**$_i$ of beer, but Bill drank at least **that much**$_i$ wine.

So to the extent that linguistic antecedents of anaphoric elements tend to be constituents, this argues in favor of the constituency of *two liters.*

Example (15) on p. 6 illustrates the case of complex measure phrases like 'sixty feet six inches'.

(13)
a. sixty feet six inches of high-quality silk
b. count adjective analysis: sixty feet six [inches of high-quality silk]
c. measure specifier analysis: [sixty feet six inches] of high-quality silk

These pose a real problem for the count adjective analysis, because either 'sixty' is adjoined to something like 'feet six inches' or 'sixty feet six' needs to be adjoined to inches. On the measure specifier analysis, 'sixty feet six inches' is a unit which has the PP adjoined to it.

Internal agreement facts illustrated in (16) also argue for the constituency of phrases like *five gallons.*

(16a) That five gallons of milk came in handy.

Singular *that* is a big suprise if *five* is functioning as a count adjective counting gallons.

4.2. Argument for shallow embedding of PP[OF]

(17) shows an argument of Selkirk's.

(17) A number of articles soon appeared about Watergate.

Extraposition is possible from quantity phrases, which is explained if the *of phrases* are more shallowly embedded than noun complements, as in Figure 2a.

4.3. Arguments that measure phrases are heads

[skipping this]

4.4. Arguments that measure phrases and quantity phrases are quantizers

Example (20) shows that count adjective quatizers liocense null-headed NPs as in (20b):

(20) I only ate three.

(21) shows an analogous phonomenon with measure phrases. (21b) forces a measure noun reading of the noun *box* and is odd in a context where it isn't clear what kind of stuff is being eaten.

(21)
b. How much did Sue eat?
c. # She ate a whole box.
d. How much chocolate did Sue eat?
e. She ate a whole box.

(21d) provides a sufficiently specified context where the same null-headed construction is licensed.

The null-head generalization is given in (29):

(29) **Among adjectives and nouns, quantizers license null heads.**

Thus, the null-head behavior motivates an analysis making count adjectives and measure phrases parallel.

(23) show that quantizers like *a number* can have both strong and weak readings.

[not shown here]

The strong reading of *number of demonstrators left* in 23a is entirely unexpected if the determiner of *a number of people* is *a*, but makes sense if *a number* is a quantizer like *many*.

Summing up thus far: We've given a number of arguments motivating the measure specifier analysis in Figure 2a, on which measure nouns are treated as functionally parallel to count adjectives.

The count quantification paradigm at the bottom of p. 9 spells out an important difference between nominal quantizers like *5 gallons* and adjectival quantizers like *many.* Two patterns are in mostly complementary distribution. Forms that take *of* forbid its omission; forms that omit it require its omission, so we have *a number of burgers* but star *a number burgers.* The nominal quantizers (*number, lot, dozen*) require an *of* phrase. The adjectival quantizers (*many, five*) do not.

The exception pattern on p. 9 bears this out. *one dozen* follows the the adjectival pattern in number (7) in the paradigm; and in the alternation with *a*, *a* is still felt as a number. That is:

a dozen = one dozen
a hundred = one hundred

But numbers can also follow the nominal pattern. Pluralization makes them unambiguously nominal. Hence: *dozens of burgers* in 10 follows the nominal pattern.

5. Semantic motivations for analysis

Figures 3 and 4 on page 10 show a semantics for *two gallons of wine* largely taken form the Krifka analysis. There are three keys points here:

1. The measure phrase *two gallons* denotes a property of **stuff**, namely that the stuff has a certain measure. The relation $\mathrm{co}_{\mathrm{ms}}$(the consists-of relation, mass version) holds between that stuff and the property of being wine. That is, the two gallons of stuff consists of wine.
2. The next important point is that *two* is NOT functioning as a count adjective in Figure 3. That is, the analysis of *two gallons* is as in figure 3, NOT as in figure 5 on page 11. We are not counting gallons on thi analysis.
3. Figure 4 on p. 10 also spells out Krifka's concealed classifier analysis. The empty quantity adjective has exactly the same 'classifying' semantic finction as the measure noun: It is a semantically restricted relation between a number and a quantity of **stuff** whose measure is that number (for the appropriate measure function).

Summing up the basic idea.

1. Measure nouns are distinguished from other nouns by their logical type ($\langle$ e, $\langle$ e, t $\rangle$ $\rangle$ versus $\langle$ e, t $\rangle$)
2. They take numerical "specifiers" lower in the tree than they take complements.

The idea of the account is that these two facts are linked. Only after a measure noun combines with its numerical specifier is a phrase created that has the same type as other nouns. The prediction, then, is that *two gallons* should have the same combinatorial possibilities as other nouns, including combining with noun complements. This is why the *of*- phrae can attach higher in the tree than other noun complements.

There is also a prediction that *two gallons* ought to be able to combine with noun modifiers such as adjectives.

The sentences in (28) show that this prediction is born out. In particular, adjectives can attach to the left of the number specifier in a measure phrase:

(28a) An unbelievably bad two gallons of wine

Thus numbers in measure phrases can have adjectives to the left, as expected. This also explains the position of the adjective in (2).

(28b) shows another possible variant where the adjective attaches inside the number.

(28b) Two unbelievably bad gallons of wine

Note a peculiarity illustrated in (28c). The indefinite article is impossible when the adjective occurs to the right of the number:

(28c) *A two unbelievably bad gallons of wine

The account of these facts is quite straightforward if both the measure specifier and count adjective analysis are allowed.

1. In example (28 a), the measure specifier analysis of Figure 2a is required, *two* functions as a measure specifier and *two gallons* is unspecified for syntactic number, as is *unbelievably bad two gallons.* Thus the singular article is licensed.
2. In example (28b), the count adjective analysis of Figure 2b is required. Since *two* functions as a count adjective, *two unbelievably bad two gallons* is plural.
3. Thus (28c) is ruled out as a number agreement clash.

If structural ambiguity is indeed responsible for the facts in (28), then syntactic contexts that block the count adjective analysis should block the configuration in (28b). This is verified in (29a):

(29a) six beautiful feet six inches of wool

This is a complex measure phrase, where, we argued before, the count adjective analysis is impossible.

Similarly, contexts requiring a true measure phrase should blockm the count adjective analysis. This is shown in (30a),

(30a) *six beautiful feet sic inches of wool

The count adjective version of a measure phrase is blocked as an adjective specifier.

(31) shows the sense change required for the count adjective analysis. Ther denotation of *gallon* must be made countable. This is done by corecing it into a group consisting of one-gallon-sized chunks of stuff.

Semantics of count adjective analysis of *two gallons*

$\lambda x[\mathrm{co}_{\mathrm{ct}}(x, \lambda w[\mathrm{gallon}(w) = 1]) \wedge \mathrm{count}(x) = 2]$

6. Extension of measure analysis to quantity nouns: $\overline{\mathrm{D}}$ quantizers

Turning now to quantity nouns. The key difference between the measure noun examples we've looked at and quantity phrases is that all quantity phrases have determiners and cannot be preceded by another determiner as in the unacceptable (32a):

(32a) * The a number of men who escaped were never captured.

In contrast to (32b)

(32b) The many men who escaped were never captured.

So if semantics were ruling here, acccording to the analysis we've been developing, these would both be acceptable. But clearly there is a syntactic constraint being violated. This is in contrast to (32d)

(32d) That five gallons of wine was superb.

where a demonstrative *that* can precede the measure phrase *five gallons* (just as it can precede a number).

We account for this by adjoining the quantity nouns under $\overline{\mathrm{D}}$ as in Figure 6 on p 13. The competing analysis on which *a number* is not a constituient is shown in Figure 7.

I'm skipping over (33), which summarizes the kind of evidence used before to argue for quantizers as constituents.

The sentences in (34) show that not all quantizers are alike. *number* accepts only modifiers suitable for a number, as in Jackendoff's (34a).

(34a) John's rather large number of objections (Jackendoff 1977)

This kind of modification divides quantizers into different classes.

(34b) # A valuable number of glasses was broken

is in sharp contrast to (34d)

(34d) a valuable group of glass was broken.

Not surprisingly, *Number* denotes a number and *group* a group.

(34f) and (g) show that that different referents are being determined with *number* and *gallons.*

(34)

f. John drank the same number of glasses Mary did.

g. John drank the same five gallons of milk Mary did.

What is the same in (34f) is the number of glasses John and Mary drank. What is the same in (34g) is the **stuff** they drank, and what makes it odd is that under most circumstances the same quantity of milk can't be drunk twice.

Fugure 8 shows an analysis capturing the difference, in which *a number* denotes a number. The indefinite has been treated along the lines of Winter (97), coerced in to an individual (a number) and simply fed to a empty quantizing determiner as an argument. The transition takes us from numbers to ordinary individuals. The denotation of the $\overline{\overline{\mathrm{N}}}$ *a number* is a number y; the denotation of the $\overline{\mathrm{D}}$ *a number* is a property of a group having count y.

7. Analysis of examples

The analysis of measure phrases and quantity expressions just give leads immediately to an analysis of example (2), shown in Figure 9 on p. 15, which in a formatting tour de force, is oin landscape mode. The key point is that the adjective *career best* requires a measure phrase in this case *73 home runs.* As we saw before, a measure phrase with the adjective attached is of unspecified number and may be determined by singilar *a*.

8. Quatizers versus determiners

I'd like to say something about the phrase structure assumed in Figures 6 and 8, the proposed analyses of quantizers. The required rules are shown in (38) on p. 17.

(38) (a) $\overline{\overline{\mathrm{D}}} \longrightarrow \overline{\mathrm{D}}\ (\overline{\overline{\mathrm{P}}})$ (restrictor) pseudopartitives, partitives

(b) $\overline{\mathrm{D}} \longrightarrow \mathrm{D}\ (\overline{\overline{\mathrm{N}}})$ (quantizer) (restrictor)

The idea is that a determiner's restrictors can come in at two syntactic levels. Rule (38a) can introduce the restrictor as a PP only when no restrictor has been supplied in the $\overline{\mathrm{D}}$ in (38b). Such PP restrictors arise only in the case of pseudopartitives (when a qauntizer has been introduced downstairs) or partitives (when a null head has been introduced downstairs).

9. Conclusion

Summing up: I started out by saying that my analysis of quantizers was going to depart from standrad right-branching structure and I've done that in making quantizers like *five gallons* and *a number* be constituents.

Along with this came a semantically motivated type distinction for nouns, allowing specifiers to attach low, and complements and modifiers to attach high.

The constituency hypothesize eventually leads to a phrase structural view of DP in which a determiner's restrictions can attach in two places, either low, as an NP, or high, as a PP.

This leads to a further partitioning of quantizers depending on where **they** attach:

1. The **Adjectival Quantizers** include our obligatorily specified empty adjective and quantity Adjectives like *many, much, more*[+cnt], *more*[+ms]
2. The **Nominal Quantizers** include measure nouns and quantity nouns.

1. **Measure Nouns** are obligatorily specified count nouns: Their unusual number agreement and distributional properties have been linked to their type: They take a number specifier in order to become relational nouns unspecified for number.
2. **Quantity Nouns** separate into two types:
    1. those that denote groups or masses of stuff with quantity restrictions (*lot, bunch, group*)
    2. and those that denote a quantity (*number*), which may be analyzed as determiner specifiers of an empty determiner.