

## Presentation 18: Processing and linguistic relativity

Topic 1: Language and time  
Topic 2: Language and perception

## Spatial metaphors for time

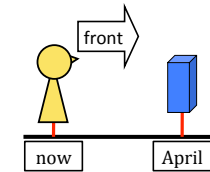
Space-time correspondences in language	
Space	Time
at the corner	at noon
from here to there	from two o'clock to four o'clock
through the tunnel	through the night
He stood <i>before</i> the house	it happened <i>before</i> evening
He was running <i>ahead</i> of me	He arrived <i>ahead</i> of me

## Two metaphors for time (Clark, 1973)



### Ego-moving

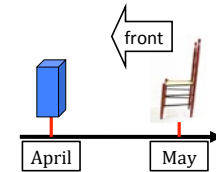
April is ahead of us



front = future-ward

### Time-moving

April is ahead of May



front = past-ward

## Interference between perspectives



### Premise:

*Ego-moving* and *time-moving* metaphors should generate distinct representations of time

### Therefore:

*Ego-moving* metaphor should interfere with *time-moving* metaphor, and vice versa

### Test:

Three experiments [Experiments 1 and 3]

## Comprehension speed

### Step 1: Read *time-moving* metaphors

I will take the Math exam  
before the English exam.

My birthday is ahead of  
John's birthday.

I will take two months  
vacation after graduation.

### Step 2: Test *time-moving* metaphor

Christmas is six days before  
New Year's day.

[consistent]

### Step 1: Read *ego-moving* metaphors

I am looking forward to the  
concert.

In the weeks ahead of him,  
he wanted to finish this  
project.

We are coming into troubled  
times.

### Step 2: Test *time-moving* metaphor

Christmas is six days before  
New Year's day.

[inconsistent]

## Test sentence

Press left or right button for correct time

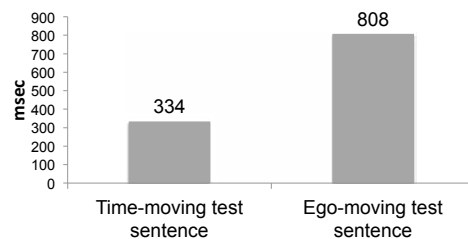
Christmas is six days before New Year's Day.

Christmas

Past New Year's Day Future

## Inconsistent metaphor is harder

Delay when test sentence is inconsistent



Boroditsky approached travelers at O'Hare Airport with watch (timer) on her wrist



E: "Hello, I'm on my way to Boston" (intro)  
"Is it later or earlier in Boston than it is  
here?" (**setting question**)

[*time-moving metaphor*]

S: "It's later there"

E: "So should I turn my watch forward or back?" (**test question**)

[*ego-moving metaphor*]

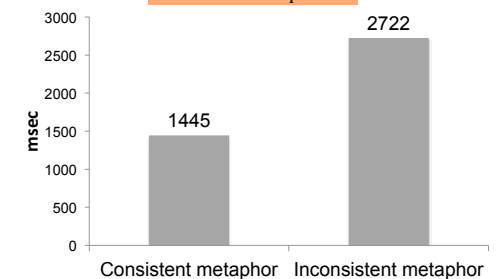
S: "Forward"

(response timed from end of test question)

E: "Great, thank you!"

## Inconsistent question is harder

Time to answer question



## Space affects time *conceptually*

### Premise:

English metaphors represent time in terms of space

### Therefore:

Even in a *non-linguistic* task, space should influence time, but not vice versa (Whorf)

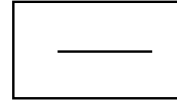
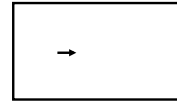
### Test:

Six experiments



**Presentation phase**  
Subjects watch lines grow over time

9 lengths X 9 durations



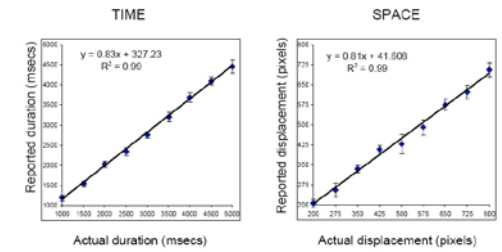
X

**Test phase**  
Subjects place mouse on X to *reproduce* either:  
1. length of line  
2. duration of line

Casasanto & Boroditsky (2007)

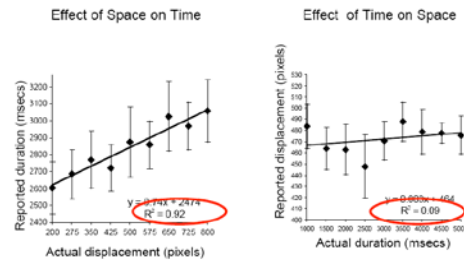
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## Estimates were very accurate



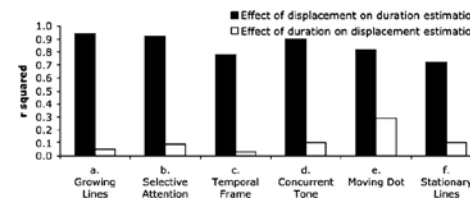
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## But: interference was asymmetrical



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Asymmetry is consistent over different forms of presentation



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## Language shapes conceptions of time



### Observation:

Mandarin has both horizontal *and* vertical metaphors for time

"What is the year *before* the year of the tiger?"

"Tuesday is *above* Wednesday"

### Therefore:

Space should prime time differently in English and Mandarin speakers

### Test:

Reaction times

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## Experiment

### Two pictures in succession

"What is relation of second object to first object?"

Button 1: earlier

Button 2: later

### Response buttons arranged ...

horizontally

**canonical:** left = earlier  
(for both English and Mandarin)

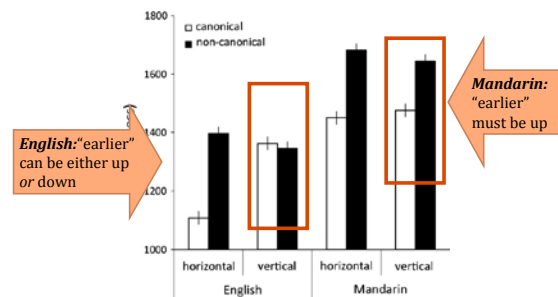
vertically

**"canonical":** top = earlier  
(for Mandarin, but *not* for English)



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## Reaction times on horizontal/vertical buttons



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## Two spatial metaphors for duration

	Distance metaphors	Quantity metaphors
English	<i>long</i> time	<i>much</i> time
Indonesian	waktu panjang	waktu banyak
Greek	makry kroniko diatstima	poli ora
Spanish	largo tiempo	mucho tiempo

Casasanto et al. (2004)

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## Language shapes conceptions of time

### Observation:

English prefers distance metaphor (*long time*); Greek prefers quantity metaphor (*much time*)

### Therefore:

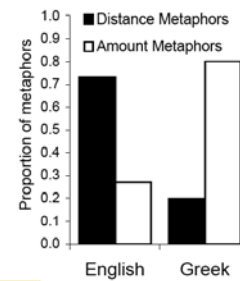
English and Greek speakers should show different interference in estimating time

Casanto et al. (2004)

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## Asymmetry reflects frequency of metaphor

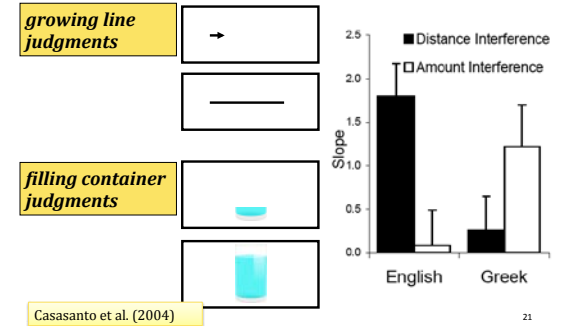
### raw frequency of metaphors



Casanto et al. (2004)

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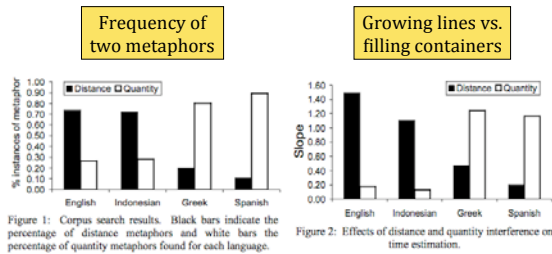
## Asymmetry reflects frequency of metaphor



Casanto et al. (2004)

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## Asymmetry reflects frequency of metaphor



Casanto et al. (2004)

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## Pormpuraaw, an aboriginal language



Participants asked to lay cards out on the ground so that they were in the correct order (in English or Pormpuraaw).



Boroditsky & Gaby (2010)

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## Two conceptions of time

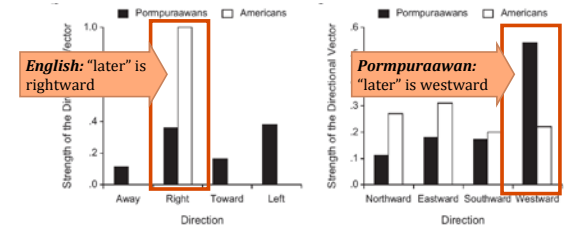
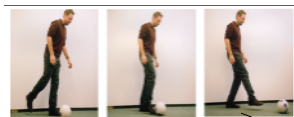


Fig. 1. Experimental materials and results. An example of a card set for the card-arrangement task is shown in (a). The photos show Lev Boroditsky at different ages. The graphs show the strength of the directional components of temporal sequences arranged by Pormpuraaws and Americans plotted in (b) relative coordinates and (c) absolute coordinates. Results from the card-arrangement and dot-drawing tasks are combined; numbers reflect by-participants averages.

Americans: Time goes left to right  
Pormpuraaws: Time goes east to west

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## Tense and time in Indonesian



**English:** He will kick/is about to kick the ball. He is kicking the ball. He kicked the ball.

**Indonesian:** He kick the ball [soon]. He kick the ball [now]. He kick the ball [already].

Boroditsky et al. (2003)

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## Tense and time in Indonesian

If

People habitually attend more to the things that are encoded obligatorily in their language

Then

Habitual encoding should affect

Ratings of similarity  
Recognition memory

Series of experiments

Boroditsky et al. (2003)

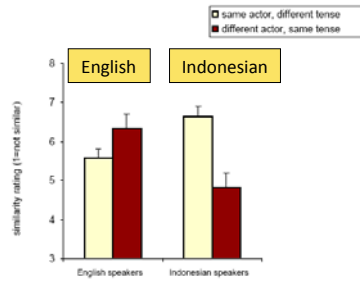
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## How similar are these?



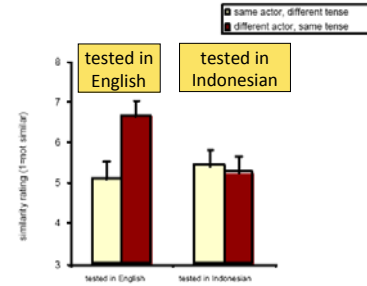
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## Similarity ratings



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## Similarity ratings in *bilingual* speakers



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## Recognition test for pictures

Show people pictures of events in progress

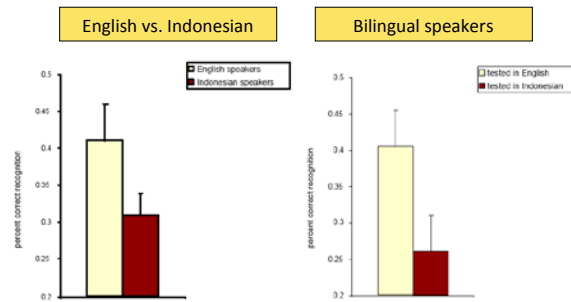
Test recognition



Which one did you see?

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## Recognition reflects language



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## Topic 2: Does language shape pitch?



Farsi: *naazok* vs. *koloft* (thin vs. thick)  
Dutch: *hoog* vs. *laag* (high vs. low)

Dolscheid, Shayan, Majid & Casasanto (2013)

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## Does language shape pitch?

### Universalist position:

Linguistic metaphors may differ across languages, but underlying pitch representations are the same.

### Relativist position:

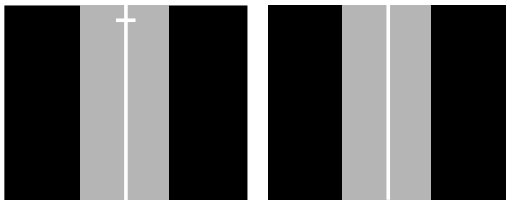
People who use different metaphors in their native languages should represent pitch differently.

Dolscheid, Shayan, Majid & Casasanto (2013)

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## Cross-dimensional interference paradigms

Cross bar took one of 9 heights  
Line had one of 9 thicknesses



Height interference

Thickness interference

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## Cross-dimensional interference paradigms

Cross bar took one of 9 heights  
Line had one of 9 thicknesses



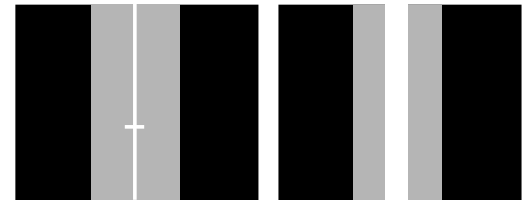
Height interference

Thickness interference

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## Cross-dimensional interference paradigms

Cross bar took one of 9 heights  
Line had one of 9 thicknesses

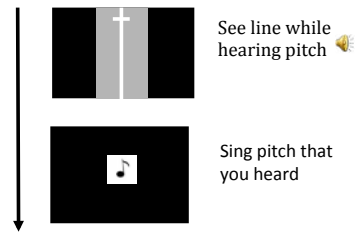


Height interference

Thickness interference

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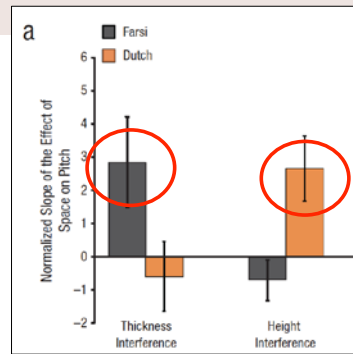
## Trial structure



Dolscheid, Shayan, Majid & Casasanto (2013)

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## Results



Dolscheid, Shayan, Majid & Casasanto (2013)

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## Conclusion

1. Language shapes mental representations of musical pitch
2. Even when people are not using language!
3. Speakers of different languages tend to form different mental representations of the same physical stimuli

Dolscheid, Shayan, Majid & Casasanto (2013)

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## Color perception (Regier, Kay, Cook, PNAS, 2005)

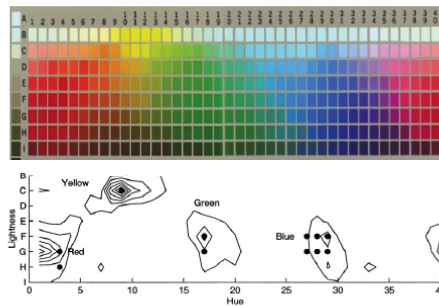
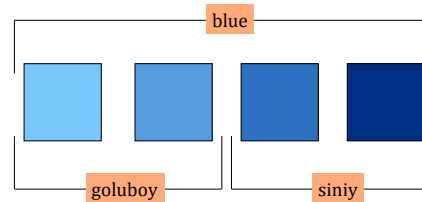


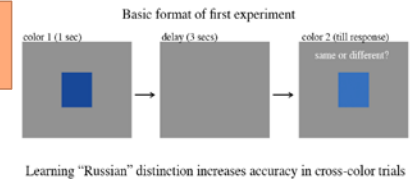
Fig. 2. Contour plot of WCS best-example choices compared with best examples of English color terms. Berlin and Kay reported more than one best-example choice for several of the English color terms; all best-example choices are displayed here.

## Russian blues

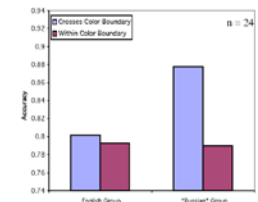


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Memory: "Same or different"



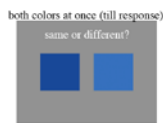
Learning "Russian" distinction increases accuracy in cross-color trials



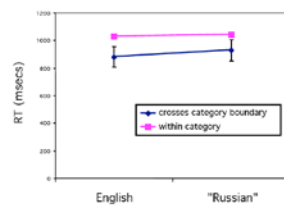
Frank & Boroditsky

Perception: "Same or different"

Basic format of second experiment



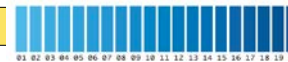
Learning "Russian" distinction produces no observable effects on reaction times or accuracies



Frank & Boroditsky

Perception: "Match to sample"

Range of blues



"Which is the match?"

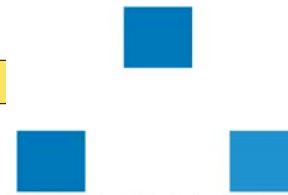


Fig. 1. The 20 blue colors used in this study are shown at the top of the figure. An example triad of color squares used in this study is shown at the bottom of the figure. Subjects were instructed to pick which one of the two bottom squares matched the color of the top square.

Winawer, Witthoft, Wu, Frank, Wade, & Boroditsky (2007)

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Russian speakers

English speakers

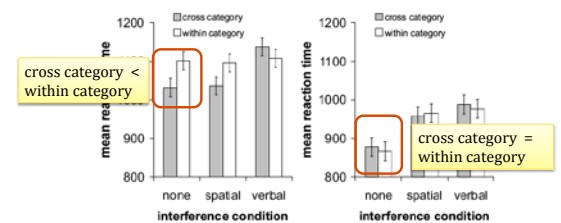


Fig. 2. Russian speakers' (Left) and English speakers' (Right) reaction times (msec) shown for the no-interference, spatial-interference, and verbal-interference conditions. Both near-color and far-color comparisons are included in these graphs. Error bars represent one SE of the estimate of the two-way interaction between category and interference condition.

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## Perception: "Match to sample"

### Interference during judgments

1. No interference
2. Verbal interference  
Silently rehearsed strings of digits
3. Spatial interference  
Maintained a spatial pattern in memory

"Which is the match?"



Winawer, Witthoft, Wu, Frank, Wade, & Boroditsky (2007)

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## Whorfian hypothesis?

Language *does* affect thought  
But effects are different in memory, perception, judgments

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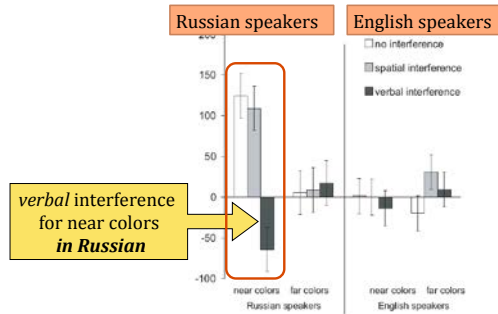


Fig. 3. Category advantage is plotted for Russian speakers (left) and English speakers (right) as a function of comparison distance (near colors vs. far colors) and interference condition (none, spatial, and verbal). Category advantage is calculated as the difference between the average reaction time for within-category trials and that for cross-category trials (ms). Error bars represent one SE of the estimate of the three-way interaction among category, interference condition, and color distance.

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## Conclusion

When blues are from different Russian categories, Russians (compared to English speakers) are:

1. more accurate in memory (same or different)
2. no faster in perception (same or different)
3. faster in simple matching to sample
4. no faster in matching to sample with verbal interference

Hence: Linguistic codes affect color judgments, but *not* basic color perception

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