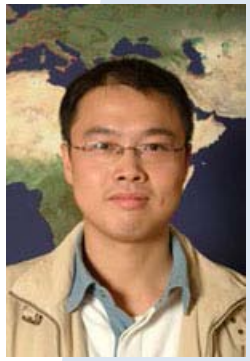
# Spatial knowledge acquisition with Mobile map, Language and Augmented Reality

Haosheng Huang
Manuela Schmidt
Georg Gartner

**Research Group Cartography**
**Vienna University of Technology**
http://cartography.tuwien.ac.at

ways2navigate



# Background

Ways2navigate project …

… investigating the suitability of mobile map, language, and Augmented Reality (AR) for communicating route information to pedestrians

Three iterative field tests …

… how these technologies can help to reduce congitive load during wayfinding

… how these technologies influence the acquisition of spatial knowledge

# Spatial Knowledge Acquisition

Spatial knowledge …

… essential for wayfinding and other spatial tasks

The effect of navigation systems on spatial knowledge acquisition …

… people would get lost when navigation systems fail

# Research Goal

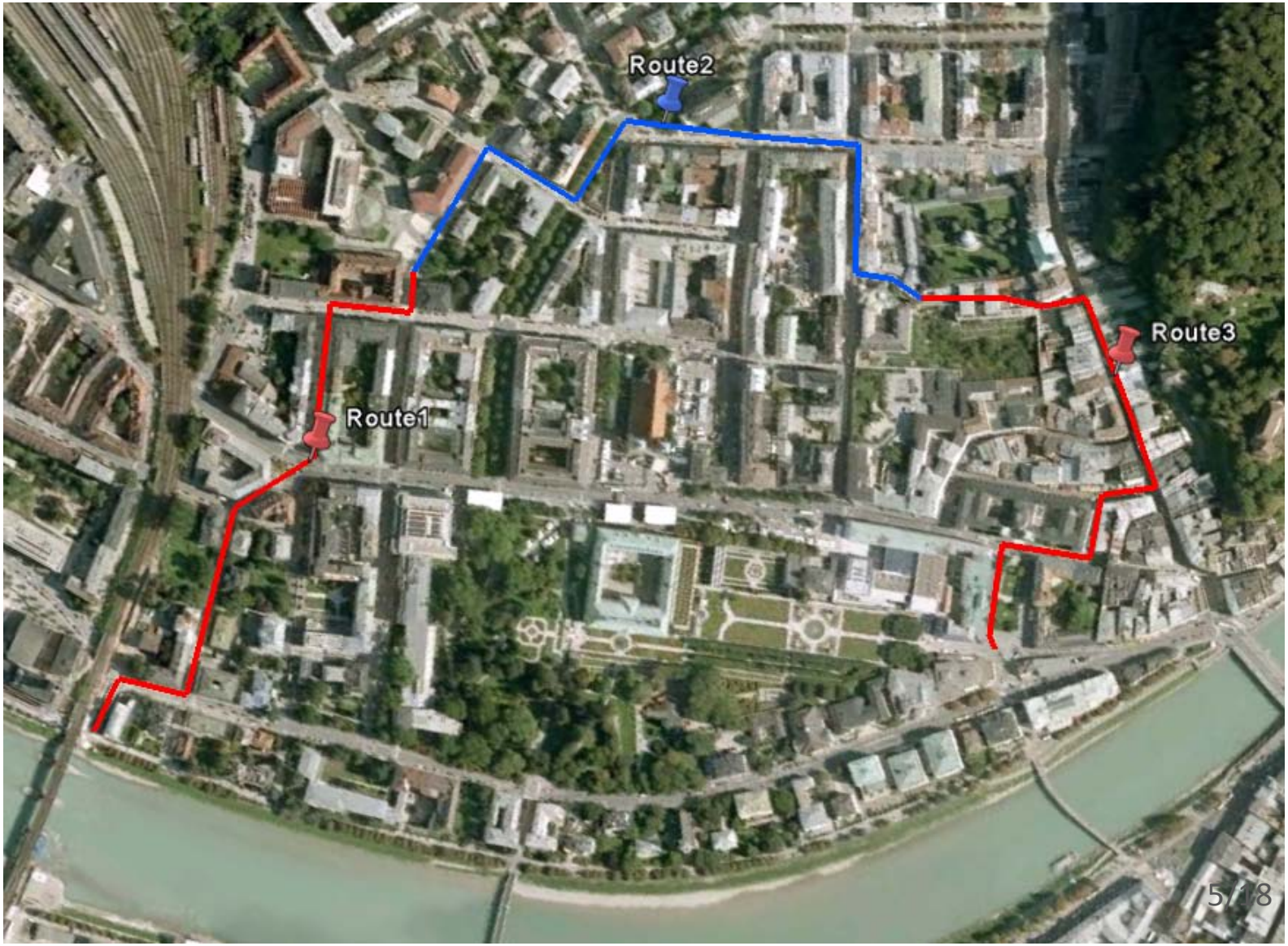
Empirically studying the differences in spatial knowledge acquisition …

… with different presentation forms:
**mobile map, language and AR**

… in the context of GPS-based pedestrian navigation

… in an urban environment

# Methodology: Test Route



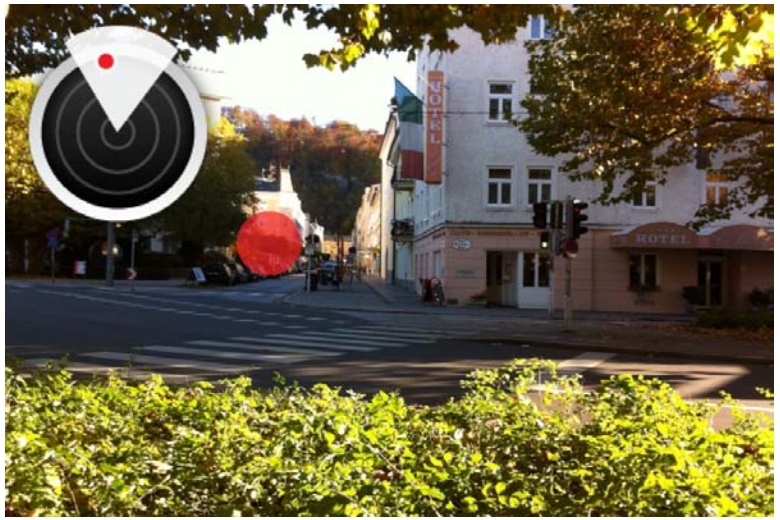
# Methodology: Test Persons

24 test persons …

- … 13 female, 11 male, age range 22-63 yrs (mean: 40)
- … divided into three groups
- … within subject design (72 person/sub-route pairs)

# Methodology: Materials


Mobile map



Augmented Reality

Turn right and use
the cross-walk
towards the hotel.

Language

# Methodology: Tasks

**Part 1:** Route following…

… movement and interaction with the system are logged

**Part 2:** Reaching the end of each sub-route …

… pointing to the start point

… drawing a sketch map

… marking the half of the sub-route

# Data Analysis

Considering **unfamiliarity** …

… 24 person/sub-route paris (8 mobile map, 8 language, 8 AR)

**Sketch maps** (focusing on topological aspects) …

… sketched landmarks

… missing/wrong/unnecessary turns

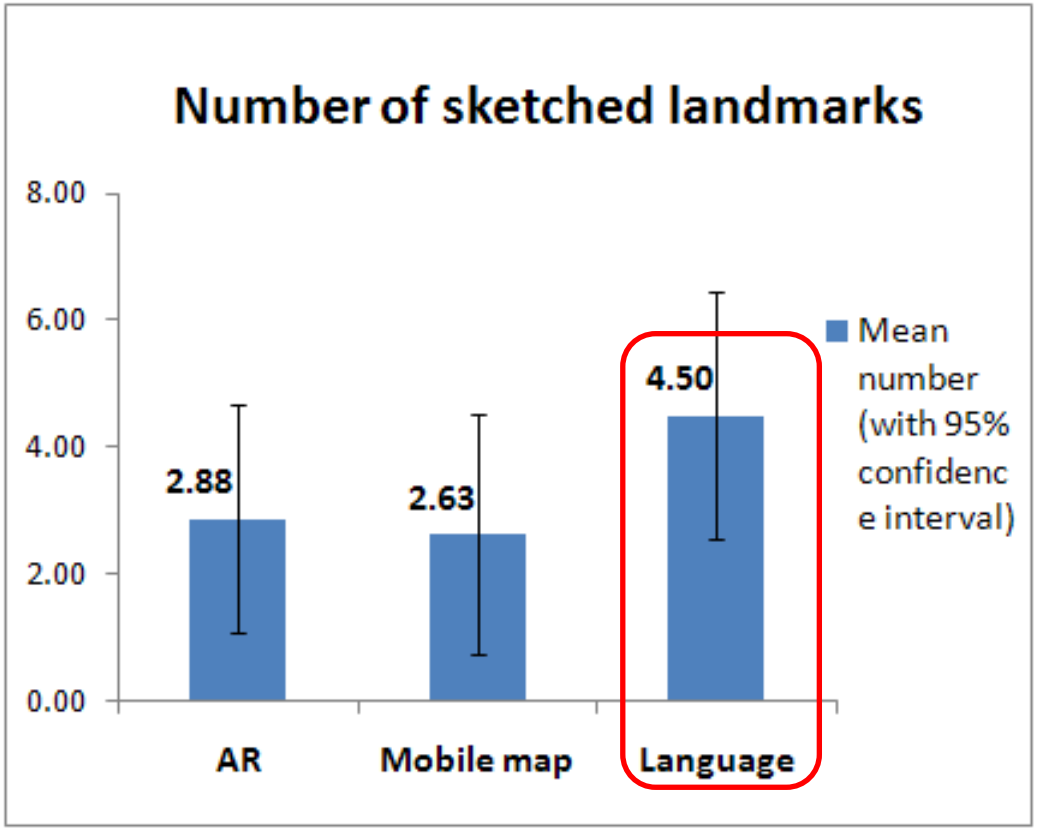
**The pointing task**: sense of direction

… the deviation between correct and pointed direction

**Marking half of the route**: sense of distance

… a grading system

# Results: Number of Sketched Landmarks

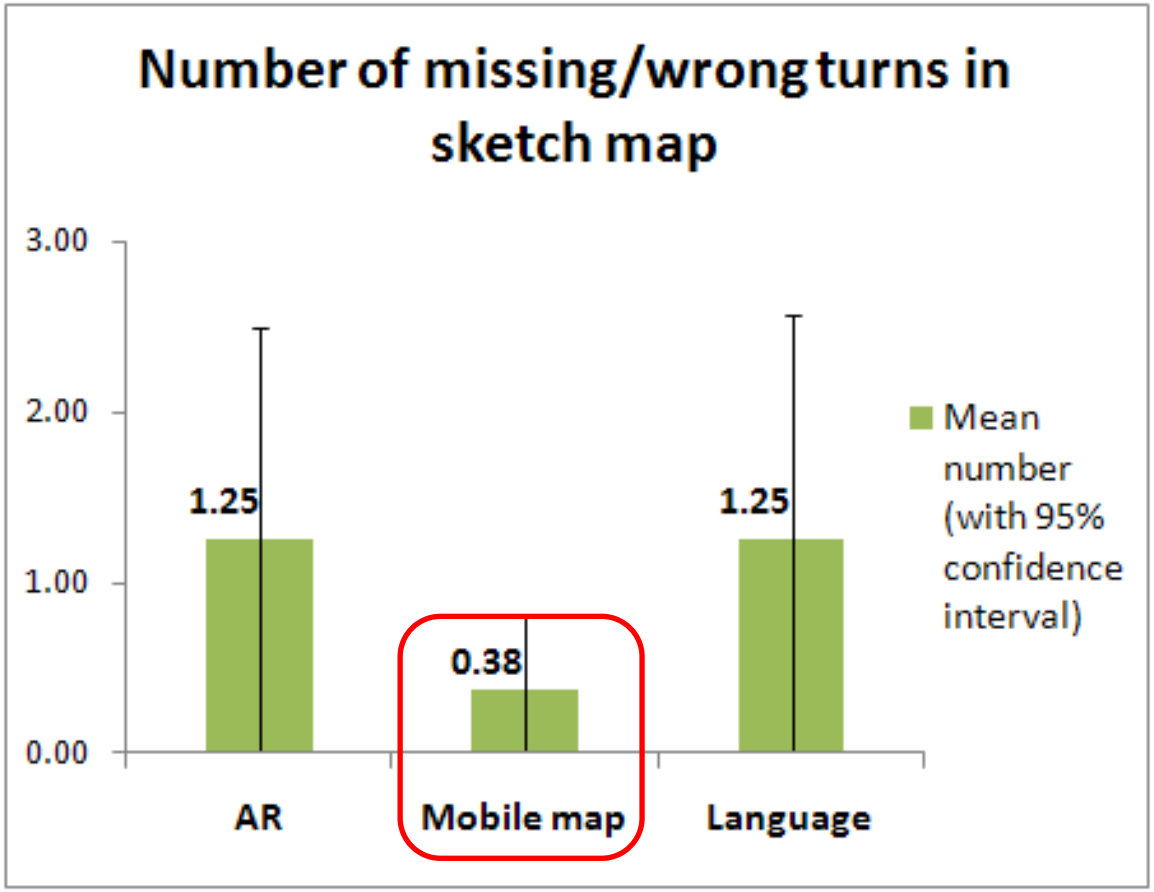



**ANOVA (analysis of variance) test**:
no significant difference in number of sketched landmarks across conditions, $F(2,21) = 1.63$, $p = 0.22$

… 78% of sketched landmarks in “language” condition are mentioned in the verbal wayfinding instruction

… Landmarks are not explicitly highlighted in “mobile map” and “AR”

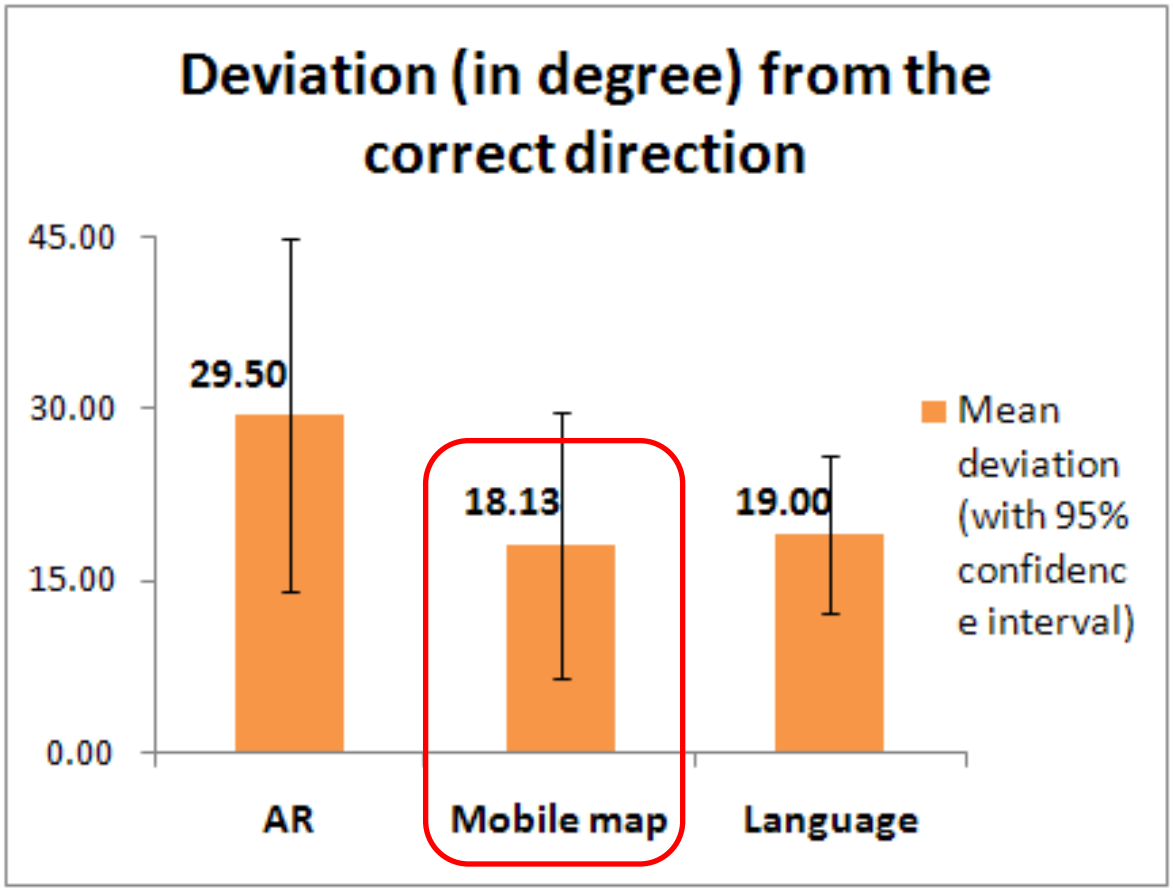
# Results: Missing/wrong turns in sketch map




**ANOVA test:**
no significant difference in number of wrong turns across conditions, $F(2,21) = 1.60$, $p = 0.31$

… in “AR” and “Language”, turns are not presented in a spatial-related overview context

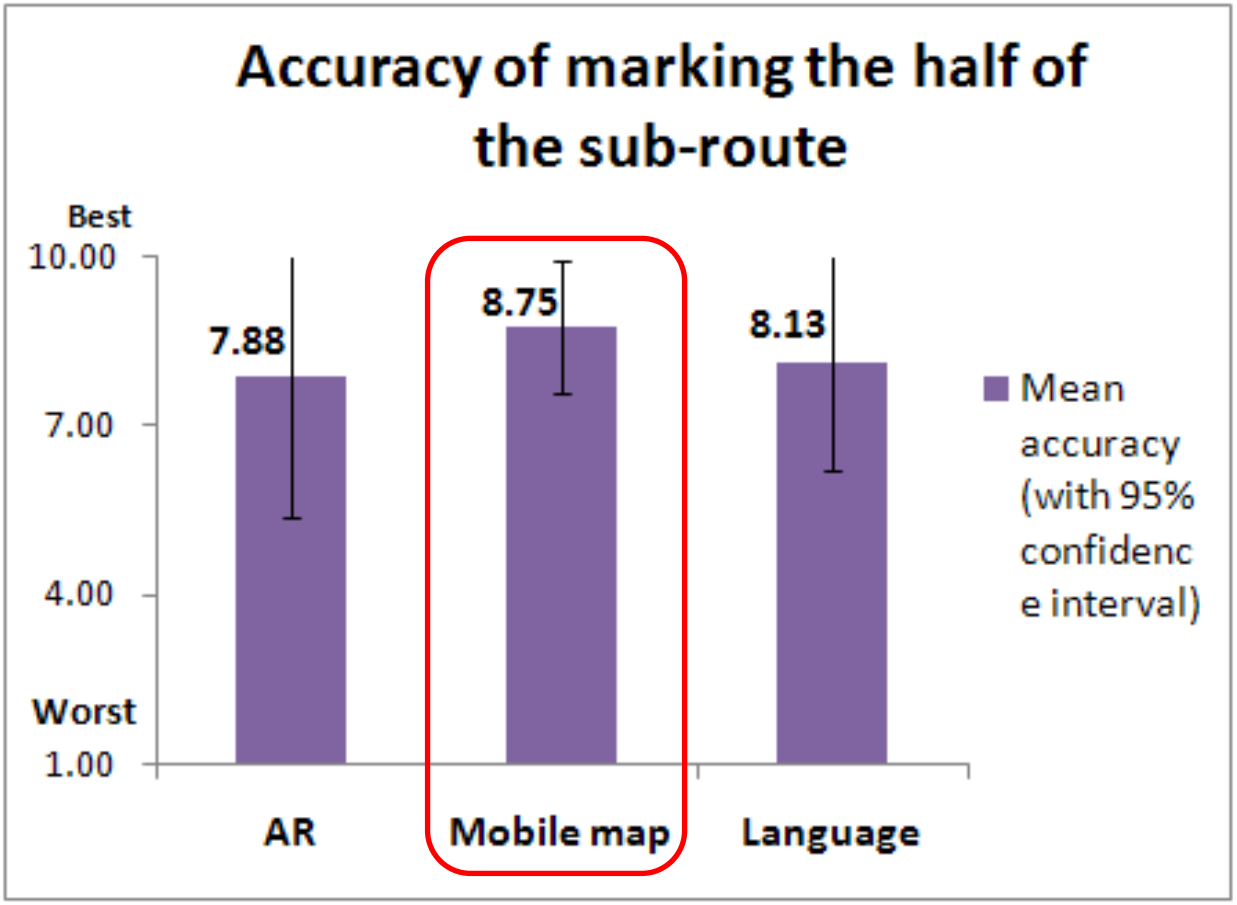
# Results: Sense of Direction




**ANOVA test:**
no significant difference in sense of direction across conditions,
$F(2,21) = 1.23$, $p = 0.23$

… “AR” suffers from the poor GPS signal: confusion
… in “mobile map” condition, subjects seldom used the zooming function

# Results: Sense of Distance




**ANOVA test:**
no significant difference in sense of distance across conditions,
$F(2,21) = 0.3$, $p = 0.74$

… For all three conditions, the knowledge on sense of distance is mainly gained from sensual perception of real world (not from presentation forms)

# Summary of the Results

Compared to “language” and “AR”, using “mobile map” leads to ***better*** spatial knowledge acquisition, reflecting by …

- … more accuracy in pointing the start point
- … more accuracy in sketching turns
- … more accuracy in marking the half of the route
- … however, no significant differences

No clear results on sketched landmarks …

- … landmarks are not explicitly highlighted in “mobile map” and “AR”

# Work in Progress: 2nd Iteration

- Improving the navigation systems: mobile map, language, and AR
- Refining the methodology
  - … differentiate three kinds of spatial knowledge (landmark, route and survey knowledge)

# Open Research Questions

Do users care about spatial knowledge acquisition?

… If yes, how can we design a navigation system which not only efficiently guides users from A to B, but also enables them to acquire spatial knowledge during navigation?

# Thank you!

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