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Facilitation of Learning Spatial Relations Among Goal Locations Does Not Require Visual Exposure to the Configuration of Goal Locations

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Introduction

- **Types of Spatial Information**

- ***Landmark-based Information***

- Permits learning a location and orientation by using objects in the environment with known positions (Gallistel, 1990).

- ***Geometric Information***

- Permits learning of location without reference to discrete visual landmarks but instead to the geometric properties of the surrounding enclosure (for a review, see Cheng & Newcombe, 2005)

Introduction

• Explanations of Spatial Learning

○ *Unitary System Accounts*

- *Associative based*
 - *Chamizo, 2003*
 - *Graham, Good, McGregor, & Pearce, 2006*
 - *Miller & Shettleworth, 2007*
 - *Pearce, Graham, Good, Jones, & McGregor, 2006*

○ *Dual-Systems Accounts*

- *Separate Feature & Geometry based systems*
 - *Cheng, 1986*
 - *Cheng & Newcombe, 2006*
 - *Gallistel, 1990*
- *Separate Landmark & Boundary based systems*
 - *Doeller & Burgess, 2008*
 - *Doeller, King, & Burgess, 2008*
 - *Burgess, 2006*

Introduction

- **Discriminating between Unitary- and Dual-systems accounts**
 - Cue Competition
 - For example
 - Blocking
 - Overshadowing
 - Existence of competition between spatial cues suggests they are processed by the same learning system
 - Absence of competition suggests they are processed by separate learning systems

Introduction

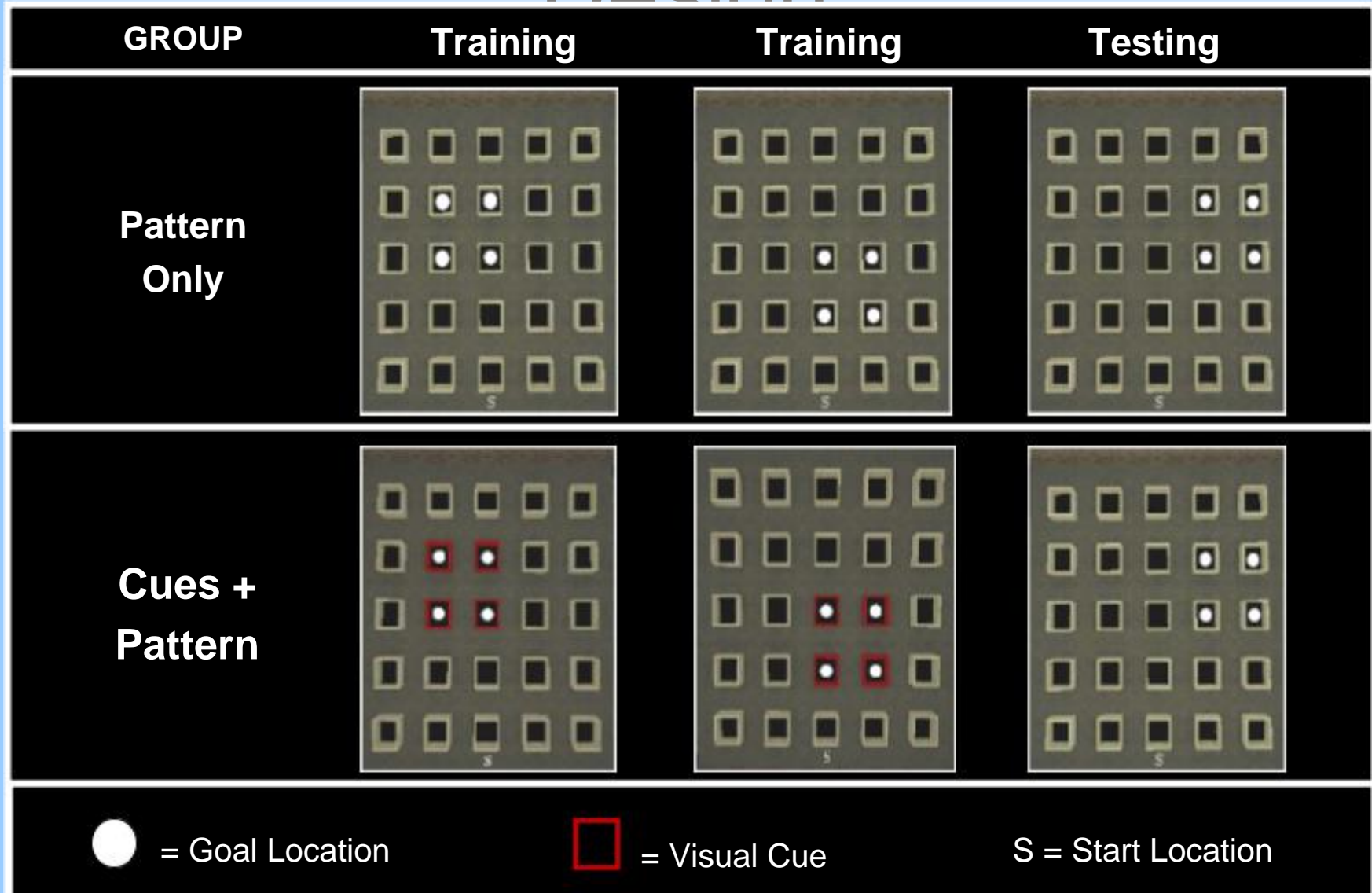
- Dual-systems models predict immunity of either geometry or boundary learning to cue competition
- Dual-system models as well as standard associative accounts predict cue competition among landmarks.

Introduction

- Sturz, Brown, & Kelly (2009)
 - Search task in which the spatial relations among goal locations were learned
 - Location of goals varied unpredictably across trials but always maintained consistent spatial relations to each other.

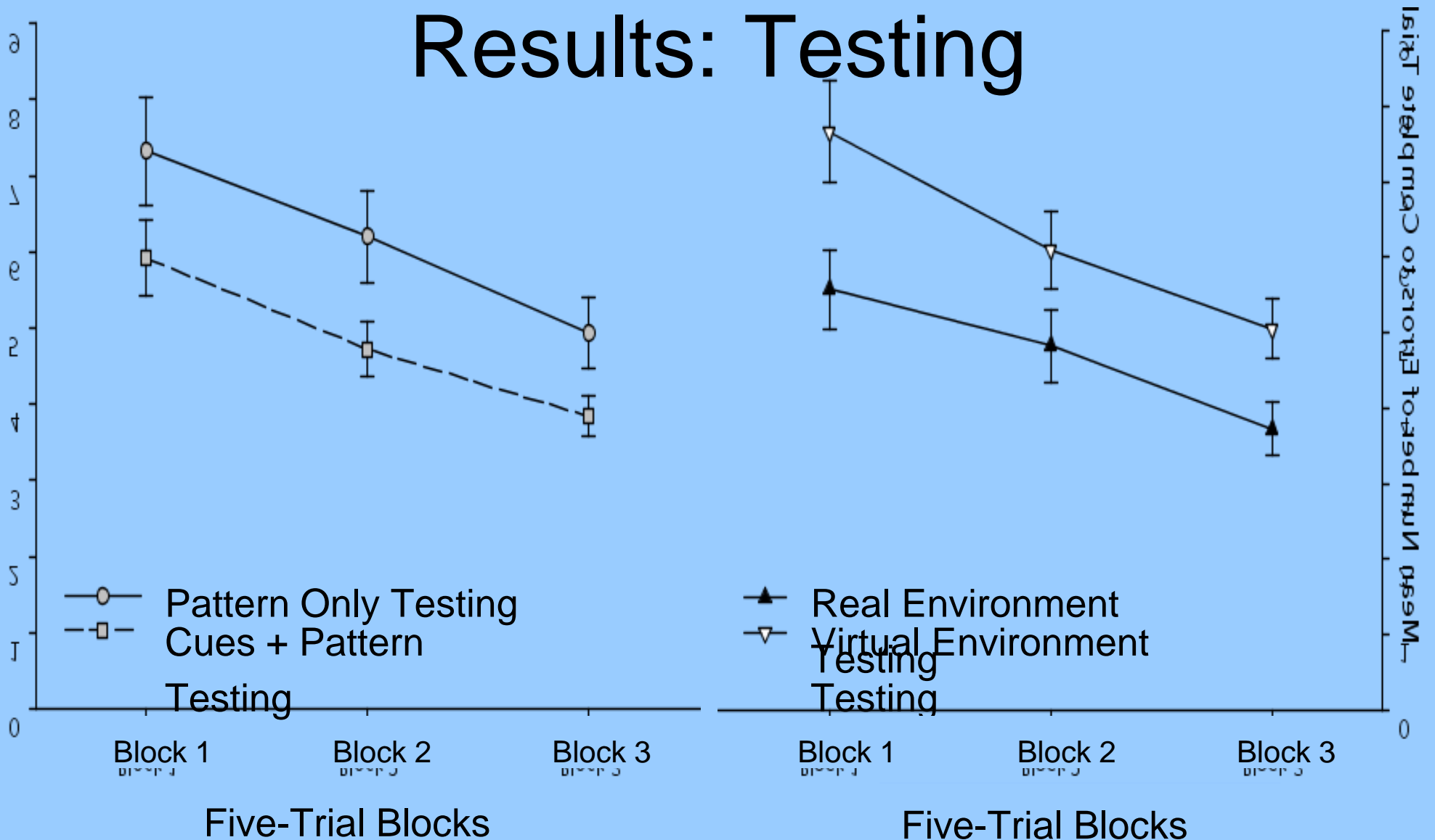
Sturz et al. (2009)

Design



Sturz et al. (2009)

Results: Testing



Sturz et al. (2009)

Conclusions

- The presence of the visual cues was not detrimental to learning the spatial relations among locations.
 - No evidence for cue competition
- Previous failures to obtain cue competition have been accounted for by dual-system models, however neither of these models can account for these results
 - Both environmental geometry and distance from boundaries were rendered irrelevant
- Results suggest that these theories must be revised to include spatial relations among locations and their immunity to cue competition

Alternative Explanations

- Two alternative explanations for our earlier finding of facilitation of learning spatial relations among locations by visual cues may be consistent with predictions derived from both unitary- and dual-systems accounts:

1. Verbal Coding Strategy

- Participants in Cues + Pattern Group Utilized a verbal label such as “square”

2. Associative Cue Potentiation

- Process that results from coincident cues and produces mutual enhancement of the saliency of those cues

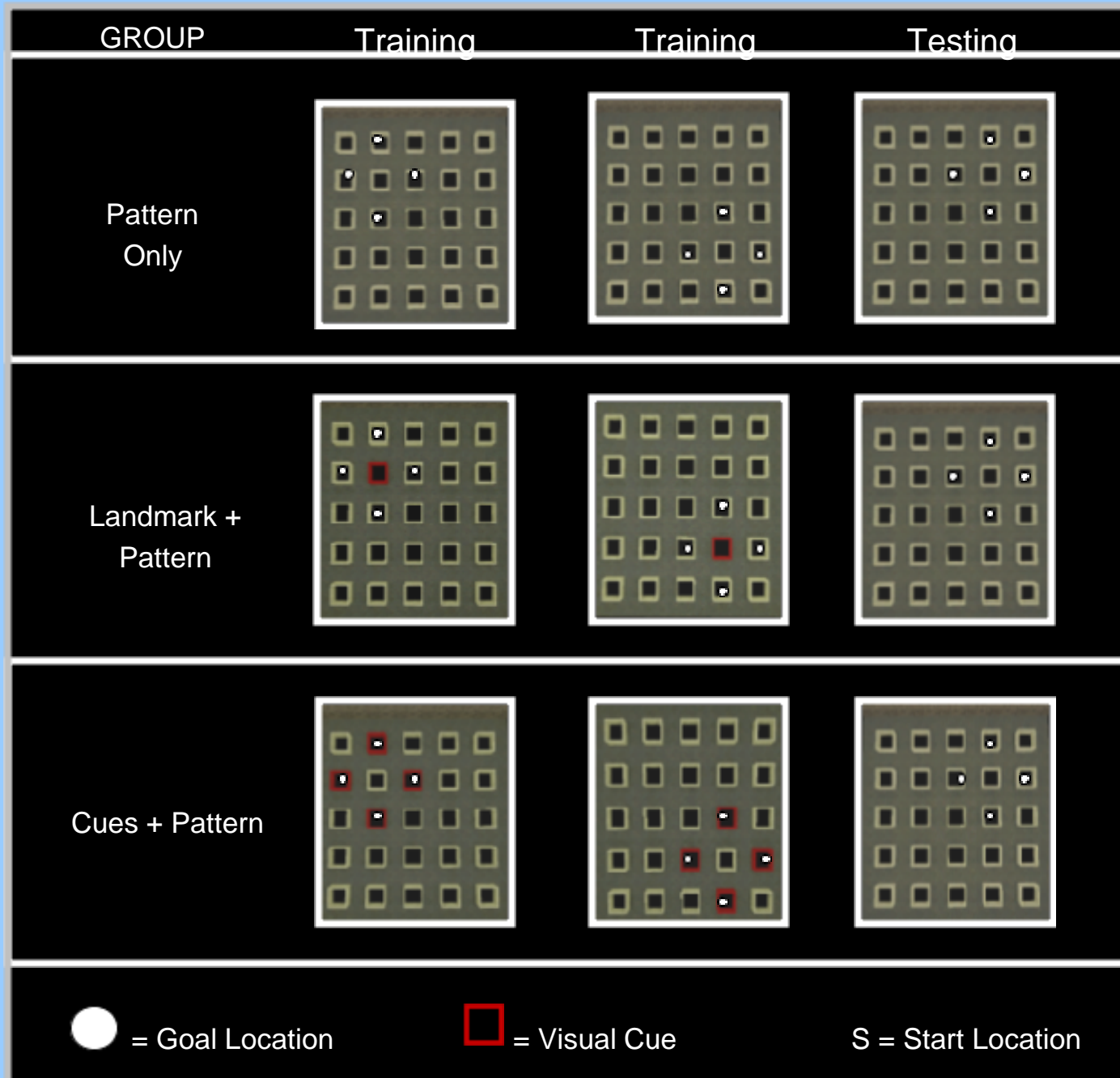
Present Experiment

- We tested these alternative explanations of facilitation by dissociating visual cues from goal locations during training.

Present Experiment

- Cues + Pattern Group
 - Trained in the presence of visual cues that marked goal locations
- Landmark + Pattern Group
 - Trained with a single cue at the non-goal location in center of pattern
- Pattern Only Group
 - Trained in the absence of these visual cues
- All groups were then tested in the absence of visual cues

Design



Present Experiment

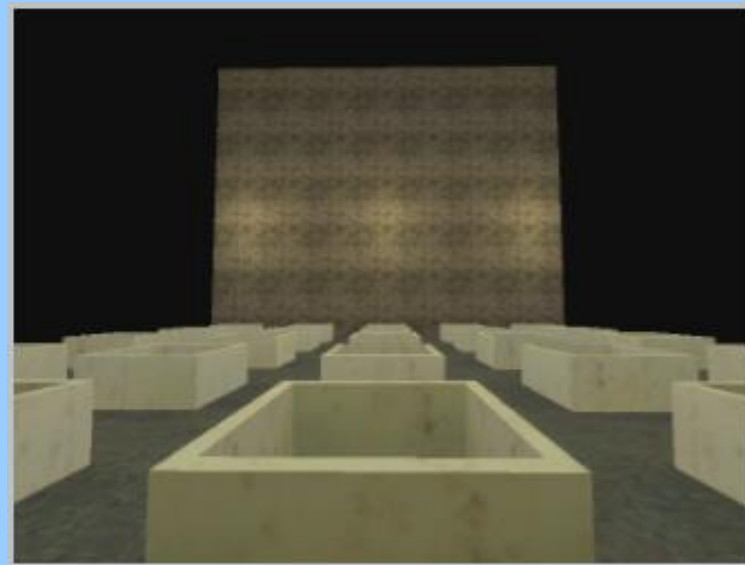
- According to unitary-system models the group trained with the visual cue(s) should learn less about the spatial relations among goal locations
- Like a unitary-system model, both dual-systems models also predict participants trained with the visual cue(s) should learn less about the spatial relations (as geometry and environmental boundaries were rendered irrelevant).

Present Experiment

- If evidence for facilitation of learning spatial relations among goal locations by visual cues is obtained for participants in the Landmark + Pattern group and the performance of this group does not differ from that of the Cues + Pattern group, such evidence could not be explained by verbal coding based on visual exposure to the configuration of goal locations or associative cue potentiation.

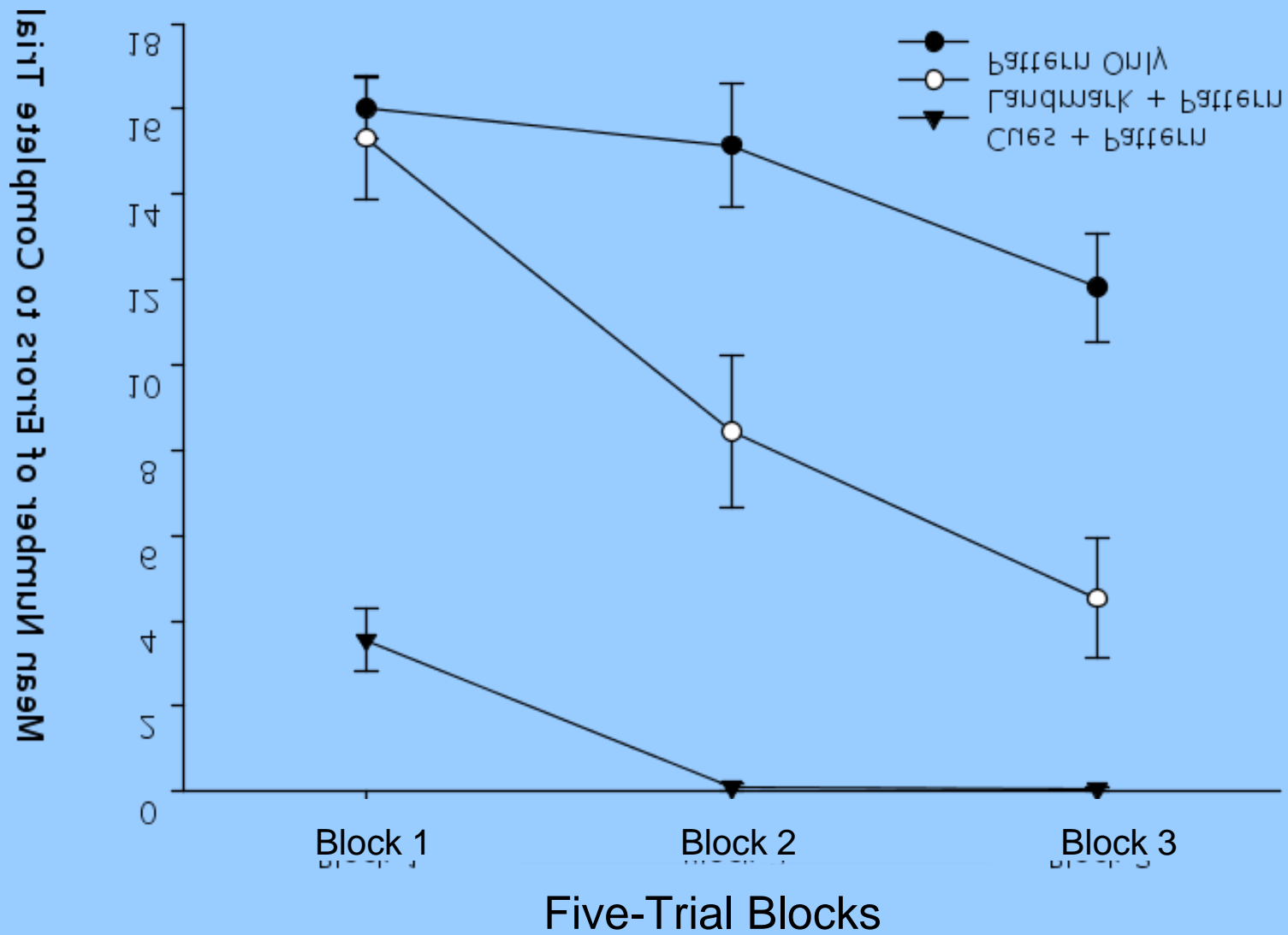
Present Experiment

- Virtual Open Field
 - 5 x 5 grid of raised bins
- Participants
 - 60 undergraduates (30 male, 30 female)
- Three Groups
 - Pattern Only (n=20)
 - Landmark + Pattern (n=20)
 - Cues + Pattern (n=20)
- Procedure
 - Training (15 Trials)
 - Participants searched for four hidden goal locations
 - Goal locations were arranged in a diamond pattern
 - The pattern moved to a random location from trial to trial
 - Differential auditory feedback was received for correct and incorrect choices
 - Testing (15 Trials)
 - Participants searched for four hidden goal locations
 - Goal locations were arranged in a diamond pattern
 - The pattern moved to a random location from trial to trial
 - All goal locations were unmarked during Testing for all groups
 - Differential auditory feedback was received for correct and incorrect choices

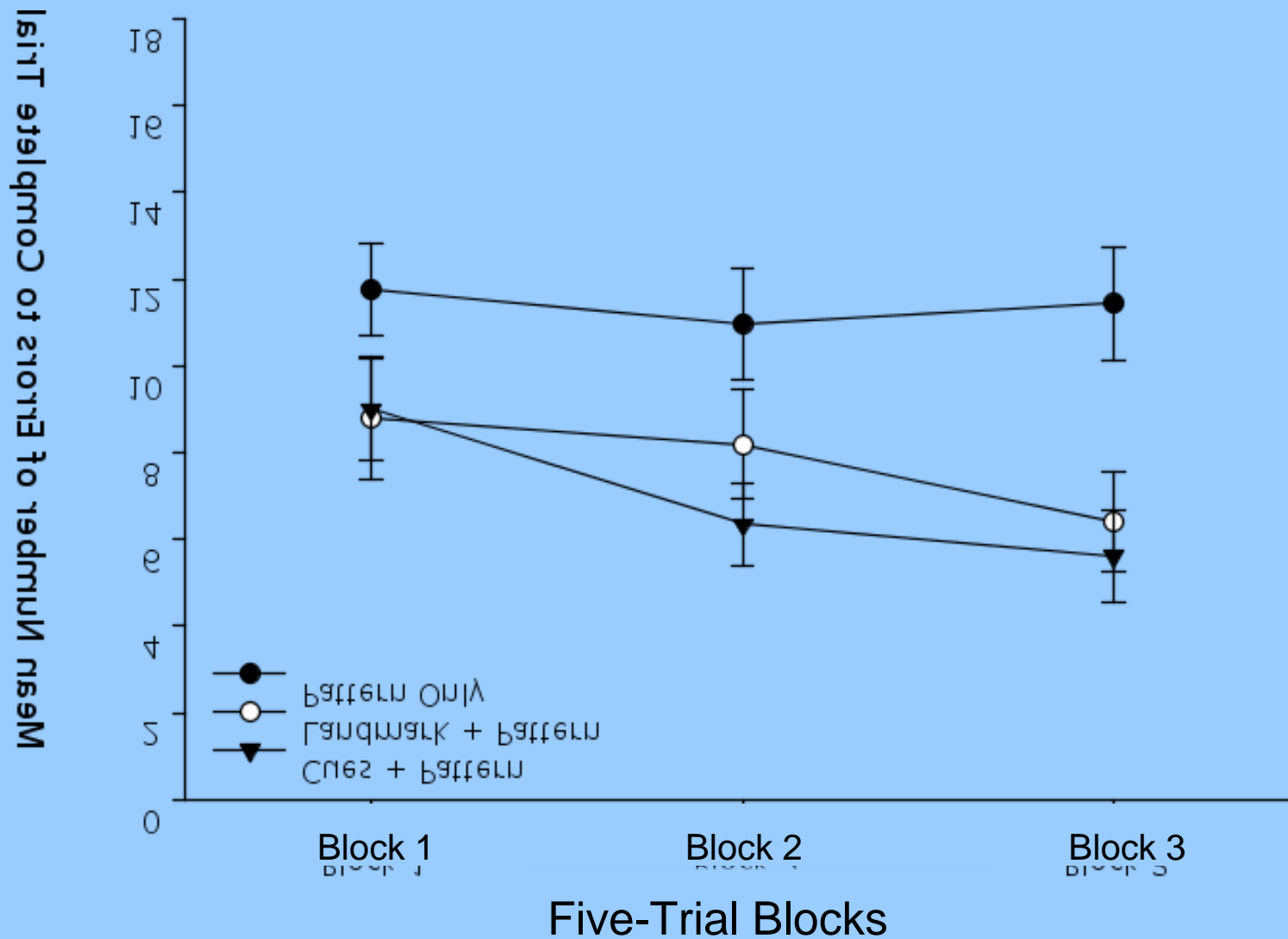


S

Results: Training



Results: Testing



Results: Testing

- ***Group Comparison***

- Cues + Pattern ($M = 6.99$, $SEM = 1.13$)
- Landmark + Pattern ($M = 7.79$, $SEM = 1.18$)
- Pattern Only group ($M = 11.39$, $SEM = 1.13$)

Conclusions

- The presence of the visual cue(s) was not detrimental to learning the spatial relations among locations.
 - No evidence for cue competition
- Previous failures to obtain cue competition have been accounted for by dual-system models, however neither of these models can account for present results
 - Both environmental geometry and distance from boundaries were rendered irrelevant
- These results that visual exposure to the entire configuration of goal locations is not responsible for the facilitation effect.
- Results suggest that these theories must be revised to include spatial relations among locations and their immunity to cue competition

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