

Effects of HUD Complexity on Visual Attention and Target Recognition in Video Games

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Abstract

Video games use heads-up displays (HUDs) to present information such as objectives, player status, controls, routes, and other game-play cues. Although this information can help players, additional interface elements may also compete with important objects in the game world for visual attention. This proposed eye-tracking experiment will investigate how altering the amount of HUD information affects where players look and how efficiently they identify task-relevant targets. Participants will view controlled gameplay screenshots under two conditions: a full-HUD condition and a reduced-HUD condition. The underlying gameplay scene will remain the same between paired images, so that only HUD complexity is altered to facilitate the players focus. Participants will be given a target-identification task while their gaze is recorded. Eye-tracking measures will be used to compare attention to HUD regions and task-relevant targets across conditions. The study is intended to determine whether additional HUD information changes visual search behavior during target recognition.

Keywords

eye tracking, video games, HUD, user interface, visual attention, target recognition

1 Introduction

Modern video games require players to process information from both the game environment and the user interface. A player may need to identify an opponent, receiver, objective, or other important target while also viewing interface elements such as route information, player indicators, ammunition, health, score, controls, or objective markers. Because these elements are presented within the same visual display, changes to the HUD can affect how players distribute their attention.

Eye tracking provides a way to measure this distribution of attention. Fatehi et al. used eye tracking to compare alternative ways of presenting information in a video game and showed that gaze data could help evaluate interface design decisions [2]. Kiili et al. similarly found that players can miss relevant game information when other visually significant elements compete for attention [4]. These findings suggest that changing the amount of information displayed by a HUD may influence how efficiently a player visually searches a game scene.

The proposed experiment will examine whether full and reduced HUD conditions produce different patterns of visual attention during a target-recognition task. Participants will view controlled screenshots and identify a specified gameplay target. Comparing gaze behavior between the two HUD conditions will provide evidence on whether additional interface information draws attention away from, or helps direct attention toward, task-relevant areas of

the game scene. It is hypothesized that HUD complexity will affect visual search behavior, with participants showing differences in fixation behavior and target-identification performance between the full-HUD and reduced-HUD conditions.

2 Background

Eye tracking has been used in previous game research to evaluate how interface design affects player attention. Fatehi et al. conducted an eye-tracking study comparing four methods of presenting text in a narrative game. Their analysis examined fixation transitions between screen elements and demonstrated that eye-tracking data could be used to inform a practical game-interface design decision [2]. This study is relevant to the proposed experiment because it shows that changing the presentation of interface information can be evaluated by measuring changes in players' gaze behavior. Caroux and Isbister examined how HUD characteristics affect players in commercial video games using eye tracking. Their findings showed that the composition and organization of the HUD can influence the experience of the player, supporting the investigation of how different HUD conditions affect visual attention [1].

Kiili et al. evaluated eye tracking in game-based learning and found substantial differences in players' perception patterns. Some players missed relevant information during gameplay, while visually extraneous elements could attract attention even when those elements were not important to the task [4]. The authors emphasized the importance of balancing crucial and extraneous visual information. This provides motivation for comparing a normal full HUD with a reduced HUD to determine whether additional interface information changes attention to important gameplay targets.

Jiang et al. used eye tracking to examine visual attention toward mobile-game navigation interfaces under free-browsing and task-oriented conditions [3]. Their results showed that fixation count, first-fixation duration, dwell-time ratio, and saccade count were useful measures during task-oriented conditions. Their work supports the use of a specific visual task rather than simply allowing participants to look freely at the screenshots. The proposed experiment therefore gives participants a target-identification task and records eye movements while they search for that target.

Together, these studies support the use of eye tracking to examine how the presentation of the game-interface affects visual attention. The present experiment applies this approach specifically to HUD complexity by comparing otherwise matched gameplay scenes with different amounts of interface information.

3 Methodology

3.1 Apparatus

The experiment will use a Gazepoint GP3 eye tracker available in the Clemson University eye-tracking laboratory. The GP3 operates at a 60 Hz sampling rate and has an accuracy of approximately 0.5–1 degree of visual angle under ideal conditions. Stimuli will be displayed on the laboratory computer monitor while the eye tracker records participants' gaze positions. The specific Gazepoint model, sampling rate, monitor specifications, screen resolution, viewing distance, and calibration procedure will be documented before data collection. Participants will use a keyboard or mouse to provide responses during the target-identification task.

3.2 Stimulus

The stimuli will consist of static screenshots from video-game scenes. Candidate scenes may be taken from games such as *College Football 27* and *Ready or Not*, provided that the screenshots can be reproduced and edited consistently. Each selected base screenshot will have two versions. The *full-HUD* version will display the normal interface information available in the scene. The *reduced-HUD* version will remove selected nonessential HUD elements while preserving the gameplay environment and target.

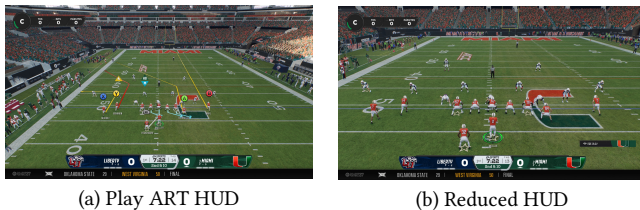


Figure 1: 3rd person gameplay stimuli for the full-HUD and reduced-HUD conditions.



Figure 2: 1st person gameplay stimuli for the full-HUD and reduced-HUD conditions.

Paired images will use the same underlying scene so that player positions, target locations, camera position, environment, and lighting remain unchanged. Only the selected HUD elements will differ. The images will use the same dimensions and display resolution. Each scene will contain a task-relevant target, such as a receiver, opposing player, soldier, or objective-related object that can be identified from the screenshot.

Areas of Interest (AOIs) will be defined for the task-relevant target and for the major HUD regions. These AOIs will allow gaze behavior toward the interface to be compared with gaze behavior toward the target.

3.3 Subjects

Approximately 10 participants are expected to take part in the study. Adult participants will be recruited from the Clemson University. Participants must be at least 18 years old and have normal or corrected-to-normal vision sufficient to view the experimental display. Participation will be voluntary. A short questionnaire will record participants' general video-game experience and familiarity with the types of game represented in the stimuli because previous gaming experience may affect how players interpret game interfaces.

3.4 Experimental Design

The independent variable will be **HUD condition**, with two levels: full HUD and reduced HUD. Participants will view stimuli from both conditions. The underlying gameplay content will remain matched between the two versions of each base scene.

The experiment will measure target-identification accuracy and response time. Eye-tracking measures will include fixation count, time to first fixation on the target, and dwell time within the target and HUD AOIs. These measures were selected because previous game-interface research has demonstrated the usefulness of fixation- and dwell-based measurements for examining task-oriented visual attention [2, 3]. Furthermore, it will use a within-subjects design in which participants are exposed to both the full-HUD and reduced-HUD conditions.

Stimuli will be presented in randomized order. A participant will not be shown both versions of the same base screenshot when doing so could allow the participant to remember the target location. Instead, the HUD version assigned to each base scene will be counterbalanced across participants when possible.

3.5 Procedures

Participants will first receive an explanation of the experiment and provide informed consent. They will then complete a short questionnaire about their gaming experience. After the participant is seated at the eye-tracking station, the Gazepoint system will be calibrated according to the laboratory procedure.

Participants will receive instructions explaining that they will view a series of video-game screenshots and will be asked to locate a specified target in each scene. Practice trials will be completed before the experimental trials so that participants understand the task.

Each trial will begin with a fixation point near the center of the screen to provide a consistent starting gaze position. The participant will then receive a short target-identification instruction. A gameplay screenshot will appear, and the participant will search for the specified target while the Gazepoint system records eye movements. The participant will provide a response using the keyboard or mouse. The next trial will begin after a short interval. Trials from the full-HUD and reduced-HUD conditions will be presented in randomized order until all experimental stimuli have been completed.

4 Results

5 Discussion

6 Conclusion

References

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