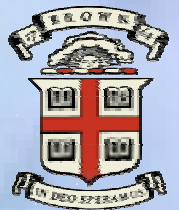


# **LANDMARKS VS. PATH INTEGRATION IN VIRTUAL REALITY**

---

**Vlada Aginsky**  
**Andrew Duchon**  
**William Warren**  
**Michael Tarr**

***Brown University***



# **Navigation**

---

**How well can people ignore visual information and instead use non-visual cues?**

**If people are compelled to use visual landmarks, which type will they rely on more: local or global landmarks?**

# Information we can use

---

## **Internal information:**

**Path Integration** of vestibular and proprioceptive signals, etc.

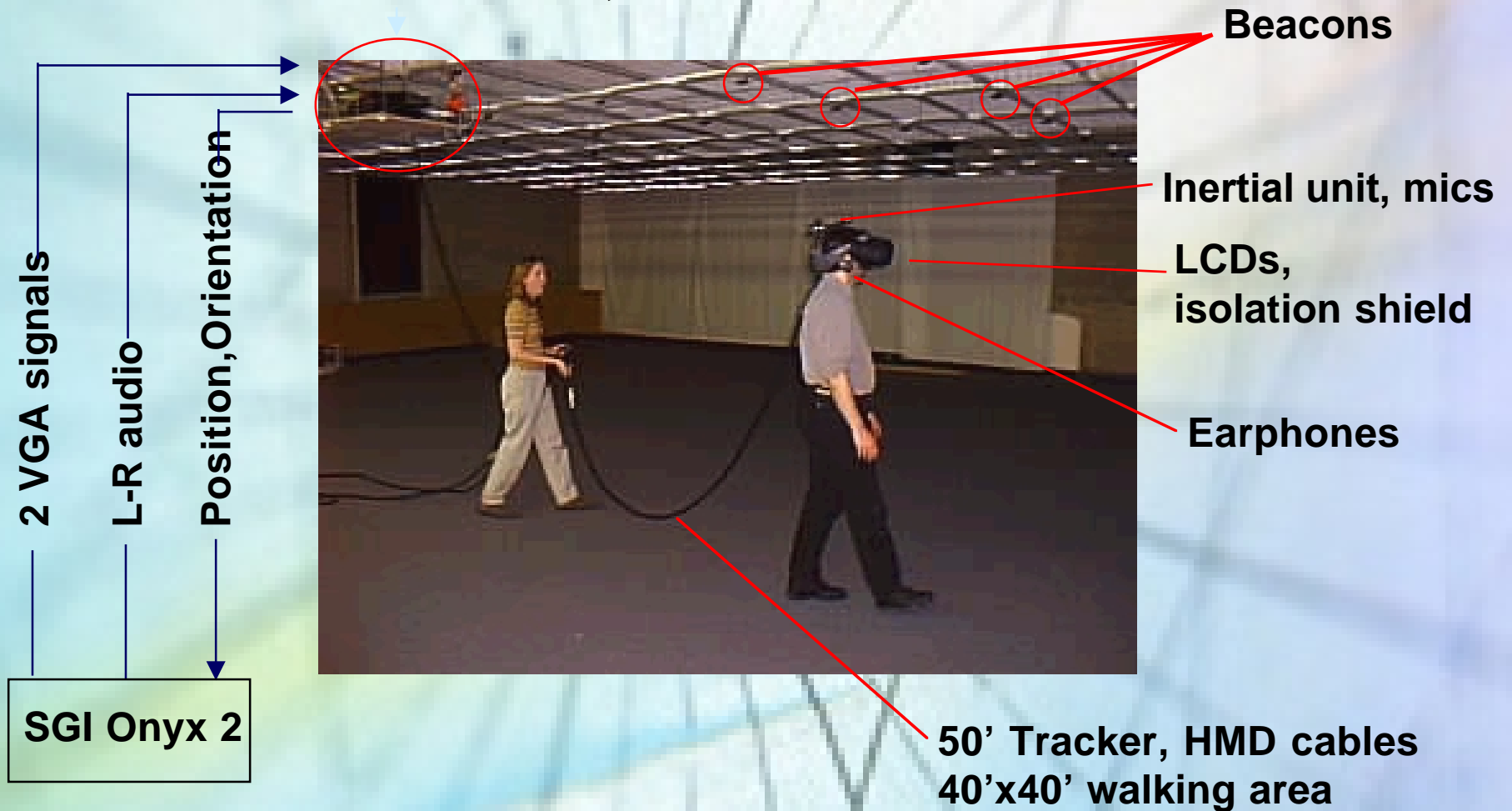
## **Environmental information:**

**Local Landmarks:** small; relatively close; many views possible

**Global Landmarks:** large; distant; single stable view; act as beacons

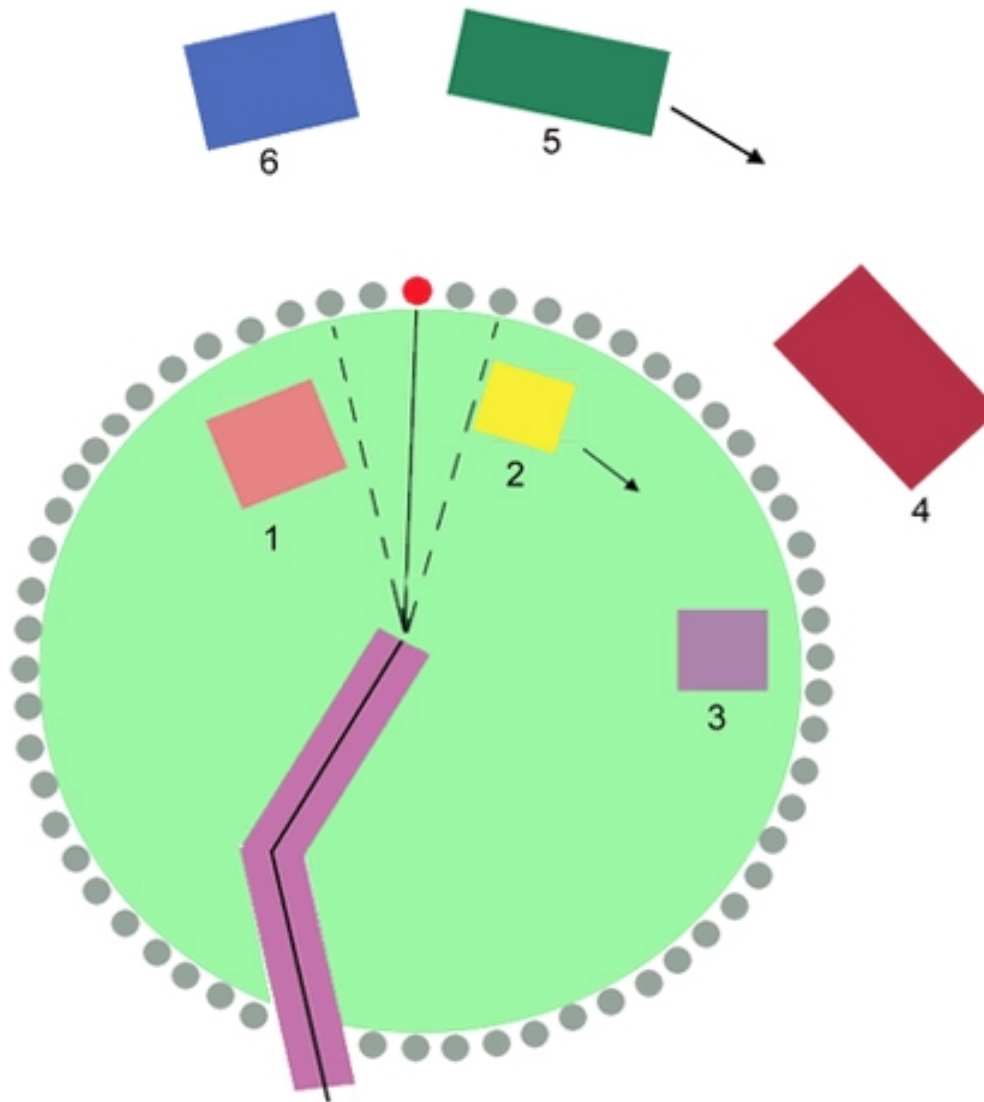
# VENLAB Hardware

Platform w/ Tracker controller, HMD controller



# Manipulating Environmental Cues

---



# **Outline of Experiments**

---

## **Experiment I - Local and Global Landmarks**

- **Joystick (pilot) - Vision and manual control feedback**
- **Walking - Vision and proprioception from locomotion**

## **Experiment II - Local Landmarks**

- **Walking - Using only local landmarks**

# **Experiment I - Local/Global**

---

## **5 landmark shift combinations**

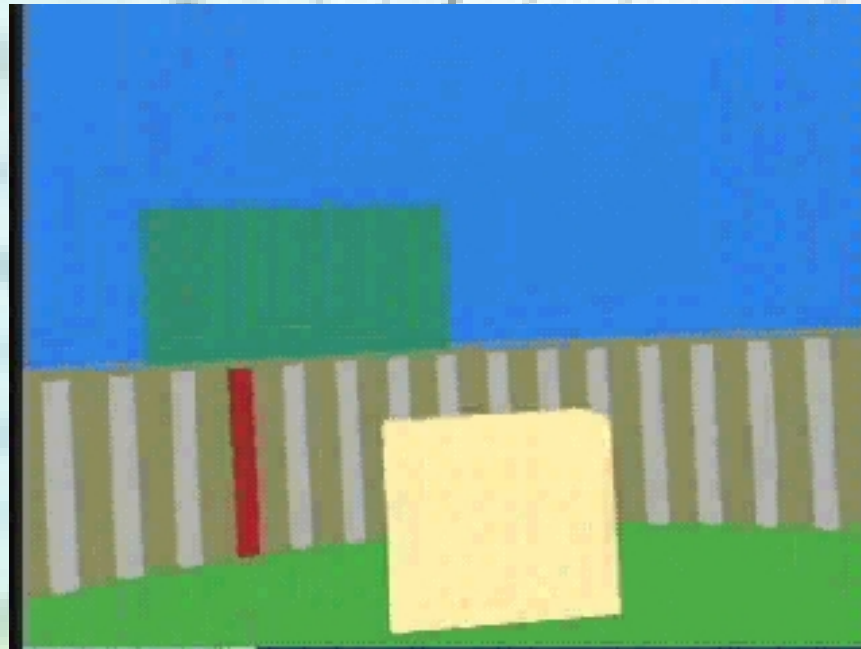
- 1. All**
- 2. All Local**
- 3. All Global**
- 4. One Local**
- 5. One Global**

## **6 shift angles**

**Left and right: 6°, 12°, 18°**

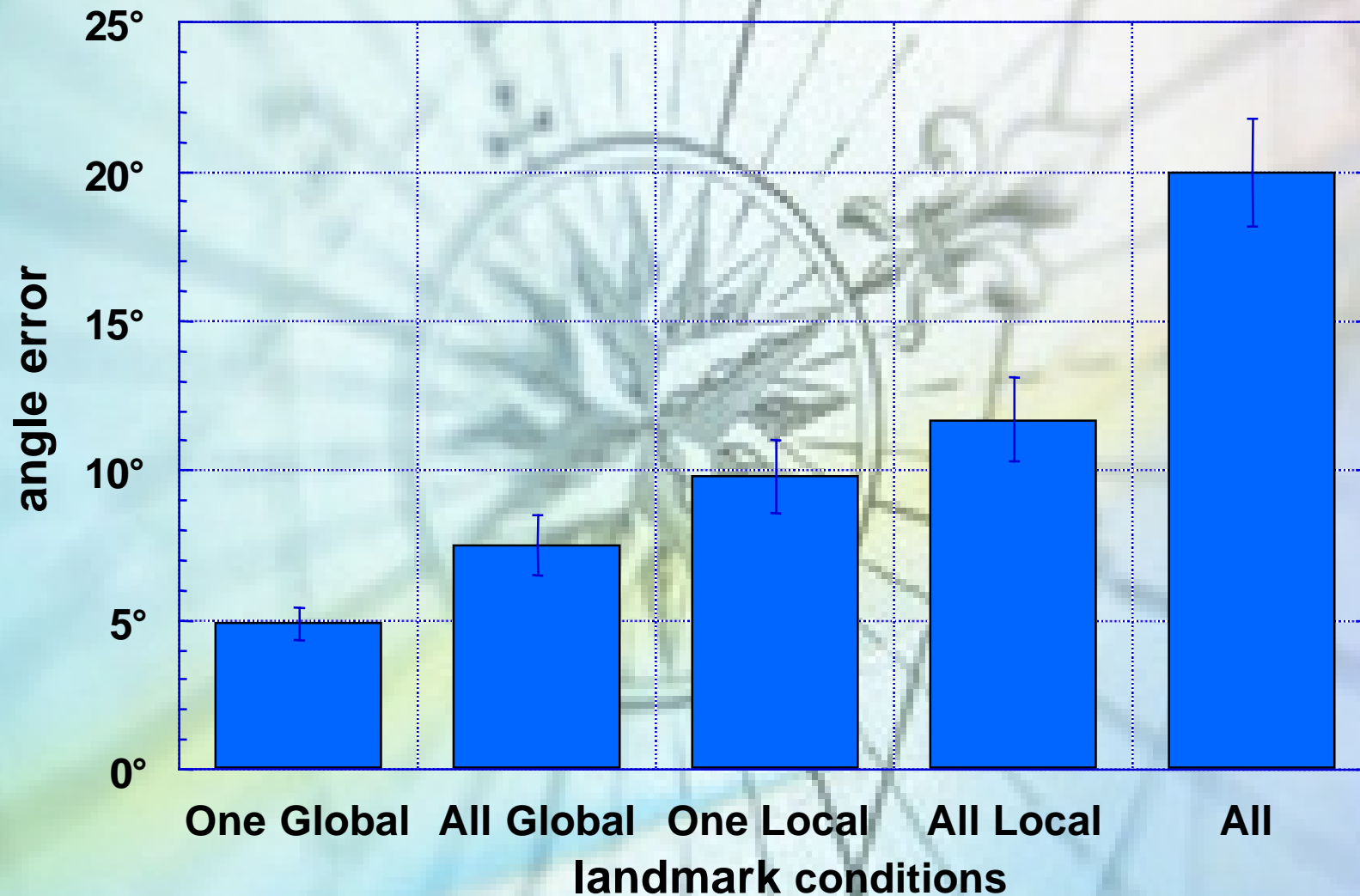
# Local/Global VR Display

---



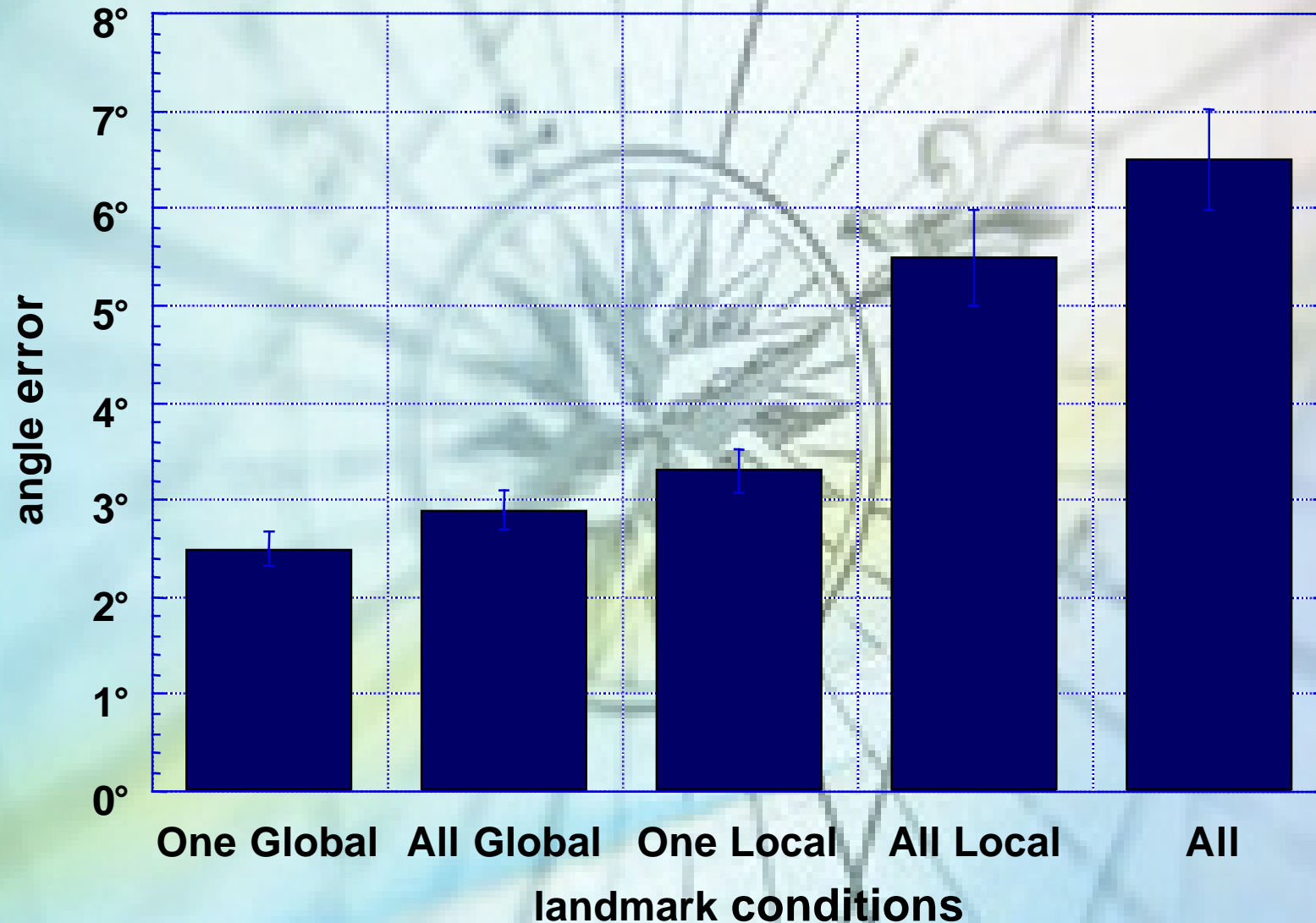
# Experiment I - Joystick

Angle error from target pole - Local/Global

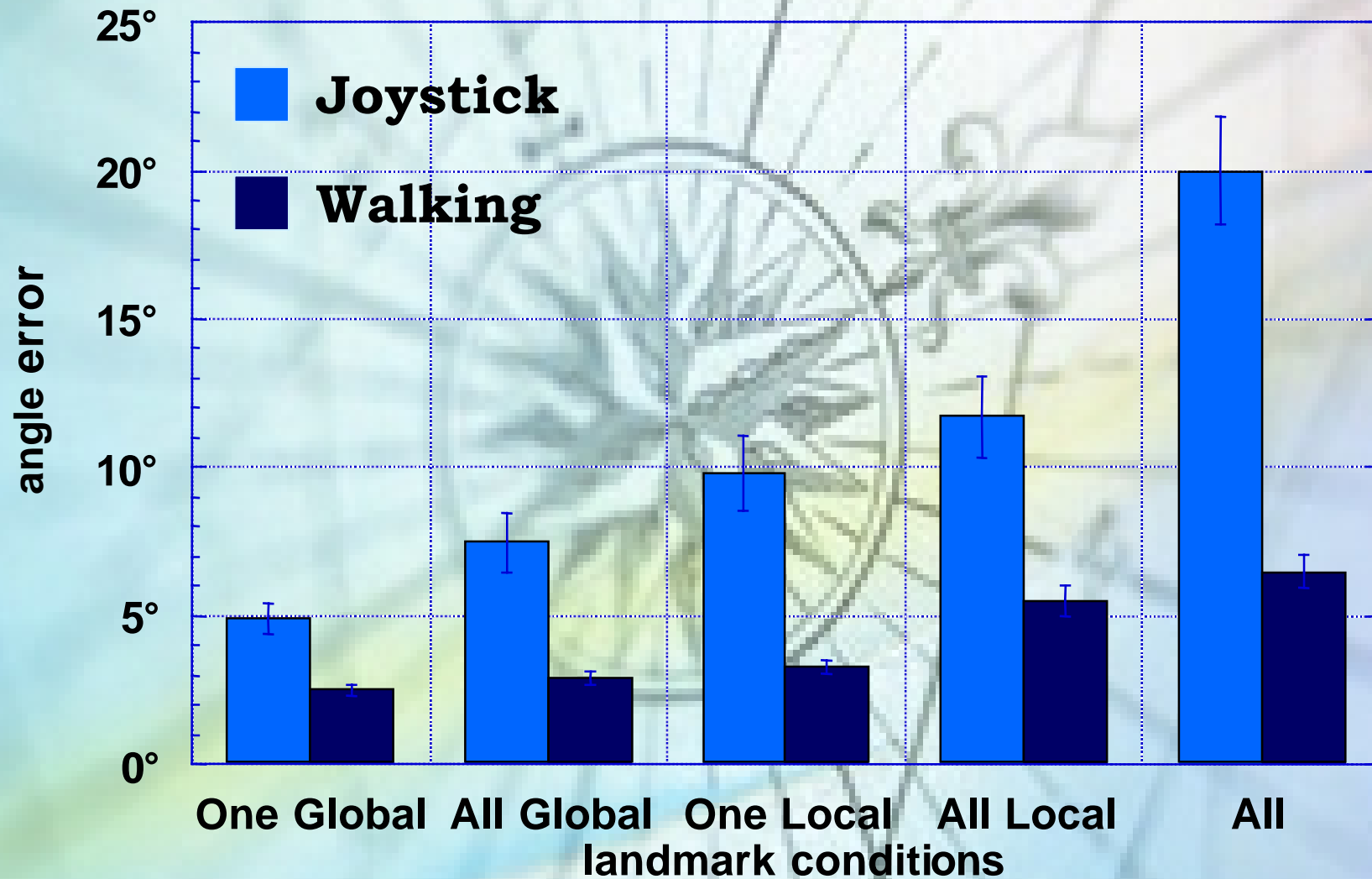


# Experiment I - Walking

Angle error from target pole - Local/Global



# Experiment I - Joystick vs. Walking



# **Experiment II - Local Only**

---

## **7 landmark shift combinations**

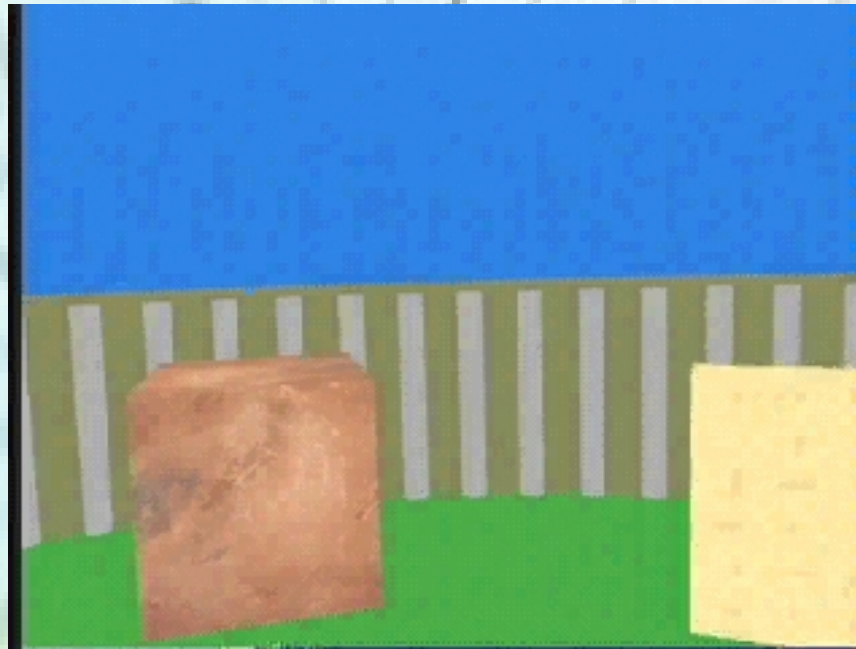
- |                      |                          |
|----------------------|--------------------------|
| <b>1. Landmark 1</b> | <b>4. Landmarks 1, 2</b> |
| <b>2. Landmark 2</b> | <b>5. Landmarks 1, 3</b> |
| <b>3. Landmark 3</b> | <b>6. Landmarks 2, 3</b> |
|                      | <b>7. All Landmarks</b>  |

## **5 shift angles**

**Left and right:  $0^\circ, 6^\circ, 12^\circ$**

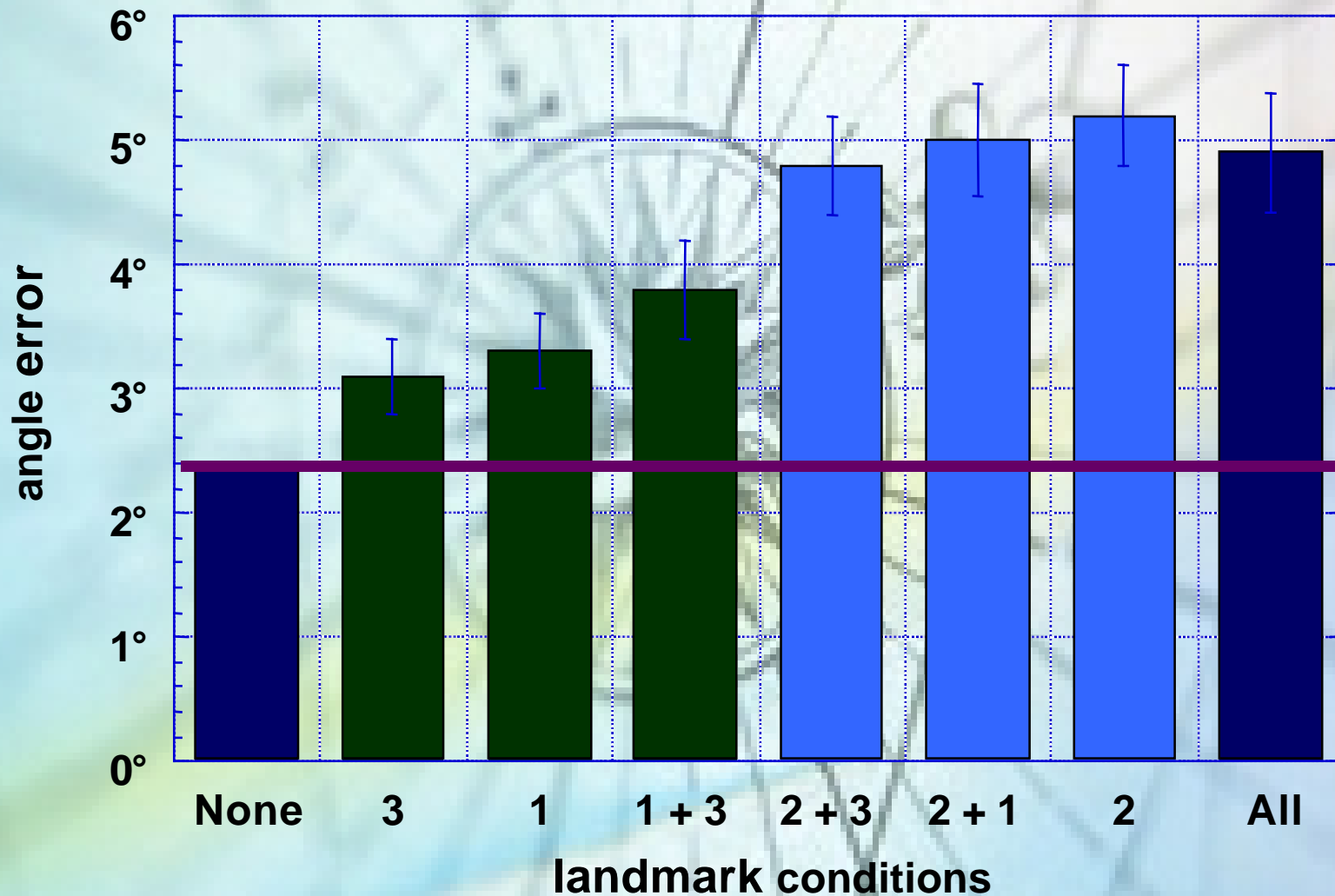
# Local Only VR Display

---



# Experiment II - Results

## Angle error from target pole - Local only



# Conclusions

---

- **Local landmarks are weighted more than global landmarks**

---
- **The local landmark closest to target location is weighted more than other local landmarks**

---
- **Global landmarks provide a visual anchor for the local landmarks**

---
- **Dead reckoning appears to account for lower error when walking**