*The Ontology and Semantics of Parts and Wholes*

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Handout 1

**Ontological and Semantic Issues Regarding Part-Whole Structure**

**1. Part-whole structure in ontology**

General intuition:

Entities generally have parts and may come with a structure organizing the parts.

What does the part relation consist in? How should we decide?

What do we talk about when we talk about parts?

Part of: spatial inclusion?

Examples with *part of* from Varzi (*Mereology* SEP):

(1) a. The handle is part of the mug.

 b. The remote control is part of the stereo system.

 c. The left half is your part of the cake.

 d. The cutlery is part of the tableware.

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|  e. The contents of this bag is only part of what I bought. |
|  f. The outermost points are part of the perimeter. |
|  g. The first act was the best part of the play. |

(1a): functional part (replaceable)

(1b) spatially discontinuous part

(1c): material part, or indeterminate part; compare

(1) c’. Half of the cake is yours.

 c’’. ?? Half of the cake is part of the cake. (any half)

(1d) part of a collection, spatially independent

(1e) part of applies unspecified type of material (or unspecific) entity

(1f) parts of abstract object

(1g) part of an event.

Standard, but not unproblematic, conditions on parthood

(2) a. Everything is part of itself. (reflexivity)

 b. P*xx*

(3) a. Any part of any part of a thing is itself part of that thing. (transitivity).

 b. (P*xy* ∧ P*yz*) → P*xz*

(4) a. Two distinct things cannot be part of each other. (antisymmetry)

 b. (P*xy* ∧ P*yx*) → *x*=y.

Some definitions

(5) Proper Parthood : PP*xy* =df P*xy* ∧ ¬*x*=*y*

(6) Proper Extension: PE*xy* =df P*yx* ∧ ¬*x*=y.

(7) Overlap : O*xy* =df ∃*z*(P*zx* ∧ P*zy*)

(8) Disjointness : D*xy* =df ¬O*xy*

Some issues with the standard conditions:

Reflexivity:

Counterintuitive? Not for the expression part of:

(9) a. John owns part of the house, maybe even all of it.

 b. John read part of the book, and in fact all of the book.

(10) All of the students were praised. 🡪 The students as a whole as well?

Transitivity:

Well-known problem cases

The integrity of the intermediary entity may block transitivity

Examples from Moltmann (1997):

(11) John is part of the class
 John’s leg is part of John.

 John’s leg is part of the class.

(12) The page is part of the book

 The book is part of the library.

 The page is part of the library.

But it depends on the nature of the whole:

(13) The page is part of the book.

 The book is part of Kant’s written work.

 The page is part of Kant’s written work.

*Written work* as mass nominal seems to allow for transitivity, to some extent, again

But not for inferences with ‘the empty pages of the book’, ‘the margins of the page’, etc.

Other cases:

Furniture: not all parts of a piece of furniture are furniture again.

Luggage: a handle of a suitcase is not luggage.

Another example with individuals and functional parts

(14) The arm is part of the body.

 The hand is part of the arm.

 The hand is part of the body.

Ways of dismissing problems for transitivity

1) dismiss functional parts as the only parts

Issue: what is the intuitive basis for the part relation, if not the applicability of *part of*?

2) distinguish different part relations, for different ontological levels:

Part relation for individuals, part relation for pluralities, part relation for stuff

Issue: transitivity problems arise within the level of individuals as well.

A different perspective

Parts depend on the nature of the whole.

What the parts of an entity are depends on the nature of the whole, its structure, functional organization etc.

The mass-count distinction for parts:

*Part of* vs. *a part of* (e.g., Moltmann 1998)

(15) a. John and Mary are part of the class.

 b. ?? John and Mary are a part of the class.

(16) a. Sugar is part of lemonade

 b. ??? Sugar is a part of the lemonade.

(17) a. Joe ate part of the apple.

 b. ?? Joe ate a part of the apple.

Extensionality

Additional principle:

(18) Strong supplementation

 ¬P*yx* → ∃*z*(P*zy* ∧ ¬O*zx*)

From (2-4) and (18) we can derive Extensionality

(19) Extensionality: Composite objects with the same proper parts are identical:

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| --- | --- |
|  | (∃*z*PP*zx* ∨ ∃*z*PP*zy*) → (*x*=*y* ↔ ∀*z*(PP*zx* ↔ PP*zy*)). |
| (20) | *x*=*y* → ∀*z*(PP*zx* ↔ PP*zy*) |

Unproblematic: is an instance of the indiscernability if identicals

|  |  |
| --- | --- |
| (21) | *x*=*y* → (φ*x* ↔ φ*y*), |

More problematic :

∀z(PPzx ↔ PPzy) → x=y

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|  |

Problem cases for extensionality

Diachronic example:

chair rebuilt as a table

Synchronic examples:

Two committees with the same members, but different functions, musical quartet and a sports team, collection of dots, heart drawn with dots, piece of furniture and work of art,

Constitution

A sculpture and the wood that constitutes it: have different temporal and modal profiles and differ in other properties.

Diagnosis of the issues

Extensionality should not hold if the whole is also individuated by structure and (practical, aesthetic) function.

Atomicity

(22) a. Atom: A*x* =df ¬∃*y*PP*yx*

 b. Atomicity:∃*y*(A*y* ∧ P*yx*)

 c. No being an atom: ∃*y*PP*yx*

Atom in natural language semantics:

Individuals with respect to the plural-specific part-relation (next session)

What is the basis for deciding about the ontology of part-whole structure

1) Considerations about what part-whole structure really is: our intuitions about them

But what about conflicting intuitions

And what sorts of evidence do we really have concerning our intuitions about reality?

Intuitions need to be uncovered, are not generally straightforward.

One way of uncovering them is through linguistic data: acceptability judgments.

2) The role of linguistic data: uncovering our intuitions about part-whole structure.

What do such linguistic intuitions consist in? E.g., uses of *part of*

But there are more linguistic data:

- Explicit part-whole related expressions

- More indirect apparent linguistic involvement of part-whole structure: semantics of plurals and mass nouns

A different approach to linguistic data (common among formal semanticists)

Compositional semantics requires a particular notion of part, which need not coincide with the notion of conveyed by explicit linguistic expressions such as *part of*. Semantics of plurals and mass nouns requires extensional mereology.

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**2. Part-whole structure in linguistics**

**2.1. Explicit expressions of part-whole-related expressions**

*Part of, a part of*

Other partitive constructions

*All of, most of, none of, much/many of*

Do all partitive quantifiers pick out the same sorts of parts as *part of*?

Completion-related expressions:

*Partial(ly), complete(ly)*

(23) a. partial copy of the paper

 b. a complete copy of the paper.

(24) a. partial realization of the plan

 b. complete realization of the plan

(25) a. partial reconstruction of the church

 b. complete reconstruction of the church.

(26) partial truth, complete truth

Adverbial use

(27) a. John partly forgot the poem.

 b. John completely forgot the poem.

Issue

Reference to reference object (original)

Reference to abstract object (event)

Completion of a whole and absence of a part

*Complete* vs. *is missing* NP

(28) a. The collection is complete.

 b. The collection is missing a piece.

(29) a. The quotation is complete.

 b. The quotation is missing a few words.

(30) a. The house is complete.

 b. The house is only missing the windows.

Other expressions of completeness

*Whole*:

(31) a. The whole collection is expensive. (every part of the collection as a whole)

 b. The whole thing is incomprehensible. (every part and overall)

 c. the whole plan was misguided (every part and overall)

 d. the whole time (every part)

German has two words for ‘complete’: *voellig* and *vollstaendig*

(32) a. die vollstaendige Uebersetzung

 ‘the complete translation‘

 b. ??? die voellige Ubersetzung

(33) a. die voellige Dunkelheit

 ‘the complete darkness‘

 b. ??? die vollstaendige Dunkelheit

*Vollstaendig* involves a reference object with discrete parts, but not so *voellig*, wich relates to a homogenous part structure.

Conclusion

Natural language displays a range of expressions involving not just a part of-relation, but also reference to concrete or abstract wholes and the structure of a whole.

**2.2. Plurals and mass nouns**

Parallels between singular count, plural, and mass NPs.

Predicates

Singular count, plural, and mass NPs can be arguments of the same predicates.

Determiners

(34) a. the / some woman (singular count)

 b. the / some women (plural)

 c. the / some personnel (mass)

Conjunction

(35) a. The man and the women met.

 b. The men and the women met

 c. The sugar and the cinnamon were mixed.

Partitive construction

(36) a. part / some / all / most of the apple

 b. part / some / all / most of the apples

 c. part / some / all / most of the sugar.

Connections to event semantics

Parallel effect of singular count, plural and mass NPs on the applicability/understanding of *in*-adverbials and *for*-adverbials:

(37) a. John ate the apple in two minutes.

 b. John ate the peas in two minutes.

 c. John ate the soup in two minutes

(38) a. ??? John ate the apple for an hour

 b. ??? John ate the apples for an hour.

 c. ??? John ate the sugar for an hour.

Standard view about the semantics of plural and mass nouns

Extensional mereology

Three domains with their own part relations

1) The domain of individuals with a part relation among individuals

2) The domain of pluralities, the set of sums of individuals, with a part relation that is closed under sum formation

Individuals as atoms with respect to the plural-specific part relation

3) The domain of quantities with its part relation that is closed under sum formation, no atoms

Definite plurals refer to sums of individuals

(39) [*the children*] = sum([*child*])

Definite mass NPs refer to sums of quantities

(40) [*the water in the glass*] = sum ([*water in the glass*])

Two diverging semantic requirements

1) Analogy between singular count, plural, mass semantics

2) Counterintuitive consequences of a singularist semantics of plural and mass NPs:

Pluralities treated as single entities.

Quantities treated as single entities.

But:

(41) a. John and Mary are two.

 b. The children are ten.

(42) a. ??? The men and the women are two.

 b. ??? The water and the wine are two.

Generalization

Pluralities and quantities never count as single entities, but the formal semantics treats them as such.

Remedy in the case of plurals

Plural reference: definite plural NPs refer to several individuals at once, rather than referring to a single collective thing (Oliver and Smiley, Yi, McKay, …)

Remedy in the case of mass NPs:

Sui generis mass reference? (McKay, …)

Issue

How is plural reference (sui generis mass reference) compatible with the semantic analogy of singular count, plural and mass NPs?

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Moltmann, F. (1997): Parts and Wholes in Semantics, Oxford UP, New York. [**Online version**](http://www.friederike-moltmann.com/uploads/Parts%20and%20Wholes%20in%20Semantics-s.pdf)

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**Next time**

Extensional mereology for natural language

**Reading**

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