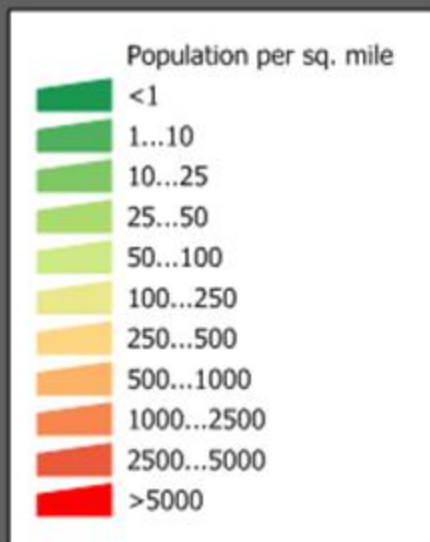# NORTH IS UP:
Spatial metaphor and geographic reasoning

Nathaniel B. Clark & Raymond W. Gibbs, Jr.

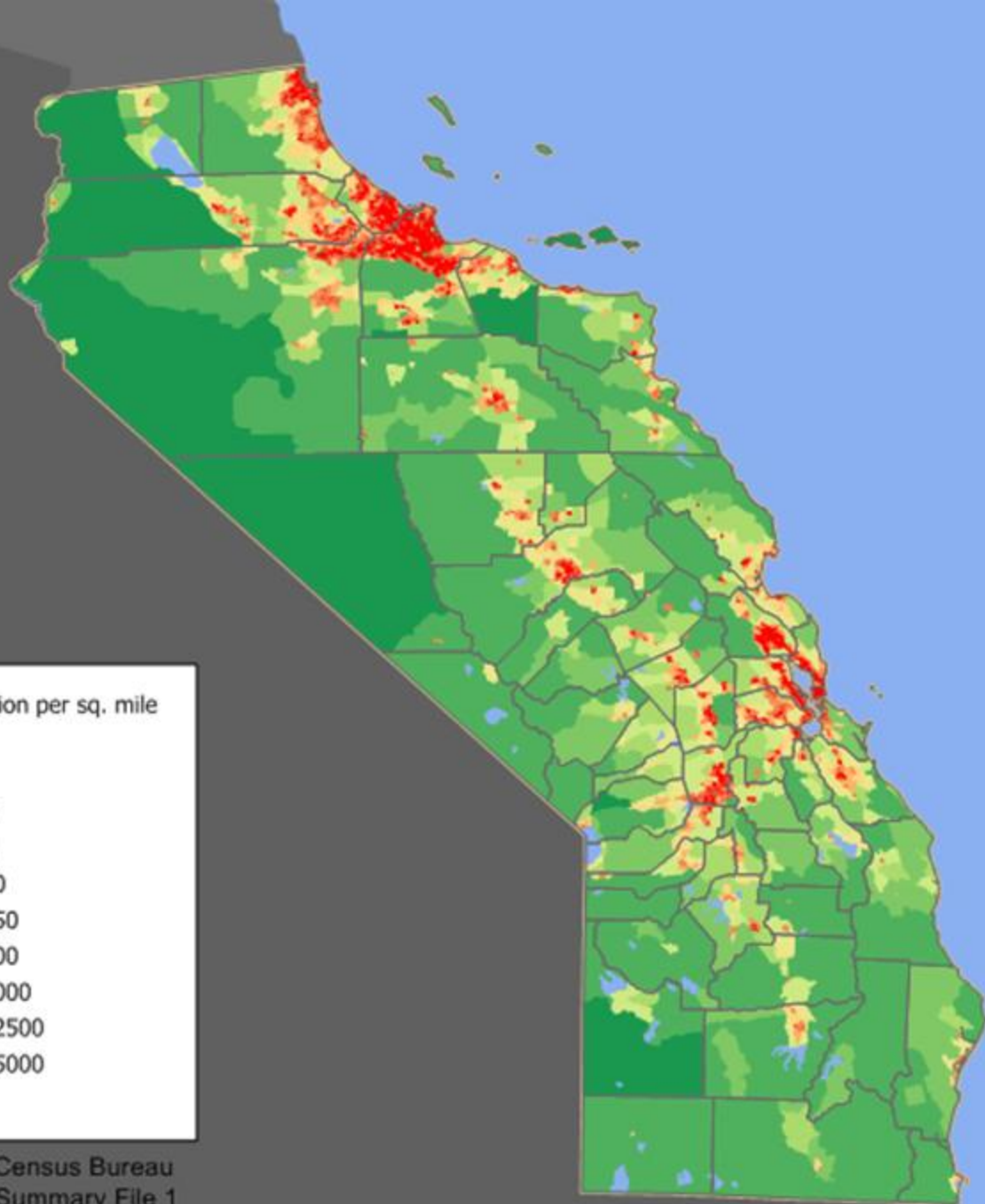Department of Psychology, UC Santa Cruz

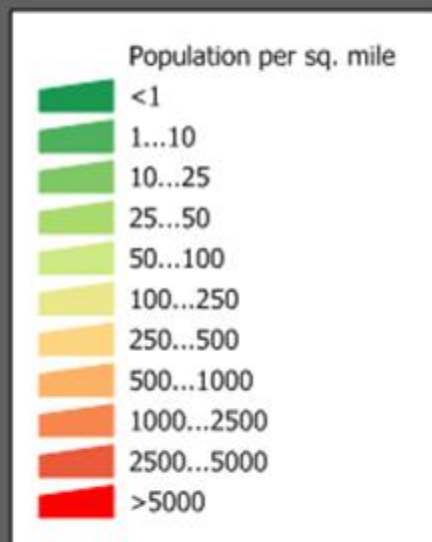ICLC, University of Alberta, Edmonton, AB
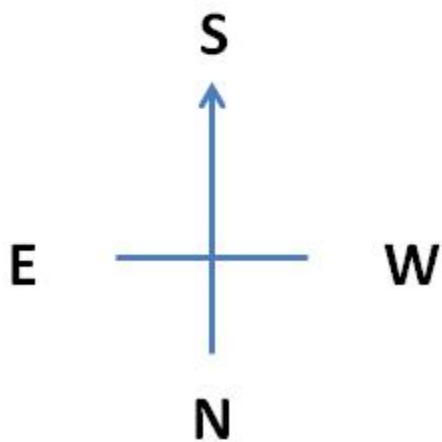
26 June 2013

Population per sq. mile

- <1
- 1...10
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Source: U.S. Census Bureau
Census 2010 Summary File 1
population by census tract

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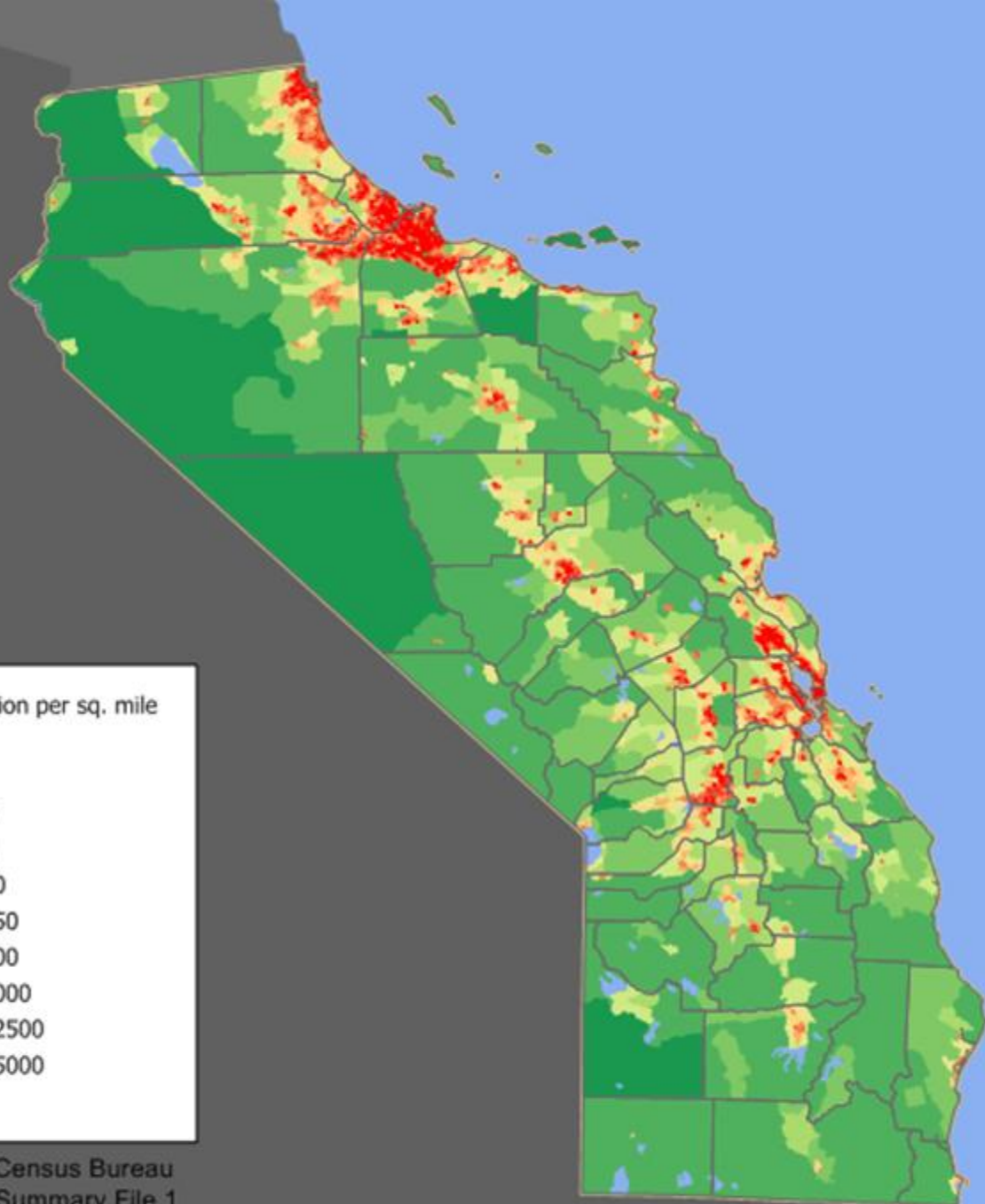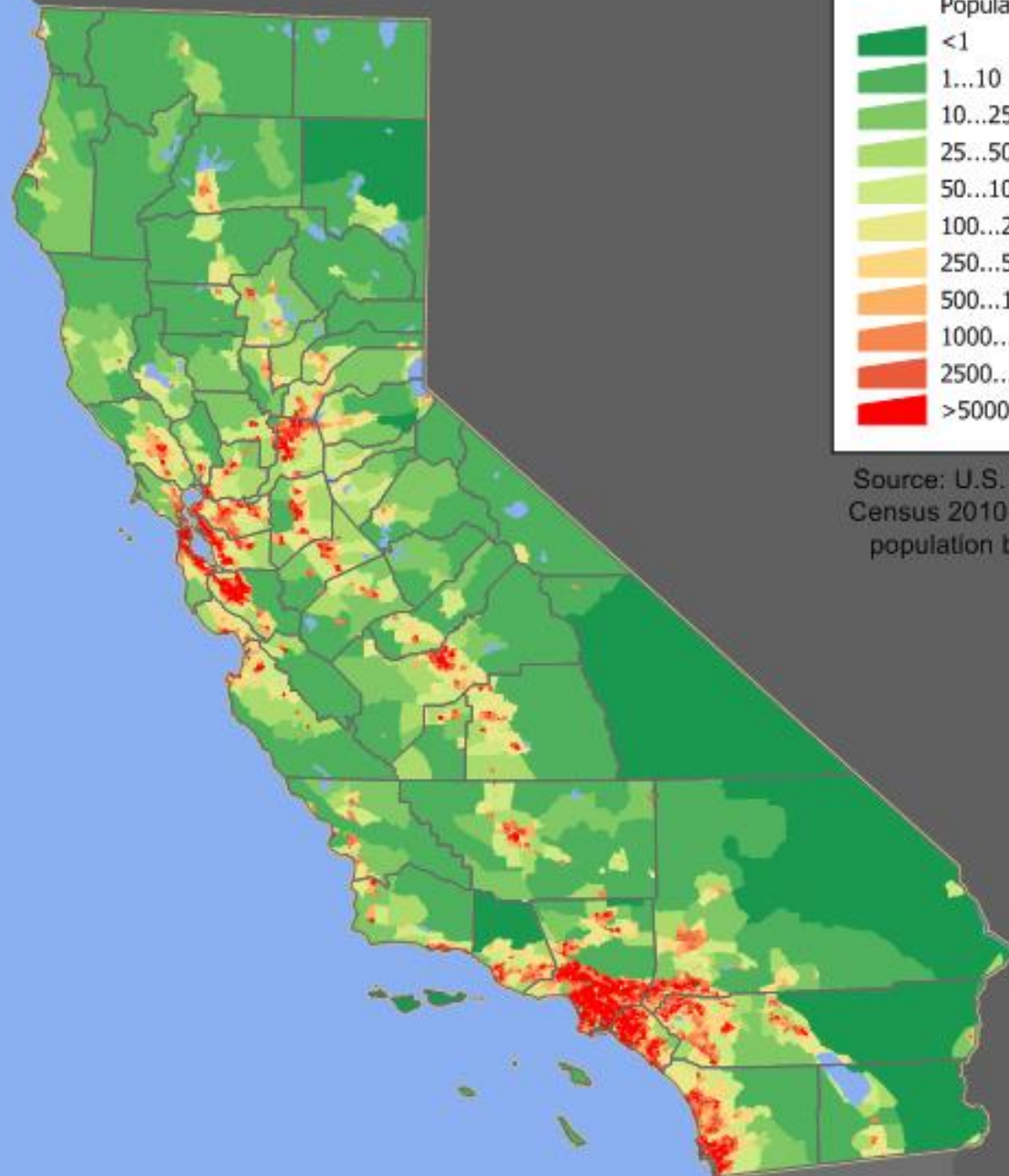
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Spatial metaphor

- Language use and map conventions suggest cardinal directions are conceptualized through bodily axes

- Experimental support:
  - Priming with cardinal directions biases movements along egocentric axes (Tower-Richardi, et al., 2012)
  - Northward travel viewed as more effortful, expensive, and time-consuming than southwards… (Nelson & Simmonds, 2009)
  - …even when going *south* is actually *uphill* (Brunyé, et al., 2012)
  - Combining metaphors: "NORTH IS UP" + "GOOD IS UP" = "NORTH IS GOOD" → northern neighborhoods viewed as more desirable & expensive, *but* not when south oriented at top of map (Meier, et al., 2011)
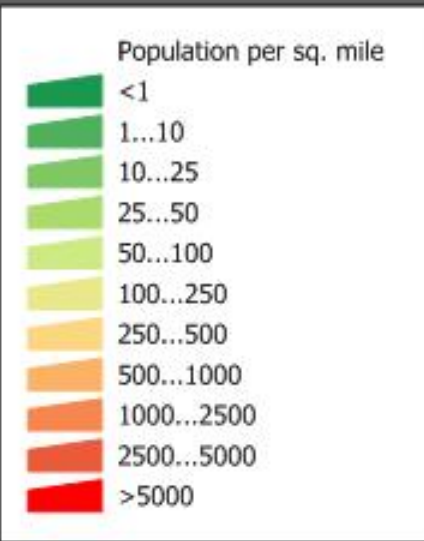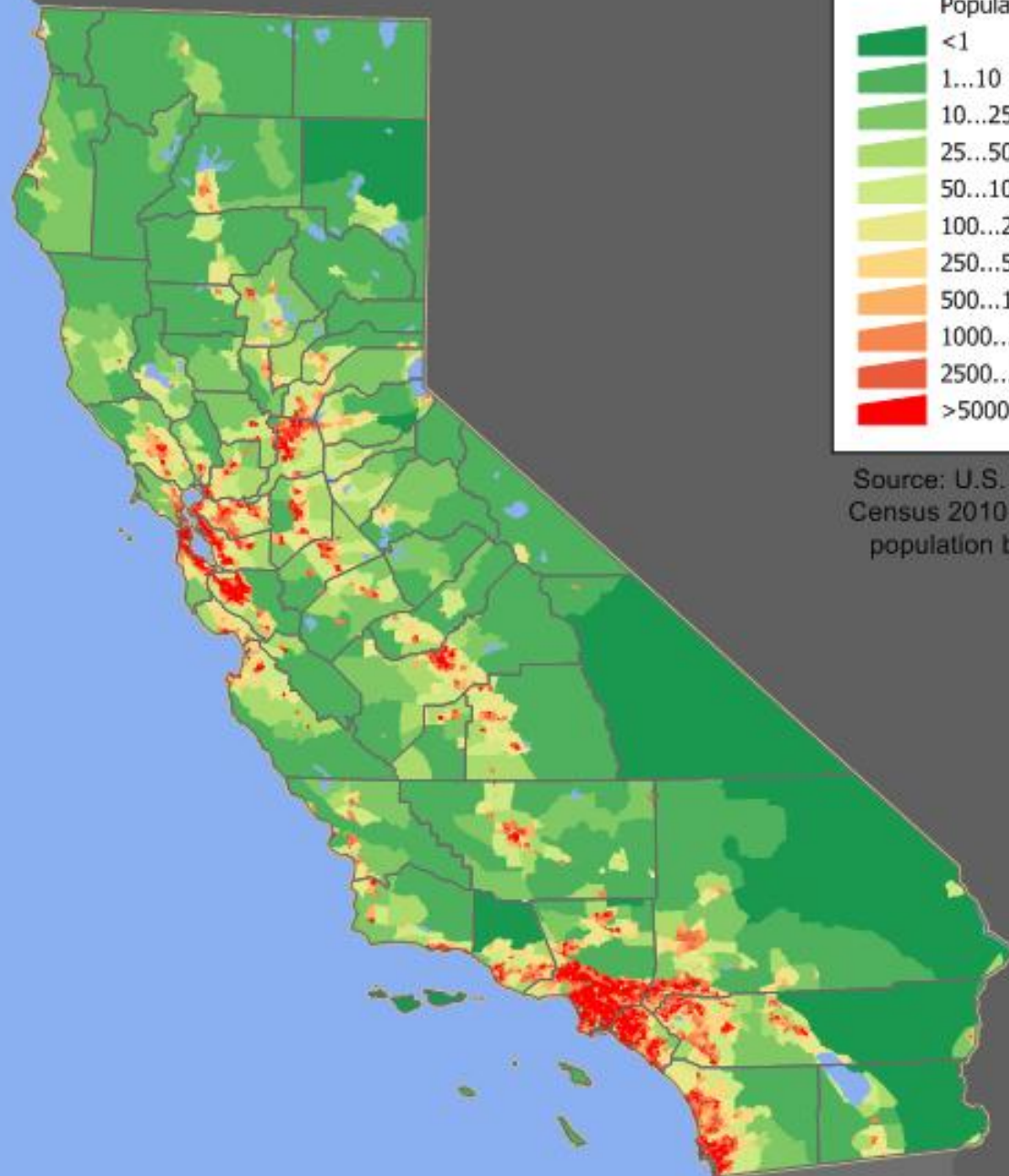
Dynamical approaches to metaphor

- Metaphorical processing is highly sensitive to constraints (e.g. Gibbs and Cameron, 2008; Gibbs and Clark, 2012)

  - physical and social constraints of situation

  - cognitive constraints of personality, knowledge, prior experience

- But how to explore these constraints in an experimental setting?

Mousetracking

- "Hand in motion reveals mind in motion" (Dale, et al, 2007; Freeman and Ambady, 2010)

- Plot trajectory of mouse movement across computer screen to response

- Different "shapes" of trajectories reveal attraction to competing responses

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Alcatraz

Population per sq. mile

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Alcatraz

Disneyland

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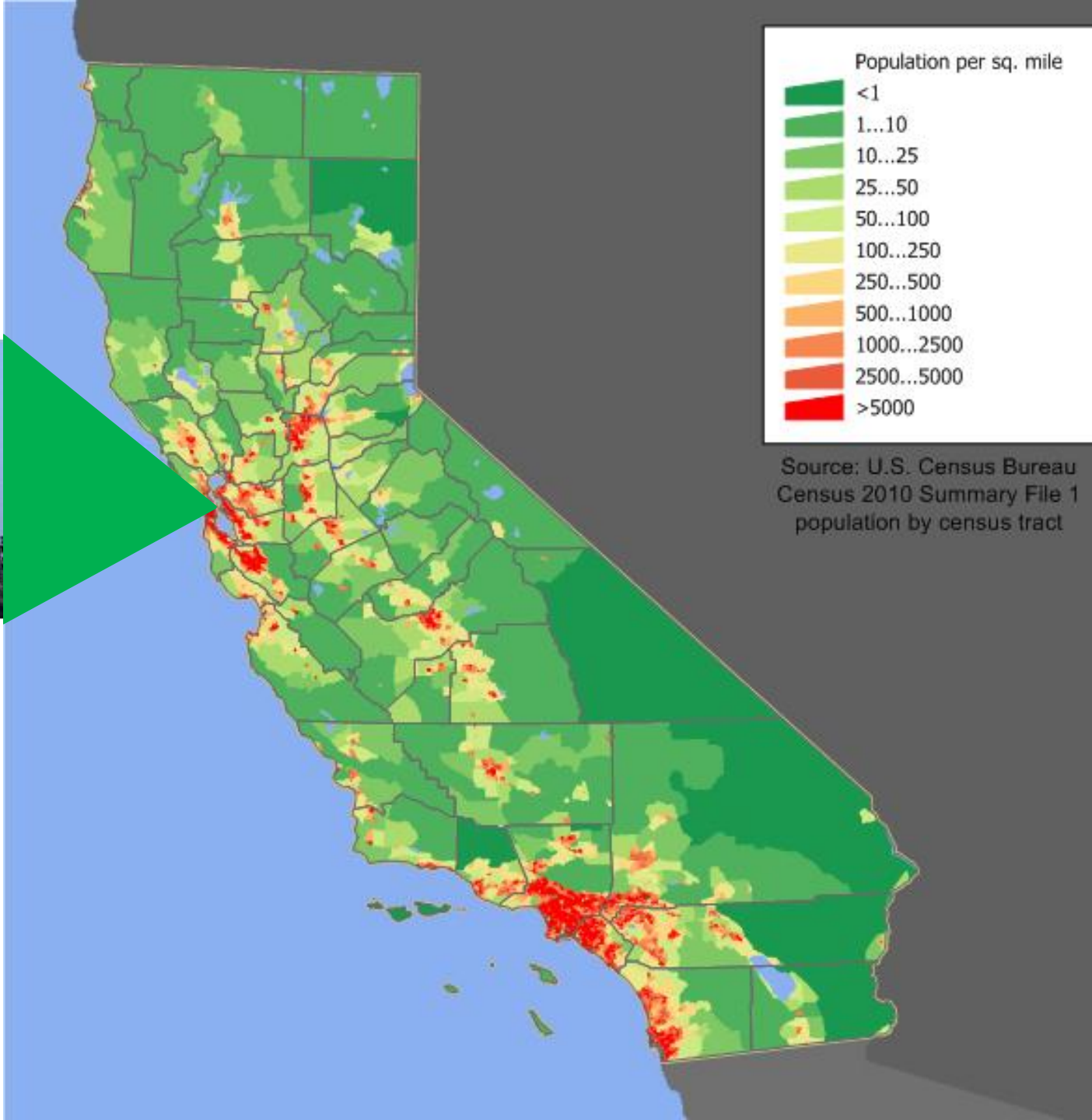
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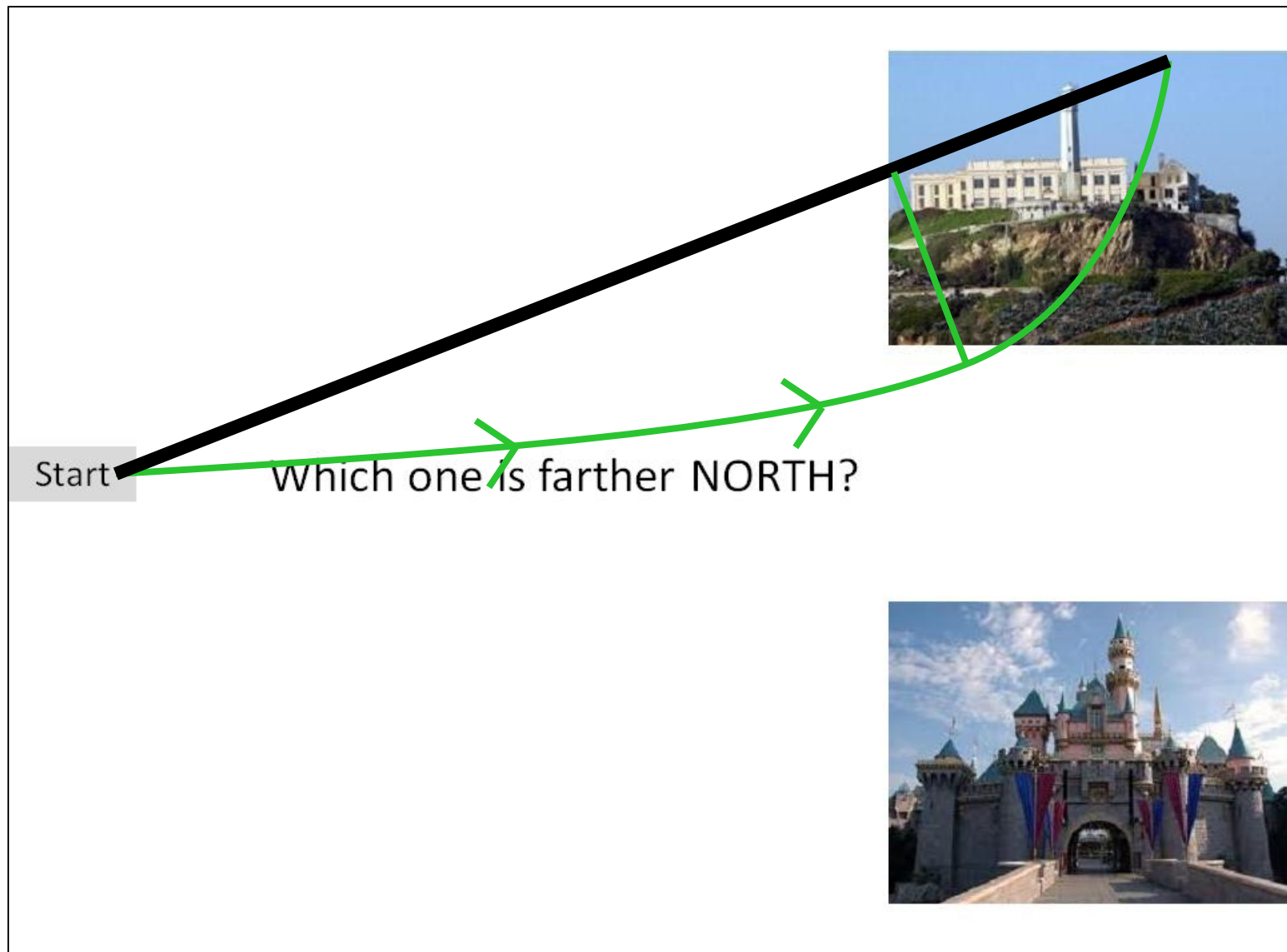population by census tract
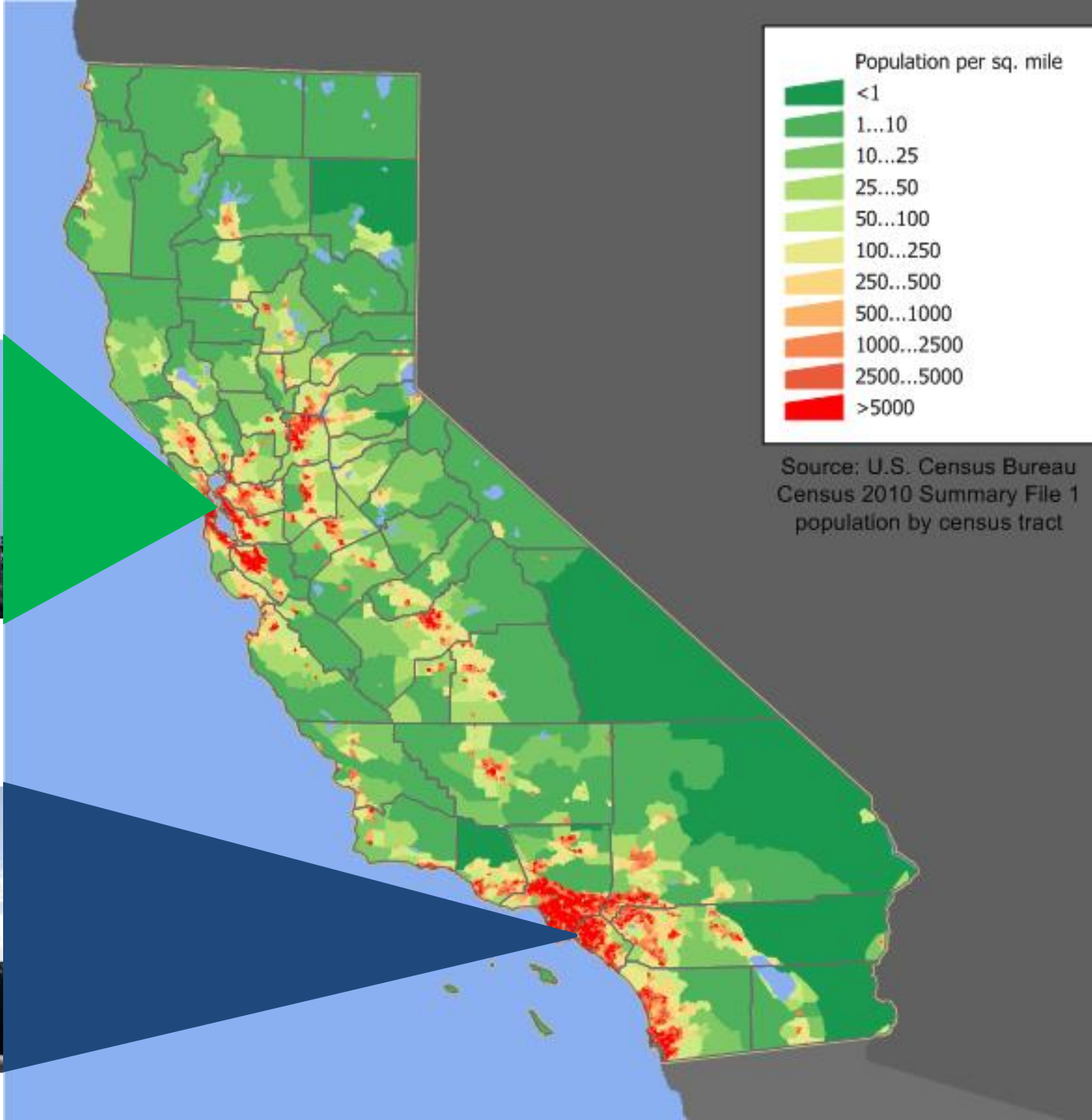
Start

Which one is farther NORTH?

Example canonical-orientation trial

Which one is farther NORTH?

Start

Example canonical-orientation trial

Start Which one is farther SOUTH?

Example reversed-orientation trial

Start Which one is farther SOUTH?

Example reversed-orientation trial

Which one is farther SOUTH?

Start
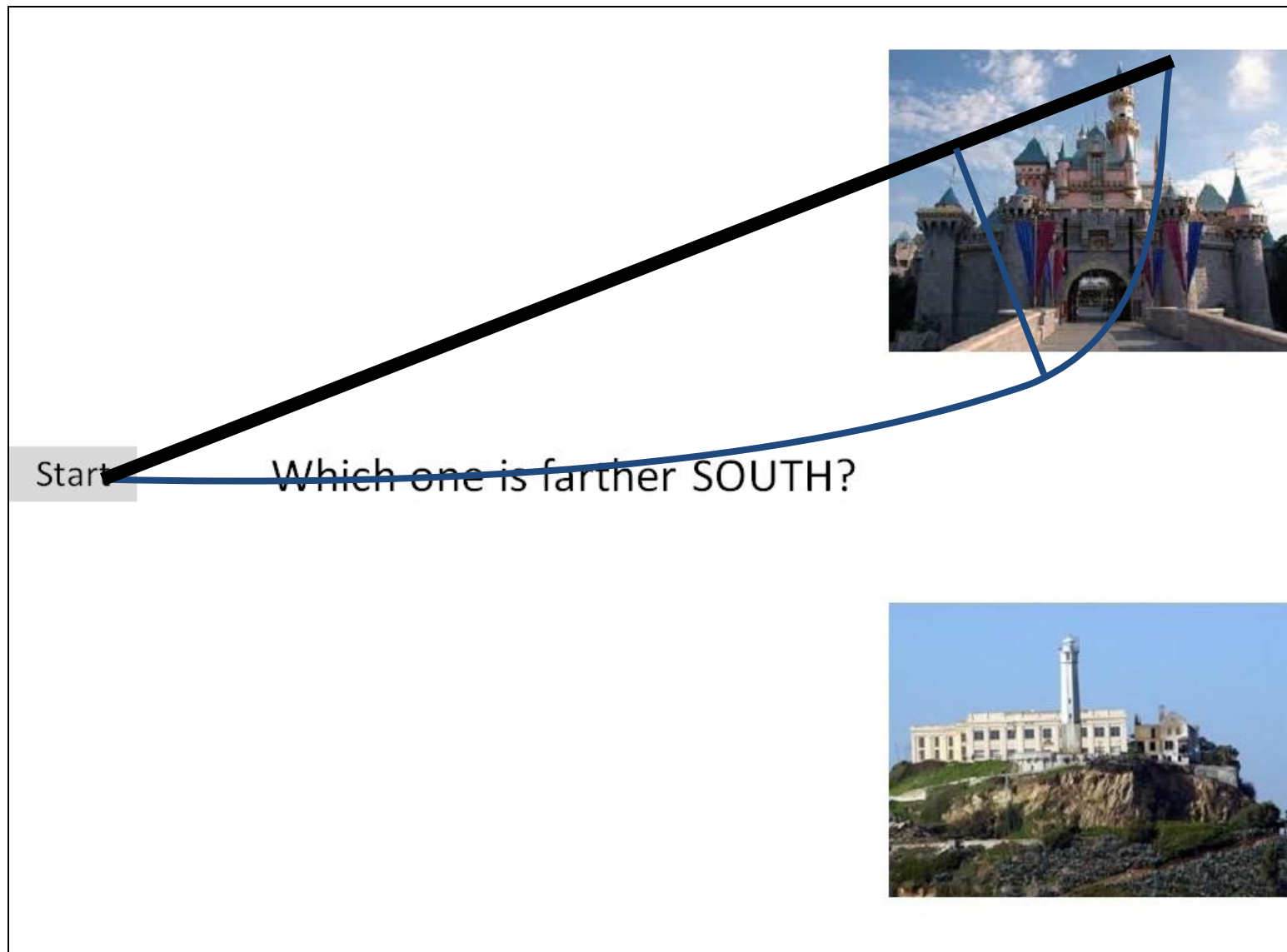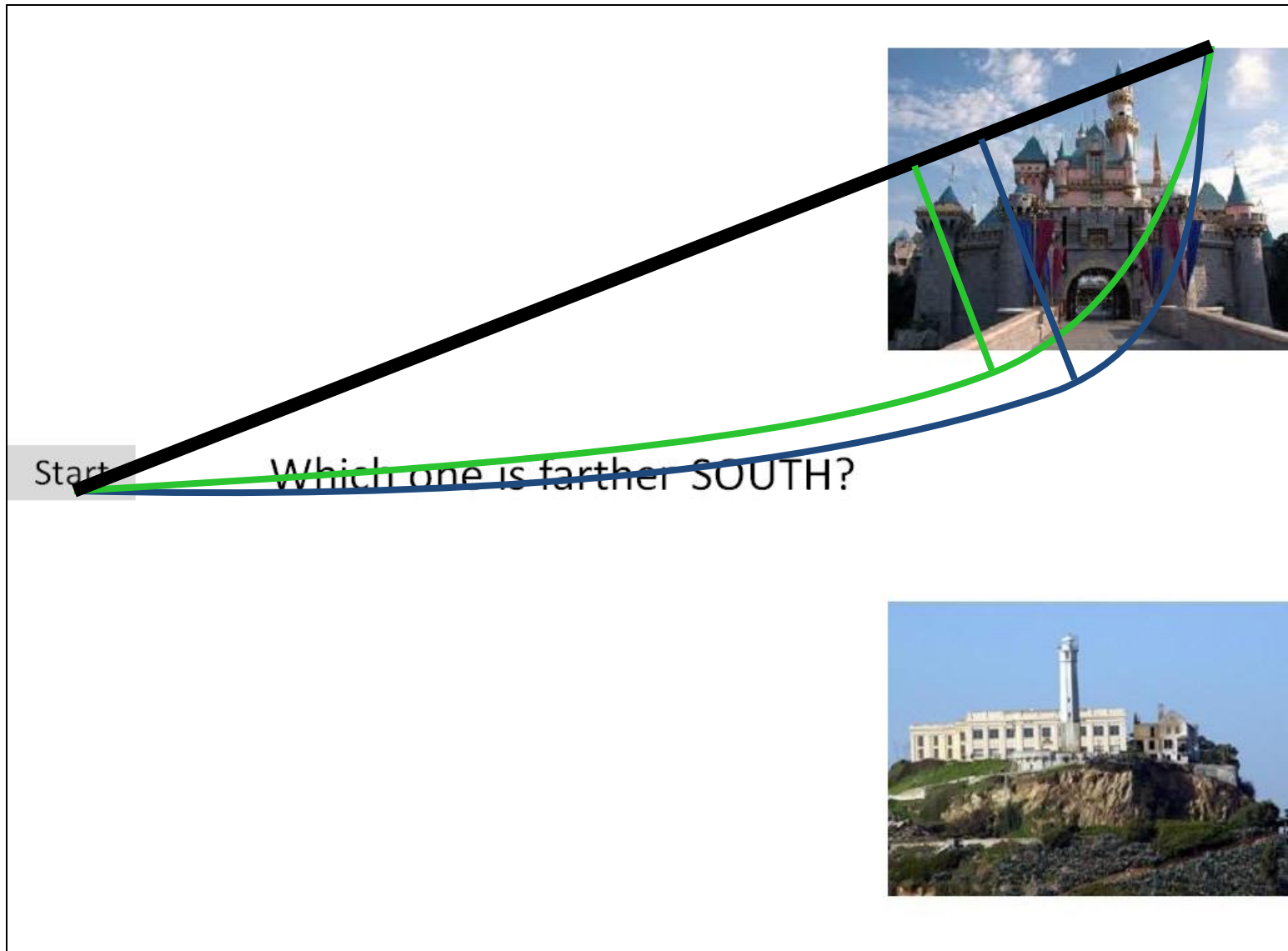
Example Maximum Deviation difference between trajectories

Constraints on spatial metaphor

- 3 main hypotheses:

  (1a) Spatial metaphor will influence behavior: Reversed-orientation trials will show greater attraction to competitor…

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Methods

- 68 UCSC in-state undergrads received credit for participating

- Part 1: Mousetracker (Freeman and Ambady, 2010)

  - Training: "Which one is Alcatraz?", 4-afc
  - Test1: "Which one is farther NORTH/SOUTH? ", 2-afc
  - Test2: "Which one is farther EAST/WEST?", 2-afc (added later – only final 42 participants had this part)
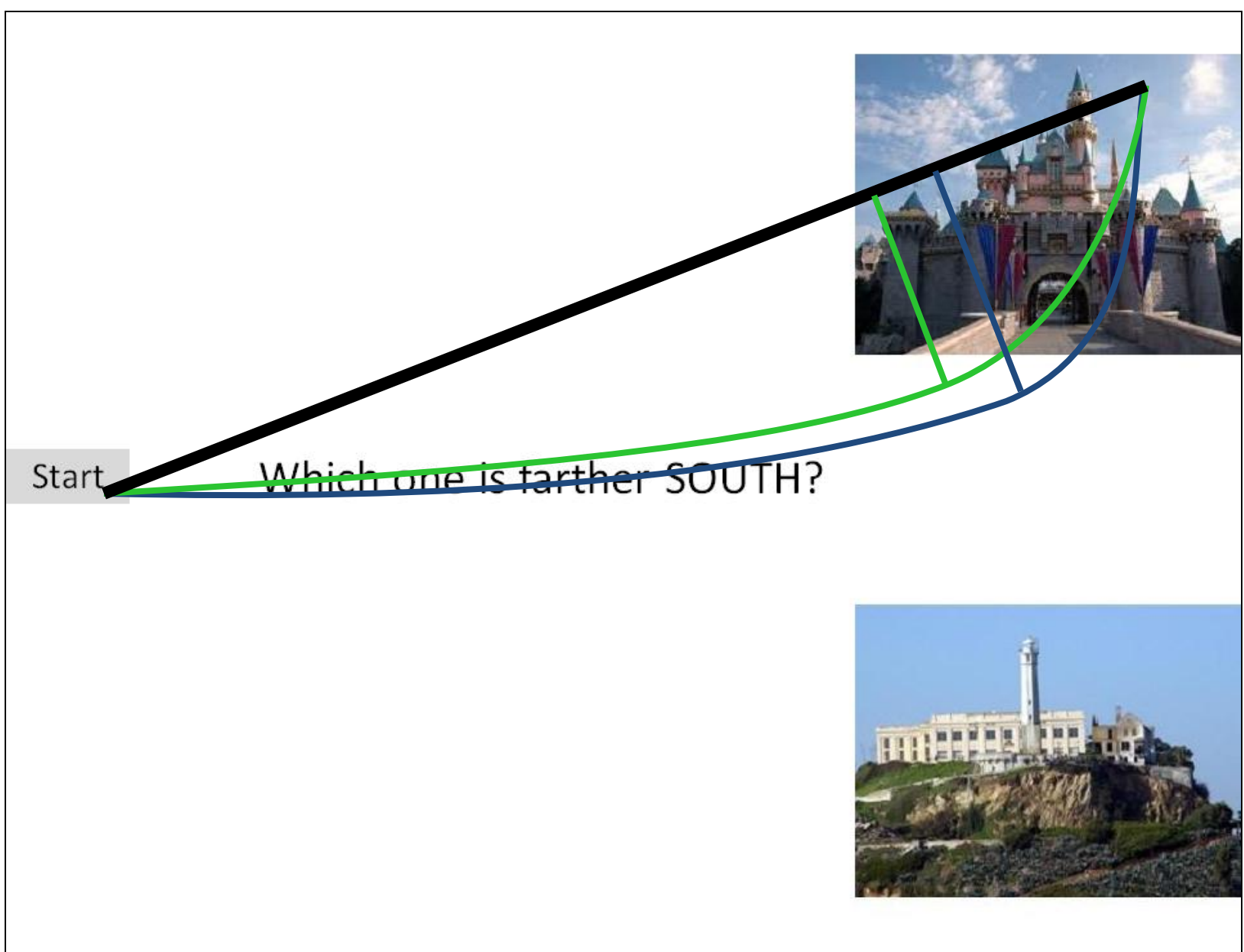
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Start

Which one is farther SOUTH?

Example trial with MaxDev difference between trajectories

Results

(1) Does orientation influence MaxDev?

MaxDev: canonical vs reversed trials

$t(67) = 3.29$, $p = .002$

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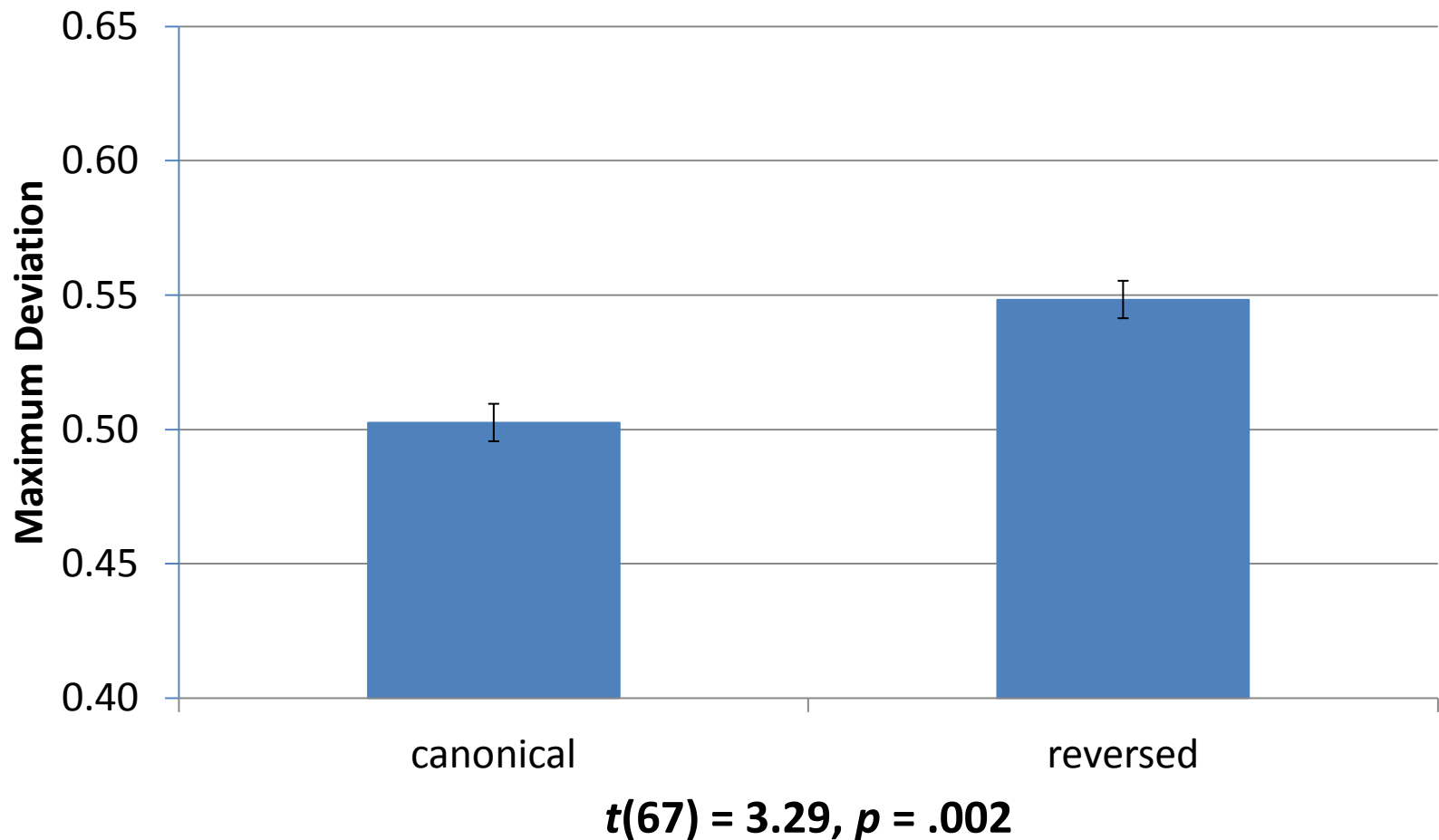
Start

Which one is farther EAST?

Example reversed-orientation trial

Alcatraz

Disneyland

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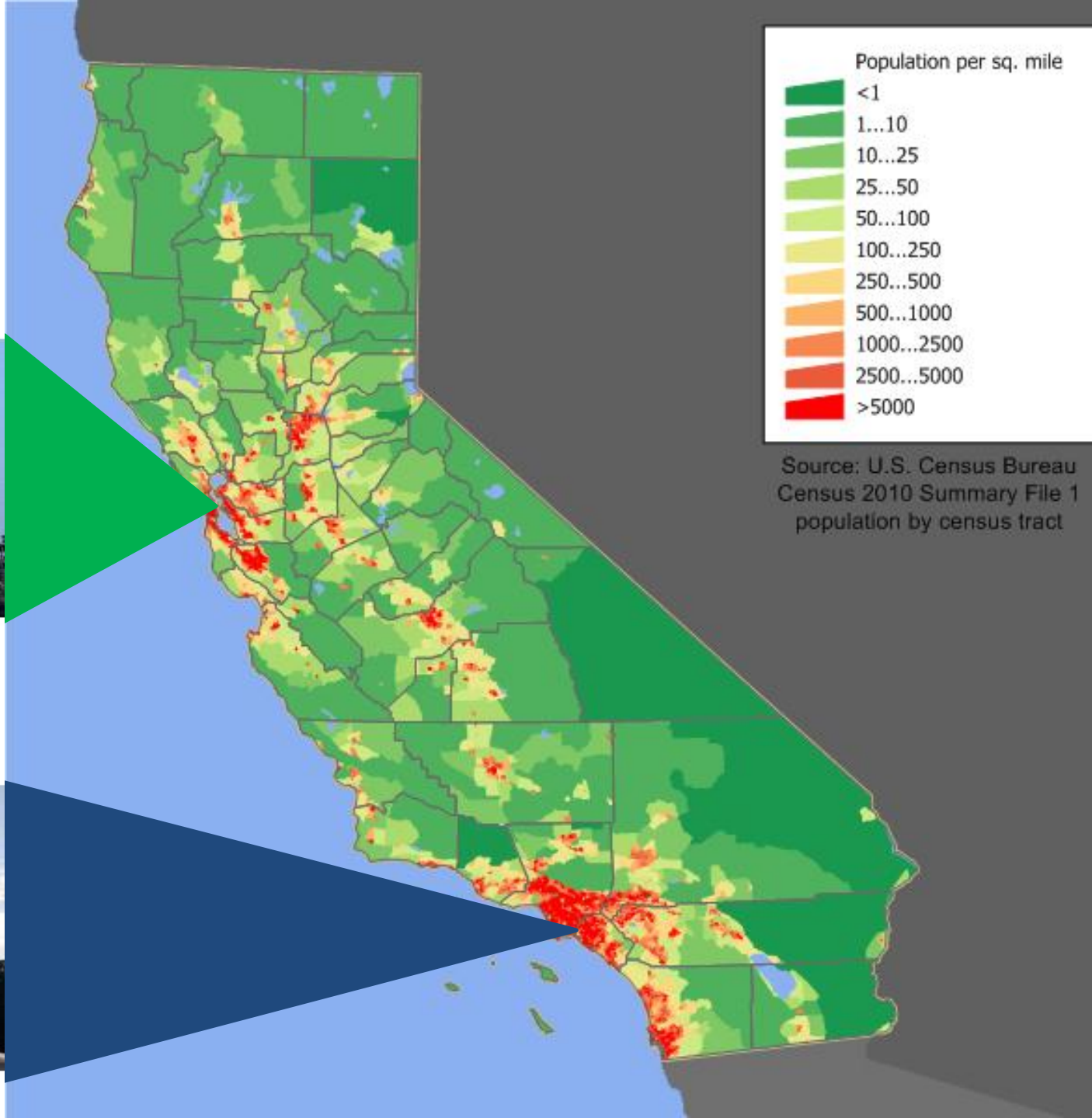
Results

(1b) Does orientation influence MaxDev in East vs West trials? (control)

MaxDev for East/West trials

$t(41) = 0.12$, $p = .908$
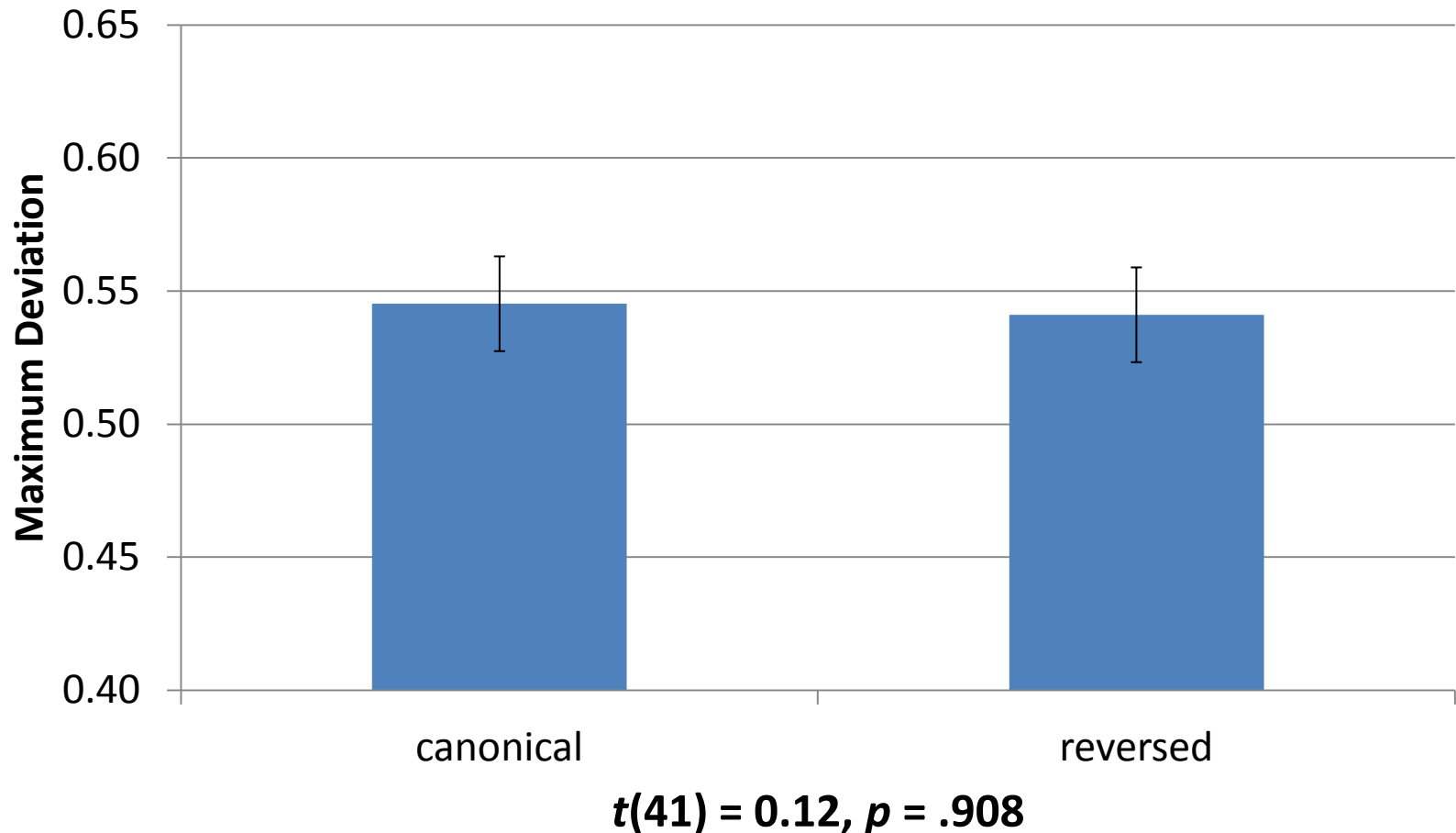
Results so far

- Spatial metaphor influences North/South decisions (Hypothesis 1a)

- But not East/West (situational constraint)

- What about cognitive constraints?

More Methods

- Part 2: Cognitive constraints

  – Familiarity: How often have you visited 12 places? (3-afc: never, a few times, frequently/lived there)

  – Cloze: filling blanks in a dialogue about a road trip

Constraints on spatial metaphor

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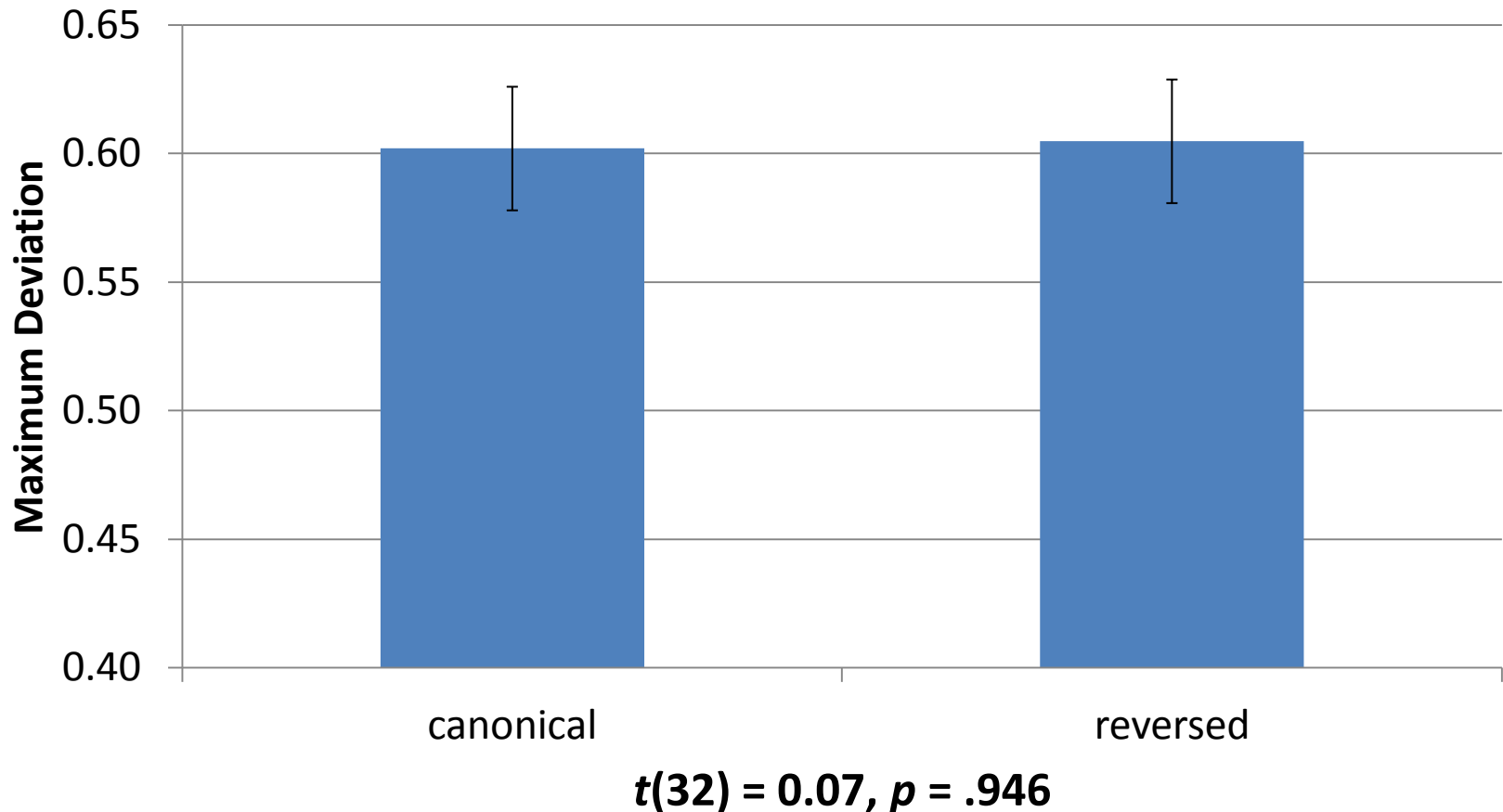
  (2) Individual differences in familiarity: greater spatial metaphor influence for unfamiliar locations

  (3)   Language use habits: greater spatial metaphor influence for those who habitually use up & down for N & S

Results

(2) Do individual differences in familiarity with locations influence effect of orientation?
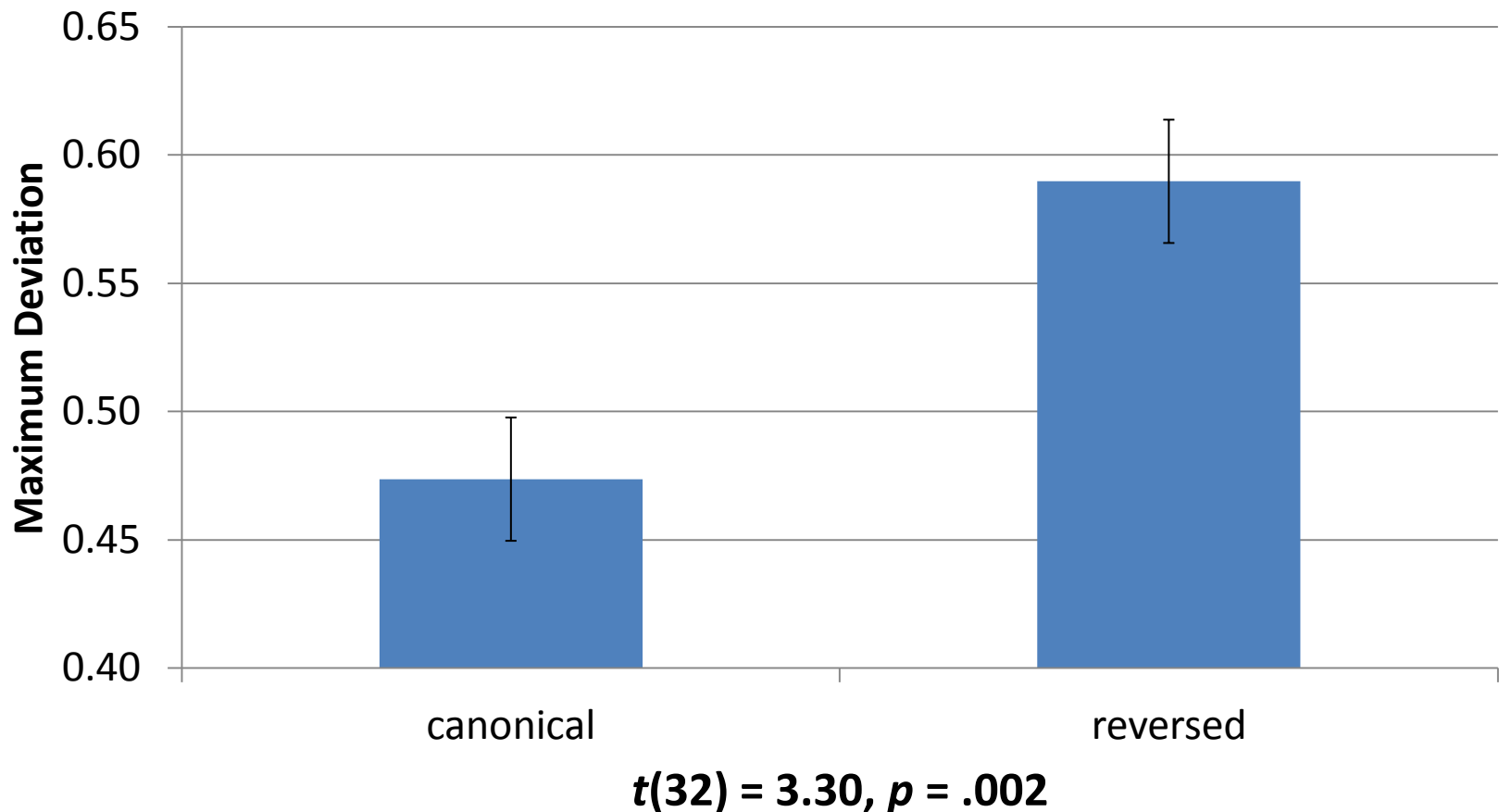
Familiar locations

$t(32) = 0.07, p = .946$

Results

(2) Do individual differences in familiarity with locations influence effect of orientation?

Unfamiliar locations

$t(32) = 3.30$, $p = .002$

Constraints on spatial metaphor

- 3 main hypotheses:

  (1a) Spatial metaphor will influence behavior: Reversed-orientation trials will show greater attraction to foil…

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  (3) Language use habits: greater spatial metaphor influence for those who habitually use up & down for N & S

Example from cloze

Sam: We could just go a couple miles _____ Highway 9 and check out Cowell or something. Or if you wanted to go a little further, we could drive _____ the Pacific Coast Highway past Monterey to Big Sur, or head _____ Yosemite.

Jordan: Yeah, those would be fun, and I've been also meeting to get _____ the North Coast, but we can also just walk a couple minutes on campus and be in nature, so it might be more fun to do something a little more urban. San Francisco? L.A.? San Diego?

Results

(3) Do language use difference influence effect of orientation?

Competitor attraction by up/down usage

x-axis: % of 'up' and 'down' consistent with N/S

r = .30, p = .014

y-axis: MaxDev in reversed trials
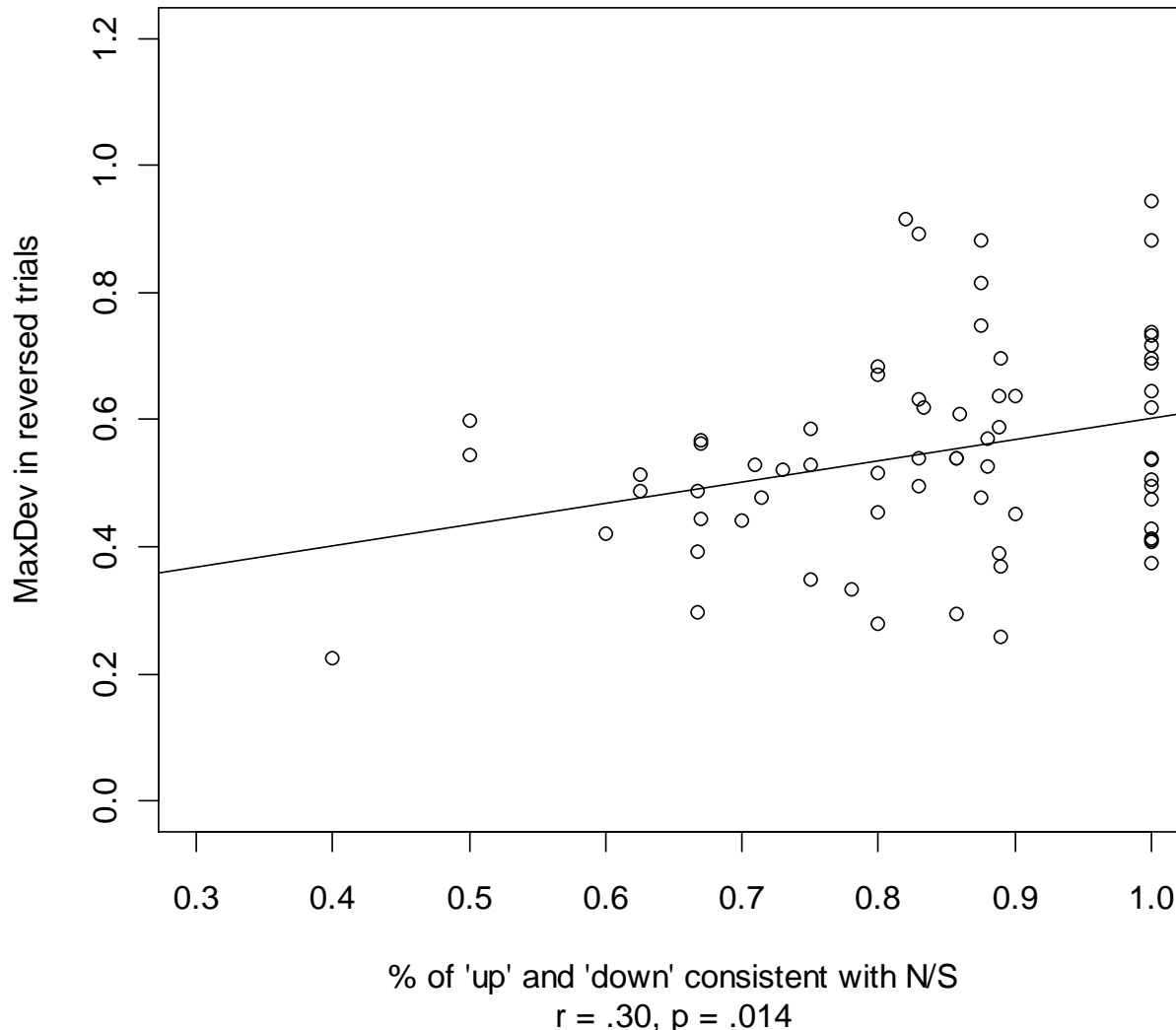
Summary of Results

- Spatial metaphor influences geographic decision making

- Effect of spatial metaphor depends on:
  - physical situation constraints (orientation)
  - social situation constraints (asking N/S vs E/W)
  - cognitive constraints (experience, speech habits)

Limitations & future directions

- When mouse moves forward, cursor moves up

- Cloze task: ceiling effect & elevation confound

- EAST IS RIGHT?

Conclusions

- NORTH IS UP isn't merely a linguistic or cultural convention – behaviorally entrenched
- But also constrained by physical, social, and cognitive factors
- Not metaphors we *have*, but metaphors we *do*
- Embracing a dynamical, constraint-based view of cognition reveals both the strengths and limits of CM

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Thank you!

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