Parts, wholes and clusters: Italian irregular plurals and a unified notion of parthood

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Introduction

Part-whole structures

- material parthood $\Rightarrow$ part of a singularity $\Rightarrow$ volume
- individual parthood $\Rightarrow$ part of a plurality $\Rightarrow$ cardinality

Vital question

- are they different or the same?

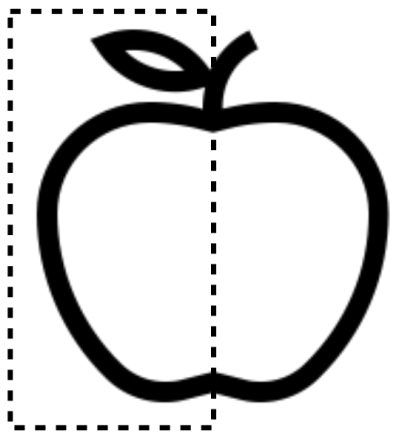


Figure 1: Material parthood

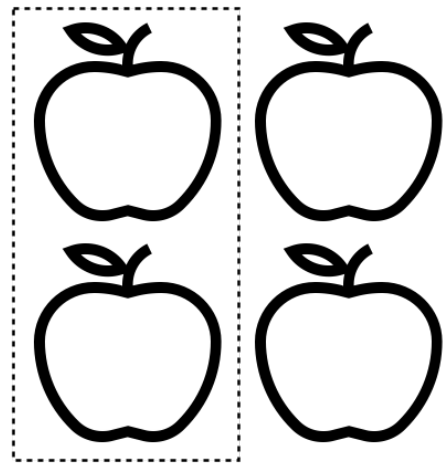


Figure 2: Individual parthood

Introduction

Standard assumptions in mereological approaches to NL

e.g., Link (1983), Bach (1986), Landman (2000), Champollion (2017)

- only $\sqsubseteq$ and $\sqcup \Rightarrow$ entities equivalent to sums of their parts
- sorted domains $\Rightarrow \sqsubseteq_m \times \sqsubseteq_i$, $\sqsubseteq_e \times \sqsubseteq_p$

Consequences

- singularities vs pluralities $\Rightarrow$ distinct part-whole structures
- compositional semantics $\Rightarrow$ not sensitive to how parts of a whole are arranged

Standpoints

- "it should be this way"

  e.g., Pianesi (2002), Champollion (2010)
- opposing views

  Krifka (1989), Moltmann (1997), Grimm (2012), Landman (2016)

Introduction

My claims

- singularities and pluralities $\Rightarrow$ unified notion of parthood
- but different topological relations between parts
- result: different part-whole structures with a shared core
- counting $\Rightarrow$ sensitive to particular topological relations

Key evidence

- Italian irregular plurals in count partitives

Introduction

Outline

- Introduction
- Unified notion of parthood
- Challenge
- Italian irregular plurals
- Core assumptions
- Mereotopology
- Analysis

Focus

- concrete nouns $\Rightarrow$ abstract nouns excluded

Unified notion of parthood

Unified notion of parthood

Argument for a unified mereology from partitive expressions
Moltmann (1997, 1998)

- analogy between partitives involving singulars and plurals
- the same proportional quantifier can quantify over
  - parts of a singularity (material parthood) $\Rightarrow$ volume
  - parts of a plurality (individual parthood) $\Rightarrow$ cardinality
- this suggests a unified part-whole structure

(1) a. Teil des Apfels
part the.GEN apple.GEN
'part of the apple' German

b. Teil der Äpfel
part the.GEN.PL apples
'some of the apples' German

Unified notion of parthood

Cross-linguistic perspective

- in English the analogy does not hold
  Schwarzschild (1996)

(2) a. part of the apple
    b. #part of the apples

- systematic ⇒ attested in multiple languages
  Germanic, Romance, Slavic, Celtic, Finno-Ugric, Semitic, Basque

(3) a. parte del muro
       part of-the.SG wall
       'part of the wall' Italian
    b. parte dei muri
       part of-the.PL walls
       'some of the walls' Italian

Unified notion of parthood

Proportional quantifiers and fractions

- similar analogy
- systematic
- cross-linguistically widespread

(4) a. most of the apple
b. most of the apples

(5) a. half of the apple
b. half of the apples

(6) a. two thirds of the apple
b. two thirds of the apples

Unified notion of parthood

Number-neutral expressions

- object mass nouns
- pluralia tantum
- ambiguity between a singular and plural reading
- systematic $\Rightarrow$ attested in many languages

(7) a. část obuvi
part footwear.GEN
'part of the footwear/some of the footwear' Czech

b. část nůžek
part scissors.GEN
'part of the scissors/some of the scissors' Czech

Unified notion of parthood

General number

Sauerland & Yatsushiro (2004), Watanabe (2013)

- languages such as Japanese
- number-neutral nominals
- ambiguity between a singular and plural reading

(8) a. Ringo-no ichibu-ga kusatteiru.
apple-GEN part-NOM is.rotten
'Part of the apple is rotten/Some of the apples are rotten.' Japanese

b. Ringo-no hotondo-ga kusatteiru.
apple-GEN most-NOM is.rotten
'Most of the apple(s) is/are rotten.' Japanese

Unified notion of parthood

Zeugma test

cf. Zwicky & Sadock (1975), Lasersohn (1995)

- indeterminacy (non-specificity) $\Rightarrow$ no zeugma effect
- ambiguous expressions $\Rightarrow$ zeugma effect
- *part* $\Rightarrow$ not ambiguous with respect to $\sqsubseteq_m$ and $\sqsubseteq_i$

(9) Ein Teil des Apfels und der Birnen sind verfault.
a part the$_{\text{GEN}}$ apple$_{\text{GEN}}$ and the$_{\text{GEN}}$ pears$_{\text{GEN}}$ are rotten
'Part of the apple and some of the pears got spoiled.' German

(10) Ein Teil der Birnen und des Apfels sind verfault.
a part the$_{\text{GEN}}$ pears$_{\text{GEN}}$ and the$_{\text{GEN}}$ apple$_{\text{GEN}}$ are rotten
'Some of the pears and part of the apple got spoiled.' German

Challenge

Challenge

Counterargument for a unified mereology

Schwarzschild (1996)

- partitive words in singular partitives ⇒ countable
- partitive words in plural partitives ⇒ uncountable
- no part-of-the-plurality reading
- different properties in different environments

(11) a. tre parti del muro
three parts of-the.SG wall
'three parts of the wall' Italian

b. tre parti dei muri
three parts of-the.PL walls
(i) part of a singularity
(ii) #part of a plurality

Challenge

Counterargument for a unified mereology

Schwarzschild (1996)

- animate nouns ⇒ stronger effects

(12) a. Parte dei ragazzi erano in Texas.
part of-the boys were in Texas
'Some of the boys were in Texas.' Italian

b. #Tre parti dei ragazzi erano in Texas.
three parts of-the boys were in Texas

(13) a. Część chłopców śpi.
part boys_{GEN} sleeps
'Some of the boys sleep.' Polish

b. #Trzy części chłopców śpią.
three parts boys_{GEN} sleep

Challenge

Implications

Schwarzschild (1996)

- uncountability of partitive words in plural partitives
- different properties $\Rightarrow$ different linguistic objects
- no unified part-whole structure
- singularities $\sim$ pluralities $\Rightarrow$ two distinct mereologies

	SINGULARS		PLURALS	
	bare	count	bare	count
quantification over parts	✓	✓	*	✓
quantification over wholes	*	*	✓	*

Table 1: Properties of partitive words

Challenge

Objection

- cardinals do not count pluralities
- domain of quantification ⇒ set of atoms
  e.g., Kratzer (1989), Chierchia (1998), Landman (2000)
- partitive words actually pattern with regular nominals

(14) a. THREE PARTS OF THE WALLS
  (i) #three pluralities of parts of the walls
  (ii) plurality of three parts of the walls
  b. THREE WALLS
  (i) #three pluralities of walls
  (ii) plurality of three walls

Interim summary

So far

- analogy between partitives with singulars and plurals
- the same partitive word ⇒ part of a singularity/plurality
- cross-linguistically systematic pattern
- unified part-whole structure for nominal expressions

(15) $\textsc{part}\ \text{DP}_{\text{SG}}$
quantification over parts of a singularity ⇒ volume

(16) $\textsc{part}\ \text{DP}_{\text{PL}}$
quantification over parts of a plurality ⇒ cardinality

Next

- Italian irregular plurals

Italian irregular plurals

Italian irregular plurals

Inflectional class

Ojeda (1995), Acquaviva (2008)

- morphological and semantic idiosyncrasy
- gender shift in the plural
- relatively small but stable class

(17) a. il tuo dito
the.M.SG your.M.SG finger.SG
'your finger' Italian

b. le tue dita
the.F.PL your.F.PL finger.PL
'your fingers' Italian

Italian irregular plurals

Two subtypes

Acquaviva (2008)

- irregular forms lacking regular counterparts
- regular plural meaning

SINGULAR	REGULAR PLURAL	IRREGULAR PLURAL
uovo ‘egg’	*uovi	uova ‘eggs’
riso ‘laughter’	*risi	risa ‘pearls of laughter’
paio ‘pair’	*paii	paia ‘pairs’
centinaio ‘hundred’	*centinai	centinaia ‘hundreds’
miglio ‘mile’	*migli	miglia ‘miles’

Table 2: Italian nouns with irregular plurals exclusively

Italian irregular plurals

Two subtypes

Acquaviva (2008)

- irregular forms with regular counterparts
- semantic idiosyncrasy

SINGULAR	REGULAR PLURAL	IRREGULAR PLURAL
muro ‘wall’	muri ‘walls’	mura ‘walls (in a complex)’
osso ‘bone’	ossi ‘bones’	ossa ‘bones (in a skeleton)’
filo ‘thread’	fili ‘threads’	fila ‘threads (in a fabric)’
fondamento ‘basis’	fondamenti ‘bases’	fondamenta ‘foundations’
urlo ‘shout’	urli ‘shouts’	urla ‘shouts (in a series)’

Table 3: Italian nouns with regular and irregular plural counterparts

Italian irregular plurals

Semantic idiosyncrasy

Ojeda (1995), Acquaviva (2008)

- nouns with both regular and irregular counterparts

(18) a. muro ∼ muri ∼ mura
wall.$\textsc{m.sg}$ wall.$\textsc{m.pl}$ wall.$\textsc{f.pl}$
'wall ∼ walls ∼ walls (in a complex)' Italian

b. osso ∼ ossi ∼ ossa
bone.$\textsc{m.sg}$ bone.$\textsc{m.pl}$ bone.$\textsc{f.pl}$
'bone ∼ bones ∼ bones (in a skeleton)' Italian

- irregular forms ⇒ collectivizers or inherently encoding cohesion of referents
- arguably a notion of connectedness of parts is involved

Italian irregular plurals

Aggregate meaning

- interaction with verbs of separation
- dissovlement of the topological structure within a plurality

(19) a. Garibaldi ha smantellato il muro.
Garibaldi has dismantled the wall
'Garibaldi has dismantled the wall.' Italian

b. Garibaldi ha smantellato i muri.
Garibaldi has dismantled the walls
'Garibaldi has dismantled the walls.' Italian

c. Garibaldi ha smantellato le mura.
Garibaldi has dismantled the walls.COLL
'Garibaldi has dismantled the walled complex.' Italian
(i) ✓ piles of stones
(ii) ✓ intact but disconnected walls

Italian irregular plurals

Interaction with cardinals in partitives

- partitives with irregular plurals ⇒ compatible with cardinals
- quantification over parts of singularities or pluralities

(20) tre parti delle mura
three parts of-the walls.COLL
'three parts of the complex formed by the walls' Italian

(i) ✓ if counting parts of walls
(ii) ✓ if counting individual walls
(iii) ✓ if counting continuous pluralities of walls

Italian irregular plurals

Observation

(21) Due parti delle mura sono rosse.
two parts of-the walls.COLL are red
'Two parts of the walled complex are red.' Italian

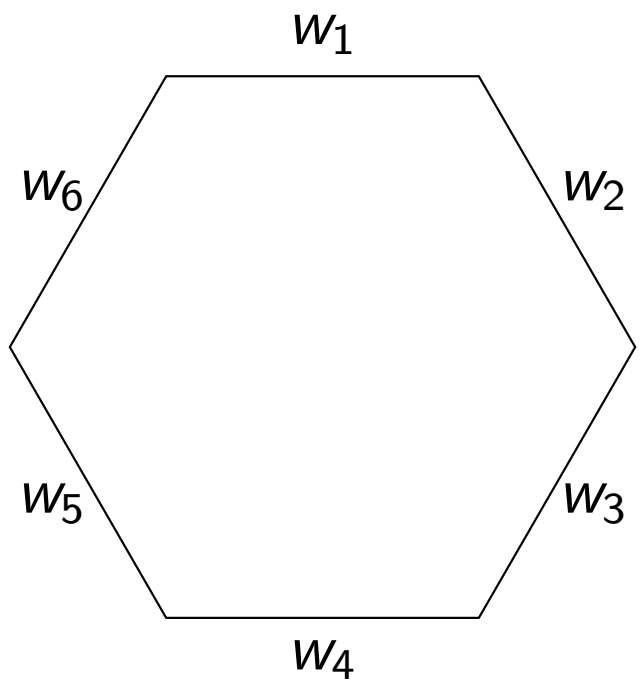


Figure 3: Sections of the city walls

Italian irregular plurals

Observation

(22) tre parti delle ossa
three parts of-the bone.COLL
'three parts of the skeleton formed by the bones' Italian

(i) ✓ if counting parts of bones
(ii) ✓ if counting individual bones
(iii) ✓ if counting continuous pluralities of bones, e.g., femur + knee, ulna + radius, and skull + neck

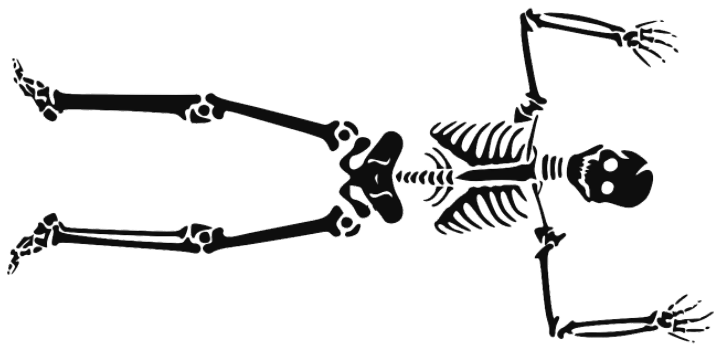


Figure 4: Skeleton

Italian irregular plurals

Italian partitives

- interaction between partitivity and number
- quantification over wholes
- subatomic quantification

	SINGULARS		REGULAR PL		IRREGULAR PL	
	bare	count	bare	count	bare	count
subatomic quantification	✓	✓	*	✓	✓	✓
quantification over wholes	*	*	✓	*	✓	✓

Table 4: Properties of Italian *parte* 'part'

Countability

- counting ⇒ possible if it operates on integrated objects

Data summary

Count singulars

- parts of a singularity form a cohesive whole
- topological relations between parts $\Rightarrow$ integrated entity

Regular plurals

- parts of a plurality do not form an integrated entity
- no topological relations between parts

Italian irregular plurals

- parts of a plurality form a cohesive whole
- topological relations between parts $\Rightarrow$ aggregate meaning

Core assumptions

Core assumptions

General counting principles

Wągiel (2018)

- non-overlap $\Rightarrow$ disjoint entities (Landman 2011, 2016)
- maximality $\Rightarrow$ mereological exhaustivity
- integrity $\Rightarrow$ individuated and integrated whole

One universal mechanism allowing for counting

- applicable on different levels of a part-whole structure
- interaction with specific properties of particular types of entities

Core assumptions

Counting

- counted parts $\Rightarrow$ maximal integrated entities
- counted parts cannot overlap

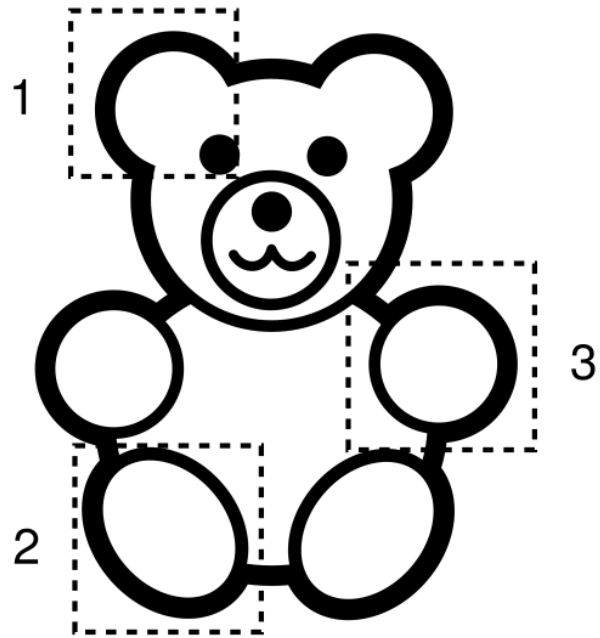


Figure 5: Counting

Core assumptions

Illegal counting

- counting discontinuous parts of an object
- overlapping parts

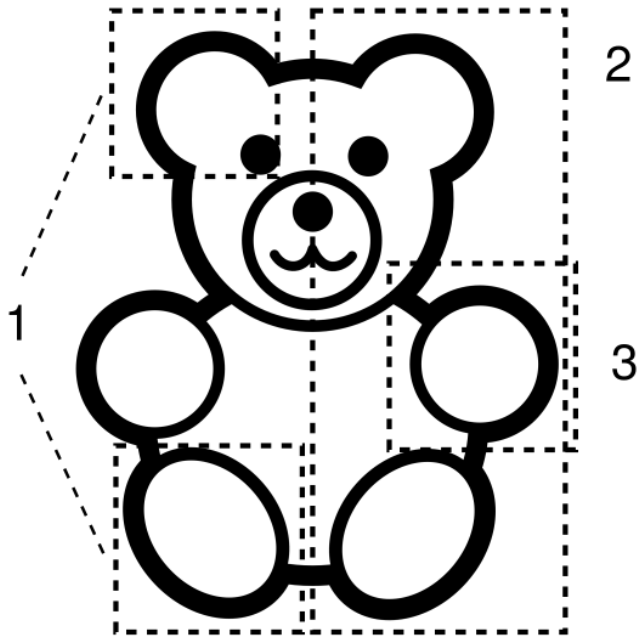


Figure 6: Illegal counting

Mereotopology

Mereotopology

Mereology + topological notions

Casati & Varzi (1999), Varzi (2007), Grimm (2012)

- mereology augmented with topological relations
- connectedness $\Rightarrow$ primitive relation
- implied by overlap

(23) Reflexivity
$\forall x[\mathrm{C}(x, x)]$

(24) Symmetry
$\forall xy[\mathrm{C}(x, y) \leftrightarrow \mathrm{C}(y, x)]$

(25) Parthood $\rightarrow$ connectedness
$\forall xy[x \sqsubseteq y \rightarrow \forall z[\mathrm{C}(x, z) \rightarrow \mathrm{C}(z, y)]]$

Mereotopology

Mereology + topological notions

Casati & Varzi (1999), Varzi (2007), Grimm (2012)

- interior, exterior, closure, boundary

(26) Interior

$ix \stackrel{\text{def}}{=} \oplus X$ where $X = \{y \ : \ \text{IP}(y, x) = \text{True}\}$

(27) Exterior

$ex \stackrel{\text{def}}{=} i(-x)$

(28) Closure

$cx \stackrel{\text{def}}{=} -(ex)$

(29) Boundary

$bx \stackrel{\text{def}}{=} -(ix \oplus ex)$

Mereotopology

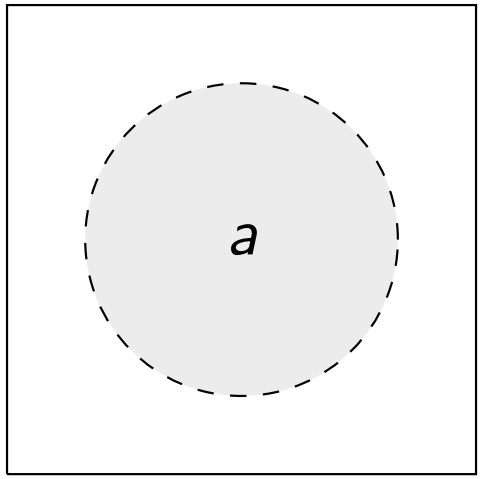


Figure 7: Interior

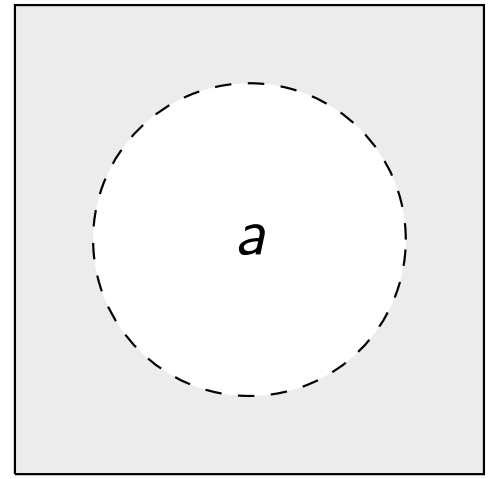


Figure 8: Exterior

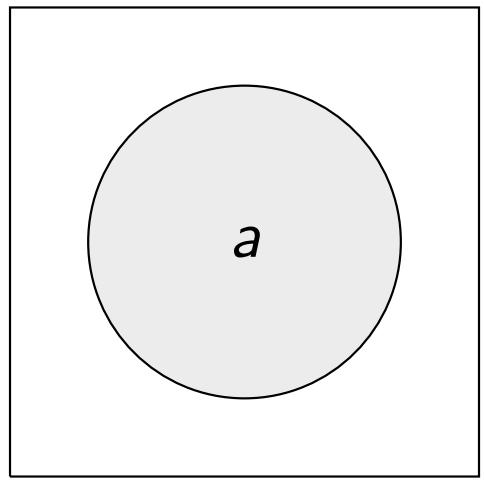


Figure 9: Closure

Mereotopology

Self-connected entity

(30) $\mathrm{SC}(x) \stackrel{\mathrm{def}}{=}$
$\forall yz[\forall w(\mathrm{O}(w,x) \leftrightarrow (\mathrm{O}(w,y) \vee \mathrm{O}(w,z))) \rightarrow \mathrm{C}(y,z)]$

- any two parts that form the whole are connected to each other

Strongly self-connected entity

(31) $\mathrm{SSC}(x) \stackrel{\mathrm{def}}{=} \mathrm{SC}(x) \wedge \mathrm{SC}(ix)$

- entity's interior is self-connected

Mereotopology

Maximally strongly self-connected relative to a property

(32) $\text{MSSC}(P)(x) \stackrel{\text{def}}{=}$
$P(x) \wedge \text{SSC}(x) \wedge \forall y[P(y) \wedge \text{SSC}(y) \wedge \text{O}(y, x) \rightarrow y \sqsubseteq x]$

- every part is connected to (overlaps) the whole
- anything else which has that property, is strongly self-connected, and overlaps is part of it

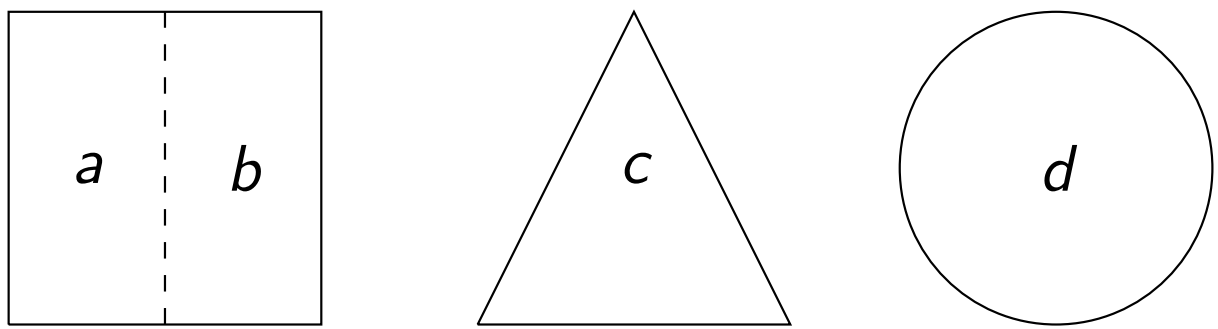


Figure 10: Wholes vs. sums

Mereotopology

Transitively connected relative to a property, connection, set

(33) $\mathrm{TC}(x, y, P, C, Z) \stackrel{\mathrm{def}}{=}$
$\forall z \in Z[P(z) \wedge (x = z_1 \wedge y = z_n) \wedge Cz_1z_2 \wedge Cz_2z_3 \ldots \wedge Cz_{n-1}z_n]$

where $Z = \{z_1, z_2, \ldots z_n\}$

- transitive connection through a sequence of entities
- a and $c \Rightarrow$ transitively connected

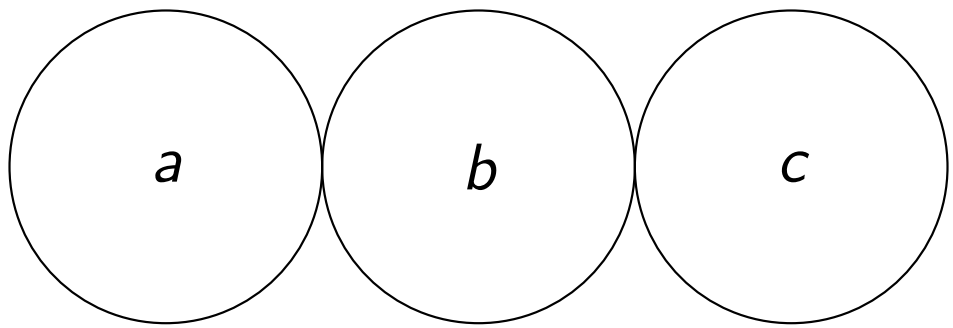


Figure 11: Transitive connection

Mereotopology

Cluster (relative to a property and connection)

(34) $\textsc{cluster}(x, P, C) \stackrel{\text{def}}{=}$
$\exists Z[x = \bigsqcup Z \wedge \forall z \forall z' \in Z \exists Y[\textsc{tc}(z, z', P, C, Y)]]$

- sum of transitively connected entities
- $a \sqcup b \sqcup c \Rightarrow$ cluster

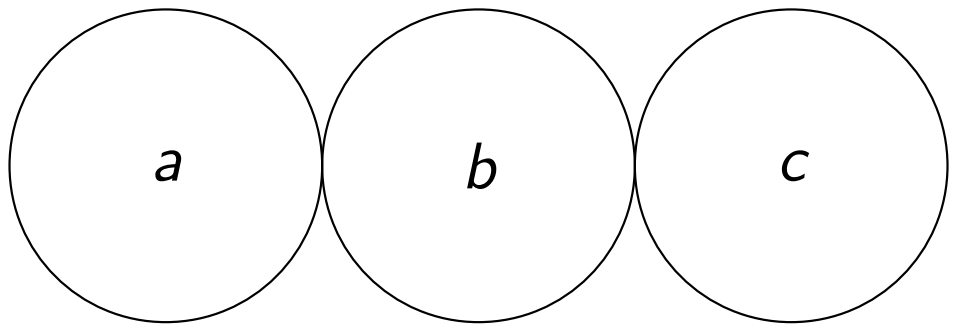


Figure 12: Cluster

Analysis

Analysis

Count nouns

- predicates of $\textsc{mssc}$ entities $\Rightarrow$ integrated wholes

(35) $[\![\text{muro}]\!] = \lambda x[\textsc{mssc}(\textsc{wall})(x)]$

Regular plurals

- pluralization $\Rightarrow$ algebraic closure
  Link (1983)
- presupposition $\Rightarrow$ $\textsc{mssc}$ predicates
- no topological constraints

(36) $[\![\text{PL}_{\text{R}}]\!] = \lambda P : P_{\textsc{mssc}}[^*P]$

(37) $[\![\text{muri}]\!] = [\![\text{PL}_{\text{R}}]\!]([\![\text{muro}]\!]) = {}^*[\![\text{muro}]\!]$

Analysis

Italian irregular plurals

- pluralization ⇒ cluster formation
  Grimm (2012)
- topological relation ⇒ plurality of connected entities
- type of connection ⇒ determined by the lexical content

(38) $[\![\text{PL}_{\text{IR}}]\!] = \lambda P : P_{\text{MSSC}}[\text{CLSTR}(P)]$

(39) $[\![\text{mura}]\!] = [\![\text{PL}_{\text{IR}}]\!]([\![\text{muro}]\!]) = \text{CLSTR}([\![\text{muro}]\!])$

Consequences

- all parts ⇒ transitively connected
- certain parts ⇒ plural integrated objects

Analysis

Cardinal numerals

- predicate modifiers
  Ionin & Matushansky (2006), Chierchia (2010)
- measure function $\#(P) \Rightarrow$ counts integrated wholes
  Krifka (1989)
- require $\textsc{mssc}$ predicates $\Rightarrow$ incompatible with mass nouns

(40) Measure function $\#(P)$
$\forall P \forall x[\#(P)(x) = 1 \text{ iff } \textsc{mssc}(P)(x)]$

(41) Cardinal numeral
$[\![\text{tre}]\!] = \lambda P : P_{\textsc{mssc}}\ \lambda x[{}^*P(x) \wedge \#(P)(x) = 3]$

Consequence

- cardinals are sensitive to the mereotopological structure

Analysis

Partitives

- partitive constraint $\Rightarrow$ entity-denoting embedded DP
  de Hoop (1997)
- definiteness $\Rightarrow$ maximization operation + uniqueness

(42) $[\![\text{DEF}]\!] = \lambda P[\text{MAX}(P)]$

Partitive expressions

- partitivity $\Rightarrow$ proper parthood
  Barker (1998)
- one general unified $\sqsubset$

(43) $[\![\text{PART}]\!] = \lambda y \lambda x[x \sqsubset y]$

Analysis

Partitioning

cf. Scontras (2014)

- partitioning function $\pi \Rightarrow$ non-overlap
- multiple possible partitions $\Rightarrow$ context determines

(44) Partitioning function π
in a given context, for any P and any x and y in $\pi(P)$
$\neg\exists z[z \sqsubseteq x \wedge z \sqsubseteq y]$

Individuation

- individuation of parts $\Rightarrow$ non-overlap + integrity
- individuating element IND $\Rightarrow \pi$ + MSSC

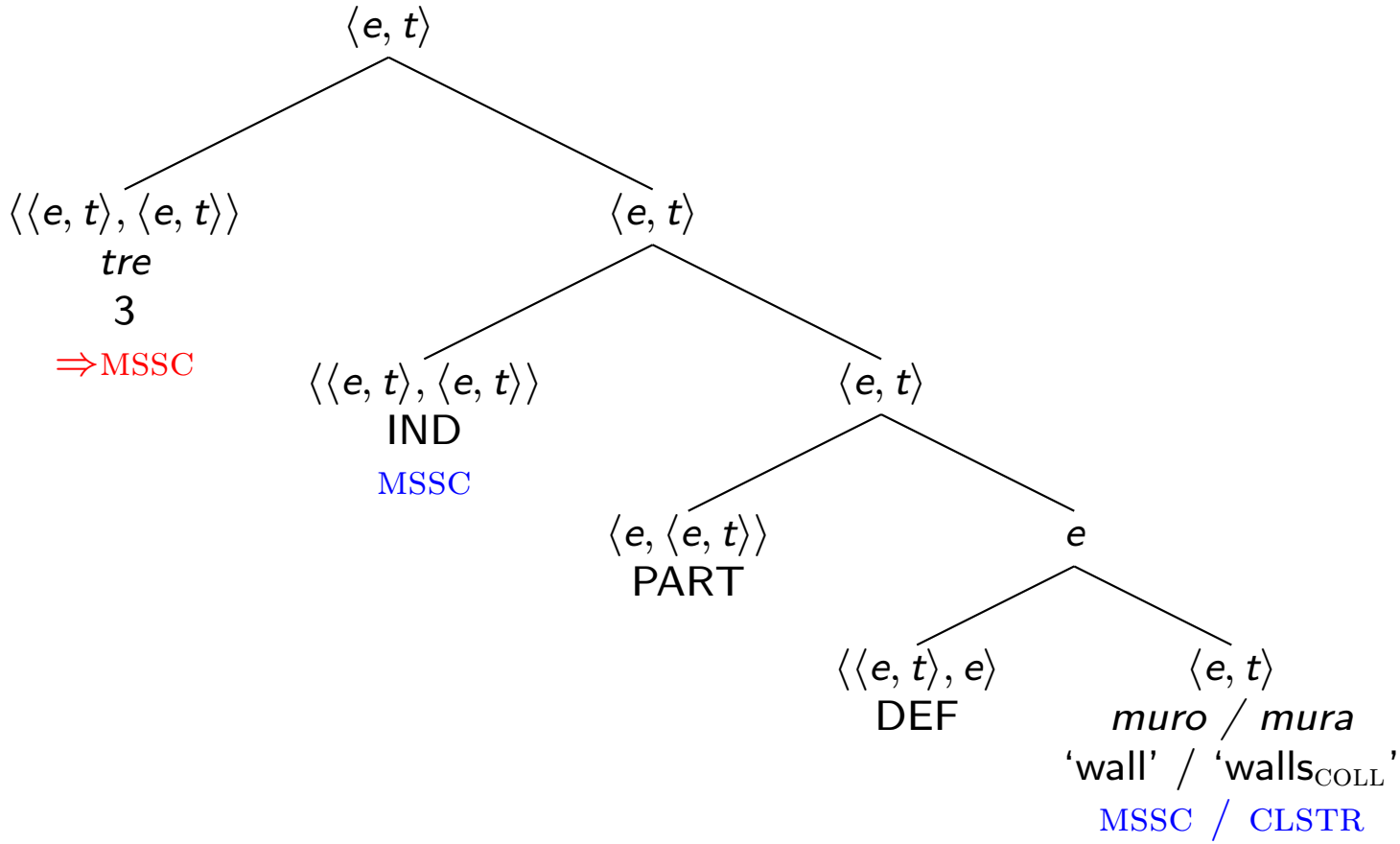
(45) $[\![\text{IND}]\!] = \lambda P \lambda x[\text{MSSC}\Big(\pi(P)\Big)(x)]$

Analysis

LF structure of count partitives

(46) tre parti del muro / delle mura
three parts of-the wall / of-the walls.COLL

(47)



Conclusion

Conclusion

Part-whole structures: the same or different?

- singularities and pluralities $\Rightarrow$ unified notion of parthood
- different mereotopological structures

Cross-linguistic distribution of partitives

- singularities $\Rightarrow$ integrity
- pluralities $\Rightarrow$ no topological commitments
- Italian irregular plurals $\Rightarrow$ clusters

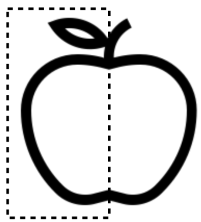


Figure 13: Material parthood

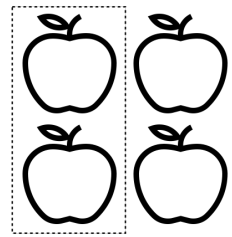


Figure 14: Individual parthood

Conclusion

THANKS!

Part-whole structures: the same or different?

- singularities and pluralities $\Rightarrow$ unified notion of parthood
- different mereotopological structures

Cross-linguistic distribution of partitives

- singularities $\Rightarrow$ integrity
- pluralities $\Rightarrow$ no topological commitments
- Italian irregular plurals $\Rightarrow$ clusters

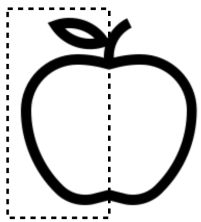


Figure 15: Material parthood

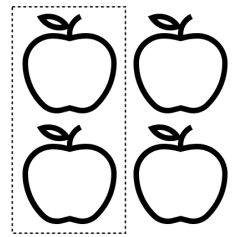


Figure 16: Individual parthood

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