ICEBERG SEMANTICS FOR COUNT NOUNS AND MASS NOUNS

Motivation

1. Mass nouns: much much water
   Count nouns: many many cats

2. Measures: *liter, kilo*
   Classifier: *slice, portion*

3. Measure phrase: *10 kilos of meat*
   Classifier phrase: *40 slices of meat*

Rothstein 2017: Measure phrases pattern with mass nouns
Classifier phrases pattern with count nouns
e.g.

Much of the *10 kilos of meat* was sold at Stop'n'Shop
(?)Many of the *20 kilos of meat* were sold at Stop'n'Shop
(the *many* reading is count and refers to kilo packages)

Many of the *40 slices of mea*t were eaten by Buck
?Much of the *40 slices of meat* was eaten by Buck

So measure phrase *10 kilos of meat* patterns with mass nouns
classifier phrase *40 slices of meat* patterns with plural count nouns

4. The problem of identity:

two liters of soup = ten portions of soup
The 500 grams of cheese = the 20 slices of cheese

$\lambda x.\text{SOUP}_w(x) \wedge \textbf{liter}_w(x) = 2$ =
Soup measuring two liters

$\lambda x.\text{SOUP}_w(x) \wedge {}^*\text{PORTION}_w(x) \wedge \text{card}_{\lambda x.\text{SOUP}(x) \wedge \text{PORTION}(x)}(x)=10$
Soup counting as 10 portions of soup

$\sigma(\lambda x.\text{CHEESE}_w(x) \wedge \textbf{gram}_w(x)=500)$ =
The cheese measuring 500 grams

$\sigma(\lambda x.\text{CHEESE}_w(x) \wedge {}^*\text{SLICE}_w(x) \wedge \text{card}_{\lambda x.\text{CHEESE}(x) \wedge \text{SLICE}(x)}(x)=20)$
The cheese counting as 20 slices of cheese

Problem: the same stuff counts as count and as mass, but how is it count and how is it mass?

Answer of the classical Boolean theory: count = counted in terms of atoms.
This means that the mass stuff and the count stuff are not literally the same, but only correspond to each other:

Take the soup. Parcel it into 10 portions. Shift these portions into the set of atoms of the count domain, the count interpretation corresponding to the mass interpretation is trhe count interpretation.
Iceberg semantics is a Boolean semantics that rejects the connection between count and sets of atoms. It takes the portion classifiers as its guide: What is semantically relevant about the complex nouns *portion of soup* and *slice of cheese* is *not* that the portions, slices are atoms, but that they are disjoint, don't overlap. The classifier *portion* **partitions** the soup into portions, the classifier *slice* **partitions** the meat into slices.

Count as disjointness

While philosophers come up with borderline cases where objects in the denotation of singular count nouns overlap, Iceberg semantics takes the semantic facts as illustrated by portion classifiers are the basis for the semantics of count nouns:

Singular count nouns denote (in countext) disjoint sets.

Sets of atoms are, by definition, disjoint, but, my claim is, atomicity is not helpful in the semantics of mass and count nouns, disjointness is.

So singular noun denotations are lifted from the atomic sea bottom of the Boolean as disjoint sets floating in sets of parts.
Pluralisation is, as before, closure under sum, so the plural is a mountain rising up from a floating disjoint set: an iceberg.

Keeping track of what you count and distribute to

The advantage of identifying singular nouns with sets of atoms is that in a complete atomic Boolean algebra, for set of atoms A, for any element $x \in {}^*A$: $AT_x \subseteq A$

This means that semantic operations can access for x in the denotation of expression α whose interpretation is based on A, $AT_x \subseteq A$.
And in classical Boolean semantics this is relevant for counting, count comparison, distribution:
$x \in$ *three black cats* = x is a sum of three atoms and each of these atoms is a black cat
most cats are black = the sum of the black cats has more atomic parts than its relative complement within the set of all cats.
The cats each ate a can of tuna =
each atomic part of the sum of the cats ate a can of tuna

Obviously if we don't build noun phrase denotations from singular sets of atoms, but from disjoint sets we need to make sure that in the course of derivation we keep track of the disjoint set because it is used in counting, count comparison and distribution.

Icebergs

In Iceberg semantics the denotations of noun phrases are i-sets.

An **i-set** is a pair of sets $X = <$**body**(X), **base**$(X)>$
with **body**$(X) \subseteq$ B and **base**$(X) \subseteq$ B
and **body**$(X) \subseteq$ ***base**(X)

The **base** of the i-set is, intuitively, the stuff that the **body** of the i-set is made of,
in the case of count noun denotation, it is the set of elements that *count as one* for the NP concept in question.
The **body** of the i-set is generated from the base with the sum operation.

The rule is: the **body** interpretation of an NP, simple of complex, is what was the interpretation of the noun phrase in classical Boolean semantics.

Head principle for bases:
The base interpretation of a complex NP is compositionally determined as the intersection of the part set of the body interpretation of that NP with the base of the interpretation of the head.

Basic iceberg semantics

Assumption 1: Singular count noun phrases
cat → <**body**, **base**>
where **body** = **base** = CAT_w and $CAT_w \subseteq D$ is a disjoint set.
in short:

cat → $<CAT_w, CAT_w>$ where CAT_w is a disjoint set

Assumption 2: Pluralization

cats → <**body**, **base**>
where **body** = $*CAT_w$
and **base** = $(*CAT_w] \cap CAT_w = CAT_w$

In short:

cat → $<*CAT_w, CAT_w>$

Similarly:

black cats → $<^*(\lambda x.CAT_w(x) \wedge BLACK_w(x)), \lambda x.CAT_w(x) \wedge BLACK_w(x)>$

three cats → $<\lambda x.^*CAT_w(x) \wedge \mathbf{card}_{CATw}(x)=3, CAT_w>$

for $x \in {}^*CAT_w$: $\mathbf{card}_{CATw}(x) = |(x] \cap CAT_w|$

three black cats →
$<\lambda z^*(\lambda x.CAT_w(x) \wedge BLACK_w(x))(z) \wedge \mathbf{card}_{\lambda x.CATw(x) \wedge BLACKw(x)}(z)=3,$
$\lambda x.CAT_w(x) \wedge BLACK_w(x)>$

The cat → $<\sigma(CAT_w), CAT_w>$ pres: CAT_w is a singleton
The cats → $<\sigma(^*CAT_w), CAT_w>$

In this theory, counting, count comparison and distribution is in terms of the set of base elements. Thus,

The cats each ate a can of tuna →
$\forall a \in (\sigma(^*CAT_w)] \cap CAT_w: ECT_w(a)$

So you don't use atoms but disjoint sets: counting goes right when the set of elements Swcounting as 1 is disjoint.
The general perspective on **bodies** and **bases**:
the **body** interpretation is the Boolean interpretation we are used to:
a set in the case of NPs
an object in the case of definite DPs
the **base** interpretation is a *perspective* on the body interpretation:

Group perspectives
the same body can be regarded
as *plural count* relative to a count base:
$<\sigma(^*CAT_w), CAT_w>$
The sum of cats as a sum of n individual cats

or as *collective singular count* relative to a collective count base:
$<\sigma(^*CAT_w), \{\sigma(^*CAT_w)\}>$

This is also the explanation as to how the *coffee* example can be count:

the coffee in the pot and the coffee in the cup mass
$<\sigma(CP) \sqcup \sigma(CC), CP \cup CC>$ with CP and CC mass sets

$<\sigma(CP) \sqcup \sigma(CC), \{\sigma(CP), \sigma(CC)\}>$ with CP and CC mass sets

The set $\{\sigma(CP), \sigma(CC)\}$ is disjoint and has two elements. So the sum counts as two relative to this set.

count - mass - neat - mess

the same body can be regarded as count relative to a count base, a disjoint set, or as mass relative to a base that is not disjoint.

i-set <**body**, **base**> is *count* iff **base** is disjoint, *mass* otherwise.

In order to derive a theory of count and mass *nouns* from this we need to extend this to count and mass intensions, and from there to nouns. This is done in Landman 2020.

Let $X \subseteq B$
$ATOM_X$ is the set of minimal elements in X^+

i-set <**body**, **base**> is *neat* iff $ATOM_{base}$ is disjoint and **base** $\subseteq$ $*ATOM_{base}$; *mess* otherwise

Neat i-set <**body**, **base**> is generated from a disjoint set of **base** atoms, but the **base** itself need not be disjoint. This generalizes the notion of count:

Fact: if <**body**, **base**> is count, it is neat.

The body of neat mass i-sets is like that of count i-sets, but they do not have a counting base.

Neat mass nouns

Neat mass nouns: furniture, pottery, poultry, livestock....

Example: *poultry* on a turkey farm. [picture]

Singular count: *turkey* → < $TURKEY_w$, $TURKEY_w$> with TURKEY a disjoint set
Plural count: *turkeys* → <$*TURKEY_w$, $TURKEY_w$>

Neat mass: *poultry* → <$*TURKEY_w$, $*TURKEY_w$>

$TURKEY_w$ is disjoint, but $*TURKEY_w$ is not disjoint.
$ATOM_{*TURKEYw}$ = TURKEY, which generates *TURKEY, hence
<$*TURKEY_w$, $*TURKEY_w$>ɣ

I call these *sum neutral* neat mass nouns, because the distinction between the body and the base is neutralized.

Example: *pottery* [picture]

P $\rightarrow$ {cup, saucer, cup and saucer, teapot, teaset, plate}
= {cup, saucer, cup $\sqcup$ saucer, teapot, cup $\sqcup$ saucer $\sqcup$ teapot, plate
pottery $\rightarrow$ <*P, P>

Neat mass nouns like *pottery* I call group neutral neat mass nouns, because for them the distinction between single pottery items and groups of pottery items is neutralized.

Neat mass nouns pattern with count nouns and with mass nouns.

With count nouns: neat mass nouns allow distributive adjectives and count comparison

Distributive adjectives: *small* versus *noisy*
The noisy boys = the boys that are individually noisy or noisy as a group
The small boys = the boys that are individually small

Fact: distributive adjectives modify count nouns and neat mass nouns but not mess mass nouns:

The small pottery = the small pottery items
#The small meat (in English, see Landman 2020 for Dutch)

50 cows are outside, 200 chickens are inside in summer.
Most farm animals are inside in summer TRUE
Most livestock is inside in summer TRUE

count comparison (even though the total volume and weight of the cows is bigger than that of the chickens)

But measure comparison is possible for neat mass and mess mass nouns, but not for count nouns:

Although more farm animals are inside than outside, *with respect to biomass*

Rothstein 2017:

Jane received more mail than Mary today (namely 17 letters versus 5 packages), but mary had more mail to carry home.

Hence: neat mass nouns are not count nouns which lack count specification: they pattern semantically both with count nouns and with mess mass nouns.

mess mass nouns

Types of mess mass i-sets

1. like *time*	p. 229
2. like *salt* dissolved in water	p.232
3. like *meat* and *soup*	p. 236
4. like *rice*	p. 240
5. like *water*	p 341