Language Tutorial
Polysemy, copredication and individuation
Day 3: Polysemy, quantification, and modification

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Topics for this tutorial

1. Polysemy and Copredication (focussing on common nouns)
   - Differentiating polysemy from other phenomena

   Question: Can we discriminate polysemy from other phenomena (e.g., lexical ambiguity, coercion, underspecification)?

2. Implications of polysemy and copredication in semantics
   - Chomsky's Argument
     - Polysemy and copredication force an abandonment of (externalist) truth-conditional semantics
   - Semantic accounts of polysemy

   Question: What are the implications of polysemy and copredication for semantic theory?

3. Polysemy, copredication, and quantification
   - Quantification and copredication over plural NPs
     - *three long misleading talks*

   Question: What roles do modifiers and quantifiers play in restricting the individuation criteria of common nouns (semantics/pragmatics interface)?

Outline for day 3

- Quantifying over copredication

(1) Three informative books are on the shelf.

- Seems to require that the books are both physically distinct and informationally distinct
- But, this can be overridden by context
- Question: What (if anything) do modifiers contribute semantically towards individuation criteria?

Recap from day 2

Polysemy and copredication seem to force either

- Impoverishment of the type theory (removing structure)
- Enrichment of the type theory (adding structure)

Richer type approaches

- Adding at least one type constructor
- Enough basic types to cover the non-polysemous cases (informational entities, eventualities, physical entities)

Today:

- Another conservatively rich approach (product types)
- Plus mereology (a theory of parts and sums of entities)

Recap: Copredication

- Based on a single antecedent, applying multiple predicates with non-overlapping domains (Pustejovsky 1995; Asher 2011)

- Polysemous nouns such as *lunch* allow for copredication without zeugma as in (2) and (3), cf. (4)
  - *lasted two hours* (dom. = Eventualities)
  - *long* (dom. = Eventualities)

(2) Lunch lasted two hours and was delicious. (PHYS, EV)

(3) Ali gave a long, but misleading statement. (INF, EV)

(4) ?The party lasted all night and left basecamp in the morning.

Polysemy and modification in numeral constructions

Readings reported in (Gotham, 2017, p. 334):

(5) Three books are heavy.

(6) Three books are informative.

(7) Three informative books are heavy.

- In (5), three physically distinct books (duplicate copies allowed)
  - E.g., 2 copies of War and Peace, one of Middlemarch
- In (6), three informationally distinct books (multi-volumes allowed)
  - E.g., One volume containing The Metamorphosis and The Trial, one copy of middlemarch
  - This intuition is disputed (Chatzikyriakidis and Luo, 2018)
- In (7), no duplicates or multi-volumes

Copredication and numeral constructions

(8) a. Three informative books are very thick.

b. Alex bought three informative, very thick books.

(9) a. Three 5-minute statements were misleading.

b. Alex made three 5-minute, misleading statements.

Question: How many of each sense?

- How many physical books? How many informational books?
- How many stating events? How many informational contents?

The **double distinctness** intuition e.g.., Gotham 2014:

- Three physically and informationally distinct books.
- Three different stating events, each with different contents.

The point of contention

Are double distinctness readings derived semantically?

- Gotham 2021, 2017, 2014: Yes
  - Modifiers restrict the individuation criteria of common nouns.
  - *heavy informative books* gives us a set of entities, each of which is physically and informationally distinct

- Liebesman and Magidor 2017, 2019: No

  (10) *Context. Librarians making two piles: informative books vs. uninformative books.*

  (11) Three informative books are heavy.

  - (11) can describe three heavy books with the same contents
  - Therefore double distinctness derived via pragmatics

- Gotham's (2021) response:
  - These exceptions are explicable in terms of loose talk.

Plan for today:

- Proposals for deriving double distinctness semantically (Gotham, 2014, 2017, 2021; Chatzikyriakidis and Luo, 2018, 2020, 2015)
  - Focus on Gotham's mereological account
- Pragmatic responses:
  - Liebesman and Magidor's argument
  - Individuation as a form of contextual nominal domain restriction (Sutton 2024, in prep)
- Overview

Gotham's critique of Type Compositional Logic

Predictions in Asher 2011

- Based on a head typing principle, and mechanisms for type accommodation, the following readings are predicted in TCL:

(12) John mastered three heavy books.

a. 3 informationally distinct books, multi-volumes allowed

(13) John picked up and mastered three books.

a. 3 informationally distinct books, multi-volumes allowed

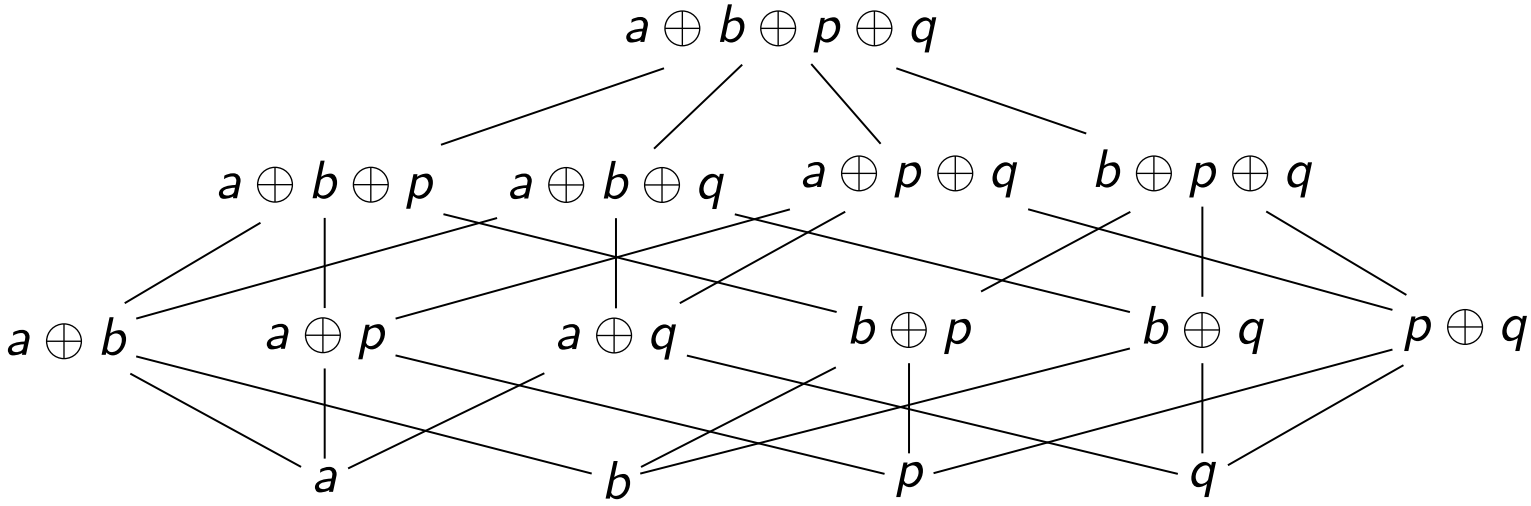
b. 3 physically distinct books, duplicates allowed

- I.e., no derived double-distinctness reading in the semantics

Gotham's account: A mereological approach

Basic idea: Polysemous nouns denote sums of entities of different sorts

- Informational entities, physical entities etc. are all of type e
- Sum formation $\oplus$
- E.g. *book* denotes a sum of a physical object and an informational entity



Gotham's account: Product types

Gotham assumes a product type constructor

- the type of ordered tuples of expressions
- Not so uncommon in semantics (Rothstein, 2010; Sutton and Filip, 2016b; Windhearn, 2021)
- Very commonly implicitly assumed (e.g. s as the type of world-time pairs)

(14) $\sigma \times \tau \in \mathbf{Typ}$ if $\sigma, \tau \in \mathbf{Typ}$ (product types)

This structure can be 'unpacked' via projection functions

- Functions that access the first and second projections of a tuple

(15) If $\alpha = \langle \beta, \gamma \rangle : \sigma \times \tau$, then:

a. $\pi_1(\alpha) = \beta : \sigma$

b. $\pi_2(\alpha) = \gamma : \tau$

Gotham's proposal: overview

CNs denote functions from (sums of) entities x to ordered pairs of

1. A proposition, the extension of the noun. E.g., $book(x)$
2. An individuation schema
   - I.e., a P-equivalence relation between sums (e.g., physical equivalence)

Modifiers restrict 1. and 2. E.g., *thick book*

1. $book(x) \wedge thick(x)$
2. can be individuated in terms of physical distinctness

Multiple modifiers stack, e.g., *thick informative book*

1. $book(x) \wedge thick(x) \wedge inf(x)$
2. can be individuated in terms of physical and informational distinctness

Individuation schemas

Individuation schemas as equivalence relations

(16) a. $\textsc{phys} = \lambda x.\lambda y.\text{phys-equiv}(x, y)$

b. $\textsc{info} = \lambda x.\lambda y.\text{info-equiv}(x, y)$

Examples

- $a \oplus p$ is phys equivalent with $a \oplus p$, $a \oplus q$, $a \oplus p \oplus q$
- $a \oplus p$ is not phys equivalent with $a \oplus b \oplus p$, $a \oplus b \oplus q$ etc.
- $a \oplus p$ is info equivalent with $a \oplus p$, $b \oplus p$, $a \oplus b \oplus p$
- $a \oplus p$ is not info equivalent with $a \oplus p \oplus q$, $b \oplus p \oplus q$ etc.

CN denotation schema

- $\lambda x.\langle P(x), \textsc{ind}\rangle$
- $x : e$, $P : \langle e, t\rangle$, $\textsc{ind} : \langle e, \langle e, t\rangle\rangle$
- $[\![[\![\mathit{CN}\ ]\!]]\!] : \langle e, \langle t \times \langle e, \langle e, t\rangle\rangle\rangle\rangle$

Stacking modifiers (simplified Gotham)

(17) $[\![\text{books}]\!] = \lambda x_{:\ e}.\langle {}^{*}\mathit{book}(x), \text{PHYS} \sqcap \text{INFO}\rangle$

a. the set of single books and sums thereof

b. Available individuation: physical or informational

(18) $[\![\text{be heavy}_{pl}]\!] = \lambda x_{:\ e}.\langle {}^{*}\mathit{heavy}(x), \text{PHYS}\rangle$

a. the set of single heavy things and sums thereof

b. Available individuation: physical

(19) $[\![\text{be informative}_{pl}]\!] = \lambda x_{:\ e}.\langle {}^{*}\mathit{inf}(x), \text{INF}\rangle$

a. the set of informative things and sums thereof

b. Available individuation: informational

Numerals (simplified Gotham)

Compressability

- A sum of atoms: $a \oplus b \oplus \phi \oplus \psi$
- Where a, b are physical entities and ϕ, ψ are informational
- $a \oplus b \oplus \phi \oplus \psi$ is PHYS compressible iff phys-equiv(a, b)
- $a \oplus b \oplus \phi \oplus \psi$ is INFO compressible iff info-equiv(ϕ, ψ)
- Written (IND-SCHEMA)$comp(x)$

Numerals affect extension cardinality. E.g., *three books*

- The set of sums formed of $>$ 3 books

But also restrict extensions another way. E.g., *three books*

- Gather all available individuation criteria i.e., INF, PHYS
- State that $\neg$((INF $\sqcup$ PHYS)$comp(x)$
  - I.e., no duplication of physical or informational entities across sums (double distinctness)

Examples

(20) $[\![\text{three heavy books}]\!] =$
$\lambda x.\langle^* \mathit{book}(x) \wedge^* \mathit{heavy}(x) \wedge |x| \geq 3 \wedge \neg((\textsc{phys})\mathit{comp}(x)), \textsc{phys}\rangle$

- any sums of three things in the extension of *book* that are physically distinct
- Allows for informational duplicates

(21) $[\![\text{three informative books}]\!] =$
$\lambda x.\langle^* \mathit{book}(x) \wedge^* \mathit{inf}(x) \wedge |x| \geq 3 \wedge \neg((\textsc{info})\mathit{comp}(x)), \textsc{info}\rangle$

- any sums of three things in the extension of *book* that are informationally distinct
- Allows for multi-volume physical books

(22) $[\![\text{three heavy and informative books}]\!] =$
$\lambda x.\langle^* \mathit{book}(x) \wedge^* \mathit{heavy}(x) \wedge |x| \geq 3 \wedge \neg((\textsc{phys} \sqcup \textsc{info})\mathit{comp}(x)),$
$\textsc{phys} \sqcap \textsc{info}\rangle$

- any sums of three things in the extension of *book* that are physically and informationally distinct
- Three physically distinct books, each with different contents

Other analyses

Double-distinctness also derived in a richly typed semantics

- Modern Type Theories (MTT, e.g., Chatzikyriakidis and Luo 2020; Luo 2010, 2018)
- A development of Semantics in the tradition of Ranta 1994
  - Argued to be both model and proof theoretic

Basic ideas:

- Dot types: Books are entities of type $p \bullet i$ (phys dot info)
- CNs denote pairs of a type and an individuation criteria (a dot setoid)

(23) $[\![\text{book}]\!] = (Book, =_{p \bullet i})$

a. $Book \sqsubseteq p \bullet i$

b. $\langle a_1, q_1 \rangle =_{p \bullet i} \langle a_2, q_2 \rangle$ iff $(a_1 =_p a_2) \vee (q_1 =_i q_2)$

- VPs and Modifiers provide counting domains
- Counting constructions negate the individuation criterion
  - $\langle a_1, q_1 \rangle \neq_{p \bullet i} \langle a_2, q_2 \rangle$ iff $(a_1 \neq_p a_2) \wedge (q_1 \neq_i q_2)$

Consensus with some count-mass theories

We need more than extensions

- Minimally, also some way of tracking one what basis we are counting

Convergence with count-mass semantics

- Independently argued for: counting criteria/bases
  - E.g., Landman 2011, 2016; Sutton and Filip 2016a, 2021
- Common nouns denote functions from entities and worlds to a pair: $\langle \text{extension}, \text{counting-base} \rangle$
- Count nouns differ from mass nouns, because the counting base is quantized (or disjoint)

Against double distinctness

Liebesman and Magidor 2017, 2019

- Double distinctness readings are pragmatically derived, not semantically encoded

(24) *Context. Librarians making two piles: informative books vs. uninformative books.*

(25) Three informative books are heavy.

- Intuition: (25) in (24) can be true if three copies of the same book from the informative pile are informative

Gotham's (2021) Reponse

Adding *different* reintroduces the double-distinctness reading

(24) *Context. Librarians making two piles: informative books vs. uninformative books.*

(25) Three informative books are heavy.

(26) Three different informative books are heavy.

- Gotham criticises LM's property inheritance view for not being able to explain this difference

Gotham's Pragmatic Explanation

Loose talk and pragmatic halos (Lasersohn, 1999)

(27) Mary arrived at 3 o'clock.

(28) The townspeople are asleep

- These sentences allow for loose talk
  - Mary arrive more or less around 3.
  - Many but not all are asleep

Slack regulators e.g., *all, exactly*

- Reduce slack

(29) Mary arrived at exactly 3 o'clock.

(30) All the townspeople are asleep

Gotham (2021): *different* is a slack regulator

(26) Three different informative books are heavy.

Pragmatic halos and copredication

Modifiers like informative have pragmatic halos (Gotham, 2021, p. 110)

- This affects the individuation criteria

(31) $\lambda x.\langle {}^{*}\mathit{informative}(x), \textsc{info}\rangle$

(32) $\lambda x.\langle {}^{*}\mathit{informative}(x), \varnothing\rangle$

If we do not care about individuation, use (32)

- Result: *Three informative books are heavy* can allow for duplicate copies in L&M's scenario

different narrows the halo

- (32) is excluded

An alternative proposal

L&M are right about the library book sorting scenario

- A classic case if contextual nominal domain restriction (Stanley and Gendler Szabó, 2000; Stanley, 2002)

Gotham is right that modifiers encode information relevant to individuation

- Double-distinctness is a strong intuition in many out-of-the-blue cases

A combined proposal

- Modifiers can contribute to contextual nominal domain restriction
- Or to individuation
- Use QUD ordering to govern which

Overview: Domain restriction and QUD sensitivity

- Common nouns undergo contextual domain restriction (Stanley and Gendler Szabó, 2000)
  - E.g., of the informational books, two of them
- Polysemous common nouns underspecify their individuation conditions. (Gotham, 2014)
- Fixing individuation criteria is also a form of domain restriction.
  - E.g. excluding duplicate informational contents for the purposes of counting
- How the domain is restricted is QUD-sensitive

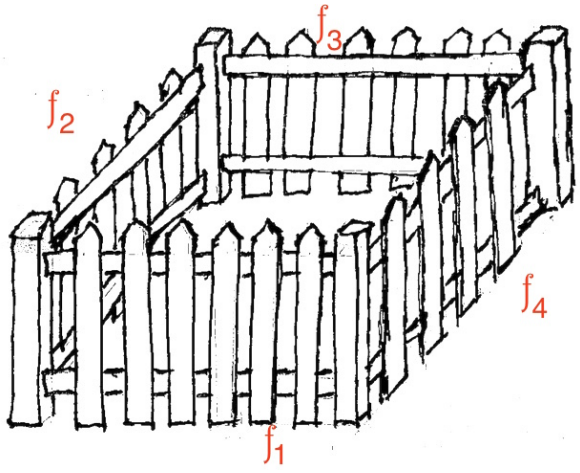
Overview: Two types of QUDs

- We can distinguish between contextually and lexically introduced QUDs
  - Context: *Which books?* (e.g. of the piles in the library)
  - Lexically (for polysemous nouns): *How are we individuating books?*
- Intersective modifiers contribute underspecified contextual updates: e.g., *informative* – the modified noun individuated at least in part by informational entities
- So *informative book(s)* can contribute towards answering either QUD
- Ordering on QUDs determines which QUD is answered

Individuation as domain restriction

Well known for some count nouns e.g., *fence* (Rothstein, 2010)

- Fencing around a square field



- $f_1, f_2, f_3, f_4, f_1 \oplus f_2 \oplus f_3 \oplus f_4 \in [\![\text{fence}]\!]$
- $f_1 \oplus f_2 \oplus f_3 \oplus f_4 \notin c_1$
- $f_1, f_2, f_3, f_4 \notin c_1$
- $[\![\text{fence}]\!] \cap c_1 \Rightarrow$ 4 fences
- $[\![\text{fence}]\!] \cap c_2 \Rightarrow$ 1 fence

Similar effects for *books*

- Suppose $[\![\text{books}]\!] = \{\langle o_1, \phi_1\rangle, \langle o_2, \phi_1\rangle, \langle o_3, \phi_2\rangle, \langle o_1 \oplus o_2, \phi_1\rangle, \langle o_1 \oplus o_3, \phi_1 \oplus \phi_2\rangle, \langle o_2 \oplus o_3, \phi_1 \oplus \phi_2\rangle ...\}$,
- $[\![\text{two informative books}]\!] = \{\langle o_1 \oplus o_3, \phi_1 \oplus \phi_2\rangle, \langle o_2 \oplus o_3, \phi_1 \oplus \phi_2\rangle, \langle o_1 \oplus o_2 \oplus o_3, \phi_1 \oplus \phi_2\rangle\}$
- Excludes e.g., $\langle o_1 \oplus o_2, \phi_1\rangle$

Contextual QUDs

Common nouns denote functions from contexts to properties

- f_c : a salient property in context c
- $[\![\text{fence}]\!] = \lambda c.\lambda w.\lambda x.fence(w)(x) \wedge f_c(w)(x)$
- $[\![\text{book}]\!] = \lambda c.\lambda w.\lambda x.book(w)(x) \wedge f_c(w)(x)$
  - I do this with TTR (see yesterday's slides)

The book piling scenario

- Two salient properties of books in the context: *Which pile?*
  - $INF = \lambda w.\lambda x.book_w(x), piled\_in\_library_w(x), inf_w(x)$
  - $NINF = \lambda w.\lambda x.book_w(x), piled\_in\_library_w(x), \neg inf_w(x)$

Contribution of *informative*

- Truth-conditions of *informative* are inconsistent with NINF
- If *Which pile?* is on top of the QUD stack, then f_c is *INF*

Two types of QUD

Common nouns denote functions from contexts to properties

- f_c : a salient property in context c
- $[\![\text{book}]\!] = \lambda c.\lambda w.\lambda x.book(w)(x) \wedge f_c(w)(x)$

Uses of polysemous nouns

- *book* underspecifies its individuation criteria
- This raises a question: *how are we individuating books?*
- Lexically introduces a set of alternatives for f_c
  - $f_c : \langle s, \langle \text{INF}, t \rangle \rangle$
  - $f_c : \langle s, \langle \text{PHYS}, t \rangle \rangle$
  - $f_c : \langle s, \langle \text{INF} \circ \text{PHYS}, t \rangle \rangle$

Modifiers can encode a constraints on the type for f_c

- E.g. *informative*: f_c must be of type $\langle s, \langle \text{INF}, t \rangle \rangle$
- If the lexical QUD is top of the stack, rules out $f_c : \langle s, \langle \text{PHYS}, t \rangle \rangle$

Advantages

Unlike L&M's approach

- Predicts double distinctness readings absent any overriding QUD

Unlike Gotham's approach

- Modifiers can have stable meanings
  - Constrain extensions of CNs
  - Constrain the types of contextual domain restriction properties (how to count)
- This has different effects depending on the QUD

Instability in the empirical landscape

When do we have double-distinctness readings?

- Intuitions seem to vary
- Mine do from day to day
  - Even out-of-the-blue, does *Three informative books are heavy* have to have a double distinctness reading?
- Suggests a need for (more) empirical testing
  - Reference matching/truth value judgment task?

Polysemy

Not a clearly defined term

- Borderline cases with lexical ambiguity
- Borderline cases with coercion
- Not clear consensus on the connection between polysemy and underspecification

Nonetheless

- Grammatical reflexes of polysemy found in corpedication
- Also cross-linguistic lexicalization patterns

Polysemy and Copredication

Raises a challenge for canonical semantics

- How should we type polysemous expressions?

Two main choices:

1. Force a collapse of some types together (and maybe try to make do with sorts)
2. Allow for at least one type constructor in addition functional types

Either way, some of the foundations of our semantic theory seem to need altering

No resolution yet

- But seemingly more work being done on this in the last few years

Polysemy, copredication, and quantification

A point of consensus among all

- Some combination of semantics and pragmatics is needed to explain the range of double-distinctness readings

A point of consensus among most

- The semantics of common nouns involves some means of tracking (constraints on) individuation criteria

A need for empirical clarity

- Unclear (at least to me) what the data are regarding copredication and quantification

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