Countability in the nominal and verbal domains

Count/Mass Variation: A 2D semantics

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Advanced Course

Plan

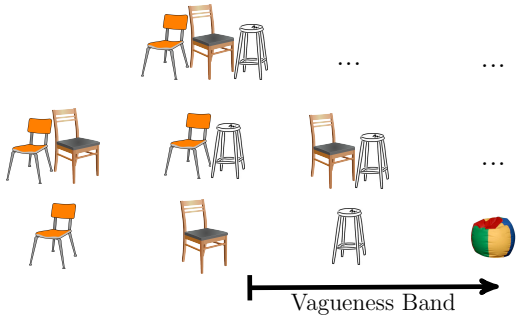
1. Overview of data
   - Cross- and intralinguistic count/mass variation.
2. Background Literature
3. Introduce our account of mass/count distinction (Sutton and Filip, 2016a)
   - Two-dimensional semantics.
   - Wider coverage of mass/count variation data.

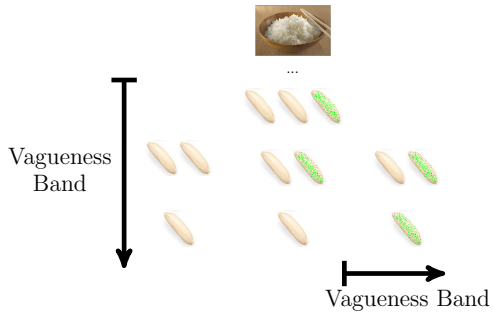
The challenge: cross- and intralingustic variation

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

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

$FENCE_{\mathrm{k}} = \{ \langle \text{  }, k \rangle, \langle \text{  }, k \rangle, \langle \text{  }, k \rangle \}$

- Weaknesses: Type-based distinction is too weak

Landman (2011)

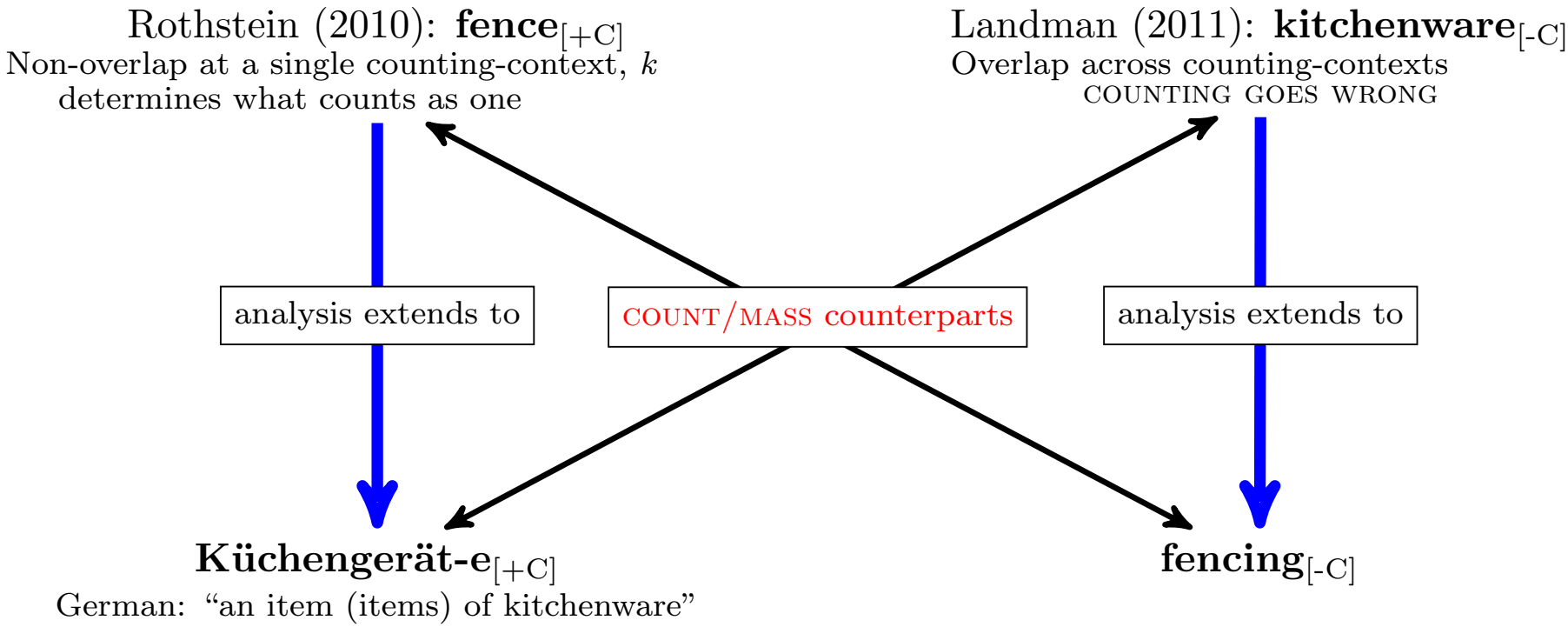
- Overlapping Generators block counting

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

The Plan

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

Rothstein (2010) & Landman (2011) Synthesis: Basic Idea



Rothstein (2010) & Landman (2011) Synthesis

Connection: Resolution/Non-Resolution of Overlap in Context

Rothstein's Contexts: $c_{i>0} \in \mathcal{C}$	Landman's Contexts: c_0
In 'default' cases, map overlapping entities $\mapsto$ disjoint set	Allows overlap in the same context.

Null Counting Context computed from all others:

$$X_{c_0} = \bigcup X_{c_{i>0}} \quad \text{computed from all } c_{i>0} \in \mathcal{C}$$

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 lentils$_{+C,PL}$ = lešta$_{-C}$ (Bulgarian) oats$_{+C,PL}$ = kaura$_{-C}$ (Finnish)

Intra oats$_{+C,PL}$/oatmeal$_{-C}$

(C2) Not-Vague nouns can be Count or Mass

Cross furniture$_{-C}$ = huonekalut$_{+C,PL}$ (Finnish)
footwear$_{-C}$ = jalkineet$_{+C,PL}$ (Finnish)
kitchenware ≈ Küchengeräte$_{+C,PL}$ (German)

Intra meubels$_{+C,PL}$ /meubilair$_{-C}$ (furniture, Dutch)
shoes$_{+C}$/footwear$_{-C}$, fence$_{+C}$/fencing$_{-C}$, rope$_{+C}$/rope$_{-C}$

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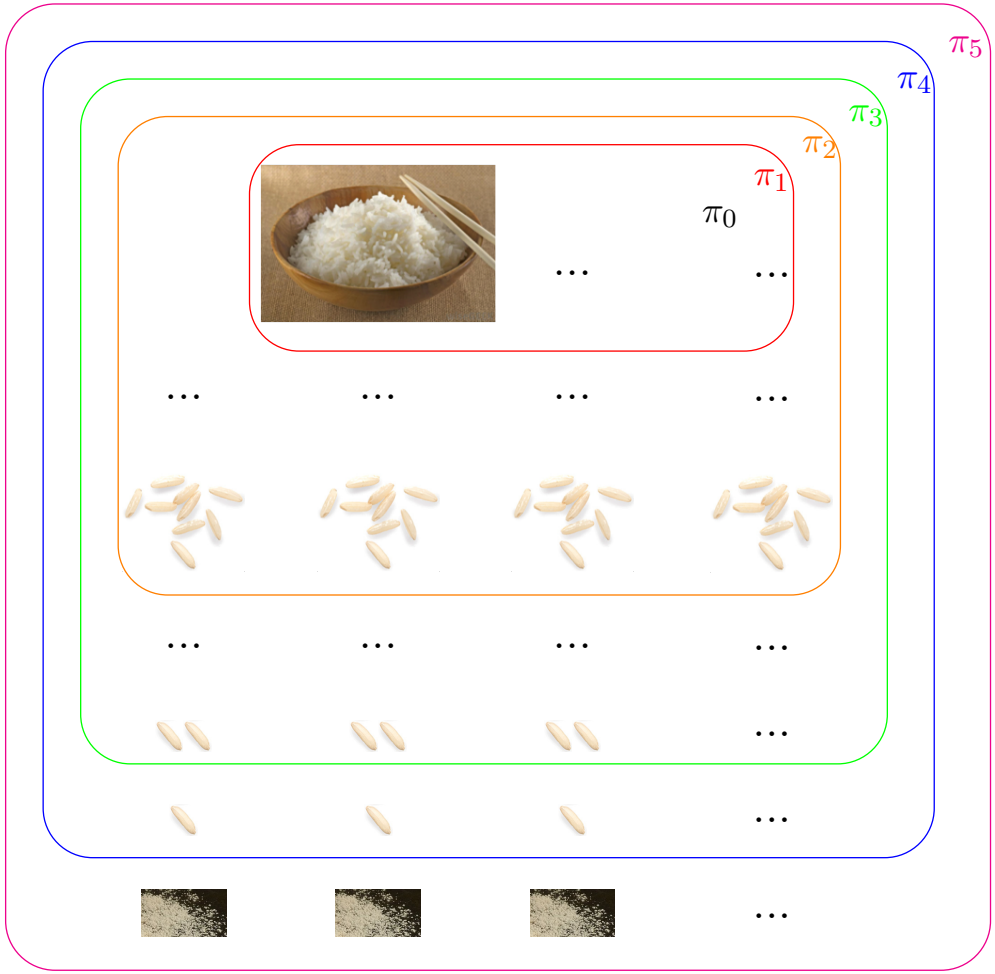
A Dual-Source Hypothesis

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

	Overlap	Non-Overlap
Vague	*mud*$_{-C}$ *lieju*$_{-C}$ (mud, Finnish) *kal*$_{-C}$ (mud, Bulgarian) blood$_{-C}$ water$_{-C}$	*oat-s*$_{+C,PL}$ *kaura*$_{-C}$ (oat, Finnish) *oatmeal*$_{-C}$ *kaurhiutale-et*$_{+C,PL}$ (oatmeal, Finnish) *vločky*$_{+C,PL}$ (oatmeal, Czech) *lentil-s*$_{+C}$ *lešta*$_{-C}$ (lentil, Bulgarian) *čočka*$_{-C}$ (lentil, Czech) *bean-s*$_{+C,PL}$ *bob*$_{-C}$ (bean, Bulgarian)
Non-Vague	*furniture*$_{-C}$ *meubel-s*$_{+C,PL}$ (furniture, Dutch) *meubilair*$_{-C}$ (furniture, Dutch) huonekalu-t$_{+C,\ PL}$ (furniture, Finnish) *fence*$_{+C}$ / *fencing*$_{-C}$ *wall*$_{+C}$ / *walling*$_{-C}$	*cat*$_{+C}$ *kissa*$_{+C}$ (cat, Finnish) *kat*$_{+C}$ (cat, Dutch) boy$_{+C}$ chair$_{+C}$

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:

$\text{IND}(cat) = \{$  $,\ldots\}$

$\text{IND}(k\_ware) = \{$  $,\ldots\}$

$\text{IND}(fence) = \{$  $,\ldots\}$

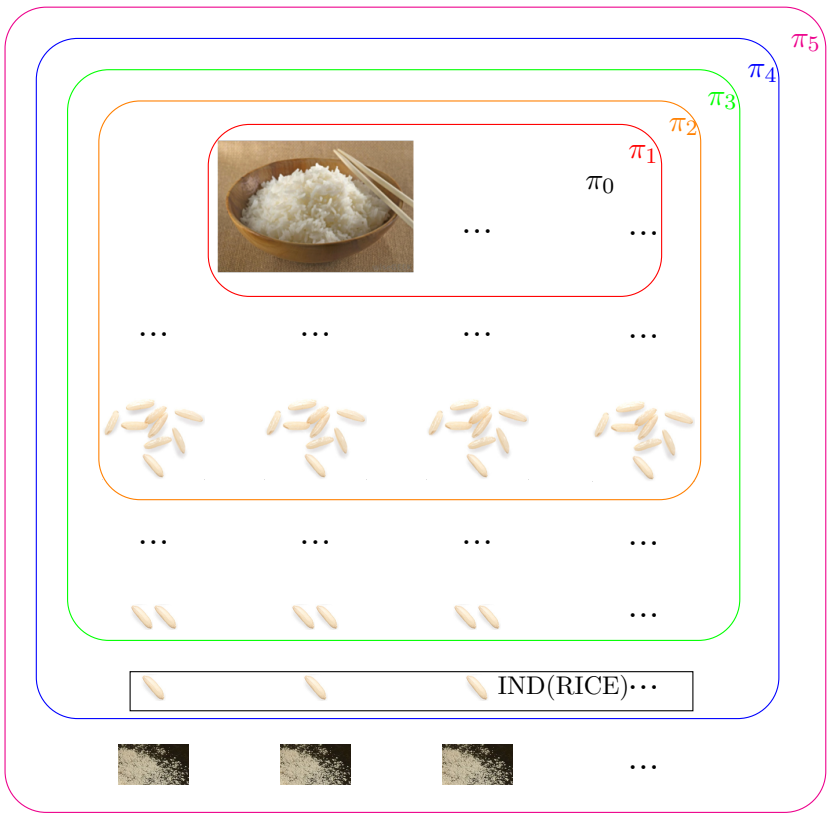
$\text{IND}(rice) = \{$  $,\ldots\}$

$\text{IND}(mud) = \{\varnothing\}$

- 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 π_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): $[\![\text{n}]\!]^{\pi_i,c_i} = \langle \mathbf{body}(N), \mathbf{base}(N) \rangle$

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

$$[\![\text{n}]\!]^{\pi_i,c_i} = \begin{cases} \langle N, N \rangle & \text{if } \mathrm{IND}(N) = \varnothing \text{ at all precisification} \\ & \text{and counting contexts } \pi_i, c_i \\ \langle N, \mathrm{IND}(N) \rangle & \text{otherwise} \end{cases}$$

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 π_0 and c_0.

- Typal distinction eliminated whenever an N is used in context

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

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

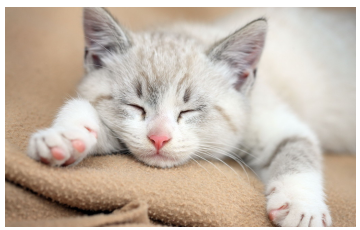
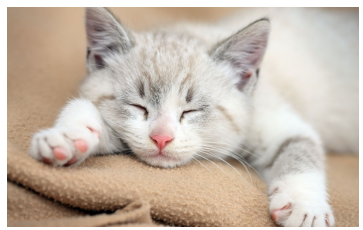
- If $\mathbf{IND}(N)_{\pi_0,c_0}$ is not disjoint or empty, then counting goes wrong.
- If $\mathbf{IND}(N)_{\pi_i,c_i}$ is disjoint and non-empty, then counting is possible.

Prototypical Objects

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

- Disjoint base at π_i, c_i and at π_0, c_0
  - COUNTABLE at π_0, c_0
  - COUNTABLE at π_i, c_i
- Stably Count expected.

c_0, π_0


- No change with counting contexts (maximally disjoint subsets)
- No change with prescisifications

Superordinate Artifacts and Homogenous Objects

$[\![\text{kitchenware}]\!]^{\pi_i,c_i} = \langle \text{K\_WARE}_{\pi_0}, \mathbf{IND}(\text{K\_WARE})_{\pi_0,c_0} \rangle$
$[\![\text{fencing}]\!]^{\pi_i,c_i} = \langle \text{FENCE}_{\pi_0}, \mathbf{IND}(\text{FENCE})_{\pi_0,c_0} \rangle$

$[\![\text{Küchengerät}]\!]^{\pi_i,c_i} = \langle \text{K\_WARE}_{\pi_i}, \mathbf{IND}(\text{K\_WARE})_{\pi_i,c_i} \rangle$
$[\![\text{fence}]\!]^{\pi_i,c_i} = \langle \text{FENCE}_{\pi_i}, \mathbf{IND}(\text{FENCE})_{\pi_i,c_i} \rangle$

- Non-disjoint base at π_0, c_0
- Disjoint base at π_i, c_i
  - not countable at π_0, c_0
  - countable at π_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

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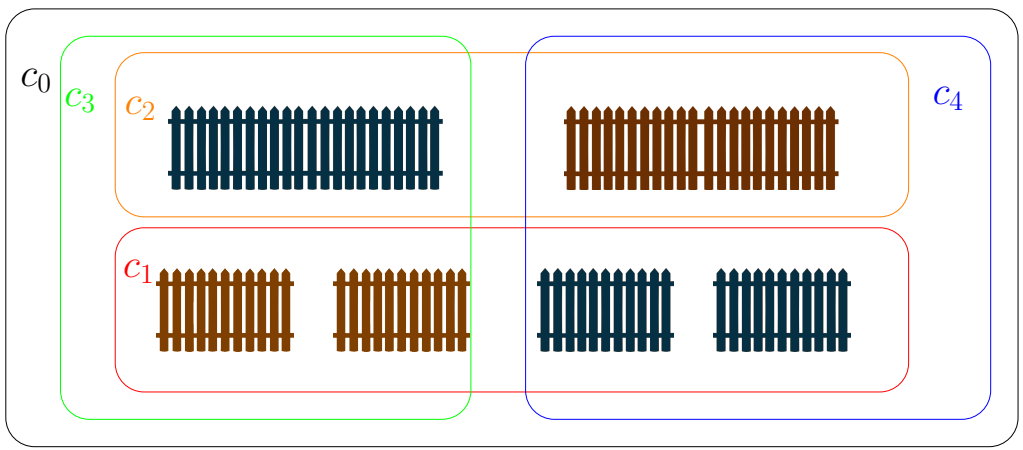
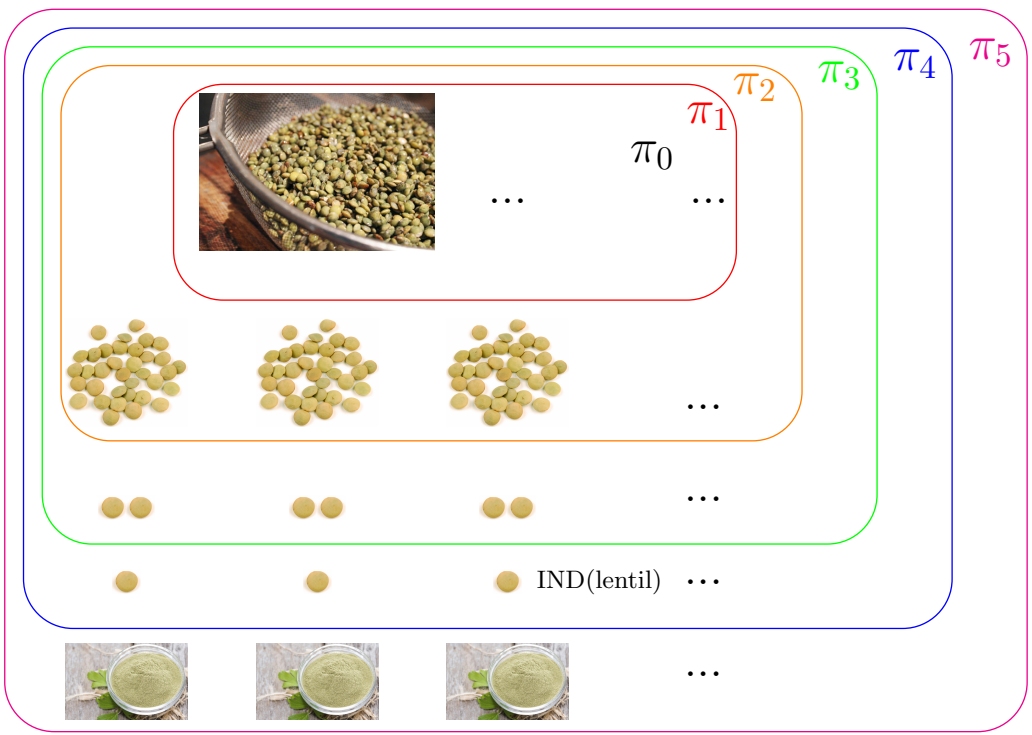


Granulars

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

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

- Empty base at π_0, c_0
- Disjoint base at π_i, c_i
  - not countable at π_0, c_0
  - countable at π_i, c_i
- Count/Mass variation expected.



- Mass interpretation at π_0
- Count interpretation at $\pi_{4 \leq n \leq 5}$
- = Variation with precisification context

Substances, Liquids, and Gasses

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

- Non-Disjoint base at π_0, c_0
- Non-Disjoint base π_i, c_i
  - not countable at π_0, c_0
  - not countable at π_i, c_i
- Stably Mass expected.

- Mass interpretation at π_0
- Even at some $\pi_{n\geq 0}$, no individuation
- = Stable encoding as mass
  - Unless some non-quantity sensitive individuation possible (Yudja? (Lima, 2014))

Summary

Two context indices and sensitivity to the substance/object distinction
$\Rightarrow$ better count/mass data coverage.

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

Noun Class	**Can be Individuated?**	**$\mathcal{C}$-sensitive**	**Π-sensitive**	**Widespread Variation?**
Prototypical Objects	Yes	No	No	No
Homogenous Objects & Superordinate Artifacts	Yes	Yes	No	Yes
Granulars	Yes	No	Yes	Yes
Substances, Liquids & Gasses	No	N/A	Yes	No

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

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

References I

Gennaro Chierchia. Mass nouns, vagueness and semantic variation. *Synthese*, 174: 99–149, 2010.

Scott Grimm. *Number and Individuation*. PhD Dissertation, Stanford University, 2012.

Manfred Krifka. Nominal reference, temporal constitution and quantification in event semantics. In Renate Bartsch and J. F. A. K. van Benthem and P. van Emde Boas, editor, *Semantics and Contextual Expression*, pages 75–115. Foris Publications, 1989.

Fred Landman. Count nouns – mass nouns – neat nouns – mess nouns. *The Baltic International Yearbook of Cognition*, 6:1–67, 2011.

Fred Landman. Iceberg semantics for count nouns and mass nouns: the evidence from portions. unpublished handout, 2015.

Suzi Lima. All notional mass nouns are count nouns in Yudja. *Proceedings of SALT*, 24:534–554, 2014.

Susan Rothstein. Counting and the mass/count distinction. *Journal of Semantics*, 27 (3):343–397, 2010. doi: 10.1093/jos/ffq007.

Nancy Soja, Susan Carey, and Elizabeth Spelke. Ontological categories guide young children's inductions of word meaning: Object terms and substance terms. *Cognition*, 38:179–211, 1991.

Peter Sutton and Hana Filip. Mass/count variation, a mereological, two-dimensional semantics. Under review for *The Baltic International Yearbook of Cognition, Logic and Communication*, 2016a.

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

Cross- & intralinguistic variation in English and Finnish

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?'