Hemifield-Specific Offline Learning of Coherent Motion Detection

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Goal
Demonstrate the existence and specificity of offline learning for subtle motion detection

Background

Visual perceptual learning
- With practice, novice observers can become experts at subtle visual discriminations
- Some perceptual learning is specific to the trained stimulus features, while other learning general (See talk #54H5 this afternoon!)

Coherent Motion Detection
- Discriminating patches of coherently moving dots from patches of randomly moving dots
- Performance known to improve with practice (e.g., Ball & Sekuler, 1987)
- Learning occurs in area V3A (Shibata et al., 2012)

Offline Learning
- Most tasks improve over the course of practice, but perceptual task improvement can sometimes occur after practice has ended
- Offline consolidation of motion coherence learning has been shown (Ashley & Pearson, 2012), but offline learning has not been demonstrated

General Procedure

Day 1
- Pre-test
- Training (8 or 10 blocks)
- Final 3 blocks

Day 2 (Post-test)
- Unattended Motion
- Trained Feature
- Post-test (5 blocks)

Ex. 1 – Central Motion

Task (Based on Shibata et al., 2012)
- Two patches of moving dots appear in succession
- One patch is random, one has some coherent motion (2-IFC)
- Coherence held constant at individualized 72% threshold (Quest procedure)
- Two motion directions (blocked): Trained and Untrained (90° CCW of trained)

Results

Untrained Direction Trained Direction

Accuracy (%)

50 55 60 65 70 75 80 85 90 95 100

Pre-Test Post-Test Pre-Test Post-Test

T

Offline learning may be specific to the Trained direction
- Improvement from end of training (avg. of last 3 blocks) to Post-Test (avg. of 3) for the Trained direction (t(8)=2.434, p=0.041*)
- No learning during training (F(7,56)=0.36, p=0.923)
- No statistically significant learning between the Pre- and Post-Test (avg. of 3) for the Untrained direction (t(8)=1.379, p=0.205)

Ex. 2 – Peripheral Motion

Task
- Two patches of moving dots appear simultaneously
- Attended patch has random motion on 50% of trials, coherent motion on 50%
- Coherence held constant at individualized 72% threshold (Quest procedure)
- Two visual hemifields: Trained and Untrained (side counterbalanced)

Results

Untrained Hemifield Trained Hemifield

Accuracy (%)

50 55 60 65 70 75 80 85 90 95 100

Pre-Test Post-Test Pre-Test Post-Test

T

Offline learning may be specific to the Trained hemifield
- Improvement from end of training (avg. of last 3 blocks) to Post-Test (avg. of 3) for the Trained hemifield (t(8)=2.707, p=0.027*)
- No learning during training (F(9,72)=0.72, p=0.686)
- No statistically significant learning between the Pre- and Post-Test (avg. of 3) for the Untrained hemifield (t(8)=1.686, p=0.199)

Summary

- Offline learning contributes to improved motion detection performance
- Offline motion detection learning may be specific to the Trained motion direction
- Offline motion detection learning may be specific to the Trained visual hemifield
- Further work is needed to determine the relative contributions of sleep and wake to offline motion detection improvement

Implications

- Offline learning may be present in a wider variety of perceptual tasks than previously known
- It may be possible to record from area V3A after learning in order to examine the exact mechanisms of feature-specific offline learning

References


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