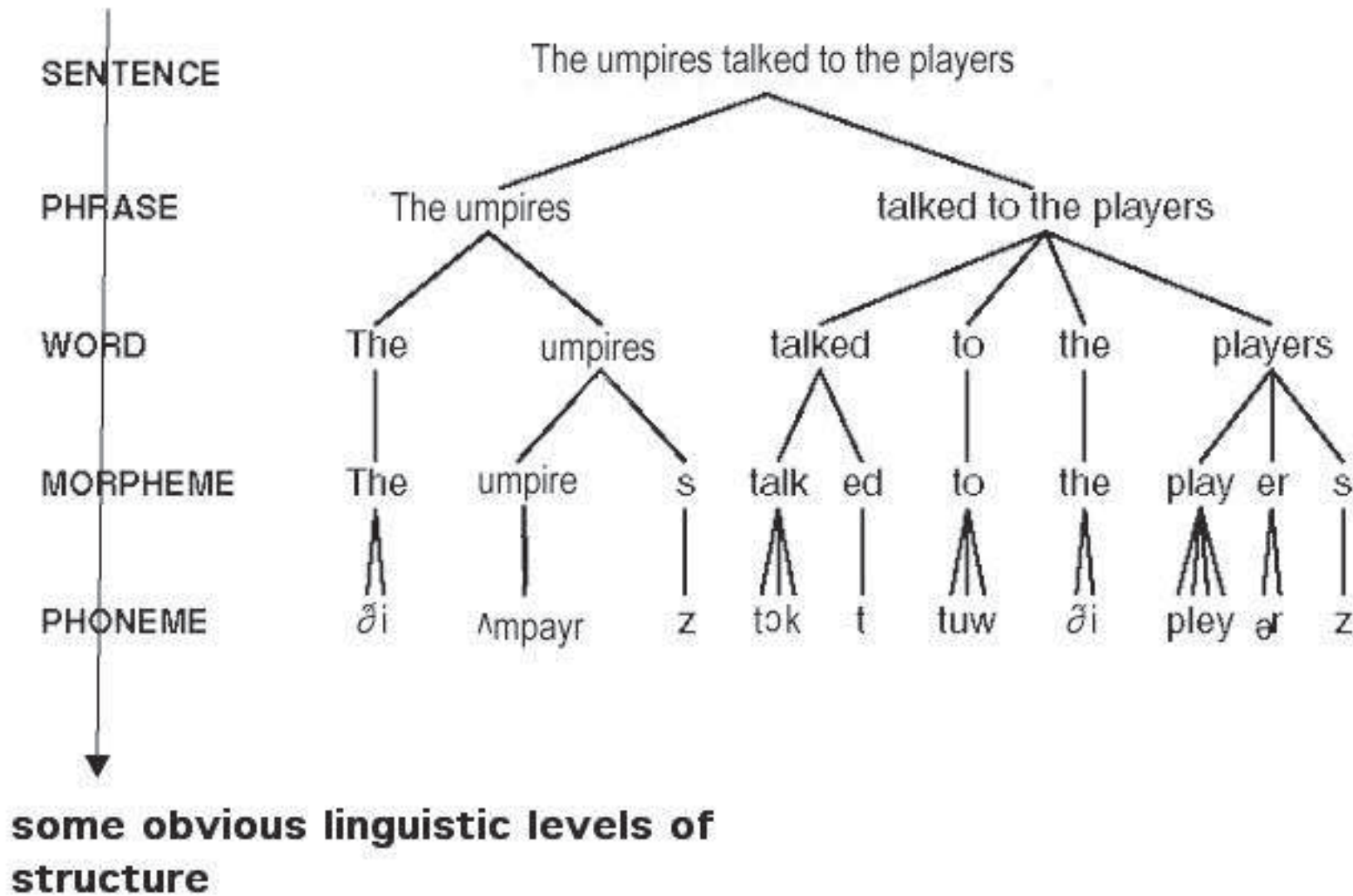


# Agenda

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- Semantic Roles
  - Thematic roles
  - Shallow Semantic Interpretation
- Selectional Restriction

# Linguistic Levels



# Thematic Roles

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- What is the commonality between the following two sentences?
- (19.19) *Sasha* broke the window  
(19.20) *Pat* opened the door
- Roles of *breaking* event – *Breaker*, *BrokenThing*  
Roles of *opening* event – *Opener*, *OpenedThing*
- Both *Breaker* and *Opener* have something in common. What?
  - they are volitional actors – they have direct causal responsibility for their events
- Thematic roles are one attempt to capture this semantic commonality between *Breaker* and *Opener* – **AGENT**

# Thematic Roles

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- Objects which are affected in some way by the action

*BrokenThing, OpenedThing* – **THEME**

- Proposed first by the Indian grammarian Panini – 7th to 4th century BCE

Thematic Role	Definition
AGENT	The volitional causer of an event
EXPERIENCER	The experiencer of an event
FORCE	The non-volitional causer of the event
THEME	The participant most directly affected by an event
RESULT	The end product of an event
CONTENT	The proposition or content of a propositional event
INSTRUMENT	An instrument used in an event
BENEFICIARY	The beneficiary of an event
SOURCE	The origin of the object of a transfer event
GOAL	The destination of an object of a transfer event

**Figure 19.5** Some commonly-used thematic roles with their definitions.

# Thematic Roles

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- (16.24) Mr.Johnson broke his collarbone
- No implication that he was the AGENT of this event
- This kind of participant is labelled – EXPERIENCER
- (16.25) The quake broke glass in several downtown skyscrappers
- Quake is not a volitional causer of an event
- FORCE – similar to AGENT but lacks any notion of volitionality
- (16.26) *It* broke his jaw
- *It* refers to event participant whose role is as the instrument of some other AGENT or FORCE – INSTRUMENT

# Thematic Roles

Thematic Role	Example
AGENT	<i>The waiter</i> spilled the soup.
EXPERIENCER	<i>John</i> has a headache.
FORCE	<i>The wind</i> blows debris from the mall into our yards.
THEME	Only after Benjamin Franklin broke <i>the ice</i> ...
RESULT	The French government has built a <i>regulation-size baseball diamond</i> ...
CONTENT	Mona asked “ <i>You met Mary Ann at a supermarket</i> ”?
INSTRUMENT	He turned to poaching catfish, stunning them <i>with a shocking device</i> ...
BENEFICIARY	Whenever Ann Callahan makes hotel reservations <i>for her boss</i> ...
SOURCE	I flew in <i>from Boston</i> .
GOAL	I drove <i>to Portland</i> .
<b>Figure 19.6</b> Some prototypical examples of various thematic roles.	




# Shallow Semantic Interpretations

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- Use of thematic roles in computational systems is as a shallow semantic language

- Shallow semantic language allow us to make simple inferences

*Company A acquired Company B*  
*Was Company B acquired?*



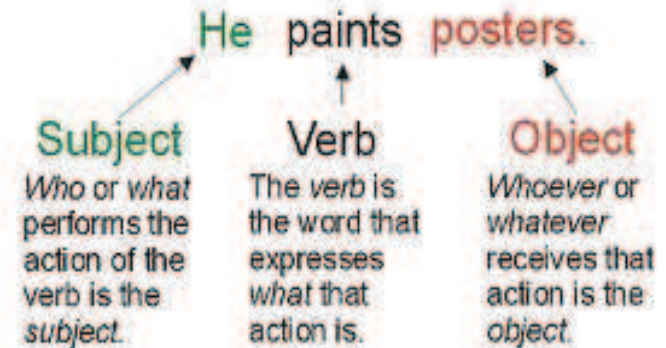
Different surface syntax

The diagram shows two sentences, 'Company A acquired Company B' and 'Was Company B acquired?', grouped by a right-facing curly bracket. An arrow points from the text 'Different surface syntax' to the bracket, indicating that these two sentences represent different surface syntactic realizations of the same underlying semantic event.

- Thematic roles are used in MT as part of intermediate language
- Helps to generalize over different surface realizations of predicate arguments

# Shallow Semantic Interpretations

- Subject, Verb, Object (Recap)



*After the final song, the **drummer** hurled his sticks at the crowd*

*Mr. John smashed the electric **guitar** with a sledge hammer*

*Very slowly, Pandora opened the **box***

?



# Shallow Semantic Interpretations

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- *Thematic hierarchy* – AGENT > INSTRUMENT > THEME for assigning the **subject** role
- Which argument of a verb will become the **subject** of a sentence
- Possible realization of verb *break*: (verb alternations)

(19.21) *John broke the window*

AGENT      THEME

(19.22) *John broke the window with a rock*

AGENT      THEME      INSTRUMENT

(19.23) *The rock broke the door*

INSTRUMENT      THEME

(19.24) *The window broke*

THEME

(19.25) *The window was broken by John*

THEME                      AGENT

SUBJECT  
OBJECT

# Shallow Semantic Interpretations

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- Dative alternations – certain verbs like *give, send, read* allows THEME or GOAL to appear as the object

(19.26) *Doris gave/sent/read the book to Cary*

*AGENT*

*THEME*

*GOAL*

*SUBJECT*

(19.26) *Doris gave/sent/read Cary the book*

*AGENT*

*GOAL*

*THEME*

*OBJECT*

- Verbs of future having (advance, allocate, offer, owe), send verbs (forward, hand, mail), verbs of throwing (kick, pass, throw)

# Shallow Semantic Interpretations

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- Affect verbs like *frighten* can appear with THEME or EXPERIENCER as subject

(16.32) *That frightens me*

*THEME EXPERIENCER*

(16.32) *That surprises me*

*THEME EXPERIENCER*

*SUBJECT*

*OBJECT*

(16.33) *I am frightened of that*

*EXPERIENCER THEME*

(16.33) *I am surprised at that*

*EXPERIENCER THEME*

# Issues in Thematic Roles

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- Many of verbal alternations violate standard thematic hierarchy
- Many verbs do not allow the dative alternation (e.g. *donate, transfer*)
- Relevant to determine the grammatical role of NP and PP arguments only and **play no part in the realization of other arguments of verbs** such as sentential complements, verb phrases, quotations
- Only useful in mapping the arguments of verbs; but nouns have arguments as well (*destruction of the city, father of the bride*)
- Two commonly used lexical resources which makes use of semantic roles:  
**PropBank, FrameNet**

# Selectional Restrictions

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# Selectional Restrictions

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- A Selectional restriction is a kind of *semantic type constraint* that a verb imposes on the kind of concepts that are allowed to fill its argument roles
- *I wanna eat **someplace that's close to ICSI***
- Two parses lead to two distinct semantic analyses
- In intransitive case, the phrase is an adjunct that modifies the event
- In transitive case, the phrase provides a true argument to the event
- How do we know that the phrase is not the direct object in this?
- The THEME of EATING event tends to be something that is *edible*
- This restriction placed by the verb *eat* on the filler of its THEME argument – selectional restriction



# Selectional Restrictions

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- Selectional restriction is a constraint on the semantic type of some argument
- It is associated with senses, not entire lexemes
- (19.51) Well, there was the time they *served* green-lipped mussels from New Zealand  
(19.52) Which airlines *serve* Denver?
- (19.51) *cooking* sense of *serve*, which restricts THEME to be some kind of foodstuff
- (19.52) *provides a commercial service to* sense of *serve*, which restricts its THEME to be appropriate location

# Selectional Restrictions

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- Selectional restriction vary widely in their specificity
- The verb *imagine* impose strict requirements on its AGENT role – (restricting it to humans and other animate entities) places very few semantic requirements on its THEME role

(16.42) In rehearsal, I often ask the musicians to *imagine* a tennis game.

(16.44) I can not even *imagine* what this lady does all day.
- The verb *lift* limits its THEME to be something liftable – physical object

(16.45) Atlantis *lifted* Galileo from the launch pad at 12:54 pm EDT.

(16.46) When the battle was over, he *lifted* the fish from the water.
- The verb like *diagonalize* places a specific constraint on its THEME role

(16.47) To *diagonalize* a matrix is to find its eigenvalues.

# Representing Selectional Restrictions

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- Use thematic roles rather than event roles

$\exists e, x, y \text{ Eating}(e) \wedge \text{Agent}(e,x) \wedge \text{Theme}(e,y)$

- To stipulate the selectional restriction that  $y$  must be something edible

$\exists e, x, y \text{ Eating}(e) \wedge \text{Eater}(e,x) \wedge \text{Theme}(e,y) \wedge \text{Isa}(y, \text{EdibleThing})$

- A semantic analyzer can form following representation for a phrase:

*ate a hamburger*

$\exists e, x, y \text{ Eating}(e) \wedge \text{Eater}(e,x) \wedge \text{Theme}(e,y) \wedge \text{Isa}(y, \text{EdibleThing})$

$\wedge \text{Isa}(y, \text{Hamburger})$

- *Hamburger* is consistent with its membership in category *EdibleThing*

whereas *eat someplace* ?

# Representing Selectional Restrictions

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- Two practical problems:
  - Using FOPC to perform the task of enforcing selectional restrictions is overkill
  - Requires a large logical knowledge-base of facts about the concepts that make up selectional restrictions
- Practical approach to state selectional restrictions is in terms of WordNet synsets, rather than logical concepts
- Exploit the hyponymy relations present in the WordNet

# Representing Selectional Restrictions

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- A meaning representation is well-formed if the role filler word is a hyponym of this synset
- Set the selectional restriction on the THEME role of the verb *eat* → synset {**food**, **nutrient**}
- Let us restrict *imagine*'s THEME to {entity} – *imagine a hamburger*  
*lift*'s THEME to {physical entity} – *lift a hamburger*  
*diagonalize* to {matrix} – ~~*diagonalize a hamburger*~~

# Representing Selectional Restrictions

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- The chain of hypernyms for *hamburgers* reveals that hamburgers are indeed food

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```
Sense 1
hamburger, beefburger --
(a fried cake of minced beef served on a bun)
=> sandwich
    => snack food
        => dish
            => nutriment, nourishment, nutrition...
                => food, nutrient
                    => substance
                        => matter
                            => physical entity
                                => entity
```

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**Figure 19.7** Evidence from WordNet that hamburgers are edible.

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# References

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- Speech and Language Processing, *Jurafsky and H.Martin*  
[Chapter 16. Lexical Semantics]