Visual Attention; Visual Search

Research has shown that while low-level visual processes happen in parallel, we only really attend to one (or none!) object at a time [1]. In this essay I will present three visual designs and discuss how their effectiveness is influenced by visual attention.

The first example is saliency in advertising. Figure 1 below is a photograph of Times Square at night. Here many advertisers are competing for highest saliency in order to attract your attention, by maximizing the perceptual differences between themselves and the other logos (distractors) [1]. Logos exploit our capability of pre-attentive processing to maximize their effectiveness. Differences in color, motion, orientation, and size are the most effective aspects in guiding visual attention [5]. The Virgin logo for example uses bright colors, is very large, and has a sharp contrast in orientation between the logo and the surrounding horizontal bars. Ironically, the effectiveness of all the logos is decreased due to the large number of distractors [6], causing an "arms race" for perpetual saliency.

Figure 1: Times Square – Saliency Competing for attention

Recently, graphical interfaces for drivers have moved towards heads-up-displays (HUD) [2]. These reduce visual search time since objects within the same field of view can be located more quickly than objects requiring an eye movement [3]. The HUD of Figure 2 demonstrates this by showing current speed and navigation near the center of the screen. Another potential use being investigated is to enhance visual search by priming a user of where the target may be [8]. This would operate by using pull or push cues to draw attention to potentially hazardous situations, such as objects on a collision course or hard-to see objects. However, such displays require careful design not to cause clutter which may distract an operator from the primary task of not

hitting other objects. Visual search efficiency generally depends on the number of objects in the scene [5]. Thus, we should aim to limit the number of objects displayed on the HUD at any one time. A suitable test for the clutter may be to estimate how salient an additional item would be amongst the existing "distractors" [6]. To minimize cognitive load, we may also want to ensure that the HUD takes best advantage of pre-attentive processing [1]. This could be done by choosing unique colors or shapes, or using motion cues such as gradual vs sudden onset [7].

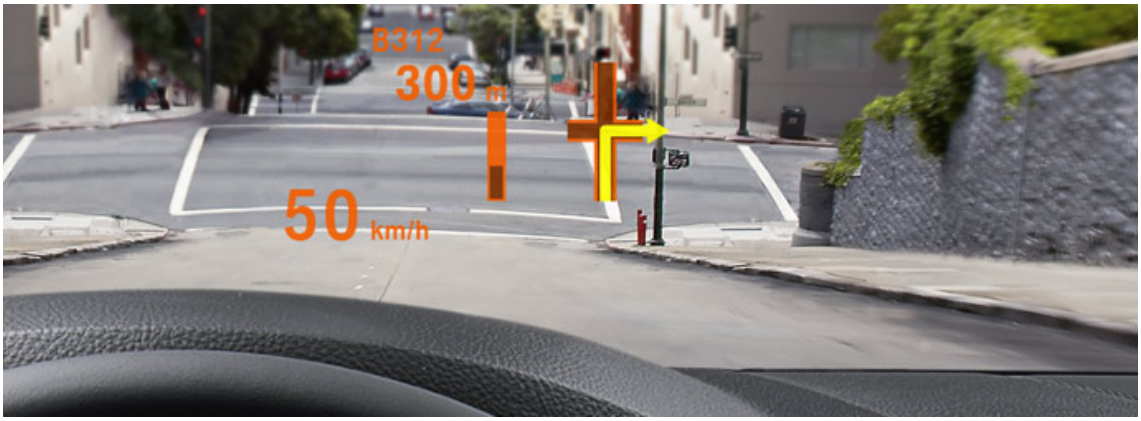

Figure 2: Automotive Heads-Up-Display (HUD)

A third visual design example is the use of depth of field in photography, cinematography, and recently being explored for use in scatter plots [1]. Many professional photographs and movies use narrow depths of field to draw attention to a particular portion of the scene, focusing on the subject and blurring everything else [9]. This works visually by lowering the contrast and saturation of the background, which decreases saliency of the distractors (clutter) and hence increases the saliency of the foreground [6]. It may also act to increase the similarity of all objects in the background, allowing them to be more easily grouped as a single object. It may be possible to use this same technique in an interactive scatter plot, map, GUI, or other display design by helping a user to attend to certain features by blurring items that are not of immediate interest.

This essay has presented how attention can influence the effectiveness of visual designs, with specific examples for advertising, automotive HUD's, and the use of depth of field in art.

References:

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[2] Juliussen (2006). *Display Trends Used in Passenger Cars,* http://www.telematicsresearch.com/PDFs/Display-Trends.pdf

[3] Wood (2005). *Attention Design – Eight Issues to Consider*

[4] Rensink (2011). *The Management of Visual Attention in Graphic Displays.*

[5] Wolfe & Horowitz (2004). *What Attributes Guide the Deployment of Visual Attention and How Do They Do It.*

[6] Rosenholtz et al. (2005). *Feature Congestion: A Measure of Display Clutter.*

[7] Findlater et al. (2009). *Ephemeral Adaptation: The Use of Gradual Onset to Improve Menu Selection Performance.*

[8] Borroz (2010). *GM makes your entire windshield a heads-up-display.* http://www.wired.com/autopia/2010/03/gm-next-gen-heads-up-display/

[9] www.Flickr.com for photos, www.IMDB.com for movie screen shots