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Usability News is a free web newsletter that is produced by the Software Usability Research Laboratory (SURL) at Wichita State University. The SURL team specializes in software/website user interface design, usability testing, and research in human-computer interaction.
Barbara S. Chaparro, Editor

The Effect of Input Device on Video Game Performance

by Kelsi Lenz

Summary: First-person shooter (FPS) games have become increasingly popular, and the player's ability to accurately control their weapon is very important in these games. This study assesses players' accuracy on eliminating targets in the FPS game Star Wars Battlefront II™ using three different input devices (mouse, Playstation 2 controller, and joystick) with two different rifle types (sniper and blaster rifle). No significant performance differences were found between input devices although subjectively participants believed they peformed the worst with the joystick.

INTRODUCTION

Over the past several years the gaming industry has become one of the fastest growing forms of entertainment to date (ESA, 2007). The Entertainment Software Association (2007) states that the number of people playing video games in the United States in the year 2000 was five times that of those who went to America's top five amusement parks combined, and two times as many as those who attended all Major League Baseball games. They also reported that computer and video game revenue had reached $7.4 billion in 2006, which is triple what it was in 1996. First-person shooter (FPS) games have become increasingly popular. A FPS game immerses a player in a virtual 3D environment with a first-person-view of the character and equipped weapon (see Figure 1). Some of the more popular FPS games include Halo, Unreal Tournament, Call of Duty, Doom, and Half-Life.

Figure 1. Screenshot of First-Person Shooter view in Star Wars Battlefront II.

One important aspect in a FPS is being able to quickly and efficiently eliminate enemy targets. The input

device you are using to control your weapon can have an impact on this. Generally, the most common input device for FPS games on the computer is the mouse/keyboard combo, while gamepads are more popular when using a game console (i.e. an Xbox or Playstation).

Several studies have examined input device performance in target acquisition. A study by Isokoski and Martin (2007) assessed the efficiency of input devices in FPS games using a mouse and Xbox360 controller. They reported that players prefer using a mouse in FPS games and found aiming with the mouse was almost twice as efficient as aiming with the Xbox360 controller. Shively, Brasil, and Flaherty (2007) conducted an experiment to assess unmanned aerial vehicle (UAV) operator control in designating targets between gamers vs. experienced pilots using three different input devices (joystick, PS2 controller, Spaceball 5000). The pilots were most familiar with the joystick, and the gamers were most familiar with the PS2 controller. Results showed the gamers correctly and accurately designated twice as many targets as the pilots when using the more familiar PS2 controller. Gamers also hit more targets overall across devices. However, the PS2 controller yielded the least number of hits across devices for both groups.

The current study examined performance across three different input devices (mouse, PS2 controller, and joystick) and two rifle types (sniper and blaster rifle) in the FPS Star Wars Battlefront II™. It was hypothesized that participants would perform poorest with the joystick, since it was the most unfamiliar input device. It was also hypothesized that participants would be able to eliminate enemies in fewer shots and a shorter amount of time when using the sniper rifle, as the bullets are more lethal and it has the ability to zoom in twice, making the target much larger. Also, because of the lethality of the weapon, participants do not have to maintain their aim on the target for as long as they would with the less lethal blaster rifle. It was expected that this may impact performance for eliminating a stationary vs. a moving target.

METHODS

Participants

Twelve students (3 female, 9 male; Mean age = 26.6 years) at Wichita State University participated in this study. All participants were experienced PC and mouse users, with 10 out of the 12 having used the PC for games. See Tables 1 - 3 for a summary of their input device and gaming experience.

Materials

A Pentium IV-based PC computer with 24-inch LCD display was used in 1920x1200 resolution. Three different input devices were used: the Razer DeathAddder Gaming Mouse™, the Logitech Rumblepad 2™(equivalent to a Play Station 2 controller), and the Logitech Extreme 3D Pro Joystic™ (see Figure 2). The input device configurations are shown in Table 4.

Figure 2. The gamepad, mouse, and joystick used for this study.

The FPS Star Wars Battlefront II was used for this study. Because FPS games tend to have functionality that can interfere with input device tests, a modified version of the game was created using the programs Zero Editor™ and BF Mod Tools™ supplied by the game's creator, Lucas Arts™. Four 3D maps were created (1 practice map, and then one corresponding to each input device) that randomly placed 4 spawn points (2 enemy spawns points and 2 friendly spawn points) in a square on the map (see Figure 3). The spawn point for the participant on each map was on top of a square of red ground, with 8 health and 4 ammunition droids positioned around it to make the participant as immune to harm from enemy fire as possible and insure that they did not run out of ammunition. An invisible barrier was placed around the spawn point that prevented enemies from coming in close to attempt to eliminate the participant.

A Sony™ camcorder was used to video tape what the participants were seeing on the screen as they played the game. The video was then transferred to an iMac™ and the application iMovie™ was used to create QuickTime™ videos of each participant's session for playback and scoring of the data.

Procedure

Participants first filled out a background questionnaire querying their level of gaming experience. They were told that they would be playing the game Star Wars Battlefront II and that their objective would be to eliminate 15 enemy robots as quickly and as efficiently as possible. It was explained that they would be playing as a member of the Empire, and the enemies they would be eliminating would be clone robots. Participants used three different input devices throughout the study, and two different weapons with each device. Participants used the sniper rifle first, followed by the blaster rifle to eliminate the enemy robots. The sniper rifle had 2 levels of zooming capability (see Figure 4), while the blaster rifle had one (see Figure 5). Participants were instructed that they would be spawning over red ground, and that they were not to move their characters from that area. They were initially allowed to position their character somewhere within the red square to start firing at enemy troops, but were instructed to move as little as possible after that. Participants were then presented their first input device, and provided practice moving, zooming, and firing. Once the game was started, the experimenter used a counter to track the number of kills; after 15 kills the game was ended. This procedure was then repeated again for the next weapon, and then also for the other two input devices.

After each participant, the recorded video was imported to an iMac computer and compressed into a full quality QuickTime™ video to be scored. Experimenters then played back the video and recorded the number of enemies killed, length of time to kill an enemy from the initial shot fired, and the number of shots fired per kill.

Table 1. Input device experience.

	None	1-6 months	1-3 years	3 + years
Mouse	0	0	0	12
Gamepad	3	2	7	0
Joystick	2	1	4	5

Table 2. Game-play experience.

Amount of Time	Number of Participants
Daily	2
At least 5 times each week	2
About once a week	5
About once a month	1
Less often than monthly	2

Table 3. Types of games played.

Type of Game	Number of Participants
First Person Shooter	9
Action/Adventure	5
Racing/Sports	3
Puzzle/Trivia/Casual	6
Role Playing Game/Real Time Strategy	4

Table 4. Input device configuration.

Input Device	Left Hand	Right Hand
DeathAdder Gaming Mouse™	**Moving:** keyboard arrow keys	**Aiming:** mouse **Trigger:** left button **Zoom:** right button
Logitech Extreme 3D Pro Joystick™	**Moving:** Buttons 5-8 on the joystick base	**Aiming:** joystick **Trigger:** front trigger button **Zoom:** thumb button on joystick head
Logitech Rumblepad 2™	**Moving:** left analog stick	**Aiming:** right analog stick **Trigger:** R1 button **Zoom:** R3 button

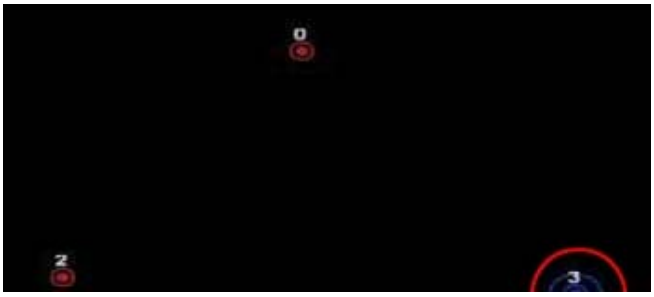


Figure 3. Layout of the 4 spawn points on the map. Spawn points 0 and 2 are enemy spawn points. Spawn points 1 and 3 are friendly spawn points, with the participant spawning at the point indicated by the red circle (point 3).

Figure 4. View when the Sniper Rifle is fully zoomed.

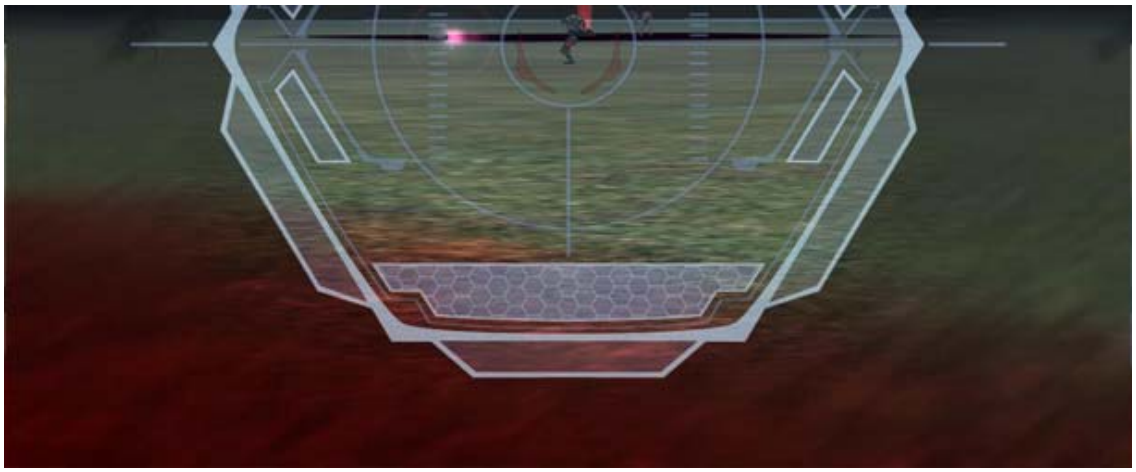


Figure 5. View when the Blaster Rifle is fully zoomed.

RESULTS

Two 2 x 3 within-subjects ANOVAs were run to examine the effects of rifle type (sniper rifle and blaster rifle) and input device (PlayStation controller, mouse and joystick) on the number of shots fired per kill and the time until kill (seconds). (For a comparison of means see Figures 5 and 6 below.) There was a main effect of rifle type for both dependent variables, $F(1, 703) = 437.64$, $p < .01$ and $F(1, 703) = 96.67$, $p < .01$, respectively, showing that the type of rifle used made a difference in both the number of shots fired to kill a target and in the time required to kill a target once the target has been spotted. The sniper rifle resulted in fewer shots fired per kill and less time to kill. There was no effect of input device or interaction in either analysis.

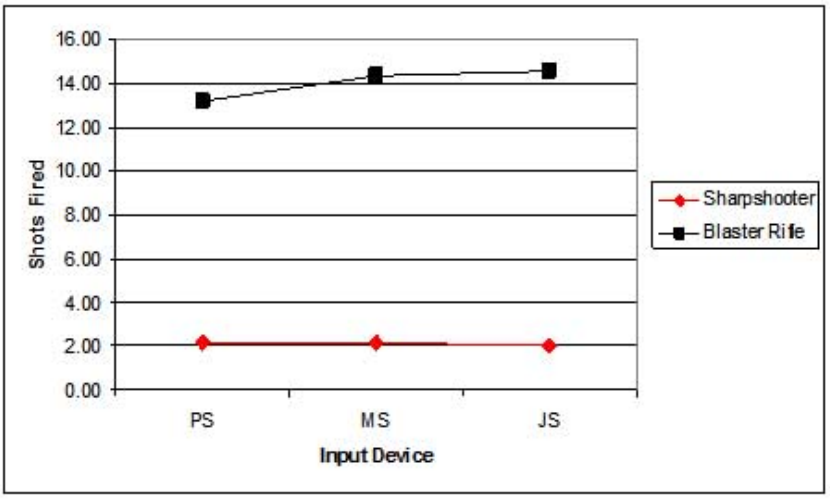
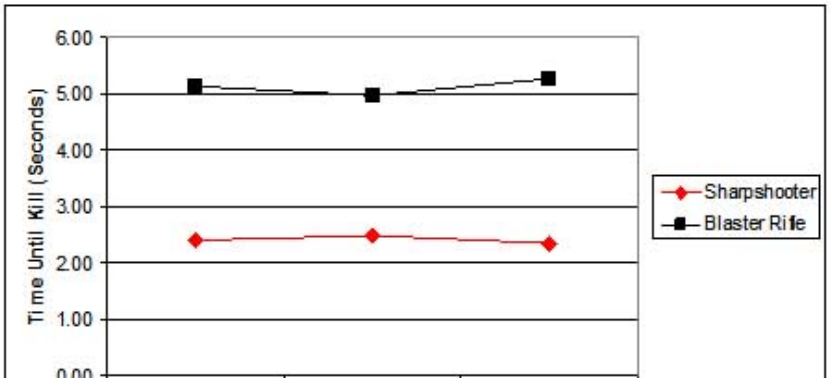


Figure 6. Mean shots fired.



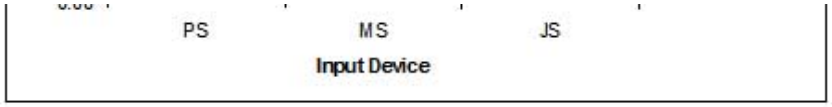


Figure 7. Mean time until kill.

DISCUSSION

The hypothesis that participants would perform poorest with the joystick was not supported. While almost all participants reported that the joystick was the most difficult device to use and that they performed the poorest with it, there were no significant performance differences between input devices. Interestingly, when using the sniper rifle participants actually fired the fewest shots per kill and eliminated targets in the least amount of time with the joystick (M = 2.02; M = 2.35 secs). A possible explanation for this is that participants lacked confidence in controlling the device, and therefore did not fire shots until they felt they would be accurate. However, when using the blaster rifle participants fired the most shots per kill and took the longest amount of time with the joystick (M = 2.35; M = 5.28 secs). This suggests that maybe the joystick may not good for a quick, repetitive shooting style. The enemy robots were "intelligent", and attempted to avoid being shot by rolling out of the way and strafing across the screen after they were fired upon. When using the sniper rifle, the targets were essentially stationary for the first shot, which normally eliminated the target. However, with the blaster rifle users had to maintain a fixed aim on the target for an average of 5 seconds while it attempted to dodge the bullets. The wrist motion required to maintain target fixation with the joystick is more intensive than with the other two devices, which may have contributed to the increased number of shots and time required per kill with the blaster rifle. This weapon is less lethal and requires the user to stay on the target for a longer amount of time as it moves about the screen. Our results may indicate that different devices may have advantages when tracking and firing upon stationary vs. moving targets.

The difference seen between shots fired and time until kill between the different rifles was expected. The sniper rifle was a more lethal weapon, and allowed users to zoom in on a target twice as close as with the blaster rifle. On average it took approximately 2 shots per kill with the sniper rifle and 5 shots per kill with the blaster rifle. With the sniper rifle, most participants took between 1 and 4 shots per kill, and appeared to strive for a high level of accuracy before they fired. However, with the blaster rifle participants often fired 15 shots or more per kill, and were much more careless with how accurate their shots were. When using the blaster rifle, participants also had to maintain a fixed aim on a moving target as well. Participants adopted a "point and spray" method with the blaster rifle, as it was possible to simply hold the trigger down to spray shots, whereas the sniper rifle had a 1/2 second recoil between shots. Running out of ammunition was not a concern for participants, which may have impacted their lack of concern in being accurate with every shot.

REFERENCES

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Isokoski, P. and Martin, B. (2007). Performance of input devices in FPS target acquisition. Proceedings of the International Conference on Advances in Computer Entertainment Technology, 240-241.

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Note:
A more detailed paper based on this work will be presented at the Human Factors and Ergonomics Society's 52nd (2008) Annual Meeting in New York, NY.

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