Polysemy and Copredication:
a situation-theoretic approach

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Outline

Background and Data

Analysis Overview

Analysis: Polysemy

Analysis: Copredication

Comparison with other theories and outstanding issues

Polysemy versus ambiguity

Not sharply divided categories, but I will assume:

Lexical ambiguity: e.g., $bank_{finance}$ vs. $bank_{river}$

- Non-related senses
- Accidental homophony – *Bank* vs *Ufer* (German)

Polysemy: e.g., $statement_{eventuality/information/physical\ object}$

- Inter-related senses
- Non-accidental homophony

Other examples of nominal polysemy:

Noun	Senses include
lunch	eventuality, physical object
book	informational content, physical object
evidence	eventuality, informational content, physical object
city	population, area, (local) government

Copredication and polysemy

Copredication:

- Based on a single antecedent, applying multiple predicates with non-overlapping domains

Polysemous nouns such as *lunch* allow for copredication:

(1) Lunch lasted for two hours and was delicious.   (Ev, Phys)

   (Adapted from Asher and Pustejovsky 2006)

- *lasted two hours*: domain = *Ev*entualities
- *was delicious*: domain = *Phys*ical objects (esp. food)

Ambiguous nouns give rise to zeugma (e.g., Asher 2011):

- *party* = a celebration; a group (e.g., one travelling together)
- (2) ?The party lasted all night and left base camp in the morning.

Previous analyses: Dot types

(Asher and Pustejovsky 2006; Asher 2011; Chatzikyriakidis and Luo 2018),
(see also Pustejovsky 1994, 1995 on dot objects)

Polysemous nouns denote 'objects' with different aspects:

- *thick book* – book qua physical object
- *interesting book* – book qua informational content

The type of these objects is a dot type

- *the book* denotes an 'object' of type *Phys • Inf*
- Chatzikyriakidis and Luo 2018: CNs also encode identity criteria $(Phys \bullet Inf, =_{Phys \bullet Inf})$

Worry:

- Dot types are motivated by the phenomena they are meant to explain, namely, polysemy and copredication

Previous analyses: Mereology

(Gotham 2014, 2017)

Polysemous nouns denote entities that are mereologically complex:

- e.g., books are sums of physical objects and informational contents

Modifiers and VPs restrict individuation criteria for numeral expressions in systematic ways and account for 'double distinctness' interpretations

- E.g., *two thick, informative books* must denote two distinct physical books that are also informationally distinct.

Worry:

- Allowing sums across denotational domains is specifically motivated by polysemy and copredication

Restrictions on co-predication: New data

For nouns that are more than 2-ways polysemous, there are interesting restrictions on copredication:

(3) a. The statement in the envelope is inaccurate.   (Phys, Inf)
   b. ?The statement in the envelope lasted half an hour.   (Phys, Ev)

(4) a. The inaccurate statement lasted half an hour.   (Inf, Ev)
   b. The inaccurate statement was sealed in an envelope.   (Inf, Phys)

(5) a. ?The half-hour statement was sealed in an envelope.   (Ev, Phys)
   b. The half-hour statement was inaccurate.   (Ev, Inf)

Felicitous copredication entails that a noun is polysemous, but a failure of copredication does not entail that a noun is not polysemous.

Further evidence from German

(6) a. *Die Stellungnahme in dem Umschlag ist sachlich.*
the statement in the envelope is factual

"The statement in the envelope is factual."

b. *?Die Stellungnahme in dem Umschlag hat eine halbe Stunde gedauert.*
the statement in the envelope has a half hour lasted

"The statement in the envelope took half an hour."

(7) a. *Die sachliche Stellungnahme hat eine halbe Stunde gedauert.*
the factual statement has a half hour lasted

"The factual statement took half an hour"

b. *Die sachliche Stellungnahme ist in einen Umschlag gesteckt worden.*
the factual statement is in a envelope put got

"The factual statement was placed in an envelope"

(8) a. *?Die halbstündige Stellungnahme ist in einen Umschlag gesteckt worden.*
the half-hour statement is in a envelope put got

"The half-hour statement was placed in an envelope."

b. *Die halbstündige Stellungnahme war sachlich*
the half-hour statement was factual

'The half-hour statement was factual."

Goals

A semantic account of polysemy that:

- Does not appeal to dot-types/aspects of one entity
- Does not appeal to mereological sums across denotational domains

An account of copredication that:

- Can explain the restrictions on copredication

Analysis overview: Polysemy

Starting point: situation theoretic semantics

- Nouns do not denote individuals of some type, but situations that witness individuals of that type

- Example: *cat* denotes situations that witness (i.e. contain) single cats.

Claim: polysemous nouns

- Polysemous nouns do not denote individuals of different types, but situations that witness individuals of different types

- Example: *lunch* denotes situations that witness both an event **and** some food
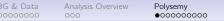
Analysis overview: Copredication

Neo-Davidsonian thematic roles

- The lexical semantics of polysemous nouns specify what thematic roles (if any) hold between entities of different types
- Example: *lunch* specifies that the food is the Patient of the lunch-eating eventuality.

Claim: Copredication

- Copredication is licensed if the lexical semantics of the polysemous noun specifies a thematic (or comparable) relation between entities of the different relevant types
- Examples:
  - *long, delicious lunch* is licensed because *lunch* specifies that the food is the Patient of the lunch-eating eventuality.
  - *inaccurate half-hour statement* is licensed because the information stated is the contents of the stating eventuality.

Type theory with records (TTR)

(Cooper 2012, 2022, among others)

Montague-style semantics within a situation theory:

- **Records** are situations that witness entities of different types (cf entities of different types).
- **Record types** are types of situations (cf sets of worlds/propositions)
- Expressions denote, records (of some type), record types, or functions from, say, records to record types.

Richly typed:

- Not just e, t, v etc. and type constructors for e.g., functional types
- Instead, e.g: *Ind*, *RecType*, *Ev*, and predicate types (*ptypes*) (Formally, predicates are *ptype* constructors)
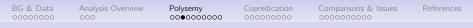
TTR assumptions: basic types

Cooper (2012, 2022): *Ind* as a basic type

- Similar to Montague's type *e*
- However, encodes individuation

I do not want to presuppose individuation in my basic types

- *Phys* for Physical entity (including objects and undifferentiated stuff)
- Also *Ev* for Eventuality
- And *Inf* for informational entity
  - I.e., something broader than a proposition, can encompass, e.g., the contents of a book or the contents of a statement

TTR example

(9) $cat \mapsto \lambda r : [x : Phys]. [c_c : cat(r.x)]$

- A function from records that witness a physical entity, to the record type in which the condition holds that entity is a cat

(10) $black \mapsto \lambda r : [x : Phys]. [c_b : black(r.x)]$

Both (9) and (10) of type $Ppty$, i.e., $([x : Phys] \rightarrow RecType)$

(11) $IntersectMod$
$\mapsto \lambda \mathcal{P} : Ppty.\lambda \mathcal{Q} : Ppty.\lambda r : [x : Phys]. \mathcal{P}(r) \wedge \mathcal{Q}(r)$

(12) $black\ cat \mapsto \lambda r : [x : Phys]. \begin{bmatrix} c_c & : & cat(r.x) \\ c_b & : & black(r.x) \end{bmatrix}$

- A function from records that witness a physical entity, to the record type in which the condition holds that individual is a cat and is black.

lunch

lunch denotes a property of situations that witness some physical individual and an eventuality such that:

- the individual is food
- the eventuality is a (lunch) eating event
- the food is the Patient of the lunch eating event

$$(13) \ lunch \mapsto \lambda r : \begin{bmatrix} x & : & Phys \\ e & : & Ev \end{bmatrix} . \begin{bmatrix} c_f & : & food(r.x) \\ c_e & : & eat(r.e) \\ c_p & : & patient(r.x, r.e) \end{bmatrix}$$

Polysemy Hypothesis

The lexical introduction of more than one entity is a necessary condition for the lexical item to be polysemous.

lunch: overly simplistic?

A non-symmetrical interaction between *Phys* and *Ev*:

(14) I made lunch but didn't eat it.   (Phys $\nvDash$ Ev)

(15) ?I ate lunch although it didn't take place.   (Ev $\vDash$ Phys)

Furthermore:

- *start lunch* is underspecified between 'start eating' and 'start making'

So the lexical entry for *lunch* may need to be amended

- partially comparable to verbs of creation?
    - $e : Ev$ is such that $eat(e) \vee make(e)$
    - Then, for $x : Phys$, $patient(x, e) \vee created(x, e)$

(16) *lunch* $\mapsto$

$$\lambda r : \left[\begin{array}{ccc} x & : & Phys \\ e & : & Ev \end{array} \right] . \left[\begin{array}{ccl} c_f & : & food(r.x) \\ c_e & : & eat(r.e) \vee make(r.e) \\ c_p & : & patient(r.x, r.e) \vee created(r.x, r.e) \end{array} \right]$$

abstract nouns

Some abstract nouns are at least three-way polysemous between the following readings: **Ev**entuality, **Inf**ormational content, and **Phys**ical object.

- *evidence, message, report, statement* etc.

(17) a. The statement lasted 10 minutes.   (Ev)
      b. The statement was untrue.   (Inf)
      c. The statement was filed away.   (Phys)

(18) a. Alex's message was 2 minutes long.   (Ev)
      b. Their message was misleading.   (Inf)
      c. This message was sent by courier.   (Phys)

Non-cooccurrence

Eventualities, informational entities and physical individuals need not cooccur:

- stating event, but no physical object (the agent just speaks)
- physical statement, but no stating event (the agent wrote something down/signed a pre-written statement)

Contrast *lunch* and *statement*

(14) I made lunch but didn't eat it.   (Phys $\not\vDash$ Ev)

(15) ?I ate lunch although it didn't take place.   (Ev $\vDash$ Phys)

(19) I gave a statement, but didn't write it down.   (Ev $\not\vDash$ Phys)

(20) I signed the statement, but never read it out.   (Phys $\not\vDash$ Ev)

But **all** statements have some kind of informational content

(21) Al's statement was informative $\vDash$
there was a written or verbal statement   (Inf $\vDash$ Phys $\vee$ Ev)

statement

The non-cooccurrence data suggests that we cannot have:

$$(22) \ statement \mapsto \lambda r : \begin{bmatrix} x & : & Phys \\ e & : & Ev \\ p & : & Inf \end{bmatrix} . [...]$$

- This would mean that we should expect all three types of entities for every statement

The data suggests that every statement is, minimally, an event **or** a physical object, but always also an informational entity.

statement

This suggests a join type: $Phys \vee Ev$. Suppose that:

- the predicate $statement\_ev\_or\_phys$ has an arity (approx. domain): $\langle Phys \vee Ev \rangle$
- the relation $contents\_of$ has an arity: $\langle Phys \vee Ev, Inf \rangle$

(23) $statement \mapsto$
$$\lambda r : \left[\begin{array}{l} j : Phys \vee Ev \\ p : Inf \end{array} \right] . \left[\begin{array}{l} c_1 : statement\_ev\_or\_phys(r.j) \\ c_3 : contents\_of(r.p, r.j) \end{array} \right]$$

$statement$ denotes a property of situations that witness some informational content and either some physical individual or an eventuality such that:

- the physical individual counts as a physical statement or the eventuality counts as a statement-making eventuality
- the informational entity is the contents of whichever manifestation of statement we have

Licensing copredication

We have, e.g.:

(24) $lunch \mapsto \lambda r : \left[\begin{array}{ccc} x & : & Phys \\ e & : & Ev \end{array} \right] . \left[\begin{array}{ccl} c_f & : & food(r.x) \\ c_e & : & eat(r.e) \\ c_p & : & patient(r.x, r.e) \end{array} \right]$

(25) $statement \mapsto$
$\lambda r : \left[\begin{array}{ccc} j & : & Phys \vee Ev \\ p & : & Inf \end{array} \right] . \left[\begin{array}{cl} c_s & : statement\_ev\_or\_phys(r.j) \\ c_c & : contents\_of(r.p, r.j) \end{array} \right]$

Lexically specified relations:

Noun	Ev & Inf	Phys & Inf	Ev & Phys
statement	Yes	Yes	No
evidence	Yes	Yes	No
lunch	–	–	Yes
book	–	Yes	–

Licensing copredication

As we've seen, there are some restrictions on copredication:

(26) a. The statement in the envelope is inaccurate.   (Phys, Inf)
     b. ?The statement in the envelope lasted half an hour.   (Phys, Ev)

(27) a. The inaccurate statement lasted half an hour.   (Inf, Ev)
     b. The inaccurate statement was sealed in an envelope.   (Inf, Phys)

(28) a. ?The half-hour statement was sealed in an envelope.   (Ev, Phys)
     b. The half-hour statement was inaccurate.   (Ev, Inf)

The copredication patterns match the lexically specified relations:

Noun	Ev & Inf	Phys & Inf	Ev & Phys
statement	Yes	Yes	No
evidence	Yes	Yes	No
lunch	–	–	Yes
book	–	Yes	–

Hypotheses

Polysemy Hypothesis

The lexical introduction of more than one entity is a necessary condition for the lexical item to be polysemous.

Copredication Hypothesis

A lexically specified relation is a sufficient condition for licensing copredication over the entities related

More work needed on the copredication hypothesis:

- What relations should be included?
- If non-thematic relations, how to constrain this set?
- Are some thematic relations excluded e.g., *experiencer*(x, e)? (*??The algebra class was hard and annoyed the teacher.*)

Copredication Example: *long and delicious lunch*
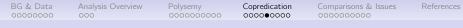
Meet of two functions (Cooper 2011, 2022):

If f_1 is a function of type $(T_1 \rightarrow T_2)$
and f_2 is a function of type $(T_3 \rightarrow T_4)$,
then $f_1 \wedge f_2$ is a function f_3 of type $((T_1 \wedge T_3) \rightarrow (T_2 \wedge T_4))$

(29) $long_{\text{temp}} \mapsto \lambda r : [e : Ev]. \ \left[\ c_l \ : \ \tau(r.e) = \textbf{long} \ \right]$

(30) $delicious \mapsto \lambda r : [x : Phys]. \ \left[\ c_d \ : \ \text{delicious}(r.x) \ \right]$

(31) *long and delicious*

$\mapsto \lambda r : [e : Ev] \wedge [x : Phys].$
$\qquad \left[\ c_l : \tau(r.e) = \textbf{long} \ \right] \wedge \left[\ c_d : \text{delicious}(r.x) \ \right]$

$\mapsto \lambda r : \left[\begin{array}{l} e : Ev \\ x : Phys \end{array} \right] . \left[\begin{array}{lll} c_l & : & \tau(r.e) = \textbf{long} \\ c_d & : & \text{delicious}(r.x) \end{array} \right]$

Copredication Example: *long and delicious lunch*

$$(32) \ lunch \mapsto \lambda r : \left[\begin{array}{ccc} x & : & Phys \\ e & : & Ev \end{array} \right] . \left[\begin{array}{ccl} c_f & : & food(r.x) \\ c_e & : & eat(r.e) \\ c_p & : & patient(r.x, r.e) \end{array} \right]$$

Via *function meet*:

(33) *long and delicious lunch*

$$\mapsto \lambda r : \left[\begin{array}{l} x : Phys \\ e : Ev \end{array} \right] . \left[\begin{array}{ccl} c_f & : & food(r.x) \\ c_e & : & eat(r.e) \\ c_p & : & patient(r.x, r.e) \\ c_l & : & \tau(r.e) = \textbf{long} \\ c_d & : & \text{delicious}(r.x) \end{array} \right]$$

A property that denotes situations that witness some food and a lunch eating eventuality. The food is delicious and the patient of the eventuality, the eventuality counts as long.

- Copredication is licensed due to the Patient relation.

Copredication Example: *inaccurate, half-hour statement*

(34) *inaccurate* $\mapsto \lambda r : [\text{p} : \mathit{Inf}]. \; \big[\; c_d \; : \; \text{inaccurate}(r.\text{p}) \; \big]$

(35) *half-hour* $\mapsto \lambda r : [\text{e} : \mathit{Ev}]. \; \big[\; c_h \; : \; \tau_{hrs}(r.\text{e}) \geq 0.5 \; \big]$

(36) *statement* $\mapsto$
$$\lambda r : \left[\begin{array}{l} \text{j} \; : \mathit{Phys} \vee \mathit{Ev} \\ \text{p} \; : \mathit{Inf} \end{array} \right] . \left[\begin{array}{l} c_s : \mathit{statement\_ev\_or\_phys}(r.\text{j}) \\ c_c : \mathit{contents\_of}(r.\text{p}, r.\text{j}) \end{array} \right]$$

(37) *half-hour statement* $\mapsto$
$$\lambda r : \left[\begin{array}{l} \text{j} \; : \mathit{Phys} \vee \mathit{Ev} \\ \text{p} \; : \mathit{Inf} \\ \text{e} \; : \mathit{Ev} \end{array} \right] . \left[\begin{array}{l} c_s : \mathit{statement\_ev\_or\_phys}(r.\text{j}) \\ c_c : \mathit{contents\_of}(r.\text{p}, r.\text{j}) \\ c_h : \tau_{hrs}(r.\text{e}) \geq 0.5 \end{array} \right]$$

(38) *inaccurate, half-hour statement* $\mapsto$
$$\lambda r : \left[\begin{array}{l} \text{j} \; : \mathit{Phys} \vee \mathit{Ev} \\ \text{p} \; : \mathit{Inf} \\ \text{e} \; : \mathit{Ev} \end{array} \right] . \left[\begin{array}{l} c_s : \mathit{statement\_ev\_or\_phys}(r.\text{j}) \\ c_c : \mathit{contents\_of}(r.\text{p}, r.\text{j}) \\ c_h : \tau_{hrs}(r.\text{e}) \geq 0.5 \\ c_d : \text{inaccurate}(r.\text{p}) \end{array} \right]$$
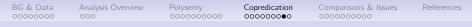
Final step: Allow for the identification of j and e

(39) *inaccurate, half-hour statement*

$$
\mapsto \lambda r : \begin{bmatrix} j : Phys \vee Ev \\ p : Inf \\ e : Ev \end{bmatrix} . \begin{bmatrix} c_s : statement\_ev\_or\_phys(r.j) \\ c_c : contents\_of(r.p, r.j) \\ c_h : \tau_{hrs}(r.e) \geq 0.5 \\ c_d : \text{inaccurate}(r.p) \\ c_= : j = e \end{bmatrix}
$$

$$
\mapsto \lambda r : \begin{bmatrix} p : Inf \\ e : Ev \end{bmatrix} . \begin{bmatrix} c_s : statement\_ev\_or\_phys(r.e) \\ c_c : contents\_of(r.p, r.e) \\ c_h : \tau_{hrs}(r.e) \geq 0.5 \\ c_d : \text{inaccurate}(r.p) \end{bmatrix}
$$

Prediction

Prediction: If further information is provided in the context such that a relation between a physical object and the eventuality, then this should improve felicity:

(40) The statement, which took half an hour to read out, was sealed in an envelope. (Ev, Phys)

Informal analysis:

- 'read out' introduces an eventuality and relates a physical object to the eventuality via a Theme relation
- *statement, which took half an hour to read out* then specifies a thematic relation between the object that was read and the event of reading it out.
- This licenses the copredication

Asher & Pustejovsky
(Pustejovsky 1994, 1995; Asher and Pustejovsky 2006; Asher 2011)

lunch denotes an entity with the dot-type $Ev \bullet Phys$

"the so-called dot objects of GL first introduced by Pustejovsky (1994) are, in effect, best understood as objects of a particular complex type with two constituent types. The constituent types pick out aspects of the object, and the object's complex type reflects the fact that it may have several, distinct, even incompatible aspects. The term dot object thus refers to objects with a complex type (not to complex objects–whatever those might be—or to pairs of objects)" (Asher and Pustejovsky 2006, p. 44)

- My approach has complex types, but no dot-type constructor.
- It also does not posit complex objects, but only complex situations.
  - And situations are one of the things that should be able to be complex!
- I do not posit aspects of one thing, rather different interrelated things in the same situation
  - E.g., an eating event with a food as a Patient

Cooper
(Cooper 2007, 2011)

Cooper more-or-less presents a Asher-style analysis in TTR, but without dot types:

(41) $lunch \mapsto$

$$\lambda r : \begin{bmatrix} x & : & Ind \end{bmatrix} . \begin{bmatrix} f & : & food \\ e & : & event \\ c_{lunch} & : & lunch\_ev\_fd(r.x, e, f) \end{bmatrix}$$

However, the three-place relation $lunch\_ev\_fd$ connects some individual to it's **aspects** of being food and being an event

- No dot types, but still aspects
- the type Ind also then becomes a bit opaque
    - For non-polysemous items, there is good reason to keep types like $Phys$ and Ev separate

Frames à la HHU: Kallmeyer & Osswald et al.
(Babonnaud et al. 2016; Kallmeyer and Osswald 2017)

Pustejovskyan aspects reinterpreted as attributes in a frame

- For *book*, the attribute CONTENT, links the physical book to the contents (as the *formal* meaning component of GL)

$$book \xrightarrow{\text{CONTENT}} information$$

- Frames, even for polysemous nouns, have one central node determining reference of the concept e.g., the physical book for *book*

Challenges

- Constraining copredication: which if the many attributes in any nominal frame count as copredication-licensing attributes?

- Choosing a central node: for, e.g., *evidence*, what is 'primary'? The physical, informational or eventive?

Gotham
(Gotham 2014, 2017)

Gotham (2014, 2017): a mereological account of copredication

- E.g., *book* denotes an sum-entity that has an informational part and a physical part
- Provides detailed work on counting & individuation with polysemous nouns

Worries:

- Should polysemy motivate us to have a semilattice-structured domain over entities of all types?
  - What is the part structure for the sums of all objects and events (and propositions, and predicates, etc.)
- For *statement* we'd need two sums $Inf \sqcup Ev$ and $Inf \sqcup Phys$
  - What, beyond stipulation, ensures that the two informational parts are identical?

Ortega-Andrés and Vicente
(Ortega-Andrés and Vicente 2019)

The closest to my proposal, but more processing-based
- Concepts are associated with a rich structure representing our world-knowledge
    - E.g., that schools are institutions for the purpose of educating with a physical location, teachers, students etc.
- These different parts of the knowledge structure may co-activated each another
- Co-activation is based upon *realisation and implementation relations*

Contrasts and comparisons:
- I have a compositional account, Ortega-Andrés and Vicente (2019) opt to remain neutral on the semantic implementation of their proposal
- The relevant relations I propose are arguably too constrained. Unclear if *realisation and implementation relations* are constrained enough.

Outstanding issue: Counting

Gotham's double distinctness:

- two half-hour statements
  - Counts distinct eventualities
- two inaccurate statements
  - Counts distinct informational contents
- two half-hour, inaccurate statements
  - Counts 'things' which are distinct both informationally and in terms of eventualities

Current work in progress:

- Combining the proposal here with previous work with Hana Filip on countability (e.g., Sutton and Filip 2021), and Gotham's view that modifiers encode individuation criteria.
- Basic idea: choice of counting base set can be constrained by modifiers

Outstanding issue: Constraining relations

A challenge for the copredication hypothesis:
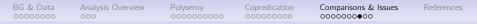Is there is a relation between the governing board for a newspaper and a physical newspaper?

(42) ?The newspaper fired its editor and fell off of the table.

(Ortega-Andrés and Vicente 2019)

(43) The newspaper has been attacked by the opposition and publicly burned by demonstrators.   (Ortega-Andrés and Vicente 2019)

Suggestion by Ortega-Andrés and Vicente (2019):

- Distinguish between newspaper as individual and newspaper as an exemplar (an instance of a kind)

- In terms of the proposal here: the governing board stands in a relation to the kind (the papers published by the firm), but not to single newspapers qua physical objects.

Summary

Goals revisited:

A semantic account of polysemy that:

- Does not appeal to abstract/complex objects
    - Yes. Only complex situations.
    - And situations are exactly the kinds of things we anyway expect can be complex!
- Does not appeal to something not independently motivated (dot-types/aspects of one entity, mereological sums across domains)
    - Yes. Only to independently justified types (situations, physical entities, informational entities etc.).

An account of copredication that:

- Can explain the restrictions on copredication
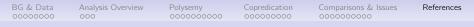   - Well, a start at least. More work to be done.

Thanks

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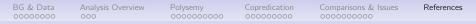
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