Countability in the nominal and verbal domains

Count/Mass Variation: A 2D semantics

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August 17, 2016
ESSLLI 2016, Bolzano
Advanced Course
Plan

1. Overview of data
   ▶ Cross- and intralinguistic count/mass variation.

2. Background Literature

3. Introduce our account of mass/count distinction (Sutton and Filip, 2016a)
   ▶ Two-dimensional semantics.
   ▶ Wider coverage of mass/count variation data.
## The challenge: cross- and intralinguistic variation

<table>
<thead>
<tr>
<th>Noun Class</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>proto-typical objects</td>
<td><em>chair</em>$<em>{+c}$; <em>tuoli</em>$</em>{+c}$ (‘chair’ Finnish); <em>Stuhl</em>$_{+c}$ (‘chair’ German)</td>
</tr>
<tr>
<td></td>
<td><em>dog</em>$<em>{+c}$; <em>koira</em>$</em>{+c}$ (‘dog’ Finnish); <em>Hund</em>$_{+c}$ (‘dog’ German)</td>
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<td></td>
<td><em>boy</em>$<em>{+c}$; <em>poika</em>$</em>{+c}$ (‘boy’ Finnish); <em>Junge</em>$_{+c}$ (‘boy’ German)</td>
</tr>
<tr>
<td>super-ordinate artifacts</td>
<td><em>furniture</em>$<em>{-c}$; <em>huonekalu-t</em>$</em>{+c,pl}$ (‘furniture’ Finnish)</td>
</tr>
<tr>
<td></td>
<td><em>meubel-s</em>$<em>{+c,pl}$, <em>meubilair</em>$</em>{-c}$ (‘furniture’ Dutch)</td>
</tr>
<tr>
<td></td>
<td><em>kitchenware</em>$<em>{-c}$; <em>Küchengerät-e</em>$</em>{+c,pl}$ (German, lit. kitchen device-s)</td>
</tr>
<tr>
<td></td>
<td><em>footwear</em>$<em>{-c}$; <em>jalkinee-t</em>$</em>{+c,pl}$ (‘footwear’ Finnish)</td>
</tr>
<tr>
<td>homogeneous objects</td>
<td><em>fence</em>$<em>{+c}$, <em>fencing</em>$</em>{-c}$; <em>hedge</em>$<em>{+c}$, <em>hedging</em>$</em>{-c}$</td>
</tr>
<tr>
<td></td>
<td><em>wall</em>$<em>{+c}$, <em>walling</em>$</em>{-c}$; <em>shrub</em>$<em>{+c}$, <em>shrubbery</em>$</em>{-c}$</td>
</tr>
<tr>
<td>granulars</td>
<td><em>lentil-s</em>$<em>{+c,pl}$; <em>linse-n</em>$</em>{+c,pl}$ (‘lentils’ German)</td>
</tr>
<tr>
<td></td>
<td><em>lešta</em>$<em>{-c}$ (‘lentils’ Bulgarian); <em>čočka</em>$</em>{-c}$ (‘lentils’ Czech)</td>
</tr>
<tr>
<td></td>
<td><em>oat-s</em>$<em>{+c,pl}$; <em>oatmeal</em>$</em>{-c}$;</td>
</tr>
<tr>
<td></td>
<td><em>kaura</em>$<em>{-c}$ (‘oats’ Finnish); <em>kaurahiutale-et</em>$</em>{+c,pl}$ (Finnish, lit. oat.flake-s)</td>
</tr>
<tr>
<td>substances, liquids, gases</td>
<td><em>mud</em>$<em>{-c}$; <em>muta</em>$</em>{-c}$ (‘mud’ Finnish); <em>Schlamm</em>$_{-c}$ (‘mud’ German)</td>
</tr>
<tr>
<td></td>
<td><em>blood</em>$<em>{-c}$; <em>veri</em>$</em>{-c}$ (‘blood’ Finnish); <em>Blut</em>$_{-c}$ (‘blood’ German)</td>
</tr>
<tr>
<td></td>
<td><em>air</em>$<em>{-c}$; <em>lenta</em>$</em>{-c}$ (‘air’ Finnish); <em>Luft</em>$_{-c}$ (‘air’ German)</td>
</tr>
</tbody>
</table>
Chierchia (2010)

- **Stable atomicity** sanctions counting.
- **Vagueness** (lack of stable atomicity) blocks counting

- Weaknesses: *furniture-* and *lentil-* type nouns

Rothstein (2010)

- Count Ns are indexed to **counting contexts**, mass Ns are not

\[ FENCE_k = \{ \langle \text{rice}, k \rangle, \langle \text{lentil}, k \rangle, \langle \text{wood}, k \rangle \} \]

- Weaknesses: Type-based distinction is too weak

Landman (2011)

- **Overlapping generators** block counting

- Weaknesses: Granulars (*rice*/*lentil-* type nouns)
The Plan

- Second Pass: Dual-Source Hypothesis.
- Dual source account.
- Derive count/mass distribution patterns for the noun classes.

Rothstein (2010): \textit{fence}_{[+C]}
Non-overlap at a single counting-context, \( k \)
determines what counts as one

Landman (2011): \textit{kitchenware}_{[-C]}
Overlap across counting-contexts
COUNTING GOES WRONG

\textit{Küchengerät-e}_{[+C]}
German: “an item (items) of kitchenware”

analysis extends to \textit{COUNT/MASS counterparts}

analysis extends to \textit{fencing}_{[-C]}

Connection: Resolution/Non-Resolution of Overlap in Context

Rothstein’s Contexts: $c_{i > 0} \in \mathcal{C}$
In ‘default’ cases, map overlapping entities $\mapsto$ disjoint set

Landman’s Contexts: $c_0$
Allows overlap in the same context.

Null Counting Context computed from all others:

$$X_{c_0} = \bigcup X_{c_{i > 0}}$$
computed from all $c_{i > 0} \in \mathcal{C}$
The Pay-Off of the Synthesis

- Adds a level of explanation to Rothstein (2010) via overlap/non-overlap in context.
- Explicitly extends Landman’s analysis to cover context sensitive count nouns (e.g. fence).
- BUT still leaves the problem of granulars (e.g. rice, lentils).
Four Challenges for Chierchia and Rothstein/Landman

Cross- and Intralinguistic Variation:

(C1) Vague nouns can be Count or Mass
Cross \textit{lentils}_{+C,pl} = \textit{le\v{s}ta}_{-C} \text{ (Bulgarian)} \quad \textit{oats}_{+C,pl} = \textit{kaura}_{-C} \text{ (Finnish)}

Intra \textit{oats}_{+C,pl}/\textit{oatmeal}_{-C}

(C2) Not-Vague nouns can be Count or Mass
Cross \textit{furniture}_{-C} = \textit{huonekalut}_{+C,pl} \text{ (Finnish)}
\quad \textit{footwear}_{-C} = \textit{jalkineet}_{+C,pl} \text{ (Finnish)}
\quad \textit{kitchenware} \approx \textit{Küchengeräte}_{+C,pl} \text{ (German)}

Intra \textit{meubels}_{+C,pl}/\textit{meubilair}_{-C} \text{ (furniture, Dutch)}
\quad \textit{shoes}_{+C}/\textit{footwear}_{-C}, \textit{fence}_{+C}/\textit{fencing}_{-C}, \textit{rope}_{+C}/\textit{rope}_{-C}

(RL1) Overlapping nouns can be Count or Mass
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(RL2) Non-Overlapping nouns can be Count or Mass
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\begin{align*}
\text{Intra} & \textit{oats}_{+C,pl}/\textit{oatmeal}_{-C}
\end{align*}
CROSS- AND INTRALINGUISTIC VARIATION:

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Four Challenges for Chierchia and Rothstein/Landman

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(Finnish)
Intra \(\text{oats}_{+C,PL}/\text{oatmeal\text{-}C}\)
### A Dual-Source Hypothesis

Some aspects of Chierchia and Rothstein/Landman could be combined to accommodate more data:

<table>
<thead>
<tr>
<th><strong>OVERLAP</strong></th>
<th><strong>NON-OVERLAP</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAGUE</strong></td>
<td></td>
</tr>
<tr>
<td><em>mud</em>ₐ</td>
<td><em>oat-s</em>+C,PL</td>
</tr>
<tr>
<td><em>lieju</em>ₐ (<em>mud, Finnish</em>)</td>
<td><em>kaura</em>ₐ (<em>oat, Finnish</em>)</td>
</tr>
<tr>
<td><em>kal</em>ₐ (<em>mud, Bulgarian</em>)</td>
<td><em>oatmeal</em>ₐ</td>
</tr>
<tr>
<td><em>blood</em>ₐ</td>
<td><em>kaurhiutale-et</em>+C,PL (<em>oatmeal, Finnish</em>)</td>
</tr>
<tr>
<td><em>water</em>ₐ</td>
<td><em>vločky</em>+C,PL (<em>oatmeal, Czech</em>)</td>
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<tr>
<td></td>
<td><em>lentil-s</em>+C</td>
</tr>
<tr>
<td></td>
<td><em>lešta</em>ₐ (<em>lentil, Bulgarian</em>)</td>
</tr>
<tr>
<td></td>
<td><em>čočka</em>ₐ (<em>lentil, Czech</em>)</td>
</tr>
<tr>
<td></td>
<td><em>bean-s</em>+C,PL</td>
</tr>
<tr>
<td></td>
<td><em>bob</em>ₐ (<em>bean, Bulgarian</em>)</td>
</tr>
<tr>
<td><strong>NON-VAGUE</strong></td>
<td></td>
</tr>
<tr>
<td><em>furniture</em>ₐ</td>
<td><em>cat</em>+C</td>
</tr>
<tr>
<td><em>meubel-s</em>+C,PL (<em>furniture, Dutch</em>)</td>
<td><em>kissa</em>ₐ (<em>cat, Finnish</em>)</td>
</tr>
<tr>
<td><em>meubilair</em>ₐ (<em>furniture, Dutch</em>)</td>
<td><em>kat</em>+C (<em>cat, Dutch</em>)</td>
</tr>
<tr>
<td><em>huonekalu-t</em>+C, PL (<em>furniture, Finnish</em>)</td>
<td><em>boy</em>+C</td>
</tr>
<tr>
<td><em>fence</em>+C / <em>fencing</em>ₐ</td>
<td><em>chair</em>+C</td>
</tr>
<tr>
<td><em>wall</em>+C / <em>walling</em>ₐ</td>
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</tr>
</tbody>
</table>
Incorporating Precisification Contexts

Null Precisification Context computed from all others:

\[ X_{\pi_0} = \bigcap X_{\pi_{i>0}} \]

computed from all \( \pi_{i>0} \in \Pi \)

- Note: No appeal to atoms!
The IND Function

- Function IND : \( \langle \langle \pi, \langle e, t \rangle \rangle, \langle c, \langle \pi, \langle e, t \rangle \rangle \rangle \rangle \)
- Applies to predicates \( P : \langle \pi, \langle e, t \rangle \rangle \)
- Introduces a counting context
- Examples:

\[
\begin{align*}
\text{IND}(\text{cat}) &= \{ , , , \ldots \} \\
\text{IND}(\text{k.kare}) &= \{ , , , \ldots \} \\
\text{IND}(\text{fence}) &= \{ , , , \ldots \} \\
\text{IND}(\text{rice}) &= \{ , , , \ldots \} \\
\text{IND}(\text{mud}) &= \{ \emptyset \}
\end{align*}
\]

- IND applies to predicates and introduces a counting context.
- This gives the COUNTING BASE for that predicate.
The basic idea

OVERLAP at $c_0$ can make counting go wrong: Too much to count.

Empty IND sets at $\pi_0$ can also make counting go wrong: Not enough to count.
Putting the Pieces Together

Similarly to Krifka (1989), we assume lexical entries for concrete nouns have both qualitative and quantitative criteria.

- Adopt the use of ordered pairs from Landman (2015):

\[
[n]^{\pi_i, c_i} = \langle \text{body}(N), \text{base}(N) \rangle
\]

Soja et al. (1991) show that the object/substance distinction is prelinguistic. We therefore reflect the distinction in lexical entries:

\[
[n]^{\pi_i, c_i} = \begin{cases} 
\langle N, N \rangle & \text{if IND}(N) = \emptyset \text{ at all precisification and counting contexts } \pi_i, c_i \\
\langle N, \text{IND}(N) \rangle & \text{otherwise}
\end{cases}
\]
Following Krifka (1989) and Rothstein (2010), there is a typal distinction between count and mass nouns. However, on our account, mass nouns are saturated with the null contexts $\pi_0$ and $c_0$.

- Typal distinction eliminated whenever an N is used in context

$$\left[ n \right]_{\pi_i,c_i} = \begin{cases} 
\langle \text{body}(N)_{\pi_i}, \text{base}(N)_{\pi_i,c_i} \rangle & \text{if n is [+C]} \\
\langle \text{body}(N)_{\pi_0}, \text{base}(N)_{\pi_0,c_0} \rangle & \text{If n is [-C]} 
\end{cases}$$

Following Landman (2011, 2015), we emphasize disjointness/non-disjointness. However, also when IND($N$)$_{\pi_0,c_0}$ is empty:

- If IND($N$)$_{\pi_0,c_0}$ is not disjoint or empty, then counting goes wrong.
- If IND($N$)$_{\pi_i,c_i}$ is disjoint and non-empty, then counting is possible.
Prototypical Objects

\[
[\text{cat}]^{\pi_i, c_i} = \langle \text{CAT}_{\pi_i}, \text{IND}((\text{CAT})_{\pi_i, c_i}) \rangle
\]

- Disjoint base at \( \pi_i, c_i \) and at \( \pi_0, c_0 \)
  - COUNTABLE at \( \pi_0, c_0 \)
  - COUNTABLE at \( \pi_i, c_i \)
- Stably Count expected.

\( C_0, \pi_0 \)

- No change with counting contexts (maximally disjoint subsets)
- No change with prescisifications
Superordinate Artifacts and Homogenous Objects

\[
[kitchenware]_{\pi_i, c_i} = \langle K\_WARE_{\pi_0}, \text{IND}(K\_WARE)_{\pi_0, c_0} \rangle
\]

\[
[fencing]_{\pi_i, c_i} = \langle FENCE_{\pi_0}, \text{IND}(FENCE)_{\pi_0, c_0} \rangle
\]

\[
[K"uchengerät]_{\pi_i, c_i} = \langle K\_WARE_{\pi_i}, \text{IND}(K\_WARE)_{\pi_i, c_i} \rangle
\]

\[
[fence]_{\pi_i, c_i} = \langle FENCE_{\pi_i}, \text{IND}(FENCE)_{\pi_i, c_i} \rangle
\]

- Non-disjoint base at \(\pi_0, c_0\)
- Disjoint base at \(\pi_i, c_i\)
  - not countable at \(\pi_0, c_0\)
  - countable at \(\pi_i, c_i\)
- Count/Mass variation expected.

- Mass interpretation at \(c_0\)
- Count interpretation at \(c_1 \leq n \leq 4\)
  - = Variation with counting context
Granulars

\[
[\text{čočka}]_{\pi_i, c_i} = \langle \text{LENTIL}_{\pi_0}, \text{IND(LENTIL)}_{\pi_0, c_0} \rangle
\]

\[
[\text{lentil}]_{\pi_i, c_i} = \langle \text{LENTIL}_{\pi_i}, \text{IND(LENTIL)}_{\pi_i, c_i} \rangle
\]

- Empty base at \(\pi_0, c_0\)
- Disjoint base at \(\pi_i, c_i\)
  - not countable at \(\pi_0, c_0\)
  - countable at \(\pi_i, c_i\)
- Count/Mass variation expected.

- Mass interpretation at \(\pi_0\)
- Count interpretation at \(\pi_4 \leq n \leq 5\)
- = Variation with precisification context
Substances, Liquids, and Gases

\[ [\text{mud}]^{\pi_i, c_i} = \langle \text{MUD}_{\pi_0}, \text{MUD}_{\pi_0} \rangle \]

- Non-Disjoint base at \( \pi_0, c_0 \)
- Non-Disjoint base \( \pi_i, c_i \)
  - not countable at \( \pi_0, c_0 \)
  - not countable at \( \pi_i, c_i \)
- Stably Mass expected.

- Mass interpretation at \( \pi_0 \)
- Even at some \( \pi_{n\geq0} \), no individuation
- = Stable encoding as mass
  - Unless some non-quantity sensitive individuation possible (Yudja? (Lima, 2014))

Filip and Sutton, ESSLLI 2016
Two context indices and sensitivity to the substance/object distinction
⇒ better count/mass data coverage.

- (At least) four semantic classes of nouns
  - 1 stably count. 2 widespread variation. 1 stably mass

<table>
<thead>
<tr>
<th>Noun Class</th>
<th>Can be Individuated?</th>
<th>C-sensitive</th>
<th>II-sensitive</th>
<th>Widespread Variation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototypical Objects</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Homogenous Objects &amp; Superordinate Artifacts</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Granulars</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Substances, Liquids &amp; Gasses</td>
<td>No</td>
<td>N/A</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Conclusions

- Many advances in recent years by the likes of Chierchia, Rothstein, and Landman.

- Nonetheless, taking a single semantic feature (e.g. overlap or vagueness) is insufficient.

- We need (at least) two such features to begin to accommodate the full range of data.

- BUT: Lacuna
  - How is the IND function defined (other than via theorists intuitions)
  - Need, at least to include a mereotopological story (such as Grimm (2012))
  - One other avenue: a theory of individuation grounded in semantic learning (beginnings in, Sutton and Filip, 2016b)
## Coverage and Comparison

<table>
<thead>
<tr>
<th>Proposal</th>
<th>Main Idea</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chierchia (2010)</td>
<td>Mass Ns are vague</td>
<td>Why <em>rice, mud</em> is mass</td>
<td>Fake mass Ns (furniture)</td>
</tr>
<tr>
<td></td>
<td>Count Ns have stable atoms</td>
<td>Why <em>cat, chair</em> is count</td>
<td>Vague count Ns (lentils)</td>
</tr>
<tr>
<td>Rothstein (2010)</td>
<td>Count Ns are indexed to counting contexts.</td>
<td>Context Sensitive Count Ns</td>
<td>Type-based distinction is too weak to predict</td>
</tr>
<tr>
<td></td>
<td>(Difference in semantic type.)</td>
<td><em>(fence, hedge)</em></td>
<td>count/mass variation</td>
</tr>
<tr>
<td>Landman (2011)</td>
<td>Count Ns: Non-overlapping <em>gen</em> sets.</td>
<td>Superordinate Artifacts</td>
<td>Granular Ns (<em>rice, lentils</em>)</td>
</tr>
<tr>
<td></td>
<td>Mass Ns: Overlapping <em>gen</em> sets</td>
<td><em>(furniture)</em></td>
<td></td>
</tr>
<tr>
<td>Sutton and Filip</td>
<td>Context indices for precisification AND</td>
<td>Widest data coverage (all</td>
<td>Dual-life Ns, <em>asparagus</em>-type Ns</td>
</tr>
<tr>
<td>(2016a)</td>
<td>counting contexts</td>
<td>classes of Ns)</td>
<td></td>
</tr>
</tbody>
</table>
References I


Peter Sutton and Hana Filip. Probabilistic mereological type theory and the mass/count distinction. Under review for *JLM* (proceedings of Type Theory and Lexical Semantics (TYTLES) workshop at ESSLLI 2015), 2016b.
Appendix
Prototypical Objects
Direct attachment of numerical expression with no coercion in either the Finnish (1) or its English translation.

(1) Ost-i-n pöydä-n ja kaksi tuoli-a
    buy-PAST-1SG table.SG-ACC and two chair.SG-PART
    ‘I bought a table and two chairs’

Superordinate Artifacts
Direct attachment of numerical expression with no coercion in Finnish (2-a). Highly infelicitous in the English (2-b).

(2) a. Ost-i-n kolme huonekalu-a pöydä-n ja
    buy-PAST-1SG three furniture.SG-PART table.SG-ACC and
    kaksi tuoli-a
two chair.SG-PART
    ‘I bought three items/pieces of furniture: a table and two chairs’

    b. #I bought three furnitures: a table and two chairs.
Variation in English and Finnish cont.

Homogenous Objects
Distinct felicity patterns after direct attachment of numerical expression.

(3)  a. My neighbour planted three new hedges.
    b. #My neighbour planted three new hedging(s).

Granulars
English: oat is count (with reference to single ordinary individuals), while oatmeal is mass; in Finnish the reverse pattern obtains

(4)  a. Add 100 grams of oats/oatmeal.
    b. Add 100 grams of #oat/#oatmeals.

(5)  a. Lisää 100 gramma-a kaura-a / kaurahiutale-i-ta
    add.IMP.SG 100 gram.SG-PART oat.SG-PART / oat.flake-PL-PART
    ‘Add 100 grams of oats/oatmeal’
    b. Lisää 100 gramma-a #kauro-j-a / #kaurahiutale-tta
    add-IMP.SG 100 gram.SG-PART oat-PL-PART / oat.flake.SG-PART
    Int: ‘Add 100 grams of oats/oatmeal’
Variation in English and Finnish cont. cont.

Substances

*Much/Many* compatibility: Finnish and English

(6)  

a. #Kuinka monta muta-a löys-i-t lattia-lta
   how many mud.SG-PART find-PAST-2SG floor.SG-ABL
   #‘How many muds did you find on the floor?’

b. Kuinka paljon muta-a löys-i-t lattia-lta
   how much mud.SG-PART find-PAST-2SG floor.SG-ABL
   ‘How much mud did you find on the floor?’