

# Verb aspect and argument activation: World vs. Word Knowledge

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# World vs. Word Knowledge

**I cooked pasta last night** in the kitchen in a pot on the stove for 8 minutes with 4 quarts of water.

- Language reports only a fraction of the detail in the world
- To what extent do language users rely on knowledge of the world vs. language usage?

## **Verb Aspect**

**Imperfect Aspect:** ongoing events

**Perfect Aspect:** completed events

# Aspect & Arguments in World & Words

Priming from imperfect verbs to locations, but not from perfect verbs (Ferretti, Kutas, & McRae, 2007).

*was cooking* → *kitchen*  
**FAST**

*had cooked* → *kitchen*  
**SLOW**

## H1: **World** Knowledge

Comprehenders use aspect to modulate how they use their world knowledge about events

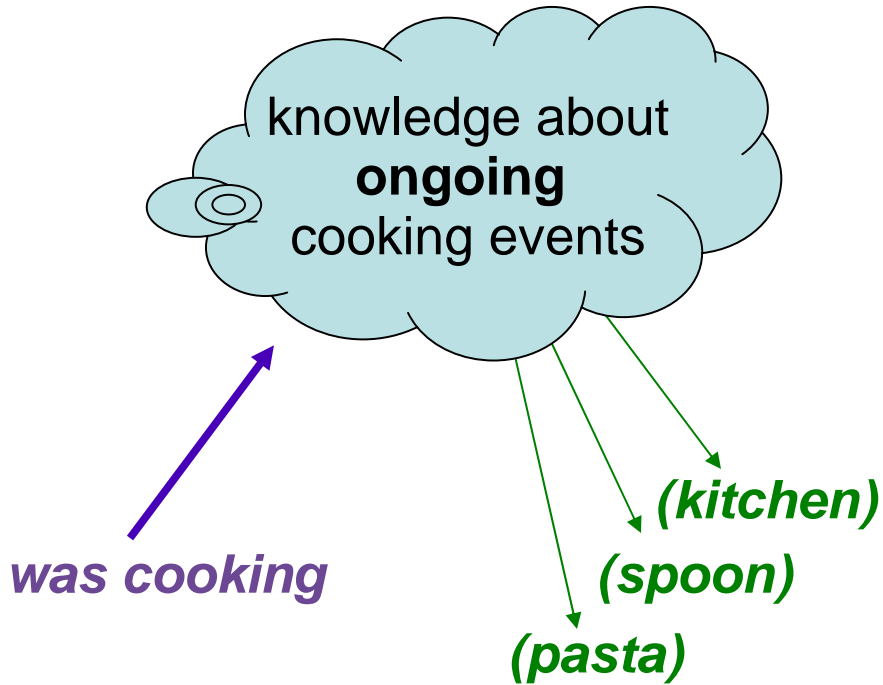
## H2: **Word** Knowledge

Comprehenders use knowledge of argument mention distributions in language

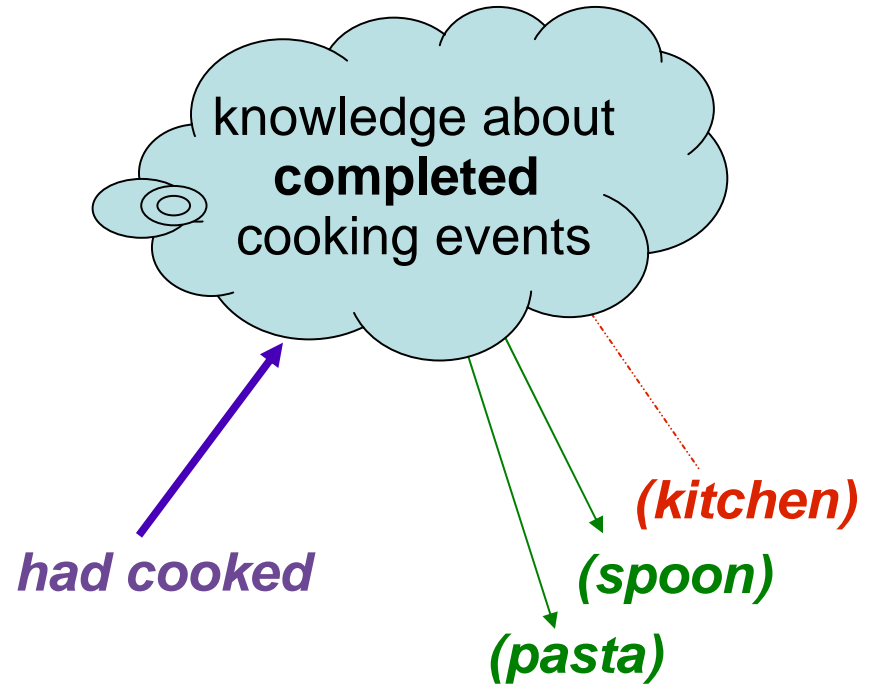
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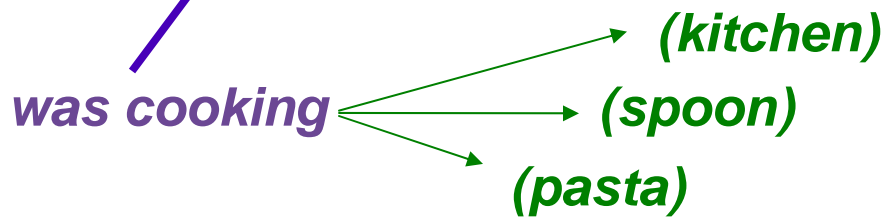


Priming via World Knowledge

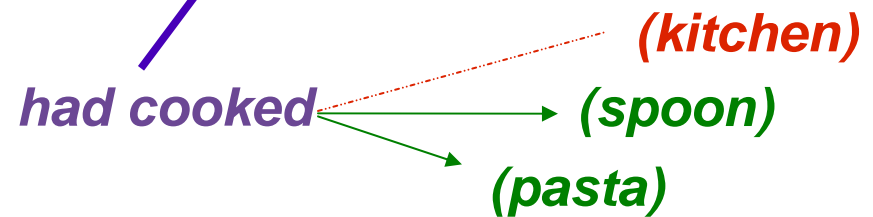
## H2: Word Knowledge

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Priming via Language Statistics

Goal: To contrast 2 explanations  
for this effect of verb aspect

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**H1:** World knowledge about likely event participants is activated differently by perfect and imperfect aspect verbforms

**H2:** Co-occurrence statistics between specific verbforms and arguments are tracked and used to aid processing

- Corpus study examining word co-occurrence
- Choose new stimulus pairs of verbs & locations
  - evaluate with corpus, ratings, & sentence completions
- Verbform-location priming study

# Corpus Study

Could language co-occurrence between aspectual forms and locations explain the observed differences in priming?

co-occurrence  
of *kitchen* with  
*was cooking*

VS.

co-occurrence  
of *kitchen* with  
*had cooked*

24 verb-location pairs from  
Ferretti et al. (2007)

Example:  $P(\textit{kitchen}|\textit{was cooking})$   
 $P(\textit{kitchen}|\textit{had cooked})$

*was cooking* → *kitchen*  
**FAST**

*had cooked* → *kitchen*  
**SLOW**

## Method

Wikipedia Corpus

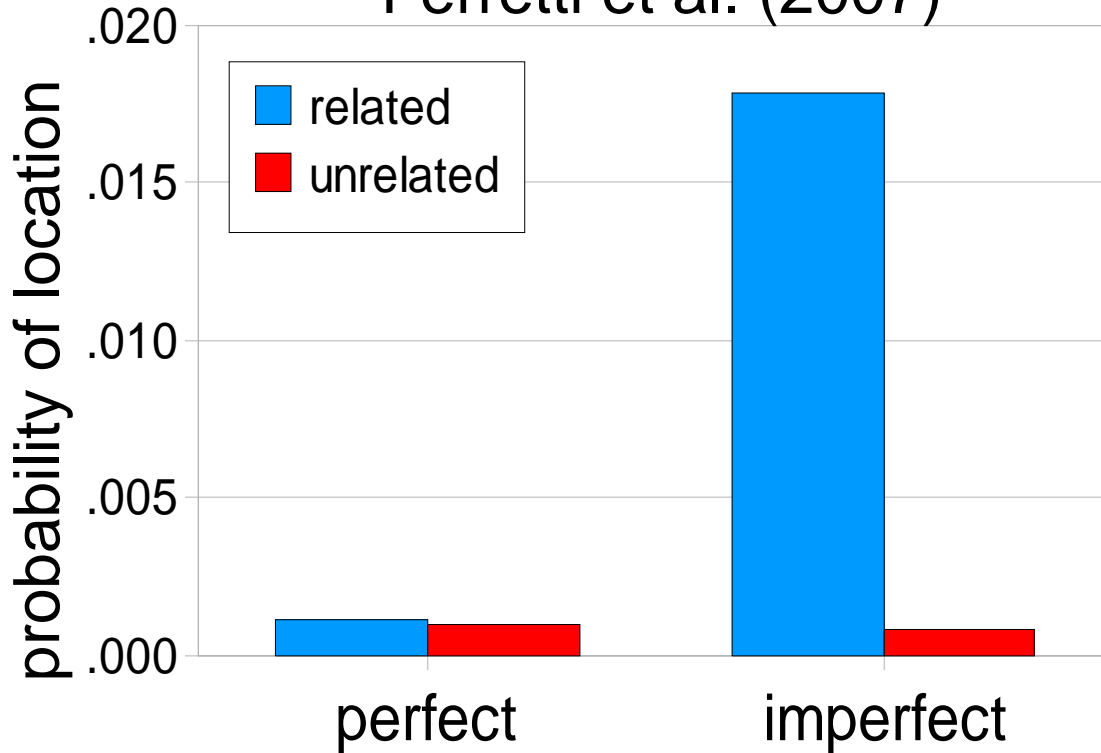
532,000,000 words

10 word window

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*was cooking* → *kitchen*

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*had cooked* → *kitchen*

**SLOW**

## Method

Wikipedia Corpus

352,000,000 words

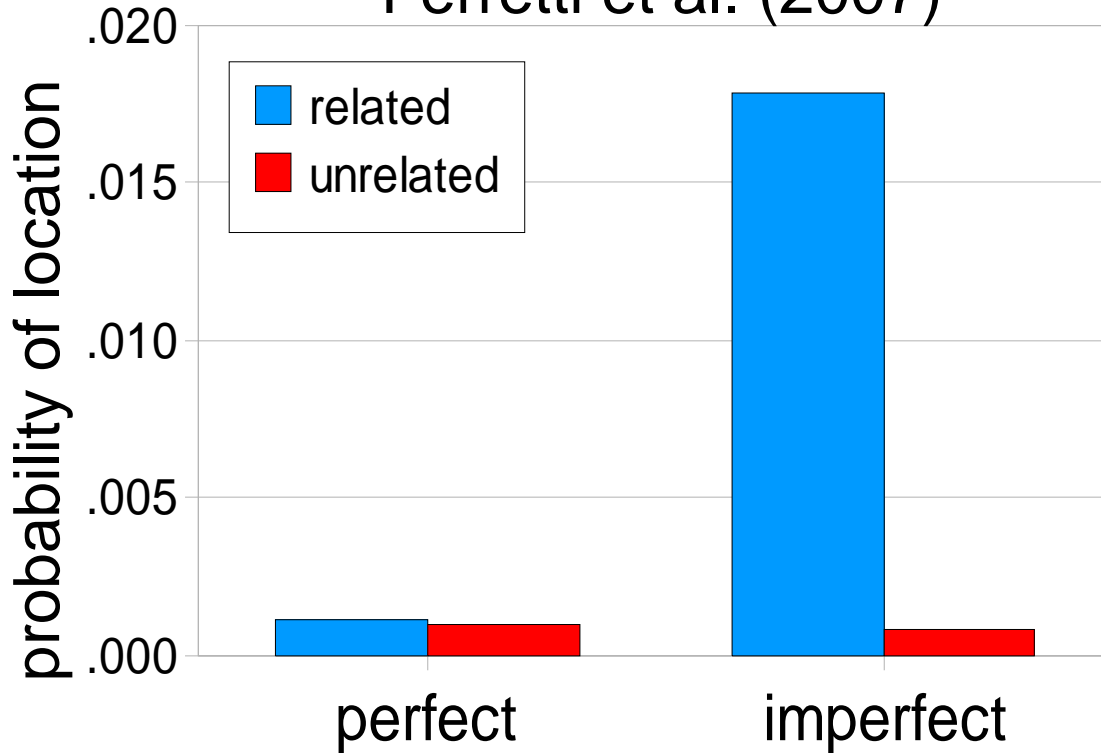
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**Example:**  $P(\textit{kitchen}|\textit{was cooking})$   
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# Corpus Study

Could language co-occurrence between aspectual forms and locations explain the observed differences in priming?

24 verbform-location pairs from  
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*was cooking* → *kitchen*  
**FAST**

*had cooked* → *kitchen*  
**SLOW**

## Conclusion:

Language statistics  
sufficient to explain  
priming effect

**Example:**  $P(\textit{kitchen}|\textit{was cooking})$   
 $P(\textit{kitchen}|\textit{had cooked})$

# New items to test whether effect of aspect due to World Knowledge vs. Language Statistics

Chose 32 new **target locations** and 6 **verbforms** for each:

Average probabilities:

	<b>Verb-Location Relationship</b>		
	high-prob	low-prob	unrelated
imperfect	5.07%	0.01%	0.00%
perfect	4.09%	0.00%	0.00%

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Previous  
naming study



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***Ocean***

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*was drifting*

*had drifted*

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Chose 32 new **target locations** and 6 **verbforms** for each:

**Example:**  
***Ocean***

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*was drifting*

*had sunk*

*was sinking*

*had drifted*

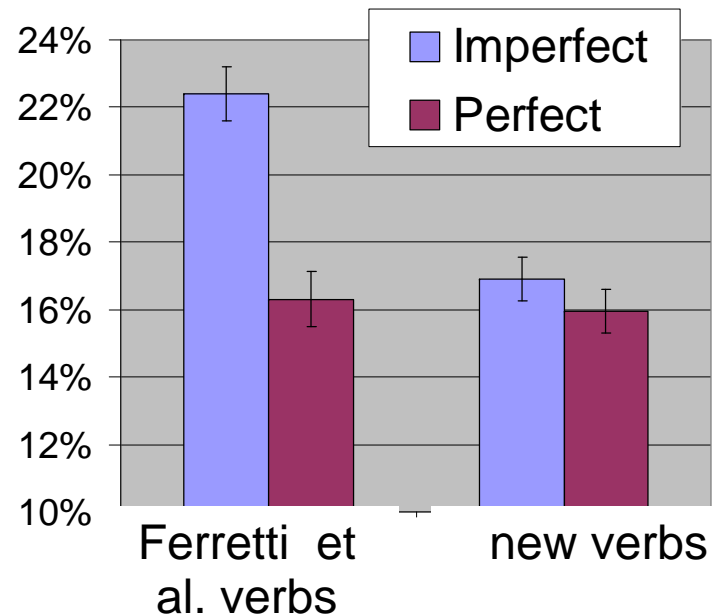
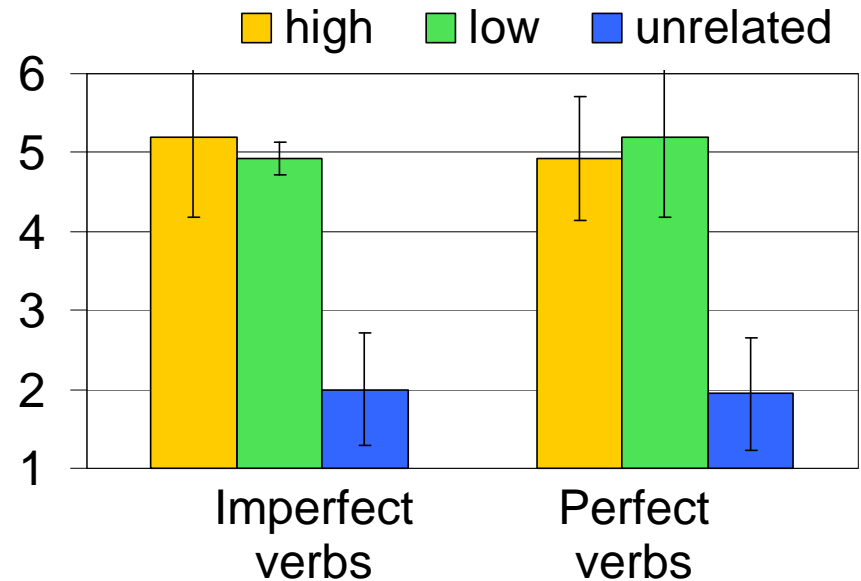
# Evaluating the new items

Semantic relatedness ratings  
for verbform and location

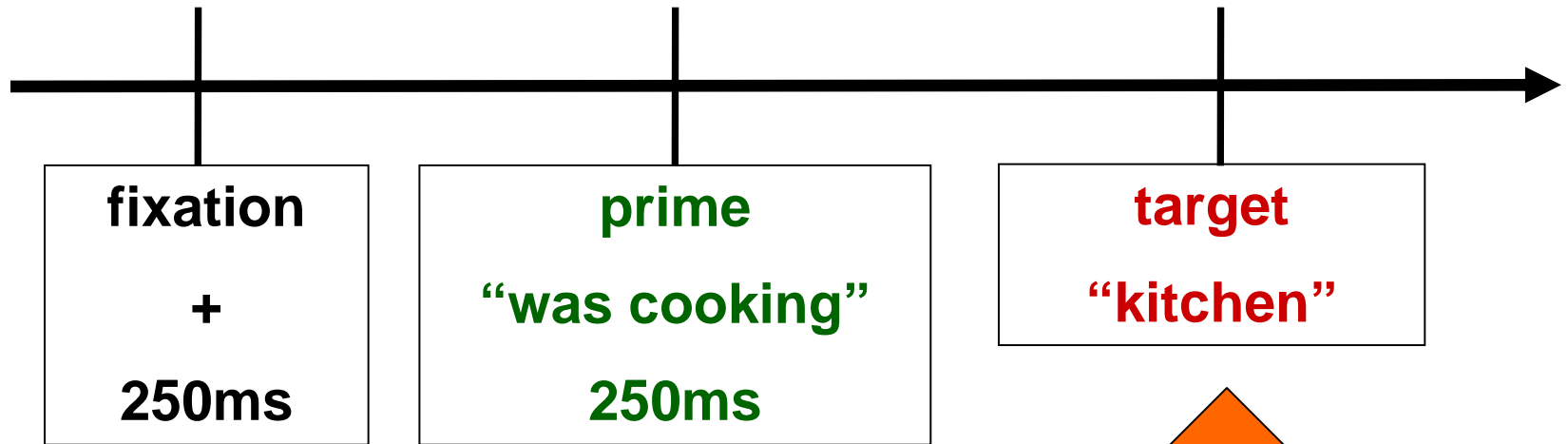
**ex:** *was drifting & ocean* 1 2 3 4 5 6 7  
*had drifted & ocean* 1 2 3 4 5 6 7  
45 participants

% sentence completions  
containing a location

**ex:** *Mary was drifting...*  
*Mary had drifted...*  
95 participants  
96 completions each



# Primed Naming



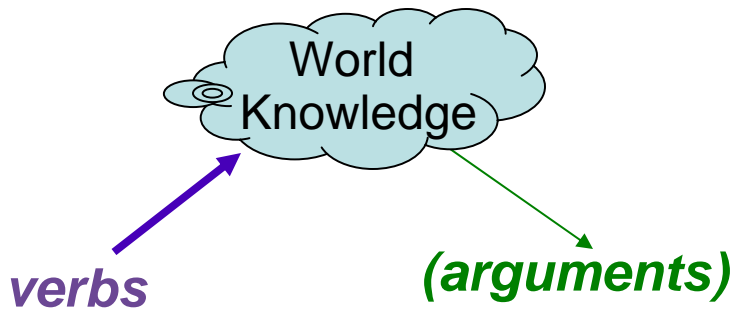
78 participants

32 trials each

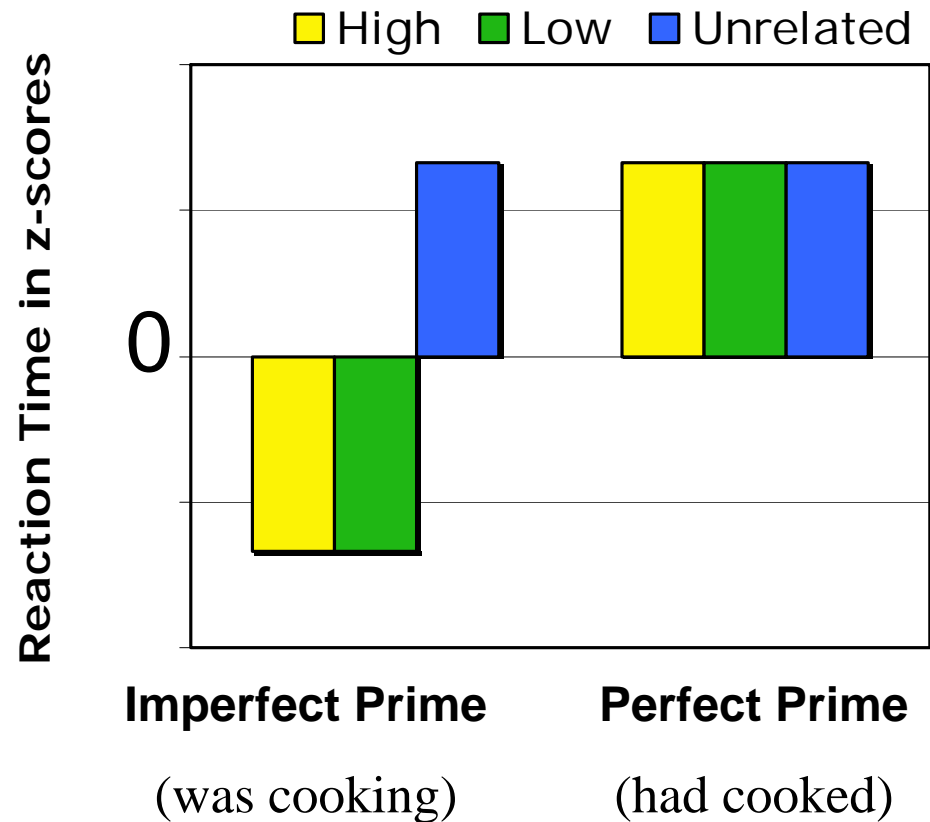
Participant reads target  
aloud as quickly as possible

# Primed Naming Predictions

**H1:** General effect of aspect on which types of arguments are activated based on event knowledge

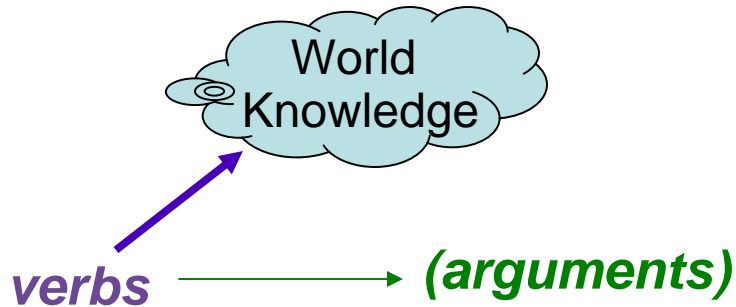


- Locations named fastest after **imperfect** verb primes
- No difference between **high vs low prob**

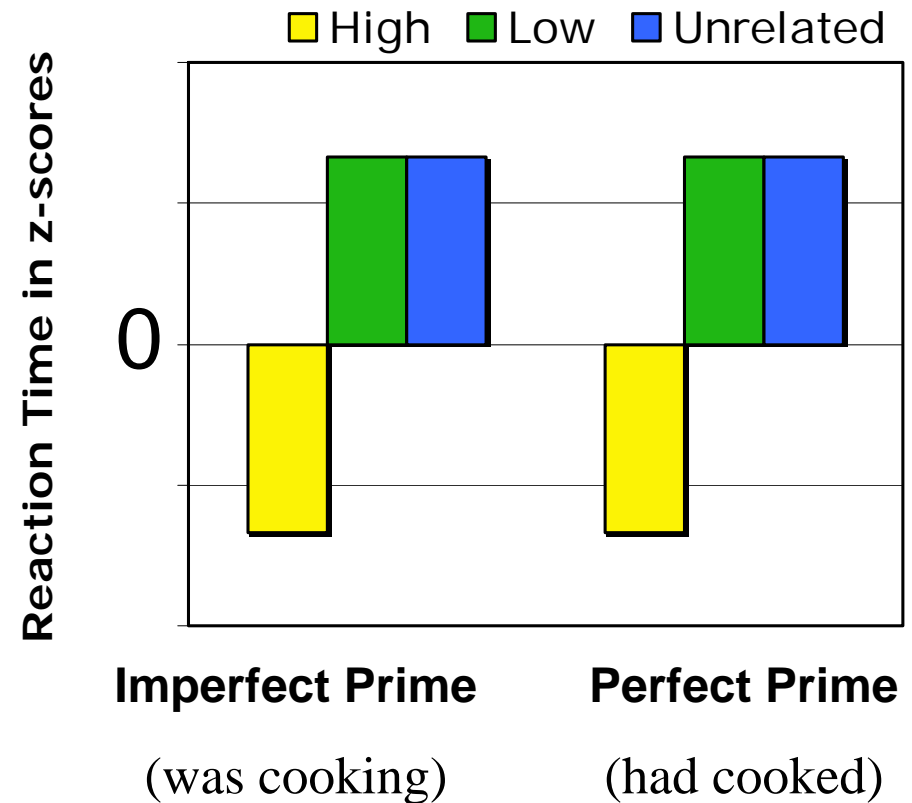


# Primed Naming Predictions

**H2:** Participants rely on fine grained co-occurrence statistics in language; between specific verbforms and mentioned arguments.

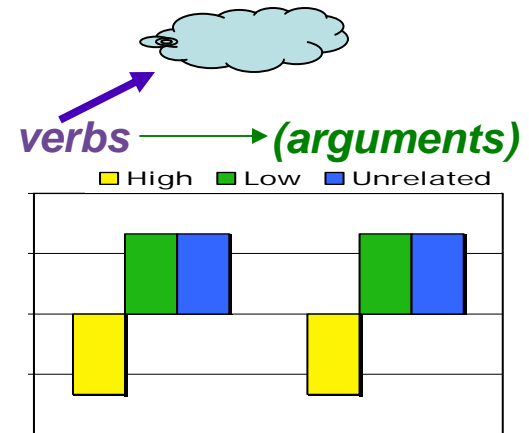
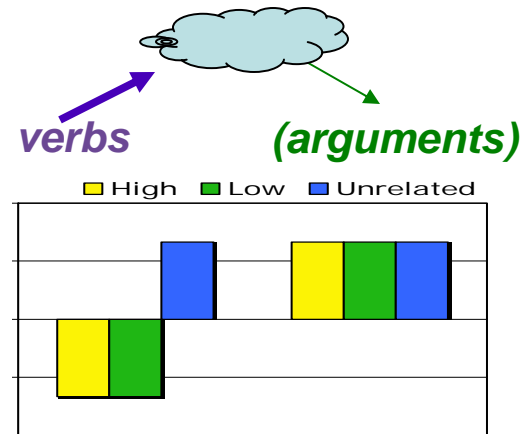
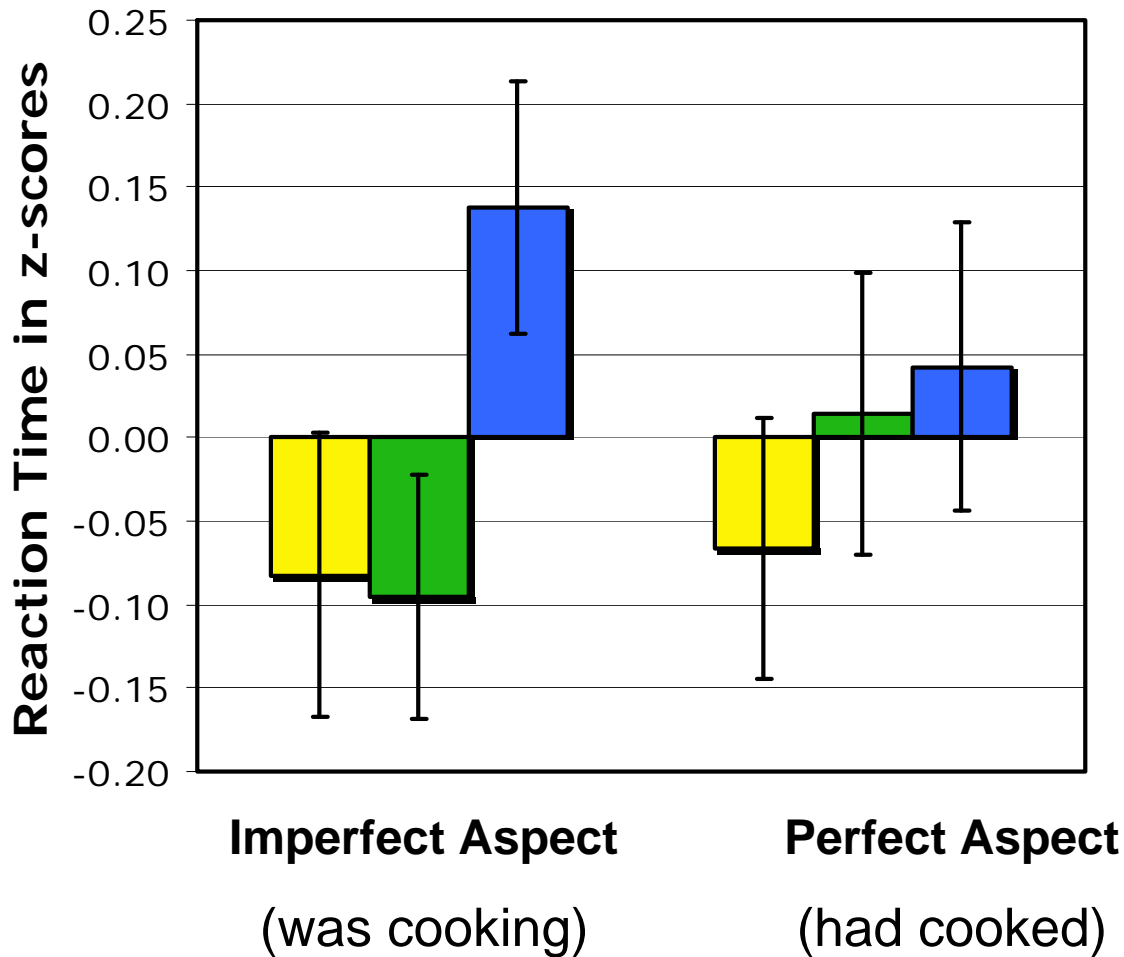


- Locations named fastest after **high-prob** verb primes
- No difference between **imperfect vs. perfect**



# Primed Naming – Results

■ High 
 ■ Low 
 ■ Unrelated



# Conclusions:

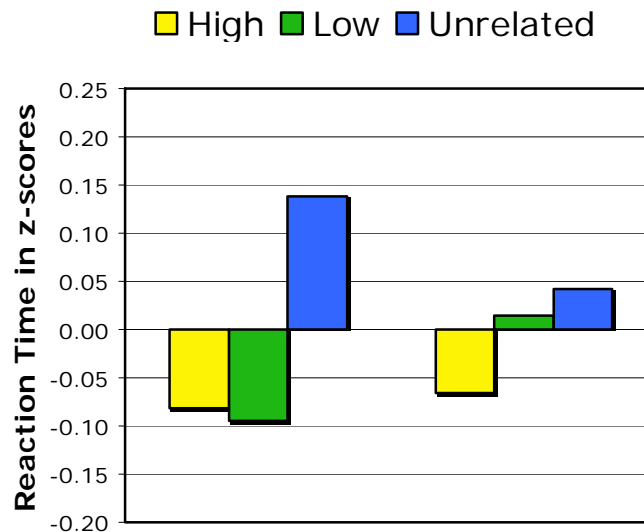
Neither model sufficient for priming data

## Evidence for Language Statistics

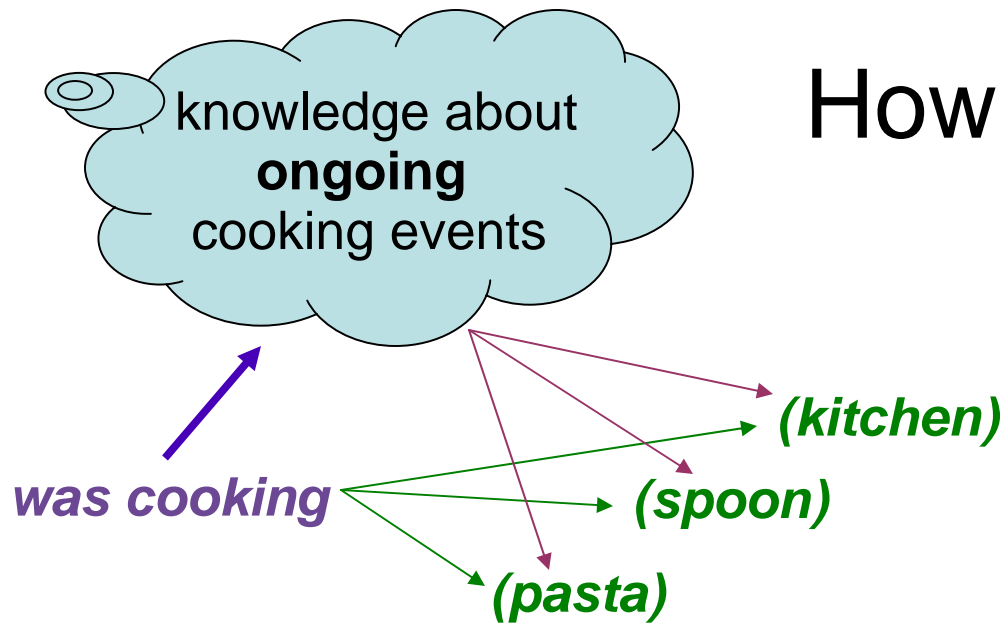
High probability locations primed by verbforms in either aspect

## Evidence for a General Effect of Aspect

Low probability (but related) locations primed by verbforms in imperfect aspect only



# How might it be both?

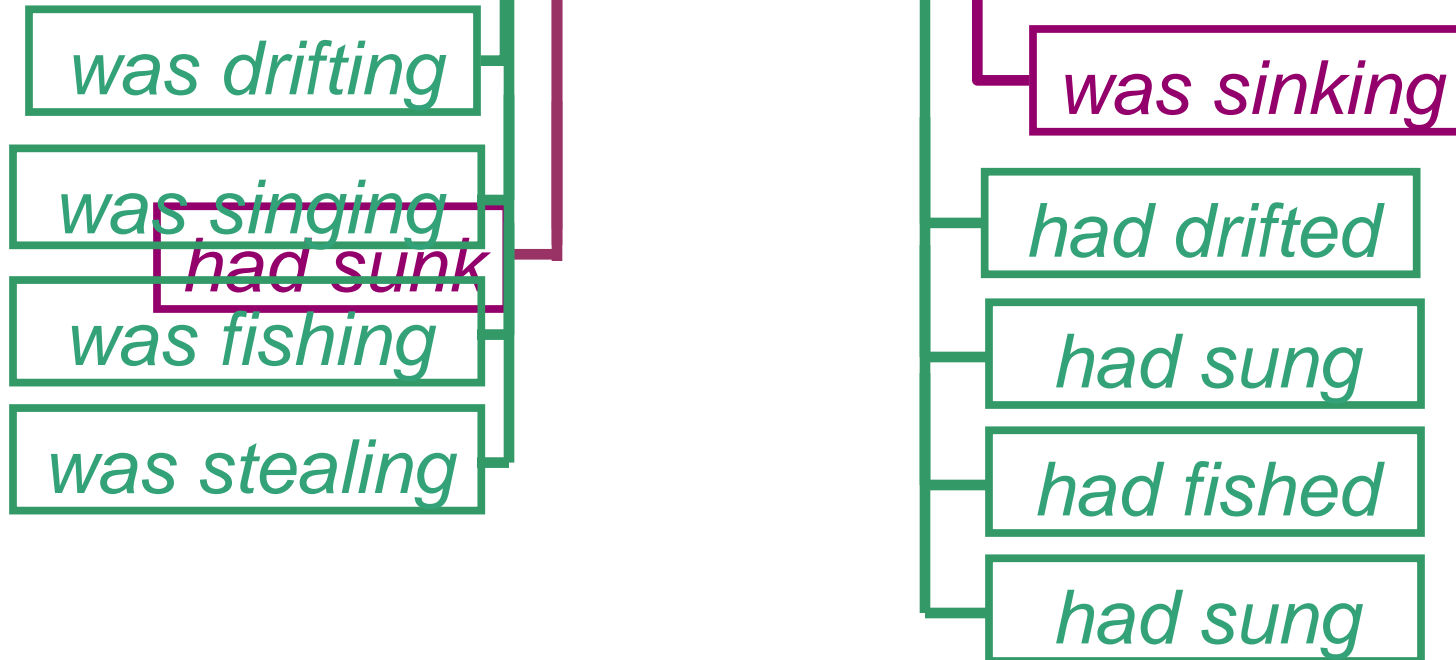


## Frequency **X** Regularity interaction

- “frequency” is item-specific probability
- “regularity” is general pattern of imperfect aspect co-occurring with locations

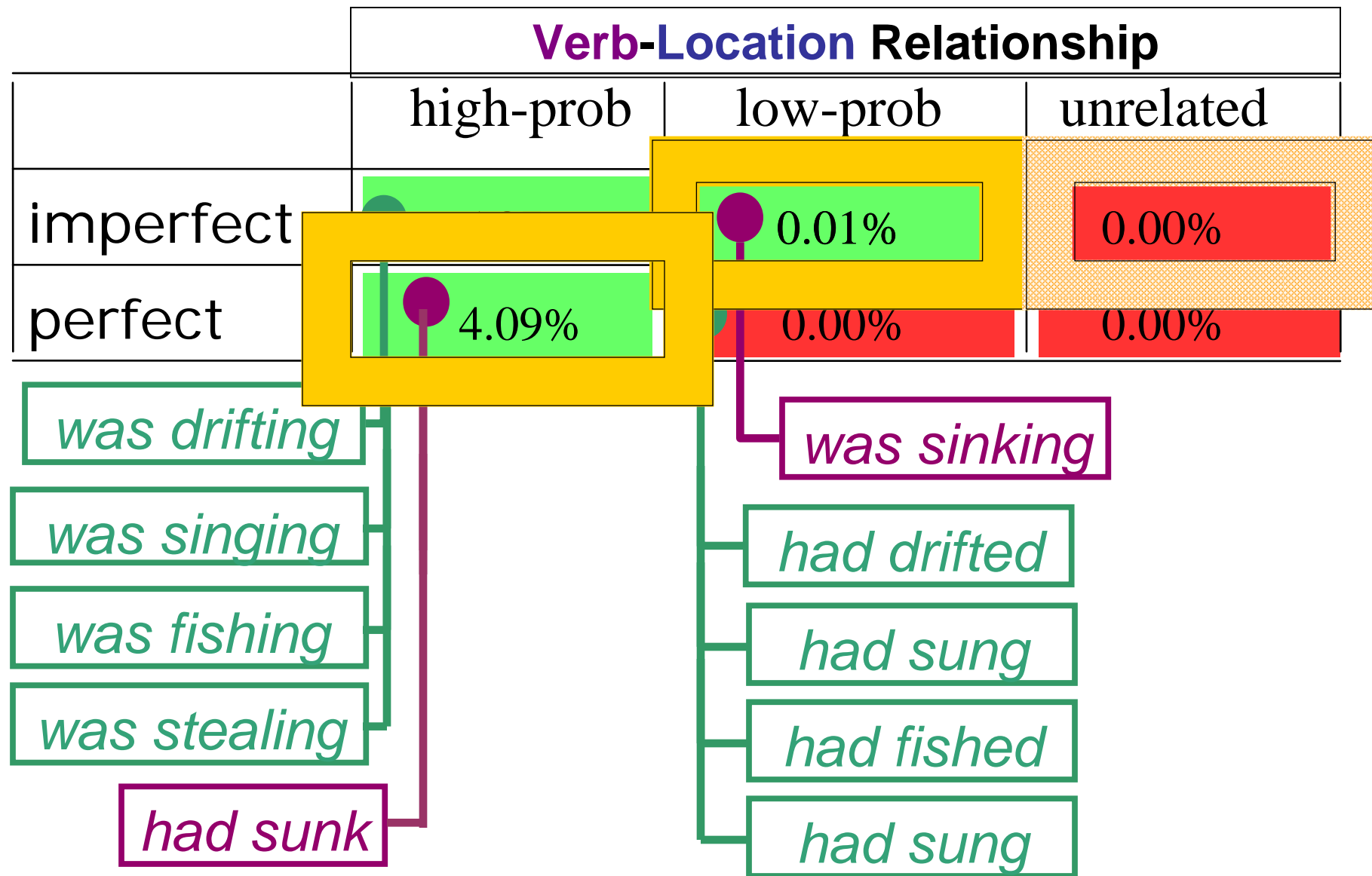
# Frequency **X** Regularity in Verb Aspect

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imperfect	5.07%	0.01%	0.00%
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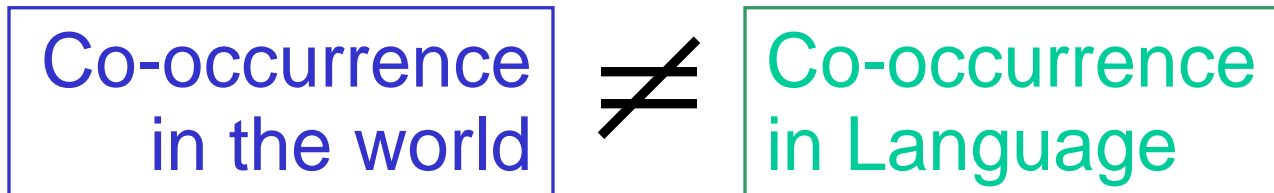
# Frequency **X** Regularity in Verb Aspect

General pattern: *was* \_\_\_*ing* co-occurs with locations



# General Conclusions

- Aspect affects language processing in 2 ways:
  - Allows specific language statistics for different forms of a verb
  - General effect on argument activation
- How could a language user learn aspect?
  - possibly schemas as in a connectionist network



*I cooked pasta last night in the kitchen in a pot on the stove for 8 minutes in 4 quarts of water.*



# Language and Cognitive Neuroscience Laboratory

## Thank you

Andrea Nett

Rebecca Rozek

Jae Yun Kim

Ariella Carlin

Allison Wolfe



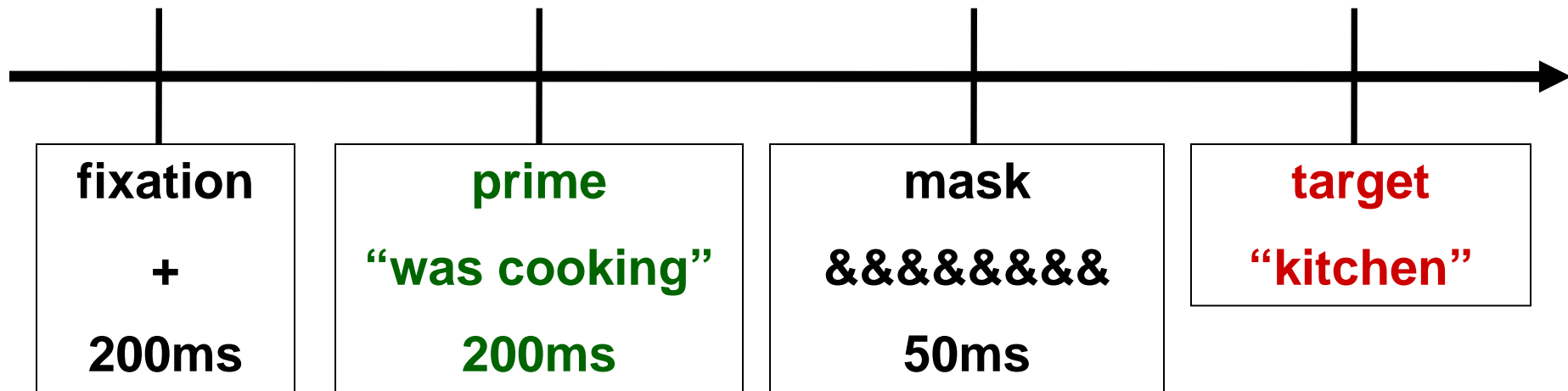
**Extra Slides!!!**

# Semantic Decision – procedure

Naming task is language-like, Pp rely on language statistics

Changing task might shift Pp to rely more on knowledge about the world

Task: Is the target a place or is it not a place?

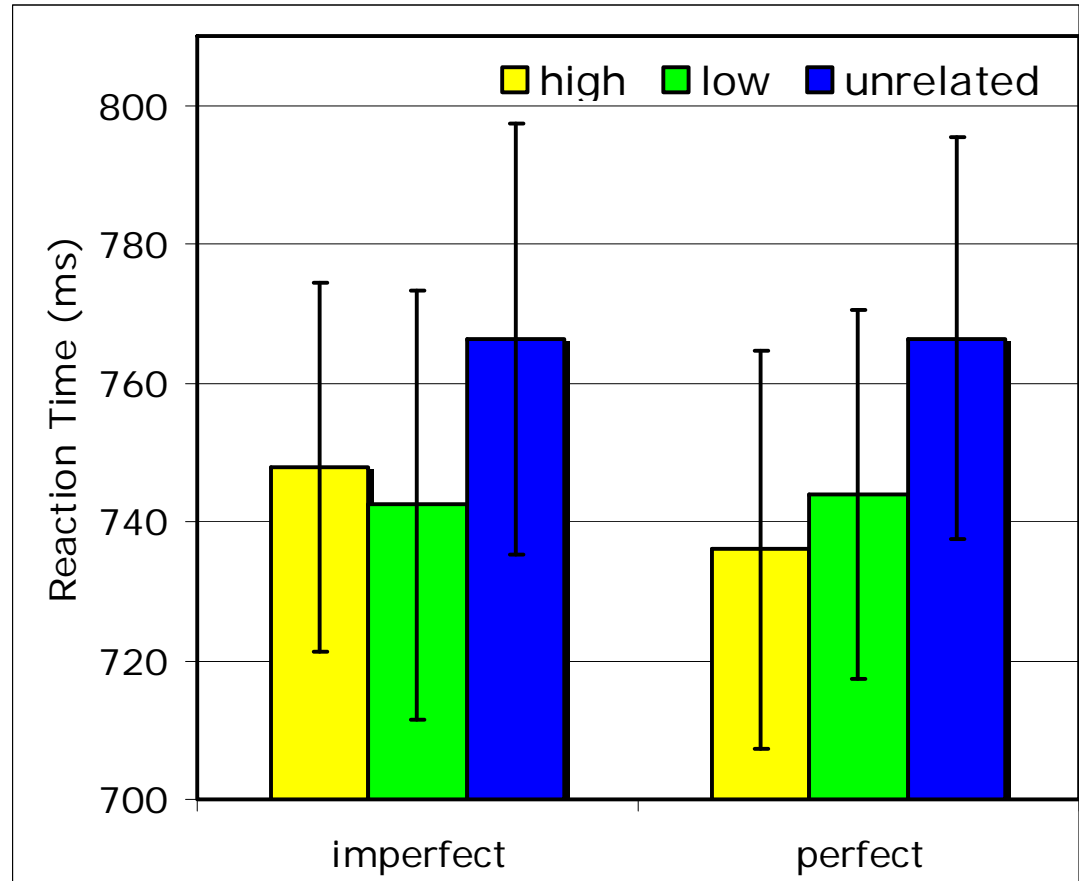


# Semantic Decision – our items

2(aspect: perf, imperf) X 3(relation: high, low, unrelated)

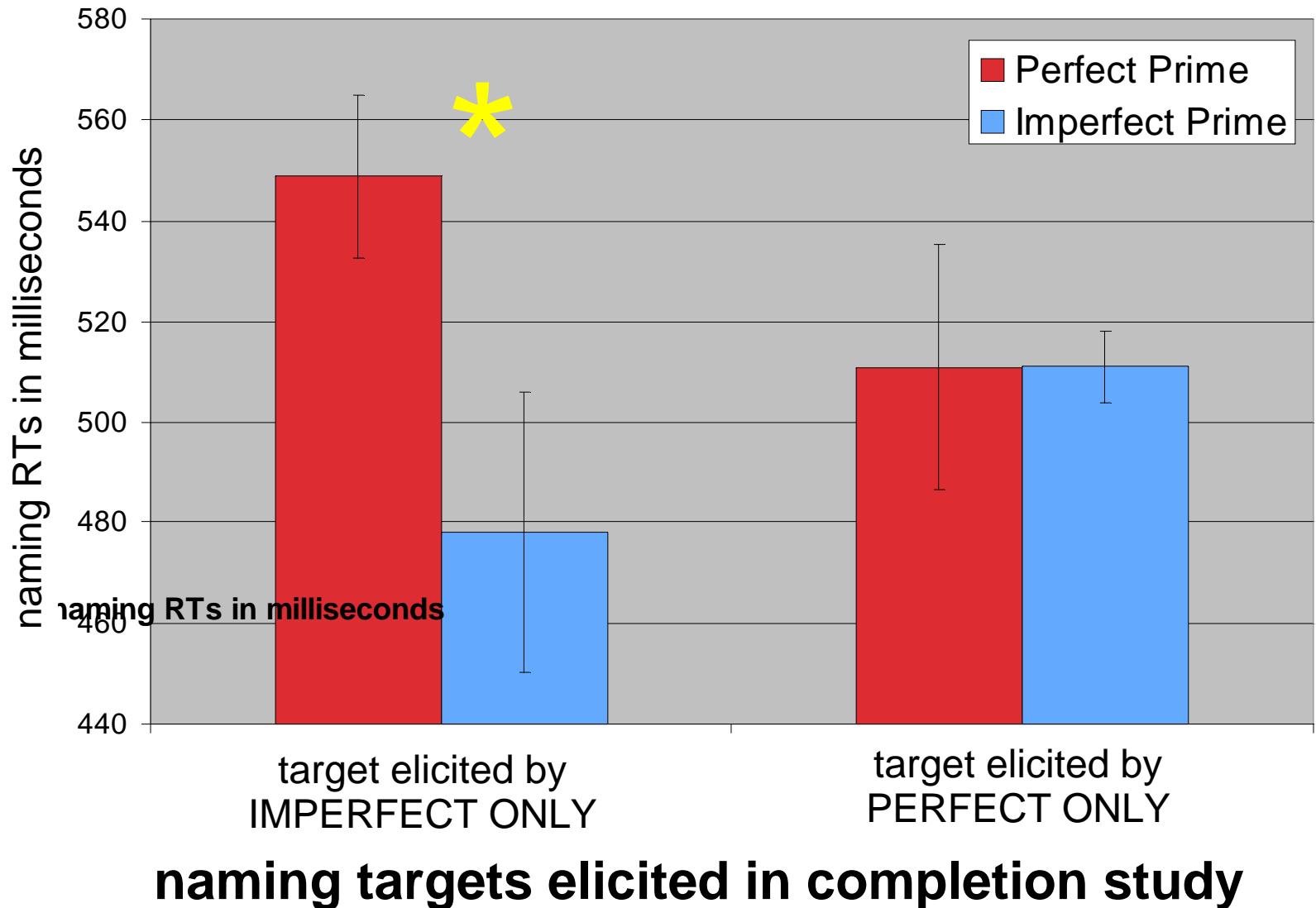
<u>By subjects</u>	<u>F</u>	<u>p</u>
Aspect	0.145	0.704
<b>Relation</b>	<b>3.221</b>	<b>0.043 *</b>
AxB	0.304	0.739

<u>By items</u>	<u>F</u>	<u>p</u>
Aspect	0.038	0.847
<b>Relation</b>	<b>3.082</b>	<b>0.061</b>
AxB	0.122	0.886



Effect of relation, no effect of aspect, by subjects and by items.  
Low patterns with high.

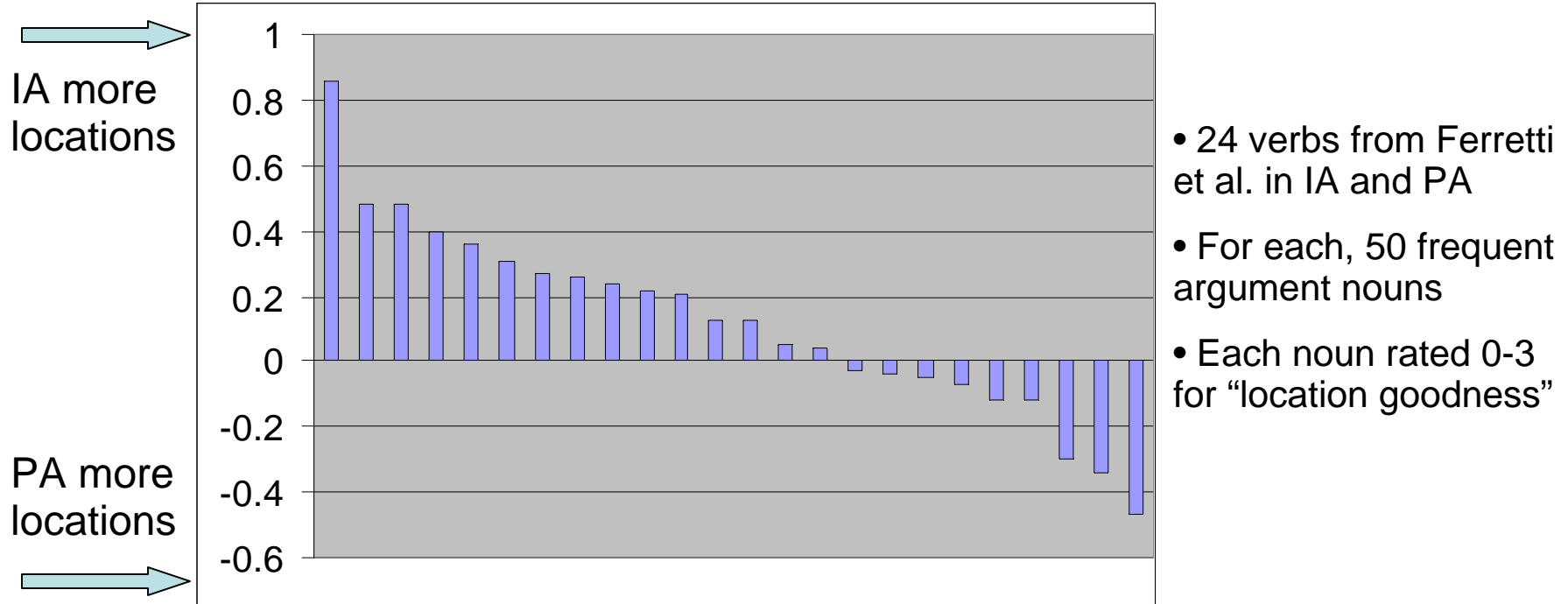
# Completions and naming RTs



# Corpus Study 2:

## Probability of any location for IA and PA verbs

Difference in locations of 50 frequent arguments  
(locations of IA arguments) – (locations of PA arguments)



### Conclusions:

1. More locations for IA than PA for most verbs.
2. Consistent with a generalized effect of aspect.