

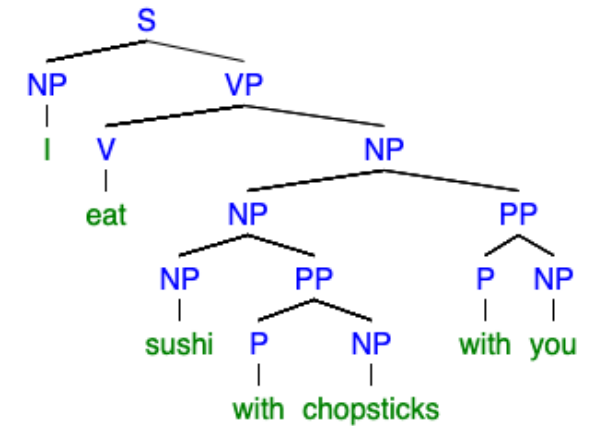
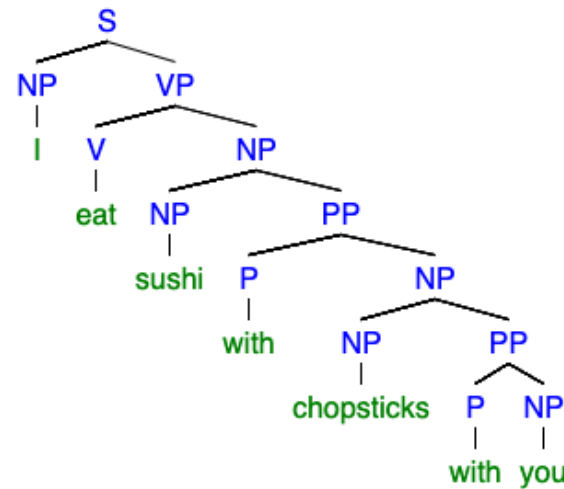
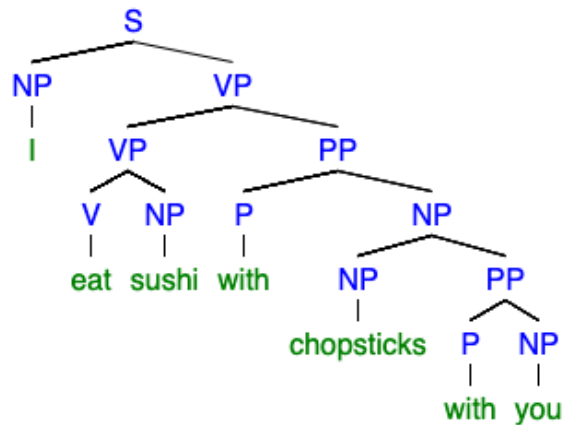
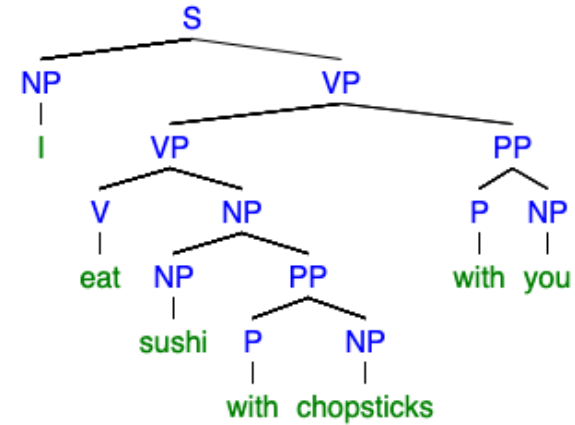
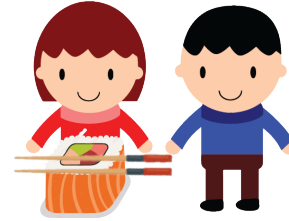
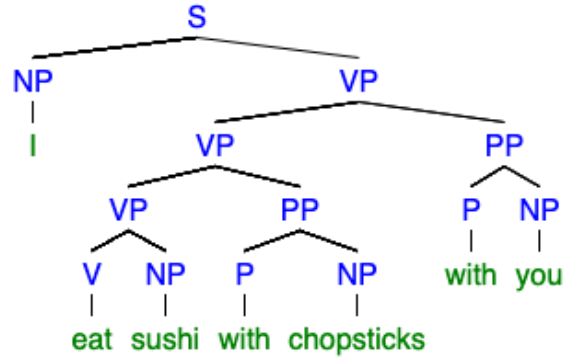
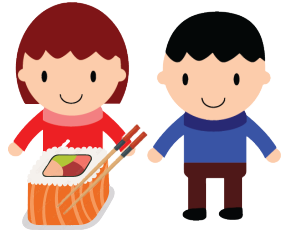
Language and its Applications

LT5903



Jixing Li
Lecture 6: Semantics

I eat sushi with chopsticks with you



Lecture plan

- Syntax review
- Lexical semantics
- Compositional semantics
- Semantic composition in the brain
- **Short break (15 mins)**
- Group discussion on HW6

Syntax review

The study of how **words and phrases** are combined into larger phrases.

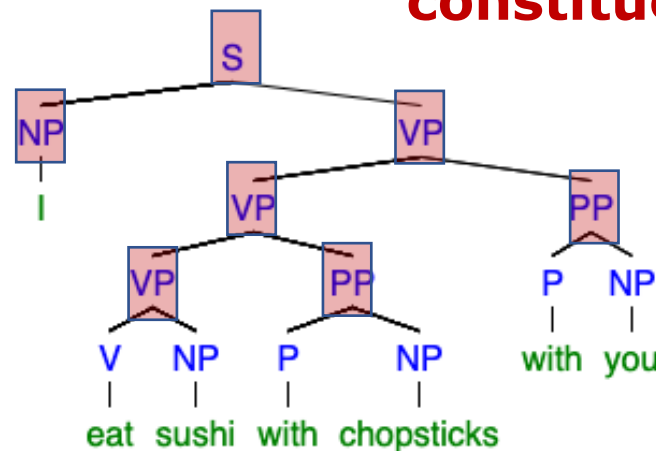
Syntactic properties

- **word order:** SVO|SOV|VSO; D NP|NP D; P NP|NP P
- **co-occurrence:** **arguments** (required): *Sally devoured an apple*
subject object/complement
- **adjunct** (optional): *small fluffy brown dogs*
- **agreement:** subject-verb agreement: *Sally likes Bob*
determiner-noun agreement: *These girls came*

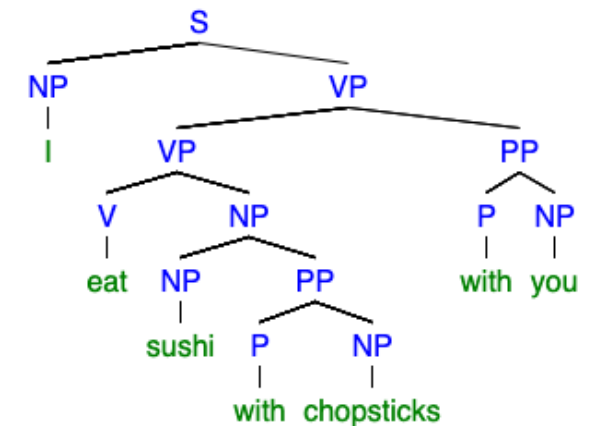
Phrase structure rules and trees

S → NP VP
NP → NP PP
NP → sushi | I | chopsticks | you
VP → VP PP
VP → V NP
V → eat
PP → P NP
P → with

constituents



ambiguity



What is semantics?

The study of how **words and phrases** are combined into larger phrases.

Semanticists are interested in:

- What are linguistic meanings?
- What is the relationship between linguistic meanings, the language user, and the world?
- How do linguistic meanings combine to produce meaning in expressions and phrases?
- How do the meanings of words, expressions, and phrases relate to each other?

Sense and reference

Sense: Mental representation of meaning or a mental concept

Reference: Specific entities the expression refers to

chair



- *Unicorn*
- *the queen of the United States*
- *the most populous country in the world*
- *the country that hosted the 2008 Summer Olympic Games*
- *Barack Obama*
- *the 44th president of the United States*

] sense, no referents

] different senses
] same referent

] different senses
] same referent

Word reference: Set theory

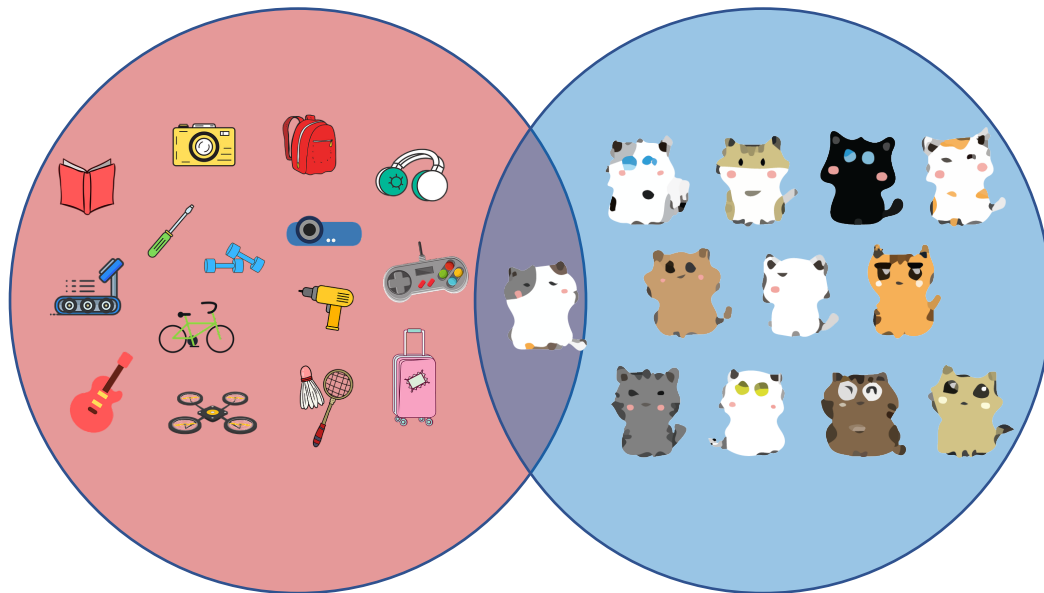
proper names: *China, Sally, CityU* → specific entities

common nouns: *country, woman, university* → set of things

Sally's cat

Sally's things

cats



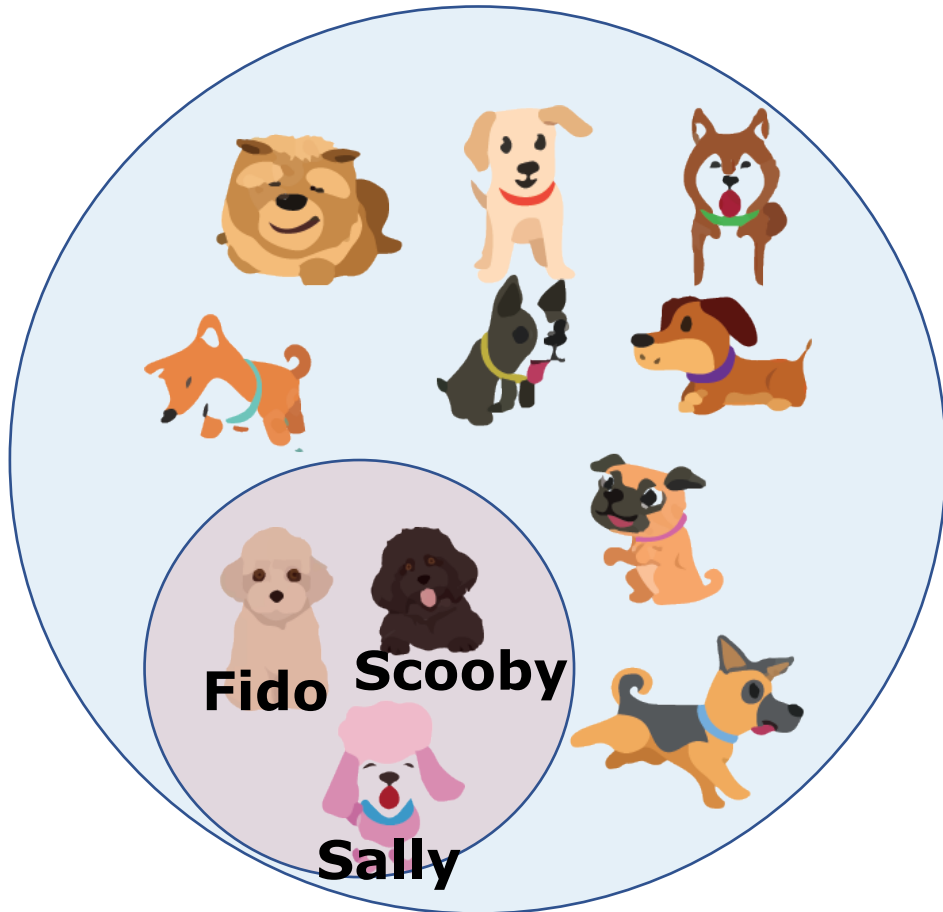
intransitive verbs and **adjectives** also have reference

run: set of things who run
green: set of green things

Meaning relationships

Hyponymy: X is a hyponym of Y if X is a subset of Y.

dog v.s poodle



poodle is a **hyponym** of dog

dog is a **hypernym** of poodle

sister terms: terms that are on the same level in the hierarchy

Sally, Fido, Scooby

Meaning relationships

Synonymy: Two words are synonymous if they have the same referent.

couch/sofa

quick/rapid

groundhog/woodchuck

baby/infant

Meaning relationships

Antonymy: Two words are antonymous if they have **opposite** meanings

complementary pairs:

something is X generally implies that it isn't Y

married /unmarried
existent/nonexistent
alive/dead

gradable pairs:

points on a continuum

wet/dry
easy/hard
old/young

reverses:

“undo” the movement

expand/contract
ascent/descent
put together/take apart

converses:

opposing points of view

lend/borrow
send/receive
employer/employee

Sentences

Do not refer to specific things or sets of things.

Compare:

(1) *the 44th President of the United States*

(2) *Barack Obama is the 44th President of the United States.*

(1) Refers to a specific person

(2) Does have pieces that refer to a specific person, but the sentence as **a whole unit** does not refer to a specific person.

→ It is making a specific claim about entities in the world

Propositions and truth values

A **proposition** is the claim (or sense) expressed by a **sentence**. Words in isolation do not express propositions

All propositions have a **truth value**: the ability for something to be true or false

Barack Obama is the 44th President of the United States is a statement that can be true or false

Truth conditions

How to know the truth value of a proposition?

truth condition: the conditions that would have to hold in a world in order for a specific proposition to be true

A speaker must be able to determine:

- Referents for words in a particular world

- How those referents relate to each other in the world

- How the words that point to the referents in the sentence relate to each other

Entailment

A relationship between propositions where proposition p is said to entail another proposition q if whenever p is true, then q is true as well; p entails q

Entailment is about **truth conditions**, not **truth values**

(1) *No dogs bark.*

(2) *Betsy's dog doesn't bark.*

(3) *Barack Obama is the 44th President of the United States.*

Does (1) entail (2)?

Does (1) entail (3)?

Relationships between propositions

mutual entailment: two propositions entail each other

- (1) *Betsy has a female sibling*
 - (2) *Betsy has a sister*
 - (3) *Betsy has a pet*
 - (4) *Betsy has a dog*
-] mutual entailment
-] not mutual entailment

incompatible: impossible for both propositions to be true

- (1) *All dogs bark*
 - (2) *No dogs bark*
 - (3) *Betsy is a student*
 - (4) *Betsy is a teacher*
-] incompatible
-] no relationship

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Compositional semantics

The Principle of Compositionality: The meaning of a sentence (or any other multi-word expression) is a function of the meanings of the words it contains, and how these words are syntactically combined

- All languages contain an infinite number of possible sentences
- People have to have some way of accessing information in order to produce and understand sentences

→ **The design feature of language: Productivity**

Idioms: multi-word lexical expressions whose meanings are not compositional

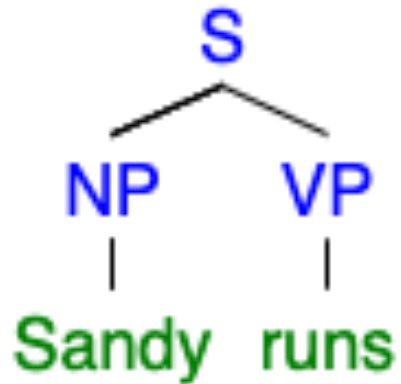
- *kick the bucket*
- *bark up the wrong tree*
- *kill two birds with one stone*

The argument is that idioms are stored separately in the lexicon, but these ideas are controversial

Combining verb phrases and noun phrases

NPs point to **specific** individuals or entities

VPs point to **sets** of individuals or entities



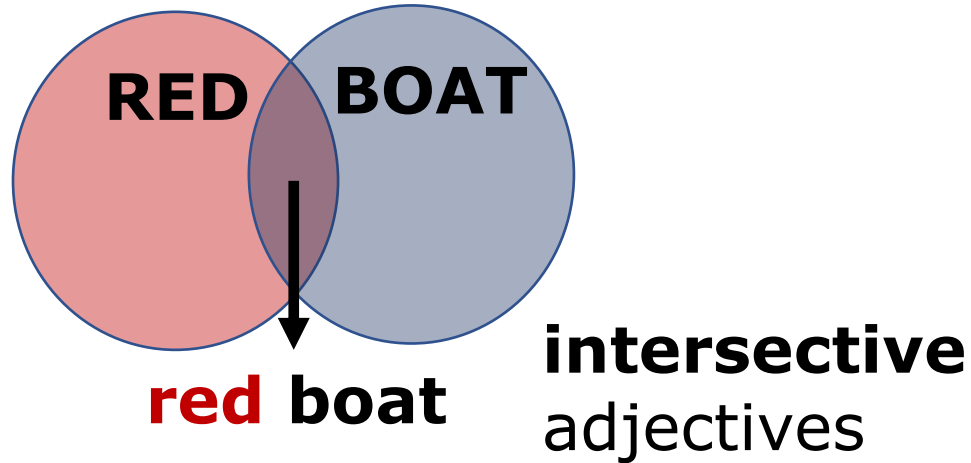
What are the truth conditions for *Sandy runs*?



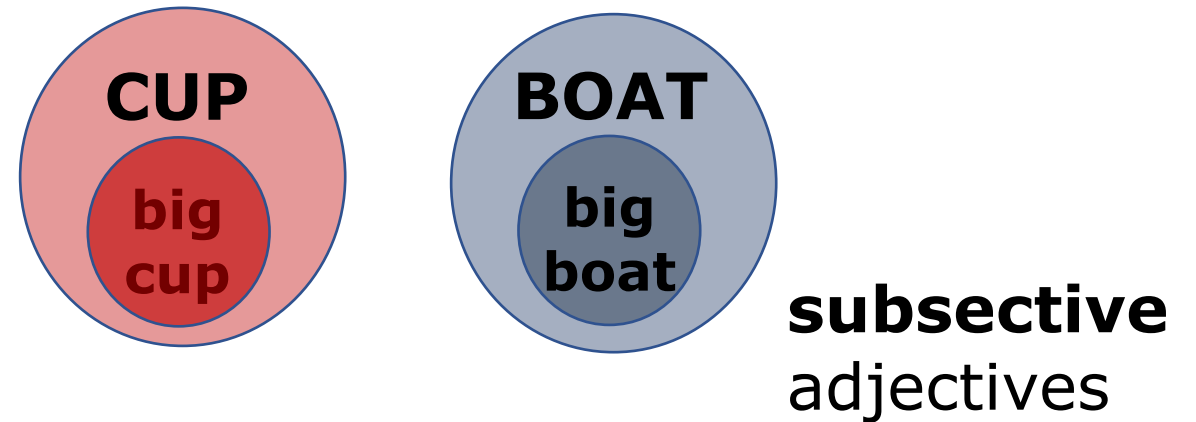
John, Mary,
Sue

Combining adjectives and nouns

pure intersection



relative intersection



non-intersection

don't entail reference to the objects denoted by the noun

anti-intersection

cannot refer to the set of reference denoted by the noun

possible solution **non-intersection** *fake diamond* **anti-intersection**
alleged thief adjectives *counterfeit money* adjectives

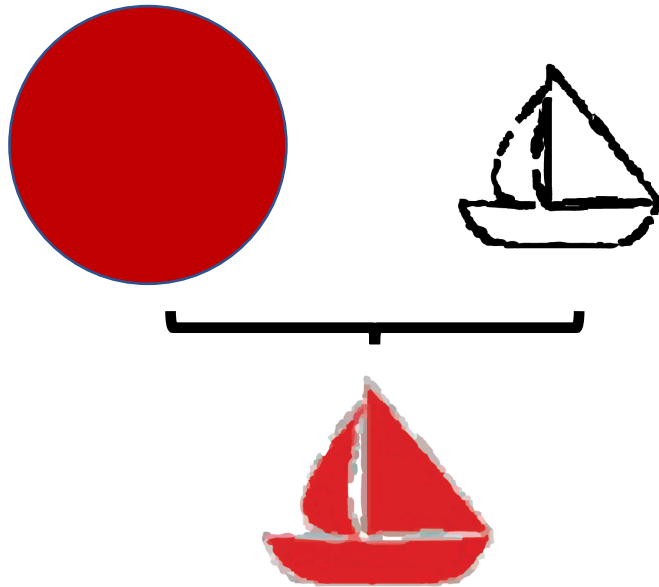
Quiz

1. What are the three meaning relationships?
2. What are hyponyms, hypernyms and sister terms?
3. What are the four types of antonymy?
4. What are entailment, mutual entailment and incompatible propositions?
5. What are the four types of adjectives?

Compositional semantics in the brain

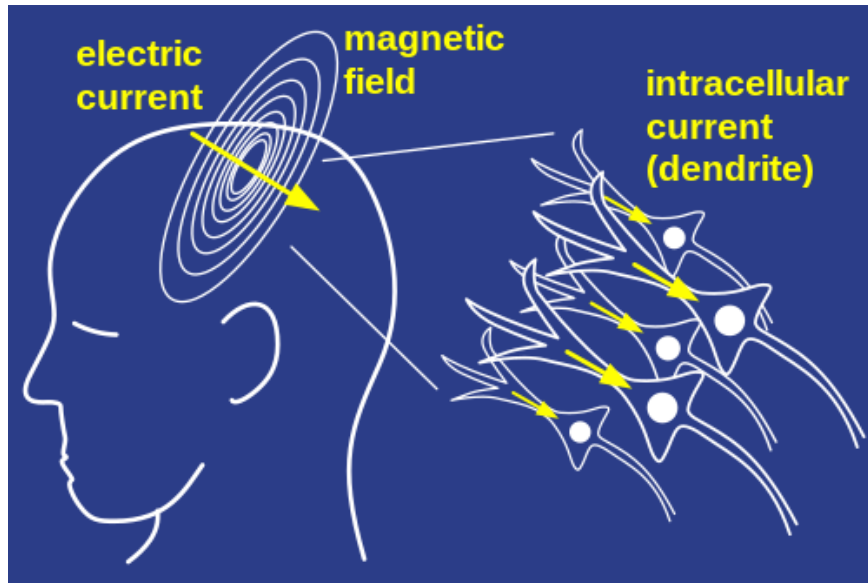
Bemis and Pylkkänen (2011): What happens in the brain when we combine an intersective adjective and a noun?

red boat

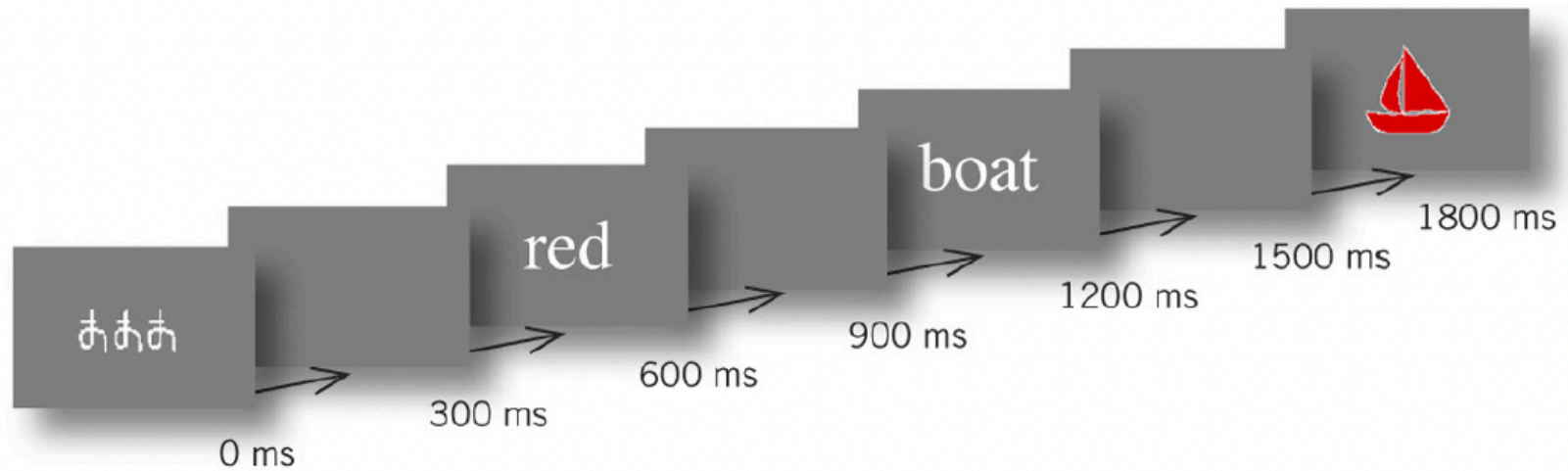




Magnetoencephalography (MEG)

MEG: a functional neuroimaging technique for mapping brain activity by recording **magnetic fields** produced by **electrical currents** occurring naturally in the brain, using very sensitive magnetometers.



Experiment design



	Composition Task			List Task		
Two words	red	boat		cup	boat	
One word	xkq	boat		xkq	boat	

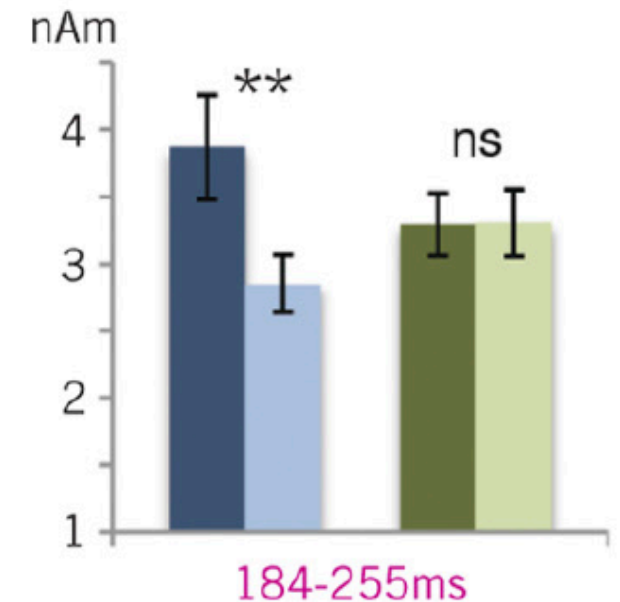
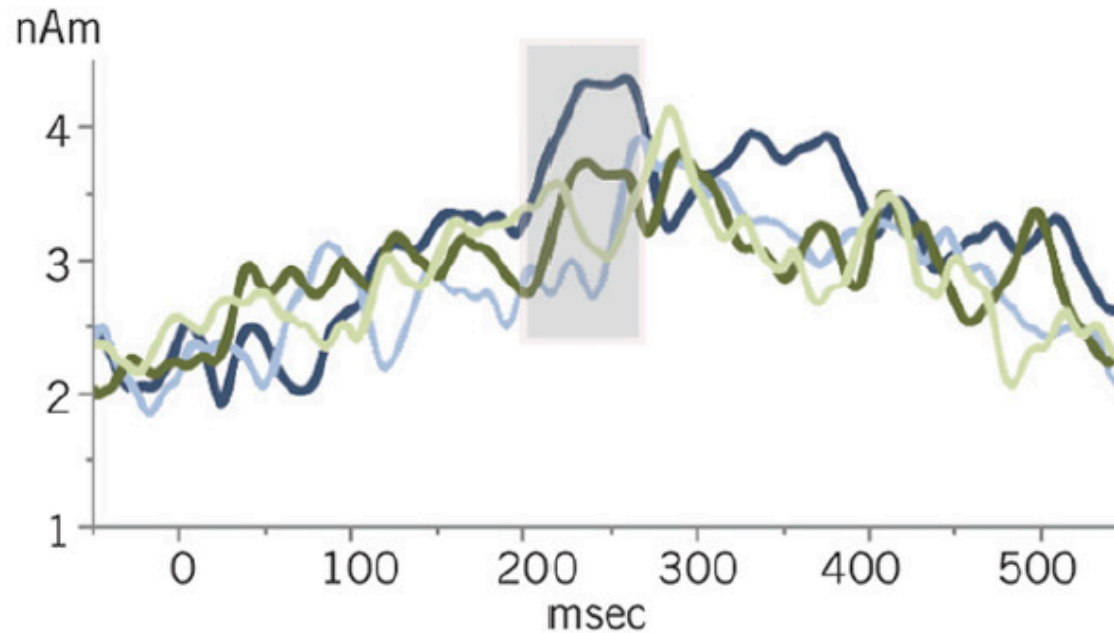
Results

Two-word Composition 

One-word Composition 

Two-word List 

One-word List 



→ The **left anterior temporal lobe (LATL)** plays an important role in semantic composition.

To do

Assign yourself to the correct group under A6!

Do HW6

Read:

This lecture: **File** Ch6

Next lecture: **File** Ch7