# Effects of visual variables on the perception of distance in Off-screen landmarks: Size, color value, and crispness

**Rui Li**

Geography & Planning

State University of New York at Albany

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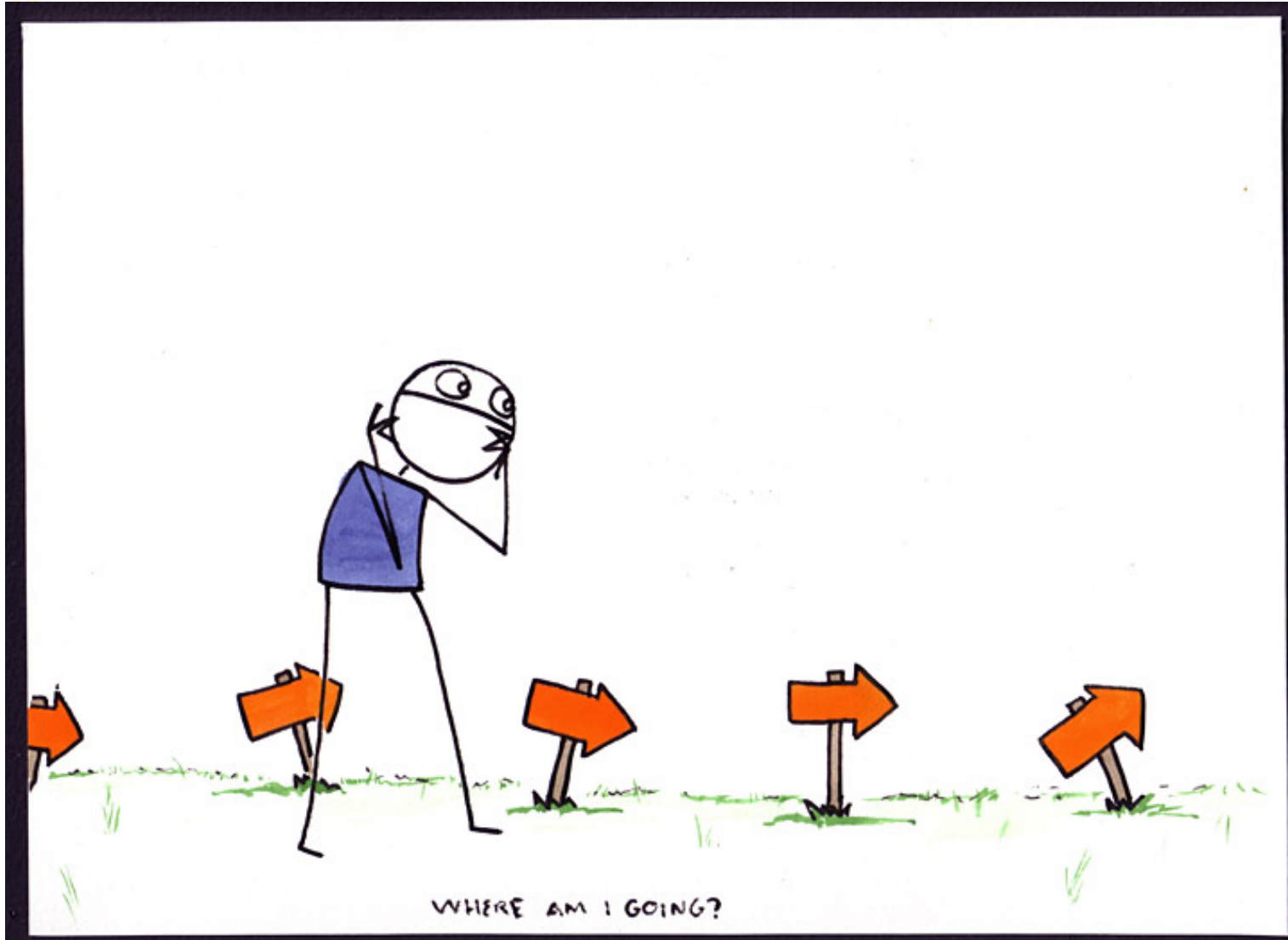Vienna, 14–16 November 2016

# February 2016



GPS Mix-Up Brings Wrong Turn, and Celebrity, to an American in Iceland
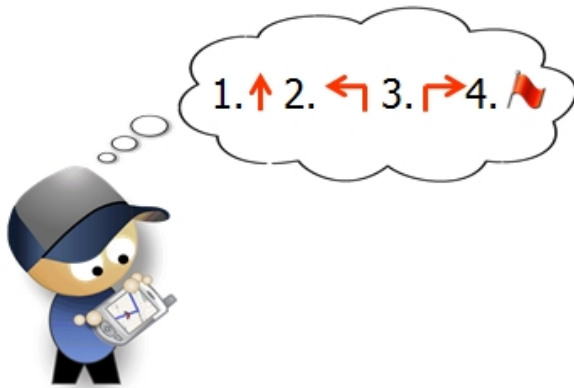
# Navigation and wayfinding



WHERE AM I GOING?

# Using landmarks?
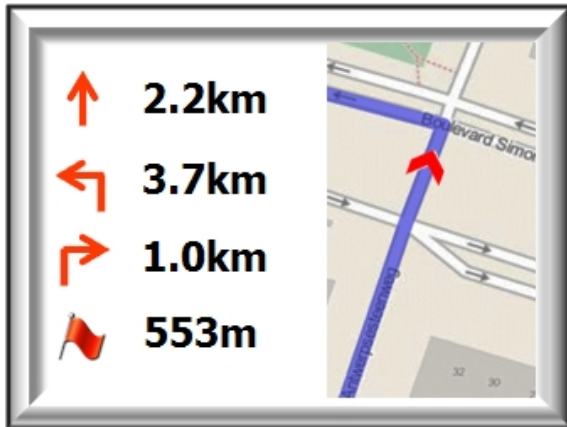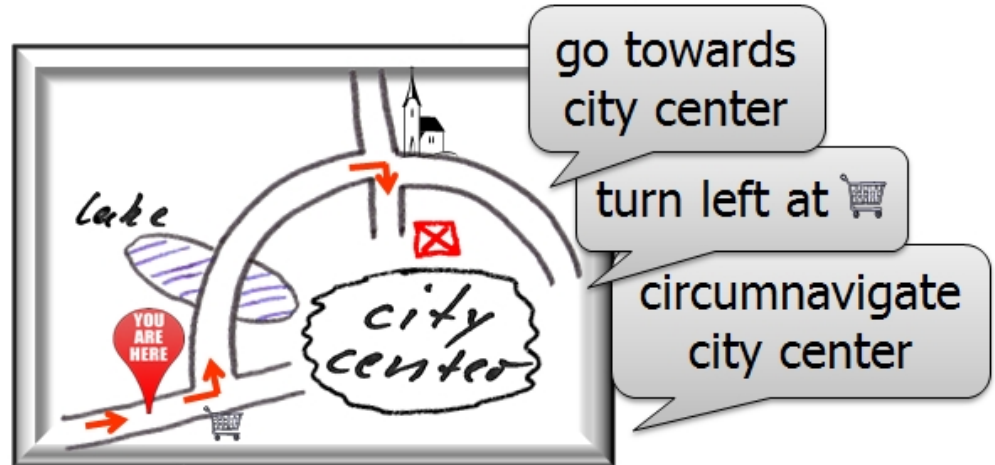
# **Acquisition from small display**

- Fragmentation of spatial knowledge
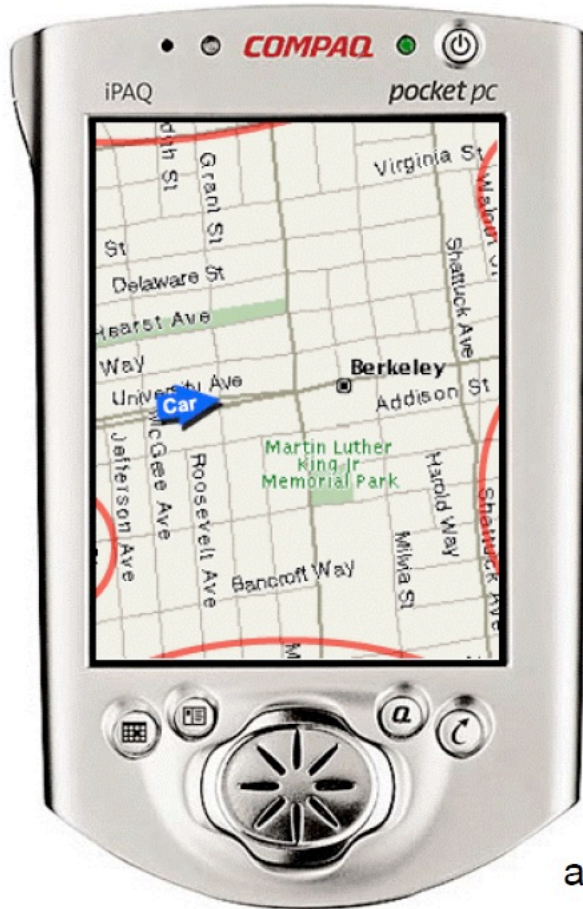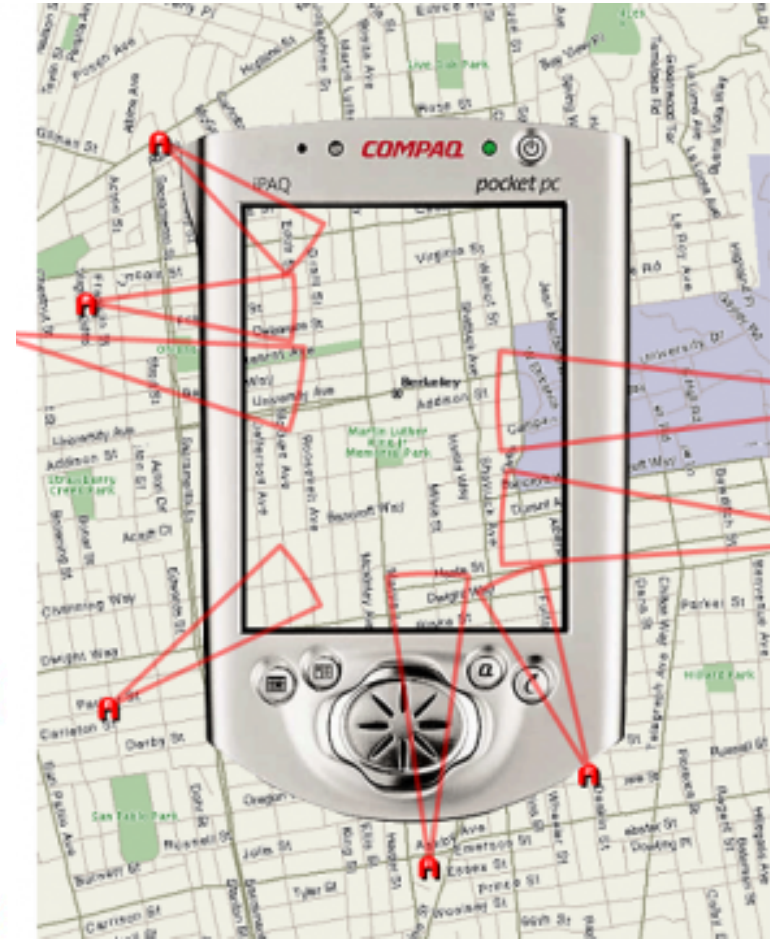- Poor wayfinding performance

# Outline

- Background
- Previous work
- Current approach
- Evaluations
- Discussion and outlook

# Displaying distant info

Halo

Wedge

a

b

(Baudisch & Rosenholtz 2003)
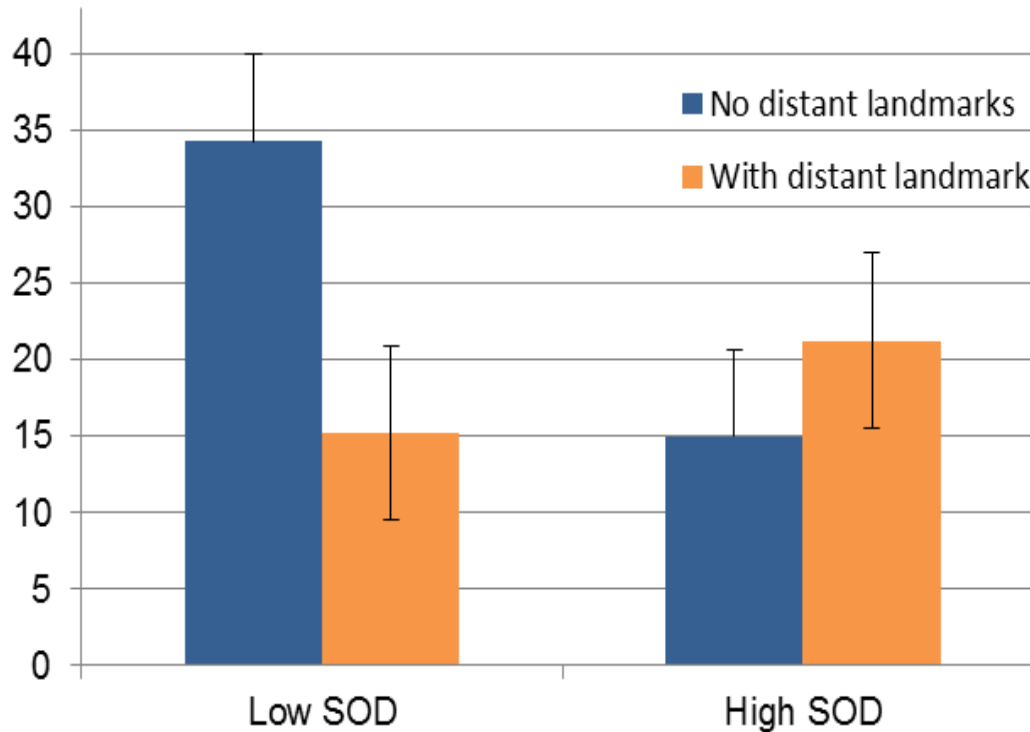
(Gustafson et al. 2008)

# @ LBS 2014

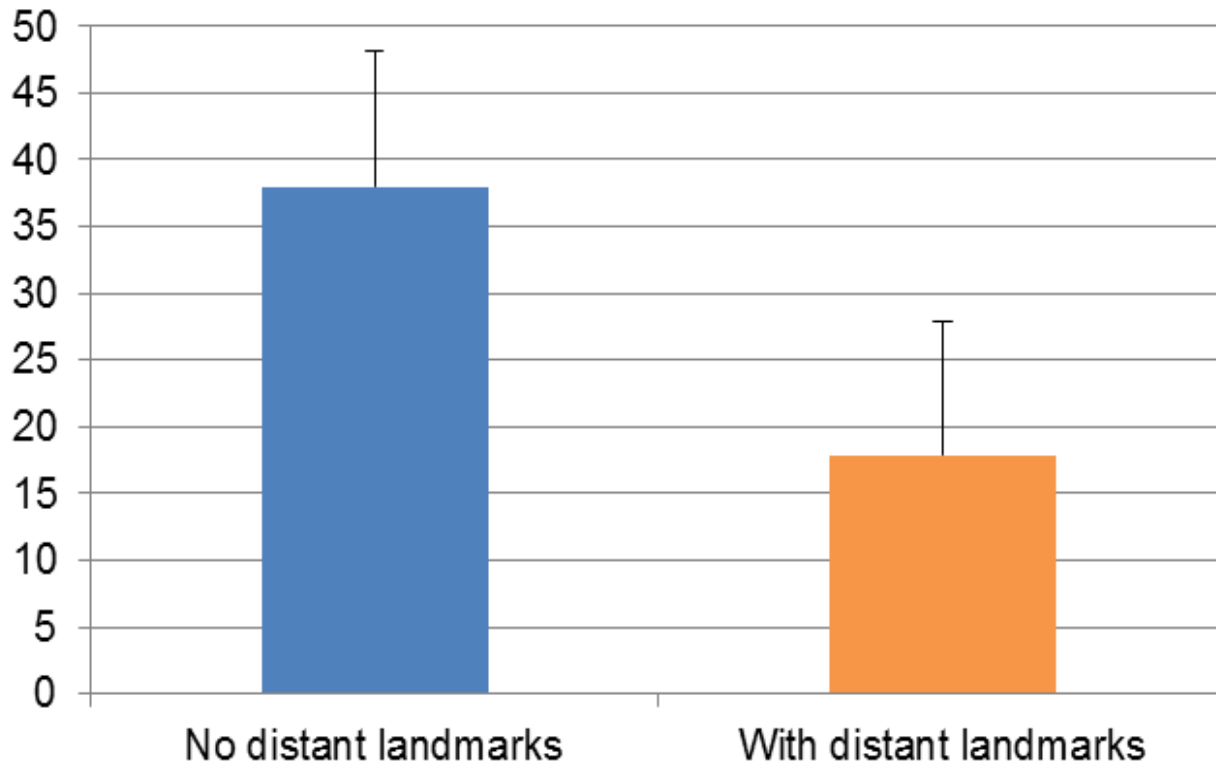# Outcome: spatial knowledge



## Average directional errors

$F(1, 20) = 5.01, p = .04$

# Outcome: interaction

## Zooming



$F(1, 20) = 10.39, p < .001$

# Problems

- Distance information is not visualized
- Acquisition of spatial knowledge is limited
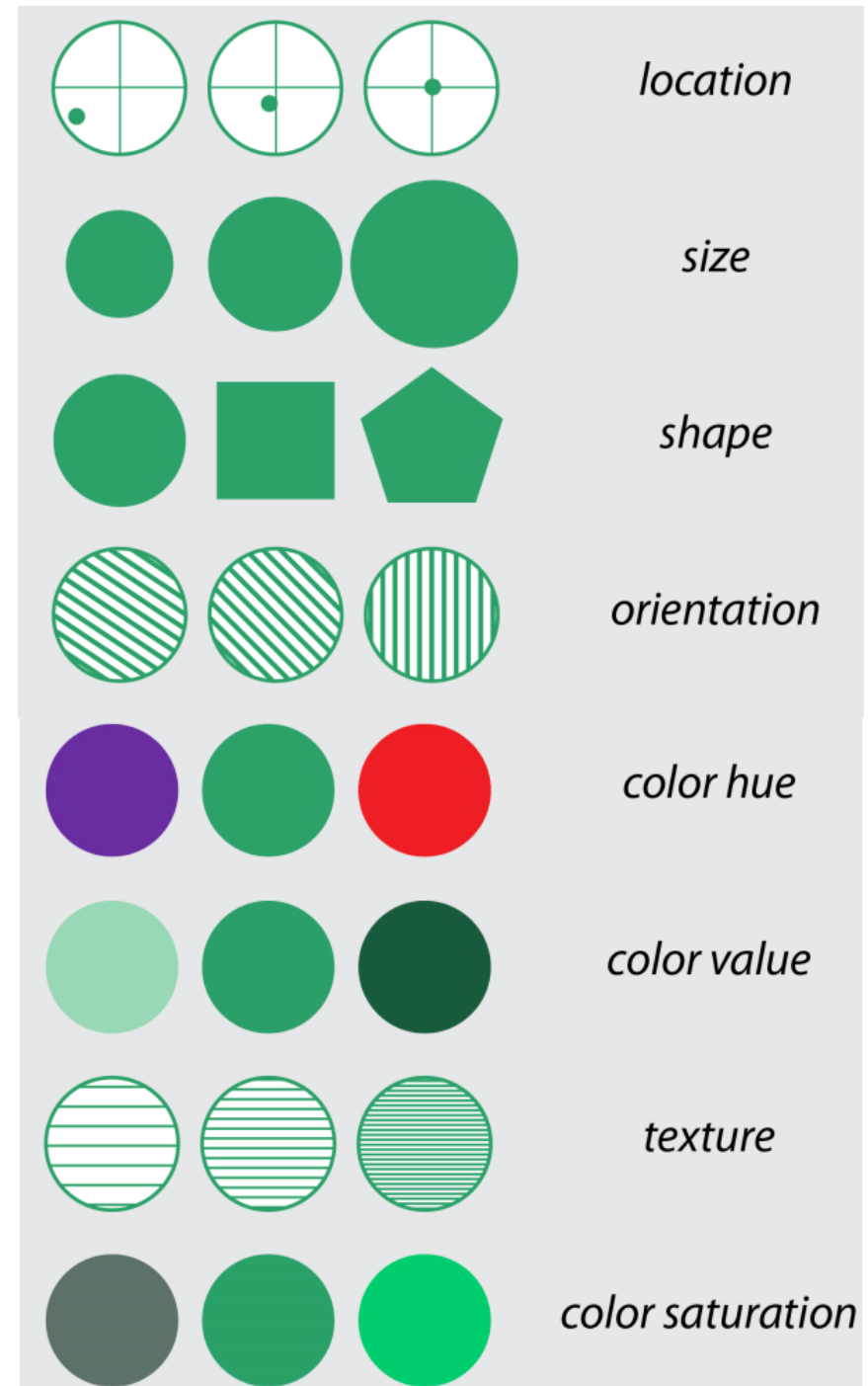
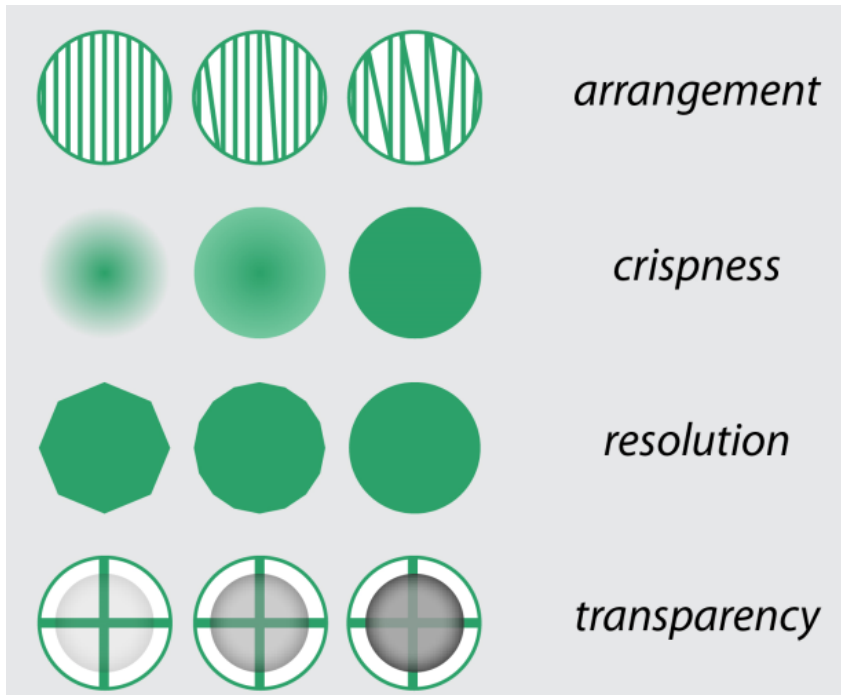# **Embedding distance in symbols**

- Goal: Direction + Distance
- Consideration: Visual variables

# Visual variables

arrangement

crispness

resolution

transparency

location

size

shape

orientation

color hue

color value

texture

color saturation

(Roth 2015; Robinson 1995; MacEachren 2012)

# Question 1

- Level of measurement?
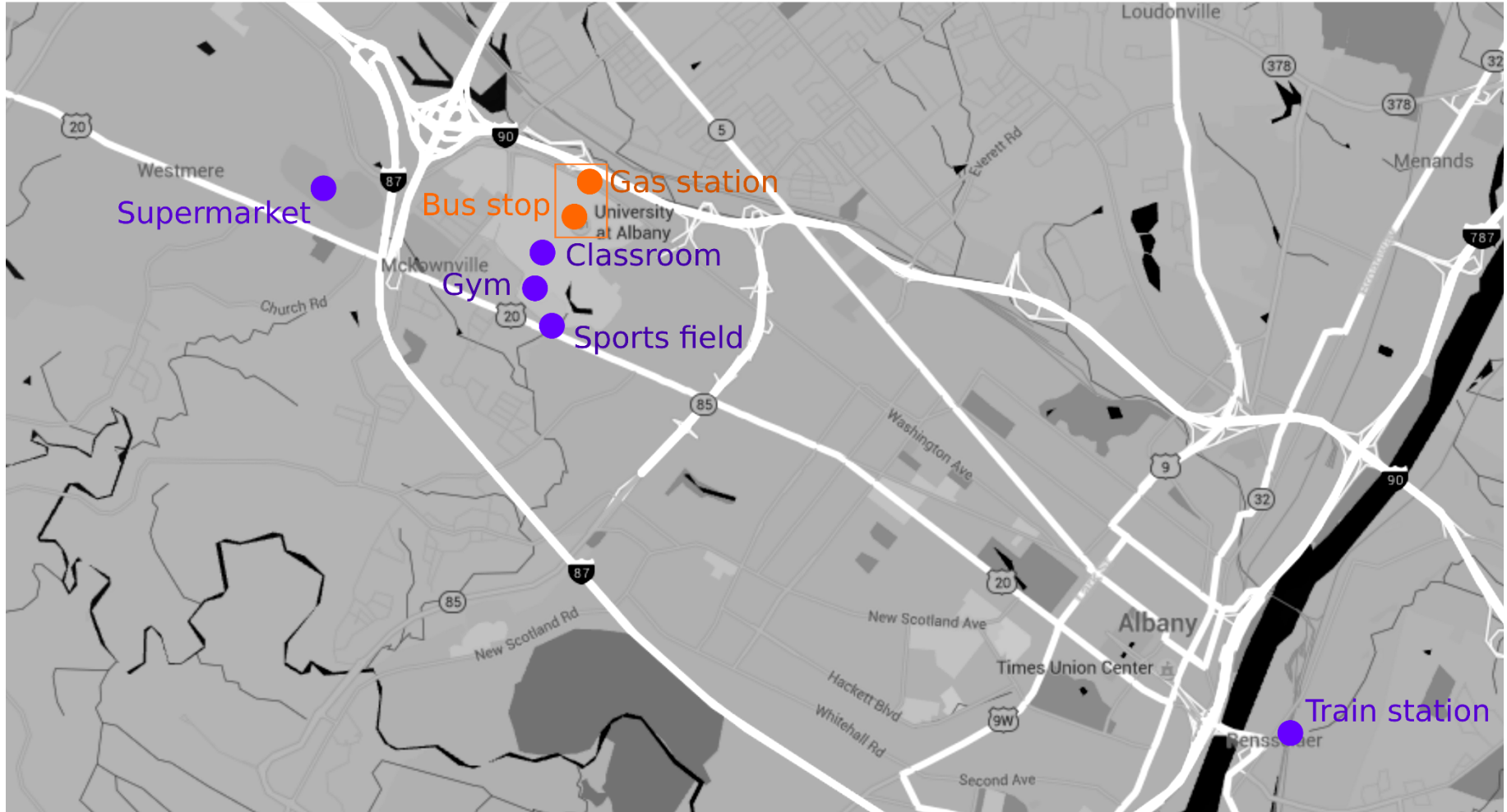  - Nominal
  - Ordinal
  - Interval/Ratio (quantitative)

# **Question 1**

- Level of measurement
  - Nominal
  - **Ordinal**
  - **Interval/Ratio**
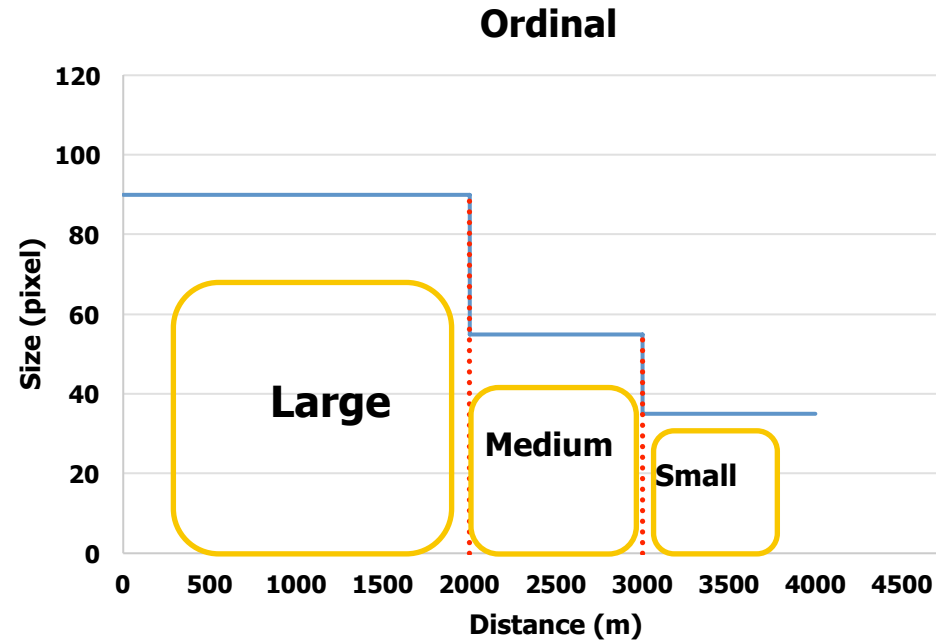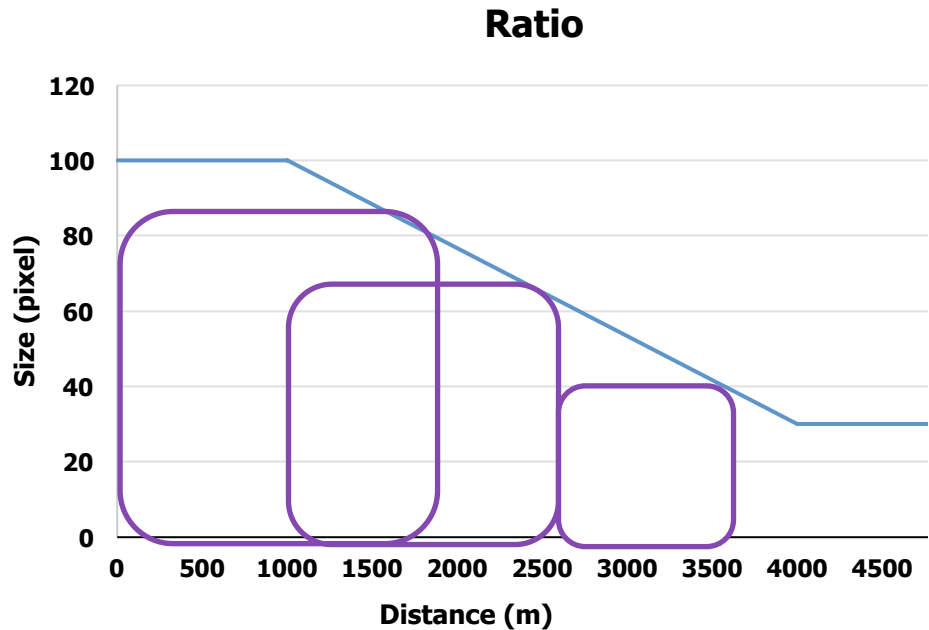


size

# Selected area

# Visualizing distance

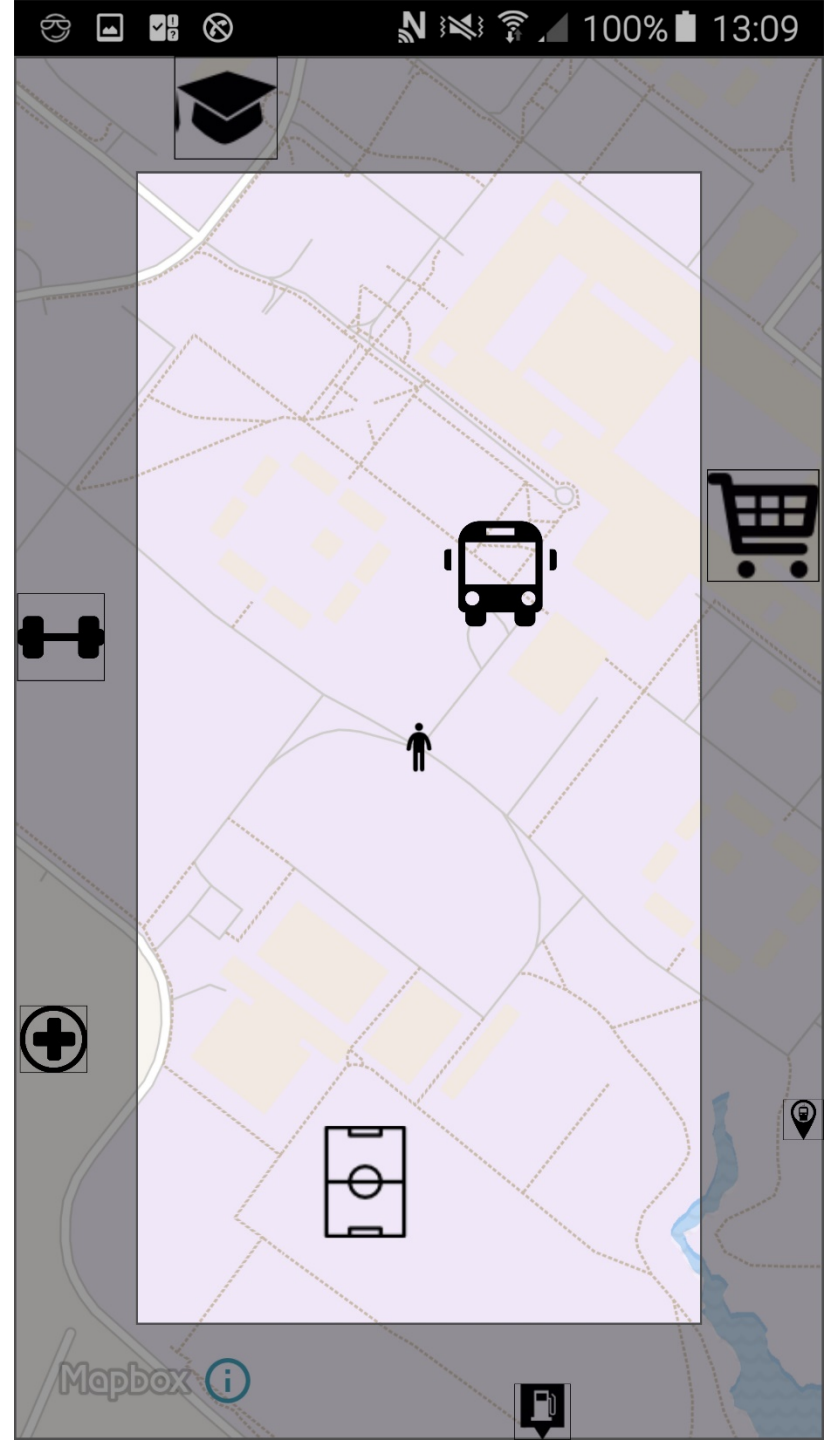- Ratio vs. Ordinal size

# **Evaluation**

- Judging closest location

# **Results**

- Distance comparison
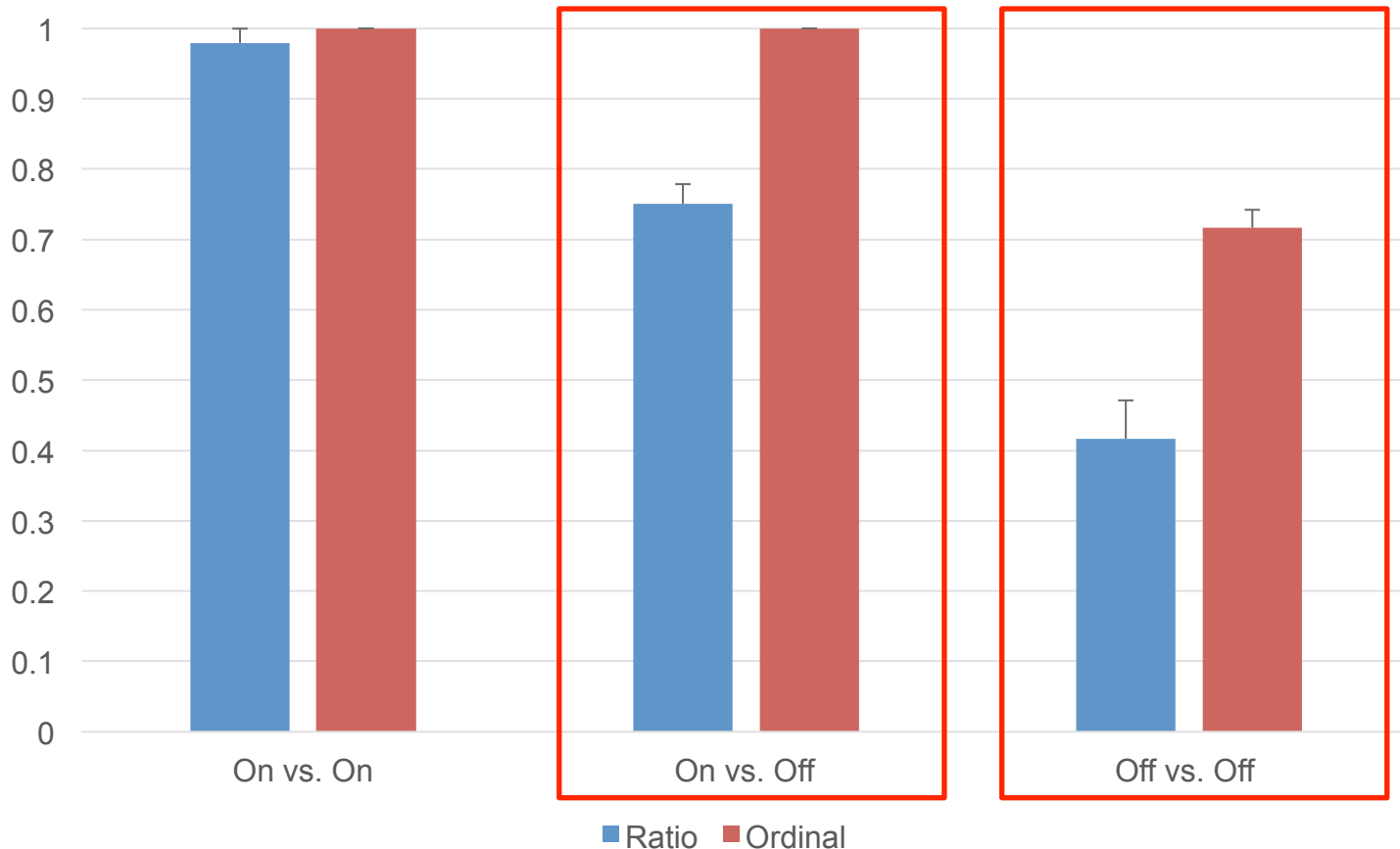
# **Summary 1**

- Ordinal symbols yield higher accuracy in comparing **relative** distances

- Both ratio and ordinal symbols have challenges in indicating the **furthest** distances

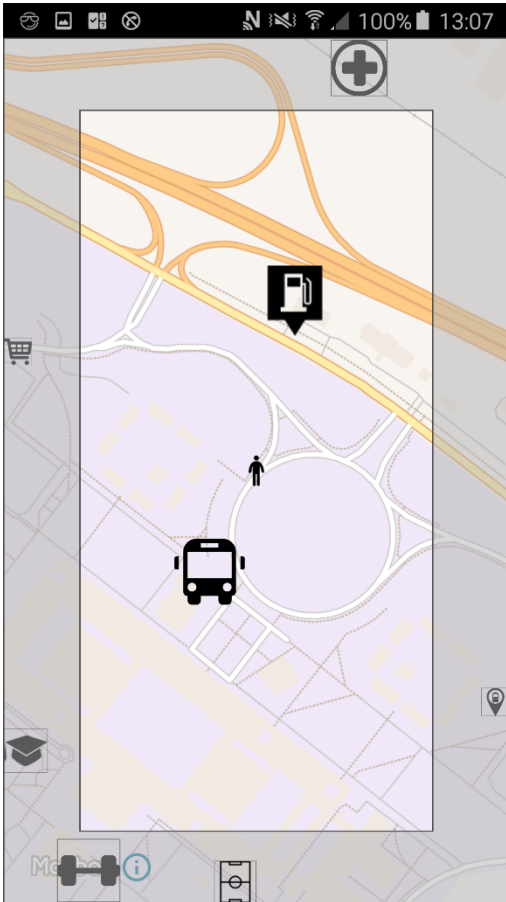# **Current study**

- Other visual variables?


color value


crispness

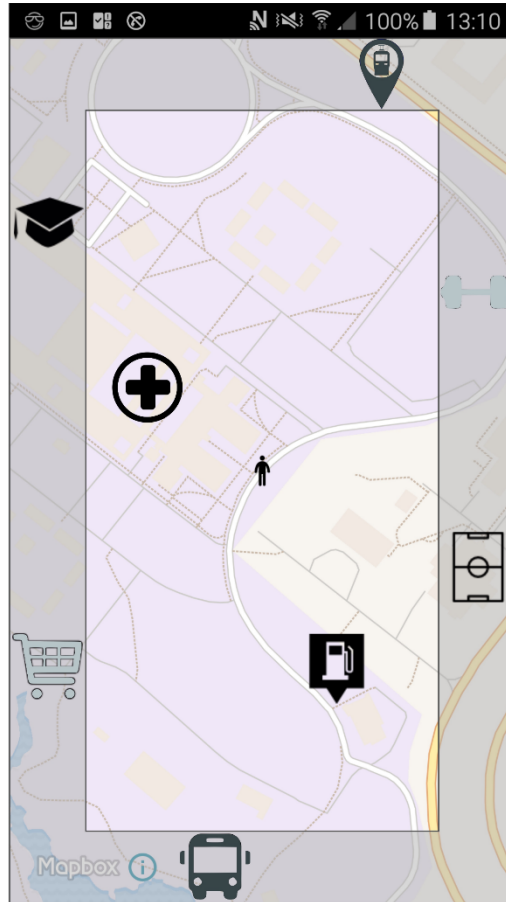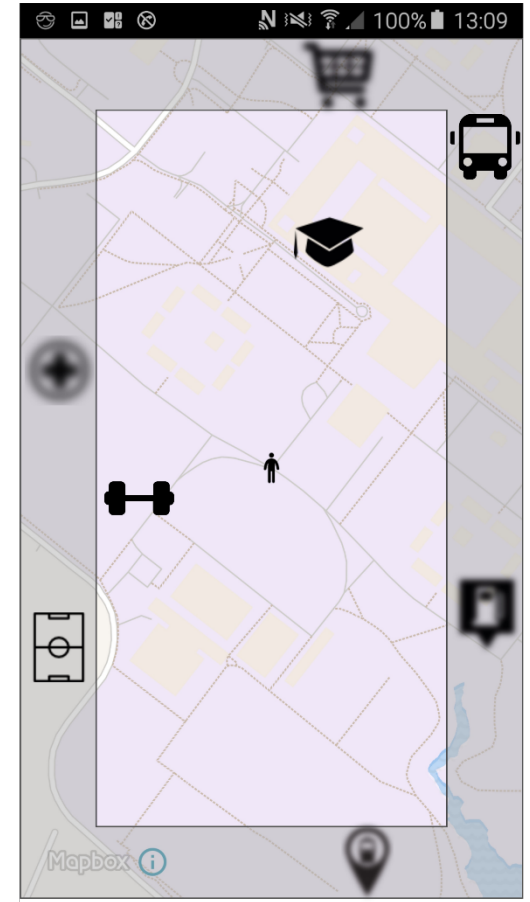# Symbols for off-screen landmarks

# All three scenarios



Ordinal size

Color value

Crispness

# **Evaluation**

- Categories of tasks
  - Closest & furthest locations
  - On-screen landmarks comparison
  - On- vs. off- screen landmarks comparison
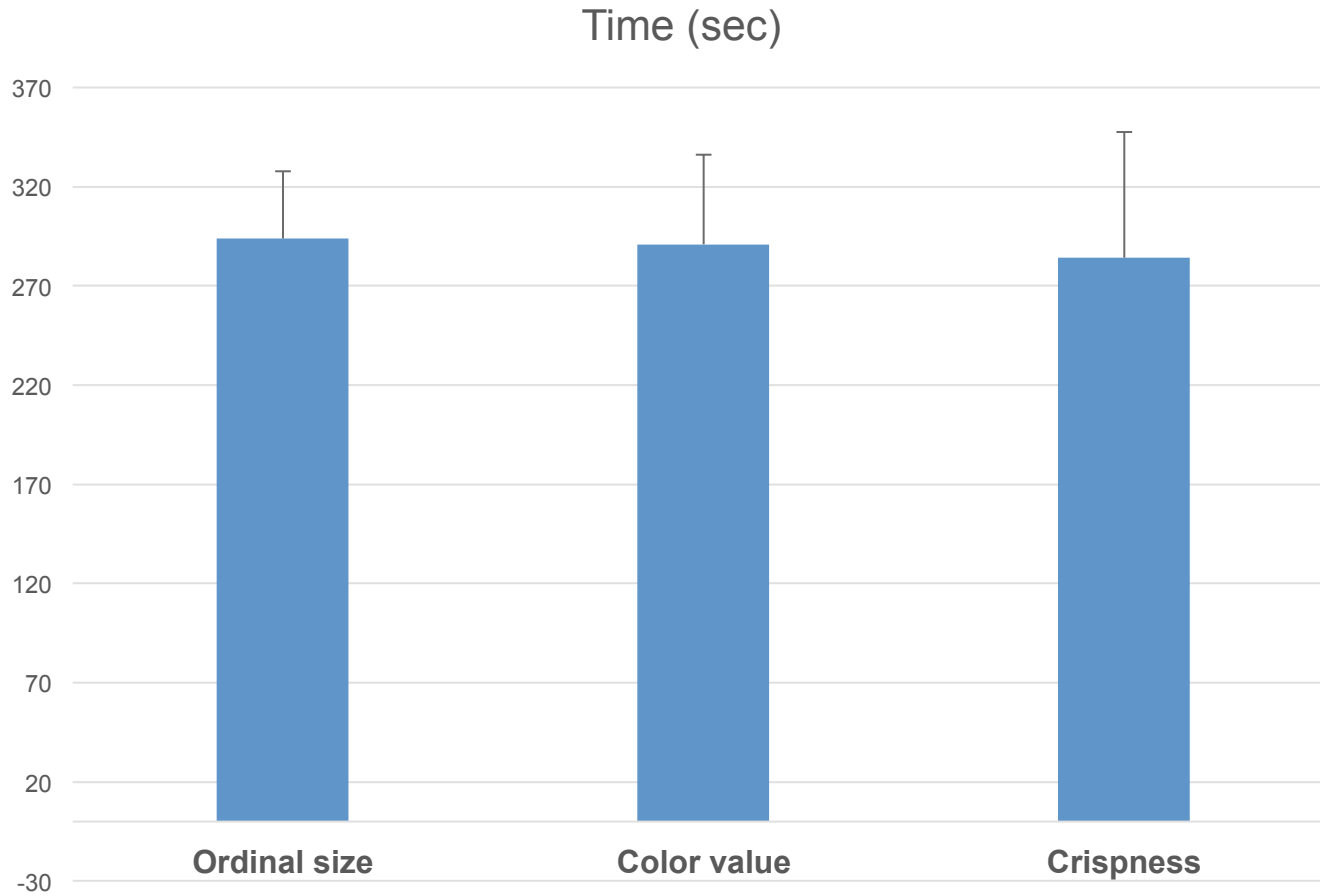  - Off-screen landmarks comparison

# **Evaluation**

- Participants
  - 51 out of 58 in color value
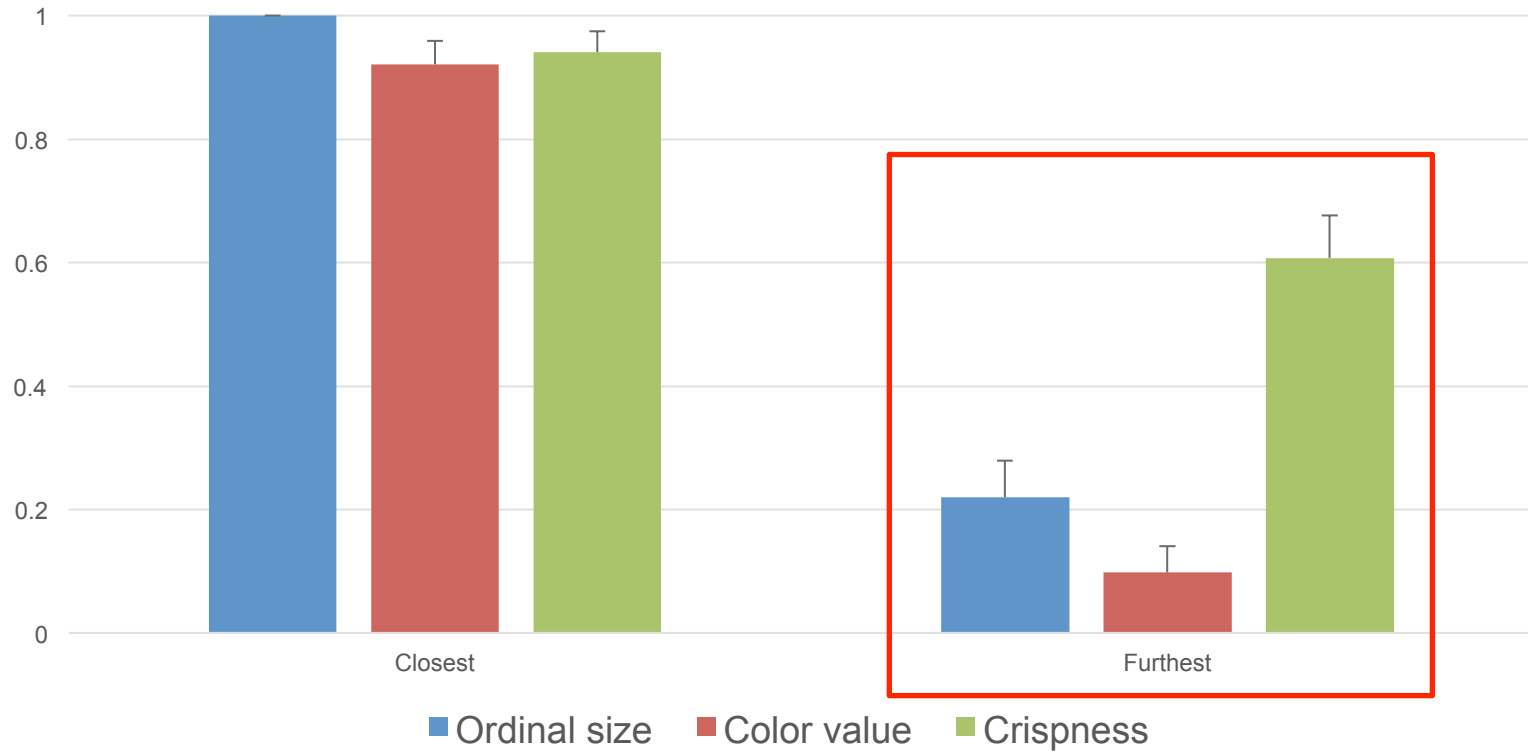  - 51 out of 57 in crispness
  - 50 out of 55 in ordinal size

**amazon** mechanical turk™
Artificial Artificial Intelligence

# Results: Time



Time (sec)

# Results: selecting landmarks

Selecting landmark according to distance



$F(2, 149) = 21.31, p < .001$
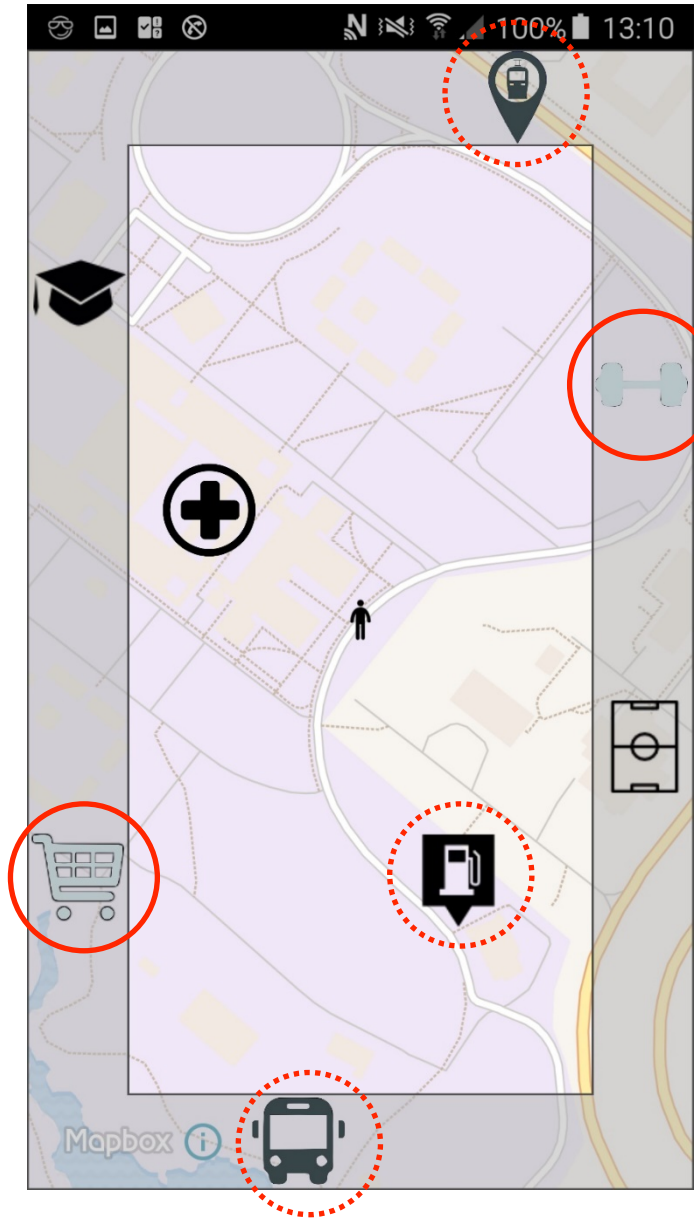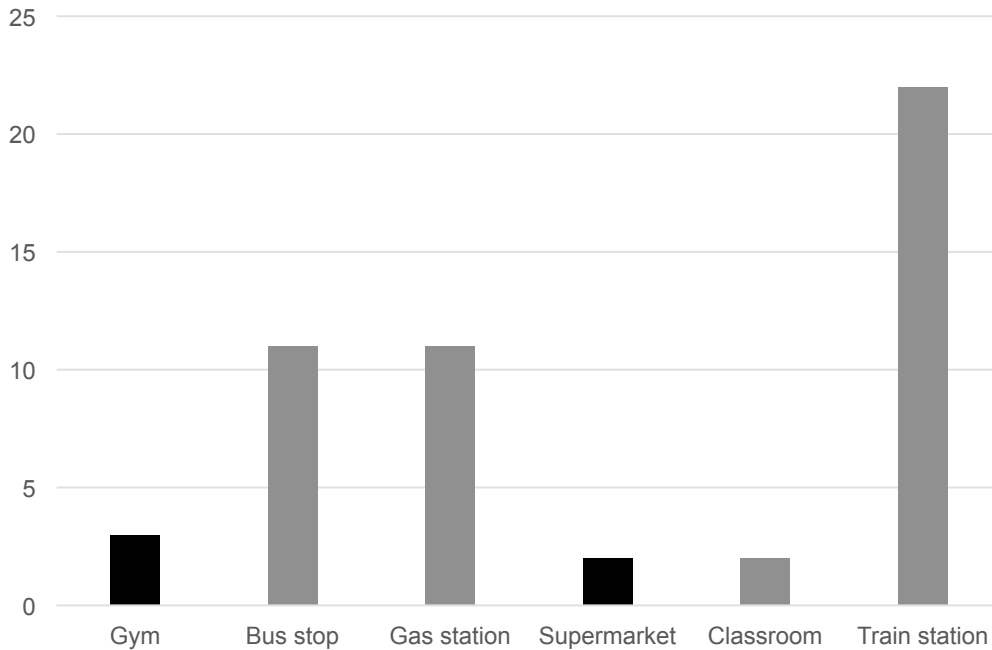
# **Incorrect landmarks**

- Ordinal size
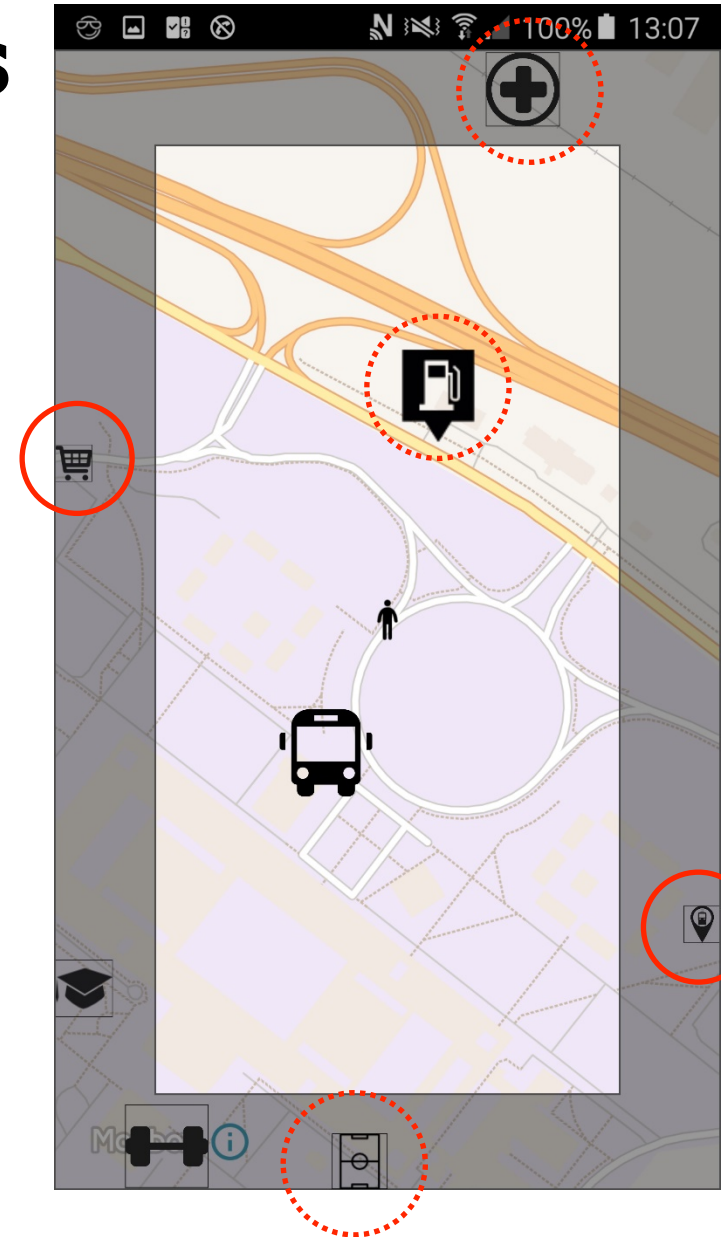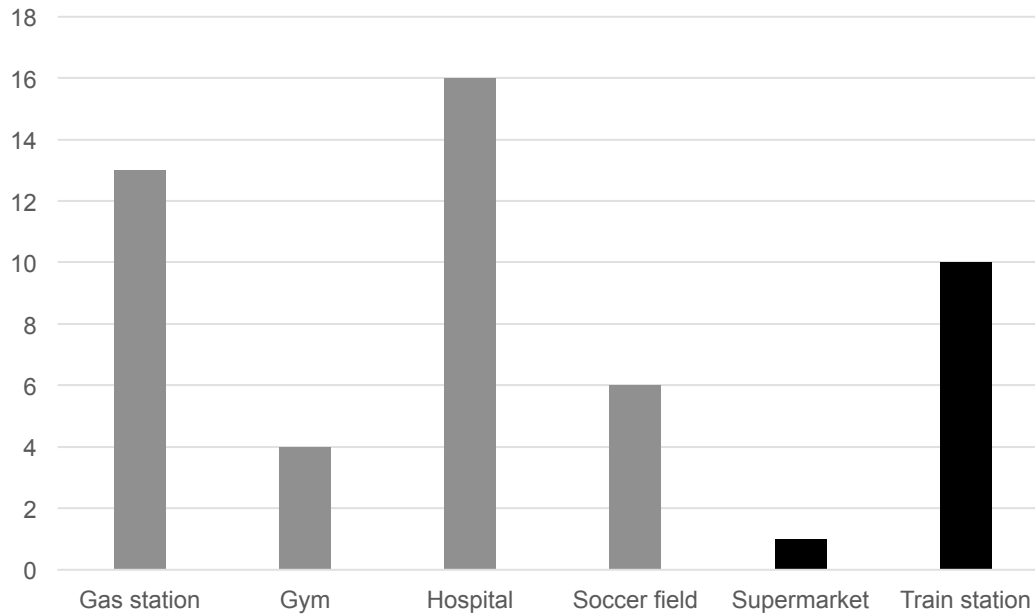
# **Incorrect landmarks**

- Color value

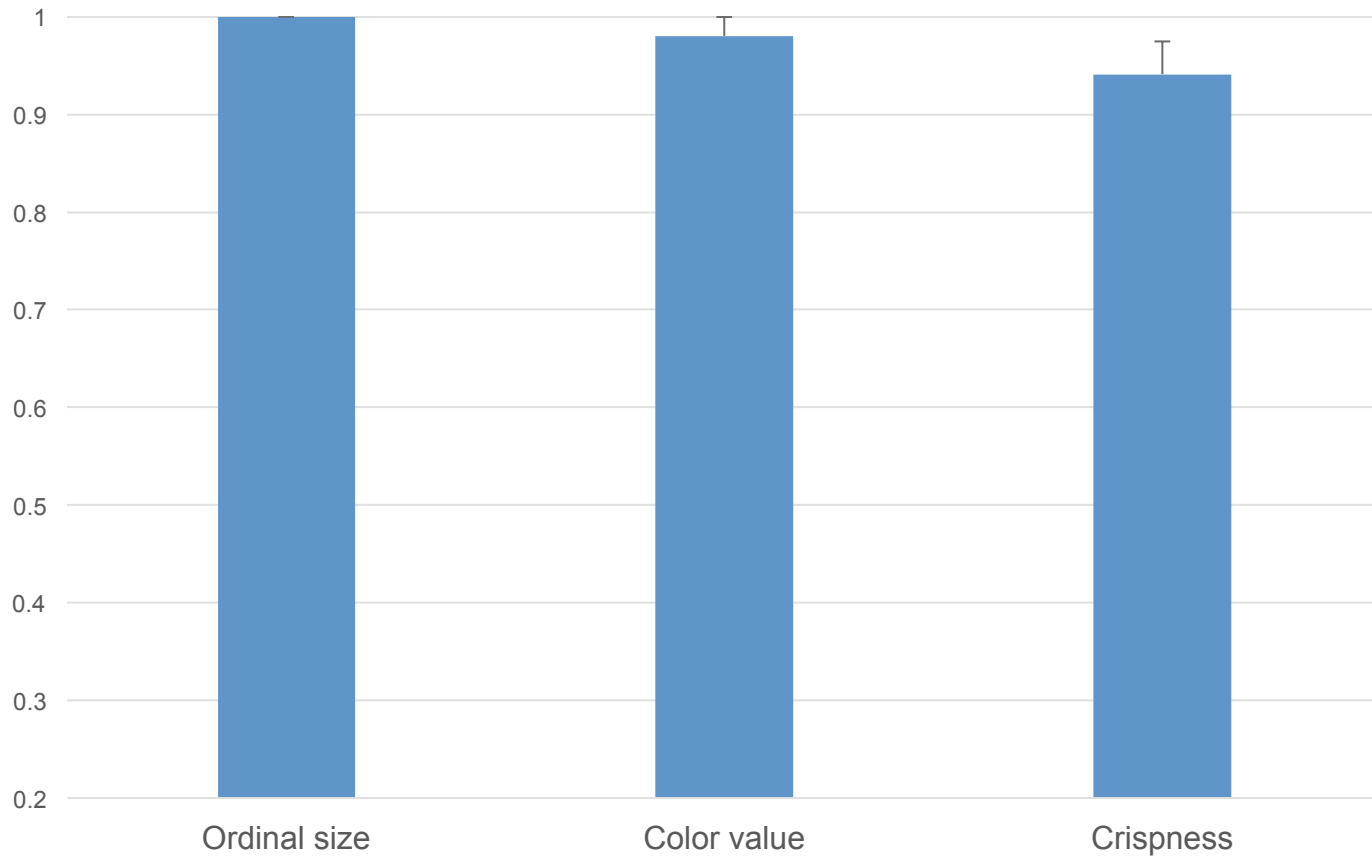# **Incorrect landmarks**

- Crispness

# **Results**

- On-screen landmarks comparison

# **Results**

- On- vs. off screen comparison
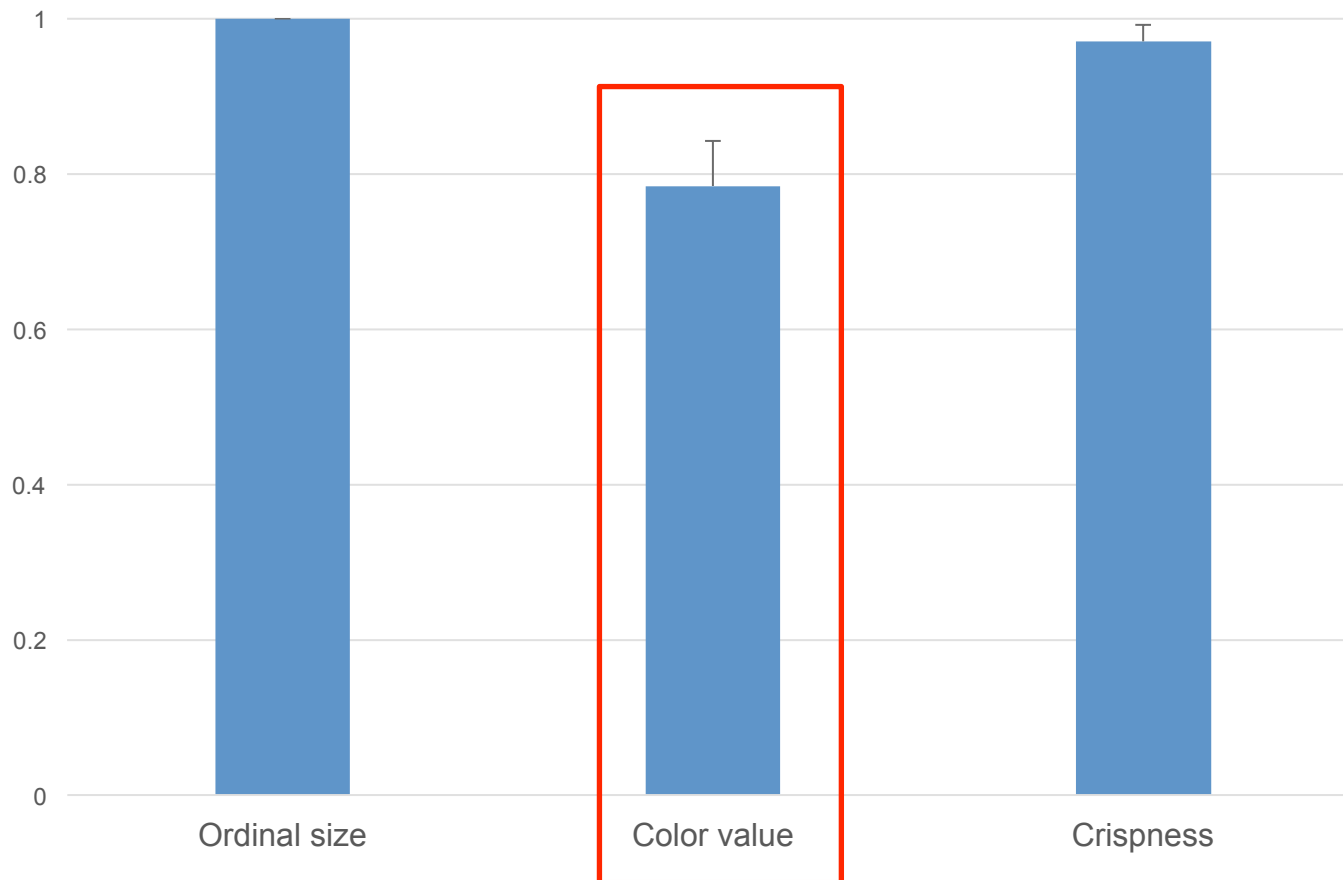


$$F(2, 149) = 10.52, p < .001$$

# **Results**

- Off-screen landmarks comparison
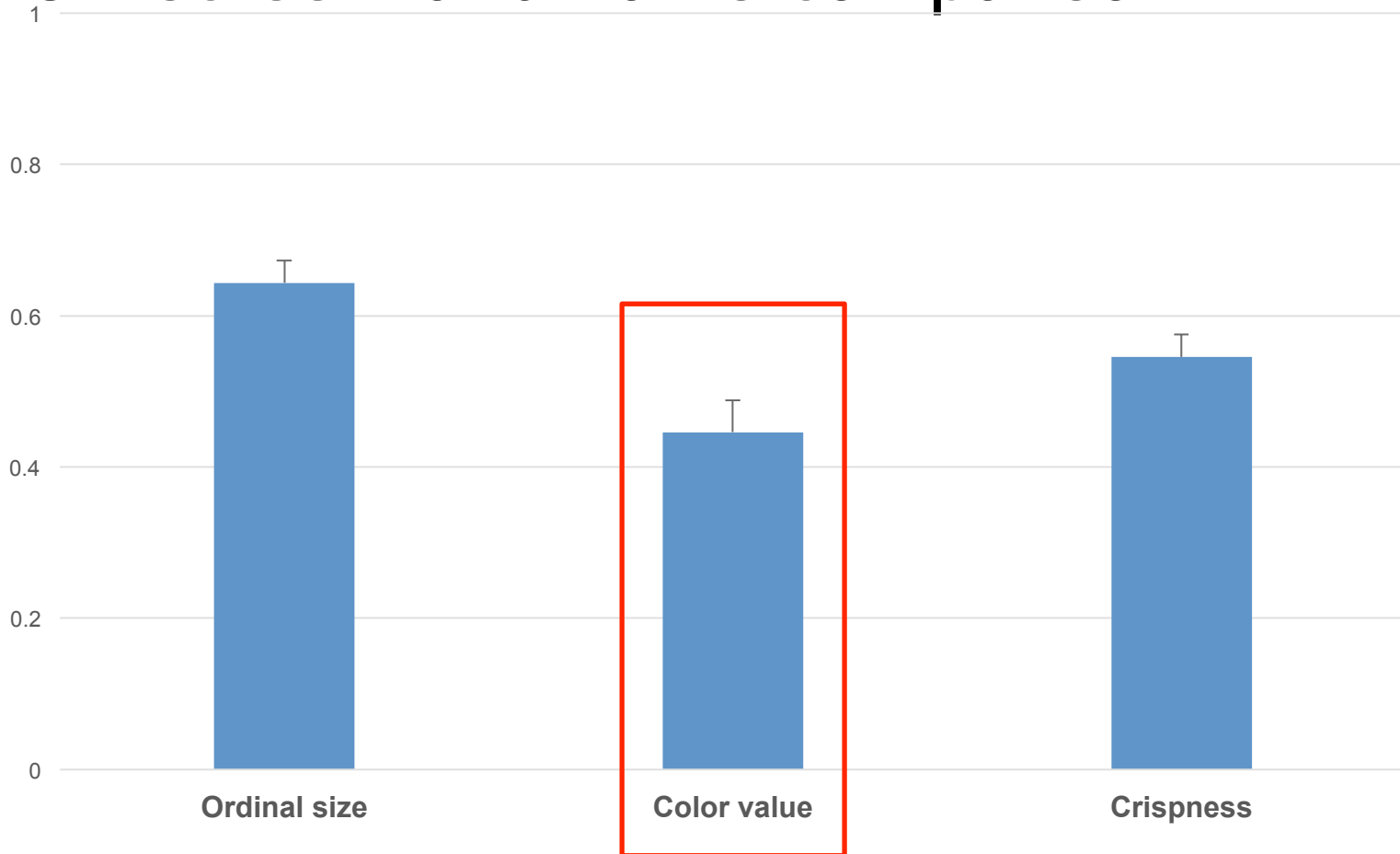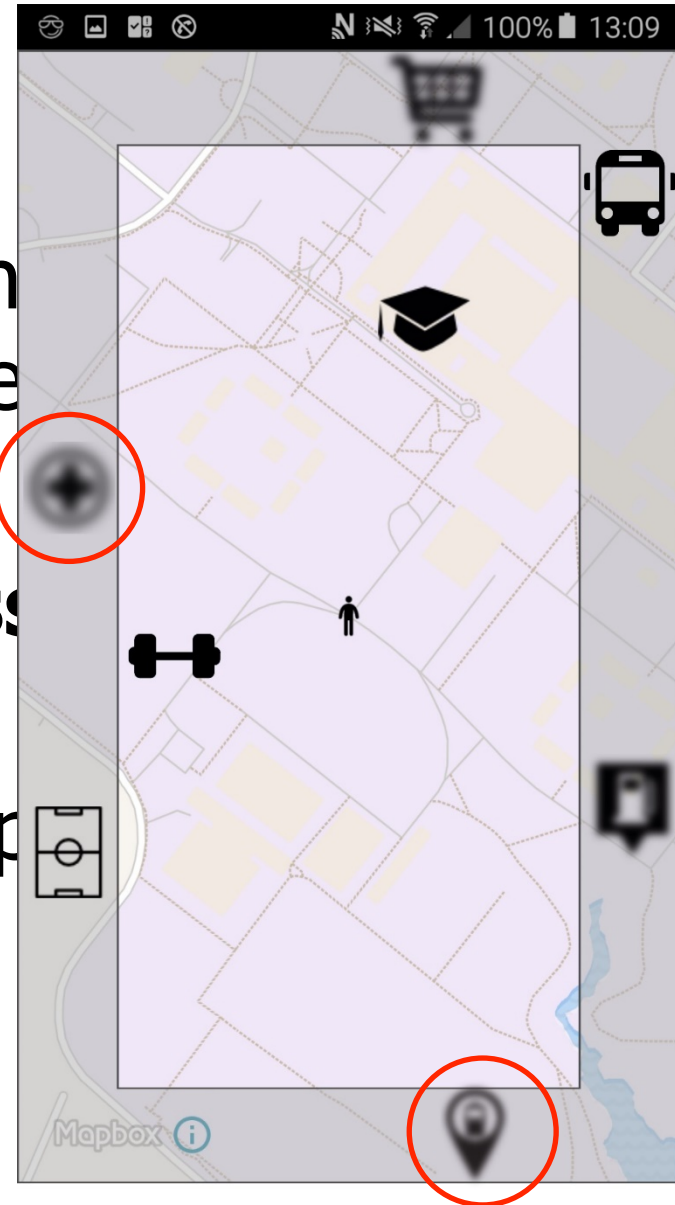


$$F(2, 149) = 8.10, p < .001$$

# **Summary**

- **Color value** seems to be th[e most] effective in supporting perce[iving] distance

- **Ordinal size** and **crispness** [are] effective

- Challenges still exist in comp[aring] screen distances

# General issues

- Off-screen landmarks are not fully understood
- Comparison of off-screen landmarks based on actual distance between symbols on screen
- Evaluation takes place online, not in real environment

# Next step?

- another visual variable?



transparency

- Influences with individual differences?

- Assessments in real environments?

- Approach of distinguishing on- and off-screen landmarks?

(Olivieri 2012)

# **Acknowledgement**

Spatial Intelligence Lab

FRAP award

Cartography specialty group

# Vielen Dank!

## Questions or comments?