

## **HCI Study of Crosshair Design: Effects on Accuracy and Visual Comfort in FPS Games**

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December 15, 2025

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### Abstract

This study investigates how crosshair attributes (shape, size, colour) influence shooting accuracy and visual comfort in first-person shooters (FPS). A short online survey ( $N = 6$ ) collected demographic data, crosshair usage, and perceived effects on aim and eye strain. Results show most participants use custom crosses or dots, favouring cyan or yellow for visibility, and report that appropriate crosshairs improve aim accuracy and reduce discomfort (e.g., “Better visibility”, “Better aim”). A literature review links these findings to prior work on visual guides enhancing performance and the role of eye-movement efficiency in expert shooters as well as the reliability of aim-training metrics. Every participant concurred that a universally perfect crosshair does not exist, highlighting the necessity for customizable UI systems. This research provides initial insights into crosshair design as a relevant interface element in HCI and highlights design factors for enhancing usability, visual ergonomics, and the overall player experience. Suggestions for future controlled experiments are examined.

### Introduction

First-person Shooter (FPS) games (like Valorant and Counter-Strike 2) are a major genre in today's world of gaming, especially esports. In this, players fight enemies. It is characterized by fast-paced motor response as well as rapid reaction times. Not to mention that the main aspect of these games is the player's aim on a target that is visually guided by a circular range, simply known as a crosshair. Not very different from the real-world, a crosshair (or a reticle) is a pattern of fine lines or dots in the eyepiece of optical devices such as rifle scopes or binoculars that are used in-game. In simple words, it's usually a cross that helps players estimate where their shots will land. Even though, its typically seen as a cosmetic preference, the crosshair is fundamentally a human-computer interaction (HCI) element, very similar to a cursor in desktop environments but used in 3D dynamic contexts that require precision, attention as well as visual comfort.

From an HCI perspective, crosshairs have a huge influence on usability (accuracy, visibility), ergonomic comfort (eye strain) as well as user experience (engagement, confidence). Prior research shows that FPS games' performance heavily relies on gaze control, visual navigation

and the eye-hand coordination (Yang et al., 2025). This is why most game developers often provide the users with the ability to customize their crosshair based off its color, shape and outlines, in order to achieve the best accuracy results. Yet, little to no research has been performed on how these variations influence the overall experience as well as performance of a player.

For this study, it's important to look at the motivation that stems from both practical player concerns including reduced visibility, limited customizability, eye strain as well as headaches, and the theoretical gaps in current HCI/game-UI literature. To explore this, I collected a few survey responses from FPS players.

After addressing this topic, here are some questions or problems that arise in one's mind. First of all being, 1) does crosshair design affect aiming accuracy in FPS games? 2) How does it influence visual comfort? 2) Is there a universally optimal crosshair, or does it depend on player-preference? 3) Does switching crosshairs or games with different crosshair systems affect our perceived performance? Looking into these, along with the survey, will help study the solutions.

## Literature Review

### **FPS Aiming as a Visual Motor**

Aiming in FPS games is the core skill of pointing your weapon at an enemy to shoot them. Yang et al. (2025) demonstrated that experienced FPS players exhibit extremely intuitive gaze patterns, specifically fewer fixations and faster saccades. These aspects directly improve shooting accuracy. This clearly underscores the role of visual markers like crosshairs.

Jeong et al. (2023) collected gaze data from FPS players (Valorant and AimLab) and reported that highly skilled players show faster reaction times and narrower gaze distributions in controlled tasks. He also found that viewing irrelevant peripheral Heads-Up Display (HUD) correlates negatively with performance.

### **HUD/Interface Characteristics Influence the Player Performance**

Caroux et al. (2022) conducted various experiments altering the physical attributes of HUDs (dimensions, colour) and their semantic structure. They showed that HUD components related to

the main task can influence performance, and that designers ought to meticulously adjust physical attributes like size and colour to prevent unintended distractions. Crosshairs serve as key HUD features in FPS games; the results suggest that the size and colour of crosshairs require thorough consideration in HCI.

### **Visual ergonomics, eye tracking, and QoE in gaming**

According to Nawaz et al. (2024), recent studies utilizing eye tracking and gaming quality-of-experience indicate that visual attention patterns and display characteristics impact subjective satisfaction and perceived quality; an appropriate frame rate and clear visual cues are linked to enhanced user experience and reduced perceptual strain. These general observations suggest that the contrast of the crosshair along with its simplicity may reduce visual search requirements and improve comfort during extended use.

### **Kinematics and Skill Markers in FPS Tasks**

In another research, Warburton et al. (2023) stated and analyzed the skill markers in FPS gameplay, showing differences in movement and control strategies between a player's skill level. His work highlights that aiming in FPS games is not analogous to some static tasks. Instead, it combines the viewpoint rotation, target tracking and precise motor/never control. All of this is possible when using the right crosshair design.

### **Accessibility and Design Guidance for Crosshairs**

Practically, accessibility guidance strongly recommends going for customizable crosshair colors as well as designs to accommodate users with visual differences (e.g. color blindness) and any situational impairments. According to Game Accessibility Guidelines, these design guidelines are echoed in recent accessibility toolkits and industry resources and justify including accessibility as a primary consideration when designing crosshair options.

### **The Real User Experience**

Player communities also actively discuss crosshair design, which offers a deep and direct insight on how gamers interpret the function and placement of crosshairs during regular gaming sessions. One of the most intriguing piece of literature came from a reddit post under r/gaming

(Reddit, 2019), with the title saying: “*FPS Design 101: Crosshairs are supposed to be in the centre of the screen.*” It argues that the crosshair are not simply decorative UI elements but meaningful indicators of weapon direction.

One commenter challenged the assumption that crosshairs must always remain centred, stating: “*Yeah, I'm going to question that. In fact, if I'm playing an FPRPG with guns, I don't want the crosshairs directly in the center of the screen unless I'm actively looking down the sights. When I'm walking around NPCs I don't want to feel like I'm constantly pointing the gun at people.*”

(Reddit user, 2019)

Another user emphasized the functional purpose of crosshairs as indicators of aim:

“*Crosshairs are supposed to indicate where the gun is aiming, surely? That might not be dead center if you aren't looking directly down the sights.*” (Reddit user, 2019)

These community insights highlight two important issues in FPS design:

1. **the semantic meaning of crosshairs** (as in, indicator of weapon direction vs. symbolic aiming aid)
2. **the contextual visibility problem**, where players prefer different reticle behaviours depending on whether they are aiming or freely exploring.

Even though these are not academic resources, such discussions reflect real-world mental models and expectations that influence how players evaluate crosshair usability and comfort, supporting the relevance of customizable or context-aware crosshair systems.

## **Summary of Gaps**

Even though recent work provides strong evidence that gaze dynamics, HUD/UI and skill markers influence FPS performance, very few studies explicitly manipulate crosshair variables and measure the associated comfort that comes with it.

## **Methodology**

### **Design**

Following is the exploratory study of a survey that collects data about crosshair usage, its perceived effects on aiming and eye comfort as well players’ cross-game experiences.

## **Participants**

Six participants (age range 16–25) responded to an online google form created recently. Players reported playing Counter Strike 2, Valorant, and Apex Legends and described varying play frequency from “rarely” to “every day.” All participants used custom crosshairs. No identifying or sensitive personal data were collected. Informed consent was obtained via the online form, stating it was meant for an academic research.

## **Materials**

An online questionnaire including demographic and play-history items, multiple choice and Likert items about crosshair type, color, perceived accuracy impact, visual comfort, cross-game performance effects, and open text comments for the users.

Items included direct questions about whether participants experienced eye strain/headaches, how they choose crosshairs, and whether they adopt the same crosshair across games.

Some were asked to provide screenshots (if comfortable) of the crosshairs frequently used.

## **Procedure**

Participants completed the survey at their convenience. However, they were given a time of two days to form the responses. Responses were exported to a table for descriptive analysis (see Table 1). Qualitative comments were sorted out and coded thematically.

Another half of the participants were asked to provide visible screenshots of their crosshairs that they use daily.

## **Measures**

### ***Quantitative measures***

- Crosshair type and colour preference
- Likert-scale comfort ratings (1–5)
- Perceived accuracy impact (“Meh,” “Somewhat,” “Significantly”)
- Reported eye strain/headache occurrences
- Reported cross-game performance differences.

## ***Qualitative measures***

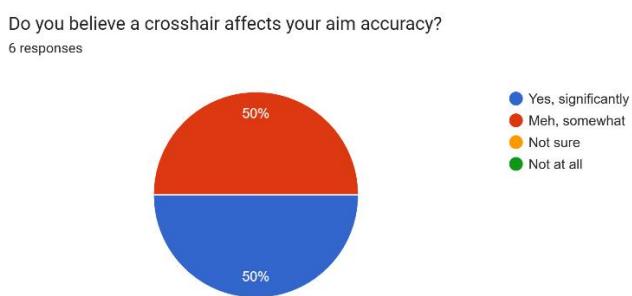
- Reasons for choosing specific crosshairs
- Situations where crosshairs negatively affected accuracy
- Descriptions of visual comfort and visibility issues
- Uploaded crosshair screenshots
- The reddit post about the question of whether a crosshair is always centered.

## **Data Analysis Plan**

Quantitative responses were analyzed using descriptive statistics (such as frequency counts, percentages, and mean Likert scores). Qualitative responses were analyzed using a thematic coding approach to identify recurring themes such as visibility, color contrast, and comfort.

## **Results**

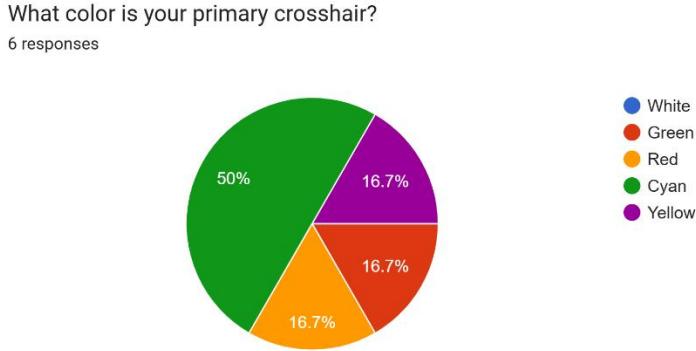
I conducted a survey for proper research. The results of the survey were as expected. Out of all the people who filled the survey, most were of age 21-25 among which there were 50% of people who think that the way your crosshair is made and designed affects your aim where as 50% of people were unsure of whether crosshairs affect your aim. The following pie chart, Figure 1 shows the above mentioned percentage:



*Figure 1. Effect of crosshair on aim accuracy*

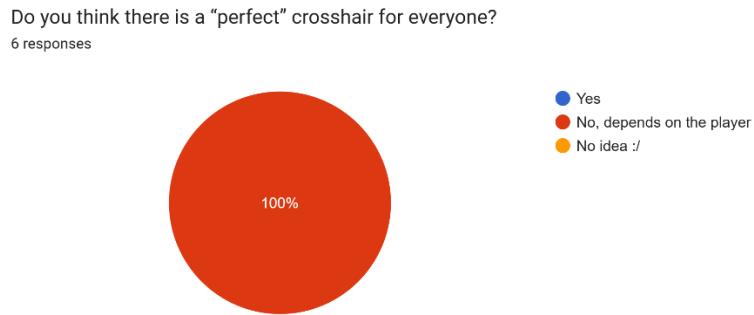
There was also the question on whether the color of the crosshair matters or not and if it affects the visibility and comfort of the eyes, to which the there were 50% of people who said that the color does affectt the visibility and comfort due to colorblindness and 50% who said that it

doesn't matter. The most commonly used color for crosshair was cyan. The other common colors for crosshair were yellow, red, green and white. Figure 2 shows the percentage of the colors:



*Figure 2. A pie chart on colors of users' primary crosshair*

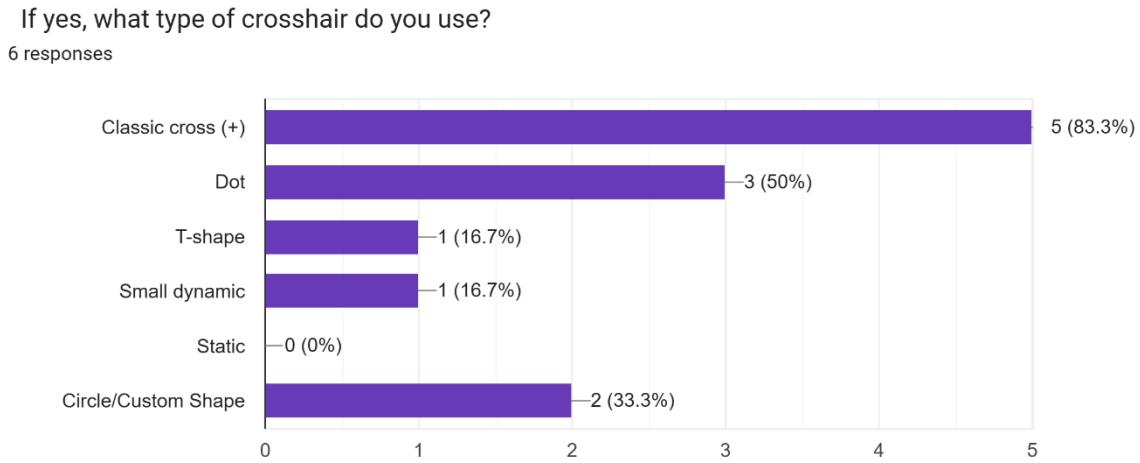
There was also the question on whether there exists a crosshair that is a single perfect crosshair which could work for everybody to which 100% of the people disagreed and said that the crosshair is dependent from person to person. The following chart from the survey depicts so:



*Figure 3. A pie chart on the "perfect" crosshair debate*

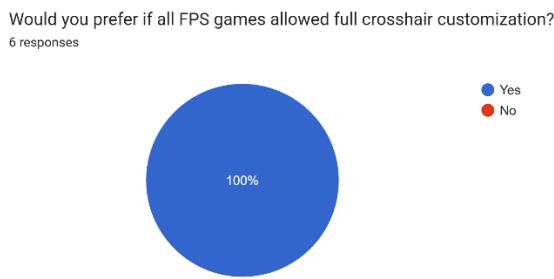
A follow-up question on what type and shape of crosshair they use, was asked after confirming that the users customize their crosshair, which was a multiple option question to which almost

84% of people said that they use a plus sign crosshair (i.e. the classic cross) and 50% said dot crosshair. Figure 3 shows:



*Figure 4. A bar chart showing what type of crosshair(s) players use*

And finally, the survey asked whether full crosshair customization should be allowed in every FPS game to which all users said “Yes”. This goes to show how important crosshairs are for a FPS player and how much it affects the gameplay because having a custom crosshair might not help in aim but it surely helps in comfort while playing the game and for some people it also helps in visibility:



*Figure 5. A pie chart mentioning how everyone agrees that full customization of crosshair is necessary.*

Figure 5 shows how much of an affect a simple crosshair can make on players’ aim and accuracy, to the point where all users want their crosshairs customized. Not to mention how many tend to learn from the esports, professional players, who are all about aiming and accuracy.

Ultimately, it's up-to the current developers to maintain the user experience and give every esports professional a chance to showcase their abilities to the fullest.

Following are the different types of crosshair used in one of the most famous and renowned game called Valorant:



Figure 7. Plus crosshair (Cyan)



Figure 6. Dot crosshair (Yellow)



Figure 8. Diamond crosshair (Red)

Every crosshair has its own pros and cons, some are too light colored, some blend in with the environment and so on but the question is, which one do the users prefer. Figures 6 7 and 8 show that the answer to that question is, whichever one helps them pinpoint the center of the screen.

The main purpose of a crosshair in the end is to just tell you where the center of the screen is because that determines where your bullets will go.

## Conclusion

This study provides initial, yet compelling, evidence supporting the critical role of crosshair design as a key Human Computer Interaction element within the First Person Shooter (FPS) genre. The findings suggest a strong correlation between customizable crosshair attributes (shape, size, color) and both, aim accuracy and visual comfort.

The survey results indicate a significant preference among participants for customized crosshairs (either plus/cross or dot shapes), with cyan and yellow being the favored colors, a choice likely driven by the need for high visibility against diverse in-game environments. Crucially, 100% of participants agreed that no single perfect crosshair exists, supporting the fact that a Customizable User Interface in a game to accommodate individual player preference, visual differences (like colorblindness), and situational context.

Furthermore, feedback regarding crosshair optimization such as "Better visibility" and "Better aim," further supports the notion that crosshair optimization is a meaningful component of the overall player experience and performance. The fact that full crosshair customization is a necessity in modern FPS games is a necessity for game developers to acknowledge.

In summary, this research highlights that crosshairs are not merely cosmetic; they are a fundamental visual guide that impacts visibility, comfortability and gameplay of a person and that the customization varies from person to person.

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