Coercion: container, portion and measure interpretations of pseudo-partitive NPs

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Introduction and main question

Interpretations for Pseudo-partitive NPs formed with receptacle nouns

Pseudo-partitive NPs have at several interpretations (i.a. Doetjes, 1997; Rothstein, 2011; Landman, 2016; Khrizman et al., 2015; Partee and Borschev, 2012):

Table 1: Paraphrases for *two glasses of beer* (Khrizman et al., 2015; Landman, 2016)

Interpretation	Paraphrase	Countability
container	two glasses filled with beer	COUNT
contents	two portions of beer, each the contents of a glass	COUNT
free portion	two one-glassful sized portions of beer	COUNT
measure	beer to the amount of two glassfuls	MASS

However, we will collapse contents and free portion. Henceforth *portion*:

Table 2: Alternative paraphrases for *two glasses of beer*

Interpretation	Paraphrase	Countability
container	two glasses filled with beer	COUNT
portion	two portions of beer, each (could be) the contents of a glass	COUNT
measure	beer to the amount of two glassfuls	MASS

Spoiler: free portion/contents distinction retrievable from portion

(Free) portion	a disjoint partition of beer, each portion is the contents of a glass *in some possible world.*
Contents	free portion evaluated at the actual world i.e. a disjoint partition of beer, each portion is the contents of a glass *in the actual world.*

Main question

Type mismatch between Cardinal (CD) numerical and Mass Noun (Mass N) prompts a mass-to-count shift:

- **two different** coerced mass-to-count shifts associated with constructions like *two wines*:

(1) a. John carried two white wines to the table.
    b. Phil drank two large red wines.

- (1a) **container interpretation**: *carried, with two wines* evokes implicit containers
  ⇒ TWO GLASSES CONTAINING WINE

- (1b) **portion interpretation**: *drink* selects liquid (the wine).
  ⇒ TWO PORTIONS OF WINE, EACH (EQUIVALENT TO) THE CONTENTS OF A GLASS.

But a coerced measure interpretation is hard to get:

(2) #There are about two wines left in the barrel.

Main question:
Why is it so hard, if not often impossible, to get the **measure** interpretation for combinations of 'CD+MassN', such as *two wines*?

Background: Previous analyses

We will take Rothstein (2011) as a representative example.

Container interpretation

A function REL that applies to the interpretation of the head, e.g. *glass*, and shifts it to a container classifier (**wine** denotes a kind; $^{\cup}$**wine** denotes a predicate):

$$\begin{aligned}
[\![\text{glasses}]\!] &= \lambda x.\exists X \subseteq {}^{*}\text{GLASS} : x = \sqcup X \\
[\![\text{glasses of wine}]\!] &= (\text{REL}([\![\text{glasses}]\!]))([\![\text{wine}]\!]) \\
&= \lambda x.\exists y.\exists X \subseteq {}^{*}\text{GLASS} : x = \sqcup X \wedge \text{ CONTAIN}(x,y) \wedge y \in {}^{\cup}\textbf{wine} \\
[\![\text{three glasses of wine}]\!] &= \lambda x.\exists y.\exists X \subseteq {}^{*}\text{GLASS} : x = \sqcup X \wedge \text{ CONTAIN}(x,y) \wedge y \in {}^{\cup}\textbf{wine} \wedge \text{CARD}(x) = 3
\end{aligned}$$

Important points:

- REL is applied to $[\![\text{glass(es)}]\!]$
- The same or a similar function sometimes used to derive contents (portion) interpretation (Landman 2016)

Measure interpretation

A function FUL–realised either by the explicit morpheme *-ful* or by a null morpheme:

$$\begin{aligned}
[\![\text{-ful}]\!] = [\![\varnothing_{ful}]\!] = \text{FUL} &= \lambda P.\lambda n.\lambda x.\text{MEAS}_{\text{volume}} = \langle P, n\rangle \\
[\![\text{three glasses}]\!] &= \lambda x.\text{MEAS}_{\text{volume}} = \langle \text{GLASS}, 3\rangle \\
[\![\text{three glasses of wine}]\!] &= \lambda x.x \in {}^{\cup}\textbf{wine} \wedge \text{MEAS}_{\text{volume}} = \langle \text{GLASS}, 3\rangle
\end{aligned}$$

Important points:

- FUL is applied to $[\![\text{glass(es)}]\!]$
- Derivational independence between container/portion and measure interpretations
- Same assumption in: Partee and Borschev (2012); Khrizman et al. (2015); Landman (2016)

Hypotheses and Predictions

The measure interpretation is NOT a part of the lexical meaning of most receptacle Ns. It is derived 'on the fly' via meaning shifts:

- *bottle*: Lexically encodes the basic sortal (receptacle) and the relational (container/portion) meaning.
- In contrast, *cup* (especially US English): Lexically encodes the sortal & relational (container/portion) meanings. *Also encodes a lexicalized standard measure meaning.*

We will take this common sense approach (see also Partee and Borschev (2012), i.a.) at face value reflected in our two hypotheses.

Hypotheses

(H1) In pseudo-partitive NPs, the container and portion interpretations are the default interpretations of receptacle Ns

- The container and portion interpretation of receptacle nouns can be represented as a dot type, when in a relational context: **container • portion**: *glass, bottle, box*, ...
  - Cf. *book* interpreted as **phys • info** (standing for 'physical object' and 'informational object') (Pustejovsky, 1993, 1995).
- Possibility of dot type analysis independently suggested by Partee and Borschev (2012), Duek and Brasoveanu (2015) (neither provides this kind of formal analysis).

(H2) The measure interpretation is derived from the portion interpretation

- *Derived...:*
  - Taking common sense assumptions at face value.
  - Sortal and Container/Portion interpretations are lexically encoded. For most receptacle Ns, the measure interpretation is not lexically encoded, but derived.
- *... from the portion interpretation:*
  - About the stuff (e.g., *wine*), not the container (e.g., *glass*)
    ⇒ PROBABLY NOT (DIRECTLY) DERIVED from the sortal or container interpretation.
  - Proposed paraphrase:
    three glasses of wine (**measure**) ≈ *wine that measures 3 with respect to a scale on which one glass-sized portion of wine measures 1.*
- Some function $\mathfrak{g}$ such that **measure** = $\mathfrak{g}$(**portion**). (Details to follow.)

Predictions

(i) The container and portion interpretations of p-p NPs (e.g. *three glasses of wine*) easily allow co-predication.

(4) The two glasses of wine with tall, thin stems are being drunk by Rachel and Matt. (C-P)

(5) Loretta drank the two glasses of wine with tall, thin stems. (P-C)

- Co-predication via the dot type **container • portion**

(6) (#) The two glasses of wine with a sour flavour were the last two left in the bottle from two days ago. (P-M)

(7) (#) The last two glasses of wine in the bottle were drunk by Carl at lunch and Harry at dinner. (M-P)

- Some speakers accept co-predication. Perhaps they are reconstructing **portion** from **measure**, since **measure** = $\mathfrak{g}$(**portion**)

(8) # The two glasses of wine with tall, thin stems were the last two left in the bottle. (C-M)

(9) # The last two glasses of wine in the bottle have thin stems. (M-C)

- **measure** blocks **container** since **measure** = $\mathfrak{g}$(**portion**)

(ii) The measure interpretation of expressions like *three wines* are generally difficult to get.

Coercion: recovering a suitable receptacle concept from the context in order to resolve the type clash between a numerical (CD) and a mass noun

- If the contextually determined receptacle (concept) is interpreted as **container • portion** by default (H1), then the type clash in (2a) and (2b) is easy to resolve.
- But: if **measure** is derived from **portion** (H2), there is no type clash (or other impetus) to trigger the application of the requisite function.
- Moreover, this function would have to apply to the portion interpretation of an implicit receptacle.
- Coercion does not operate over semantic types of implicit linguistic material.

Analysis with a frame-based semantics

Preliminaries

Standard features:

- functional types formed from basic types e, t, w, n, d, f (w for worlds, n for numbers, d for dimensions (e.g. volume), f for frames (see below)).
- typed variables and constants, λ-abstraction

Non-standard features:

- Propositions are frames (sets of (recursive) labelled fields)
- Modification can be done on specific fields (parts of a frame)

Example:

$$[\![\text{n}]\!] = \lambda x. \begin{bmatrix} \text{cbase} & = & \lambda y.P(y) \\ \text{ext} & = & {}^*P(x) \end{bmatrix}$$

⇒ Set of Ps or sums of Ps individuated in terms of the property $\lambda y.P(y)$. Of type $\langle ef \rangle$ with f a basic type for frame. [Frames as sets of label-formula pairs e.g., $\{\langle \text{cbase}, \lambda y.P(y)\rangle, \langle ext, {}^*P(a)\rangle\}$]

Labels can be used to refer to properties or propositions in frames:

$$\text{cbase}([\![\text{n}]\!](x)) \leftrightarrow \lambda y.P(y)_{\langle et \rangle}$$
$$\text{cbase}([\![\text{n}]\!](x)) \leftrightarrow {}^*P(x)_{\langle t \rangle}$$

Sutton and Filip's analysis of the mass/count distinction

Expression	Type	Description
glass, wine, ...	$\langle et \rangle$	Predicates. Stand-ins for e.g., bundle of perceptual, functional, and (mereo)topological properties
$\mathcal{O}$	$\langle et, et \rangle$	Object unit function: A function from predicates to predicate for entities that can count as 'one'
$\mathcal{S}_{i>0} \in \mathbb{S}$	$\langle et, et \rangle$	Individuation Schema: A function from predicates P to predicate with an extension that is a maximally disjoint wrt the extension of P
$\mathcal{S}_0 \in \mathbb{S}$	$\langle et, et \rangle$	The Null Individuation Schema: The identity function. More formally: $\mathcal{S}_0(P) = \bigcup_{\mathcal{S}_{i>0} \in \mathbb{S}} \mathcal{S}_i(P)$

Examples of CN lexical entries:

$$[\![\text{glasses}]\!]^{\mathcal{S}_i} = [\![\text{glasses}]\!](\mathcal{S}_i) = \lambda s.\lambda x. \begin{bmatrix} \text{cbase} = \lambda y.s(\mathcal{O}(\text{glass}))(y) \\ \text{ext} \;\; = {}^*s(\mathcal{O}(\text{glass}))(x) \end{bmatrix} (\mathcal{S}_i)$$

$$= \lambda x. \begin{bmatrix} \text{cbase} = \lambda y.\mathcal{S}_i(\mathcal{O}(\text{glass}))(y) \\ \text{ext} \;\; = {}^*\mathcal{S}_i(\mathcal{O}(\text{glass}))(x) \end{bmatrix}$$

Set of individual glasses/sums of individual glasses under schema $\mathcal{S}_i$. Disjoint counting base. Cumulative extension.

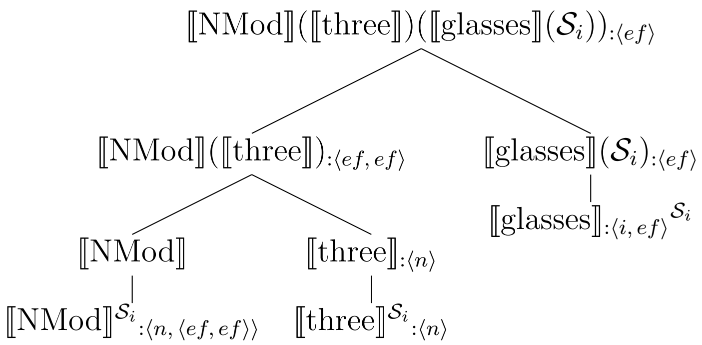
$$[\![\text{wine}]\!]^{\mathcal{S}_i} = [\![\text{wine}]\!] = \lambda x. \begin{bmatrix} \text{cbase} & = & \lambda y.\mathcal{S}_0(\text{wine})(y) \\ \text{ext} & = & \mathcal{S}_0(\text{wine})(x) \end{bmatrix}$$

Set of all possible partitions of wine. Overlapping and non-quantized counting base. Cumulative extension.

$$[\![\text{furniture}]\!]^{\mathcal{S}_i} = [\![\text{furniture}]\!] = \lambda x. \begin{bmatrix} \text{cbase} & = & \lambda y.\mathcal{S}_0(\mathcal{O}(\text{furniture}))(y) \\ \text{ext} & = & {}^*\mathcal{S}_0(\mathcal{O}(\text{furniture}))(x) \end{bmatrix}$$

Set of pieces of furniture and sums thereof. Overlapping and non-quantized counting base. Cumulative extension.

Direct counting: *three glasses*



- NMod shifts numeral to adjective (amo Landman, 2004)
- $\mathcal{S}_i$ only impacts interpretation of numerical
- i for individuation schema abbreviates $\langle et, et\rangle$

A set of sums of individual glasses that have cardinality 3 with respect to the property of being a single individual glass ($\lambda y.\mathcal{S}_i(\mathcal{O}(\text{glass}))(y)$):

$$[\![\text{three glasses}]\!]^{\mathcal{S}_i}$$

$$= [\![\text{NMod}]\!]^{\mathcal{S}_i}([\![\text{three}]\!]^{\mathcal{S}_i})([\![\text{glasses}]\!]^{\mathcal{S}_i})$$

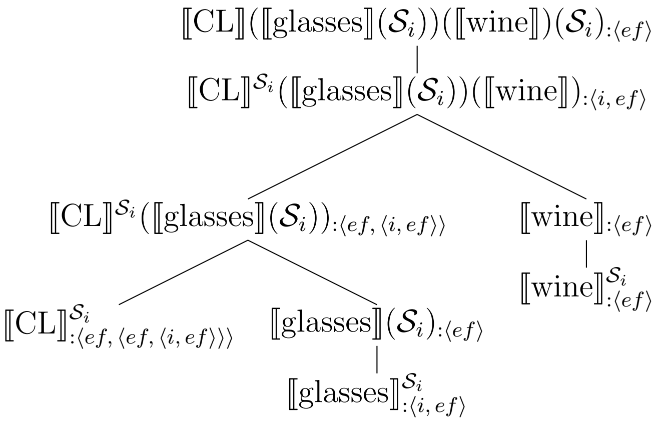
$$= [\![\text{NMod}]\!]([\![\text{three}]\!])([\![\text{glasses}]\!](\mathcal{S}_i))$$

$$= \lambda F.\lambda x.\begin{bmatrix} cbase = cbase(F(x)) \\ ext \;\;\;= ext(F(x)) \\ restr = \mu_{card}(x, cbase(F(x)), 3) \end{bmatrix} (\lambda x.\begin{bmatrix} \text{cbase} = \lambda y.\mathcal{S}_i(\mathcal{O}(\text{glass}))(y) \\ \text{ext} \;\;\;= {}^{*}\mathcal{S}_i(\mathcal{O}(\text{glass}))(x) \end{bmatrix})$$

$$= \lambda x.\begin{bmatrix} cbase = \lambda y.\mathcal{S}_i(\mathcal{O}(\text{glass}))(y) \\ ext \;\;\;= {}^{*}\mathcal{S}_i(\mathcal{O}(\text{glass}))(x) \\ restr = \mu_{card}(x, \lambda y.\mathcal{S}_i(\mathcal{O}(\text{glass}))(y), 3) \end{bmatrix}$$

Pseudo-partitive NPs with receptacle expressions

Container and Portion: *glasses of wine*



- CL derives a relational **container • portion** concept
- $[\![\text{CL}]\!]^{\mathcal{S}_i}([\![\text{glasses}]\!]^{\mathcal{S}_i})$ could be stored as a discrete sense
- $\mathcal{S}_i$ ensures apportioning of contained stuff

$$[\![\text{CL}]\!]^{\mathcal{S}_i} =$$

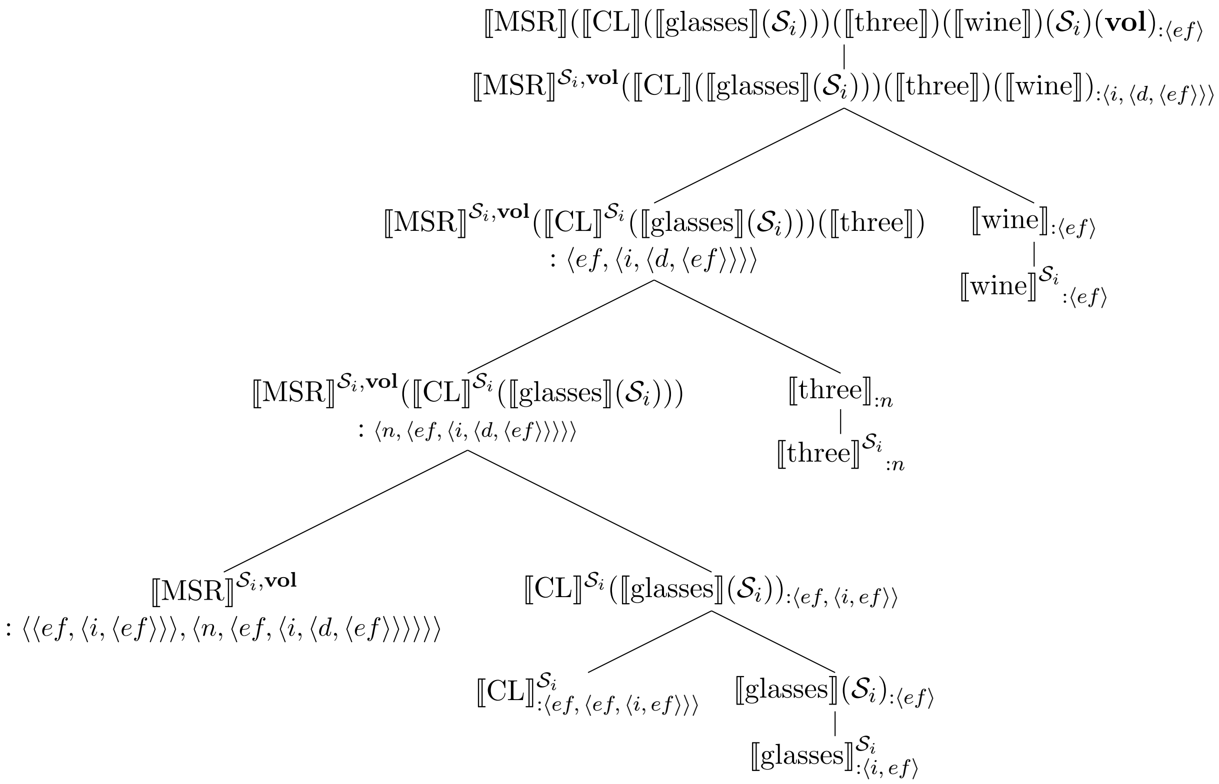
$$\lambda F.\lambda G.\lambda s.\lambda x.\begin{bmatrix} cntnr = \begin{bmatrix} cbase = cbase(F(x)) \\ ext \;\;\;= ext(F(x)) \\ restr = \forall y\exists z.[y \sqsubseteq x \wedge cbase(F(x))(y) \rightarrow ext(G(z)) \wedge contain(y,z)] \end{bmatrix} \\ prtn = \begin{bmatrix} cbase = \lambda y.s(cbase(G(x)))(y) \\ ext \;\;\;= \lambda y.{}^{*}s(ext(G(y)))(x) \\ restr = \forall y.\exists w.\exists z.[y \sqsubseteq x \wedge cbase(G(x))(y) \rightarrow \\ \qquad cbase(F(x))(z)(w) \wedge contain(z,y)(w)] \end{bmatrix} \end{bmatrix}$$

$$[\![\mathrm{CL}]\!]^{\mathcal{S}_i}([\![\text{glasses}]\!]^{\mathcal{S}_i})([\![\text{wine}]\!]^{\mathcal{S}_i}) = [\![\mathrm{CL}]\!]([\![\text{glasses}]\!](\mathcal{S}_i))([\![\text{wine}]\!])(\mathcal{S}_i) =$$

$$\lambda x. \begin{bmatrix} \mathit{cntnr} = \begin{bmatrix} \mathit{cbase} = \lambda y.\mathcal{S}_i(\mathcal{O}(\mathit{glass}))(y) \\ \mathit{ext} \quad = {}^*\mathcal{S}_i(\mathcal{O}(\mathit{glass}))(x) \\ \mathit{restr} = \forall y.\exists z.[y \sqsubseteq x \wedge \mathcal{S}_i(\mathcal{O}(\mathit{glass}))(y) \\ \qquad\qquad \rightarrow \mathcal{S}_0(\mathit{wine})(z) \wedge \mathit{contain}(y,z)] \end{bmatrix} \\ \mathit{prtn} = \begin{bmatrix} \mathit{cbase} = \lambda y.\mathcal{S}_i(\mathit{wine})(y) \\ \mathit{ext} \quad = {}^*\mathcal{S}_i(\mathit{wine})(x) \\ \mathit{restr} = \forall y.\exists w.\exists z.[y \sqsubseteq x \wedge \mathcal{S}_i(\mathit{wine})(y) \\ \qquad\qquad \rightarrow \mathcal{S}_i(\mathcal{O}(\mathit{glass}))(z)(w) \wedge \mathit{contain}(z,y)(w)] \end{bmatrix} \end{bmatrix}$$

Container:	Sums of/single individual glasses containing wine Disjoint counting base. Cumulative extension.
Portion:	Portions of wine (wine partitioned by $\mathcal{S}_i$) that could each be contained in a glass. Disjoint counting base. Cumulative extension.
Contents:	Portions of wine (wine partitioned by $\mathcal{S}_i$) that are actually contained in a glass ($w = w_0$). Disjoint counting base. Cumulative extension.

Measure interpretation of *three glasses of wine*



$$[\![\mathrm{MSR}]\!]^{\mathcal{S}_i,\mathbf{vol}} = \lambda\mathcal{F}.\lambda n.\lambda G.\lambda s.\lambda d.\lambda x. \begin{bmatrix} \mathit{cbase} = \mathit{cbase}(G(x)) \\ \mathit{ext} \quad = \mathit{ext}(G(x)) \\ \mathit{restr} = \mu(x, d, \lambda z.\mathit{prtn}(\mathcal{F}(G))(z)(s), n) \end{bmatrix}$$

$$[\![\mathrm{MSR}]\!]([\![\mathrm{CL}]\!]([\![\text{glasses}]\!](\mathcal{S}_i)))([\![\text{three}]\!])([\![\text{wine}]\!])(\mathcal{S}_i)(\mathbf{vol})$$

$$= \lambda x. \begin{bmatrix} \mathit{cbase} = \lambda y.\mathcal{S}_0(\mathit{wine})(y) \\ \mathit{ext} \quad = \mathcal{S}_0(\mathit{wine})(x) \\ \mathit{restr} = \mu(x, \mathbf{vol}, \lambda z. \begin{bmatrix} \mathit{cbase} = \lambda y.\mathcal{S}_i(\mathit{wine})(y) \\ \mathit{ext} \quad = {}^*\mathcal{S}_i(\mathit{wine})(z) \\ \mathit{restr} = \mathbf{contain}(\mathit{glass}, \mathit{wine}) \end{bmatrix}, 3) \end{bmatrix}$$

Where **contain**($glass, wine$) abbreviates:
$\forall y.\exists w.\exists z.[y \sqsubseteq x \wedge \mathcal{S}_i(wine)(y) \rightarrow \mathcal{S}_i(\mathcal{O}(glass))(z)(w) \wedge contain(z, y)(w)]$

Paraphrase: Set of amounts of wine that measure 3 with respect to volume, and the property of being a glass-sized portion.
– Overlapping counting base.
– Quantized extension.

Coercion: Why are measure readings (usually) blocked?

Explanation 1: Resolving Type Mismatches

Type mismatches between CD and Mass N are resolved by retrieving a **container • contents** concept from the context

- Type mismatches: CD + Mass N
- Agents must coerce the Mass N into a Count N interpretation.
  - Requires supplying additional relational concept that is salient or conventional (e.g. **container • contents** concept for *glass*).
- Type mismatches are resolved by shifting to a **container • contents** interpretation
  - No need to shift **container • contents** to **measure**

Shifting **container • contents** to **measure** would CREATE A CLASH!

- Standard interpretation for [NP [CD] [N]] is to shift CD to an adjective (e.g. ⟦NMod⟧(⟦three⟧))
- Expression like ⟦MSR⟧(⟦CL⟧)(⟦glass(es)⟧) is NOT the right type to combine with an adjectival numerical

Explanation 2: Cognitive burden

Coercion typically involves shifting of meaning of LEXICALLY PROVIDED, OVERT linguistic material to resolve a type clash. E.g.
⟦wines⟧ ⇒ (⟦CL⟧(⟦glass(es)⟧))(⟦wine⟧)

- ⟦CL⟧(⟦glass(es)⟧) is contextually, implicitly retrieved type shifter that operates on the meaning of lexically provided *wine*

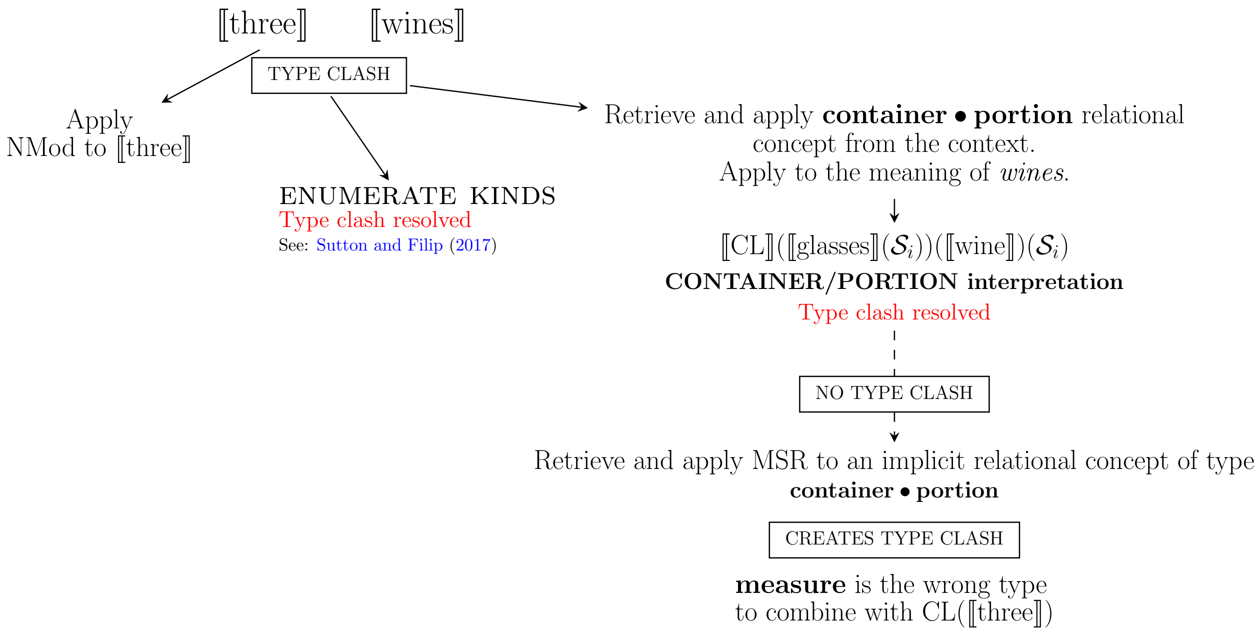
Measure interpretation would involve shifting of NON-LEXICALLY PROVIDED, IMPLICIT, content. E.g.

$$\begin{aligned} [\![\text{wines}]\!] &\Rightarrow \big([\![\text{CL}]\!]([\![\text{glass(es)}]\!])\big)\ ([\![\text{wine}]\!]) \\ &\Rightarrow [\![\text{MSR}]\!]\big([\![\text{CL}]\!]([\![\text{glass(es)}]\!])\big)(x : n)([\![\text{wine}]\!]) \end{aligned}$$

- ⟦MSR⟧ is contextually, implicitly, provided type shifter that operates on the shifted, portion, meaning of ⟦wine⟧, which is the result of the application of the function ⟦CL⟧(⟦glass(es)⟧) to ⟦wine⟧.

Speculation: Such a process is too cognitively burdensome to achieve in most contexts.

Accessibility hierarchy



Discussion and Conclusions

Our two hypotheses or the interpretation of p-p NPs can explain:

1. Variation in felicity of co-predication for interpretations of p-p NPs
   - But then we need to formally mark the difference between
     - Default, lexically encoded interpretations
     - Derived interpretations
   - Not obvious that MeasP (*three glasses*) can be understood as combining with N (*wine*) intersectively
2. Why measure interpretations are hard to get via coercion.
   - The count/mass distinction is not based on a linguistic misunderstanding.
     - Explanation for 2. crucially turns on coercion as a type clash and repair strategy.
     - Any explanation if English has no lexicalized mass/count distinction?
     - How could accounts such as Pelletier (2012) and Borer (2005) account for this puzzle?

Selected References (see slides for full reference list)

Hagit Borer. *Structuring Sense I: In Name Only*. OUP, 2005.

Jenny Doetjes. *Quantifiers and Selection*. PhD thesis, University of Leiden, 1997.

Karen Duek and Adrian Brasoveanu. The polysemy of container pseudo-partitives. *Proceedings of Sinn und Bedeutung 19*, pages 214–231, 2015.

Keren Khrizman, Fred Landman, Suzi Lima, Susan Rothstein, and Brigitta R. Schvarcz. Portion readings are count readings, not measure readings. *Proceedings of the 20th Amsterdam Colloquium*, pages 197–216, 2015.

Fred Landman. *Indefinites and the Type of Sets*. Blackwell, 2004.

Fred Landman. Iceberg semantics for count nouns and mass nouns: The evidence from portions. *The Baltic International Yearbook of Cognition Logic and Communication*, 11:1–48, 2016.

Barbara H. Partee and Vladimir Borschev. Sortal, relational, and functional interpretations of nouns and russian container constructions. *Journal of Semantics*, 29:445–486, 2012.

Francis Jeffry Pelletier. Lexical nouns are both +MASS and +COUNT, but they are neither +MASS nor +COUNT. In Diane Massam, editor, *Count and mass across languages*, pages 9–26. Oxford University Press, 2012.

James Pustejovsky. Type coercion and lexical selection. In James Pustejovsky, editor, *Semantics and the Lexicon*, pages 73–94. Kluwer. Dordrecht, 1993.

James Pustejovsky. *The Generative Lexicon*. MIT Press, 1995.

Susan Rothstein. Counting, measuring and the semantics of classifiers. *The Baltic International Yearbook of Cognition, Logic and Communication*, 6:1–41, 2011.

Peter R. Sutton and Hana Filip. Restrictions on subkind coercion in object mass nouns. *Proceedings of Sinn und Bedeutung 21*, page (To appear), 2017. Preprint available at: https://sites.google.com/site/sinnundbedeutung21/proceedings-preprints.