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

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The Count-Mass Distinction - A Linguistic Misunderstanding?
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Outline

Data 1: Three interpretations of pseudo-partitive NPs

- Pseudo-partitive NPs, such as *two glasses of wine*, admit of a several interpretations (i.a. Doetjes, 1997; Rothstein, 2011; Landman, 2016; Khrizman et al., 2015; Partee and Borschev, 2012).

(1) a. He turned to reach the two glasses of wine that stood on a bedside table. (BNC)

b. i (*sic.*) should set the record straight with Clayart that two glasses of red wine a day have beneficial health results. [UKWaC]

c. Two glasses of wine is equal to 3 standard drinks of any alcoholic beverage. [UKWaC]

- (1a) has a **container reading**: the verbs, *reach* and *stand*, select for objects with (relatively) stable boundaries at any given time, e.g., containers (like glasses), and not for stuff lacking them, e.g., wine;
- (1b) has a **portion reading**: the contents (wine) of exactly two glasses has the effect on health, not the containers;
- (1c) has a **measure reading**: singular agreement in the equative construction, the equivalence is between volume or alcoholic content of the totality of alcoholic beverage contained in the relevant containers.

Count/mass and interpretations of pseudo-partitive NPs

- Khrizman et al. (2015); Rothstein (2011, 2016, 2017); Landman (2016) argue that:
  - measure interpretation is mass, other interpretations are count

Table: *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

- We accept this position. We won't review the arguments here.
- For contrast, see Partee and Borschev (2012). Their "concrete portion" (in place of "free portion") is analysed as a subclass of measure.

Collapsing portion and contents

- We will collapse 'free portion' and 'contents' into one category: portion

Table: *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	a portion evaluated at the actual world (a disjoint partition of beer, each portion is the contents of a glass in the actual world).

Data 2: Coercion

- **CD + Mass N** (‘CD’ is ‘cardinal numerical’, Penn Treebank tags), e.g., *two wines*:
- type mismatch between a CD (*two*) and a mass N (*wines*) prompts a mass-to-count shift of the N denotation:
  - We get **two different coerced** mass-to-count shifts:

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

  - (2a) **container interpretation**: *carried* selects for objects with (relatively) stable shape, hence *two wines* evokes implicit containers
    ⇒ TWO GLASSES CONTAINING WINE;
  - (2b) **portion interpretation**: *drink* selects for liquids, hence *two wines*
    ⇒ TWO PORTIONS OF WINE, EACH (EQUIVALENT TO) THE CONTENTS OF A GLASS.
- **A coerced measure interpretation is hard to get:**

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

For *wine* and *beer* combined with CD‘s, a subkind shift is far more common: e.g., *Two wines were served with dinner: a Malbec and a Sauvignon.*

Interim summary:

State of the art:

- Pseudo-partitive NPs, such as *two glasses of wine*, have at least 3 interpretations:
  - Container
  - Portion
  - Measure

Novel observation:

- For pseudo-partitive NPs (*two wines*), coercively re-interpreted with an implicit classifier-like concept (*two* GLASSES OF *wine*), it is much harder (if at all possible) to get measure interpretations.

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*?

Outline

Introduction and main question

Background

Hypotheses and Predictions

Analysis within a frame based semantics
- Preliminaries
- The mass/count distinction
- Pseudo-partitive NPs with receptacle nouns
- Coercion: Why are measure readings (usually) blocked

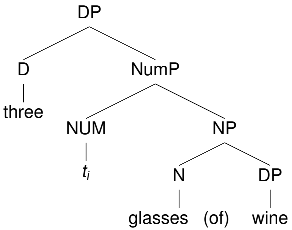
Discussion and Conclusions

Outline

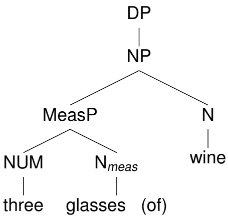
Counting versus measuring

Rothstein (2011, 2016, 2017) argues for a syntactic distinction between container readings and measure readings:

Container/Contents



Measure



- Container/contents interpretations much like a CD + Count-N structure, but with a complex NP (*glasses of wine*).
- Measure reading formed from a measure (*three glasses*) and an argument (*wine*)

Similar structures in Partee and Borschev (2012).

Container interpretation: A function on the receptacle concept

There are different implementations of this idea. One representative example:

- Rothstein (2011): A function REL that applies to the interpretation of the head, e.g. *glass*, and shifts it to a container classifier:[1]

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

- Important points:
  - REL is applied to $[\![\text{glass(es)}]\!]$, i.e., to the basic concrete-receptacle meaning of *glass(es)*.
  - Same function sometimes used to derive contents (portion) interpretation (Landman, 2016)

[1] **wine** denotes a kind; $^{\cup}$**wine** denotes a predicate; $^{*}X$ indicates the upward closure of the set X under mereological sum; $\sqcup X$ is the (sum) entity that is the supremum of the set X.

Measure interpretation: A function on the receptacle concept

There are different implementations of this idea. One representative example:

- Rothstein (2011): A function FUL–realised either by the explicit morpheme *-ful* or by a null morpheme:

$$[\![\text{-ful}]\!] = [\![\varnothing_{ful}]\!] = \text{FUL} = \lambda P.\lambda n.\lambda x.\text{MEAS}_{\text{volume}} = \langle P, n \rangle$$

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

- Important points:
  - FUL is applied to $[\![$glass(es)$]\!]$, i.e., to the basic concrete-receptacle meaning of *glass(es)*.
  - Derivational independence between container/portion and measure interpretations.
  - Same assumption in: Partee and Borschev (2012); Khrizman et al. (2015); Landman (2016).

Outline

Assumptions regarding receptacle nouns

Senses of receptacle Ns (*glass*, *jar* etc.)

- clearly have a sortal use: *This is a glass*.
- also have a relational, CLASSIFIER-like use
- commonly taken to be polysemous between the sortal, container and portion senses
  - sortal or relational sense determined by context of use
  - Evidence: lexicographic practice
    for instance, a part of the OED‘s lexical entry for *glass*:
    - “4.a. A glass vessel or receptacle. Also, the contents of the vessel.
    - 5. A drinking-vessel made of glass; hence, the liquor contained, and (fig.) drink.”

Assumptions regarding receptacle nouns (cont.)

- 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 some cases, the measure interpretation has become lexicalized as a standard measure, along with the basic sortal meaning and the relational (container/portion) senses:
    - *cup* (US English): Lexically encodes the basic sortal and the relational (container/portion) meanings, and *also* has a lexicalized standard measure meaning (250 ml - 8 fl. oz).

  Nb. There are also standard measures, such as *pint* (British English), which shifted to and have become lexicalized as container/portion relational concepts.

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

Hypothesis 1 for p-pNPs formed with receptacle Ns

(H1) The container and portion interpretations are the default interpretations.

- 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).
- The possibility of a dot type analysis for the relational interpretations of receptable nouns independently suggested by Partee and Borschev (2012), Duek and Brasoveanu (2015)
  - neither provides this kind of formal analysis

Hypothesis 2 for p-pNPs formed with receptacle Ns

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

- *Derived ...*
  - Recall: The common sense assumption:
  - the sortal (receptacle) and the relational (container/portion) interpretations are lexically encoded. For most receptacle nouns, the measure interpretation is not a part of their lexical meaning, but is derived.
- *... from the portion interpretation:*
  - About the stuff (e.g., *wine*), not the container (e.g., *glass*).
    So PROBABLY NOT (DIRECTLY) DERIVED from the sortal or container interpretation.
  - Proposed paraphrase:
    three glasses of wine (**measure**) $\approx$ *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**$)$
  - Formal details to follow

Two predictions

(H1) The container and portion interpretations are default;

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

If (H1) and (H2) are correct, then we expect the following to hold:

(i) The container and portion interpretations of full p-p NPs (e.g. *two glasses of wine*) easily allow co-predication on the same object;

(ii) the measure interpretation of expressions like *two wines* are generally difficult to get. (Details to follow.)

Co-predication I: Container-Portion

Prediction (i) is borne out:

(i) The container and portion interpretations of p-p NPs (e.g.,*two glasses of wine*) easily allow co-predication on the same object;

Receptacle nouns, such as *glass, bottle, pot*, have simultaneously accessible *container* (C) and *portion* (P) interpretations:

(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 II: Portion-Measure

Further predictions about co-predication which follow from (H1) and (H2):

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

- There is a function $\mathfrak{g}$ such that **measure** $= \mathfrak{g}($**portion**$)$ (H2)
- Some speakers may be able to reconstruct **portion** from $\mathfrak{g}($**portion**$)$
- But reconstructing **portion** from $\mathfrak{g}($**portion**$)$ is not as straightforward as selecting **container** or **portion** from **container** $\bullet$ **portion** interpretation (H1)

  - This is what we see. The portion and measure interpretations may be available for co-predication for some speakers, while others find them less than fully felicitous:

(6) (#) The two glasses of wine with a sour flavour were the last two 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)

Co-predication III: Container-Measure

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

- **measure** $= \mathfrak{g}($**portion**$)$ (H2)
- **container** interpretation 'disappears' as part of the derivation for **measure**
- **measure** blocks access to a co-predication **container**

- This is what we see in sentences, such as 8 and 9.

(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)

Also noted by Partee and Borchev (2012):

(10) ?? On uronil s podnosa dva s polovinoj stakana vina.
He dropped from tray two-ACC with half-INSTR glass-GEN wine-GEN
'He dropped two and a half glasses of wine from the tray.'

Summary: (H1), (H2) and (i)

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

(i) The container and portion interpretations of p-p NPs (e.g. *two glasses of wine*) easily allow co-predication on the same object.

Our account suggests the following partial order for felicity of combinations of meanings in co-predications:

Most Felicitous				Least Felicitous
C-P P-C	>	M-P P-M	>	C-M M-C

- The container and portion are default dot-type interpretations
  - Available for co-predication
- If **measure** $=$ $\mathfrak{g}$(**portion**), some, but not all speakers, may be able to reconstruct **portion** from **measure** for co-predications
- If **measure** $=$ $\mathfrak{g}$(**portion**), **measure** blocks **container**

Main puzzle: unavailability of **measure** via coercion

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

(ii) measure interpretation of expressions like *two wines* is generally difficult to get.

(2) a. John carried two white wines to the table. **container**
b. Phil drank two large red wines. **portion**

(3) #There are about two wines left in the barrel. **measure**

Coercion: requires recovering some receptacle (concept) from the context in order to resolve the type clash between a numerical 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 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.

Outline

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Why Frame Semantics

Sources of inspiration:

- Type theory with records (TTR)
- Other frame semantics (Fillmore, 1976; Barsalou, 1992; Löbner, 2014)
- Landman's *Iceberg Semantics* (⟨**body**, **base**⟩)

Why a different formalism:

- Much simpler than TTR, but retains ability to represent dot types
- Like TTR, retains Montague-style compositional semantics (other frame semantics lose this)
- Ability to represent richer lexical structures than Landman's *Iceberg Semantics*.

Standard features:

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

Non-standard features:

- Propositions are frames (sets of (recursive) labelled fields)

  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*

- Modification can be done on specific fields (parts of a frame)
  - Labels can be used to refer to properties or propositions in frames:

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

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Sutton & Filip's account of the mass/count distinction

Expression	Type	Description
glass, wine, ...	$\langle et \rangle$	Predicates. Stand-ins for e.g., bundle of perceptual, functional, and 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: $\mathcal{S}_0(P) = \bigcup_{\mathcal{S}_{i>0} \in \mathbb{S}} \mathcal{S}_i(P)$)

Inspirations and origins:

- $\mathcal{O}$: Landman's (2011) generator sets, Krifka's (1995) OU function
- $\mathcal{S}_{i>0}$: Landman's (2011) variants, Rothstein's (2010) default counting contexts
- $\mathcal{S}_0$: Landman's (2011) contexts for object mass nouns
- The context sensitivity of individuation: (Chierchia, 2010; Rothstein, 2010)
- (More in our work with TTR) mereotopological properties in a theory of individuation (Grimm, 2012)

Expression	Type	Description
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Examples:

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

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

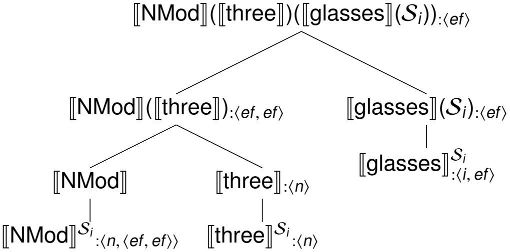
$$[\![\text{wine}]\!]^{\mathcal{S}_i} = [\![\text{wine}]\!] = \lambda x.\begin{bmatrix} \text{cbase} & = & \lambda y.\mathcal{S}_0(wine)(y) \\ \text{ext} & = & \mathcal{S}_0(wine)(x) \end{bmatrix}$$

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

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

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

Three glasses



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

$$
\begin{aligned}
&[\![\text{three glasses}]\!]^{\mathcal{S}_i}\\
&= [\![\text{NMod}]\!]^{\mathcal{S}_i}([\![\text{three}]\!]^{\mathcal{S}_i})([\![\text{glasses}]\!]^{\mathcal{S}_i})\\
&= [\![\text{NMod}]\!]([\![\text{three}]\!])([\![\text{glasses}]\!](\mathcal{S}_i))\\
&= \lambda F.\lambda x.\begin{bmatrix} cbase & = cbase(F(x))\\ ext & = ext(F(x))\\ restr & = \mu_{card}(x, cbase(F(x)), 3)\end{bmatrix}(\lambda x.\begin{bmatrix} \text{cbase} & = \lambda y.\mathcal{S}_i(\mathcal{O}(glass))(y)\\ \text{ext} & = {}^{*}\mathcal{S}_i(\mathcal{O}(glass))(x)\end{bmatrix})\\
&= \lambda x.\begin{bmatrix} cbase & = \lambda y.\mathcal{S}_i(\mathcal{O}(glass))(y)\\ ext & = {}^{*}\mathcal{S}_i(\mathcal{O}(glass))(x)\\ restr & = \mu_{card}(x, \lambda y.\mathcal{S}_i(\mathcal{O}(glass))(y), 3)\end{bmatrix}
\end{aligned}
$$

A set of sums of individual glasses that have cardinality 3 wrt the property $\lambda y.\mathcal{S}_i(\mathcal{O}(glass))(y)$

Outline

Dot types

Inspired by Cooper's (2011) treatment in TTR

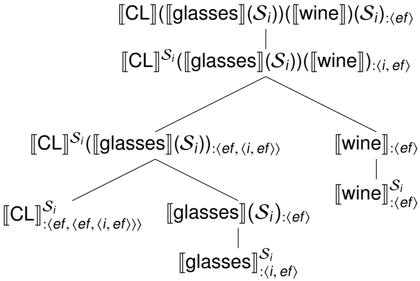
- TTR approach is close to Asher's (2011) proposal
- Asher's approach recommended by (but not implemented in) Partee and Borschev (2012)

$$\lambda x. \begin{bmatrix} \textit{cntnr} & = & \begin{bmatrix} \textit{cbase} & = & \lambda y.P(y) \\ \textit{ext} & = & P(x) \end{bmatrix} \\ \textit{prtn} & = & \begin{bmatrix} \textit{cbase} & = & \lambda y.Q(y) \\ \textit{ext} & = & Q(x) \end{bmatrix} \end{bmatrix}$$

Requires some leeway with the type for *x* (here, no details about the requisite a rich type theory)

- *x* is a container/portion...
  - ...with the container aspect represented in the *cntnr* field
  - ...with the portion aspect represented in the *prtn* field

glasses of wine (container and portion)



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

$$[\![CL]\!]^{\mathcal{S}_i} = \lambda F.\lambda G.\lambda s.\lambda x.$$

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

Container: E.g., glasses (F) containing wine (G)
Portion: E.g., portions of wine (G) at $\mathcal{S}_i$, that could each be contained in a glass (F).

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

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

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

three glasses of wine (container and portion)

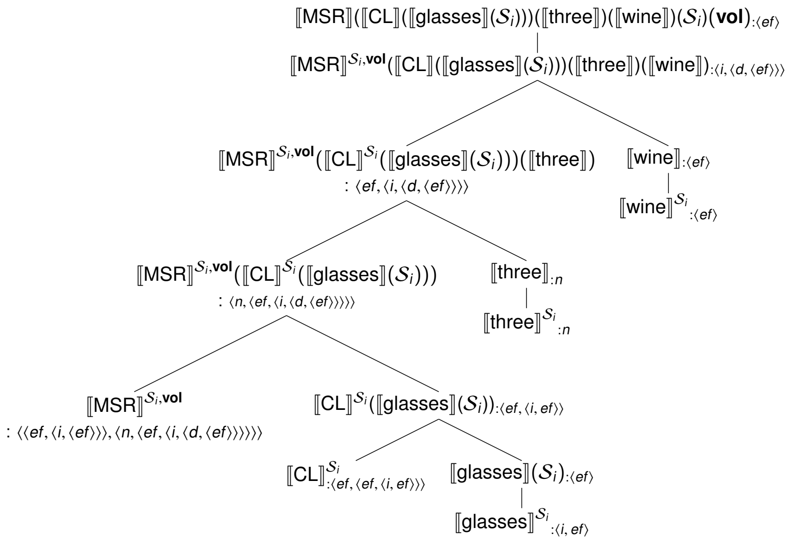
$$
[\![\text{NMod}]\!]([\![\text{three}]\!])([\![\text{CL}]\!]([\![\text{glasses}]\!](\mathcal{S}_i))([\![\text{wine}]\!])(\mathcal{S}_i)) =
$$

$$
\lambda x. \begin{bmatrix}
\mathit{cntnr} = \begin{bmatrix}
\mathit{cbase} = \lambda y.\mathcal{S}_i(\mathcal{O}(\mathit{glass}))(y) \\
\mathit{ext} \quad = \mathcal{S}_i(\mathcal{O}(\mathit{glass}))(x) \\
\mathit{restr} \quad = \forall y \exists z.[y \sqsubseteq x \wedge \mathcal{S}_i(\mathcal{O}(\mathit{glass}))(y) \\
\qquad \qquad \rightarrow \mathit{ext}(G(z)) \wedge \mathit{contain}(y, z)] \\
\mathit{restr}_2 \quad = \mu_{card}(x, \lambda y.\mathcal{S}_i(\mathcal{O}(\mathit{glass}))(y), 3)
\end{bmatrix} \\
\mathit{prtn} = \begin{bmatrix}
\mathit{cbase} = \lambda y.\mathcal{S}_i(\mathit{wine})(y) \\
\mathit{ext} \quad = {}^*\mathcal{S}_i(\mathit{wine})(x) \\
\mathit{restr} \quad = \forall y \exists w.\exists z.[y \sqsubseteq x \wedge \mathcal{S}_i(\mathit{wine})(y) \\
\qquad \qquad \rightarrow \mathcal{S}_i(\mathcal{O}(\mathit{glass}))(z)(w) \wedge \mathit{contain}(z, y)(w)] \\
\mathit{restr}_2 \quad = \mu_{card}(x, \lambda y.\mathcal{S}_i(\mathit{wine})(y), 3)
\end{bmatrix}
\end{bmatrix}
$$

From now on:

Abbreviate cntnr.restr and portn.restr to **contain**(*glass*, *wine*)

three glasses of wine (measure)



Compatible with, but does not presuppose, the syntactic analysis of Rothstein

$$[\![\text{MSR}]\!]^{\mathcal{S}_i,\textbf{vol}}$$

$$= \lambda\mathcal{F}.\lambda n.\lambda G.\lambda s.\lambda d.\lambda x.\begin{bmatrix} cbase = cbase(G(x)) \\ ext \quad = ext(G(x)) \\ restr \;\; = \mu(x, d, \lambda z.prtn(\mathcal{F}(G))(z)(s), n) \end{bmatrix}$$

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

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

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.

Summary: Interpretations for receptacle Ns in p-p NPs

Interpretation	Lexically encoded	Countability
Container (C)	Yes: dot type with (P)	Count
Portion (P)	Yes dot type with (C)	
Free portion	◦ container at some possible world	Count
Contents	◦ container at the actual world	Count
Measure (M)	No: derived, via MSR, from (P)	Mass

Felicity patterns in co-predication

Most Felicitous				Least Felicitous
C-P P-C	>	M-P P-M	>	C-M M-C

Outline

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 of 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.

$$[\![\text{wines}]\!] \quad \Rightarrow \quad ([\![\text{CL}]\!]([\![\text{glass(es)}]\!]))([\![\text{wine}]\!])$$

  - $[\![\text{CL}]\!]([\![\text{glass(es)}]\!])$ 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.

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

- $[\![\text{MSR}]\!]$ is contextually, implicitly, provided type shifter that operates on the shifted, portion, meaning of $[\![\text{wine}]\!]$, which is the result of the application of the function $[\![\text{CL}]\!]([\![\text{glass(es)}]\!])$ to $[\![\text{wine}]\!]$.

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

Accessibility hierarchy (coercion case)

⟦three⟧ ⟦wines⟧

TYPE CLASH

Apply NMod to ⟦three⟧

ENUMERATE KINDS

Type clash resolved

See: Sutton and Filip (2017)

Retrieve **container • portion** relational concept from the context. Apply to the meaning of *wines*

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

CONTAINER/PORTION interpretation

Type clash resolved

NO TYPE CLASH

Retrieve and apply MSR to an implicit relational concept of type **container • portion**.

CREATES TYPE CLASH

measure is the wrong type to combine with NMod(⟦three⟧)

Outline

Discussion: The status of measure interpretations

Two hypotheses for the interpretation of p-p NPs

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

Can explain:

1. Variation in felicity of co-predication on the same p-p NP

Relation to other proposals:

- 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.

Discussion: Count/Mass a linguistic misunderstanding?

Two hypotheses for the interpretation of p-p NPs

(H1) The container and portion interpretations are default interpretations;
(H2) the measure interpretation is derived from the portion interpretation.

Can also explain:

2. Why measure interpretations of p-p NPs like *two wines* are hard to get via coercion.

Some key results:

- The count/mass distinction is not based on a linguistic misunderstanding.
  - Explanation for 2. crucially turns on coercion as a type clash between lexically encoded meanings and repair strategy.
  - Any explanation if English has no grammaticized lexical mass/count distinction?
    How could accounts, such as Pelletier (2012) and Borer (2005), account for this puzzle?

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