# A conceptual-epistemic perspective on model theory

Sven Lauer[1] Alex Djalali[2]

[1]Zukunftskolleg/Department of Linguistics
University of Konstanz

[2]Department of Linguistics
Stanford University

Models in Formal Semantics and Pragmatics
ESSLLI '14, University of Tübingen
August 20, 2014

# What are models about?

- Zimmermann (1999) considers, and rejects various possible understandings of models in NL semantics.
  1. Models as disambiguations
  2. Models as worlds
  3. Models as domains
  4. Models as languages
- We agree that these are not it.

# The epistemic understanding of model theory

Zimmermann (1999, p. 543):

> *"In order to see what models are about one only needs to imagine what one would do without them."*

We would fall into ...

**Bloomfield's Abyss**

"In order to give a scientifically accurate definition of meaning for every form of a language, we should have to have a scientifically accurate knowledge of everything in the speaker's world" (Bloomfield 1933)

# The epistemic understanding of model theory

## The epistemic understanding of model theory

"Model spaces turn out to be models of the semanticists' ignorance (or agnosticism) about non-semantic matters. And a particular model models one *epistemic* possibility of what the world [and logical space] may look like."

# The epistemic understanding of model theory

## Consequence (I): a class of isomorphic, 'intended' models

**Consequence: a class of isomorphic 'intended models'.**

- In each model space, there is a class of intended models which are isomorphic to the real world / real logical space.
- This class of course is unknown to the theorist.

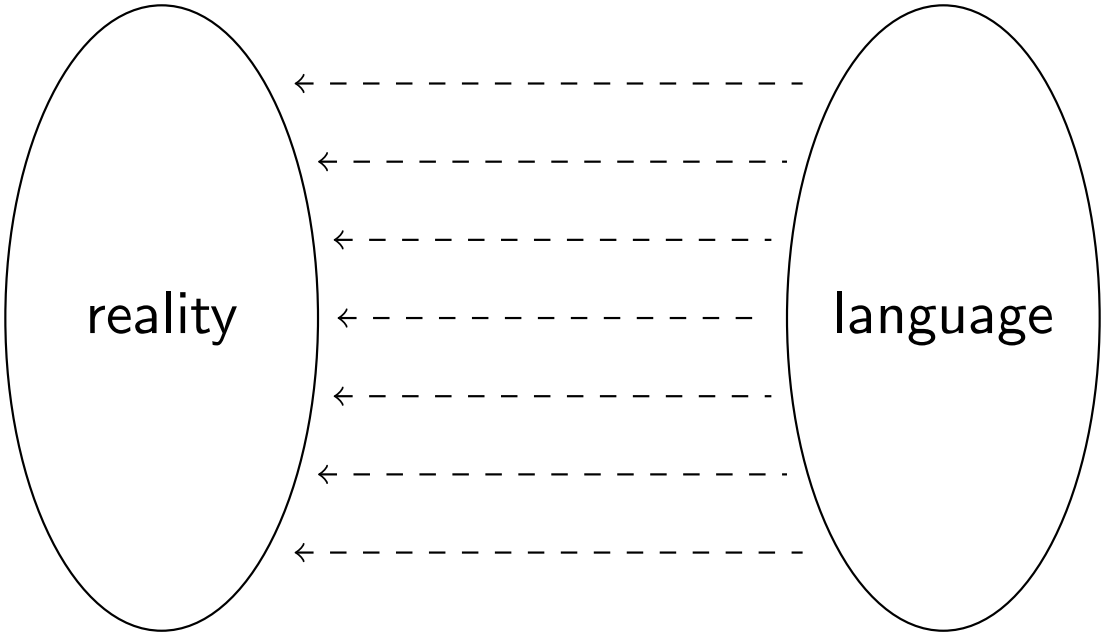
## Consequence: Models are inessential

- The use of models is incidental to the semantic enterprise.
- We need them as 'crutches' because of our imperfect knowledge about the world / logical space.
- An omniscient semanticist would have no use for models in stating a semantic theory.

# The conceptual-epistemic understanding of model theory

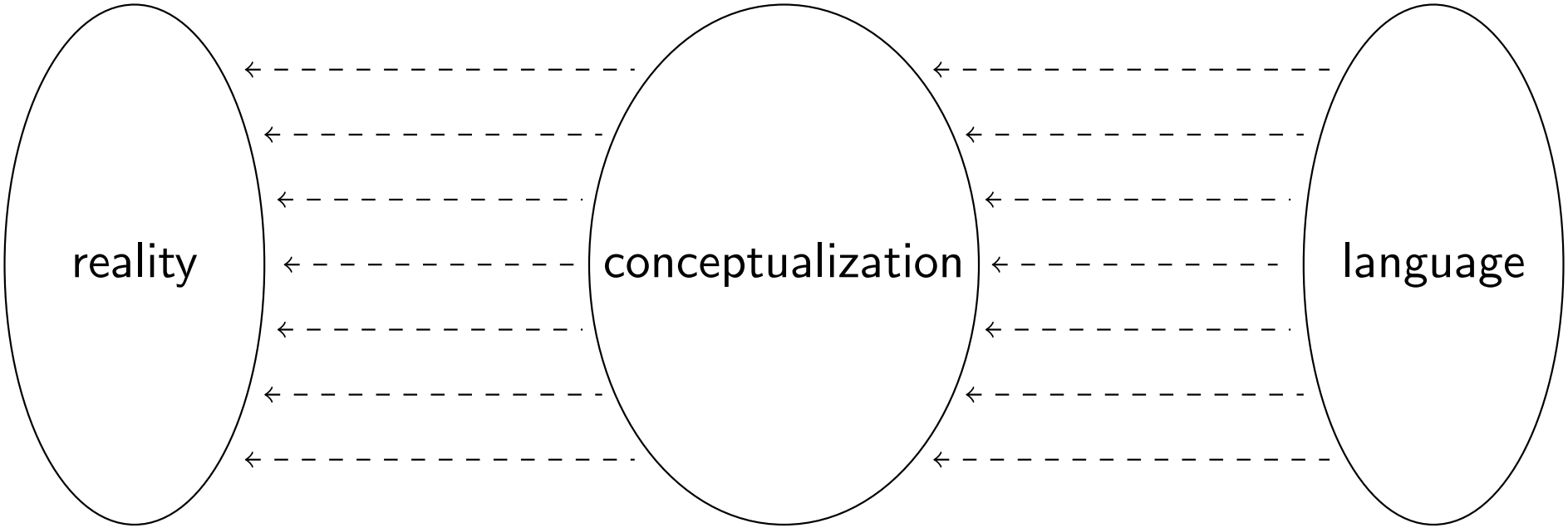
- We advocate an alternative construal, the **conceptual-epistemic understanding of model theory**.
- In fact, we think that is how many formal semanticists construe their models.
- But it is only occasionally made explicit.
  - e.g. Bach (1986, 'Natural language metaphysics')

# Epistemic understanding / 'absolute interpretation'




- Models used to approximate reality.
- Variation in model space: Theorists' uncertainty about reality.

# Conceptual-epistemic understanding




- Models used to approximate language users' **conceptualization** of reality.
- Variation in model space: Theorists uncertainty about conceptualization **and variation in conceptualization**.

# Plot

1. Case study I: Adjectival Comparatives
2. Case study 2: The mass/count distinction
3. Some consequences of the conceptual-epistemic understanding

# Gradable adjectives

- Gradable adjectives like **tall**, on standard accounts, are taken relate individuals to gradable properties or amounts.
  (Seuren 1973, Cresswell 1976, Kennedy 1997)

(1) John is taller than Mary.
≈ John has more height than Mary.
≈ Johns (maximal) height is larger than Mary's (maximal) height.

# Gradable adjective and model theory

- Models contain structure which represents gradable properties/amounts.
- *viz.* gradable adjectives denotes a **scale** composed of **degrees**.
- These scales must have certain properties, as evidenced from entailment patterns.

(2) a. John is taller than Mary.
b. Mary is taller than Fred.
c. $\Rightarrow$ John is taller than Fred.

# Non-referring predicates Wheeler (1972)

*"[W]hy, if someone invents the word glof and says the truths John is glofer than Mary and Mary is glofer than Fred, we can know that John is glofer than Fred even though we don't know what glof means[?]"*

*Wheeler (1972)*

(3) a. John is glofer than Mary.
b. Mary is glofer than Fred.
c. $\Rightarrow$ John is glofer than Fred.

# What does -**er** impose constraints on?

- Evidently, the comparative morpheme -**er** imposes a transitivity constraint on the interpretation of the adjective it combines with.
- But what does it impose this constraint *on*?
- Formally: On the scale denoted by the property.
- But what does this scale represent?

# Multi-dimensional adjectives and scales

- For **tall**, we can just say that the constraint is satisfied by the real-world property height, which the tallness-scale represents.
- But what about other adjectives, e.g. multi-dimensional ones like **clever** (Kamp 1975)?
- Cleverness is an aggregation of properties:
  - mathematical problem solving skills
  - quick-wittedness
  - skill in verbal argumentation
  - ...

  $\hookrightarrow$ *Prima facie* unclear that there is a real-world property that is isomorphic to the (transitive) **clever** scale.

# Interim conclusion

- Transitivity constraint imposed by **-er** is arguably not a constraint on the real-world referents of gradable adjectives.
- It is a constraint on something extra.
- *viz.*, the conceptual level of representation of reality, which should be regarded as an ineliminable ingredient of interpretation rather than an eliminable stand-in for reality.

# Outline

1. Case study I: Adjectival Comparatives
2. Case study 2: The mass/count distinction
3. Some consequences of the conceptual-epistemic understanding

# The mass-count distinction

- **Mass/count**: A distinction between nominal predicates.
- Correlates roughly with the intuitive distinction between **substances** vs. **individuals**.
  - e.g. **water**: substance / mass
  - e.g. **dog**: individuals / count

# The mass/count distinction

## Morpho-syntactic reflexes

The mass/count distinction has morpho-syntactic reflexes:

- Only mass nouns are compatible with quantifiers such as **much** and **little**.

  (4) **much water** vs. # **much dog(s)**

- Only count nouns are compatible with plural marking, quantifiers like **many**, cardinal quantifiers.

  (5) **many dogs** vs. # **many water(s)**

  (6) **three dogs** vs # **three water(s)**

# Caveat: Kind readings

Mass nouns can be used with count morphosyntax when they refer to **kinds** or **sorts**.

(7) three cheeses
≈ three kinds of cheese

(8) various fine wines
≈ various kinds of fine wine

We set those uses aside here.

# Mereology

- Dominant approach to modelling the mass/count distinction semantically: Assume models contain **mereological structure**.
  - (Proper) part-of relation $>$.
  - Sum-operation $\oplus$.

(9) $Atom(x) = [\neg\exists y : y < x]$

(10) $Cumulative(P) = [P(x) \wedge P(y) \rightarrow P(x \oplus y)]]$

(11) $Divisive(P) = \forall x[P(x) \rightarrow \forall y[y < x \rightarrow P(y)]]$

- Grimm (2012a,b): More structure needed $\hookrightarrow$ **mereotopology**.

# Two options

- If models directly represent the world, we have two options:

1. Locate the mass/count distinction *in the world*.
2. Locate the mass/count distinction *in the grammar*.

- **Arguments against Option 1:** Linguistic mass/count distinction has a certain amount of arbitrariness to it.

# Against a realistic conception of mass/count

## Arbitrariness (I): Cross-linguistic variation

- Languages differ on specific lexical items.

(12) English: **oats** (count)

(13) German: **Hafer** (mass)

(14) a. I cut my hair. **hair**: mass
b. Mi sono tagliato i capelli. **capelli**: count

> "**Hair**, *used to refer to what grows on our head, seems to be mass in English, and count in Italian. Yet clearly we are referring to the same stuff. Your hair doesn't change, as we change language.*"
>
> *(Chierchia 2010)*

# Against a realistic conception of mass/count

## Arbitrariness (II): Doublets

Within one language, we find (near-)synonymous expressions which differ in mass/count status.

(15) **leaves** (count) vs. **foliage** (mass)

(16) **coins** (count) vs. **change** (mass)

> *"In fact, the same slice of reality can be classified as either count or as mass, as attested by the existence of near synonyms."*
> *(Chierchia 1998, p. 56)*

# Against a realistic conception of mass/count

## Arbitrariness (III): Contextual variation

- Mass nouns can sometimes be used with count morphosyntax ('packaging').

(17) He drank three beers. [=three glasses of beer]

- Count nouns can sometimes be used with count morphosyntax ('grinding').

(18) There was apple in the salad.

(19) There was rabbit all over the road.

(cf. Pelletier 1991)

# Against a realistic conception of mass/count

## Arbitrariness: Summary

If the nature of the denoted entity determined the mass/count status of the noun, we should not find . . .

- variation across languages (**Hafer**/**oats**).
- variation within a language (**foliage**/**leaves**)
- variation across contexts (**much beer** / **three beers**)

. . . but we do.

# Two options

1. ~~Locate the mass/count distinction *in the world*.~~
2. Locate the mass/count distinction *in the grammar*.

- Conclusion (e.g., Chierchia (1998)): The mass/count distinction has nothing to do with the things talked about, it is a merely grammatical distinction.
- **BUT:** The arbitrariness of the mass/count distinction is crucially **limited** in ways that do not appear to have linguistic motivation.

# Against a (purely) grammatical account

## Limits of arbitrariness

- **Grinding** and **packaging** are far from universal.
- **Doublets** are not true synonyms.
- Even unrelated languages draw the mass/count distinction in largely the same way.

# Against a (purely) grammatical account

## Limits of arbitrariness (I): Grinding/Packaging

- 'Grinding and 'packaging work in a surprising number of cases.

(20) There was rabbit all over the road.

- But they are far from universal (Bloom 1990, Ware 1975, Brinton 1998, Borer 2005, Bale & Barner 2009, Chierchia 2010, a.o.)

(21) #There was bicyle all over the floor.

(22) #Rices adorned the altar.

# Against a (purely) grammatical account

## Limits of arbitrariness (I): Grinding/Packaging

- **Packaging** largely depends on there being a **conventionally given unit size**.

- **Grinding** works well for nouns denoting certain kinds of objects (animals, foodstuff) . . .
  - e.g. animals
  - e.g. foodstuff
- . . . but is much more difficult for others.
  - e.g. (complex) artifacts
  - e.g. groups

(cf. Djalali, Clausen, Grimm and Levin (2011), Grimm (2012b))

# Against a (purely) grammatical account

## Limits of arbitrariness (II): Doublets

- **Doublets** are not quite synonyms.
- In particular, they aren't generally interchangeable.

(23) a. I raked the leaves into a neat pile.
b. #I raked the foliage into a neat pile.

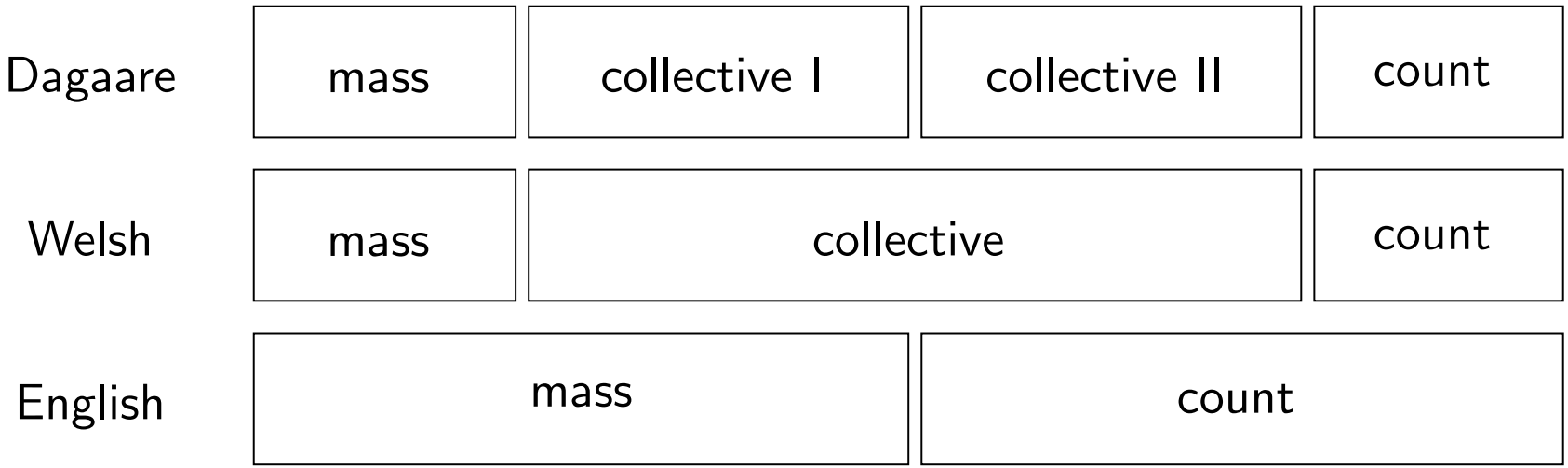
# Against a (purely) grammatical account

## Limits of arbitrariness (III): Cross-linguistic variation

- Cross-linguistic differences in particular lexical items (**oats**/**Hafer**).
- But stable tendencies cross-linguistically.
- Tendencies along an intuitive dimension of 'individuation'.

# The scale of individuation (Grimm 2012b)

| Liquids/ Substances | Granular Aggregates | Collective Aggregates | Individual Entities |
|---|---|---|---|
| e.g., **water** **beer** | e.g., **sand** **sugar** | e.g. **oats** **ants** | e.g. **dogs** **students** |



# Against a purely grammatical distinction of mass/count

If the mass/count distinction were an arbitrary grammatical one, we should not find . . .

- variation in the acceptability of grinding/packaging.
- limits on cross-linguistic variation that do not seem to have a linguistic motivation.

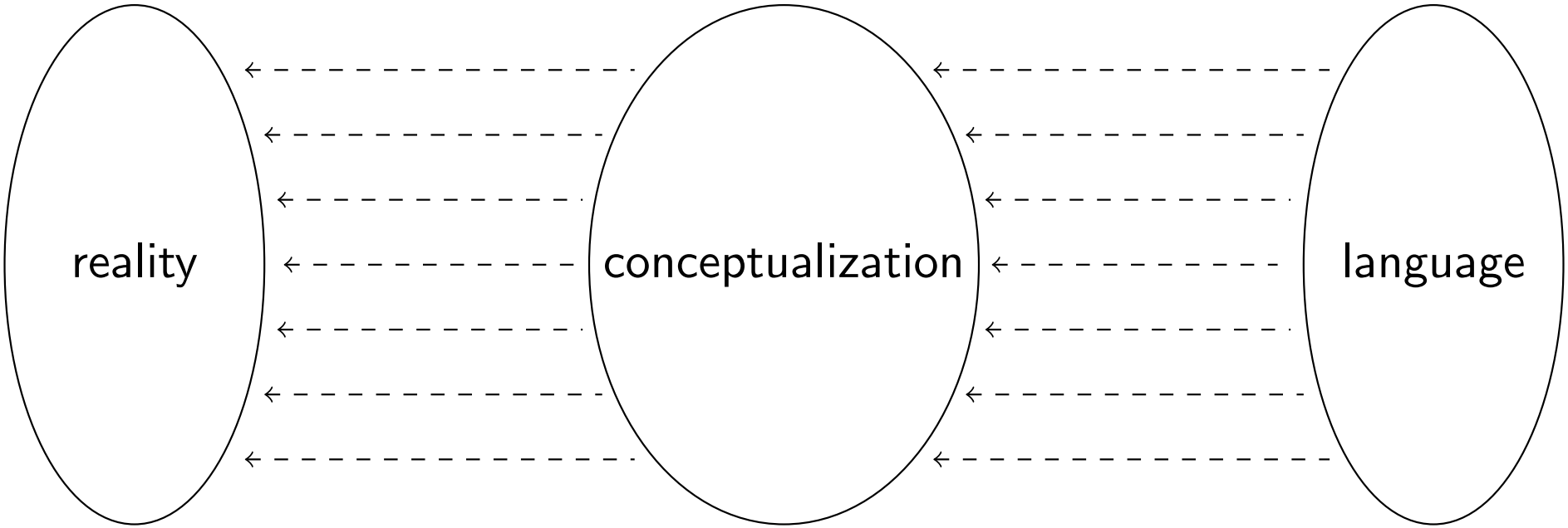
But we do.

# Two options

1. ~~Locate the mass/count distinction *in the world*.~~
2. ~~Locate the mass/count distinction *in the grammar*.~~

- In the less-formal literature, we frequently find the claim that mass/count is a matter of how entities are *conceptualized* or *construed*.
- E.g. Wierzbicka (1985), who identifies two main factors that influences the mass/count status of nouns:
  - **The canonical mode of interaction** with the denoted entity.
  - **The distinguishability of constituent elements**, which in turn is influenced by their **size** and **contiguity**.

# Locating the mass/count distinction on the conceptual level



# Krifka on the role of models

*"Model-theoretic semantics in the tradition of Montague, Lewis and Cresswell has often been seen as opposed to cognitive approaches as developed by Lakoff, Langacker, Wierzbicka, Jackendoff, Bierwisch, and others. It was believed that model-theoretic semantics is forced to a 'realistic' view, in which natural-language expressions are interpreted by real entities, like objects and possible worlds, whereas cognitive semantics is concerned with cognitive models of reality. I dont see that model-theoretic semantics has to be realistic in this sense. We can make use of the techniques developed in the model-theoretic tradition and assume that expressions are interpreted by elements of conceptual structures that in turn are related to real entities by some extra-linguistic matching. This is how I would like to understand the algebraic structures dis- cussed below: As attempts to capture certain properties of the way we see the world, not as attempts to describe the world how it is."*

*(Krifka 1998)*

# 'Arbitrariness' revisited: Cross-linguistic differences

**oats** (count) vs. **Hafter** (mass)

| e.g., | e.g., | e.g. | e.g. |
|---|---|---|---|
| **water** | **sand** | **oats** | **dogs** |
| **beer** | **sugar** | **ants** | **students** |

| | Liquids/ Substances | Granular Aggregates | Collective Aggregates | Individual Entities |
|---|---|---|---|---|
| English | mass | | count | |
| German | mass | | count | |

- Suggestion: Esp. at the borders, **two** conceptualizations can be available each with a different mereological (mereotopological) structure.
- So the lexical item can be specified for mass (as in German **Hafer**) count (as in English **oats**).

# ‘Arbitrariness’ revisited: doublets

**foliage** (mass) vs. **leaves** (count)

- Similarly for **foliage** vs. **leaves**.
- Again we can assume that the same portion of reality can be conceptualized in two ways (with a substance-like part-whole structure or a plurality-of-individuals part-whole structure).
- But both conceptualizations will not always be equally suited.

(24) #The foliage was raked into a neat pile.

# 'Arbitrariness' revisited: grinding/packaging

- Again, multiple conceptualizations of the same referents may be available.
- It stands to reason that certain 'shifted conceptualizations' need special contexts or are difficult to access at all.

(25) #Rices adorned the altar.

(26) #There was toaster all over the table.

# Conclusion: Mass/count distinction and the level of conceptual representation

- The mass/count distinction seems to be appropriately located at the **conceptual level**.
- At the same time, our mereo(topo)logical models contain the necessary structure to represent the distinction.
- **Ergo:** Models should be construed as representations of the conceptual representation, not reality.

# Plot

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# The conceptual-epistemic understanding of model theory

- There is good reason for assuming that:
  - a level of conceptual representation intervenes between the language that is to be interpreted and the reality talked about.
  - this level is the the appropriate place to for constraints on admissible models to operate.
- Consequently, models should be viewed as a representation of this conceptual level.

# The conceptual-epistemic understanding of model theory

## 'Intended models'

On the conceptual-epistemic understanding, there will not be a class of 'intended models' that are isomorphic to reality.

- Because reality may only by **coarsely approximated** by the conceptual representation.
- Because conceptualization may **impose structure** on reality that is not inherent in it.

# The conceptual-**epistemic** understanding of model theory

## Variation across model space

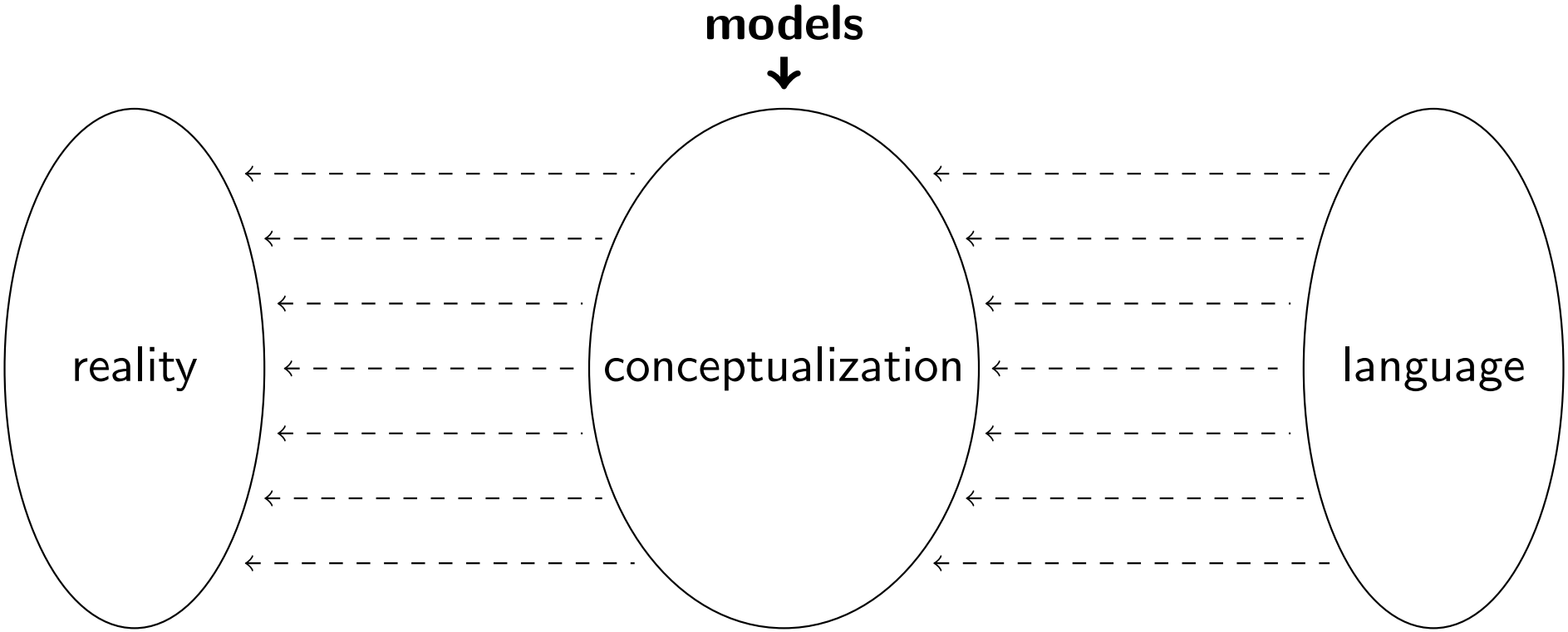
Variation across the space of admissible models receives a different interpretation than on Zimmermann (1999)'s epistemic understanding.

- Some such variation reflects the ignorance of the theorist about how language users conceptualize the world.
- But some variation also reflects differences in conceptualization (across or within speech communities).

$\hookrightarrow$ Even an omniscient semanticist would need to allow for non-isomorphic models.

- On the conceptual-epistemic understanding, constraints on admissible models constitute **hypotheses about what users of a language must agree on** in order to meaningfully communicate.
- They are hypotheses about something non-linguistic (*viz.* conceptualization).
- They specify conditions on what conceptualization of reality must be like for the language to work as the theorist claims it does.

# The conceptual-epistemic understanding of model theory




Thanks to: Cleo Condoravdi, as well as the 'mass count collective': David Clausen, Scott Grimm, Beth Levin and Tania Rojas-Esponda.

# Scale of individuation

| Language | liquids/ substances | granular aggregates | collective aggregates | individual entities |
|---|---|---|---|---|
| Dagaare | 0 | 0/Singulative (*–ruu*) | 0/Singular (*–ri*) | 0/Plural (*–ri*) |
| Welsh | 0 | 0/Singulative (*–yn*) | | 0/Plural (*–od*) |
| English | 0 | | 0/Plural (*–s*) | |

Figure : Grimm (2012b, Table 3.4), The scale of individuation: Dagaare, Welsh and English.

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