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# *Furniture* and Other Functional Aggregates: More and Less Countable than Mass Nouns

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## Setting the Context

Grammatically non-countable nouns include well-behaved mass nouns (*water, sand*) and some misfits.

- ▶ *furniture, mail, luggage, change, jewelry, ammunition, ...*

# Setting the Context

Attention has been increasingly turning to these “*furniture-nouns*” (Wierzbicka 1985, Wisniewski & Murphy 1989, Chierchia 1998, Barner & Snedeker 2005, Mihatsch 2007, Rothstein 2010).

*Furniture-nouns* have attracted attention because of a surprising combination of properties, which straddles mass and count.

# Properties of Furniture-Nouns: Non-Countable Syntax

- ▶ Like core mass nouns, liquids and substances (e.g. *water*, *butter*, *sand*, *sugar*), they are non-countable:
  - ▶ furniture/\*furnitures, mail/\*mails
  - ▶ \*two furnitures, \*three mails
  - ▶ water/\*waters, gravel/\*gravels
  - ▶ \*two waters, \*three gravels

# Properties of Furniture-Nouns: Constituent Objects

- ▶ In contrast to core mass nouns, denotations of these nouns appear to include individual entities, which have their own names:
  - ▶ e.g. *furniture* may be comprised of *chairs*, *tables*, *beds*, *sofas* (compare *sand*/*grain of sand*)
  - ▶ hence their apparent substitutability with constituent nouns (*furniture*  $\approx$  *tables* + *chairs*)

# Properties of Furniture-Nouns: Heterogeneity

- ▶ The individual entities which are constituents of e.g. *furniture* are of different types, e.g. tables, chairs, desks, sofas, . . .
  - ▶ This heterogeneity is at odds with the standard observation that entities named by mass nouns are homogeneous (in the non-technical sense).

# Primary Research Question

## Key question addressed in this talk:

- ▶ What is in the denotation of *furniture*-nouns that allows them to have this puzzling conjunction of properties?



# Primary Research Questions

Previous studies have either emphasized:

- ▶ that *furniture*-nouns are like mass nouns (liquids or substances); that is, they are also “unindividuated” (Wisniewski et al. 1996)
- ▶ that the denotations of these nouns contain constituent objects, hence Barner & Snedeker’s (2005) label *object*-mass nouns as opposed to *substance*-mass nouns, such as *sand* or *oil*

We propose an analysis of *furniture*-nouns that recognizes both facets.

# Our Proposal

**Key to the analysis:** *furniture*-nouns denote artifacts.

- ▶ Artifacts have a **function** and thus participate in some way in an **associated event**, e.g. furnishing for *furniture*

The properties of *furniture*-nouns follow from the type of function, or associated event, at issue

Specifically, for *furniture*-nouns the associated event canonically involves participation of multiple entities

Thus, *furniture*-nouns could be considered **functional aggregates** (cf. granular aggregates such as *sand*, *gravel*, and *sugar*)

# Previous Approaches

The salient properties have motivated two previous approaches:

## Heterogeneity:

- ▶ *Mass Superordinate View*  
motivated by the recognition that the constituent objects have something in common despite their diversity (found in the categorization literature)

## Individuals in denotation:

- ▶ *Collection of Individuals View*  
motivated by substitutability of *furniture*-nouns by nouns denoting their constituent objects

## Collection of Individuals View

Evidence that the constituent objects are linguistically relevant:

- ▶ these individual elements are in principle countable
  - ▶ *Ed listed the furniture in the dining room.*
- ▶ they are modifiable (Schwarzschild 2006)
  - ▶ *big furniture* distributes over the individual pieces
- ▶ they provide for a dimension of comparison (Barner & Snedeker 2005)
  - ▶ If Ed has more pieces of furniture than Eva, then he may be considered to have more furniture

## Collection of Individuals View

The visibility of the constituent objects has led to an analysis in which the denotation of *furniture*-nouns is simply composed of these objects (e.g. Chierchia 1998, Bale & Barner 2009)

- ▶ that is, they denote a collection of individuals
- ▶ under this view, *furniture*-nouns are synonymous and co-extensive with their component parts

## Collection of Individuals View

“What else can the denotation of *furniture* be, if not all the pieces of furniture (down to the single ones)?” (Chierchia 1998: 68)

- ▶ **Evidence:** the inter-substitutability of, e.g. *mail* and *letters* or *living room furniture* and *sofa, coffee table, chairs*

John arranged { the furniture.  
the sofa, coffee table, chairs.

## Collection of Individuals View

- ▶ Non-countability is not a problem since proponents consider count vs. mass classification to be arbitrary (Chierchia 1998, Pelletier 1991, Rothstein 2010)  

“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: 56)
- ▶ Cross-linguistic variation in the status of certain translation equivalents lends plausibility to this view:
  - ▶ English *furniture* (uncountable) vs. French *meuble* (countable)

## Artifacts and Their Associated Events

However, the focus on constituent parts is at the expense of another equally important dimension of meaning present in these nouns:

- ▶ *Furniture*-nouns designate artifacts

The artifact vs. natural kind distinction is an essential conceptual distinction among entities, as discussed by philosophers and cognitive and developmental psychologists (e.g. Aristotle, Wiggins 2001, Keil 1993, Wierzbicka 1985).



## Artifacts and Their Associated Events

Artifacts differ from natural kinds in that they have a function, evoking what Nichols (2008) calls an ‘associated event’, cf. the ‘telic’ component of Pustejovsky’s (1995) qualia structures

“two types of noun meaning

- a. nouns whose meaning is based on physical properties of the referent, and
- b. nouns whose meaning is represented by the canonical event associated with the referent” (Nichols 2008: 694)

# Artifacts and Their Associated Events

The artifact/natural kind distinction is also grammatically relevant, having a linguistic manifestation in the names given to entities in the world. (Wisniewski & Love 1998, Brown 1999, Kemler Nelson et al. 2003, Nichols 2008)

Furthermore, these naming patterns underscore the importance of recognizing an associated event in the characterization of an artifact.

## Naming Patterns for Artifacts vs. Natural Kinds

Although many entities have morphologically simple names, some may have morphologically complex names.

In a study of how items imported from Europe were named in the languages of the Americas, Brown (1999) found that these languages tended to have complex names for artifacts more often than for natural kinds.

## Naming Patterns for Artifacts vs. Natural Kinds

- ▶ 63% of the names of artifacts make reference to their function
  - ▶ That is, these names are deverbal  
(cf. English *grater*, *dryer*, *copier*, *can-opener*)
- ▶ Only 10% of natural kind names refer to function  
Those that do could be seen as having a function:
  - ▶ e.g. *horse* in Cherokee is literally 'he carries heavy things'
- ▶ Thus, artifacts often wear their associated event on their "sleeve"

## Naming Patterns for Artifacts vs. Natural Kinds

When natural kinds are given complex names, they are likely not to be deverbal:

- ▶ Most often they make reference to a perceptual property (size, color, shape, texture): e.g. 'sour orange' for *lemon*

These names are compounds headed by a noun, which puts the entity named into a taxonomic category (e.g. orange), with the modifying element (e.g. sour) distinguishing that entity from other entities in the same category.

## Naming Patterns for Artifacts vs. Natural Kinds

Wisniewski & Love found similar results in a study of English noun-noun compounds.

Further, they note that even when noun-headed compounds are used to name artifacts, the relation between the head and the modifier is different than it is for natural kinds, implicitly evoking the associated event, rather than perceptual properties.

### **English noun-noun compounds:**

**Natural kind:** leopard lizard, candy barrel cactus, snow goose

**Artifact:** coat hook, pencil cup, drafting stool, thumb tack, trash can

## Naming Patterns for Artifacts vs. Natural Kinds

There is convergent evidence from language acquisition:

“that there is an intimate relation between names for artifacts and the functions that artifacts perform, and that this relation is appreciated by young children, as well as adults. There was a clear and general tendency for both adults and four-year-olds to invent novel names for objects that derived from the functions, rather than the perceptual features of objects for which they lacked conventional labels.” (Kemler Nelson et al. 2003: 833)

# Artifacts and Their Associated Events

The canonical associated events for *furniture*-nouns:

- ▶ *furniture*: furnishing a space
- ▶ *mail*: transmittal through the postal system
- ▶ *luggage*: pulling or carrying throughout a journey
- ▶ *change*: returned money from monetary transaction



## Evidence for the Associated Event

*Etymological Evidence:*

*Furniture*-nouns are often deverbal:

- ▶ *furniture* (< French *fournir* 'to furnish')
- ▶ *luggage* < *lug* (v.) + *-age*
- ▶ *change* < *change* (v.)

Or are closely tied to an event:

- ▶ *mail* is derived from bags used by couriers ("mail of letters"), cf. Modern French *malle* 'suitcase'

## Beyond Individuals

The constituent objects of *furniture*-nouns are clearly an important part of their meaning.

However, we now show that the associated event is an important second dimension of meaning.

## Beyond Individuals

Evidence that both dimensions must be acknowledged comes from the differing grammatical behavior of *furniture*-nouns and their purported constituents.

These differences arise because the functions of *furniture*-nouns may be distinct from those of their constituents.

- ▶ **Substitutability**: there are limits to substitutability
- ▶ **Adjectival Modification**: some adjectival modifiers occur more happily with the *furniture*-noun rather than its component parts, and vice versa
- ▶ **Comparison**: comparisons need not be based on component parts, but may involve the fulfillment of function

# Substitutability

To the extent that a *furniture*-noun is a collection of individuals, its component parts should be substitutable for the whole.

However, the whole and purported parts are not always interchangeable.

# Substitutability

## An example: Mail vs. letters and packages

What makes something qualify as mail?

- ▶ Simply that it has been mailed.

# Substitutability

**Mail:** a set of entities which have in common that they travel together through the postal system

- ▶ may include letters, but also magazines, packages, postcards, and the like.

# Substitutability

**Letters and packages:** far narrower classes of entities, that need not be mailed:

- ▶ Letters are written to convey information to some recipient(s)
- ▶ Packages are used to facilitate the transportation of goods

**Key point:** Not all letters or packages are mail, nor is all mail letters or packages.

# Substitutability

Nevertheless the contents of someone's mailbox on a given day could be truthfully described as either *mail* or *letters*.

Objects in the world have many attributes and a given name only highlights some of them.

- ▶ In using either *mail* or *letters* as the label for the contents of the mailbox, the speaker chooses to pick out a particular subset of the attributes of the mailbox contents on that day.



# Substitutability

Patterns of inferences demonstrated by *furniture*-nouns are sensitive to the function and component parts:

- ▶ Ed touched a letter.  $\Leftrightarrow$  Ed touched mail.
- ▶ Ed touched a chair.  $\Rightarrow$  Ed touched furniture.
- ▶ Ed touched furniture.  $\nRightarrow$  Ed touched a chair.

# Adjectival Modification

Due to their function, *furniture*-nouns may lend themselves to modification patterns distinct from those of their component parts.

A corpus analysis reveals real and systematic differences in the adjective types found with the two noun types which further suggest that the associated event is important.

# Adjectival Modification

## The Corpus Study

Extracted all adjective-noun pairs headed by *furniture*-nouns and plausible constituent objects from British National Corpus (BNC)

<i>Furniture</i> -Nouns	Tokens	Constituent Nouns	Tokens
Mail	364	Letters	587
Furniture	460	Chairs	283
		Tables	242
		Beds	200

Adjectives coded for one of the GermaNet semantic categories (approx. 50)

# Adjectival Modification

## Distribution of Adjective Types:

Type	Example	<i>Furniture</i>	<i>Chairs, tables, beds</i>
Total Spatial		6%	<b>18%</b>
Shape	<i>oblong, high-backed</i>	< 1%	<b>6%</b>
Dimension	<i>high, narrow</i>	0%	<b>4%</b>
Localization	<i>opposite, central</i>	0%	<b>2%</b>
Style/Period	<i>Victorian, Louis XV</i>	<b>14%</b>	1%

# Adjectival Modification

Adjectives denoting shapes, dimensions or localization should in principle be applicable to nouns naming pieces of furniture or to the noun *furniture* itself:

- ▶ However, these adjectives are more prevalent with nouns naming individual pieces of furniture
- ▶ This is an instantiation of the observation that dimensional (shape) adjectives apply to individual objects (Bunt 1985)
- ▶ cf. such adjectives are known to prefer count rather than mass nouns: *round bowl* vs. \**round soup*

# Adjectival Modification

Adjectives designating the style or period should in principle be applicable to nouns naming pieces of furniture or to the noun *furniture* itself:

- ▶ However, style adjectives are more prevalent with *furniture* than the nouns naming individual pieces of furniture
- ▶ Most likely because style is something typically discussed for the furnishings of a location as a whole, rather than for individual pieces

# Adjectival Modification

Some adjective-noun combinations specify properties of the event:

**Distribution of Adjective Types** (*mail vs. letters*):

Category	Example	Mail	Letters
Delivery	<i>express, international</i>	<b>45%</b>	2%
Behavior-Related	<i>malicious, poignant</i>	1%<	<b>21%</b>
Mood-Related	<i>cheery, dreadful</i>	1%<	<b>10%</b>

## Adjectival Modification: Mail/Letters

The distinct adjectival modification patterns reflect the distinct associated events:

- ▶ The adjectival modifiers for *mail* overwhelmingly concern the event tied to the noun, its delivery.
- ▶ The adjectival modifiers for *letters* often characterize the content of the letters, consistent with a letter's core function of conveying information.



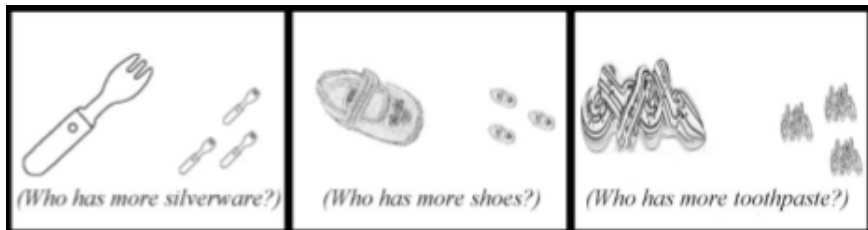
# Comparison

In comparison contexts, constituent objects of *furniture*-nouns could determine judgements of quantities.

Barner & Snedeker (2005) demonstrate exactly that.

## Comparison

Their task involved making judgements for differing quantities of *furniture*-nouns, count nouns, and substance-mass nouns.



## Comparison

**The general finding:** The syntactic status of a noun, i.e. (non-)countability, did not determine how quantity judgements were made:

- ▶ For substance nouns, participants judged one large portion to be “more” than three tiny portions.
- ▶ For count nouns, participants judged according to number of physical objects.
- ▶ For *furniture*-nouns (their “object-mass” nouns), participants also judged according to number of physical objects.

# Comparison

While the experiment shows that individuals can be relevant:

- ▶ heterogeneity may not have been adequately controlled for
- ▶ there may be other relevant dimensions of comparison (Solt 2008, Rothstein 2010)
  - ▶ Specifically, our hypothesis was that the associated event provides another dimension for comparison

## Comparison: The Experiments

Three experiments were carried out to examine the role of the associated event in comparisons.

The stimuli were presented on Amazon's Mechanical Turk.

Each item was seen by 20 participants.

50% or more of the items were fillers.

# Comparison

**Experiment 1** investigates whether the heterogeneity of constituent entities affects comparisons:

- ▶ Participants evaluated which counted as more furniture:
  - ▶ (i) five chairs
  - ▶ (ii) a sofa, two chairs, a coffee table, and a bookcase (five items)

# Comparison

## Experiment 1 results:

- ▶ 20 participants unanimously chose (ii) — the heterogeneous set
- ▶ many commented that this set better performed the function of furnishing

The results are problematic for a theory where the denotation of *furniture* is only equivalent to the constituents in the set.

# Comparison

**Experiment 2** investigates whether the associated event provides a dimension for comparison.

When a set of entities related to a *furniture*-noun fulfills the function better, will they be judged as “more” than a set which has greater cardinality?



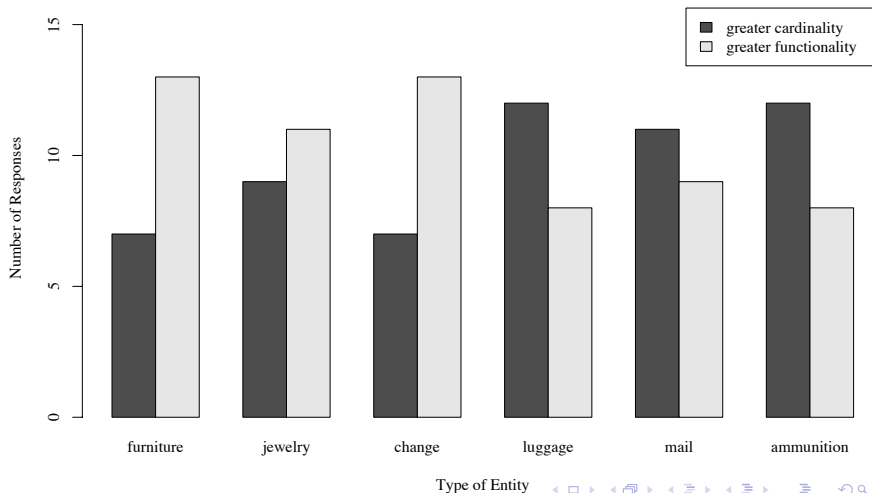
# Comparison

CONTEXT: Two women are at a gala event.

- ▶ Woman A is wearing two gold bracelets, a diamond tiara, and a ruby and emerald necklace. (4 items)
- ▶ Woman B is wearing three gold rings, a pearl necklace and a silver bracelet. (5 items)

Who has more jewelry?

# Comparison



## Comparison

The participants left comments, which showed that they were deciding between the cardinal and functional dimensions of comparison.

- ▶ **Jewelry:** “Although Woman B has one more piece of jewelry, Woman A’s jewelry appears to be more elaborate, with more jewels, probably larger, and probably more valuable.”
- ▶ **Furniture:** “Friend A has fewer pieces but a more diverse and practical collection”
- ▶ **Mail:** “The packages and boxes are generally bigger in mass, therefore it would appear to me that Resident B received more mail for the day.”

# Comparison

**Experiment 2 conclusion:** having more pieces is not always enough to count as “more”.

Multiple dimensions of comparison:

- ▶ number of pieces
- ▶ fulfillment of function

# Comparison

**Experiment 3** investigates the extent to which function plays a part.

Judgements along the “fulfillment of function” dimension should be sensitive to the immediate context, viz. whether the entities are engaged in that function or not.

# Comparison

## Function in effect:

CONTEXT: You are visiting different friends.

- ▶ Imagine upon entering Friend A's room, you see a sofa, an easy chair, a coffee table and a small bookcase. (4 items)
- ▶ Imagine upon entering Friend B's room, you see one table and four chairs. (5 items)

Whose room has more furniture?

# Comparison

## Function neutralized:

CONTEXT: Different dealers bought furniture at an antiques auction.

- ▶ Dealer A bought a sofa, an easy chair, a coffee table and a small bookcase. (4 items)
- ▶ Dealer B bought one table and four chairs. (5 items)

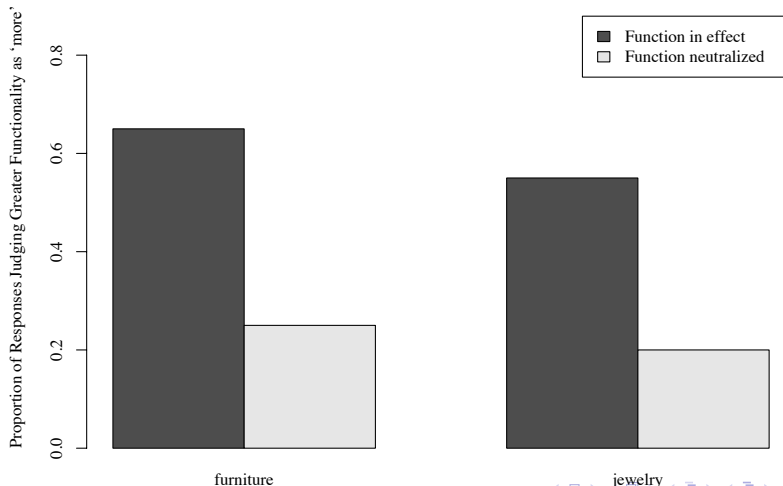
Which dealer bought more furniture at the auction?

# Comparison

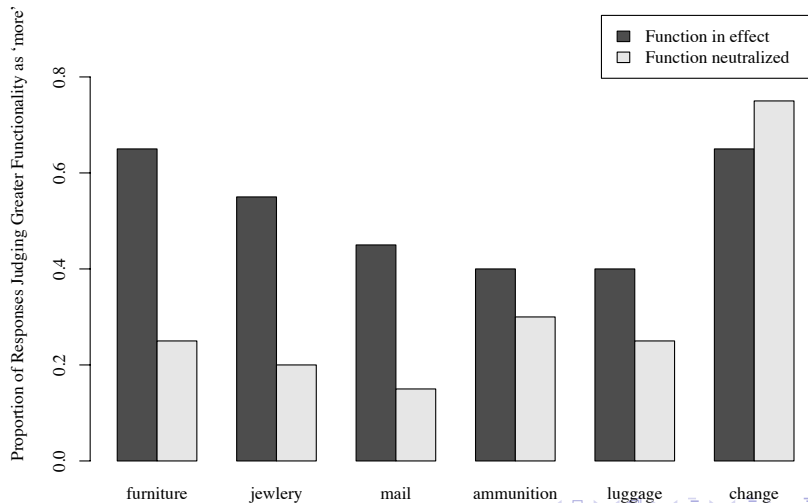
Results for <i>Furniture</i>	Function in effect	Function neutralized
Greater Functional Value	65%	25%
Greater Cardinal Value	35%	75%
	100%	100%



# Comparison



# Comparison



# Comparison

**Experiment 3 conclusion:** What counts as “more”—i.e. which dimension is used for comparison—is often dictated by the context in which the comparison takes place.

## Outline of Proposal: Functional Aggregates

Artifacts encode a relation between entities and a predicate designating the associated event.

*Furniture*-nouns are a specific type of artifact noun.

- ▶ They are special in that the associated event permits, and typically implies, a set of elements in the relevant relation.

Thus, we call them “functional aggregates”.

## Outline of Proposal: Functional Aggregates

We call *furniture*-nouns “functional aggregates” to recognize important connections with granular aggregates (*gravel, rice, salt*).

- ▶ Granular aggregates are notable for the **similarity in form** among their elements.
- ▶ Analogously, elements of a “functional aggregate” show **similarity in function**:
  - ▶ *Furniture*-nouns name sets whose members are in some sense identical—they all participate in the same associated event.

# Analysis

Once the artifactual nature of functional aggregates is recognized, the denotations are straightforward.

The denotation of *mail* will simply be those entities which participate in the associated event of *being in the postal system*.

$$(1) \quad \textit{mail} := \lambda w \lambda x [\textit{In-the-postal-system}(x)(w)]$$

# Analysis

However, artifact identity is often less simple:

- ▶ The relation between artifacts and the associated event is often *potential* rather than *actual*:
  - ▶ A hammer does not have to be involved in a hammering event at every moment to qualify as a hammer.
  - ▶ Similarly, furniture stacked in a hallway still qualifies as furniture even though it is not actively furnishing a space.

# Analysis

A denotation of a functional aggregate involving a modal component:

$$(2) \quad \textit{furniture} := \lambda w \lambda x \lambda loc \exists w' [wRw' \wedge \textit{furnishes}(x)(loc)(w')]$$



# Analysis

Countability properties of artifact nouns follow from the nature of the associated event.

For countable artifacts, any given instance of the associated event is typically tied to a single entity:

- ▶ e.g. for *hammer*, the associated event is hammering, viz. force is applied to some instrument to make contact with some target location.
  - ▶ If two hammers are involved, two distinct points of contact are involved and, therefore, can be divided into two distinct events.

# Analysis

For countable artifacts, given an associated event type, each (minimal) instance of the event yields a unique object:

- ▶ A set of minimal events then provides an atomic base for these nouns, parallel to typical countable nouns.

For functional aggregates, one (minimal) event typically yields multiple objects in the relevant relation to the event:

- ▶ The associated events of functional aggregates allows them to be number neutral: there is no requirement that a particular type of individual (singular, plural, group, . . . ) satisfy the associated event.

# Analysis: Consequences

## Heterogeneity:

Heterogeneity is a frequently noted property of functional aggregates, but not a necessary one.

Several different types of entities may participate in the same way in the associated event, hence the connotation of heterogeneity.

## Analysis: Consequences

### Inferences:

The correct inferences are obtained:

A chair is clearly able to participate in a furnishing event:

- ▶ Ed touched a chair.  $\Rightarrow$  Ed touched furniture.

If an object is a letter, it need not be in the postal system, so:

- ▶ Ed touched a letter.  $\nRightarrow$  Ed touched mail.

## Analysis: Consequences

Cumulativity and divisibility up to minimal parts are satisfied:

Cumulativity:

In-the-postal-system( $x$ )  $\wedge$  In-the-postal-system( $y$ )  $\rightarrow$   
In-the-postal-system( $x \oplus y$ )

Divisibility:

In-the-postal-system( $x \oplus y$ )  $\rightarrow$   
In-the-postal-system( $x$ )  $\wedge$  In-the-postal-system( $y$ )

## Analysis: Consequences

This perspective helps to make sense of the apparent arbitrariness in the world-to-word mapping within and across languages:

- ▶ *letters vs. mail*
  - ▶ Focus on the individual vs. the aggregate, as well as on different associated events.
- ▶ English *furniture* (uncountable) vs. French *meuble* (countable)
  - ▶ Entities have many attributes, and these names pick up on different sets of them.

## Conclusion

- ▶ *Furniture*-nouns are better understood as *functional aggregates*.
- ▶ They designate more than just a collection of individuals.
- ▶ The notion of functional aggregate accounts for observed semantic properties (non-countable syntax, heterogeneity, reference to function).
- ▶ Functional aggregates merit a place in an ontology of nouns:
  - ▶ show similarities with core count and mass nouns, but are distinct from both;
  - ▶ have properties that reflect the nature of the associated event.

# Thank You

Thank you!



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## Comparison

In Experiment 3, *change* behaved differently than the other nouns

- ▶ Participants largely used monetary value as the dimension of comparison

	Function in effect	Function neutralized
Greater cardinality	35%	25%
Greater value	65%	75%
	100%	100%