Interacting Memory Systems: Using Attentional Cues to Enhance Learning

Natasha Avis
UC Santa Barbara

Maria Borja
UC San Diego

Ana Beth Van Gulick
Vanderbilt University

TA: Robert Lindsey
University of Colorado, Boulder

TDLC Bootcamp Group Project
22 August 2009
Background & Motivation

• In a complex visual environment there are many competing stimuli
• Must decide which stimuli are most important and should be attended
  – Ex. Control console in an airplane
• Experts are better at this than novices
• How can novices best learn to make these decisions like an expert?
Previous Research

• Computer system “RADAR” makes decisions for novices the way an expert would to play a military action game

• RADAR-controlled novices are more successful than control novices
  – Navigate the environment better
    • Use context dependent cues
  – Less likely to run out of gas etc.
  – More Kills

Love et al, 2008
Previous Research

Love et al 2008
The Big Plan

• Eye movements contain important information for navigating a given context
• Encouraging attention shifts in the pattern of the solution to a problem encourages problem-solving
• Implicit perceptual cues to attention can help participants learn a problem-solving task (Grant & Spivey, 2003; Thomasa & Llerasb, 2009)
• Building a model of visual attention and learning
Question for Current Study

• Will directing eye movements to the target in visual search task enhance learning of context-target pairs?
• Will expert-like visual cues help or hinder learning context-target pairs, or have no effect?
The Current Study

• Use eye tracking to observe participants visual search patterns and latency to target detection
• 1-to-1 match texture-color pairs to be learned over the course of the experiment.
  – 10 pairs
  – Each texture shown with target color square and 3 distracter color squares
• Target Square was cued in some trials
  – 5 pairs cued target during training – ALWAYS cued in TRAINING BLOCKS
  – 5 pairs uncued target during training – NEVER cued
• 16 training blocks (15 included in data)
• 4 test blocks in which no targets were cued – ALL TRIALS

Texture 1  Color 1  Texture 2  Color 2
Experiment 1

- Target cue = 100ms early onset of target square prior to onset of distracter squares
- Target reinforced with 500ms late offset after offset of distracter squares
Experiment 1

Fixation

+ 500ms

Texture

100ms

Target

Response

Single Cued Trial

500ms
Experiment 1 Results

No change in mean search time due to cues

Mean Search Time in Training Blocks

N=5

\[ p=0.50\]

Mean Search Time in Test Blocks

\[ p=0.48\]
Experiment 1 Conclusions

- Perceptual cues of this type did not enhance learning
- Visual cues may not have been salient enough
- Experiment 2 uses a different cue type
Experiment 2

- Target Cue = Target shown at 40% saturation for 50ms before shown at 100% saturation.
- Target and distracters have common onset
- Distractors always shown at 100% saturation
Experiment 2

Fixation

Texture

500ms

+ Less Saturated Target

50ms

Response

500ms

Single Cued Trial

Target
Experiment 2 Results
Training: Cued & Uncued Trials

*N=7

* = p< 0.001
Sample Eye Paths

Uncued Trial
Single Sample

Cued Trial
Single Sample

• Faster for cued trials
Experiment 2 Results
Test: Cued and Uncued Trials

\[ p = 0.1757 \]
Experiment 2 Results
Mean Search Time, Training and Test

Mean Search Times in Training Blocks

Mean Search Times in Test Blocks
Experiment 2 Results
Search Times in Test Blocks

N=7

Histogram of search times in test blocks

Uncued
Cued
Experiment 2 Results

Bubbles are an awesome texture!
Textures

Bubbles
Experiment 2 Results
Target Location Matters

Counter-clockwise searching?

Test and Training Blocks: N=17

Top Left
Bottom Right
Bottom Left
Top Right

Mean Search Time (ms)
Experiment 2 Conclusions

• No evidence that cues enhanced learning of context-object pairs

• Cues did confer a difference when present during training but not during test
  – Cues may only be effective when present: do not encourage any learning only draw attention
  – By test, pairs may be overlearned so that cued/uncued trail type is irrelevant

• This could be due to our small sample size, methodology such as cue type or task, or the nature of learning and memory mechanisms
Future Directions

• The current study was one of many future pilot studies

• Next, we’ll try:
  – Targets as locations (not colors)
  – Changing the instructions

• End goal:
  – Have a model of an experts eye movements
  – Use the model to cue novices in order to enhance learning
Thanks!

• Temporal Dynamics of Learning Center and National Science Foundation
• Gary Cottrell and Andrew Kovacevic
• Michael Mozer
• Fellow Bootcampers