Constant Field of View Display Size Effects on First-Person Aiming Time

Josef Spjut,[1,*] Ben Boudaoud,[1] and Joohwan Kim[1]

[1] *NVIDIA, Santa Clara, CA 95051*

[*]*jspjut@nvidia.com*

Abstract: Under constant display field of view, FPS game aiming performance improves with display size, resulting in 3% faster aiming time comparing 13 and 26 inches diagonal.

1. Introduction

In the world of competitive video games, or esports, players compete at the highest levels of skill and seek any potential advantage. Competition in many cases leads humans to meet and exceed the greatest levels of skill and ability. While many factors contribute to this human skill and achievement, in this work we focus on a set of experiments to test the impact of display size [1].

First we study whether display size matters when the physical field of view to the display is held constant by moving the display away from the player as the display size gets bigger from 13-65″ diagonal [1]. Then, another experiment identifies smaller benefits between 25″ 1080p and 27″ 1440p makes a difference in natural gaming conditions [2]. In both cases, we find that the smaller displays result in worse FPS aiming task completion time, though the change in task completion time is relatively small compared to the entire task.

2. Related Work

Some prior work shows that large screens can reduce task time. One study found that larger screens reduced cognitive load and reaction time [3], and others found a similar reaction time improvement for 2D targeting [4], though both studied changing display size and resolution together. Two other studies found that larger screens improved spatial task performance by through improved egocentric spatial perception [5, 6]. In contrast, one study shows that display size has negative effects on 2D targeting performance when resolution and FoV are kept constant [7], and others find no effect on perceptual decision-making times [8]. So while some work has addressed similar questions before, the answer for FPS esports needs more study to resolve.

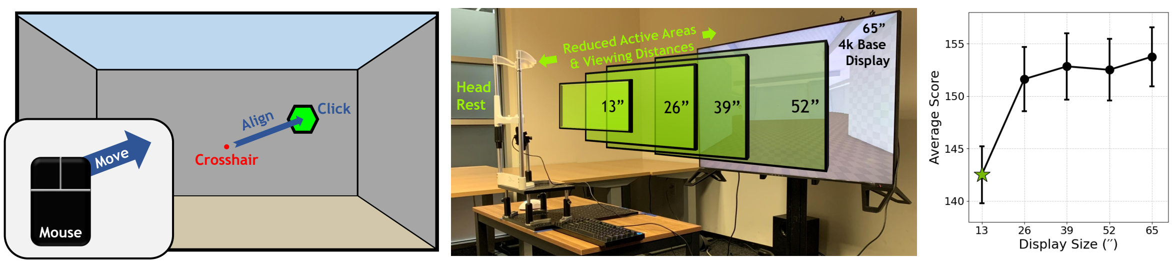

Fig. 1. (Left) A First-Person Targeting task. (Center) Experiment setup maintaining display field of view. (Right) Score calculated out of completion time and accuracy (see [1]) show significant differences between the 13” and all other conditions.

3. Task

As described previously, and shown in Fig. 1, we kept the physical field of view of the display constant by having participants in our study use a chin rest, and move a single display closer and farther away for the different phases of the experiment. We used a single display panel, only showing information on a smaller subset of the pixels to emulate smaller displays – a useful process for keeping display brightness, contrast, and response times constant. Users completed the experiment on each of 5 different display sizes, 13″ , 26″ , 39″ , 52″ , and 65″.

[1]This work was originally presented at SIGGRAPH Asia [1] with additional insight from Spjut et al. [2]

We had each user complete a series of aiming tasks where they move a mouse by hand to place the aiming crosshair over the target before clicking, and we measure the time it takes to complete each task. This aiming task and data collection was implemented using FirstPersonScience [9]. We included 30 gamers results in this study from a range of skill levels, though each player habitually uses a mouse and keyboard for FPS gaming. Each player completed an aiming task to click on a stationary target over 1000 times similar to FPS video games. We refer the interested reader to the full paper for more details on the participants and the specific task.

4. Results

In-depth analysis of results can be found in the original paper [1] and we summarize the main points here. First, we found a significant main effect of display size on score (task time remaining), with the mean score improving with most increases in size. Our post-hoc tests found significant differences between the 13″ and each other display size. We find that a 13″ display is worse for FPS aiming than a 26″ or above, and more minor benefits may be had with even larger display sizes. An alternate interpretation is that viewing a display from too close can penalize FPS aiming performance.

Since the results identified the presence of an effect of display size on FPS aiming time, we considered several possible origins for this effect. We avoid confounding effects of visual acuity by measuring all subjects' Snellen acuity prior to the experiment. We hypothesized that a degradation in peripheral vision through greater (relative) focal disparity in the periphery might create this effect, but reject that theory due to initialization times improving with larger visual eccentricity in our experiment. Personal and display factors may also matter, such as familiarity and apparent pixelation to keep the shown resolution constant (each pixel was shown as 5×5 on the 65″).

5. Conclusion

We demonstrate effects of display size on first-person targeting performance under constant display field of view and resolution. Aiming time improved significantly between 13″ and 26″ displays then continued to improve modestly beyond 26″, though not statistically significance. Our experimental control and analyses rule out individual differences in visual acuity and distance-dependent change in peripheral visual quality as possible explanations. This leaves changes in viewing distance or size, and spatial perception as possible causes of the effect. For gamers, playing on a desktop display in the 25″ to 32″ range provides most of the aiming time benefits we observe.

6. Acknowledgements

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