Lexicon in psycholinguistics
Day 1

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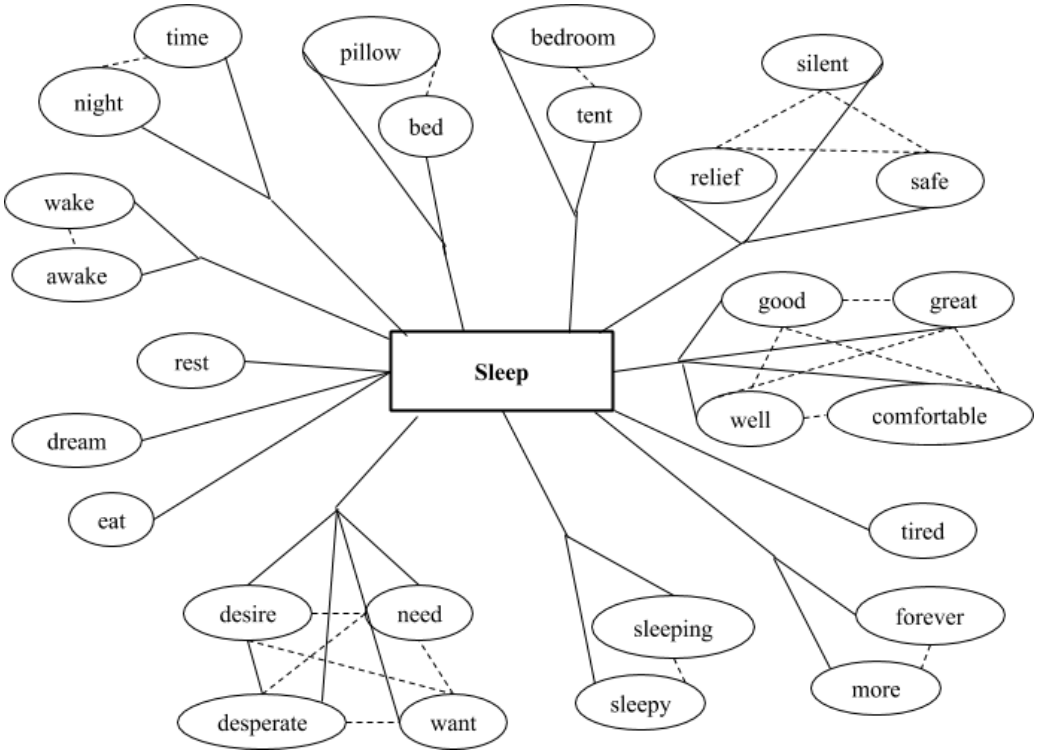
Course overview

- What is ‘the mental lexicon’?
- What experimental methods can be used to study it?
- How different meanings are stored in the mental lexicon?
- How do we process semantic ambiguity?
- What are the perspectives?

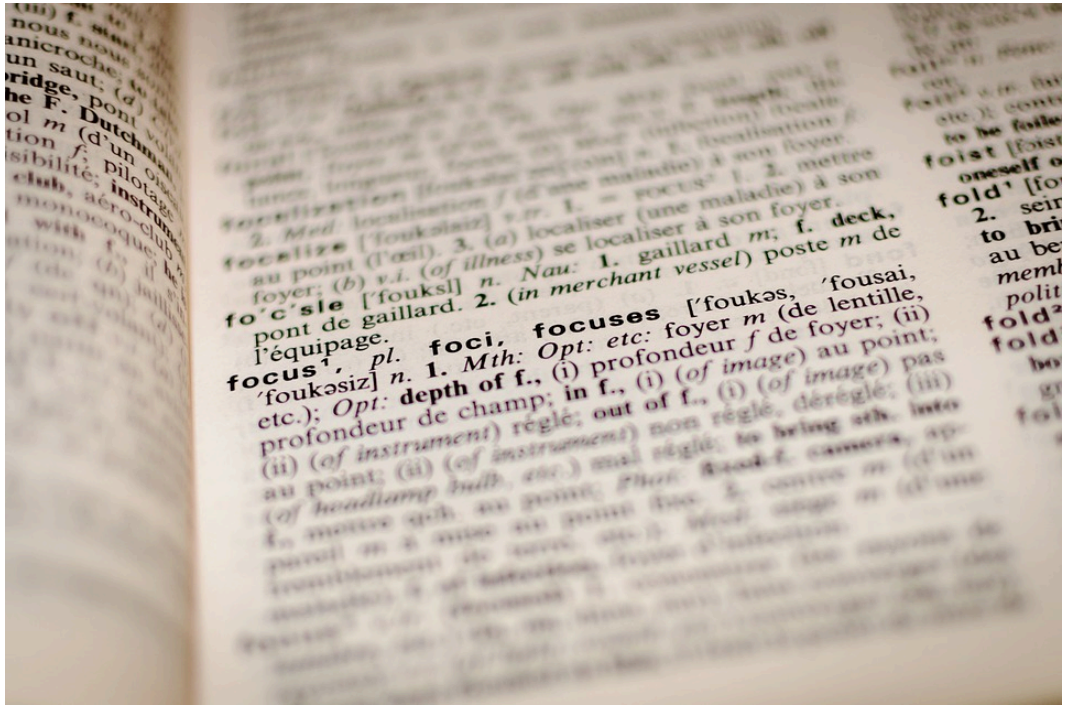
Mental Lexicon

Giant network containing information about all the words, an internal “dictionary”



Mental Lexicon

Not really a good analogy

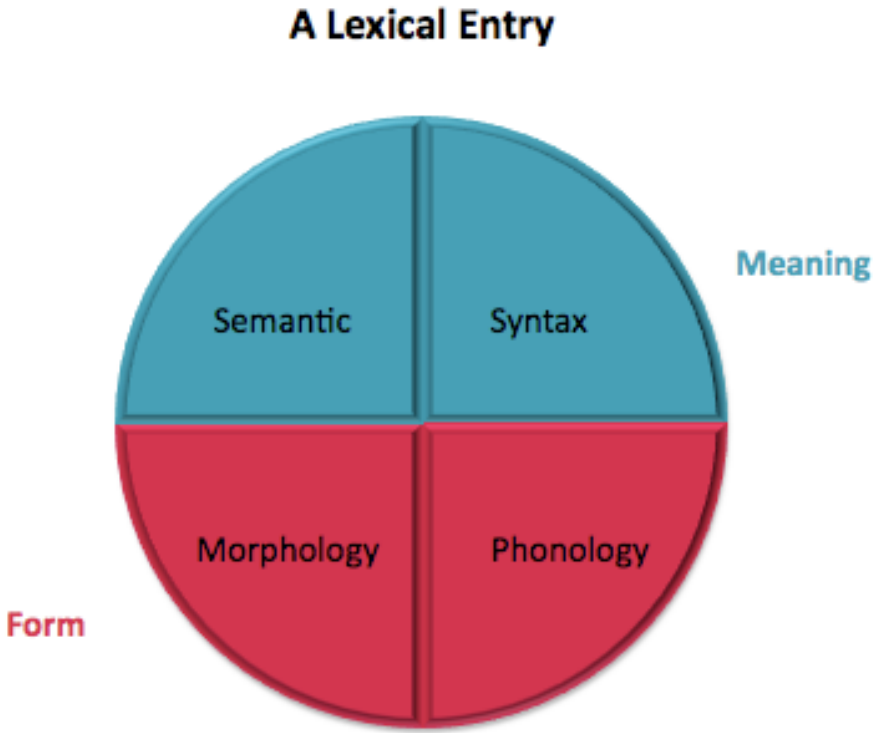


Mental Lexicon

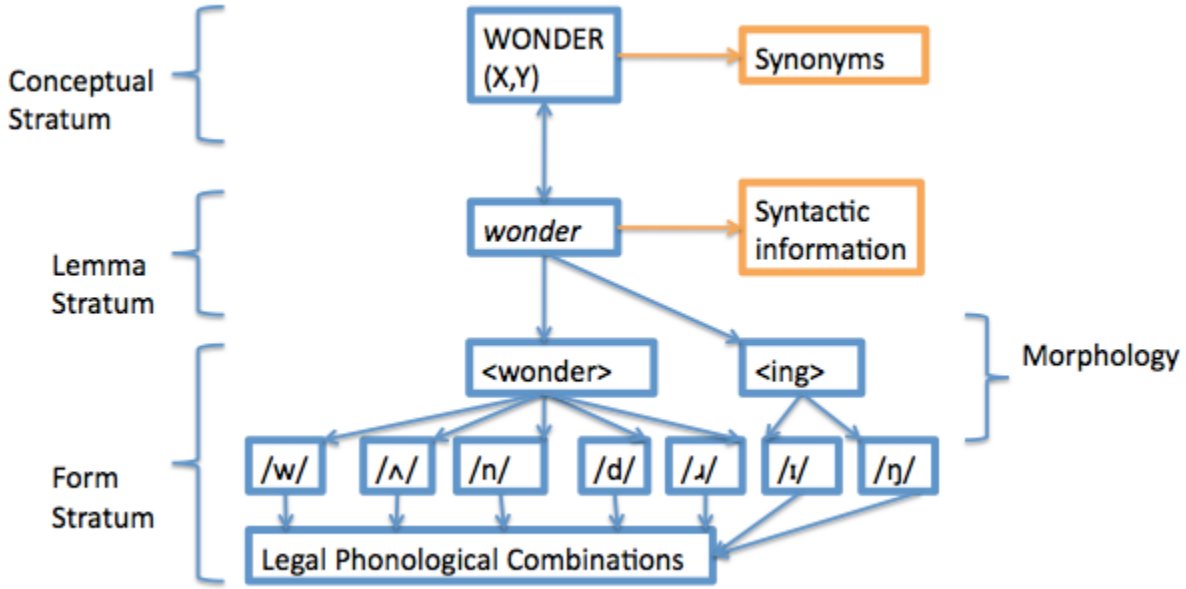
Words that are close in meaning, orthography, or pronunciation are linked

банан, варан, таран, буран, барон...

Mental Lexicon

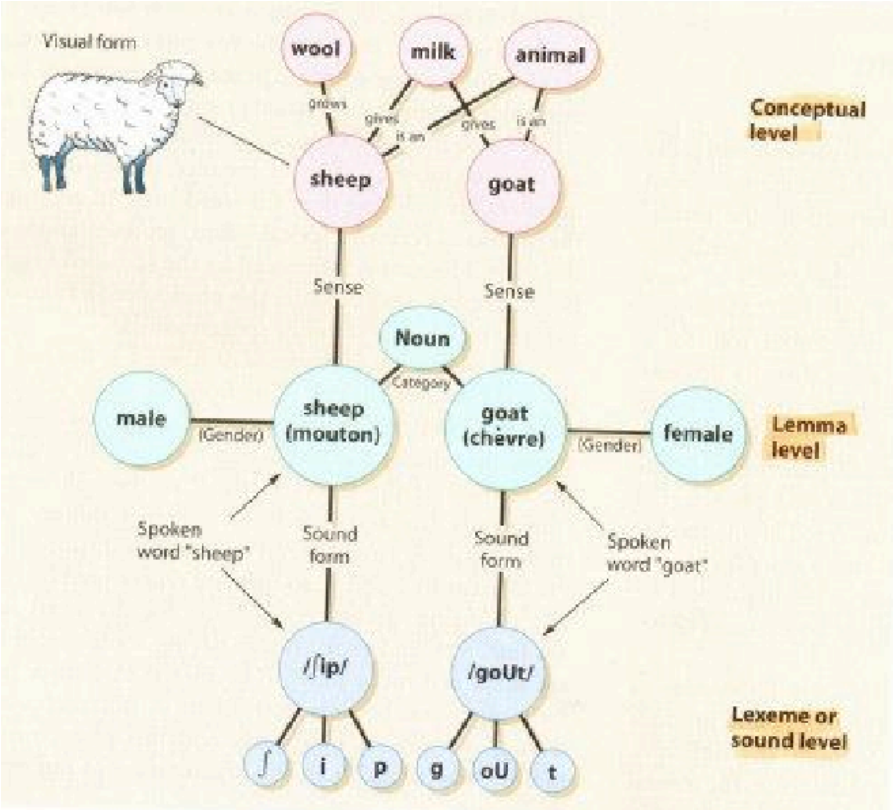


Mental Lexicon - spreading activation model



Bock & Levelt, 1994

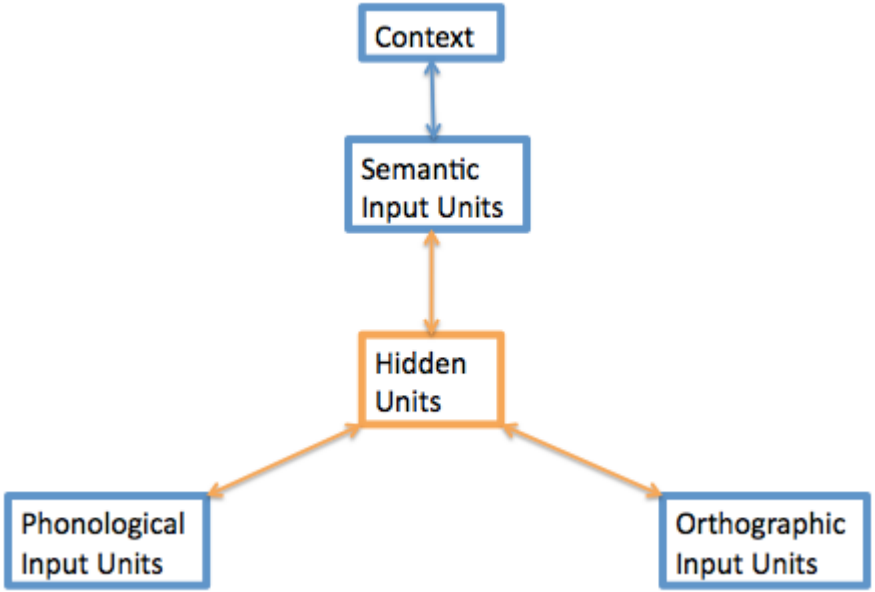
Mental Lexicon



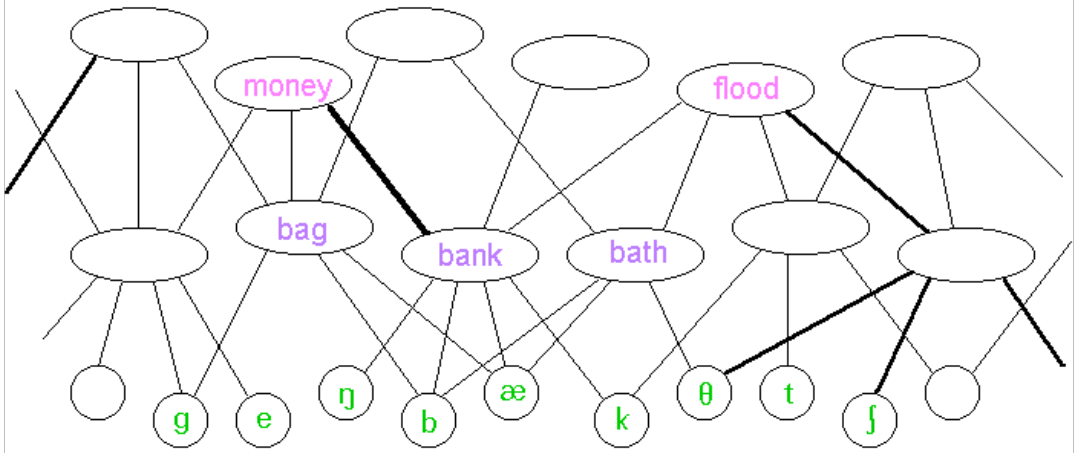
Mental Lexicon - connectionist (spreading activation) models

Word's lexical representation and information is not localized in any node.

The model tends to group words (completely bottom-up) based on categories such as "noun," "verb," "animal" etc.



Connectionist Model of the Lexicon



- Connection strength varies with frequency of usage
- That determines how much activation they send to other nodes

Mental Lexicon - morphology

Unclear

Lexical access is influenced by

- frequency effect,
- word/non-word effect,
- word superiority effect,
- length effect,
- imageability effect

By the way, there is a database for Russian verbs and nouns - http://stimdb.ru/database/

Lexical access

Mostly studies using ambiguous words.

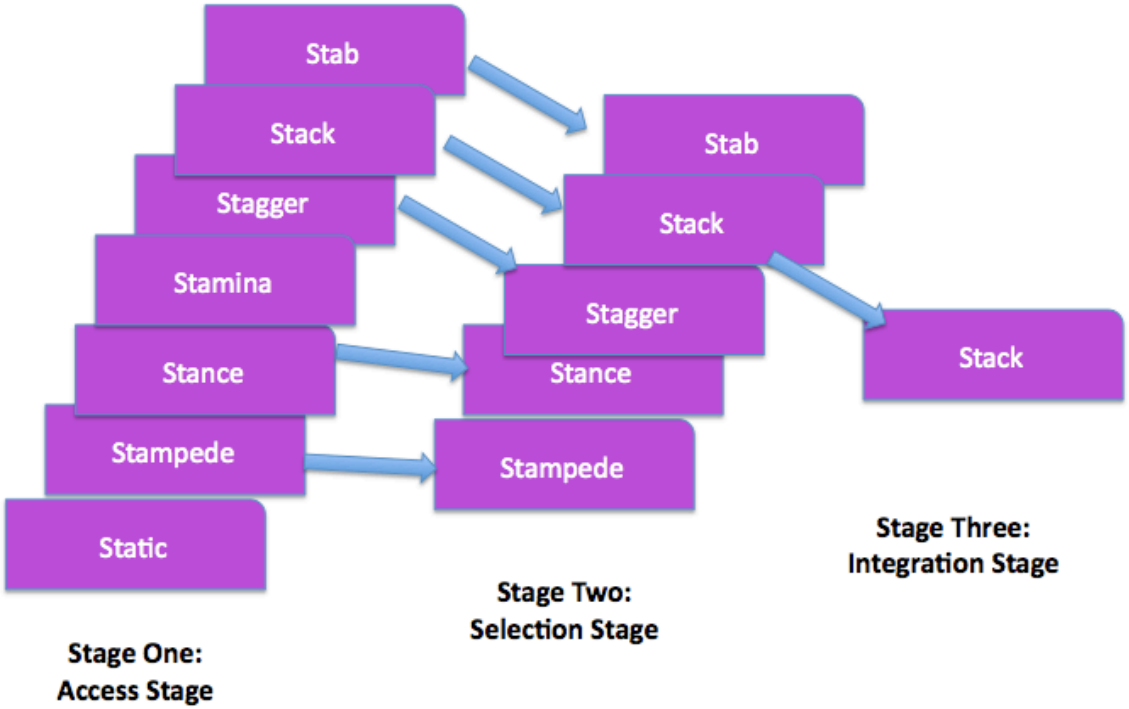
- is lexical access exhaustive or selective?
- how are dominant and subordinate meanings accessed?

Lexical access

- serial search (as searching for a book in a library) - Forster’s (1976) autonomous search model

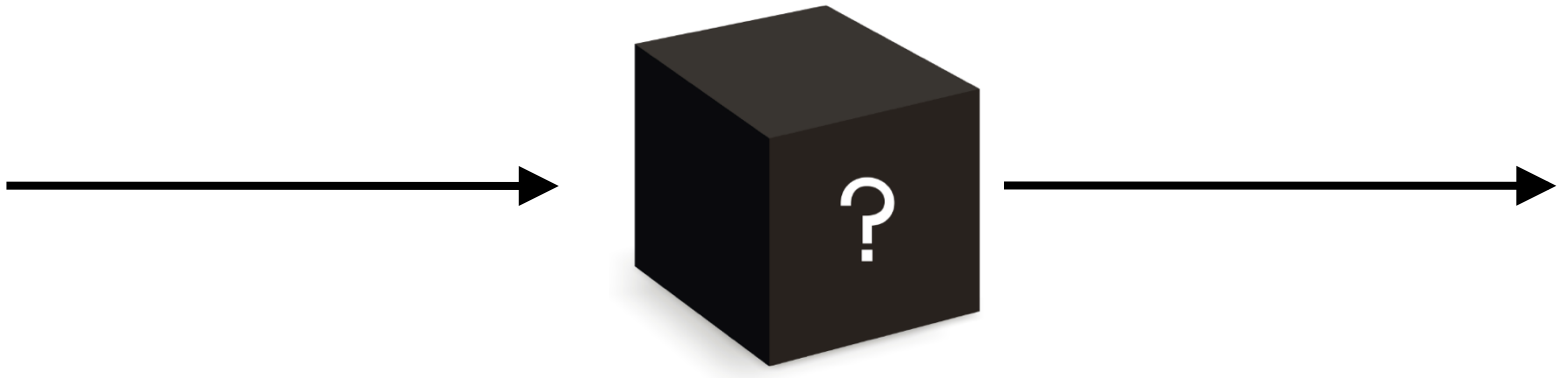
- parallel search (neural network) - Marslen-Wilson’s (1987) cohort model, McClelland & Seidenberg's (1989) connectionist model and Morton’s (1969) logogen model

The cohort model



How do we know that?

Experimental testing



Experiments register measurable human reactions

Experimental Methods

- testing multiple entities (one word can be different from the other)
- testing multiple subjects (one person’s representations can differ from those of another person)
- using multiple experimental paradigms (a paradigm can tap in some unrelated processes)

What do we measure?

- accuracy (% correct answers out of all answers)
- reaction time / response time

=> lower accuracy and increased reaction time signal about processing difficulty

Lexical Decision

WUG

Lexical Decision

WUGESS

Repeat 10 times the word **blood**.

Answer immediately

What flows through the veins?

Answer immediately

What flows when you cut your finger?

Answer immediately

What color is the traffic light when we cross the street?

So_p

So_p

Priming (lexical access)

DOCTOR

Priming (lexical access)

NURSE

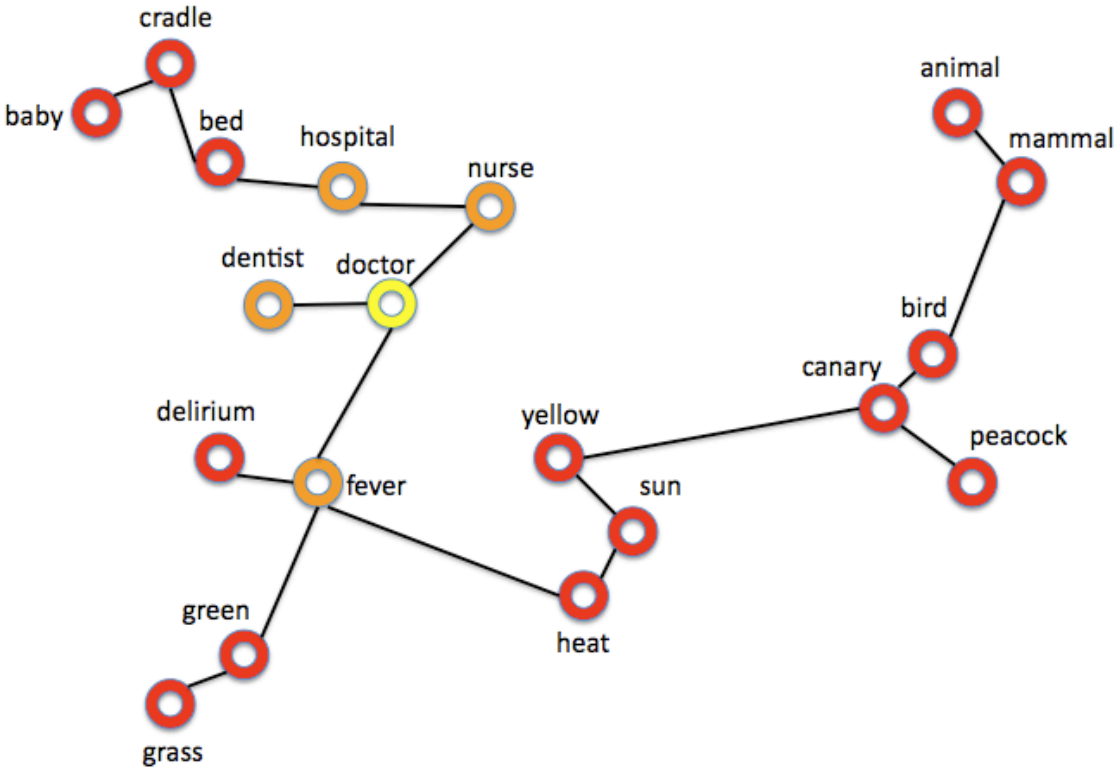
Priming (lexical access)

ACTOR

Priming (lexical access)

NURSE

Priming


cradle
baby
bed
hospital
nurse
dentist
doctor
delirium
fever
green
grass
heat
yellow
sun
animal
mammal
bird
canary
peacock

Priming & Lexical ambiguity

Rumor had it that, for years, the government building had been plagued with problems. The man was not surprised when he found several bugs in the corner of the room.

ANT – SPY – SEW

Priming & Lexical ambiguity

Rumor had it that, for years, the government building had been plagued with problems. The man was not surprised when he found several spiders, roaches and other bugs in the corner of the room.

ANT – SPY – SEW

Priming & Lexical ambiguity

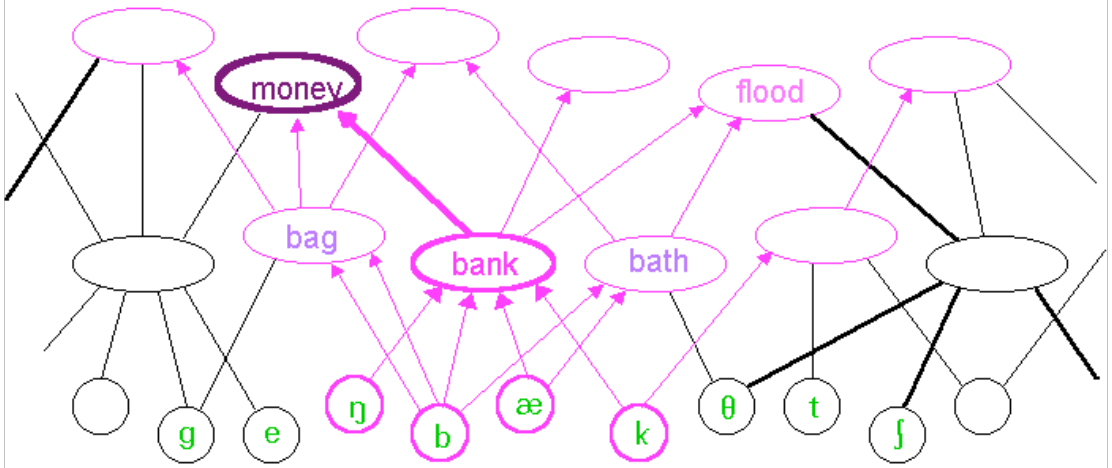
- very short-lived effect, goes away after 200 ms

Priming & Lexical ambiguity

Can vary time lag between prime & target to tap into prime processing at different points

= Stimulus Onset Asynchrony (SOA)

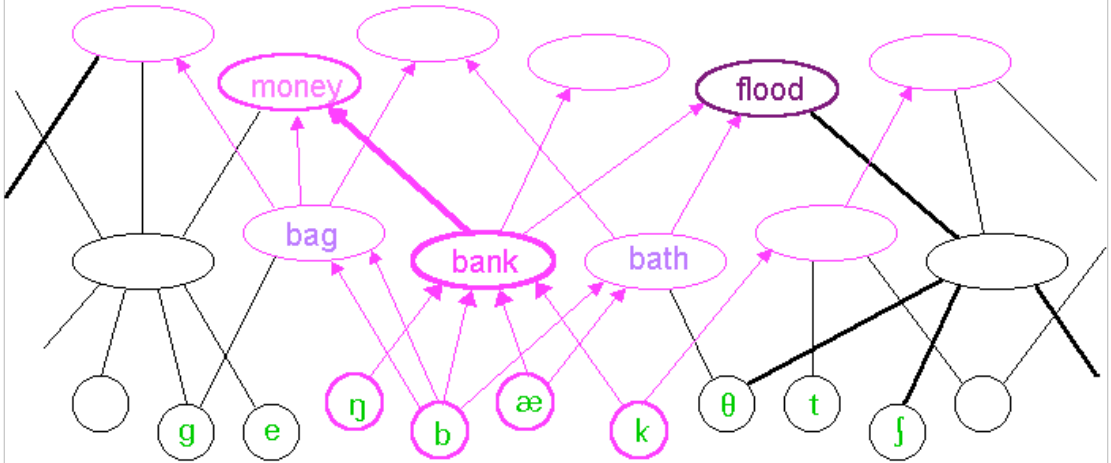
Connectionist Model of Lexical Ambiguity Resolution
(when context supports the <u>more</u> frequent meaning)



After several days of falling stock prices, the mayor went downtown to check on the banks.

Would a priming study show **<u>selective</u>** priming only of targets related to the contextually appropriate meaning? **<u>Maybe</u>**

Connectionist Model of Lexical Ambiguity Resolution
(when context supports the <u>less</u> frequent meaning)



After several days of non-stop rain, the mayor went down to the river to check on the banks.

Would a priming study show **<u>selective</u>** priming only of targets related to the contextually appropriate meaning? **<u>No</u>**

Self-paced reading

--- ------- ------ ------- --- ------ -------- --- -----
--------.

Self-paced reading

```
The ------- ------ ------- --- ------ -------- --- -----
--------.
```

Self-paced reading

```
--- complex ------ ------- --- ------ -------- --- -----
--------.
```

Self-paced reading

--- ------- houses ------- --- ------ -------- --- -----
--------.

Self-paced reading

--- ------- ------ married --- ------ -------- --- -----
--------.

Self-paced reading

--- ------- ------ ------- and ------ -------- --- -----
--------.

Self-paced reading

--- ------- ------ ------- --- single -------- --- -----
--------.

Self-paced reading

--- ------- ------ ------- --- ------ soldiers --- -----
--------.

Self-paced reading

--- ------- ------ ------- --- ------ -------- and ----- --------.

Self-paced reading

--- ------- ------ ------- --- ------ -------- --- their --------.

Self-paced reading

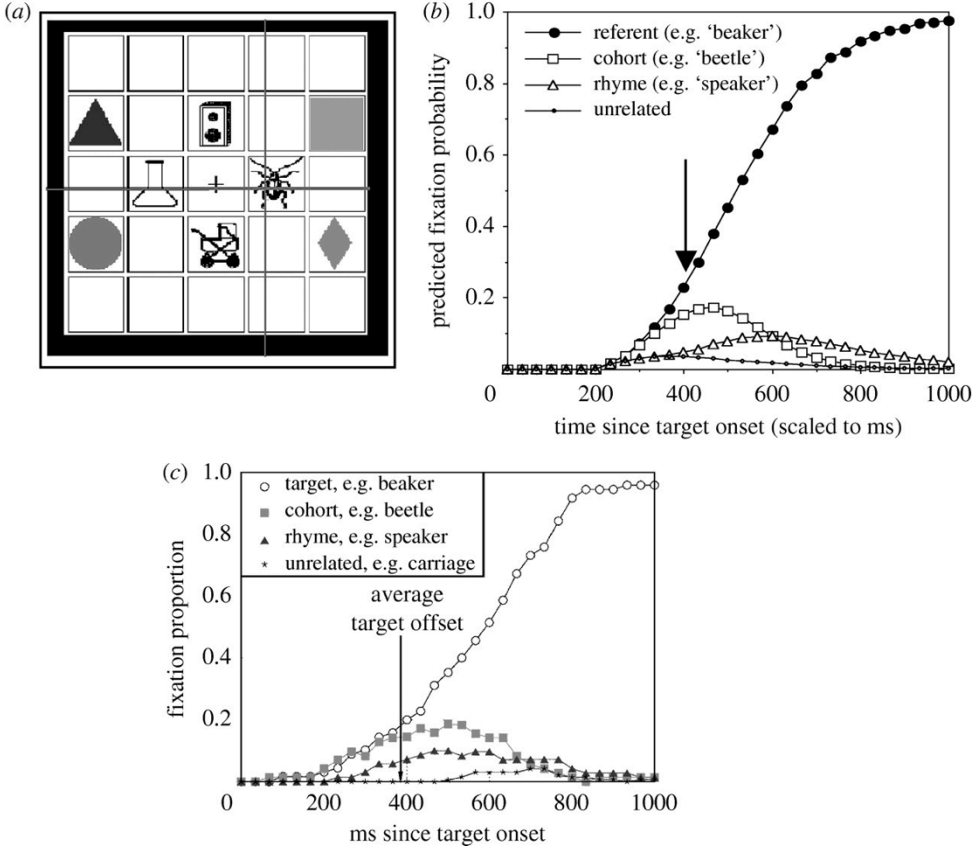
```
--- ------- ------ ------- --- ------ -------- --- -----
families.
```

Self-paced reading

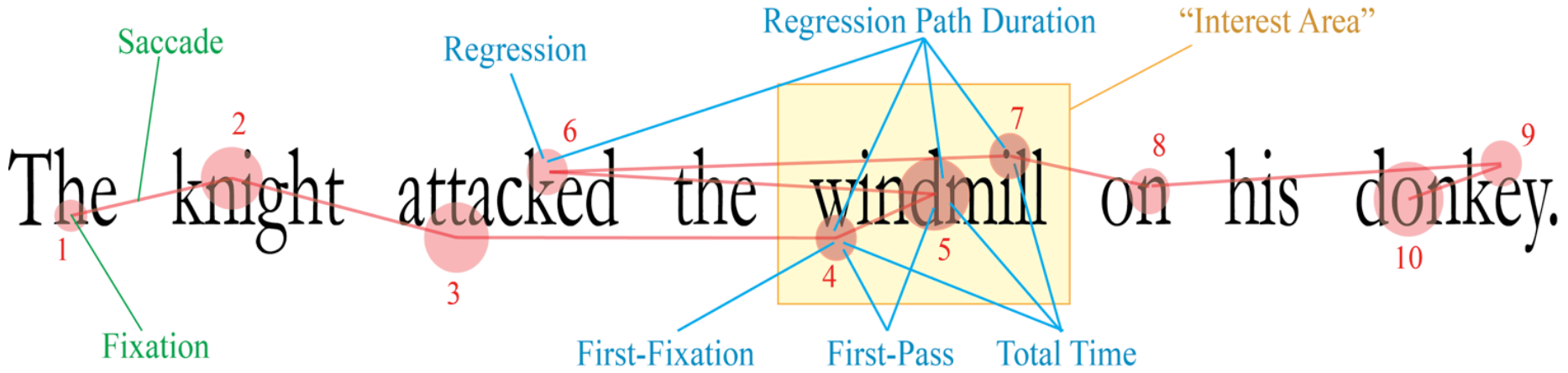
The complex houses married and single soldiers and their families.

Eye tracking

Visual world studies (eye-tracking)



Eye tracking while reading



Lexical ambiguity. Storage

Experiments with homonyms

Experiments with lexical decision (with priming) revealed that two meaning of a homonym compete for activation:

bank —> ‘bank of the river’

—> ‘bank of America’

The two meanings interfere and inhibit each other.

Homonymy storage

One phonological representation is connected to severel semantic representations.

Homonyms are stored separately.

Polysemy

A word acquires different, though obviously related, senses, often with respect to particular contexts

Terminology: *senses* vs *meanings*

Polysemy

wrapping paper / daily paper

John baked a potato / John baked a cake

банан

Hypotheses of sense storage

Separate sense account

Single sense account

Hypotheses of sense storage (I)

Separate sense account

Polysemy is conceived as a list of pre-defined established senses stored in the mental lexicon

- checklist theory of lexical meaning
- sense enumeration lexicon

Pros & Cons

+ One immediately picks up one intended sense when processing a polysemous word

- uneconomical sense storage
- impossibility of novel / occasional sense processing
- problem of sense distinction (How do we split words into senses?)

MACMILLAN DICTIONARY

point - definition

★★★

NOUN Pronunciation /pɔɪnt/ Word

Menu

1. idea/opinion/reason
2. aspect/feature
3. particular time
4. particular place
5. unit (for game score)
6. area of light/color
7. sharp end of something
8. piece of land
9. decimal point
10. direction on compass
11. electrical outlet

+phrases

Collins

point in British
(pɔɪnt)

Word Frequency ●●●●●

noun

1. a dot or tiny mark
2. a location, spot, or position
3. any dot or mark used in writing or printing, such as a decimal point or a full stop
4. short for vowel point
5. the sharp tapered end of a pin, knife, etc
6. a pin, needle, or other object having such a point
7. mathematics
   a. a geometric element having no dimensions and whose position in space is located by means of its coordinates
   b. a location

   point of inflection
8. a promontory, usually smaller than a cape
9. a specific condition or degree
10. a moment

    at that point he left the room
11. an important or fundamental reason, aim, etc

    the point of this exercise is to train new teachers
12. an essential element or thesis in an argument

    you've made your point
    I take your point
13. a suggestion or tip
31. an aggressive position adopted in bayonet or sword drill
32. military
    the position at the head of a body of troops, or a person in this position
33. the position of the body of a pointer or setter when it discovers game
34. boxing
    a mark awarded for a scoring blow, knockdown, etc
35. any diacritic used in a writing system, esp in a phonetic transcription, to indicate modifications of vowels or consonants
36. jewellery
    a unit of weight equal to 0.01 carat
37. the act of pointing
38. ice hockey
    the position just inside the opponents' blue line

Questions?

Lexicon in psycholinguistics
Day 2

Anna Laurinavichyute
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Hypotheses of sense storage

Separate sense account

Single sense account

Hypotheses of sense storage (II)

Single sense account

Specific senses of a word are constructed on the fly depending on the context in which they are used

- core meaning
- generative lexicon

Pros & Cons

+ economical storage

+ unlimited number of senses in context

- more time and processing power to derive a particular sense

Hypotheses of sense storage: predictions

Separate sense account (similarly to homonyms)	—>	inhibition
Single sense account	—>	facilitation

How would you test the two hypotheses?

Experiments of Klein and Murphy (2001)

Research question: Are different senses represented distinctly in the mental lexicon or there is a common core meaning?

Paradigm: sensicality judgement with priming; “judge as quickly as possible whether phrases make sense”.

Dependent variables: reaction time (RT), accuracy of judgements

Experiments of Klein and Murphy (2001)

Stimuli(1): PRIME —> TARGET

wrapping paper —> *shredded paper* (consistent condition)

wrapping paper —> *liberal paper* (inconsistent condition)

Experiment 1: results

Stimuli(1): PRIME —> TARGET

wrapping paper —> shredded paper (consistent condition)

wrapping paper —> liberal paper (inconsistent condition)

Experiments of Klein and Murphy (2001)

Stimuli(2): PRIME —> TARGET

commercial bank —> savings bank	(consistent condition)
commercial bank —> creek bank	(inconsistent condition)
wrapping paper —> shredded paper	(consistent condition)
wrapping paper —> liberal paper	(inconsistent condition)

Experiment 2: results

Stimuli(2): PRIME —> TARGET

commercial bank —> savings bank	(consistent condition)
commercial bank —> creek bank	(inconsistent condition)
wrapping paper —> shredded paper	(consistent condition)
wrapping paper —> liberal paper	(inconsistent condition)

Experiments of Klein and Murphy (2001)

Stimuli(3): PRIME —> TARGET

wrapping paper —> *shredded paper*	(consistent condition)
wrapping paper —> *liberal paper*	(inconsistent condition)
_____ paper —> liberal paper	(neutral condition)

Experiment 3: results

Stimuli(3): PRIME —> TARGET

wrapping paper —> shredded paper (consistent condition)

_____ paper —> liberal paper (neutral condition)

wrapping paper —> liberal paper (inconsistent condition)

Conclusions from the experiments

Words like *paper* cannot be represented by a single semantic description that is accessed every time.

Different senses of a polysemous word = different meanings of a homonym

! Each sense has a separate representation in the mental lexicon.

Why polysemes are processed like homonyms?

Why do the results show so little overlap in polysemous senses if the senses are related, often by productive relations?

Possible explanation: senses of a word are related, although are not similar.

wrapping paper	—>	boring paper (relatedness)
(object made of wood pulp, has a manufacturer, color, texture, …)		(piece of information, has semantic content, has an author, …)

Experiments of Klein and Murphy (2002)

Research question: How strong are the relations between polysemous senses and what is the type of these relations?

Paradigm: forced-choice sorting task

Dependent variable: choice alternative

Forced-choice sorting task

wrapping PAPER

(1)liberal PAPER

senses of a word

(2) smooth CLOTH

members of the same taxonomic / thematic category

Forced-choice sorting task

wrapping PAPER

(1)liberal PAPER

senses of a word

(2) smooth CLOTH

members of the same taxonomic / thematic category

(1) shredded PAPER

(2) smooth CLOTH

Results of Klein and Murphy (2002)

wrapping PAPER

(1)liberal PAPER

20%

(2) smooth CLOTH

(1) shredded PAPER

70%

(2) smooth CLOTH

Conclusions from the experiments

Senses of a polysemous word are not similar: different senses are rarely grouped together.

Different senses of a polysemous word = different meanings of a homonym

! Senses are stored separately, probably with little semantic overlap between some senses.

Experiment of Rodd, Gaskell, and Marslen-Wilson (2002)

Research question: Are words with multiple senses (polysemes) processed faster than words with multiple meanings (homonyms)?

Task: lexical decision

Dependent variable: RT, accuracy

Stimuli

unambiguous words	homonyms	polysemes
bus *fee* *hotel*	*jumper* *pupil* *yard*	*affair* *china* *net*

Results

non-words	homonyms	polysemes	unambiguous words
636 ms	**577** ms	**561** ms	**556** ms

Conclusions from the experiments

Everything else being equal, polysemous words are recognized faster than homonyms.

Meanings of homonyms compete to activate semantic representations and thus inhibit each other.

Different meanings of a homonym ≠ different senses of a polysemous word

In polysemes, participants access a representation of the word’ s core meaning.

The discrepancy between studies

Klein and Murphy: homonyms = polysemes

Like homonyms, different senses of polysemous words inhibit each other. They should be stored in separate representations.

Rodd et al.: homonyms ≠ polysemes

Unlike homonyms, different senses of polysemous words facilitate processing. They should be stored in one core representation.

What is the reason of this discrepancy?

What is the reason of this discrepancy?

1) Different experimental paradigms:

lexical decision // lexical decision (sensicality judgements) with priming

2) How reliable / reproducible are the results?

Homonymy vs Polysemy

- distinguish polysemy and homonymy

BUT there are no sharp boundaries between them: *nail, батарея, ладья*

- polysemy is not a uniform fenomenon

Hypotheses of sense storage (III)

Hybrid approach to sense storage

Close senses are stored in the same representation, while other may have separate representations.

- frequency of a sense
- number of overlapping semantic components

Overlapping semantic components

rabbit

friendly rabbit — [+ animate, + farm animal, + furry, + hop, + big ears, + edible]

tasty rabbit — [+ edible, + meat, + stew, + delicacy, + farm animal]

Hypotheses of sense storage (III)

Hybrid approach to sense storage

Close senses are stored in the same representation, while other may have separate representations.

- frequency of a sense
- number of overlapping semantic components
- number of senses: few senses ~ single representation, many senses ~ several representations

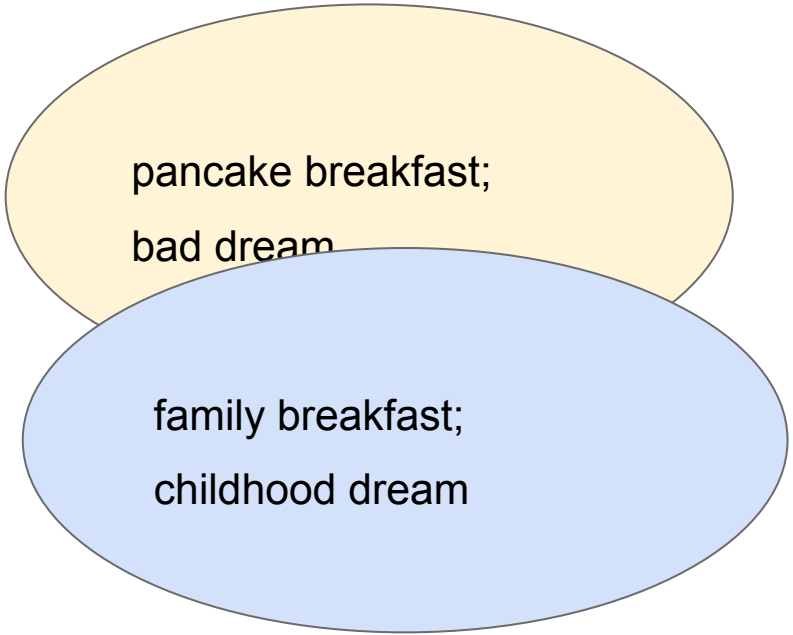
Hypotheses of sense storage (III)

Hybrid approach to sense storage

Close senses are stored in the same representation, while other may have separate representations.

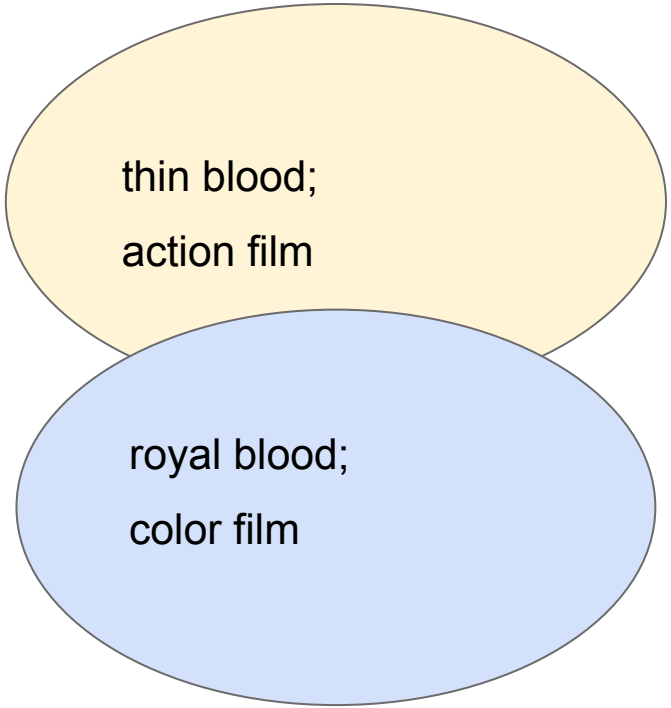
- frequency of a sense
- **number of overlapping semantic components**
- number of senses: few senses ~ single representation, many senses ~ several representations

Klepousniotou, Titone, and Romero (2008)



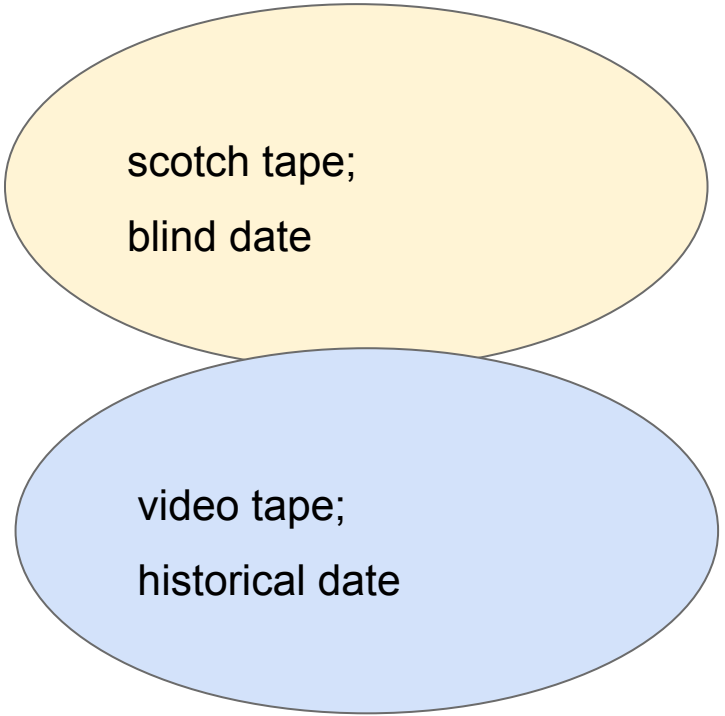
high-overlap words

Klepousniotou, Titone, and Romero (2008)



moderate-overlap words

Klepousniotou, Titone, and Romero (2008)



low-overlap words

Klepousniotou, Titone, and Romero (2008)

Research question: Are senses with different overlap processed differently and do they have different representations in the mental lexicon?

Paradigm: sensicality judgement with priming (like in (Klein and Murphy, 2001))

Dependent variables: reaction time (RT), accuracy of judgements

Klepousniotou, Titone, and Romero (2008)

Three types of the semantic overlap and three context conditions:

- high-overlap words: consistent, neutral, inconsistent contexts
- moderate-overlap words: consistent, neutral, inconsistent contexts
- low-overlap words: consistent, neutral, inconsistent contexts

Results: reaction time

high-overlap: consistent, inconsistent < neutral

moderate- and low-overlap: consistent < neutral and inconsistent

Results: reaction time

New!
Whatever sense was activated, it benefits processing

high-overlap: consistent, inconsistent < neutral

moderate- and low-overlap: consistent < neutral and inconsistent

Similar to Klein and Murphy (2001) and homonyms: consistency speeds up, inconsistency slows down

Conclusions from the experiment

High-overlap words are processed differently from moderate- and low-overlap words, which differed minimally.

High-overlap words have a unified lexical representation (core meaning) that is always activated, irrespective of context.

Moderate- and low-overlap ambiguous words should have distinct meaning representations.

The results of Klein and Murphy may have arisen because of a mixture of word types in the stimulus set.

Polysemous verbs: same pattern (Brown, 2008)

clean the shirt - clean the cup

break the glass - break the radio

run the track - run the shop

bank the plane - bank the money

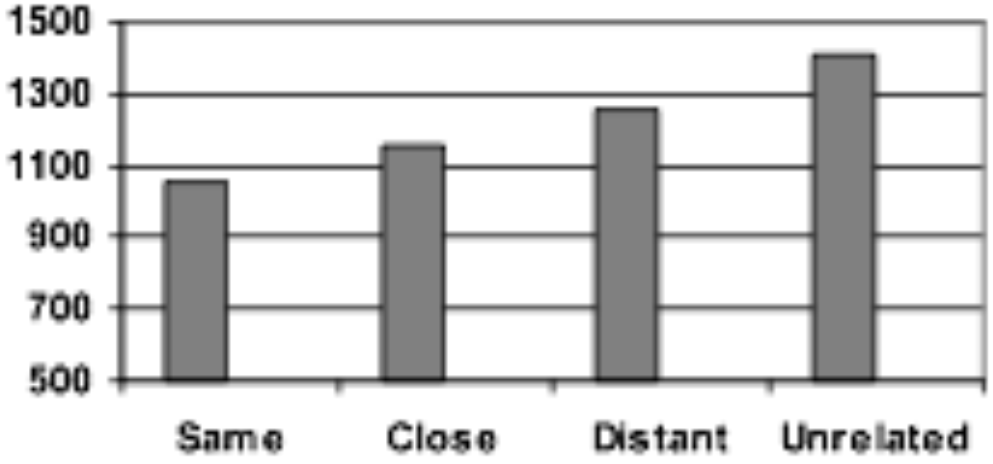


Figure 1. Mean response time (ms).

Semantic overlap and semantic relations

high-overlap words = metonymies?

turkey dinner — formal dinner (FOOD / EVENT)

young chicken — juicy chicken (ANIMAL / FOOD)

heavy book — best-selling book (INFORMATION OBJECT / CONTENT)

a river with crocodiles — crocodile handbag

Semantic overlap and semantic relations

moderate- and low-overlap words = metaphors?

thin blood — royal blood

friendly guide — TV guide

indoor tracks — mouse tracks

a river with crocodiles — He was a real crocodile.

Hybrid approach to sense storage

Literal and metonymic senses may be stored together in one representation

Metaphorical senses may be stored separately.

Perhaps this is the case!

Can we generalize these conclusions to all types of metonymies and metaphors?

Maybe we can’t :)

Jager and Cleland (2015)

Stimuli: animal / person metaphors (*snail, gorilla*); animal / food metonymies (r*abbit, herring*)

Maybe we can’t :)

Jager and Cleland (2015)

Stimuli: animal / person metaphors (*snail, gorilla*); animal / food metonymies (r*abbit, herring*)

Results: metaphors < metonymies

Maybe we can’t :)

Jager and Cleland (2015)

Stimuli: animal / person metaphors (*snail, gorilla*); animal / food metonymies (r*abbit, herring*)

Results: metaphors < metonymies

Explanation: the relationship between animals and the products derived from them may have been lost because of the urban life.

Questions?