An Evaluation of the Brandeis Semantic Ontology

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What is the BSO?

- GL is meant to be used
- GL-based Lexical resource for the NL community
- Currently in development at Brandeis
- Consists of an ontology and a dictionary
- Build a lexicon/ontology for English, following SIMPLE specification

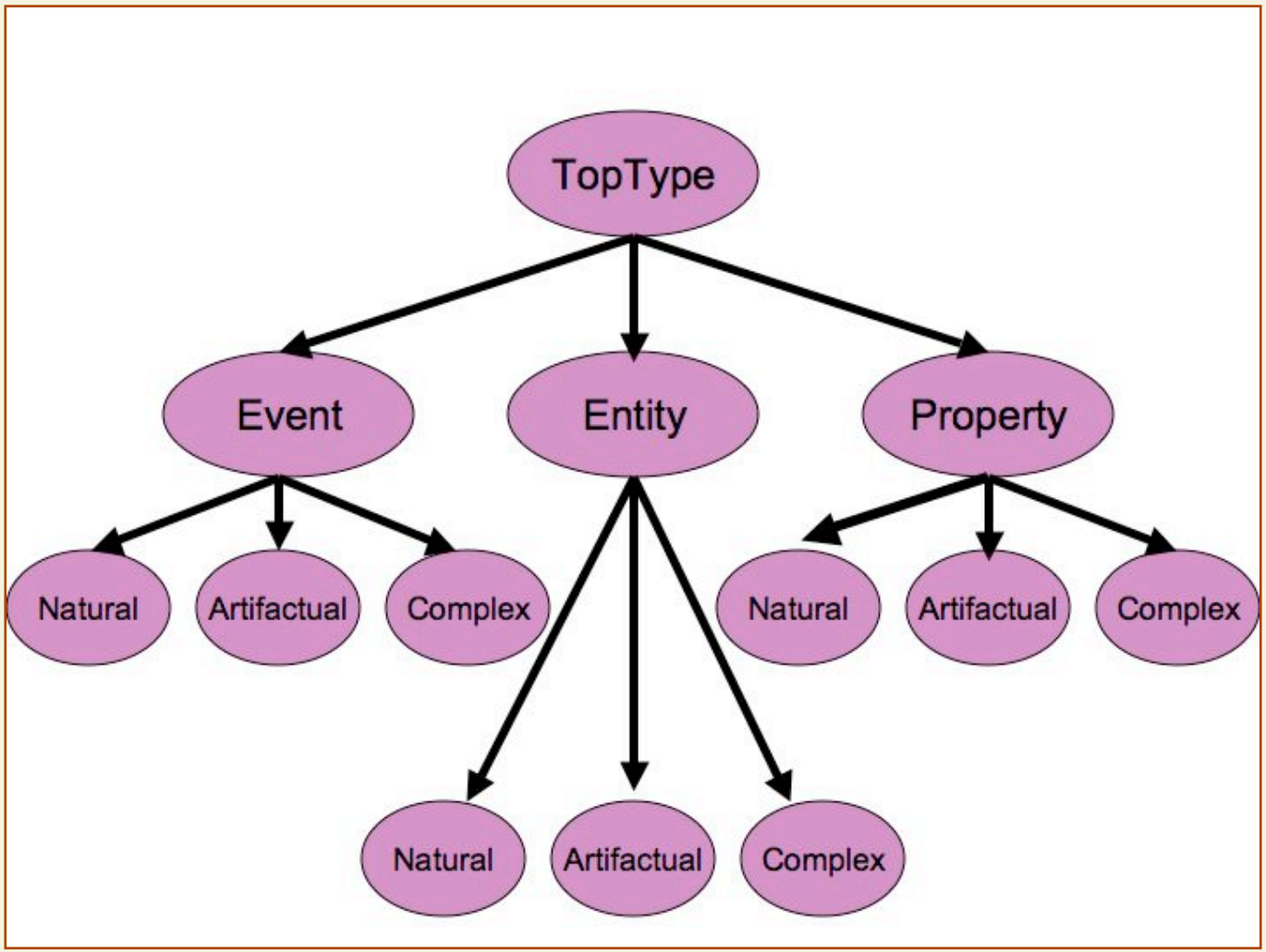
What's in the BSO?

- Four levels of information:
  - **Lexical typing structure**
  - **Argument structure:** *specifies predicate's arguments*
  - **Event structure:** *specifies event type and sub-events*
  - **Qualia structure**
- Distinguishing between Natural, Artifactual, and Complex types

Vital Statistics

- 40,000 lexical Items
- 3,500 ontological Items
- 1,400 of these have qualia other than formal

The Upper Ontology



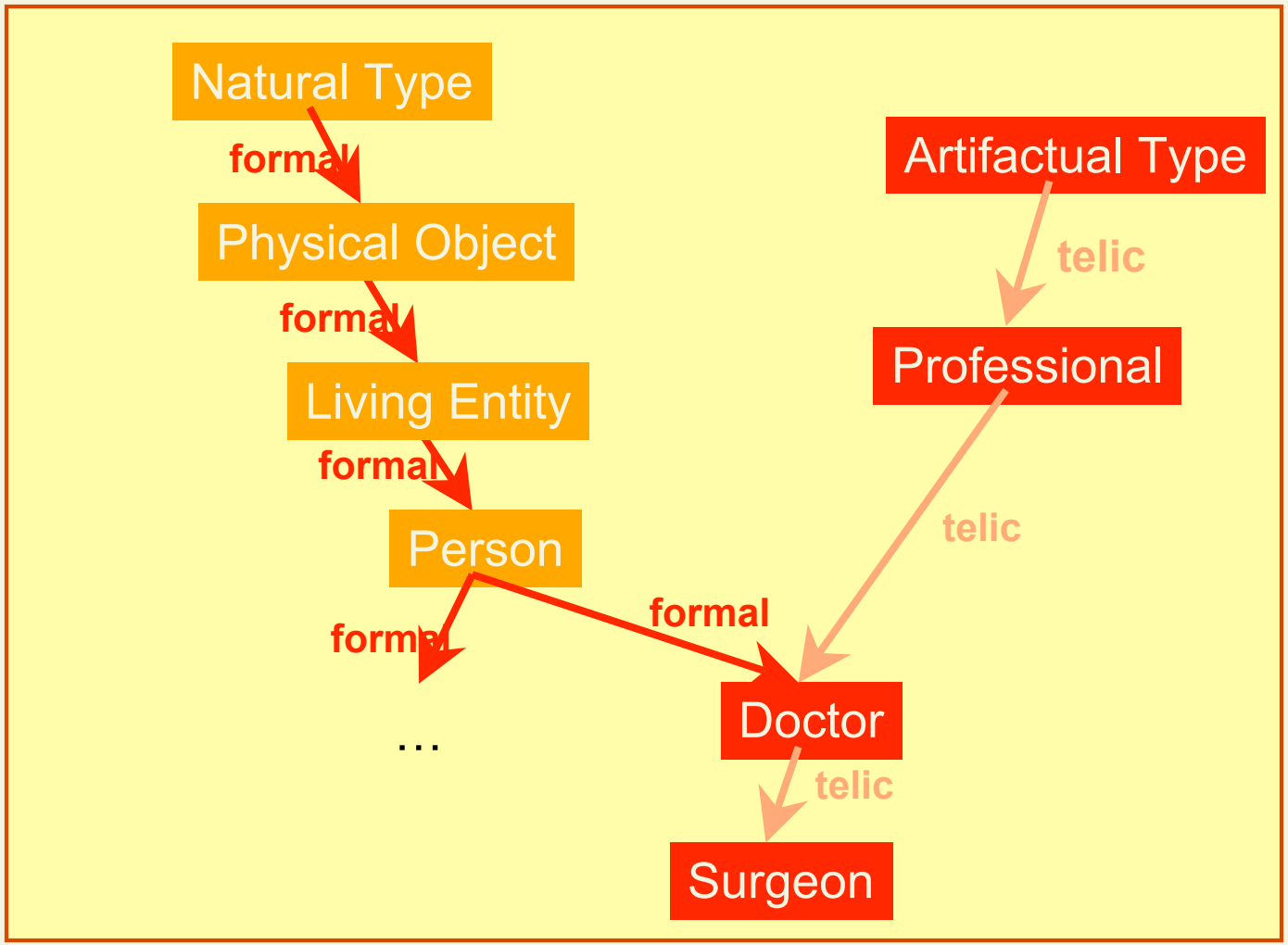
The BSO Hierarchy

- **Qualia** are defined for **Entity** types
- **Argument types** are specified for **Events**
- Entity hierarchy:
  - **Natural types**
    - Inherit formal qualia of supertype
  - **Artifactual types**
    - Inherit telic qualia of supertype
    - Formal qualia is inherited through **formal mapping**
  - **Complex types**
    - "dot types" (e.g. *building, book, lecture*)
    - very shallow hierarchy
    - inherit from two or three functional and/or natural types

Inheritance in the BSO

- Type inheritance principles:
  - Inheritance is typed
  - A simple type may inherit its qualia from different supertypes
  - Inheritance for **Entities** follows **qualia** links
  - Inheritance for **Events** mirrors **argument** type inheritance

Inheritance Plan



Types of Qualia

- **Formal**: the basic type distinguishing the meaning of a word
- **Constitutive**: the relation between an object and its constituent parts
- **Telic**: the purpose or function of the object (Direct, Indirect and Instrumental)
- **Agentive**: the factors involved in the object's origins or "coming into being" (Direct and Indirect)

Qualia in the BSO

BEER

- **Type**: Alcoholic Beverage
- **Indirect Agentive**: Brew
- **Constitutive**: Alcohol, Hops
- **Telic**: Drink Activity

Example: Beer

BSO

1. Sense 1

Tag:	noun	**Indirect Agentive:**	Create Material Entity Activity
Type:	Beer	**Indirect Telic:**	Drink Activity
Has Elements:	Alcohol	**Constitutive:**	Alcohol

Example: Book

BSO

1. Sense 1

Grammar Roles:	The #ppHead1 is a of. The #ppHead2 is a for. The #ppRole1 is a #directTelic. The #ppRole2 is a #indirectTelic.	**Direct Telic:** **Indirect Agentive:** **Indirect Telic:**	Describe Relation Write Activity Read Activity
Tag:	noun		
Type:	Book		

Browsing the BSO

BSO - The Brandeis Semantic Ontology

Search the BSO

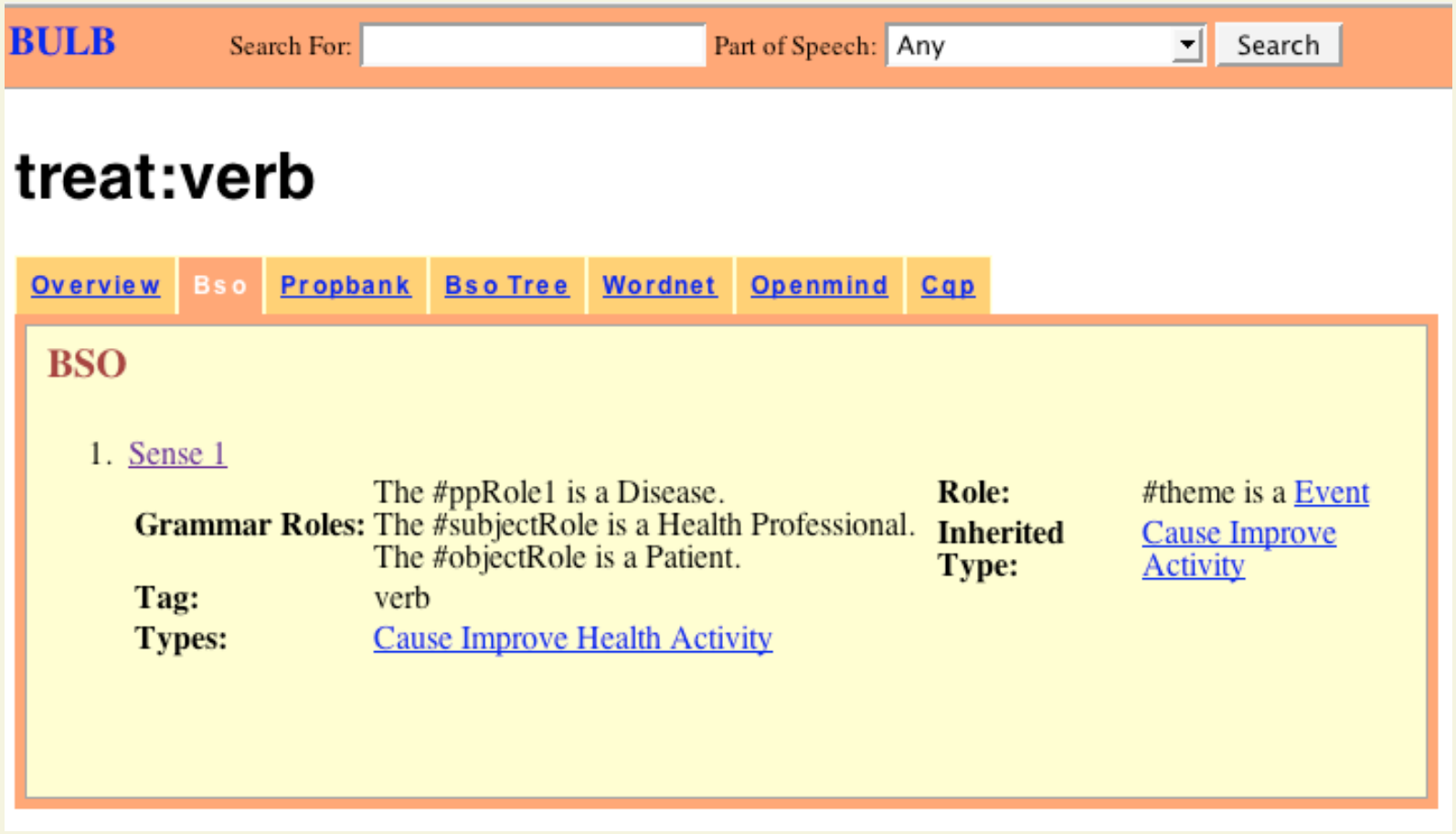
Word:
Lexicon Ontology Search

Name: mental
Types: Mental Process
TopType > Event > Dynamic Event > Relational Process > Living Entity Relational Process > Human Relational Process
Tag: adjective
Grammar Roles:
The #subjectRole is a #theme.

Inherited Type: Human Relational Process
Role: #externalArgument is a Computing Entity

+Mental Process
- + Compare Activity
- - Compute Activity
  - - Accounting Activity
    - + Bookkeeping Activity
    - + Reduce Tax Activity
- + Doubt Activity
- + Dream Activity
- + Incoherent Reasoning
- + Mental Creation Process
- + Predict Activity
- + Privative Predict Activity
- + Privative Remember Activity
- + Read Activity
- - Remember Activity
  - + Identify Activity
  - + Memorize Activity
- + Study Activity

BULB

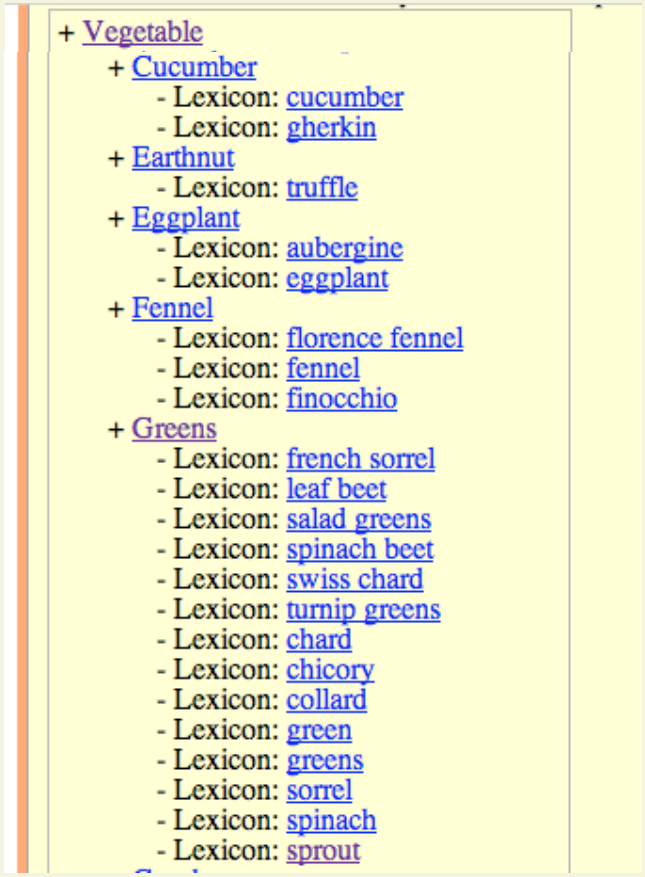

BULB
Search For:
Part of Speech:
Any
Search
treat:verb
Overview
Bso
Propbank
Bso Tree
Wordnet
Openmind
Cqp
BSO
1. Sense 1
Grammar Roles:
The #ppRole1 is a Disease.
The #subjectRole is a Health Professional.
The #objectRole is a Patient.
Tag:
verb
Types:
Cause Improve Health Activity
Role:
#theme is a Event
Inherited Type:
Cause Improve Activity

An Extended Example: Sprout

1. Sense 1
   Tag: noun
   Type: Greens

2. Sense 2
   Grammar Roles: The #subjectRole is a #externalArgument. **Role:** #theme is a Plant
   The #objectRole is a #theme.
   Tag: verb
   Type: Grow Plant Activity

The Tree


+ Vegetable
+ Cucumber
- Lexicon: cucumber
- Lexicon: gherkin
+ Earthnut
- Lexicon: truffle
+ Eggplant
- Lexicon: aubergine
- Lexicon: eggplant
+ Fennel
- Lexicon: florence fennel
- Lexicon: fennel
- Lexicon: finocchio
+ Greens
- Lexicon: french sorrel
- Lexicon: leaf beet
- Lexicon: salad greens
- Lexicon: spinach beet
- Lexicon: swiss chard
- Lexicon: turnip greens
- Lexicon: chard
- Lexicon: chicory
- Lexicon: collard
- Lexicon: green
- Lexicon: greens
- Lexicon: sorrel
- Lexicon: spinach
- Lexicon: sprout

The Parent Type

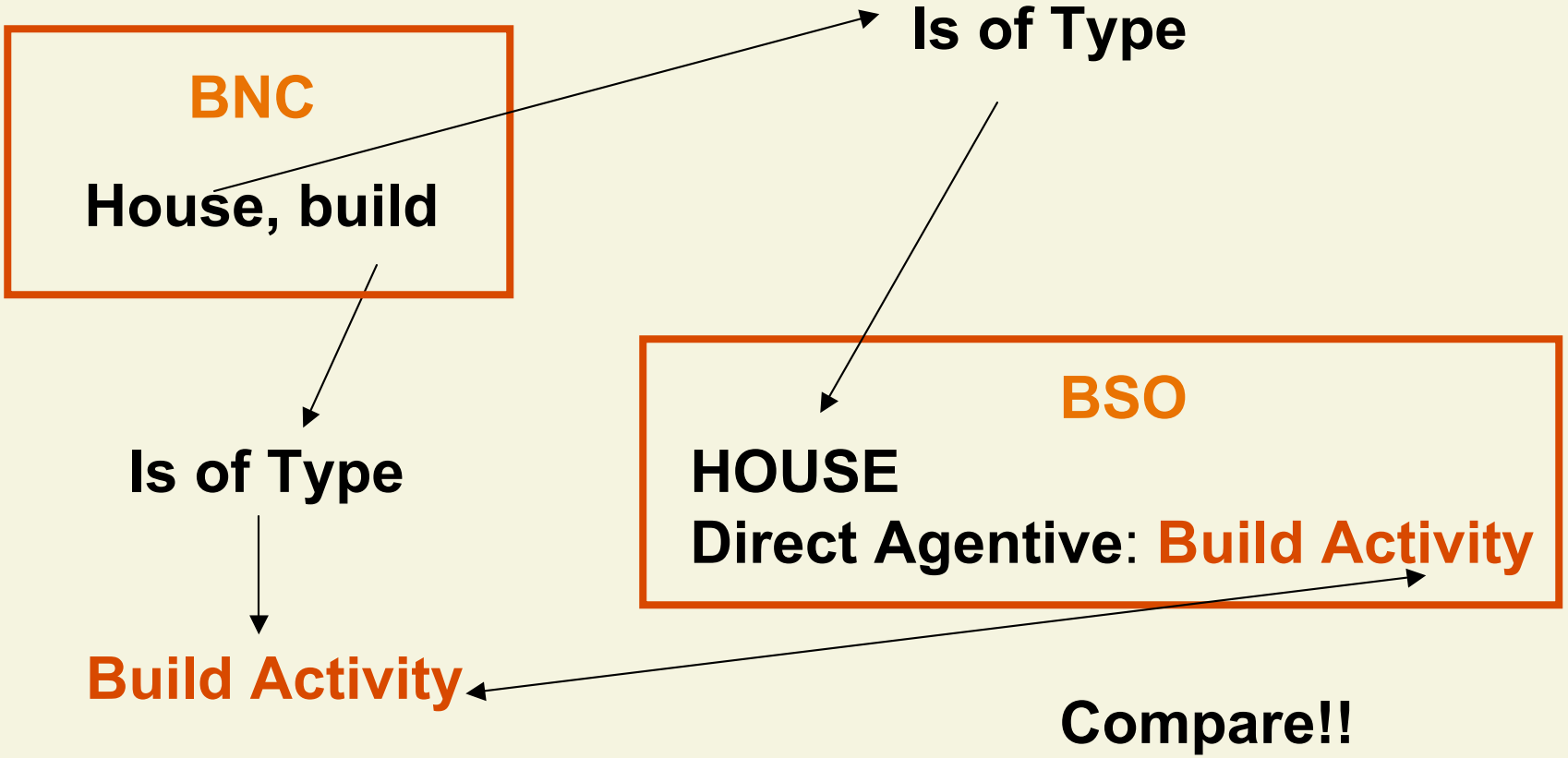
Sense 1

Parent Type(s):	Produce	**Indirect Agentive:**	Prepare Food Activity
		Indirect Telic:	Eat Activity
		Direct Agentive:	Origin Relation
		Constitutive:	Constitutive Relation

An Evaluation of the BSO

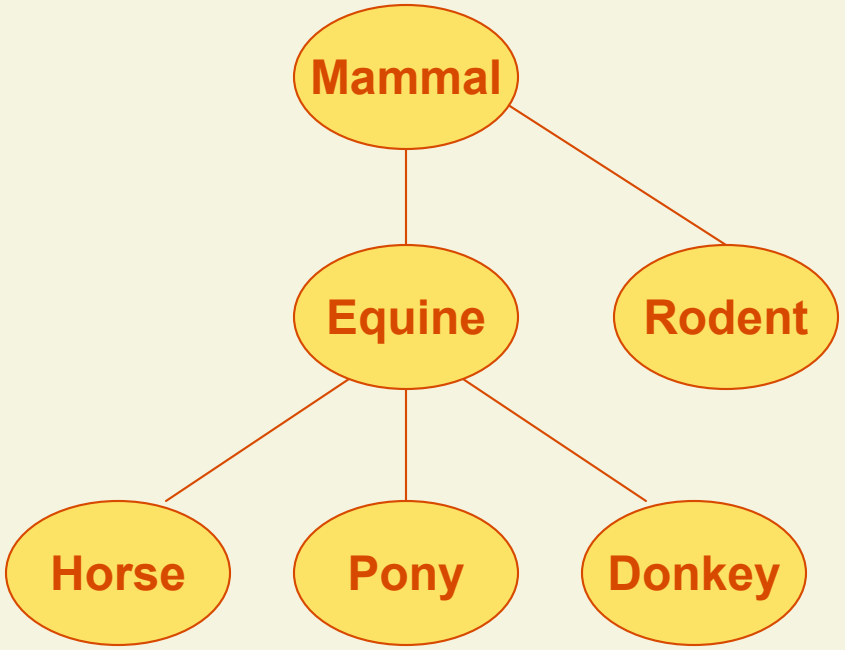
- How does the BSO compare with different types of resources?
  - BNC - corpus based resource
  - ConceptNet - normal language
- Accuracy and “Node Coverage”

Two Pairs of Words



The Measurements

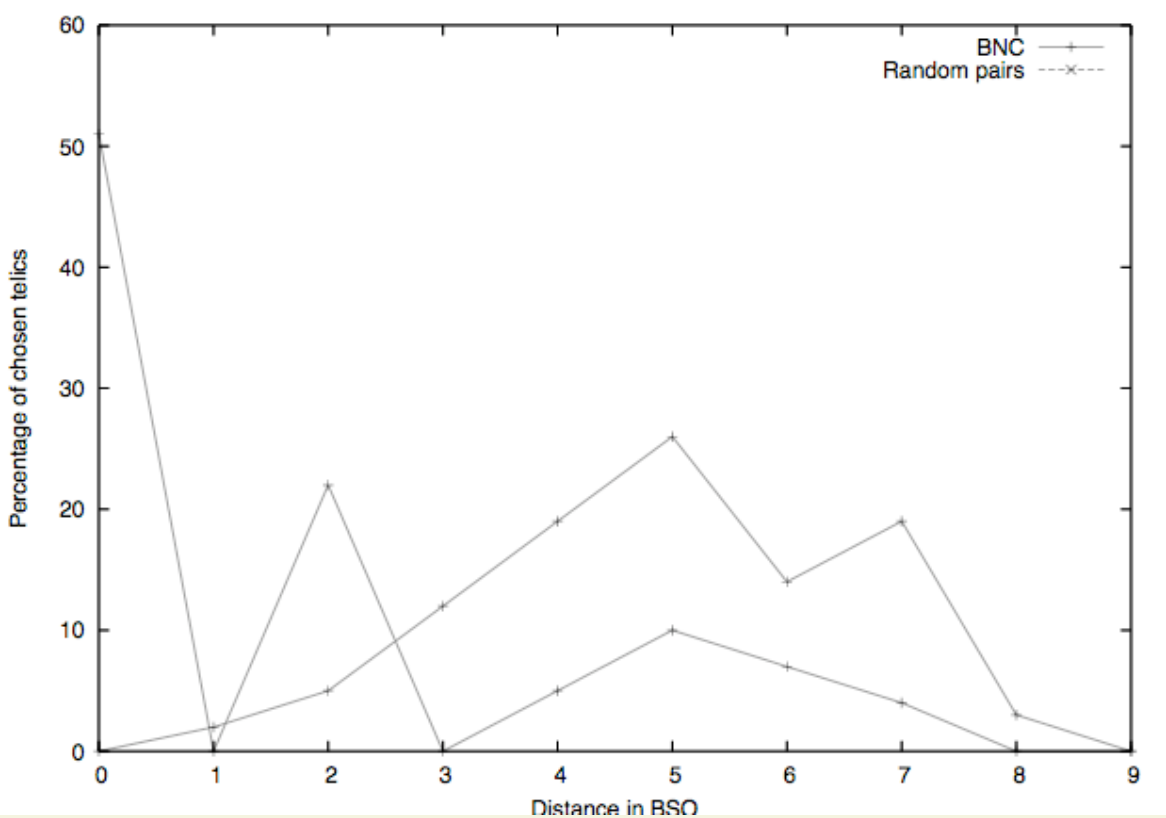
- How many “hops” it takes to get from one graph location to another
  - “Horse” to “Pony” is 2
  - “Horse” to “Rodent” is 3



BNC Pairs

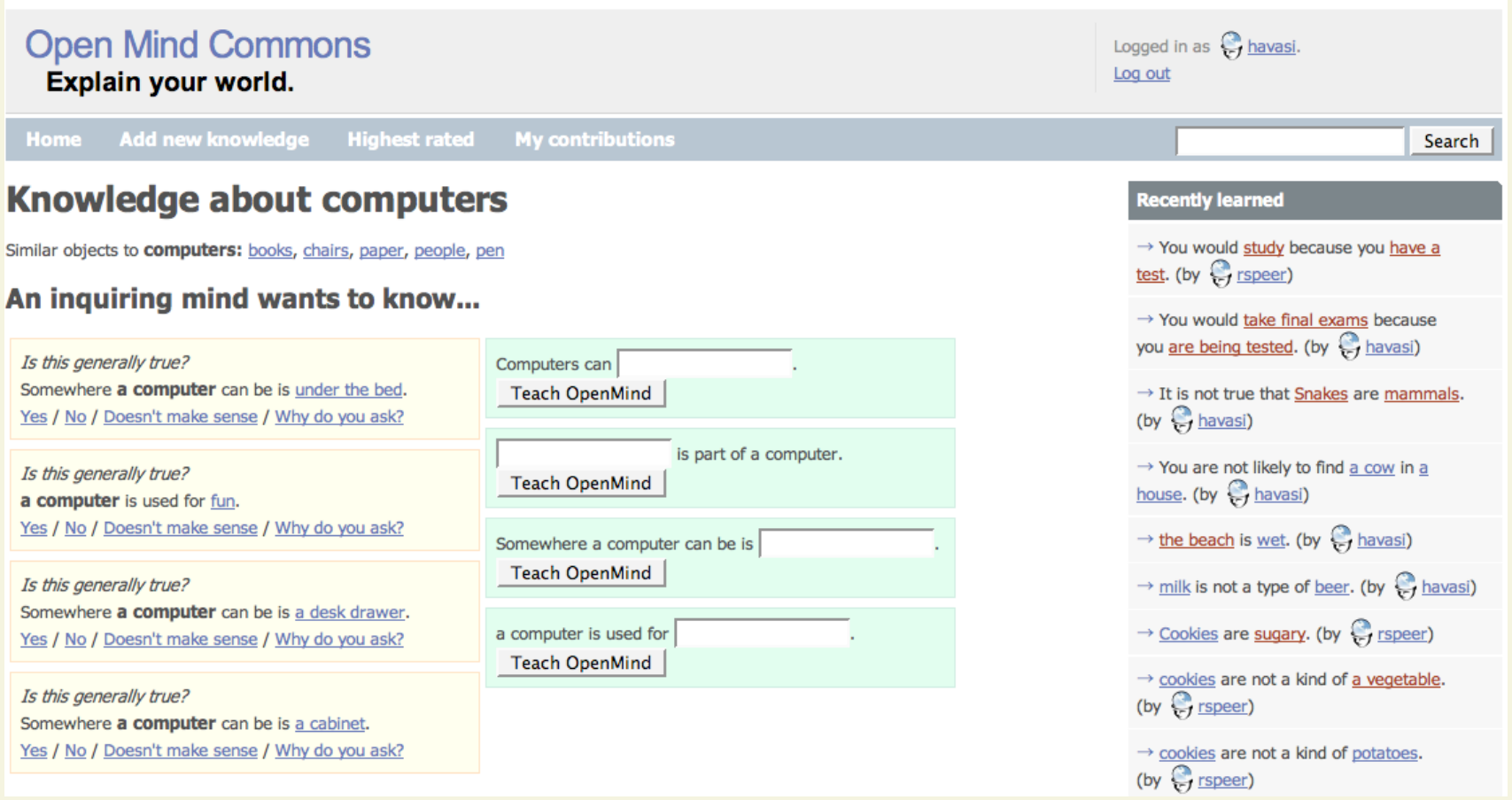
- burn incense
- knit lace
- eat lamb
- play music
- wear shorts
- read thesis
- blow trumpet
- read philosophy
- writing letters
- eat food
- ride horses
- build houses
- give interviews
- fly jets
- hear music
- grow sugar

Versus the BNC

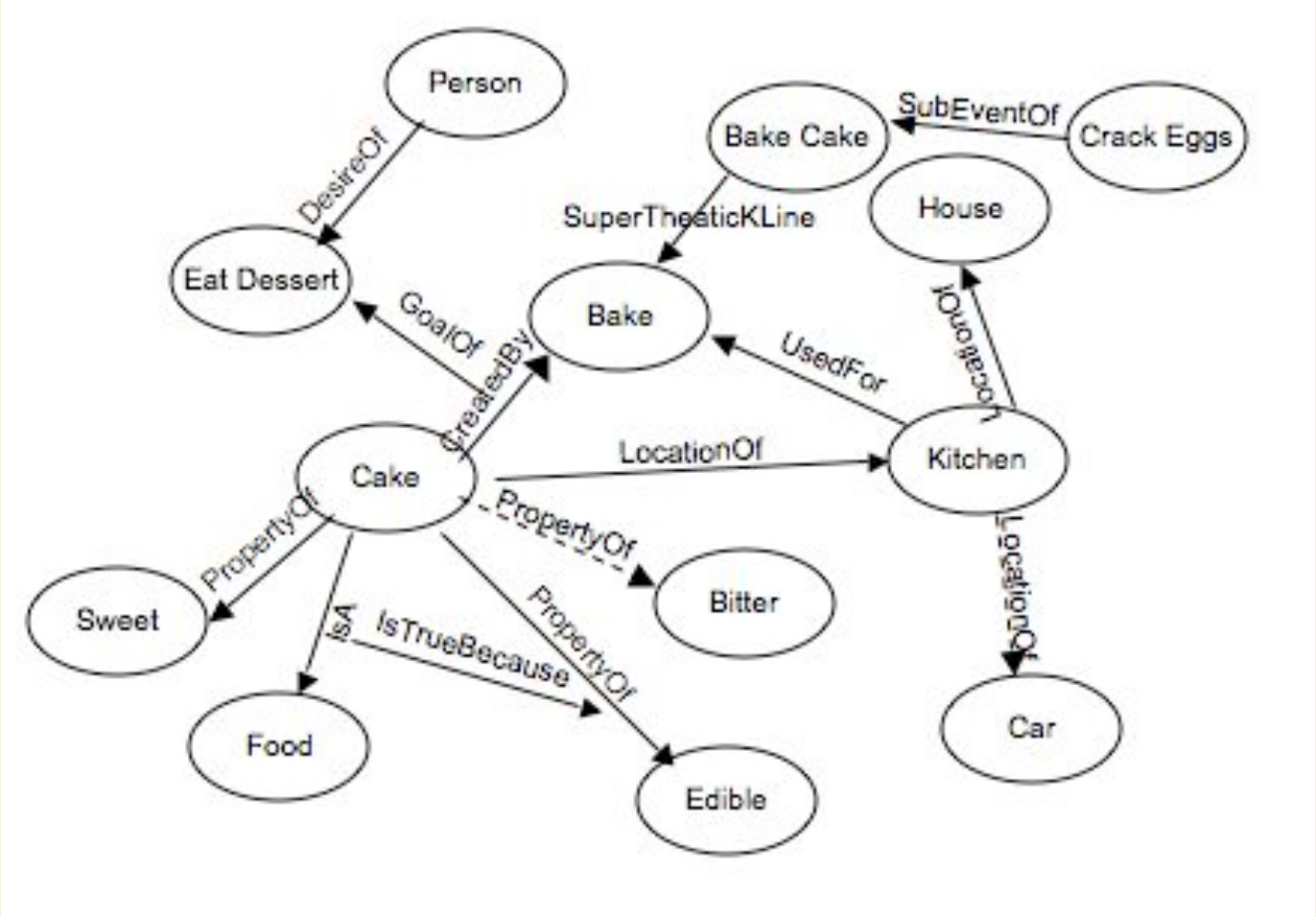


BSO: 51% Exact Matches. Average Distance 1.84
Random: 0% Exact Matches. Average Distance 5.00

Wait? From the internet?



A Web of Relations



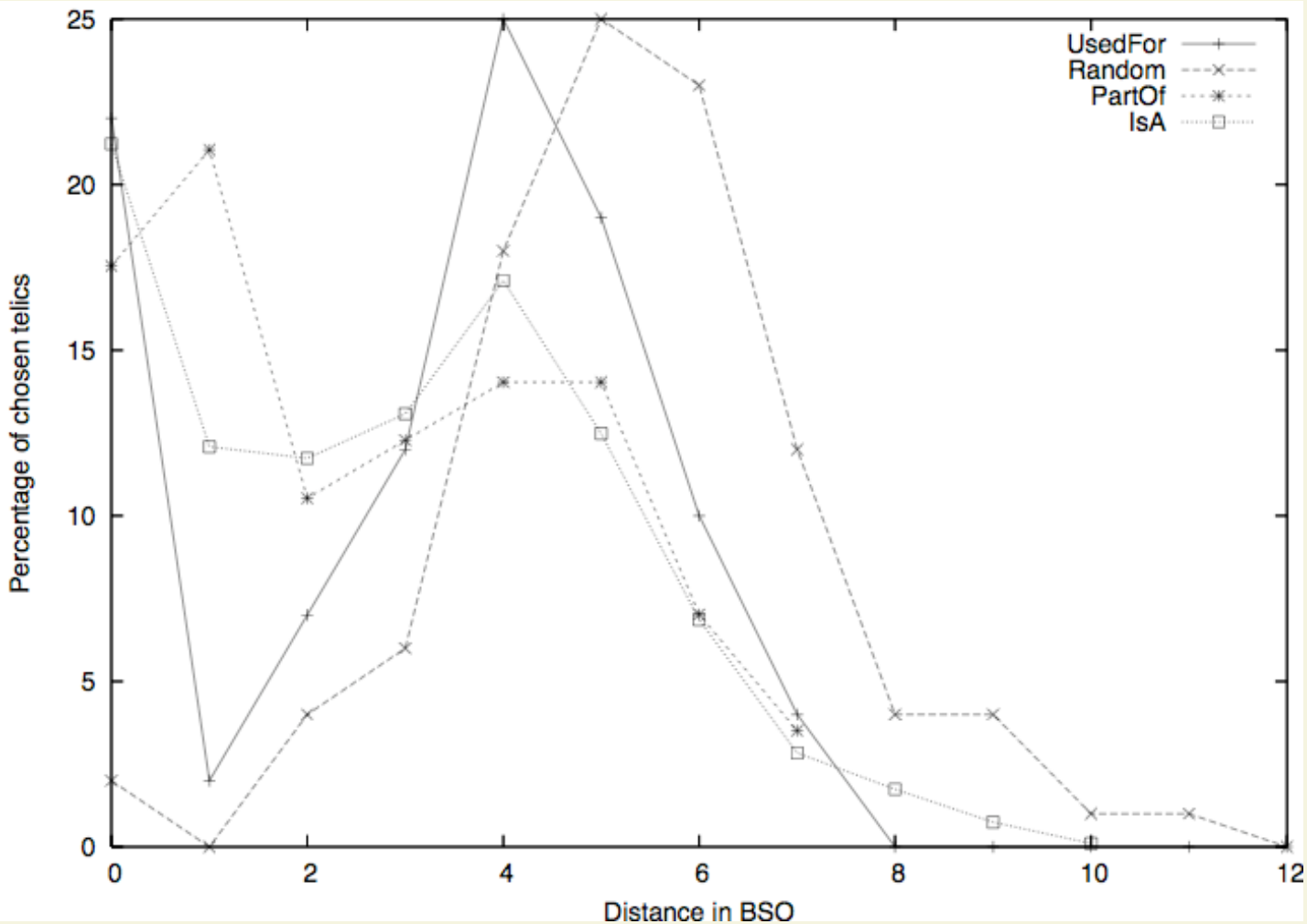
Common Sense in GL

- Focuses on relations between words
- IsA can map to formal
- UsedFor can map to telic
- MadeOf can map to constitutive
- New relation added for agentive - no data yet

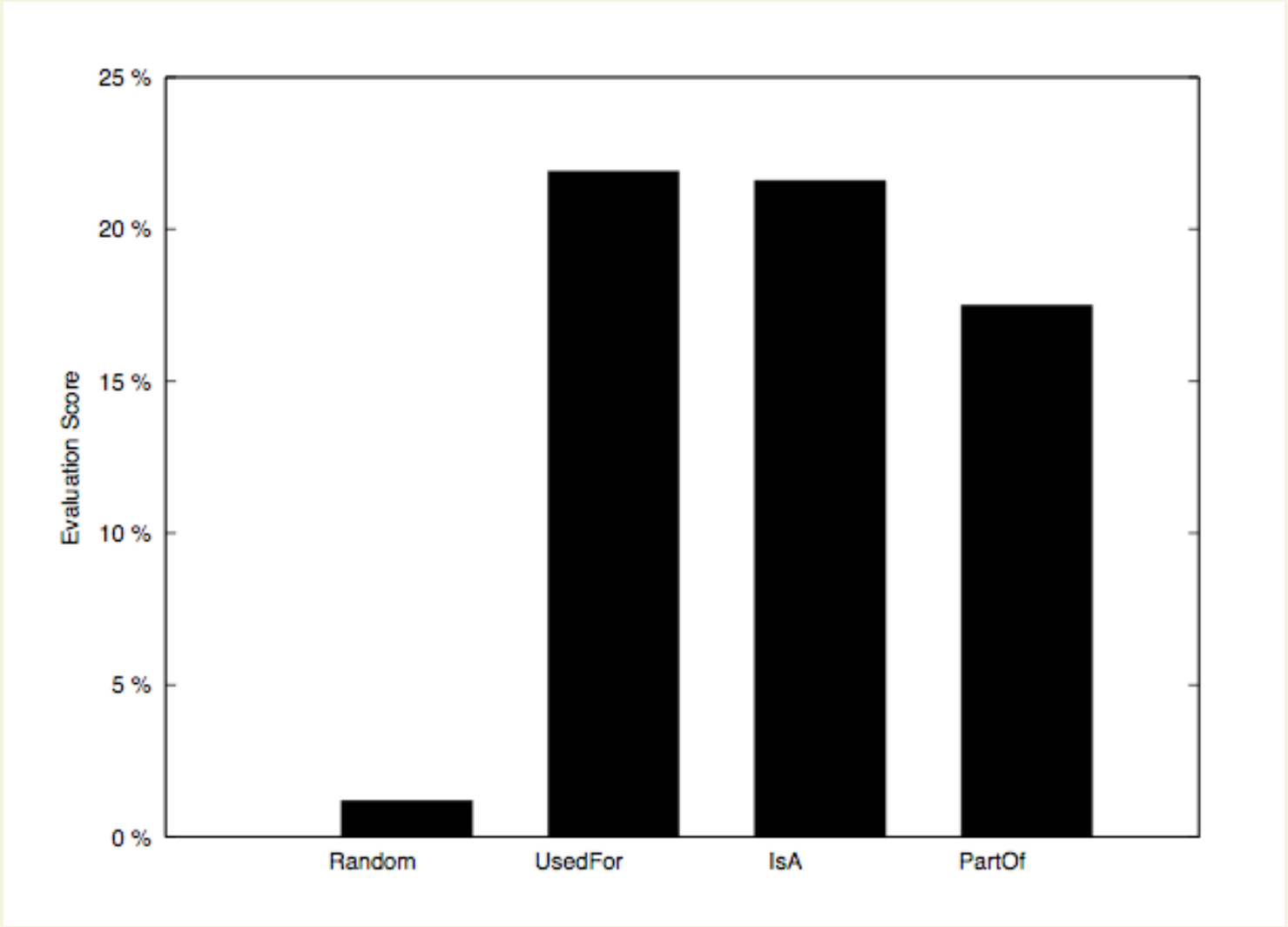
More Beer

OMCS Statement	Qualia Relation
``Beer is a type of alcoholic beverage"	Type
``beer is for drinking."	Telic
``Something you find in beer is alcohol”	Constitutive
``Beer is made from hops and barley"	Constitutive
``all beer has the property of being brewed."	Agentive

Versus the BSO



… for each Qualia Type



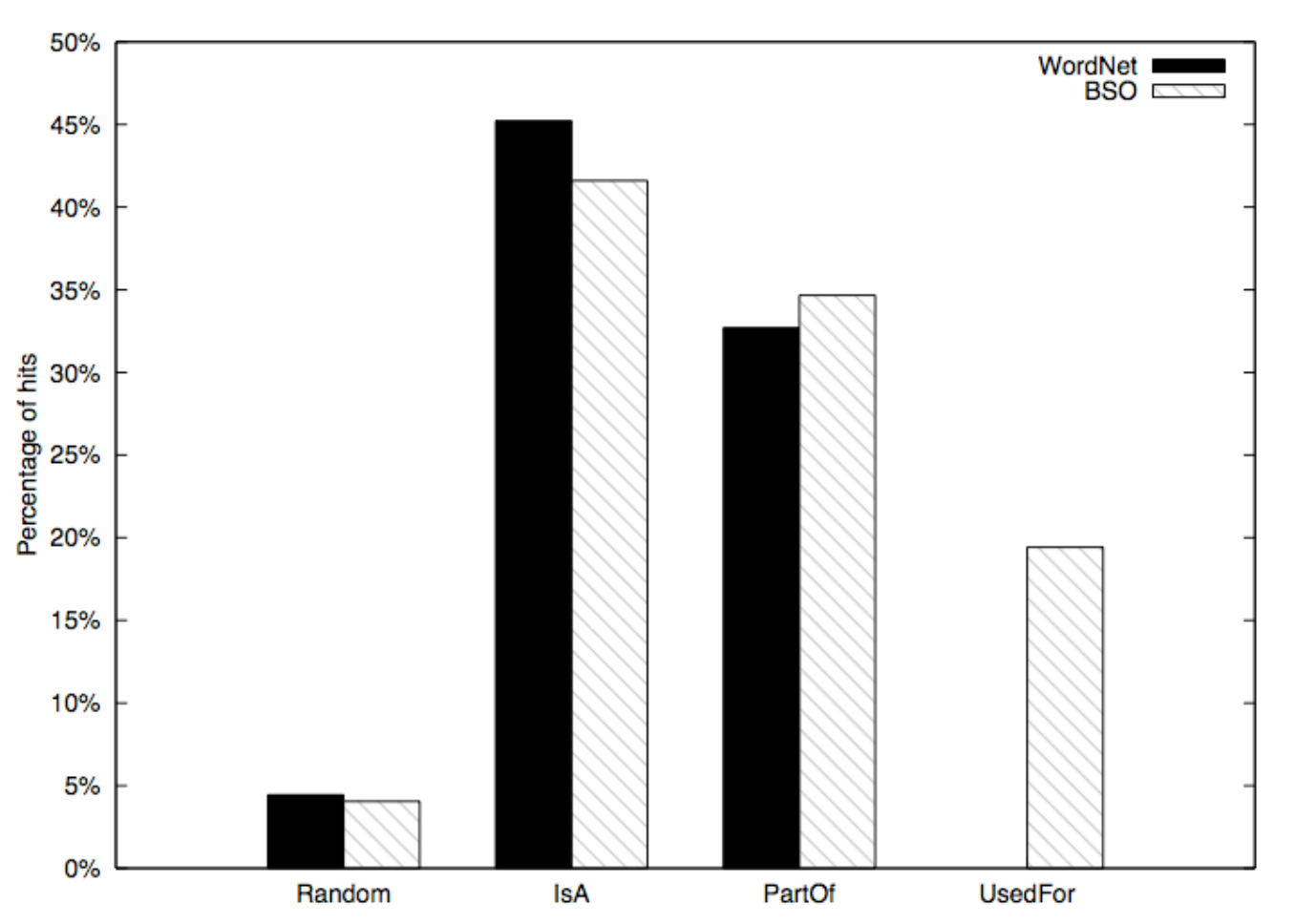
Average Distances

- Random: 4.05
- Formal: 1.37
- If it isn’t an exact match, then it isn’t far away.

Allowing for Granularity

- What if the BSO is simply more fine-grained than ConceptNet?
- Check if the lexical item is a direct ancestor of the target term.
- Apply the same checks to Wordnet vs. ConceptNet

Inheritance Scoring



Web Addresses of Interest

- BULB:

http://eurydice.cs.brandeis.edu:8000/dev/

- BSO Browser:

http://eurydice.cs.brandeis.edu/BSOonline/BSOtester.py

- OpenMind Commons:

http://commons.media.mit.edu:3001

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Questions?