Lexical Semantics

Advanced/Aufbau/Masterseminar

Heinrich Heine University at Düsseldorf
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TOPIC 1 (continued):
Aspectual Classes: Basic meaning components
Empirical background
&
Classical Extensional Mereology (CEM)

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Goals

1. Classical Extensional Mereology
2. Aspectual classes and their mereological properties
3. Mereological approach to grammatical aspect: imperfective and perfective

CLASSICAL EXTENSIONAL MEREOLOGY

- Mereology
- Core axioms and concepts
  - parthood
  - sum
- Higher order properties:
  - cumulativity
  - divisivity (aka divisiveness)
  - atomicity

CLASSICAL EXTENSIONAL MEREOLOGY

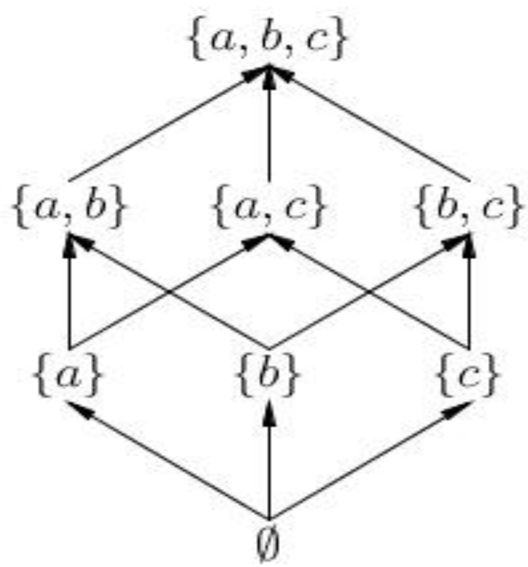
- Mereology
  - is the theory of parthood
  - derived from the Greek *μέρος* (meros), meaning "part" (also "portion", "segment")
  - origins: the Pre-Socratics (6th and 5th century BC, see Varzi 2011), Leśniewski (1916), Leonard & Goodman (1940) and Goodman (1951)
  - formalized by means of mathematical structures: namely, Boolean algebras.

- In the Boolean algebra
  - the values of variables are the truth values (true, false),
  - the main operations are
    - conjunction (or meet) $\wedge$,
    - disjunction $\vee$, and
    - negation **¬.**

    (In elementary algebra, the values of variables are numbers and the main operations are addition and multiplication.)
  - A common way of defining a Boolean algebra is as a lattice structure, a type of algebraic structure [see next slide].

CLASSICAL EXTENSIONAL MEREOLOGY

Boolean lattice of subsets



Is a subset of $\subseteq$

CLASSICAL EXTENSIONAL MEREOLOGY

- Mereology
- **Core axioms and concepts**
  - **parthood**
  - **sum**
- Higher order properties:
  - cumulativity
  - divisivity (aka divisiveness)
  - atomicity

CLASSICAL EXTENSIONAL MEREOLOGY

- Classical Extensional Mereology (CEM) consists of
  - **THREE AXIOMS** and requires only
  - a **SINGLE PRIMITIVE NOTION** in terms of which the rest of the mereological system can be defined.

- The three basic axioms are given in Lewis (1991) informally as follows:
  - AXIOM 1 (**Unrestricted Composition**): Whenever there are some objects, then there exists a mereological sum of those objects.
  - AXIOM 2 (**Uniqueness of Composition**): It never happens that the same objects have two different mereological sums.
  - AXIOM 3 (**Transitivity**): If x is part of some part of y, then x is part of y.

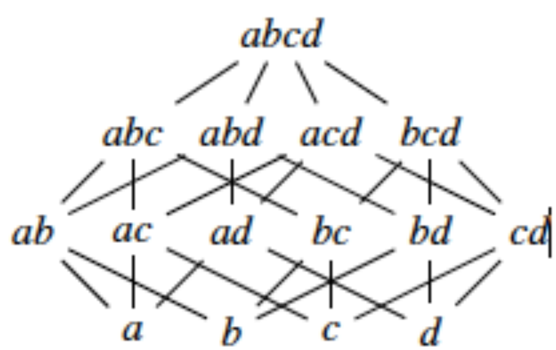
- The single primitive can be chosen to be
  - **proper parthood** $<$,
  - **proper-or-improper parthood** $\leq$,
  - **sum** $\oplus$,
  - **overlap** $\otimes$,
  - **disjointness**.

Other notions are definable in terms of whichever one is taken as primitive.

CLASSICAL EXTENSIONAL MEREOLOGY

- AXIOM 1 (**Unrestricted Composition**): Whenever there are some objects, then there exists a mereological sum of those objects.
- Example: Suppose the entire universe consists of
  - Ann (*a*),
  - Bill (*b*),
  - one car (*c*) and
  - one dog (*d*).

then we need to represent not only these four entities (at the bottom of the lattice) but all of their combinations, among which is Ann together with Bill which corresponds to the meaning of the conjunction *Ann and Bill*:



CLASSICAL EXTENSIONAL MEREOLOGY

- Algebraically speaking,
  - parthood is a mere partial ordering, and
  - CEM has the strength of a complete Boolean algebra, with the zero element or "null individual" deleted.
  - Recall that in the set theory, the null set (empty set) is a member of every set.

    The null/empty set: Ø, {}.

    $\emptyset \subseteq \emptyset$ TRUE

    $\emptyset \subseteq \{\emptyset\}$ TRUE

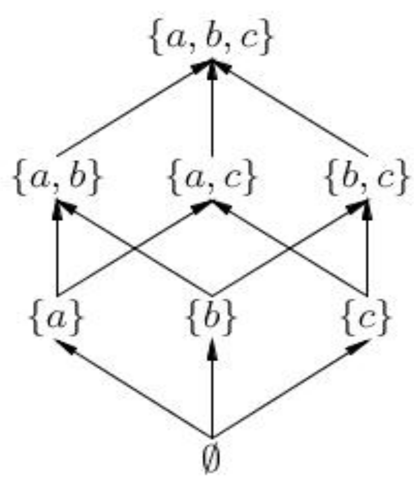
CLASSICAL EXTENSIONAL MEREOLOGY

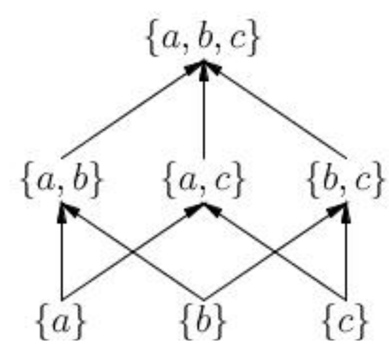
No "null individual"

- The standard versions of CEM used in philosophy and semantic theory restrict the admissible algebraic structures to those that have no “null individual”, i.e., an individual which belongs to all other individuals in the way that the empty set is a member of all other sets in set theory.

- The existence of such a null individual is taken to be counterintuitive.

- Consequently, the structures that are assumed are a special type of lattice, a **SEMILATTICE,** an UPPER SEMILATTICE. The "semi-" indicates that the structure is closed under only one operation, here **sum** operation.





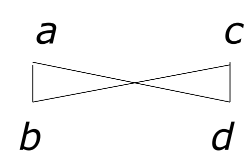
SEMILATTICE: Boolean algebra structure with the bottom null element removed

CLASSICAL EXTENSIONAL MEREOLOGY

- AXIOM 2 (**Uniqueness of Composition**): It never happens that the same objects have two different mereological sums.
- Example: It excludes (1) and (2), because not every two elements have a unique sum.

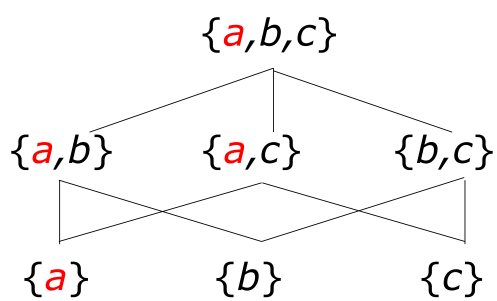
(1)

(2)



- AXIOM 3 (**Transitivity**): If *x* is part of some part of *y*, then *x* is part of *y*.
  Example: {*a*} is a part of {*a*,*b*,*c*}, because it is a part of one its parts

(3)



CLASSICAL EXTENSIONAL MEREOLOGY

- The single primitive can be chosen to be
  - **proper parthood** $<$,
  - **proper-or-improper parthood** $\leq$,
  - **sum** $\oplus$,
  - **overlap** $\otimes$,
  - **disjointness**.

  The other notions are definable in terms of whichever one is taken as primitive.

- Most commonly
  - the **part** $\leq$ **relation** is taken as the primitive notion and the sum operation us defined from it (Tarski 1929, 1956), or
  - the **sum** $\oplus$ **operation** is taken as the primitive notion and the part relation is defined from it (e.g., Krifka 1986 and elsewhere).

CLASSICAL EXTENSIONAL MEREOLOGY

The sum operation as the primitive notion

Krifka (1998, p.199): Definition of a part structure *P*

- $P = \langle U_P, \oplus_P, \leq_P, <_P, \otimes_P \rangle$ is a part structure, iff

  a. 'U_P' is a set of entities: individuals, eventualities and times

  $I_P \cup E_P \cup T_P \subset U_P$

  b. '$\oplus_P$' is a binary **sum operation**, it is a function from $U_P \times U_P$ to U_P. (It is idempotent, commutative, associative:

  $\forall x,y,z \in U_P [x \oplus_P x = x \wedge x \oplus_P y = y \oplus_P x \wedge x \oplus_P (y \oplus_P z) = (x \oplus_P y) \oplus_P z]$

  c. '$\leq_P$' is the **part relation**: $\forall x,y \in U_P [x \leq_P y \leftrightarrow x \oplus_P y = y]$

  d. '$<_P$' is the **proper part relation**: $\forall x,y \in U_P [x <_P y \leftrightarrow x \leq_P y \wedge x \neq y]$

  e. '$\otimes_P$' is the **overlap relation**: $\forall x,y,z \in U_P [x \otimes_P y \leftrightarrow \exists z \in U_P [z \leq_P x \wedge z \leq_P y]]$

  f. **remainder principle**: $\forall x,y,z \in U_P [x <_P y \rightarrow \exists! z [\neg [z \otimes_P x] \wedge z \oplus_P x = y]]$

CLASSICAL EXTENSIONAL MEREOLOGY

- An axiom known as the **REMAINDER PRINCIPLE** or SUPPLEMENTATION is used in order to ensure that the following structures be excluded: namely, for instance, a structure where one object *a* has a solitary proper part *b*:

$$\begin{array}{c} a \\ | \\ b \end{array}$$

- **REMAINDER PRINCIPLE**: $\forall x,y,z \in U_P\ [x <_P y \ \rightarrow \exists z[\neg[z \otimes_P x] \wedge z \leq_P y]$
Whenever something has a proper part, it has more than one—i.e., there is always some *mereological difference* (a remainder) between a whole and its proper parts (Stanford Encyclopedia of Philosophy).

- Alternative definition: $\forall x,y,z \in U_P\ [x <_P y \rightarrow \exists! z[\neg\ [z \otimes_P x] \wedge z \oplus_P x = y\ ]]$
  - Whenever *x* is a proper part of *y*, there is exactly one "remainder" *z* that does not overlap with *x* such that the sum of *z* and *x* is *y* (Krifka 1998).

"∃!" the symbol for uniqueness quantification

"there is **one and only one**"

CLASSICAL EXTENSIONAL MEREOLOGY

The part relation as the primitive notion.

Tarski (1929, 1956)

- The **"part-of"** relation is reflexive, transitive and antisymmetric:

Axiom of reflexivity: $\forall x[x \leq x]$
Everything is (part of) itself.

Axiom of transitivity: $\forall x \forall y \forall z[x \leq y \wedge y \leq z \rightarrow x \leq z]$
Any part of any part of a thing is itself part of that thing.

Axiom of antisymmetry: $\forall x \forall y[x \leq y \wedge y \leq x \rightarrow x = y]$
Two distinct things cannot both be part of each other.

Note on the axiom of reflexivity: identity is a limit (improper) case of parthood.

Notes on Axiom of reflexivity: $\forall x[x \leq x]$ "Everything is (part of) itself."

- Reflexivity tells us that everything is part of itself, so if *x* and *y* share all of the same parts (material coincidence), then each must be a part of the other.
- Material coincidence (the sharing of parts) explains spatial coincidence (the sharing of place).
- Hence, it is possible for two material objects to exist in the same place at the same time.

Next - Example: *The Puzzle of the Statue and the Clay*
("Material Constitution" SEP)

The Puzzle of the Statue and the Clay.

- Main point: It is possible for two material objects to exist in the same place at the same time.

1. Suppose that, on Monday, a sculptor purchases an unformed lump of clay, which he names 'Lump'.

2. Suppose further that, on Tuesday, the artist sculpts the clay into the form of the biblical king David and names his statue 'David'. It is tempting to say that, in this case, there is only one object in the sculptor's hands—David *just is* Lump. But, on reflection, this identification is problematic, since Lump and David seem to differ in various respects:

   – First, Lump and David **differ** in their *temporal properties*: Lump existed on Monday, while David did not.
   – Second, they **differ** in their *persistence conditions* (i.e., the conditions under which they would and would not continue to exist): Lump could survive being squashed, David could not.
   – Third, they **differ** in *kind*: Lump is a mere lump of clay, while David is a statue. More generally, we can say that Lump and David differ in their *non-categorical properties*, where these include all of the various ways that a thing *was*, *will*, *would*, *could*, or *must* be.

3. But if Lump and David differ in even *one* respect, they are not the same thing, for *Leibniz's Law* tells that, for any *x* and *y*, if *x* = *y*, then *x* and *y* have all the same properties. Thus, it seems as if the sculptor holds not one, but two, material objects in his hands: a statue *and* a lump of clay.

Therefore, it is possible for two material objects to exist in the same place at the same time.

Notes on Axiom of reflexivity: $\forall x[x \leq x]$ "Everything is (part of) itself."

- Lump and David exist at the same place at the same time, but differ in their non-categorical properties, so it is possible that there are two material objects in the same place at the same time.

- This view is sometimes referred to as *the constitution view* since it holds that the statue is constituted by, but not identical to, the lump of clay from which it is formed.

Constitution is not identity (Johnston 1992, Baker 1997).

- Constitution is distinguished from identity insofar as it is an *asymmetric* relation: Lump constitutes David, but not *vice versa*.

- Taking reflexivity (and antisymmetry) as constitutive of the meaning of ‘part’ amounts to regarding identity as a limit (improper) case of parthood:

  – x is an improper part of y if and only if $x = y$
  – x is a proper part of y if and only if x is a part of y and $x \neq y$

- Identity is a limit (improper) case of parthood.

CLASSICAL EXTENSIONAL MEREOLOGY

Based on the "part-of" relation ≤, we define the relations of proper-part and overlap:

- **proper-part-of relation <**
  restricts parthood to nonequal pairs:

  $x < y =\text{def}\ x \leq y \wedge x \neq y$
  A proper part of a thing is a part of it that is distinct from it.

  or

  $x < y =\text{def}\ x \leq y \wedge \neg(y \leq x)$
  x is a proper part of a thing if it is a part of a thing which itself is not part of x.

- **overlap relation ⊗**
  $x \otimes y =\text{def}\ \exists z[z \leq x \wedge z \leq y]$
  Two things overlap if and only if they have a part in common.

CLASSICAL EXTENSIONAL MEREOLOGY

The sum operation $\oplus$

- any pair of suitably related entities must have a ***minimal underlapper***—something composed exactly of their parts and nothing else. This requirement is sometimes stated by saying that any suitable pair must have a mereological "sum", or "fusion", though it is not immediately obvious how this requirement should be formulated in the formal language (SEP, "Mereology").

- In terms of parthood and overlap, the notion of a mereological sum (aggregate/ fusion) for example can be defined as follows (Koslicki 2006, p.130):

  s is a mereological sum of some objects *x1 … xn*, just in case *s* has all of *x1 … xn* as parts and has no part that does not overlap any of *x1 … xn.*

- Note that this is stronger than requiring that any pair of suitably related entities must underlap, i.e., have an upper bound:

  $\forall xy \rightarrow \exists z(Pxz \wedge Pyz)$

CLASSICAL EXTENSIONAL MEREOLOGY

The sum operation $\oplus$

- The classical definition is due to Tarski (1929, 1956). (For other definitions, see Sharvy 1979, 1980, for instance.)

$$\text{sum}(x,P) =_{def}\ \forall y[P(y) \rightarrow y \leq x] \wedge \forall z[z \leq x \rightarrow \exists z'[P(z') \wedge z \otimes z']]$$

  - A sum of a set *P* is a thing that contains everything in *P* and whose parts each overlap with something in *P*.
  - "sum(x,P)" means "x is a sum of (the things in) P".

Tarski (1956) (see Betti and Loeb 2012 "On Tarski's Foundations of the Geometry of Solids", *The Bulletin of Symbolic Logic*):

- Definition I. An individual *X* is called a proper part of an individual *Y* if *X* is a part of *Y* and *X* is not identical with *Y*.
- Definition II. An individual *X* is said to be disjoint from an individual *Y* if no individual *Z* is part of both *X* and *Y* .
- Definition III. An individual *X* is called a sum of all elements of a class *a* of individuals if every element of *a* is a part of *X* and if no part of *X* is disjoint from all elements of *a*. ([Tarski, 1956a], p. 25)
- Postulate I. If *X* is apartof *Y* and*Y* is a part of *Z*,then *X* is a part of *Z*.
- Postulate II. For every non-empty class *a* of individuals there exists exactly one individual *X* which is the sum of all elements of *a*.([Tarski, 1956a], p. 25)

CLASSICAL EXTENSIONAL MEREOLOGY

- Mereology
- Core axioms and concepts
  - parthood
  - sum
- **Higher order properties:**
  - **cumulativity**
  - **divisivity (aka divisiveness)**
  - **atomicity**

CLASSICAL EXTENSIONAL MEREOLOGY

Cumulativity

- CUMULATIVE(P) $\leftrightarrow$ $\forall x,y[P(x) \wedge P(y) \rightarrow P(x \oplus y)]$
  A predicate *P* is *cumulative* if and only if, whenever *P* applies to any *x* and *y*, it also applies to the sum of *x* and *y* (assuming that *x* and *y* to which *P* applies are two distinct entities).

- Mass nouns have the property of CUMULATIVE REFERENCE, as Quine (1960, p. 91) proposes: "any sum of parts which are water is water." (Quine attributes this property to Goodman (1951).)

CLASSICAL EXTENSIONAL MEREOLOGY

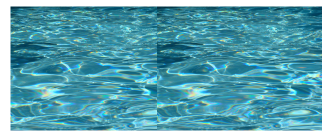
Cumulativity

- Holds for true mass nouns (*water*), aggregate mass nouns *furniture*) (Quine (1960) and bare plurals (*apples*) (Link 1983):

(1) A is water and B is water. ⇒ A and B together are water.

A B A⊕B





(2) A are apples and B are apples. ⇒ A and B together are apples.

A B ⇒ A⊕B



- Does not hold for singular count nouns (*boy, apple*):

(3) A is an apple and B is an apple. ⇏ A and B together are an apple.

A B ⇏ A⊕B



CLASSICAL EXTENSIONAL MEREOLOGY

Divisivity (aka divisiveness)

- STRICTLY DIVISIVE(P) $\leftrightarrow \forall x[P(x) \rightarrow \forall y[y < x \rightarrow P(y)]]$

  A predicate *P* is *strictly divisive* if and only if, whenever *P* applies to *x*, then for all *y* such that it is a proper part of x, P applies to y.

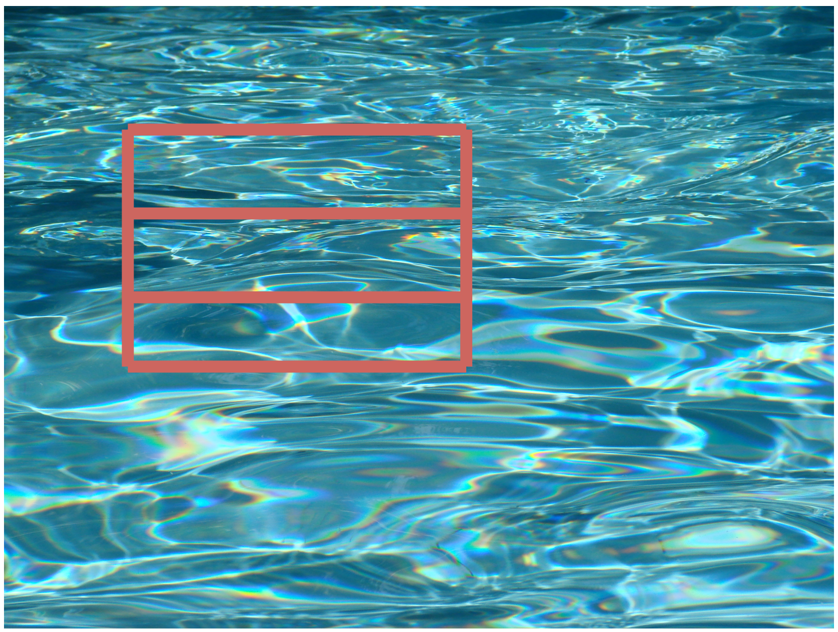
  Mass nouns are DIVISIVE in their reference (see Frege 1884, p.66 (cited in Pelletier 1975, p.453), also Aristotle *Metaphysics* 1016b17-24; 1052a32), namely, they permit something that they are true of to be ARBITRARILY divided and to be true of these parts as well.

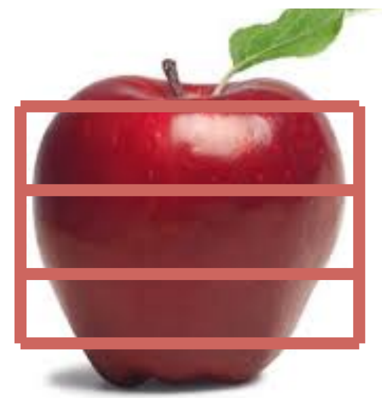
- Sometimes assumed for true mass nouns (*water*): non-atomic ontology (Link 1983).

- Does not hold for aggregate mass nouns (*furniture*), plurals (*apples*) and singular count nouns (*apple, boy*).

CLASSICAL EXTENSIONAL MEREOLOGY

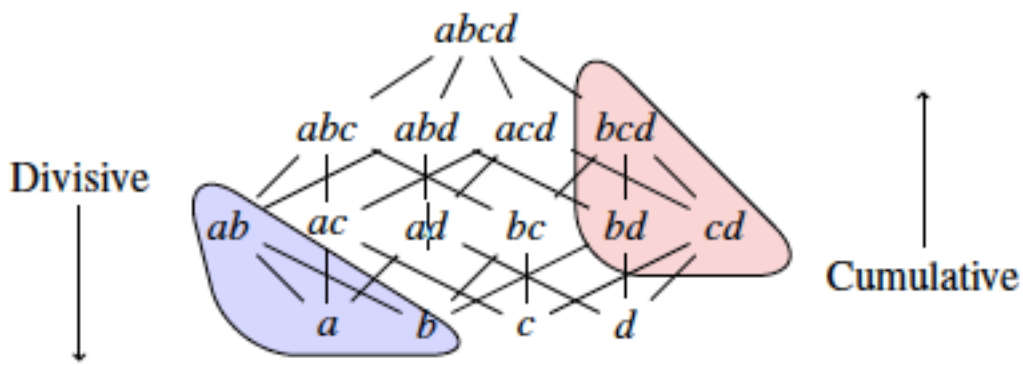
Divisivity (aka divisiveness)





CLASSICAL EXTENSIONAL MEREOLOGY

Cumulativity and Divisivity as Closure Properties



(The representation taken from Grimm 2012, p. 113, Figure 4.4)

- In terms of the part structure, cumulativity is closure under sum formation, while divisivity is closure under part-taking.

- If a predicate is cumulative, it permits "going upwards" in the semilattice, and if it is divisive, it permits "going downwards" in the semilattice.

[A set has **closure** under an operation if performance of that operation on members of the set always produces a member of the same set.]

CLASSICAL EXTENSIONAL MEREOLOGY

Atomicity

- The property of atomicity characterizes discrete individuals.
  An atom is an individual which has no proper parts:

  $$\mathrm{Atom}(x) \leftrightarrow \neg\exists y(y < x)$$

  An atom is an individual which has no proper parts.

- Atomicity is a restriction on the part relation. It differs from cumulativity and divisivity in so far as it is not a closure condition.

- Some approaches have models that are atomistic (Link 1983, Chierchia 1998).
  I.e., they have an additional axiom requiring for everything in the domain to be composed of atoms:

  $$\forall x\exists y[y \leq x \wedge \neg\exists(z < y)]$$ Atomicity

  For any element, there is a part for which there does not exist a proper part.

CLASSICAL EXTENSIONAL MEREOLOGY

Atomicity

- Atoms are also defined relative to a property:

  Atomic(x,P) = $P(x) \wedge \neg\exists y[y < x \wedge P(y)]$ (Atomic relative to a property)
  P applies to *x*, but not to a proper part of *x*.

- Given this definition, we can define what it means for a predicate to be atomic (taken from Krifka 1989):

  Atomic(P) = $\forall x[P(x) \rightarrow \exists y[y \leq x \wedge \mathrm{Atomic}(y, P)]]$ (Atomic predicate)
  P is atomic iff every *x* that is *P* contains a *P*-atom.
  "Atomic(P)" means "atomic relative to a predicate P".

- Singular count nouns (*cat*), bare plurals (*cats*), aggregate mass nouns (*furniture*) express atomic predicates.

- Sometimes also assumed for true mass nouns (*water*), e.g. Chierchia (1998).

Goals

1. Classical Extensional Mereology
2. **Aspectual classes and their mereological properties**
3. Mereological approach to grammatical aspect: imperfective and perfective

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

eventualities (Bach 1986)	DISTINGUISHING PROPERTY:
states — non-states	strongly homogeneous
processes — events	weakly homogeneous
protracted — momentaneous	*COS* has no proper parts[1]
culminations — happenings	*e* has no proper parts

[1] Semantic property (A): momentaneous change of state (COS) at the culmination or onset of events

STATES: *(be) intelligent, resemble x, own x, love x*
PROCESSES: *walk, push a cart, be mean* (Agentive)
EVENTS protracted: *build x, walk to Boston*
culminations: *die, reach the top*
happenings: *flash once, recognize, notice*

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Atomicity (relative to a property)

- clearly **does not apply** to
  - **PROCESS predicates:**

    If an eventuality *e* falls under the description of *John swam in the ocean yesterday,* then there are proper parts of that eventuality that are describable with *John swam in the ocean yesterday.*

  - **STATE predicates:**

    If an eventuality *e* falls under the description of *John was intelligent / drunk,* then there are proper parts of that eventuality that are describable with *John was intelligent / drunk.*

- clearly **applies** to all **MOMENTANEOUS** predicates:
  - HAPPENING (semelfactive) predicates: *flash once, recognize, notice*
  - CULMINATION predicates: *die, arrive, reach the top*

    If an eventuality *e* falls under the description of *John arrived in London,* then **no proper part** of that eventuality is describable with *John arrived in London*.

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Atomicity PUZZLE (relative to a property)

- Atomicity applies to at least some PROTRACTED EVENT predicates (aka accomplishments), but some fail to be atomic (like (1b)):

(1) a. ?? John wrote a letter for ten minutes.
b. ?? John wrote a sequence of numbers for ten minutes.

- both odd with *FOR x* time, which suggests that they denote protracted events (accomplishments)
- only (1a) is atomic
- (1b): if an eventuality *e* falls under the description of *John wrote a sequence of numbers,* then there are at least some proper parts of that eventuality that are also describable with that same sentence.

See Zucchi and White (1996, 2001), Krifka 1998 (and references therein)

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Atomicity PUZZLE (relative to a property)

- Source of the puzzle

  Example: Take *a sequence of numbers.*

  – Suppose we have a sequence of numbers *1 2 3 4*

  – ⟦*a sequence of numbers*⟧ = {<1, 2, 3>, <2, 3, 4>, <2, 3>, …}

  Since there are members of the extension of *a sequence of numbers* having proper parts which are also members of the extension of *a sequence of numbers*, the predicate *is a sequence (of numbers)* cannot be atomic.

- Many other similar examples are easy to find:
  - singular count (non-)sortal nouns like *a fence, a ribbon*
  - nonstandard vague measures of amount like *a long/short distance*, *a large/small quantity*, *a large/small piece* (cf. Cartwright 1975, Lønning 1987)
  - vague determiner quantifiers like *many, a lot, (a) few*, *some* and *most*
  - cardinal determiner quantifiers combined with *at least /at most*
  - the definite article *the* or possessive pronouns combined with mass and bare plural CN's.

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Cumulativity (see Krifka 2013):

- does not apply to **EVENT** predicates:
  If *e1*, *e2* fall under the description of *arrive, win, hit, flash (once),* then their mereological sum *e1*⊕*e2* does not fall under *arrive, win, hit, flash twice.*

- seems to apply to
  - **PROCESS** predicates
    If two eventualities *e1*, *e2* fall under the description of *run*, *rain*, then the mereological sum of *e1* and *e2*, *e1*⊕*e2*, does not necessarily fall under the description of *run*, *rain twice.*
  - **STATE** predicates:
    If two eventualities *e1*, *e2* fall under the description of *(be) intelligent, (be) drunk*, then the mereological sum of *e1* and *e2*, *e1*⊕*e2*, does not necessarily fall under the description of *(be) intelligent, (be) drunk twice.*

We may dub this 'weak cumulativity'.

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Strict divisivity (aka divisiveness)

- does not apply to **EVENT** predicates.
- does not apply to **PROCESS** predicates, since they are divisive only down to certain sufficiently large proper parts.
- applies to all **state** predicates:
  - stage-level predicates (Carlson 1977): *(be) intelligent, resemble, own, love*
  - individual-level predicates (Carlson 1977): (*be) in London, (be) drunk*

    If an eventuality *e* is a state of *John was in London* with the running time τ(s), then at any time (subinterval or moment) of τ(s) the state of *John's being in London* is true. The same holds true for *John was intelligent.*

- In this sense,
  - process predicates are WEAKLY HOMOGENEOUS,
  - state predicates are STRONGLY HOMOGENEOUS (because also strictly divisive).

- So homogeneity means something different for states and processes.

One way to capture this difference is in terms of Landman's (1992) distinction between the 'part-of' relation and the '**STAGE-OF**' relation

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

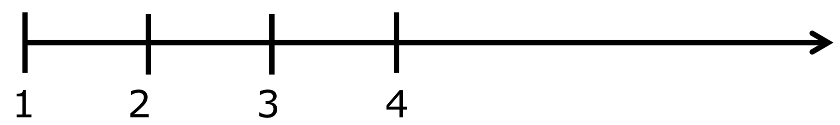
- Landman (1992): eventualities are ordered not only by the 'part-of' relation but also by the '**STAGE-OF**' relation

- Motivation:
  - the semantics of *PROG* (Landman 1992, 2008)
  - the differences and similarities between states versus processes in the way they interact with *FOR* x time ADVs (Landman and Rothstein 2012)

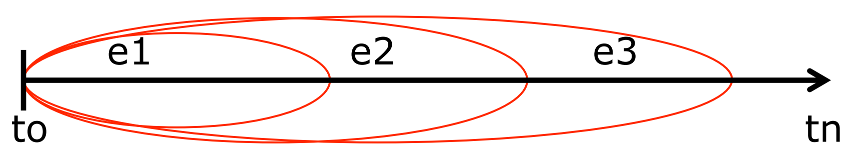
ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

STAGES

- **State predicates** denote eventualities that are homogeneous along the SEGMENTAL (POINT) AXIS, they are **segmentally homogeneous**:



- **Process predicates** denote eventualities that are homogeneous along the INCREMENTAL AXIS, they are **incrementally homogeneous**: i.e., the predicate characteristics are preserved for each event from its onset (i.e., the time it takes for a process like running or waltzing to 'establish itself' as running or waltzing) through all incremental development stages:



- Therefore, process predicates do not hold at points state predicates, but instead only at intervals of time.

ASPECTUAL CLASSES AND THEIR MEREOLOGICAL PROPERTIES

Landman (1992): **STAGE-OF** relation

For events: *e1* is a stage of *e2*: $e1 \preceq e2$.
If *e1* and *e2* are events and *e1* is a stage of *e2* then:

i. Part of: $e1 \leq e2$, *e1* is part of *e2* (and hence $\tau(e1) \subseteq \tau\ (e2)$).
ii. Cross-temporal identity: *e1* and *e2* share the same essence: they count intuitively as the same event or process at different times.
iii. Kineisis: *e1* and *e2* are qualitatively distinguishable, *e1* is a earlier version of *e2*, *e1* grows into *e2*.

Goals

1. Classical Extensional Mereology
2. Aspectual classes and their mereological properties
3. **Mereological approach to grammatical aspect: imperfective and perfective**

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

Landman's (1992, 2008) truth conditions for PROG

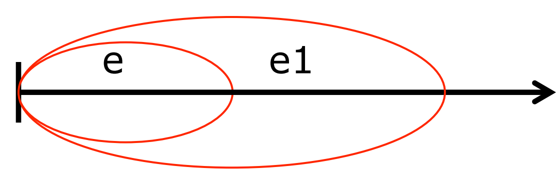
PROGRESSIVE = Landman 2008

$\lambda P \lambda e. \exists e1 \in P{:}\ e \preceq_e e1 \wedge$ **CONTINUATION**(e,e1)

e and *e1* are variables over eventualities

P is a variable over sets of eventualities.

- *PROG* is a function from a set of eventualities *P* onto the set of all eventualities that are stages of some eventuality in *P*. A progressive sentence is true if a stage of an eventuality in *P* develops into an eventuality in *P* with a further modal constraint added.
- **CONTINUATION**(e,e1) means that if stage *e* of *e1* is realized in a world, then the minimal i-stage of *e1*, e_m, that *e* is part of is realized in that world, and *e1* itself is realized in world where a reasonable amount of interruptions of the continuation process of e_m are discarded.



- Cp. with the extensional truth conditions of Krifka (1992) and Filip (1993/99):
  PROG is a function from sets of eventualities in the denotation of *P* to sets of eventualities that are their proper parts.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

PROG of protracted events (accomplishments)

- The imperfective paradox (Dowty 1979) or the partitive puzzle (Bach 1986)

(1) a. John was composing a symphony.
    b. John composed a symphony.

- What we assert in sentences like (1a) is that there is an ongoing event, which may develop into an event of the kind denoted by (1b).

- If John gets interrupted while composing a symphony, the event validating the assertion in (1a) is not a stage of an actual event that leads to the composition of a whole symphony, expressed by (1b); instead, it is merely a STAGE of a symphony-composing event in a world similar to ours.

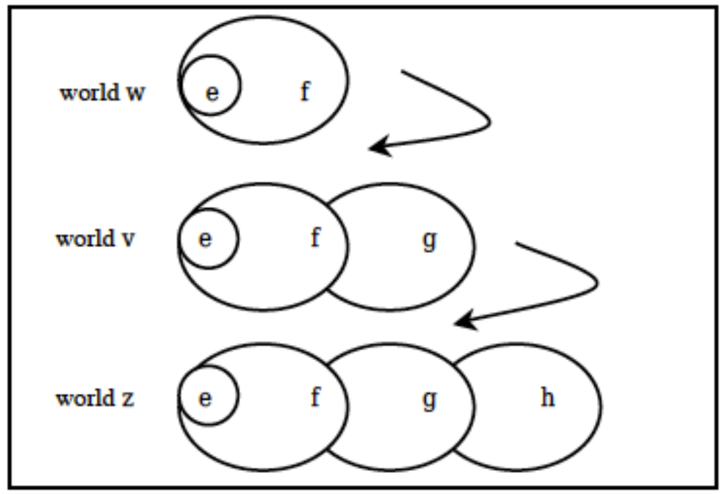
MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

Continuation Branch

- When evaluating a progressive sentence, one takes the event stage that warrants the assertion in the world of evaluation and follows this event stage through its development. If it **culminates** in the world of evaluation, then the sentence is true.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

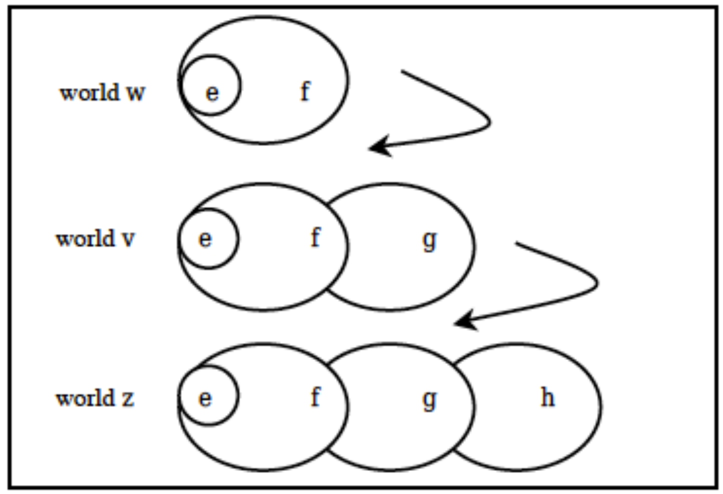
Continuation Branch



If the event is interrupted before it can culminate, i.e. **it ceases to develop in the world of evaluation**, we jump to the closest world—which is like the world of evaluation, except that the event was not interrupted in this world—and follow through its development there. If there is another interruption, we jump to the next closest world and carry on following through the development of the event … and so on.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

Continuation Branch



Eventually, either one finds that the original event stage **culminates**, in which case the sentence is true, or one decides that we are too far from the original world, in which case the sentence is false.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

Continuation Branch - too far

(2) Mary was wiping out the Roman army. Landman 1992, p.29, ex. (20)

- False when uttered in the following context:

  'Mary is violently opposed to Roman occupation of her part of Gaul, and one day decides that it is her duty to do as much damage to the army as she can; she enters the town barracks one day at noon and attacks whomever she sees. There is really no chance that she can wipe out the well-trained local garrison, much less the whole army' (Portner 1998: 9).

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

PROG of processes (activities)

(3) a. Yesterday morning it was raining.
    b. Yesterday morning it rained.

- With activity VPs, PROG's contribution is trivial since process VPs are **(weakly) homogeneous**.
- Therefore, every sufficiently large stage of raining develops into an event of the kind described by (3b).
- (3a) entails (3b), no imperfective paradox.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

PROBLEM for Landman's (1992, 2008) analysis of the progressive:

- **The progressive cannot apply felicitously to stative predicates.**
  The output of the progressive operation on a set of eventualities is always a set of stages, never states. If the input is a set of states (i..e. the interpretation of a stative VP), the output is going to be empty or undefined, since states do not have stages.

MEREOLOGICAL APPROACH TO GRAMMATICAL ASPECT

PERFECTIVE is a maximality operator: Filip and Rothstein (2005), Filip (2008)

- MAX_E is a monadic operator, such that $MAX_E(\Sigma) \subset \Sigma$, which maps sets of partially ordered events Σ onto sets of maximal events $MAX_E(\Sigma)$.
  - The input of the perfective operator is a set of ordered stages of eventualities: stages of processes and events.
  - The output of the perfective operator is the set of stages **among those** that are **maximal** with respect to the appropriate ordering criterion (or 'measurement') in a given context. The output will be the set of maximal events that we count as one, i.e., the maximal event represents a new entity in the domain of events, instead of being merely a maximal sum of events.

- Let $\preceq = \preceq s \cup \preceq e$ Landman 2008

  PERFECTIVE = $\lambda P \lambda e.P(e) \wedge \forall e1 \in P$: $e \preceq_e e1 \rightarrow e = e1$

  e is a variable over eventualities.

- The following sentence is verified by a situation in which MAX_E picks the largest unique event stage at which the situation **ceases to develop**:

  ?? John wrote a sequence of numbers for ten minutes.

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