Differential effects of aging on a visuomotor paradigm.

Lee A. Baugh & Jonathan J. Marotta

Perception and Action Lab

Department of Psychology, University of Manitoba

UNIVERSITY OF MANITOBA

Introduction

The present study describes the use of a viewing window paradigm[1] to examine the effects of aging in a complex visuomotor adaption task.

There has been little consensus as to whether age-related visuomotor adaptation effects are present. Some studies have found slower adaptation and/or reduced overall levels of adaptation[3]. In contrast, other methodologically similar studies have found no such evidence of aging effects on adaptation[2].

By using a complex, realistic, goal driven task, a further understanding of the effects of aging on visuomotor adaptation is provided.

Experiment 1

Purpose

To examine the effects of aging on a task requiring visuomotor adaptation.

Method

Participants

Twelve young (2 male, mean age = 22, SD = 4.6), and eight aged (1 male, mean age = 68, SD = 4.4) individuals participated. All subjects were right handed, and had normal or corrected-to-normal vision.

Stimuli

Digital images were modified using a Gaussian blur algorithm. This procedure resulted in two distinct images of each object.

Example Images

Clear Image Blurred Image

The Viewing Window

The "window" is a circular region, controlled by a touchscreen monitor, which allows participants to move the window via a stylus held in their dominant hand.

Viewing Window Example

Procedure

Three visuomotor "flip" conditions were created for the identification task by varying how the participant's body movements affected the onscreen movement of the viewing window.

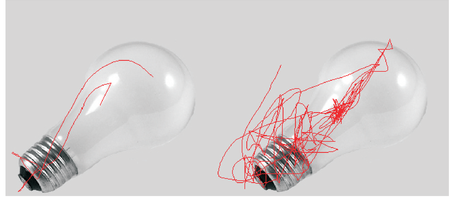
Movement Type	X-Axis Body Movement	Y-Axis Body Movement
Normal	Remains Veridical	Remains Veridical
Full Flip	Results in opposite on-screen movement	Results in opposite on-screen movement
Flip in X-Axis	Results in opposite on-screen movement	Remains Veridical
Flip in Y-Axis	Remains Veridical	Results in opposite on-screen movement

Results

Sample Scanpaths

When no visuomotor transformation was required, aged participants engaged in more scanning of the presented object when compared to younger controls.

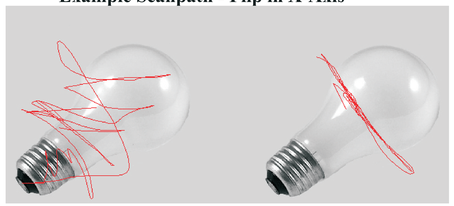
Example Scanpath - No visuomotor flip



Control Aged

When a visuomotor transformation was required, aged participants had greater difficulty adapting to the new relationship of body movement and window movement.

Example Scanpath - Flip in X-Axis



Control Aged

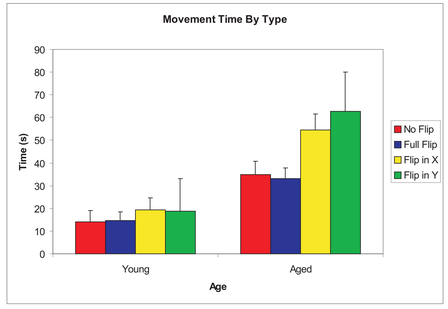
Overall, inspection of the scan-paths revealed aged participants had a tendency to re-visit areas of the image previously explored.

Movement Time

1) Aged participants spent significantly longer identifying the object than did the younger control subjects.

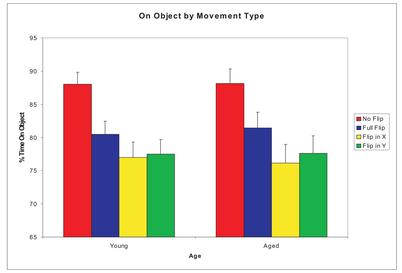
2) During a full-flip, aged participants had movement times approximately equal to the no-flip condition.

3) Aged participants displayed a significantly larger effect of both the Flip in X-Axis and Flip in Y-Axis conditions than did the younger control subjects.



On vs. Off Target

A second analysis was conducted examining the percentage of total movement time that the viewing window was over the target object:



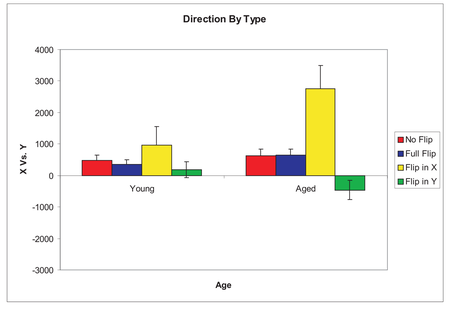
No significant differences between the percentage of "On Object" time with age and visuomotor condition as factors were found.

While aged individuals were taking considerably longer while looking at the object, they were able to both see the boundaries of the presented object and keep the viewing window in a diagnostically useful region.

Movement Direction

Analysis on the primary axis of movement in each of the four visuomotor flip conditions was conducted by taking the summed movement on the X-Axis and subtracting the summed movement from the Y-Axis.

Therefore, positive values indicated a bias to moving the window along the left-right dimension, and negative values indicated a bias towards moving the window along the top-bottom direction.



While not statistically significant (p's = .07 and .12), the data trended in the expected manner:

1) During an X-Axis flip, aged participants were making more X-Axis movement compared to the young controls,

2) During a Y-Axis flip the aged participants were making more Y-Axis movement than the controls.

Additionally, an overall bias towards left-right movement was readily observable.

Conclusions

The present study demonstrates that task performance in a viewing window paradigm decreases as part of the natural aging process.

Aged participants spent longer identifying objects and were differentially affected by both a solitary flip in the X-axis, and a solitary flip in the Y-axis.

Further, in each of the solitary axis flip conditions, aged participants displayed increased movement along the same axis.

Finally, visual inspection of obtained scan-paths revealed aged participants had a tendency to re-visit areas of the image, a pattern not seen in younger controls.

Implications

The current study provides additional evidence in support of theories that posit the mechanisms involved in visuomotor transformations are negatively affected by age.

References

1) Baugh LA, Marotta JJ. A new window into the interactions between perception and action. J. Neurosci. Methods 2007; 160: 128-134.

2) Roller CA, Cohen HS, Kimball KT, Bloomberg JJ. Effects of normal aging on visuomotor plasticity. Neurobiol. Aging 2002; 23: 117-123.

3) Teulings HL, Contreras-Vidal JL, Stelmach GE, Adler CH. Adaptation of handwriting size under distorted visual feedback in patients with Parkinson's disease and elderly and young controls. J. Neurol. Neurosurg. Psychiatry 2002; 72: 315-324.

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