# Spatial Navigation: Why is Active Exploration Better than Passive Exploration?

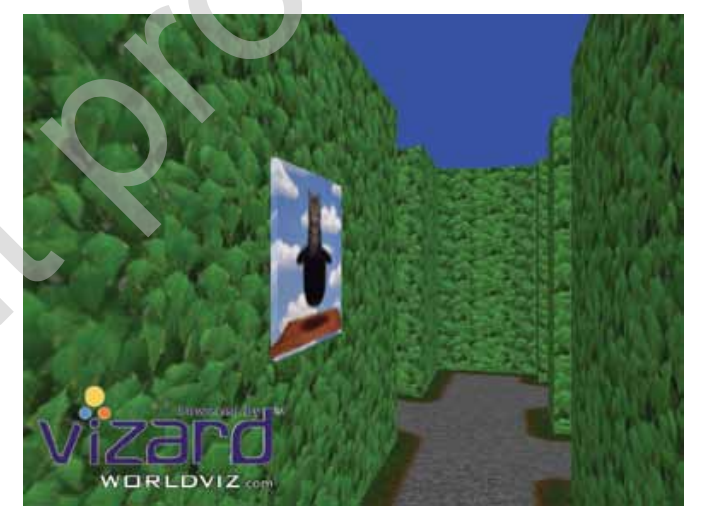
Elizabeth Chrastil & William Warren          Cognitive, Linguistic, & Psychological Sciences

## Purpose

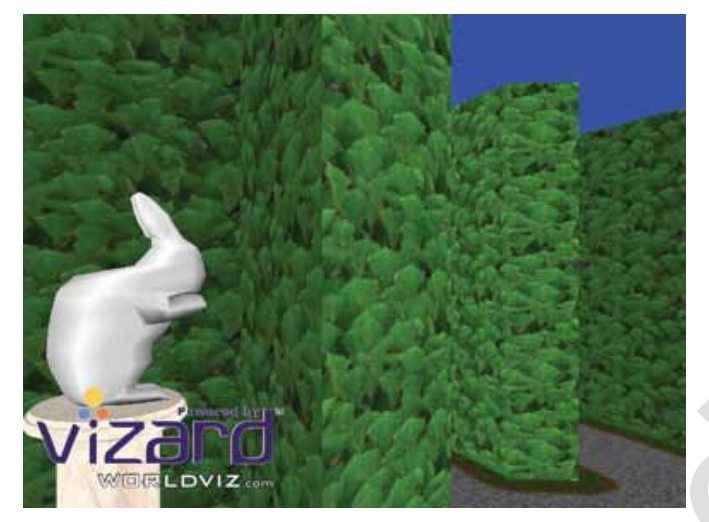
- Actively walking around a new city seems to yield better spatial knowledge than passively riding in a taxi.
- But the literature is mixed, in part because it confounds different notions of "active".
- Here we test the contributions of several components of active exploration to route learning:
  - Motor/Proprioceptive information
  - Vestibular information
  - Cognitive decision-making
  - (Allocation of attention)

## Methods

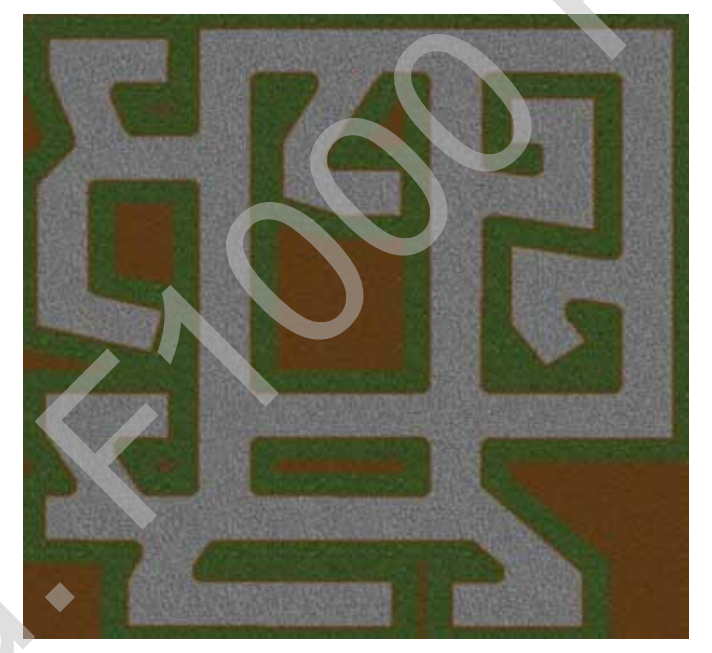
- Conducted in VENLab, 12x12m VR Environment
- Rockwell-Collins HMD, 63 x 53 FOV
- Ultrasonic/inertial head tracker (50ms latency)
- N = 16 per group, 6 groups



Landmark Painting



Target Object



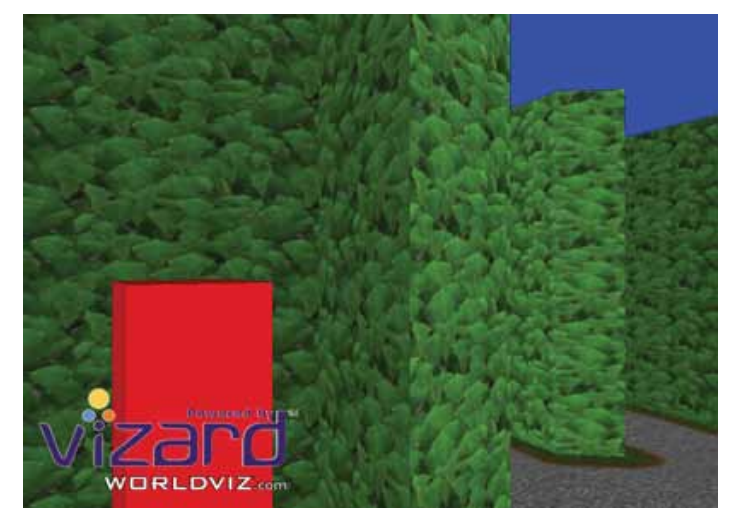
Overhead View of Maze

### 6 Exploration Conditions (10 Min)

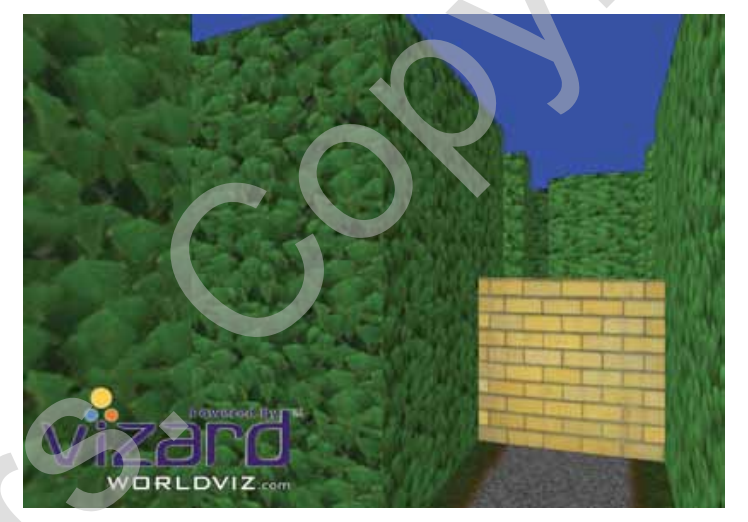
| | Vision | Vestibular | Proprioception/ Motor Efference | Decisions |
|---|---|---|---|---|
| Free Walking | ✓ | ✓ | ✓ | ✓ |
| Guided Walking | ✓ | ✓ | ✓ | |
| Free Wheelchair | ✓ | ✓ | | ✓ |
| Guided Wheelchair | ✓ | ✓ | | |
| Free Video | ✓ | | | ✓ |
| Guided Video | ✓ | | | |

### Route Test

- Take route from A to B through maze
- 8 targets, 5 trials each, 2 detour catch trials
- Debriefing and individual difference measures



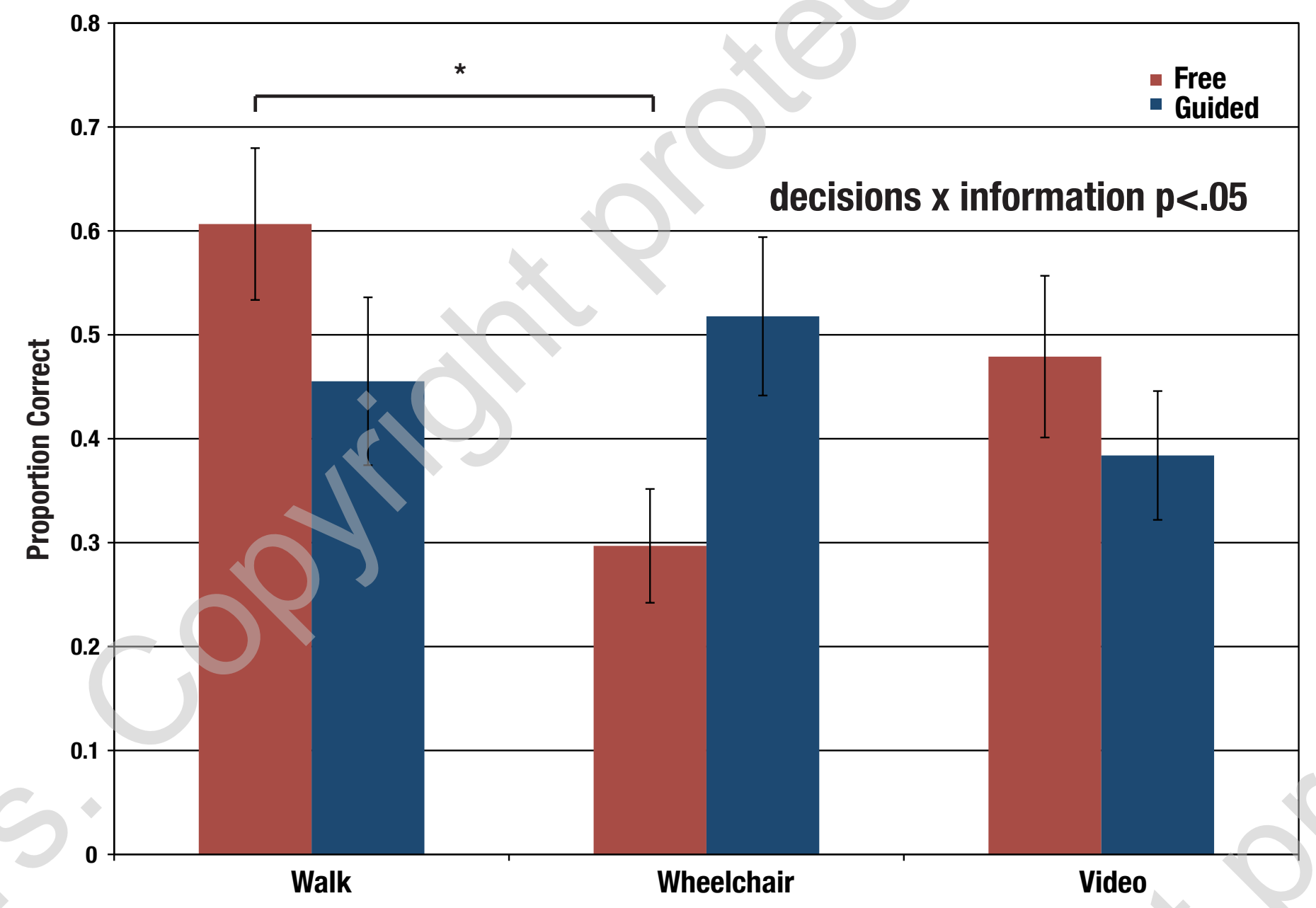
Targets Become Red Blocks During Test



Detour

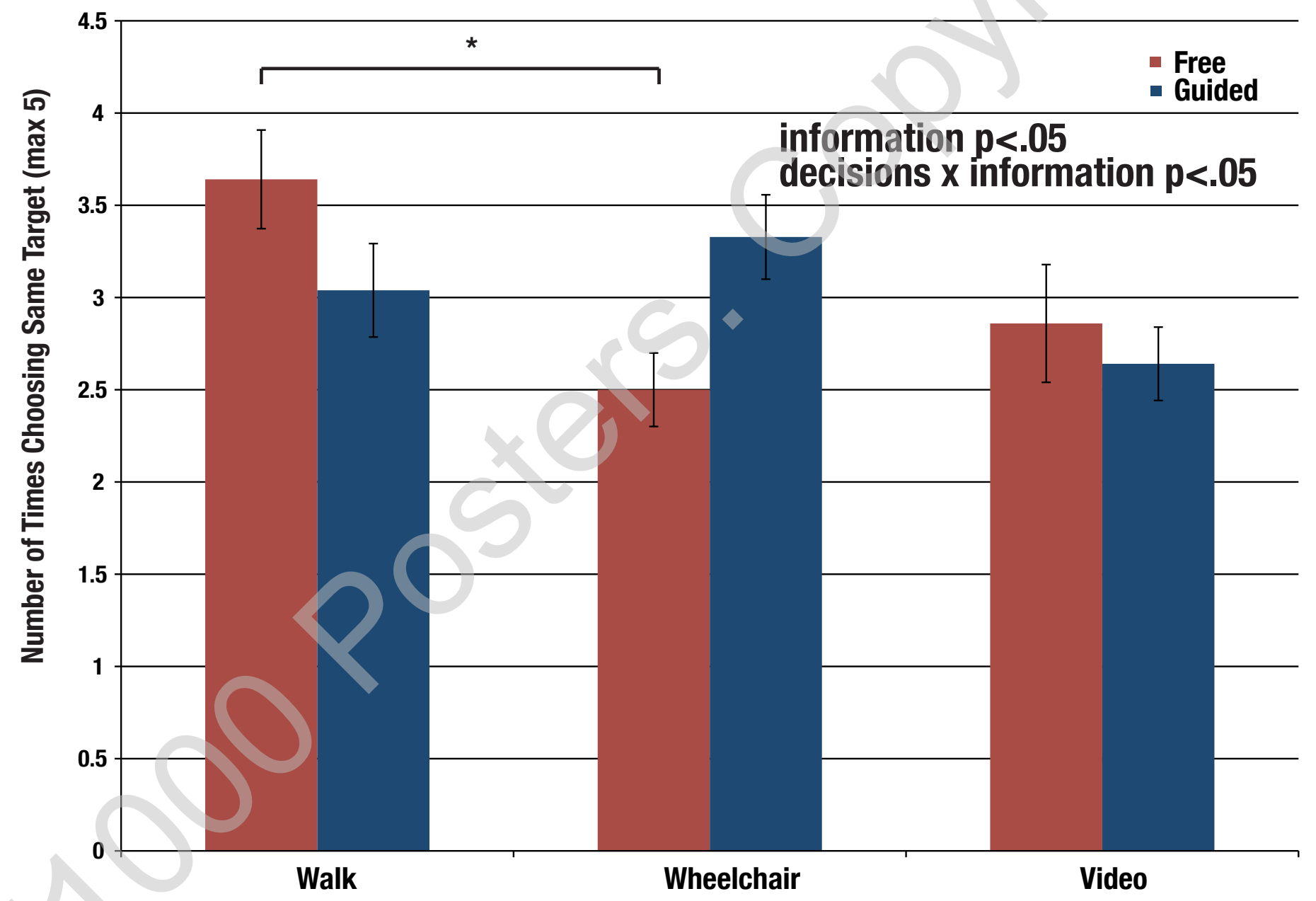
## Results

### Proportion Correct



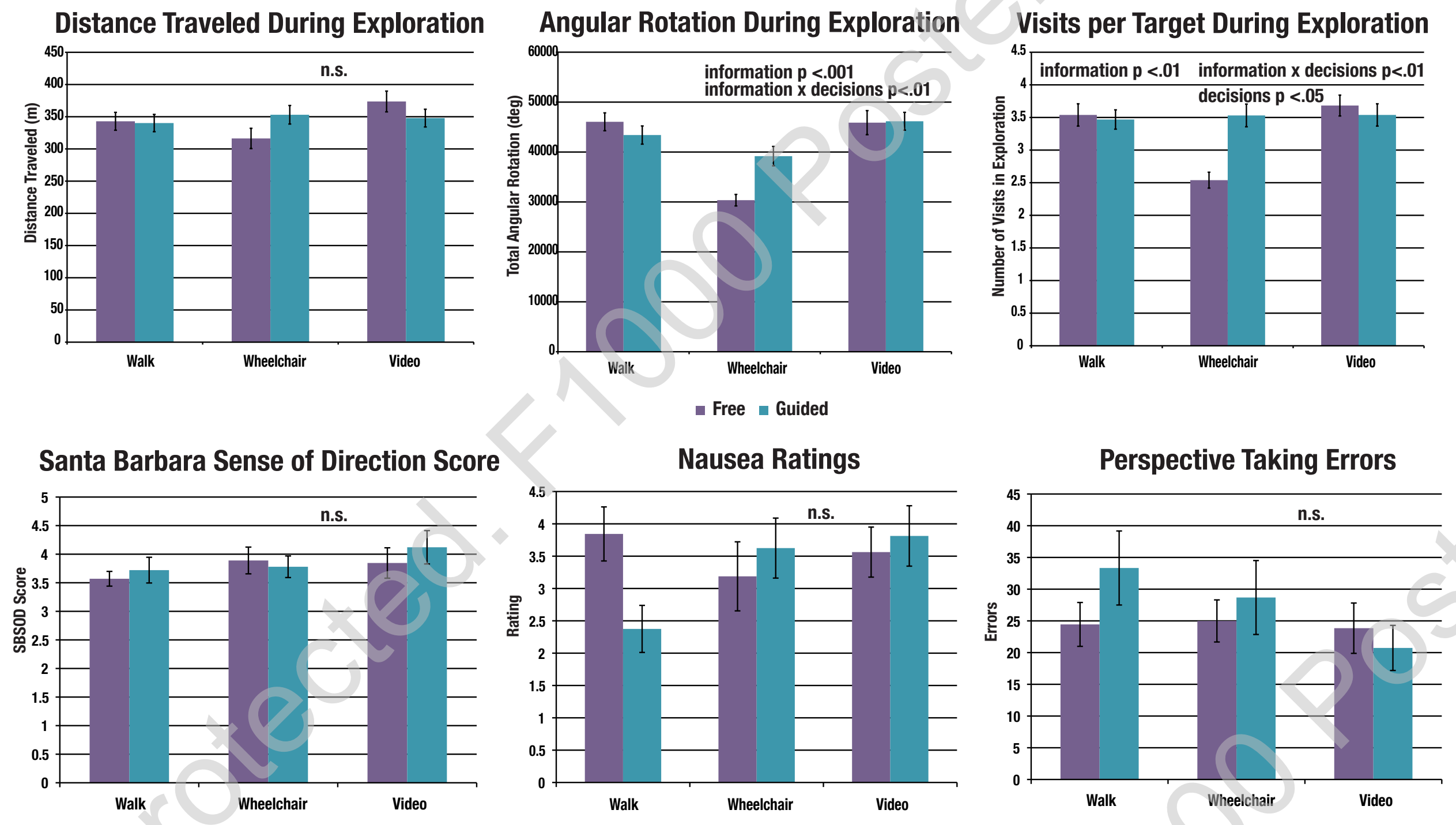
- Free Walking yields better route learning overall (trend)
- Decision-making interferes with route learning in the Free Wheelchair condition, in the absence of motor/proprioceptive information (interaction p<.05)
- Otherwise, purely passive Guided Video yields least route learning overall (trend)

### Consistency



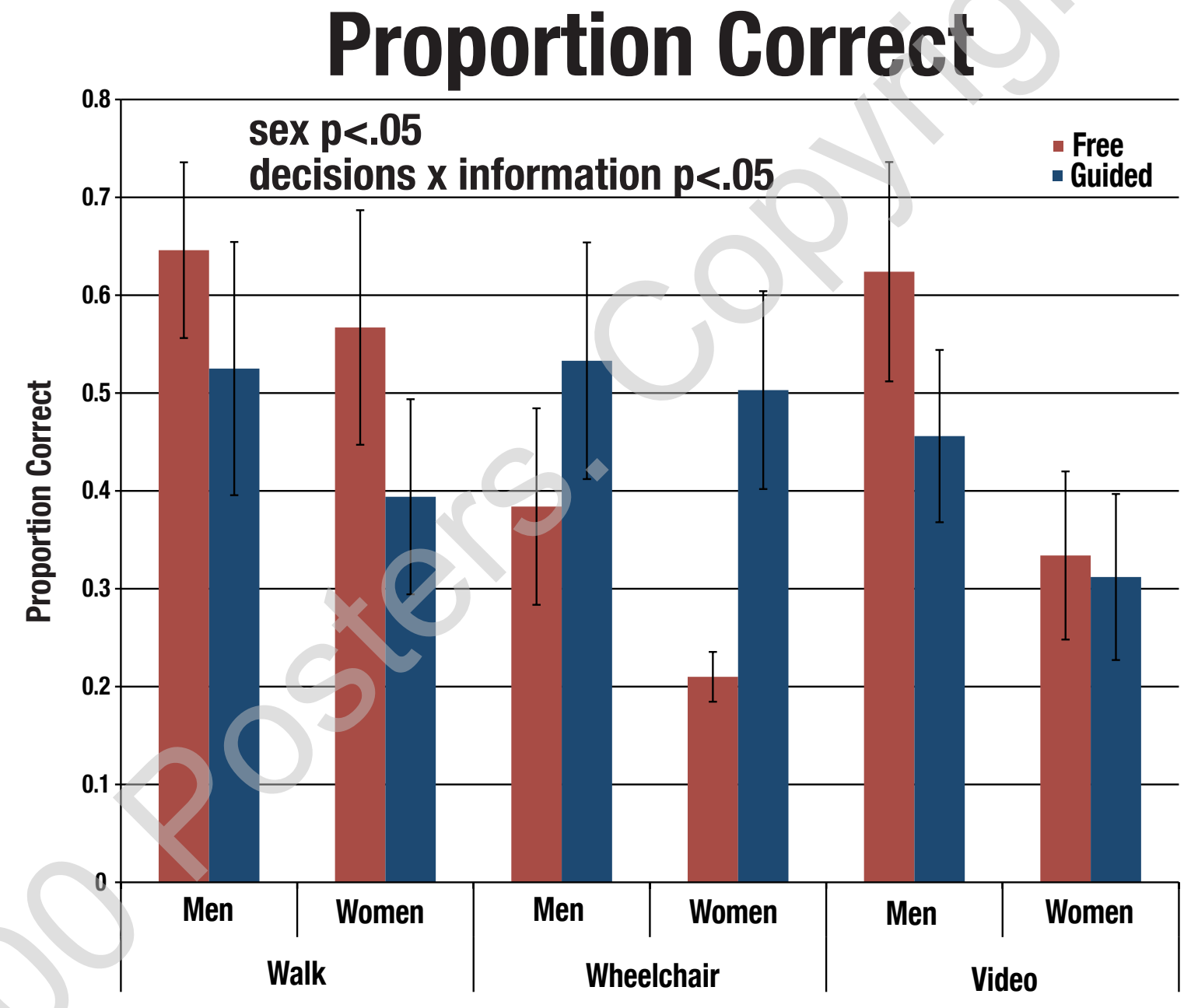
- Number of trials (out of 5) that participant returned to same object, even if not correct
- Free Walking yields more consistent performance, with video conditions less consistent (main effect of information p<.05)
- Decision-making interferes with route learning in the Wheelchair condition (interaction p<.05)

### Group Analysis

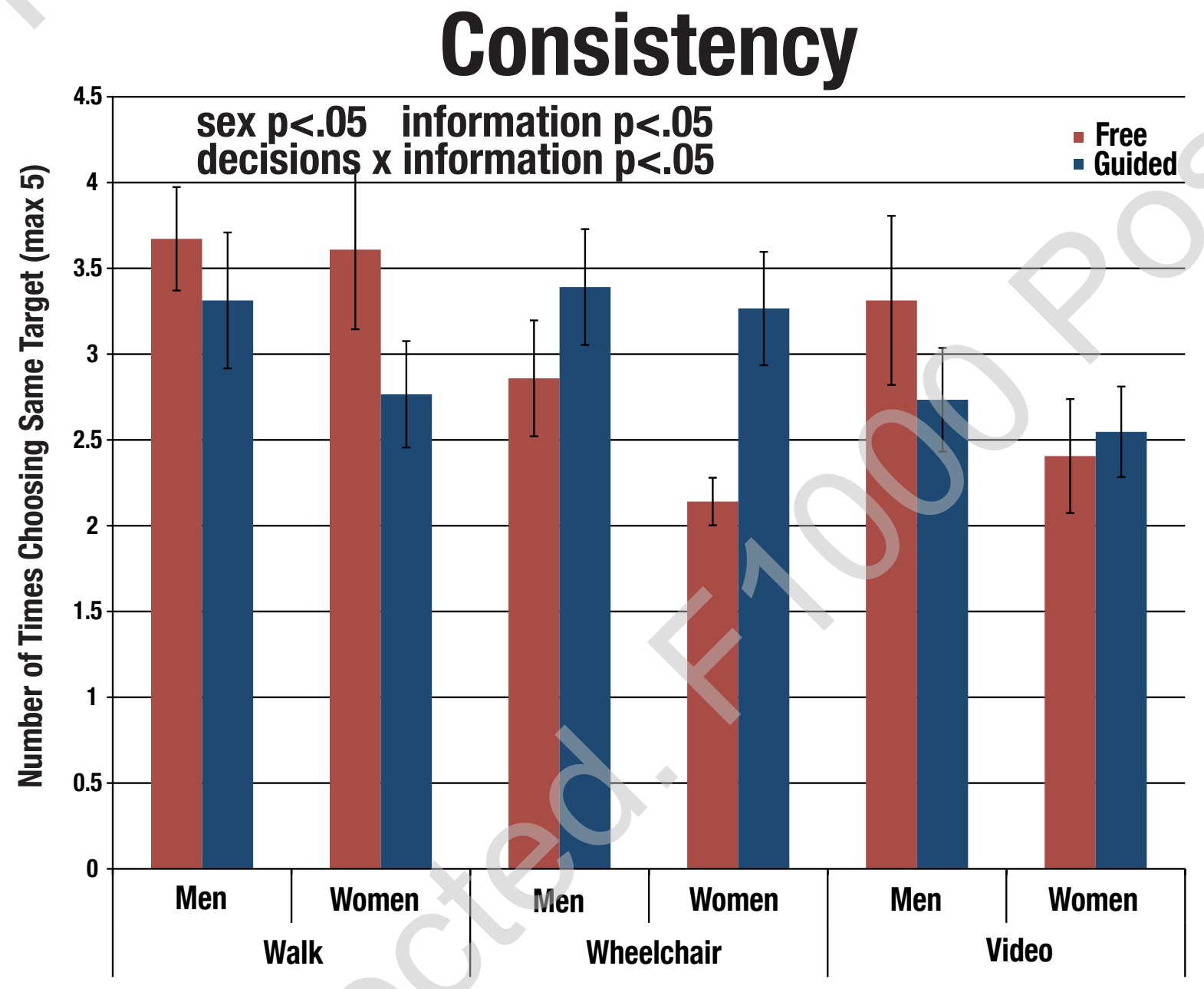


- No group differences in individual measures
- Groups do not differ in distance traveled during exploration
- Free Wheelchair group rotated less and visited fewer objects during exploration

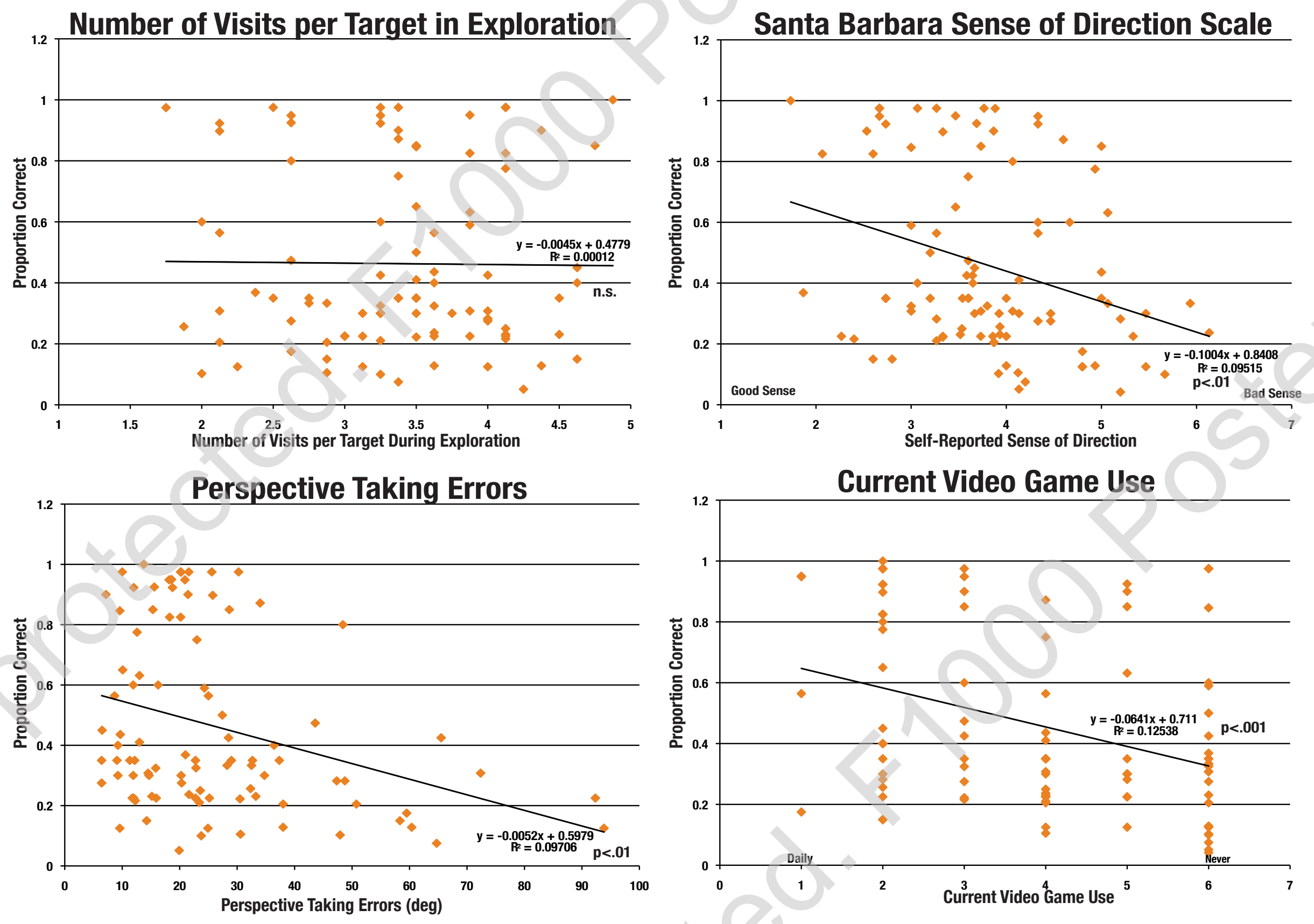
### Sex Differences

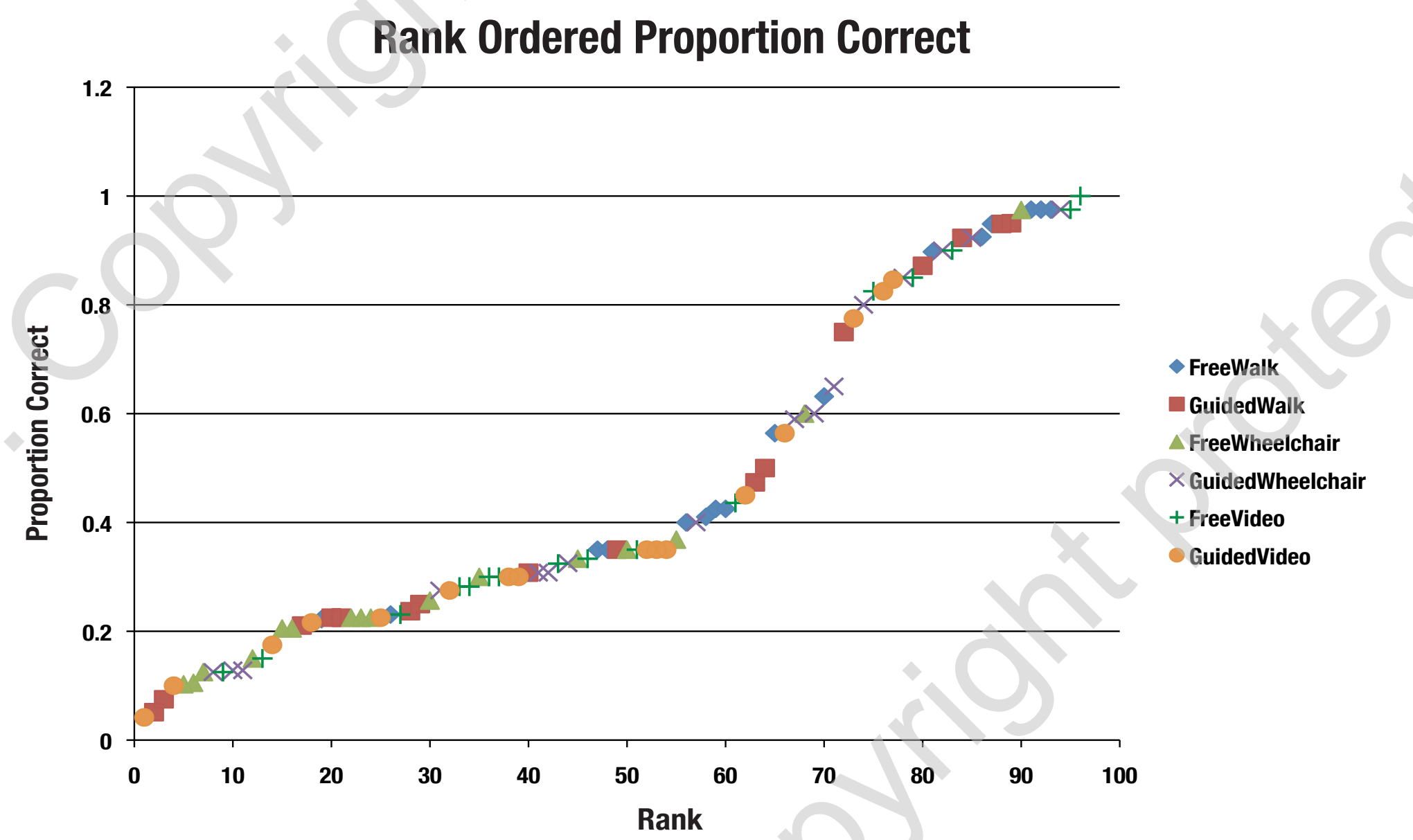


- Main effect of sex (p<.05)
- Interactions of decisions X information are significant in females only (p<.05)
- Similar patterns, but decision manipulation is more pronounced in women than in men



### Individual Differences





- Route learning ranges from chance to near-perfect learning
- Most learn a few routes, but do not learn the entire maze
- Free Walk seems to prevent very poor learning
- Route learning is correlated with sense of direction, video game use, and perspective-taking errors, but not with visits to targets

## Conclusions

- Decision-making contributes to route learning, but only when paired with full idiothetic information
- This effect is stronger in women, who tend to learn routes less well overall
- Route learning is correlated with some individual difference measures, but not with pattern of exploration
- Role of attention?

## References

Hegarty et al. (2002). *Intelligence*, 30, 425-447.
Hegarty & Waller (2004). *Intelligence*, 32, 175-191.
Waller et al. (2007). *Psych Bull Rev*, 10, 987-993.
Wilson & Peruch (2002). *Curr Psych of Cog*, 21, 601-633.

Supported by NSF BCS-0214383 and BCS-0843940
Poster 36.405          chrastil@brown.edu