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Saliency of Peripheral Targets in Gaze-contingent Multi-resolutional Displays

Eyal M. Reingold

University of Toronto

Lester C. Loschky

Abstract

The three experiments reported document a slowing of peripheral target acquisition associated with the presence of a gaze-

indistinguishable from a constant high-resolution display (Loschky, McConkie, Yang, & Miller, 2001). However, such a display may not always be feasible, or even needed, for most applications. Thus, most GCMRD human factors research investigates the perception and performance effects produced by perceptible GCMRDs (i.e., displays with abnormalities that are quite perceptible to the user). This second line of work may therefore contribute to our understanding of the operation of the human visual system while laying the groundwork for selecting GCMRD system design characteristics to achieve specified human performance goals.

Experiment 1

This experiment employed a GCMRD with full-motion video and had observers search for a moving ring target. The present study posed the following question: If degraded objects in the visual periphery are less salient than those in the high-resolution window, will viewing a scene completely in low-resolution make it easier to locate a salient peripheral target? Though counterintuitive, this might occur if objects in the high-resolution window competed for attention with the peripheral target, which would be less likely to happen when both the foveal and perip

conditions: 1) all lowpgcresolution, 2) a small window, 3) a large window, and 4)all highpgc resolution.-

luminance of about 60 fL.

raised by 40 to 80% relative to the background. This coloring technique was designed to make target search dependent on the motion of the target (i.e., it would be difficult to discriminate the target from the background in a static scene). There were four directions of target motion: vertically down the left side, vertically down the right side, diagonally down and to the left, and diagonally down and to the right. The backgrounds were 16 video clips of mountainous and desert terrains shot from a moving helicopter, some from a forward-looking vantage point, which contained optic flow cues for forward self-motion, and some from directly above looking down. All background motion was from the top to the bottom of the screen, but never the in the same direction and speed as the target motion-dow 4.5 0right lookin83down. Apparatuing he47eripheral7

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as background imagery and part of the other channel as a window at the participant’ s point of gaze-tracking accuracy had declined, the experimenter initiated a full calibration before the next trial. However, this occurred very infrequently.

3.37, *p*

conting 0 rgindow on the detection eripheral

As is clearly shown in Figure 2, the latency to acquire the target yielded a similar pattern of results. An analysis of variance of the data showed main effects of Filtering, $F(1,59) = 36.58$, $p<.001$, and Windowing, $F(1,59) = 7.72$, $p<.01$, and no interaction, $F<1$. Thus both the presence of the window and the filtering of the periphery caused a slowing of target acquisition.

The results of this study show that both the presence of a window and low-pass filtering of the peripheral target increase the time taken to initiate the first saccade to a peripheral target and to acquire that target. By distinguishing the effects of windowing and low-pass filtering, we can rule out any explanation of the results of resulting in longer initial saccadic latencies found in both experiments. Unfortunately, neither

Experiment 1 nor Experiment 2 provide any way of distinguishperi(eitherre laive to ith t) Tj4018.25 0 TD -029726 Tc 0

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Second, we wanted to see if we could replicate the window effect of Experiments 1 and 2 with a GCMRD using static images. Since both of the above experiments used full-motion video,

Each participant performed in 12 blocks of 72 trials. Across blocks, each of the 288 image-by-target-location combinations appeared once in each of the 3 window conditions (Filtered No-window vs. Sharp--

effect appears to be quite general and was obtained with either moving video (Experiments 1 and 2) or still images (Experiment 3).

We propose an account of the window effect in terms of attentional factors. Specifically, we hypothesize a type of attentional capture caused by the gaze-

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together, the window effect and previous findings showing shorter saccade lengths and longer search times in GCMRDs

Author Note

Eyal M. Reingold, Department of Psychology, University of Toronto; Lester Loschky, Department of Psychology, University of Illinois at Urbana-Champaign.

We gratefully acknowledge David Stampe for his invaluable assistance in programming the experiments and providing input throughout the project, and Steve Ito for ve It.

Figure Caption

Figure 1. Initial saccadic latency and target acquisition latency in milliseconds (mso/ a ( ) Tj 44.25 -25 TD -588967

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Figure 1