How Representation of Game Information Affects Player Performance

Matthew Paul Bryan
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Senior Project
Computer Science Department
California Polytechnic State University

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Abstract

The goal of this small experiment was to see if it could be determined whether or not user interface design and the way information is portrayed in a game can affect a player's performance in that game. During this study, 26 anonymous participants selected one design of a timer from three different categories to be used in a simple, objective-based game. 10 different participants were then run through three levels of that game, with each level corresponding to a different version of timer. The amount of objectives completed were recorded, as well as their thoughts on which version they preferred and why. These results were then analyzed to determine if any conclusion could be reached. Regardless of outcome, it is my hope that this study will embolden others to find out more about how important a game's interface is to the player's experience.

Introduction

User Interface (UI) design is a key element in any game. It is crucial to the player experience, as it is the most straightforward way of providing the player with the information they need to play the game. The health of the character, the resources available, the location, and the current objective are common pieces of such information usually shown in the interface. In order to best supplement the player experience, this information must be easily absorbed without providing too much distraction from the game itself. The best games will strike a balance between these two aspects of UI design.

Application

Purpose

The purpose of this experiment was to make some discoveries regarding how the way game information is communicated to the player affects their performance in the game. The idea was to have participants play a game that required their concentration to complete a certain objective within the given time limit. During the playthrough, the player would utilize a different style of timer to gauge how much time they had left. They would then use this to make informed decisions throughout their playthrough.

Hypothesis

The author's hypothesis is as follows: After separating different styles of timers into three categories, visual, auditory, and fixed-location, a timer from the auditory category will provide an increase in player performance. The auditory category was chosen because the other two categories involve visual distraction. The main idea in this hypothesis is that if important game information is represented to the player through a visual method, and the player is currently undertaking an objective that already requires their visual concentration, a reduction in

performance will occur. This will be due to the distraction caused by the player needing to look away from their objective to view the information.

Game

The game used in this experiment was a two-dimensional, dungeon-exploring game. The player used basic movement controls through either the W, A, S, and D or arrow keys to move their character around the level. The objective in this game was to collect as many gold coins, shown in Fig. 2, as they could within the given time limit. These coins were hand-placed by me throughout each level, and were collected by the player simply running their character through each coin. Each level started with the player only able to see in a small square around them. As the player moved through the level, they would uncover more rooms and the coins found within them. The final mechanic in this game was the ability of the player to exit a level prematurely. Exiting a level before the time had run out would award the player an extra five bonus coins. In order to use the exit object, shown in Fig. 3, and end the level, the player needed only to position their character over the exit sign and press the E key.

Figure 1: Example starting position

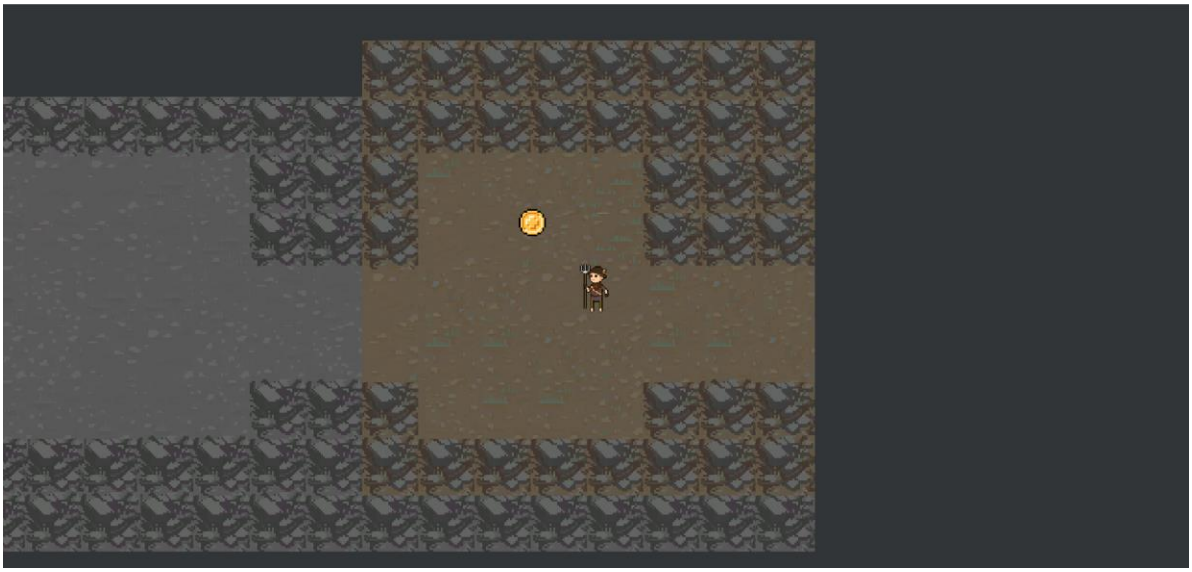

Figure 2: A coin has been found after exploring further

Figure 3: The exit object used to end a level

Timers

The varying factor between each of the three levels was in how the amount of time left would be shown to the player. There were three different options for displaying the amount of time left, with each timer being chosen as the best from among others in the same category.

The three timer options were as follows: A set of rectangles on either side of the screen that fell down as time progressed (Fig. 4), an auditory timer whose speed increased over the course of the level, and a final static text timer (Fig. 5). The participants were run through three consecutive tests, with each test having a different timer option. Afterwards, the amount of objectives they completed were recorded. Finally, the participants were asked to identify which timer, in their opinion, would be the most effective in conveying the information in the game.

Figure 4: The rectangle timer

Figure 5: The text timer

Background

The game that was used in this experiment was created using the Unity3D game engine. This is a free engine that, despite its name, can be used to build both 2D and 3D applications.

In order to build an application in Unity, scenes are created which are comprised of many different objects. Each scene can represent a level in a game, but it can also be used to represent other useful parts of a game, such as the main menu or a cutscene. It is also possible to have an entire game contained within one scene, where all the objects in the game are simply rearranged, enabled, and disabled in order to get the desired effect.

Each object in a scene can have many different components attached to it. An example of such a component is an audio source. This component allows an object to emit a sound. Another example would be something called a collider, which is Unity's way of preventing two objects from passing through each other. A final important component to be mentioned is called a rigid body. A rigid body component is just a fancy way of saying that the game designer wants said object to physically react as any object would in the real world, reacting to forces like gravity or the push of another object.

In order to use these components, objects will usually have scripts attached to them. These scripts allow a programmer to reference components of objects, and objects themselves, and perform actions upon said components or objects.

In combination, all these aspects provide all the tools needed to create amazing player experiences.

Design

Phase 1

The first phase of this experiment involved showing still images, or sound clips, of the eight different timer options in an online survey. The examples that were shown were created to give the participant the impression of what each timer would look or sound like, without having them be distracted by game play in the current phase of the experiment. During the survey, the participants were asked to select which timer option in each category, in their opinion, would be the most effective in displaying the amount of time left in the game. The amount of votes per timer option was recorded and later used to determine which timer options would advance to the actual gameplay phase of the experiment. The five other timer options that did not receive enough votes to make it to phase two of testing were as follows:

- A circle timer, in which a red circle appears at the top of the screen, and as time decreases, the circle begins to disappear (See Fig. 5)
- A flashing timer, in which the screen would flash red with increasing frequency as time decreases (See Fig. 6)
- A whiteout timer, in which the screen would slowly become more white as the end of the time limit approaches (See Fig. 7)
- A sound volume timer, in which a sound would get louder as time progresses
- A piano tone timer, in which piano notes would play throughout the time limit, and the tones would get lower in pitch until the end of the allotted time

Figure 6: The circle timer, which received fewer votes than the text timer in the Fixed Location timers

Figure 7: The flashing timer, which flashed the screen red with an increasing speed as time ran out. This timer lost to the rectangle timer in the visual timer category.

Figure 8: The whiteout timer. This timer gradually made the screen white as time ran out, until nothing could be seen at all. This timer also lost to the rectangle timer in the visual timer category.

Phase 2

During the second phase of the experiment, only the three timer options that received the most votes from the previous round were used. Each of these three timers were tested by each participant in a round-robin order, meaning that the first participant was run through timers A, B, and then C, while the second participant was run through B, C, and then A. This was done to ensure that a player naturally getting better at the game would not be attributed to the last timer option. After a participant was run through all three tests, they were asked a series of post-test questions. These tests included what their preferred timer option was, how much general video game experience they have, and if they had any other miscellaneous notes to give about the timer options.

Implementation

Foundation

I created the foundations of the game that was used to judge the performance of each of the participants in a previous class. This foundational game provided an already working player movement system, as well as a scripting environment that significantly reduced the amount of work that would have been required for a project done from scratch. The decision to use this pre-built game made it possible to complete this experiment in the time allotted. It was then modified from its original state to reduce the number of uncontrolled variables and support a more quantifiable and testable objective.

Modifications

While the foundational game provided a good starting point, some alterations had to be made to better align it with the task at hand. First, the original game contained enemies that could be killed for experience points and items. These had to be removed from any and all levels, so the focus would only be on the collecting of the coins. Next, the actual three levels had to be created. For this task, I used the same random map generator included in the original game, but I modified it to only produce maps of a certain size. Then, I ran the map generator several times, and picked out three maps that were related in terms of size and spacing of rooms. Finally, I hand-placed eighteen coins in each level, spaced out in such a way that it would be impossible to collect all of them within the time limit. After integrating all eight timers into the three chosen levels, testing was able to begin.

Timer Implementation

The eight different timer options were all implemented as extensions of a base *Timer* script that handled the per-second updating of the class' internal timer value. This base class

had an abstract function that each extension had to fulfill. The abstract function dealt with the parts of each timer that were specific to that implementation. This system allowed me to reuse the same timing process for each timer while also getting the functionality that was different between the separate options.

Analysis

Phase 1 Results

A total of 26 people responded to the online survey posted for the first phase of this experiment, the first section of which dealt with demographic information of the participants. Of those 26 people, 24 fell within the 18 to 30 age range. This was expected given that the survey was posted mainly in Cal Poly social media groups. When asked to gauge how often they play video games, 13 of the 26 respondents said they played video games every day, with another 5 saying they played video games at least once every few days. Using this information, we can see that a majority of respondents had enough experience with video games to make informed decisions on the style of user interface they would prefer in a game.

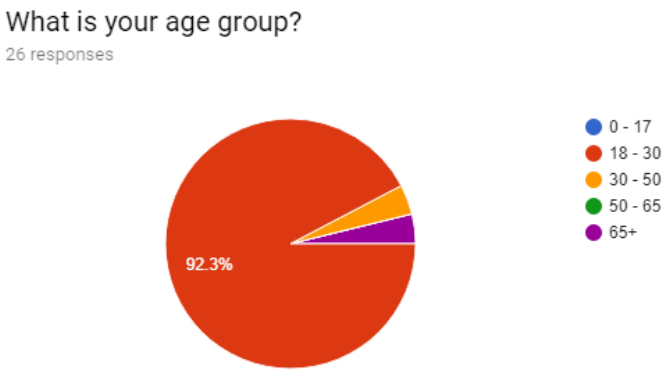

Figure 9: Age group of survey respondents

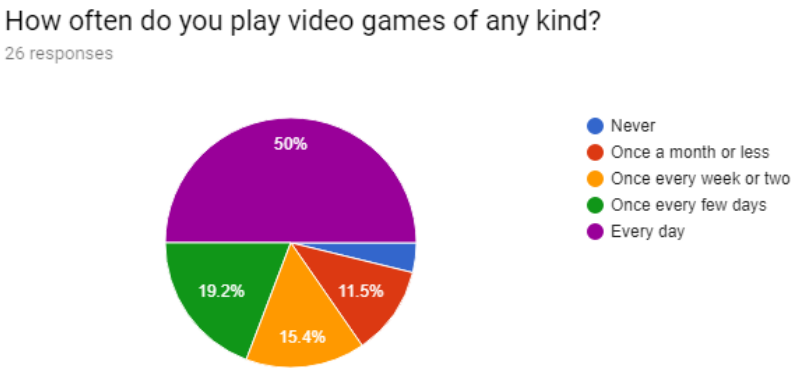

Figure 10:Video game experience of survey respondents

The remaining sections of the survey showed the participants an example of a timer option in the specified category. At the end of each section, the participant was asked to choose which timer they felt was most effective at conveying the amount of time left, and which timer they felt would help them be most successful in a simple, objective-based game. The answers between these two questions in each category did not vary significantly.

Of the visual timers, the rectangle timer option won with 65.4% of respondents. In the static timer category, the text timer won with 88.5% of the votes. Finally, in the auditory category, the frequency-increasing timer option won with 84.6% of the votes. These three timers were then chosen to move on to the second phase of the experiment.

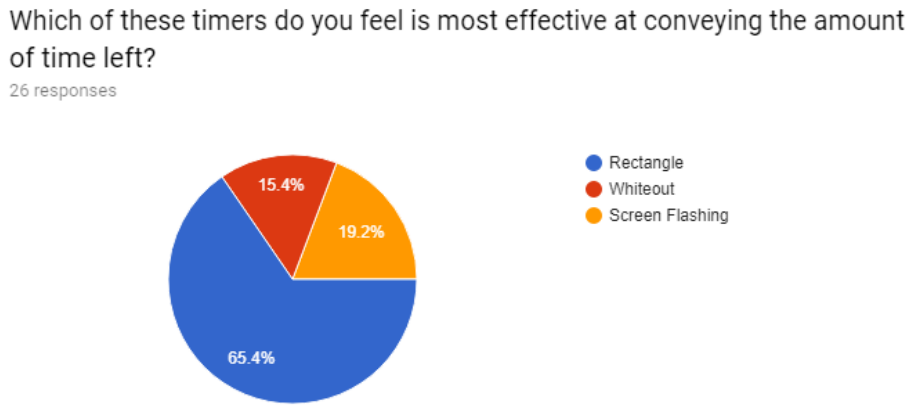

Figure 11:Results for visual timer options

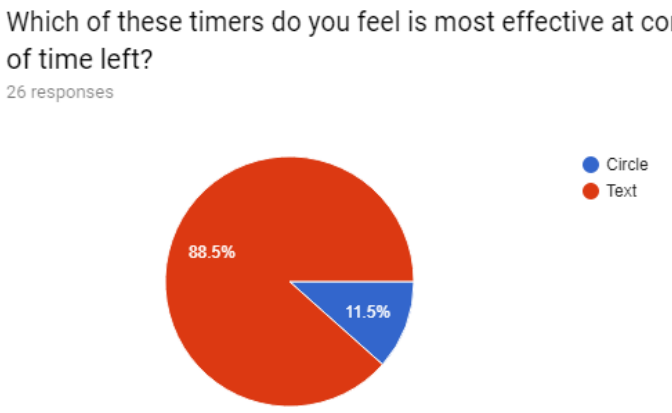

Figure 12:Results for fixed-location timer options

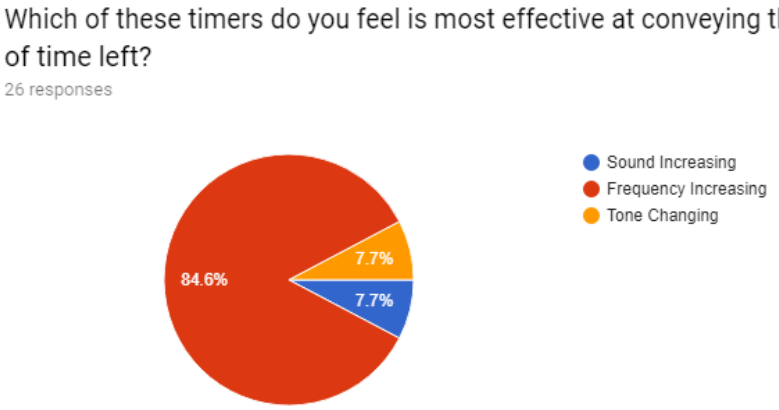

Figure 13:Results for auditory timer options

Phase 2 Results

During this final phase of the experiment, a total of 10 participants were run through the test. On the first level, an average of 9.2 coins were collected, with only 20% of the players choosing to exit. The second level saw an increase in both data points, with an average of 10.1 coins collected and 60% of the players choosing to exit. Finally, on the third level, an average of 12.8 coins were collected, and 70% of the players chose to exit.

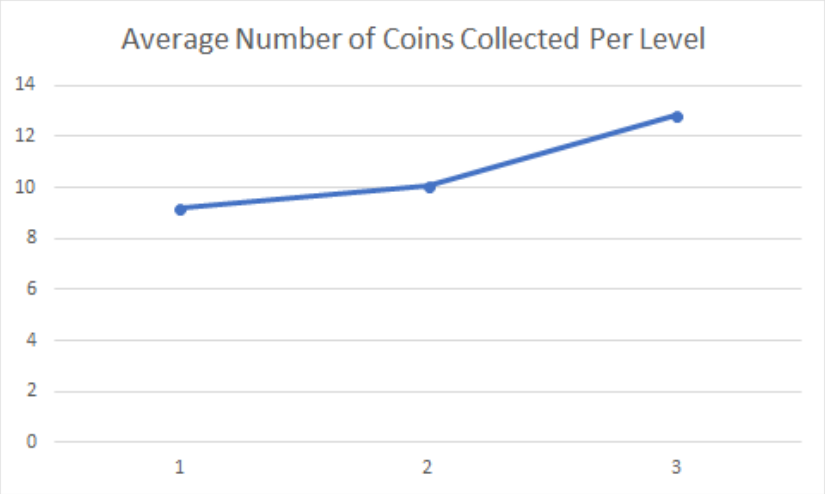

Figure 14: Average number of coins collected per level, with no separation between which timer option

After averaging the number of coins collected per level as a whole, the data can be split up between each of the timer options, which were used in round-robin order.

For the first level, participants using the text timer collected an average of 9.5 coins, and none of the players chose to exit. The players who were using the rectangle timer were not far behind with an average of 8.66 coins collected, and 30% of users choosing to exit. Finally, players who were using the frequency-increasing timer on the first level collected an average of 9.33 coins, and 30% chose to exit.

On the second level, the text timer participants collected an average of 11 coins, and all participants chose to exit. The rectangle timer was nearly tied with the text timer, collecting 10.75 coins on average, and with 50% of the players choosing to exit. For the final timer category, frequency-increasing timer users collected an average of 8.33 coins, and only 30% exited.

Finally, on the last level, text timer users collected 12.66 coins on average, and 66% of players exited the level. Rectangle users pulled ahead, with 13.33 coins collected on average, and 100% of users choosing to exit. Players who were using the frequency-increasing timer came up with 12.5 coins collected on average, with 50% of users choosing to exit.

The last portion of results comes from the post-test questions asked of the players. With 10 total participants, 5.5 preferred the text timer, 3 preferred the frequency-increasing timer, and 1.5 preferred the rectangle timer (half points were assigned by one individual). Another important note is that the average video game experience amongst the 10 participants was in the low to medium range, on a scale of none, low, medium, and high.

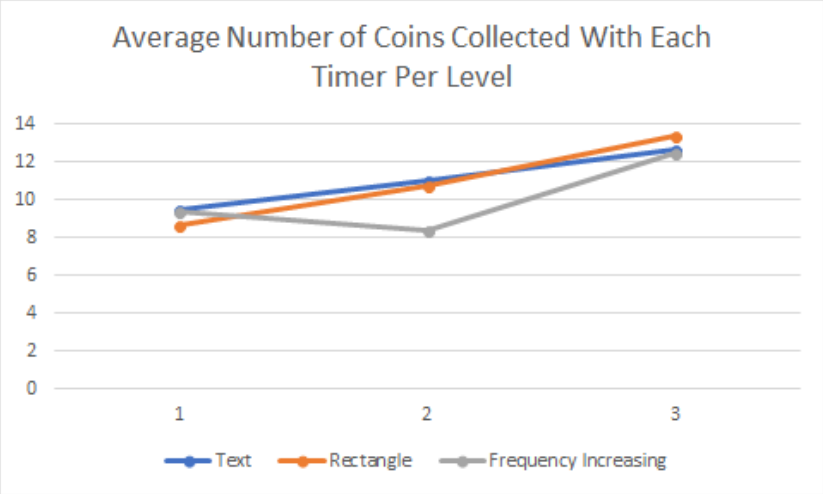

Figure 15: Average coins collected per timer option per level

Discussion

When examining just the average coins collected per level with no separation between the timer options, we can see a clear and steady increase in the amount of coins collected as more trials are performed. This increase regardless of the timer used can most likely be attributed to one of two options: either some of the levels are easier than others, or players just generally get better at the game with each trial. Given that the three maps were made to be of similar size, it is this author's opinion that a general increase in player skill is the cause of the overall increase in number of coins collected per trial.

After separating the results by timer, it is quite difficult to determine if any of the timers had any advantage or disadvantage. All three timers started with very similar scores for the first level, with less than half of players exiting the level for the bonus. This could be due to the fact

that participants were told that exiting the level was not required of them, and they perhaps wished to explore the level more and find out if exiting early was really worth it. Seeing as how the amount of players exiting a level generally increases per level, I would attribute this low exit amount to such a phenomenon.

The second level test provides a bit more information with respect to finding the best timer. It is during this test that the frequency-increasing timer falls quite a bit short of the other two timer options, both in the amount of coins collected and the amount of players exiting the level for the bonus. Both the rectangle and text timers were safely above the frequency-increasing timer by at least 2.5 coins, and at least half of the players exited the level for the bonus in both cases. It is this section of the tests that begins to cast doubt upon the original hypothesis that fueled this experiment.

The third and final level in this test is confusing in that all three timer scores are within one coin collected of each other, with the only fairly significant difference being that all players who used the rectangle timer on this level were able to exit and earn the bonus. While the rectangle timer did pull slightly ahead in terms of both coins collected and players exited, the margin by which this timer beat the others is nowhere near large enough to label it as the best.

A conclusion may not be able to be reached regarding the quantifiable data, but the overall user preference might be able to determine which type of timer players themselves would favor. With over half of the participants choosing the text timer, it is the clear winner in terms of player preference. When asked to provide more insight as to why they chose the way they did, there were a few different reasons given. A popular reason given as to why the text timer was chosen was that some players found the other timers too stress-inducing, thereby lessening their enjoyment of the game. The 3 players who chose the auditory timer did echo statements similar to the hypothesis of this paper, that the auditory timer provided less distraction, but the text timer was still a clear winner in terms of player preference.

In summation, the quantifiable results do not differ enough to provide a clear indication of an increased or decreased performance per timer, and therefore the hypothesis cannot be confirmed. Players favored the text timer overall, but there is no indication of performance change.

Related Work

One interesting study relating to UI design was done on user interface modifications in the popular MMORPG *World of Warcraft* (Llanos and Jørgensen). This study covered the game community's opinion surrounding user interface modifications, as well as how the majority of players preferred to modify their interfaces. The main takeaway from this study that would provide useful information in the context of this author's experiment was that a significant majority of players preferred to modify the game's original user interface to better align with the goals they wanted to achieve in the game. We can conclude from this information that, in at least some specific types of games where concentration and fast digestion of information is important for performance, the user interface and the way that game details are displayed to the player serve an important role in that player's performance.

A similar conclusion was reached by another group of researchers during a study done regarding the intrusiveness of user interfaces on the immersion of a game versus the effectiveness of how the information was displayed (Targett et al.). In this study, the researchers had players play a specific game and discussed the players' reactions to having part of the user interface removed from their view. The conclusions reached by this study were that no one way of interface design was inherently better than another, and that it was more important that the way the information was presented to the user matched the experience that the game designer was trying to craft. All that really mattered when it came to how the game details were shown to the player was that they were communicated both clearly and precisely.

Future Work

In order to fully discover how user interfaces can affect a player's performance, more experiments will need to be performed. What is perhaps most crucial is that these future experiments must have a larger sample size, as I believe that more can be discovered with more people. Also, more trials will need to be performed, as this could reduce the chances of general skill increases being mistaken for performance gain by user interface design. Finally, it may be beneficial in future works to use a game that requires even more concentration on the player's part. I think that if a higher amount of concentration is required of the player, distractions provided by the interface could be more easily seen and measured.

Conclusion

The results in this experiment unfortunately did not differ widely enough for any general claims to be made about the effects of user interface design on player performance. This also means that the hypothesis that was the inspiration behind this study could not be confirmed at this time.

However, I do believe that some use can come from the comments made by the participants about why they preferred certain designs over others. The fact that some of the timer options induced stress in some players could be useful to both future research into how interface designs can increase or reduce stress, or perhaps to future game designers who could use this information to purposely cause their players to feel stress.

At the very least, I hope that this small experiment can inspire others to look further into how the way we provide information to a player can affect them.

Works Cited

C Llanos, Stein & Jørgensen, Kristine. (2011). Do Players Prefer Integrated User Interfaces? A Qualitative Study of Game UI Design Issues.

Targett, S & Verlysdonk, Victoria & Hamilton, H.J. & Hepting, Daryl. (2012). A Study of User Interface Modifications in World of Warcraft. Game Studies. 12.