Understanding the Effect of the Combination of Navigation Tools in Learning Spatial Knowledge
Indoor Navigation Apps
Purpose of Indoor Navigation Apps

- Reaching to the desired destination
- Explore and Learn the environment
Purpose of Indoor Navigation Apps

How these applications can provide such immersive experience?

- Reaching to the desired destination
- Explore and Learn the environment
Basic Structure of Navigation Applications

- Reference Frames
- Navigation Cues
Reference Frames

Map Interface

Video Interface
Navigation Cues

Directional Arrows

- Turn Left
- Go Straight
- Turn Right

Relative Location Updates

- Location Marker
- Navigation Circle
- Map Interface: Current location on the map
- Video Interface: Current direction of the destination
Map Interfaces

**Directional Arrow**
- Turn-by-Turn Update

**Relative Location Update**
- Real Time Update

**Map Interface with Directional Arrow**

**Map Interface with Location Marker**
Map Interfaces

Directional Arrow
Turn-by-Turn Update

Relative Location Update
Real Time Update

Lazy Approach

Hard Approach

Map Interface with Directional Arrow

Map Interface with Location Marker
Video Interfaces

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Video Interface with Directional Arrow

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Video Interfaces

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Lazy Approach

Hard Approach

Video Interface with Directional Arrow

Video Interface with Navigation Circle
Getting There and Beyond: Incidental Learning of Spatial Knowledge with Turn-by-Turn Directions and Location Updates in Navigation Interfaces, SUI 2018
Research Question

More Navigation Cues $\sim$ More Spatial Knowledge
More is better

But

The navigation tools (reference frame and navigation cues) will have to work coherently.
<table>
<thead>
<tr>
<th>Interface Designs</th>
<th>Allocentric Encoding</th>
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## Hypotheses

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Study Design

User Study

60 Participants

15 Participants

15 Participants

15 Participants

15 Participants
User Study Design

Assisted Navigation Tasks

Tests to measure Incremental Survey Knowledge

Completed 4 Tasks?

Test to measure Integrated Survey Knowledge

Tests to measure Route Knowledge

Completed 3 Tasks?

End
User Study Design

Assisted Navigation Tasks

Tests to measure Incremental Survey Knowledge

Completed 4 Tasks?

No

Test to measure Integrated Survey Knowledge

Yes

Tests to measure Route Knowledge

Completed 3 Tasks?

No

Orientation Test

Path Recall Test

Yes

End
User Study Design

Assisted Navigation Tasks

Tests to measure Incremental Survey Knowledge

Completed 4 Tasks?

No → Test to measure Route Knowledge

Completed 3 Tasks?

No → Orientation Test

Yes → Test to measure Integrated Survey Knowledge

Yes → Path Recall Test

End
User Study Design

Assisted Navigation Tasks

Tests to measure Incremental Survey Knowledge

Completed 4 Tasks?

Yes

Test to measure Integrated Survey Knowledge

Tests to measure Route Knowledge

Completed 3 Tasks?

No

No

Orientation Test

Path Recall Test

Floor Plan Recall Test

No

Yes

End
Tests to measure Route Knowledge

1. Location Recognition Test
2. Unassisted Navigation Test
## Results

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<tr>
<td><img src="image3" alt="Floor Plan Recall Test" /></td>
<td>![Thumb Up]</td>
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<tr>
<td><img src="image4" alt="Location Recognition Test" /></td>
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<td>![Thumb Down]</td>
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Beyond our hypothesis
Incoherent cues were distracting.

They can negatively effect the performance of the users.
Map and Video-based Reference Frames can complement each other.
Combining Map and Video

Map-based FR With a Video Window

Video-based FR With a Map Window
Results

Map-based FR with both Arrow and Location Marker

Map-based FR with a Video Window

Video-based FR with Navigation Circle

Video-based FR with a Map Window
Results

Map-based FR with both Arrow and Location Marker

Video-based FR with Navigation Circle

Map-based FR with a Video Window

Video-based FR with a Map Window
Results

Location Recognition Test

Map-based FR with both Arrow and Location Marker

Map-based FR with a Video Window

Video-based FR with a Map Window
Results

Video Screen too Small

Map-based FR with both Arrow and Location Marker

Location Recognition Test

Map-based FR with a Video Window

Video-based FR with a Map Window
• Having more cues is not always beneficial for acquiring spatial knowledge. It is only beneficial when the cues coherently complement each other.

• Combining Map- and Video-based interfaces can benefit users in acquiring incidental spatial knowledge.
Future Work

Toys teaching spatial skills

Sensory aided landmarks learning
Thank You

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Prof. Wai Fu
Prof. Karrie Karahalios

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