Sorting neat nouns in Iceberg semantics

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Part 1 Neat mass nouns in Iceberg semantics – Landman 2017

1.1. Boolean background

Semantic interpretation domains: Complete Boolean algebra **BOOL** ordered by part-of relation $\sqsubseteq$, with minimum 0 and operations $\sqcup$ and $\sqcap$ of complete join and meet.

Non-null elements Let $X \subseteq$ BOOL

$X^+ = X - \{0\}$ The set of non-null elements of X

Boolean part set: Let $z \in$ BOOL, $X \subseteq$ BOOL

$(z] = \{b \in \text{BOOL}: b \sqsubseteq z\}$ The set of all Boolean parts of z

$(X] = (\sqcup X]$ The set of all Boolean parts of $\sqcup X$

Closure and generation under sum $\sqcup$: Let $X,Y \subseteq$ BOOL

$*X = \{b \in \text{BOOL}: \text{for some } Y \subseteq X: b = \sqcup Y\}$ The set of all sums of elements of X

Y *generates* X *under* $\sqcup$ iff $X \subseteq *Y$ and $\sqcup Y = \sqcup X$

All elements of X are sums of elements of Y, and X and Y have the same supremum.

Disjointness and overlap: Let $x,y \in$ BOOL, $X,Y \subseteq$ BOOL

x and y *overlap* iff $x \sqcap y \in \text{BOOL}^+$, otherwise x and y are *disjoint*

Two elements overlap if they share a non-null part, otherwise they are disjoint.

X *overlaps* iff some $x, y \in X$ overlap, otherwise X is *disjoint*

A set overlaps if two of its elements overlap, otherwise it is disjoint.

X *overlaps* Y iff some $x \in X$ and some $y \in Y$ overlap, otherwise X *is disjoint from* Y

A set overlaps another set if some element of the one overlaps some element of the other, otherwise they are disjoint.

1.2. Atoms and atomicity

Classically, atoms in **BOOL** are the minimal elements in BOOL^+.
This is generalized here to arbitrary subsets of BOOL.

Atomicity: Let $a \in \text{BOOL}$, $X \subseteq \text{BOOL}$. $z \in X$

a is an X-*atom* iff $a \in X^+$ and for every $x \in X^+$: if $x \sqsubseteq a$ then $x = a$.
a is an X-atom if a is a minimal element of X^+

ATOM_X is the set of X-atoms   The set of minimal elements in X^+

$\text{ATOM}_X(z) = (z] \cap \text{ATOM}_X$ The set of parts of z that are X-atoms

X is *atomic* iff for every $z \in X^+$: $\text{ATOM}_X(z) \neq \emptyset$
Every element of X^+ has at least one part that is an X-atom.

X is *atomistic* iff for every $z \in X$ there is a set $A \subseteq \text{ATOM}_X$: $z = \sqcup A$
Every element of X is the sum of X-atoms.

X is *atomless* iff $\text{ATOM}_X = \emptyset$
There are no X-atoms, i.e. X^+ has no minimal parts

The classical notion are derived by taking X = BOOL:

a is *an atom in* **BOOL** iff $a \in \text{ATOM}_{\text{BOOL}}$
BOOL is *atomic/atomistic/atomless* iff BOOL is *atomic/atomistic/atomless*

Theorem: If **BOOL** is a complete Boolean algebra, then **BOOL** is atomic iff **BOOL** is atomistic.

This theorem does *not* generalize to arbitrary subsets:

Fact: Let **BOOL** be a complete Boolean algebra and $X \subseteq \text{BOOL}$:
X can be atomic without being atomistic.
[this is discussed in Part 4]

1.3. Iceberg intensions

Iceberg intensions Let W be the set of world-time indices.

An *i-set intension* is a function X that maps every world-time index $w \in W$ onto an i-set

$X_w = <\mathbf{body}(X_w), \mathbf{base}(X_w)>$,

where for every $w \in W$: $\mathbf{body}(X_w), \mathbf{base}(X_w) \subseteq \text{BOOL}$ and
$\mathbf{body}(X_w) \subseteq {}^*\mathbf{base}(X_w)$ and
$\sqcup\mathbf{base}(X_w) = \sqcup\mathbf{body}(X_w)$

An i-set intension is a function that maps every world w onto a pair consisting of a body and a base where the body is generated by the base under $\sqcup$.

The body is the familiar semantic interpretation in Boolean semantics.

Base-information is used for:
1. Distinguishing count nouns from mass nouns
2. Distinguishing neat nouns from mess nouns
3. For count nouns: base is used for:
   -*counting:* ***More than three*** cats purred.
   -*count comparison:* ***Most*** cats purr.
   -*distribution:* ***Three cats*** must ***each*** have their own basket.

Compositionality: the base of the interpretation of a complex noun phrase is a function of the base of the interpretation of the head.

Compositionally related expressions often have intensions that differ only in the body, not the base.

[The theory extends to DP interpretations which are i-object intensions.]

1.4. Three i-sets and one i-object, all with the same base

Reading the pictures:

base(X_w)

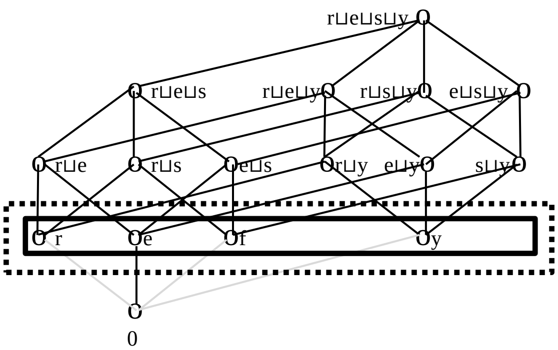
body(X_w)

Grey lines: except for 0, the structures in the picture are floating at some height inside BOOL (icebergs): the cats are atomic with respect to ***base**(X_w), not with respect to BOOL. (i.e. they have parts in the structure that are not themselves cats).

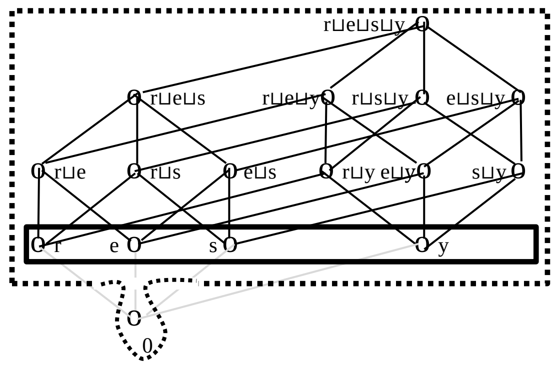
Little tail: $0 \in$ ***base**, even if the cat parts in between are not.

Let CAT_w = {ronya, emma, shunra, yiremiyahu}, a disjoint set.

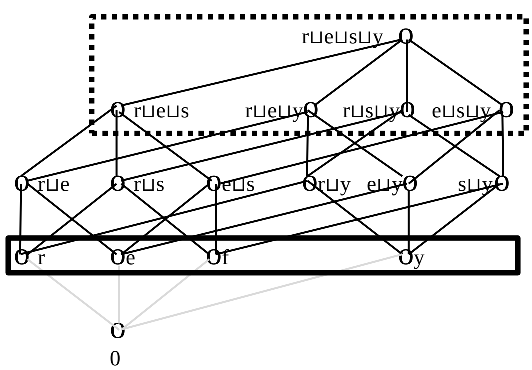
Singular noun *cat*:
$<CAT_w, CAT_w>$



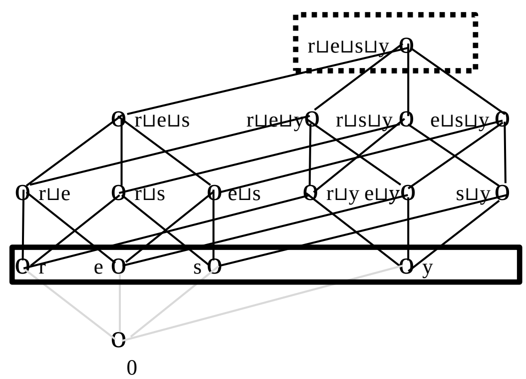
Plural noun *cats*
$<{}^*CAT_w, CAT_w>$



Numerical noun phrase *at least three cats*:
$<{}^*CAT_w \cap \lambda x.|ATOM_{CATw}(x)|=3, CAT_w>$



Definite DP *the cats*
$<\sigma({}^*CAT_w), CAT_w>$



1.5. Intensional bases

Most of this talk is concerned with bases, and not with bodies.
We abstract away from bodies by defining ***intensional bases***:

Intensional bases:
An *intensional base* is a function B: W $\rightarrow$ **pow**(BOOL)

For i-set intension X, B_X, the *intensional base of X* is given by: $B_X = \lambda w.\mathbf{base}(X_w)$.
The function that maps every world w onto **base**(X_w).

Let $B \in \mathcal{B}$ be an intensional base.
For intensional base B, $\mathcal{X}_B$, the set of *i-set intensions based on B*, is given by:
$\mathcal{X}_B = \{X_B \in \mathcal{X}:\ \lambda w.\mathbf{base}(X_{Bw}) = B\}$
The set of functions whose intensional base is B.

Note:
-we are concerned with i-set intensions that are the interpretations of natural language expressions.
-we are concerned with intensional bases that the interpretations of natural language expressions are based on.
-This means that when we constrain the relation between, say, X_w and X_v, we *are* constraining indirectly two possible extensions for the same natural language expression.
This imposes a meaning postulate on natural language expression α, if α is interpreted as X.

1.6. ***Count, mass, neat, mess***

-*count*, *mass*, *neat*, *mess* for nouns, noun phrases, and DPs are defined in terms of *count*, *mass*, *neat*, *mess* for i-set intensions (see Landman 2016 for discussion).

-*count*, *mass*, *neat*, *mess* for i-set intensions are defined in terms of *count*, *mass*, *neat*, *mess* for intensional bases:

> i-set intension X is *count*/*mass*/*neat*/*mess* iff B_X is *count*/*mass*/*neat*/*mess*

-*count*, *mass*, *neat*, *mess* for intensional bases are defined pointwise in terms of base extensions:

> Intensional base B is *count*/*mass*/*neat*/*mess* iff
> for every $w \in W$: B_w is *count*/*mass*/*neat*/*mess*

-*count*, *mass*, *neat*, *mess* for base extensions are defined as in Landman 2017:

Let B be an intensional base, $w \in W$:

> B_w is ***count*** iff B_w is disjoint — B_w is ***mass*** otherwise
>
> B_w is ***neat*** iff $ATOM_{Bw}$ is disjoint and B_w is atomic — B_w is ***mess*** otherwise

Thus B_w is *mess* iff either $ATOM_{Bw}$ is not disjoint or B_w is not atomic.

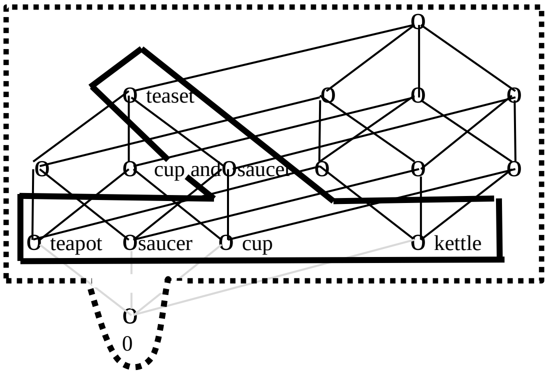
We add a fifth notion, based on Landman 2017:

> B_w is ***number neutral*** iff $ATOM_{Bw}$ is disjoint and $B_w = {*}ATOM_{Bw}$.
> B_w is the closure under $\sqcup$ of a disjoint set.

1.7. Itemized neat mass nouns in Landman 2011

The general definition of neat mass nouns fits itemized neat mass nouns like *kitchenware* and *furniture*. The following example is from Landman 2011:

kitchenware: $K_w = \langle {}^*\mathbf{base}(K_w), \mathbf{base}(K_w) \rangle$



In this example we assume, for *kitchenware*, that the base contains *kitchenware items that are sold as* ***one*** *in our shop*:

kettles, ***teapots***, ***saucers***, ***cups***, ***cup and saucers***, and ***teasets***.

K is the i-set intension that is the interpretation of *kitchenware*

$\mathbf{base}(K_w)$ = {***teapot***, ***saucer***, ***cup***, ***cup and saucer***, ***teaset***, ***kettle***}
$\text{ATOM}_{\mathbf{base}(K_w)}$ = {***teapot***, ***saucer***, ***cup***, ***kettle***}, a ***disjoint*** set of kitchenware items.

$\text{ATOM}_{\mathbf{base}(K_w)}$ is disjoint. $\mathbf{base}(K_w)$ is atomic. Hence K_w is neat.

$\mathbf{base}(K_w)$ is not disjoint Hence K_w is neat mass.

1.8. Number neutral neat mass nouns in Landman 2017

Let B be the intensional base that maps every world w onto the ***disjoint*** set B_w,
where B_w is the set of domesticated birds in w kept by humans for their eggs, their meat or their feathers (Wikipedia's definition of *poultry*).

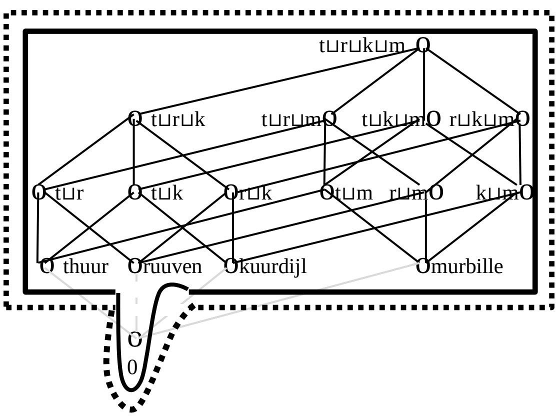
Let *poultry* $\rightarrow P$ where $P = \lambda w.\langle {}^*B_w, {}^*B_w \rangle$

-Then P is a number neutral i-set intension.
-**base**(P) = $^*B_w$, which is not disjoint, hence P is *number neutral neat mass*.

Example:

B_w = {thuur, ruuven, kuurdijl, murbille} [turkeys in Anton Koolhaas' 1958 story *De trechter/the funnel*]

poultry: $P_w = \langle {}^*B_w, {}^*B_w \rangle$



Note the similarity with singular count nouns and plural count nouns:

turkey	$\rightarrow$	$\lambda w.\langle B_w, B_w \rangle$	body = base		disjoint(base)
turkeys	$\rightarrow$	$\lambda w.\langle {}^*B_w, B_w \rangle$		body = *base	disjoint(base)
poultry	$\rightarrow$	$\lambda w.\langle {}^*B_w, {}^*B_w \rangle$	body = base	body = *base	

singular count and plural count: the same disjoint base
number neutral and singular count: body = base
number neutral and plural count: body = *base (since **X = *X)

Part 2 Conceptual and contextual atomicity

2.1. Landman 2011

-Schwarzschild 2011: 'stubbornly distributive' adjectives like *big* do not allow collective readings: (1a) can mean (1b) but not (1c):

(1) a. The boxes are big.
  b. Each box is big. YES
  c. Thought each box is small, together they take up a lot of space. NO

-Rothstein 2011: 'stubbornly distributive' adjectives can apply to neat mass nouns with a distributive reading.

-Landman 2011: interpretational difference between itemized neat mass nouns like *kitchenware* and number neutral neat mass nouns like *poultry*:
big poultry = big birds, not big sums of birds
big kitchenware: can include certain big sums of kitchenware

Here: shape adjectives, rather than degree adjectives.

a

$b \sqcup c$

d

$e \sqcup f$

(2) a. $a \in$ *the heart-shaped poultry*, $b \sqcup c \notin$ *the heart-shaped poultry*
  heart-shaped poultry denotes the set of ***individual*** heart-shaped birds
  b. $d, e \sqcup f \in$ *the heart-shaped kitchenware* $e, f \notin$ *the heart-shaped kitchenware*
  heart-shaped kitchenware denotes the set of ***simple or compound*** heart-shaped kitchenware items.

We notice here – what Landman 2011 does not mention – that this contrast also holds for count expressions:

(3) a. The heart-shaped birds {a}
  b. The heart-shaped kitchenware items {d, $e \sqcup f$}

2.2. Rothstein 2010

Rothstein 2010 discusses this contrast for count nouns, but gives an analysis that does not extend to neat mass nouns (so the discussions of Rothstein and Landman are in a way complimentary).

Rothstein 2010 (p. 375): Contrast between "highly naturally atomic predicates" like *boy* and less naturally atomic ones like *table*. cf. (4a) and (4b):

(4) a. ✓There are two tables that may be put together to make a bigger table.
b. #There are two boys that may be put together to make a bigger boy.

Rothstein (p. 375): if you put tables a and b together to make a bigger table a⊔b, then in that context, a and b no longer count as semantic atoms.

Rothstein (p. 357) on mass noun *furniture*: "varying the situational context would affect what is understood as the individual entities relevant for quantity judgments."

Cf. Count comparison in (5):

Max's furniture Lucy's furniture

a b d⊔e⊔f

(5) a. When d⊔e⊔f is regarded as ***3 stools***, Lucy has ***more*** furniture than Max.
b. When d⊔e⊔f is regarded as ***1 stool***, Lucy has ***less*** furniture than Max.

Rothstein's analysis: *boy* and *turkey* are naturally atomic, while *stool* and *table* are not:

Natural atomicity (Rothstein 2010 p. 373):
If N is a *naturally atomic predicate,* then: $\forall x\ \forall k\ \forall k'[[x \in \boldsymbol{\pi}_1(N_k) \wedge x \in \boldsymbol{\pi}_1(*N_{k'})] \rightarrow \boldsymbol{\pi_1}(N_{k'})]$

If N is naturally atomic, then for any two contexts k and k',
if x is an atom in N_k, and x is in $N_{k'}$, x is also an atom in $N_{k'}$.

Problem: Natural atomicity is defined in terms of counting context k, which is only available for count denotations. Hence, this definition applies only to count nouns.

In fact, Rothstein assumes that *furniture* is naturally atomic (p.356).
This means that, while Rothstein's analysis can distinguish between *turkey* and *table*, it cannot distinguish between *poultry* and *furniture*.

2.3. Conceptual and contextual atomicity

We define a notion of *conceptual atomicity*.
-Conceptual atomicity is equivalent to Rothstein's natural atomicity for count nouns.
-Conceptual atomicity does not rely on Rothstein's notion of counting context k.
-Conceptually atomic: count nouns like *turkey*, neat mass nouns like *poultry*.
Contextually atomic: count nouns like *stool*, neat mass nouns like *furniture*.

Intensional base *B* is *conceptually atomic* iff *B* is neat and
$\forall w \in W: \forall x \in ATOM_{Bw}\ \forall y \in BOOL: y \sqsubset x \ \rightarrow \neg\exists v \in W: y \in ATOM_{Bv}$
B is *contextually atomic* otherwise

B is conceptually atomic iff for every world w and *B*-atom x in w: there is no world v where a *proper* part of x is a *B*-atom in v.

[Note: we interpret $y \sqsubset x$ as y is a proper part of x ***and not cross-world identical to x***. Thus, we ignore cases where $y \sqsubset x$, because y is x after his haircut. We don't work cross-world identity into the definitions, but assume generally that = stands for cross-world identity. See the note on page 17.]

For i-set intension *X*, we write here **base**(*X*) for B_X (for typographical reasons of subscripts).

Turkey $\rightarrow$ *T* a *conceptually atomic* count i-set intension.
Fact: since for every world $w \in W$ $\mathbf{base}(T_w) = ATOM_{\mathbf{base}(Tw)}$ it follows that if Ruuven is a turkey in w, there is no world v where a proper part x of Ruuven is a turkey in v.

Stool $\rightarrow$ *S* a *contextually atomic* count i-set intension.
There may well be stool s_1 in world w and a proper part s_2 of s_1 which is itself a stool in some other world v.

Poultry $\rightarrow$ *P* a *conceptually atomic* neat mass i-set intension.
If Ruuven $\in ATOM_{\mathbf{base}(P)w}$, there is no world v where a proper part x of Ruuven is in $ATOM_{\mathbf{base}(P)v}$.

Furniture $\rightarrow$ *F* a *contextually atomic* neat mass i-set intension.
Here also what are atomic furniture items in w may well have proper parts that are atomic furniture items in some other world v.

2.4. Counting with count nouns

Conceptually atomic count nouns: cardinality of elements in **body**(X) is invariable across worlds.
Contextually atomic count nouns: cardinality of elements in **body**(X) varies across worlds.

(6) a. ✓I took two tables, put them together, so now I have one table.
b. #I took two coins, glued them together, so now I have one coin.

Cardinality in Iceberg semantics:

$$\mathbf{card} = \lambda w \lambda X \lambda x. \begin{cases} |(x] \cap \mathbf{base}(X_w)| & \text{if } X \text{ is count and } x \in {}^*\text{base}(X_w) \\ \bot & \text{otherwise} \end{cases}$$

x counts as n turkeys in world w iff x has n parts that are in **base**(T_w)

Here is a picture for (6a):

a b

Let **base**(T_w) = {a,b} and **base**(T_v) = {a⊔b}
It follows that: $\mathbf{card}_{Tw}(a \sqcup b) = |\{a,b\}| = 2$
$\mathbf{card}_{Tv}(a \sqcup b) = |\{a \sqcup b\}| = 1$

Israeli urban legend: if you glue two 10 agorot coins together,
vending machines will treat the result as one 5-shekel coin (100 agorot to the shekel).

c d

However, as the infelicity of (6b) shows, the result of gluing *two coins* c and d together to c⊔d does *not* make c⊔d count as *one coin* (maybe as *one fake coin*).

2.5. Distributive modification of count nouns

Landman 2017: The set in terms of which x is counted is the same as the distribution set for x.

Hence, if x has variable cardinality across worlds, you can distribute to x when x counts as one, but only x's parts when x counts as many.

Let *kitchenware item* → *KI*   a contextually atomic count intension
Look at the pepper shaker e and the salt shaker f:

e  f

Let **base**(KI_w) = {e⊔f} and **base**(KI_v) = {e,f}
w is the world where Piperis and Salis are still living together.
v is the world where they broke up: Piperis took e, and Salis took f.

It follows that: $\mathbf{card}_{KI_w}(e \sqcup f) = |\{e \sqcup f\}| = 1$ $\mathbf{card}_{KI_v}(e \sqcup f) = |\{e,f\}| = 2$
In w, e⊔f counts as *one kitchenware item*, while in v, both e and f count as one kitchenware item, so e⊔f counts as *two kitchenware items.*

Similarly, in w, e⊔f counts as a *heart-shaped kitchenware item*. In v, e⊔f is no longer a *heart-shaped kitchenware item*, nor does it count as *two heart-shaped kitchenware items*.

In contrast, in no world will the pair of birds b⊔c count as a *heart-shaped bird* (because in no world do they count as a single bird), but also, in no world will they count as *two heart-shaped birds*: because for conceptually atomic count nouns like *bird*, *heart-shaped* can only distribute to single birds, not to pairs of birds.

b  c

2.6. Distributive modification of neat mass nouns

The contrast between *kitchenware item* and *bird* extends to the mass domain:

- $e \sqcup f$ **can** fall under the denotation of *heart-shaped kitchenware*.
- $b \sqcup c$ **cannot** fall under the denotation of *heart-shaped poultry*.


a


b⊔c


d


e⊔f

Let *poultry* $\to P$ a conceptually atomic neat mass intension
kitchenware $\to K$ a contextually atomic neat mass intension

pace Landman 2011, 2017:
$\mathbf{base}(P_w) = \{0, a, b, c, a \sqcup b, b \sqcup c, a \sqcup c, a \sqcup b \sqcup c\}$
$\mathbf{base}(K_w) = \{d, e, f, e \sqcup f\}$

Landman 2017: Let X be a *neat mass* i-set intension and $x \in {}^*\mathbf{base}(X_w)$:

1. X is *conceptually atomic*: distribution set for x is the disjoint set $\mathrm{ATOM}_{\mathbf{base}(X_w)}(x)$
2. X is *contextually atomic*: distribution set for x is a contextually specified disjoint subset of $(x] \cap \mathbf{base}(X_w)$, i.e. the context selects a disjoint subset, in our example, $\{d,e,f\}$ or $\{d, e \sqcup f\}$.

Landman: for *contextually atomic **count*** i-set intension X the world-time index w acts like a context and selects for X as $\mathbf{base}(X_w)$ a *disjoint* set.

Schoenfeld: generalize this to:
or *contextually atomic **neat*** i-set intension X the world-time index w acts like a context and selects for X a base such that $\mathrm{ATOM}_{\mathbf{base}(X_w)}$ is *disjoint.*

Hence: Counting and distribution is counting and distribution of atomic parts *both* for count i-set intensions and for neat mass i-set intensions.

[This, of course, does not mean that *three* or *each* can apply to neat mass intensions. The proposal is a proposal *within* the general framework of Iceberg semantics.]

2.7 Schoenfeld's proposal for neat mass nouns

i-set intension X is *number neutral* iff for some *count* intensional base B, $X = \lambda w.\langle {}^*B_w, {}^*B_w \rangle$

Proposal: ***neat mass noun intensions are number neutral***
poultry $\rightarrow P$, where P is a number neutral conceptually atomic i-set intension.
kitchenware $\rightarrow K$, where K is a number neutral contextually atomic i-set intension.

Look at K_w and K_v, in the same situations as above.

d e f

Landman: $\mathbf{base}(K_w) = \mathbf{base}(K_v) = \{d, e, f, e{\sqcup}f\}$
Schoenfeld: $\mathbf{base}(K_w) = \{0, d, e{\sqcup}f, d{\sqcup}e{\sqcup}f\}$ and $\mathbf{base}(K_v) = \{0, d, e, f, d{\sqcup}e, d{\sqcup}f, e{\sqcup}f, d{\sqcup}e{\sqcup}f\}$

1. Distribution is to base-atoms: $\text{ATOM}_{\mathbf{base}(K\text{w})} = \{d, e{\sqcup}f\}$ and $\text{ATOM}_{\mathbf{base}(K\text{w})} = \{d, e, f\}$
2. We build from this number neutral neat mass denotations:
   $\lambda w.\langle {}^*(\text{ATOM}_{\mathbf{base}(K\text{w})} \cap \textit{heart-shaped}), {}^*(\text{ATOM}_{\mathbf{base}(K\text{w})} \cap \textit{heart-shaped})\rangle$

-*Kitchenware* is contextually atomic:
in context w, *heart-shaped kitchenware* is $\rightarrow \langle\{0, d, e{\sqcup}f, d{\sqcup}e{\sqcup}f\}, \{0, d, e{\sqcup}f, d{\sqcup}e{\sqcup}f\}\rangle$
in context v, *heart-shaped kitchenware* $\rightarrow \langle\{0, d\}, \{0, d\}\rangle$

-Since *poultry* is conceptually atomic, in no context do pluralities of birds fall under the denotation of *heart-shaped poultry*.

So, *poultry* and *kitchenware* are both interpreted as number neutral neat mass i-set intensions. The difference lies in whether there is variability of sets of base-atoms (yes for *kitchenware*, no for *poultry*).

[note: to make sure that *kitchenware* stays mass, we may have to redefine overlap so that {0, a} counts as an overlapping set.]

Part 3 Sorting count nouns and neat mass nouns

3.1 Another definition of conceptual atomicity

Partition: Let $z \in BOOL^+$. $X \subseteq BOOL^+$

X is a *partition* of z iff X is disjoint and $\sqcup X=z$

A partition of z is a disjoint set whose sum is z

Refinement: Let X and Y be partitions of z

Partition X *refines* partition Y, $X \preccurlyeq Y$, iff for every $x \in X$ there is a $y \in Y$: $x \sqsubseteq y$

every element of Y can be split into elements of X

Obviously, if *B* is an intensional base then for every $w \in W$ such that $z \in {}^*B_w$, $ATOM_{B_w}(z)$ is a partition of z. This means that we can reformulate conceptual atomicity in terms of partitions:

Conceptual atomicity

Intensional base *B* is *conceptually atomic* iff *B* is neat and

$\forall z \in BOOL^+\ \forall w, v \in W$: if $ATOM_{B_w}(z) \neq \emptyset \wedge ATOM_{B_v}(z) \neq \emptyset \rightarrow ATOM_{B_w}(z) = ATOM_{B_v}(z)$

This means that for any object z, in all worlds in which z has B-atomic parts z has the same set of B-atomic parts.

Intensional base *B* is *contextually atomic* iff *B* is atomic but not conceptually atomic.

i-set intension *X* is *conceptually atomic* iff B_X is conceptually atomic,
contextually atomic if *X* is atomic but not conceptually atomic.

[As above, identity in these definitions should be interpreted as cross-world identity.]

Fact: The present definition of conceptual atomicity entails the previous one:

Namely:

Let *poultry* $\rightarrow$ *P*, and let *P* be conceptually atomic.

Let $y \sqsubset$ Ruuven and let $y \in ATOM_{\mathbf{base}(P_w)}$.

then $y \in ATOM_{\mathbf{base}(P_w)}$(Ruuven), and hence, by conceptual atomicity,
$y \in ATOM_{\mathbf{base}(P_v)}$(Ruuven) for any world where $ATOM_{B_v}$(Ruuven) $\neq \emptyset$, and this means, by disjointness, that there cannot be a world v where Ruuven $\in ATOM_{B_v}$.

3.2 Contextual atomicity in the limit

Conceptual atomicity in the limit Let *B* be an intensional base.

B is *conceptually atomic in the limit* iff *B* is neat and
$\forall z \in \text{BOOL}: \exists w \in W: \text{ATOM}_{Bw}(z) \neq \emptyset \rightarrow$
$\exists w \in W\ \forall v \in W: \text{ATOM}_{Bv}(z) \neq \emptyset \rightarrow \text{ATOM}_{Bw}(z) \preccurlyeq \text{ATOM}_{Bv}(z)$

For every object z that has *B*-atomic parts in some world, here is a world w in which the set of B-atomic parts of z **refines** the sets of B-atomic parts of z in all other worlds where $\text{ATOM}_{Bv}(z) \neq \emptyset$.

B is *neat but contextually continuous* iff *B* is neat and not conceptually atomic in the limit.

The idea is that for neat noun intensions that are conceptually atomic in the limit, the sets of base-atomic parts of any element z (partitions of $\sqcup(\text{ATOM}_{Bw}(z))$ may vary contextually, but only in so far that there is a unique most fine-grained such partition.

The intuition is that, what counts as minimal kitchenware items part of z may vary in context, but *ultimately*, all these contextually minimal sets are built from a *fixed set* of minimal kitchenware items that are part of z: the set of such atomic parts is fixed in the limit.

The idea is that this applies to itemized neat mass nouns: you may have in w as atoms in *kitchenware* the *teaset* and *the pan*, and in *the teapot* and *the cup and saucer* and *the pan*, but in the limit, you can break these down into *the teapot* and *the cup* and *the saucer* and *the pan* and these you cannot break down anymore while keeping them in *kitchenware* (possibly you can still break down *the teapot* into *the pot proper* and *the lid*, but that is debatable).

[Note on cross-world identity. We assume a set *I* of identity functions, partial functions from W into BOOL, such that: $\forall i,j \in I$ if for some $w \in W$: $i_w = j_w$ then $i = j$.
For x, y ∈ BOOL: x ~ y, x and y a*re cross-world identical* iff $\exists i \in I \exists w,v \in W: i_w = x \wedge i_v = y$.
For X, Y ⊆ BOOL, X ~ Y, X and Y are *cross-world identical* iff there is a bijection h between X and Y such that for every x ∈ X: x ~ h(x).]

3.3. Sorting neat nouns

-***Conceptually atomic***:

count nouns	**neat mass nouns**	**typical instances**
turkey	*poultry*	natural kinds

-***Conceptually atomic in the limit***:

count nouns	**neat mass nouns**	**typical instances**
kitchenware item	*kitchenware*	compound artifacts

-***Neat but contextually continuous***:

count nouns	**neat mass nouns**	**typical instances**
fence, line	*fencing*	nouns allowing iterated splitting
heap of hay, grain of sand		nouns with vague classifiers

splitting: *one* fence can split in context into *two* fences….

Note: sorting beyond *conceptual atomicity* is not absolute.
e.g. *prototypical metal ware*: conceptually atomic in the limit
But if our shop sells *metal fencing*, the fencing will presumably count as *metal ware*.
-Possible resolution: *fencing that is sold in our shop* does not allow unbounded iterated splitting, and may count as conceptually atomic in the limit.

***Moral*: directing the focus of contextual atomicity on 'normal' cases**
Rothstein uses *fences* as the prototypical case of contextually atomic count nouns.
Chierchia, and following him Sutton and Filip, seem to take vagueness cases as prototypical cases of contextually atomic neat mass nouns.

The semantics of *heaps* and *grains* (*of sand*) have been studied in semantics since Eubulides, Aristotle's nemesis from Crete (mentioned in St. Paul's letter to Titus). Vagueness and iterative splitting have, of course, lead to a plethora of semantic analyses.

Obviously, we should not ignore vagueness and iterated splitting for nouns where these phenomena are relevant, but we should not think of them as the *core cases* on which to model the semantics of all neat mass nouns. It seems to us that in the domain of neat nouns they are really a bit of a *side show* of extreme cases.

Normality in neat nouns is centered on the domain of i-set intensions that are conceptually atomic and those that show a *restricted* form of *contextual* atomicity, like conceptual atomicity in the limit.

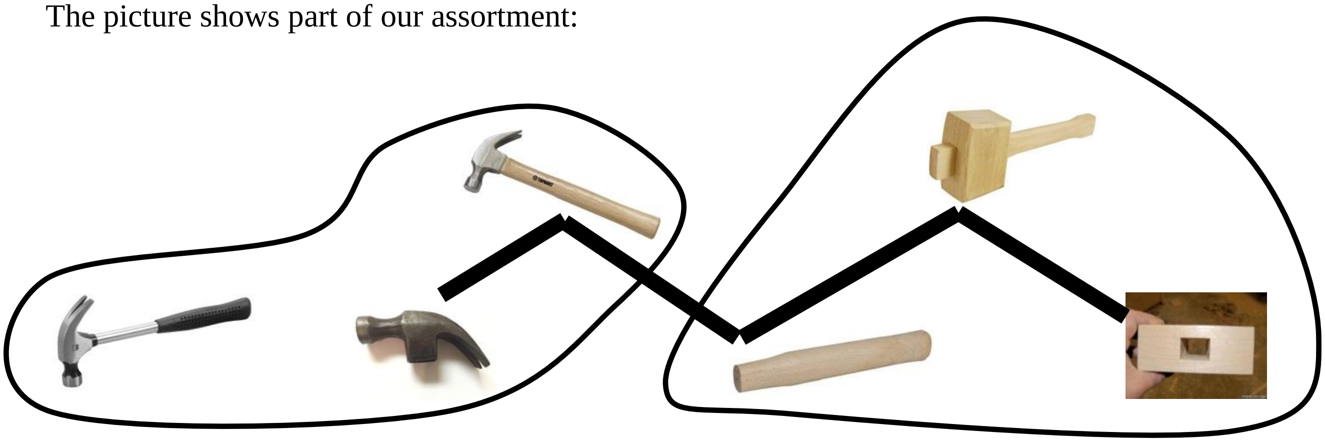
Direction of the semantics suggested here:
-for contextual atomicity focus on itemized neat nouns
-try to use the modal structure already available in i-set intensions before importing supervaluation techniques from the vagueness fringe.
-*Envoy*: *Prince*, if you think that allowing *fences* as *metal ware* is a problem: what about going one challenge more extreme: neat-mess hybrid itemized nouns like *eco-friendly paintware*, which includes *brushes*, *rollers*, but also *paint*, in fact, many different *paints*, and *turpentine*.

Part 4. Atomisticity

4.1. ***Atomicity versus atomisticity of bases***

Schoenfeld: neat intensional bases are, by definition, atomistic: $\forall w \forall x \in B_w$: $z = \sqcup ATOM_{B_w}(z)$.
Landman 2017: neat intensional bases can be atomic but not atomistic.

Example: In our shop we sell, among others, *metal ware* and *wood ware*.
The picture shows part of our assortment:



base(M_w) **base**(W_w)

-the base of the interpretation of *metal ware* (**base**(M_w)) contains ***two hammers*** and ***a metal hammer head***,
-the base of the interpretation of *wood ware* (**base**(W_w)) contains ***a wooden hammer handle***, ***a wooden hammer head (mallet head)*** , and ***a wooden hammer (mallet)*** mallet.
(The idea is that you can choose whether you want the wooden handle to be the handle of a metal hammer or of a mallet.)

We assume: *metal ware* $\rightarrow \lambda w.<{}^*\mathbf{base}(M_w), \mathbf{base}(M_w)>$
wood ware $\rightarrow \lambda w.<{}^*\mathbf{base}(W_w), \mathbf{base}(W_w)>$

1a. $ATOM_{\mathbf{base}(W_w)}$ = {hammer handle, wooden mallet head} is disjoint.
1b. $ATOM_{\mathbf{base}(M_w)}$ = {metal hammer, metal hammer head} is disjoint.

2a. **base**(W_w) is atomic: the mallet has the hammer stem and the mallet head as part, and both are two base-wood ware atoms.
2b. **base**(M_w) is atomic: the hammer with wooden stem and metal head has the metal hammer head as part, and the latter is a base-metal ware atom.

3a. **base**(W_w) is atomistic: the mallet is the sum of the hammer stem and the mallet head, both are base-wood ware atoms.
3b. **base**(M_w) is *not* atomistic: it is not the sum of base-metal ware atoms.

Landman 2017 allows such denotations. Schoenfeld will have to analyze this case differently.

4.2 Conceptual atomisticity in the limit

Here too one may entertain an intuition for itemized neat mass nouns that non-atomisticity should be eliminable in the limit. This cannot really be formulated by restriction to a single intension: we are not proposing to make the wooden stem *metal ware* in the limit.

Yet, the intuition is: we can go from *metal ware* and *wood ware* to the union-intension: *metal and wood ware* and in *that* intension, the non-atomistic base has been replace by an atomistic one. The following definition and constraint try to capture this intuition.

Conceptual atomisticity in the limit:
Let $\boldsymbol{B}$ be the set of intensional bases that are conceptually atomic in the limit. Let $B \in \boldsymbol{B}$.

> B is *conceptually atomistic in the limit* iff there is a ***salient atomistic*** intensional base $C \in \boldsymbol{B}$ such that: $\forall \mathrm{w} \in \mathrm{W}$: $B_{\mathrm{w}} \subseteq C_{\mathrm{w}}$ and $\mathrm{ATOM}_{B\mathrm{w}} \subseteq \mathrm{ATOM}_{C\mathrm{w}}$.

Proposal: Itemized nouns denote i-set intensions whose bases are conceptually atomistic in the limit.

The proposal means that non-atomisticity is allowed for itemized nouns, but it can always be eliminated in the limit (though not within one intension).

Some references

Chierchia, Gennaro, 2010, 'Mass nouns, vagueness, and semantic variation,' in *Synthese* 174.

Sutton, Peter and Hana Filip, 2016, 'Mass/count variation, a mereological, two-dimensional semantics,' in Susan Rothstein and Jurģis Šķilters (eds.), *Number: Cognitive, Semantic and Cross-linguistic Approaches. The Baltic International Yearbook of Cognition, Logic and Communication* 11, 2016, https://doi.org/10.4148/1944-3676.1110

Landman, Fred, 2011, 'Count nouns – mass nouns – neat nouns – mess nouns,' in: Michael Glanzberg, Barbara H. Partee and Jurģis Šķilters (eds.), Formal Semantics and Pragmatics: Discourse, Context and Models. The Baltic International Yearbook of Cognition, Logic and Communication 6, 2010, http://thebalticyearbook.org/journals/baltic/issue/current

Landman, Fred, 2016, 'Iceberg semantics for count nouns and mass nouns: classifiers, measures and portions,' in: Susan Rothstein and Jurģis Šķilters (eds.), Number: Cognitive, Semantic and Cross-linguistic Approaches. The Baltic International Yearbook of Cognition, Logic and Communication 11, 2016, http://dx.doi.org/10.4148/1944-3676.1107

Landman, Fred, 2017, ' Iceberg semantics for count nouns and mass nouns - when does mass count,' to appear in: Hana Filip (ed.), *Counting and Measuring in Natural Language*, Cambridge University Press, Cambridge.

Rothstein, Susan, 2010, 'Counting and the mass-count distinction,' in: *Journal of Semantics* 27.

Rothstein, Susan, 2011, 'Counting, measuring, and the semantics of classifiers,' in: Michael Glanzberg, Barbara H. Partee and Jurģis Šķilters (eds.), *Formal Semantics and Pragmatics: Discourse, Context and Models. The Baltic International Yearbook of Cognition, Logic and Communication* 6, 2010, http://thebalticyearbook.org/journals/baltic/issue/current

Rothstein, Susan, 2017, *Semantics for Counting and Measuring*, Cambridge University Press, Cambridge.

Schwarzschild, Roger, 2011, 'Stubborn distributivity, multiparticipant nouns and the count/mass distinction,' in: *Proceedings of NELS 39*, GLSA, University of Massachusetts, Amherst.