What Are You Looking At? A Usability Study On Minimaps in League of Legends

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Abstract

This research investigated whether the default minimap size in League of Legends was optimized for threat detection or if an increased minimap size would enhance players' situational awareness. Multiplayer Online Battle Arena (MOBA) games like League of Legends have a massive global player base and market. The minimap in these games plays an important role, offering players real-time information that significantly impacts their experience. Despite its importance, research on the design of minimaps in MOBA games remains limited. To explore this, we conducted a biometric eye-tracking experiment with two treatment groups: one using the default minimap size and the other with a maximized minimap. Both groups were instructed to complete the same task, with incoming enemy threats serving as a secondary task to monitor. By analyzing eye-tracking metrics, we evaluated how quickly and accurately each group detected incoming threats while engaged in their task. Our findings indicate that players with the default minimap size actively looked at the minimap more frequently, while players with the large minimap relied on passive detection for incoming enemy threats. This research offers insights for optimizing minimap sizes and enhancing player experience in MOBA games.

Introduction

The Importance of Minimap in MOBA Games

In MOBA games like League of Legends, players face dynamic and complex environments where quick decision-making is very important to winning the game. Minimap is one of the primary tools aiding players in these decisions, providing players with an overview of the game's map state, ally positions, and enemy threats. It is an extremely important tool that a player can view to quickly gain more information about the current state of the game (Zhu 2021). However, the default minimap size in League of Legends may be too small for detecting threats, potentially hindering players from quickly recognizing approaching enemies.

The Massive Global Market and User Base for MOBA Games

MOBA games have grown to become a massive industry, projected to reach over 140 billion USD worth of market value (Kim 2018). League of Legends, the leader in this genre, boasts a staggering 150 million monthly users (Demirkol, 2024) and continues to attract a global audience. There are over 99.6 million unique viewers tuned in to watch Worlds 2018, one of League of Legends' most prominent events, surpassing Super Bowl's 98.2 million (Kim 2018).

Research Purpose and Significance

Understanding how minimap size affects player awareness has implications not only for League of Legends, it also can be applied to other MOBA games. By evaluating biometric eye-tracking data, we aim to answer a key question: Is the default minimap size in League of Legends optimized, or will increasing the minimap size be more favorable for detecting incoming threats? Insights from this research could guide minimap design improvements in MOBA games and enhance the gaming experience for millions of players worldwide.

Related Work

Minimap for Visually Impaired Gamers

Minimaps are critical for accessing in-game information, but visually impaired players (VIPs) have difficulty observing minimaps. Nair et al. (2021) addressed this issue by developing acoustic minimap alternatives, including echolocation cues and directional scanning, to enhance spatial comprehension for visually impaired players. This study emphasizes the important role of minimap design in game-accessibility for VIPs. However, while Nair et al. focused primarily on accessibility, our study examines how optimal configurations can be determined by adjusting default settings to improve usability for all players, not just VIPs.

Minimap Detection in League of Legends

Zhu (2021) explored the potential of machine learning to enhance minimap functionality by automatically detecting champion icons, providing players with real-time insights into the game's state. By automating the identification of these elements, Zhu's work aims to support players' situational awareness and strategic decision-making by quickly alerting them to important map information (Zhu, 2021). Both Zhu's study and ours emphasize the importance of minimap design in optimizing player performance. While Zhu's work focuses on automating map awareness through machine learning, our research investigates how changes in minimap size can impact threat detection and gameplay for players.

Enhancing Player Experience in League of Legends

Mora-Cantallops and Sicilia (2018) conducted a player experience study within League of Legends. Using surveys from over 400 players in Spain's largest eSports organization, the study employed the PENS (Player Experience of Need Satisfaction) model and SPGQ (Social Presence in Gaming Questionnaire) to assess how factors like player rank, team dynamics, and role selection influence player experience. Results revealed that player experience suffers significantly when players feel their contributions to the team are overlooked. This insight inspired our research to increase players' awareness of their teammates' actions and contributions by optimizing minimap settings, aiming to enhance player experience.

Maps in Video Games

Dormann, Pötscher, and Wallner (2023) developed a classification of video game maps by reviewing online articles and community posts. Their classification highlights the diverse roles and design types of game maps, providing examples and discussing how certain map features can enhance gameplay and player immersion. This study underscores the versatility and importance of maps in video games across genres. While Dormann et al. focus broadly on categorizing map types, our research narrows in on one specific map element—the minimap—and investigates how optimizations to its settings can improve players' situational awareness and threat detection, potentially enhancing the overall gaming experience.

Minimap in VR

Di Domenico et al. (2024) evaluated the efficacy of 2D minimaps in improving navigation within immersive VR settings. Their study compared three teleportation techniques: World in Miniature (WIM), WIM displayed on a 2D panel, and a standalone 2D minimap. The findings revealed that the 2D minimap significantly enhanced navigation efficiency. Both Di Domenico et al.'s work and our study emphasize the critical role of minimaps in enhancing user performance and engagement within digital environments. However, while Di Domenico et al. focused on VR applications, our research investigates how adjustments to minimap size can optimize situational awareness and threat detection specifically within competitive gaming environments.

Method

For this research project, we conducted a biometric study using a Smart Eye AI-X eye tracker. We utilized the iMotions software to handle synchronization and analysis of the eye tracker as well as the screen and cursor recording of the participants' sessions.

Participants

A total of 8 participants were tested, but only 6 participants' results were used for analysis. One participant's data was excluded from the final analyses due to technical error of the eye tracker. Another participant's rank was not close enough to the majority of participants and their data was excluded due to being an outlier. They were all male and aged from 23 to 25 years old. Using League of Legends' in-game ranking system, 4 of the participants were ranked Emerald and the other 2 were ranked Diamond (Emerald is one rank below Diamond).

We had two treatment groups based on the size of the minimap we set for our participants: default and large. The default treatment group had their minimap set to the default setting, and the large treatment group had their minimap set to the largest possible size for comparison. Participants were split up into these treatment groups by rank, looking to have as equal mean rank between the two treatments as possible.

Game Context

In order to explain the tasks the participants completed, it is important to understand some aspects about League of Legends. The game has a "fog of war" system covering the entire map for both teams, meaning information such as enemies' locations are hidden from the player where their team does not have vision. Allied structures, minions, champions (in-game player characters), and wards (purchasable in-game consumables) provide vision for their team, revealing what is in the fog of war, as shown in Figure 1.

Figure 1: A demonstration of the effects of wards and vision in relation to fog of war

A large portion of League of Legends gameplay is spent performing a task that is referred to as ‘farming’ or ‘CSing’. This task involves non-player characters called minions that spawn in waves from both teams’ bases at regular intervals constantly throughout the game and march down each of the three lanes as shown in Figure 2. These minions are worth in-game currency if the player is able to get the ‘last hit’ on the minion (being the one to bring the minion’s health to 0). Doing this consistently in order to generate in-game currency is what ‘farming’ is and is the one of the main tasks for our participants.

Figure 2: Minions (little blue and red circles) spawning and marching down each lane

Tasks

In order to figure out how effectively the minimap is being used, we had a few criteria in mind. We wanted to emulate real gameplay as closely as possible so that the information we gather can be applied to real players, we wanted to understand if there were any potential downsides to a larger minimap, as well as potential upsides. We settled on a combination of two tasks:

1. The participant loads into a custom game on their most comfortable champion, goes to the middle lane and 'farms' for the duration of the session, aiming to be as accurate as possible.
2. Monitor the minimap and if they spot an enemy champion, utilize the in-game communication system to ping "Enemy Missing" on the minimap where they spotted the enemy.

The first task aims to achieve realism by including a task that players are constantly performing throughout regular gameplay. The result of the first task is measured in-game as a count of how many 'last-hits' on minions you performed. The second task aims to measure how effectively the minimap is being used.

In order to ensure that there would be enemies to spot in consistent manners between participants and to further try to imitate the variation of minimap events of a real game, we devised multiple "vision setups" to employ for each of our participants, shown in Figure 3.1, 3.2, 3.3, and 3.4. In each of these figures, the blue line represents the edge of the vision radius the ward or champion provides and the white arrows represent the path the enemy champion will take through the vision so that they appear on the participant's minimap in what we further refer to as an "event".

In order to set up these vision setups for each participant, we started a custom game for each one. The participant would join the blue team alongside two other testers who would place the wards and provide the vision for the setups. A third tester would join the red team and would walk the path shown in Figure 4. The allied testers would play random champions as their champions do not affect anything, and the enemy tester would play the champion named 'Ashe' to keep consistency between participants.

Figure 3.1: Vision Setup #1, includes events 1 and 2, the top white arrow and bottom white arrow respectively. Event 1 around 2:05 in game and Event 2 around 3:05 in game.

Figure 3.2: Vision Setup #2, for event 3, which occurs roughly 4:10 in game time.

Figure 3.3: Vision Setup #3, includes events 4 and 5, shown by the right and left white arrows and around 5:40 and 6:50 in game time respectively.

Figure 3.4: Vision Setup #4, for event 6 at roughly 8:35 in game time.

By utilizing these vision setups, the location and duration that the enemy champion appears on the participant's minimap is consistent between participants for each event. We designed the setups so that each event is varied in both location on the minimap and duration of exposure on the minimap. For example, event 3 (shown in Figure 3.2) is one of the shorter exposure times as the enemy champion crosses vision very quickly and thus appears on the minimap for a very short duration. In comparison, event 6 (shown in Figure 3.4) is one of the longest exposures as the enemy champion crosses a large amount of vision over an extended period of time. The full route that the enemy champion takes as well as how the vision setups are laid out can be seen in Figure 4.

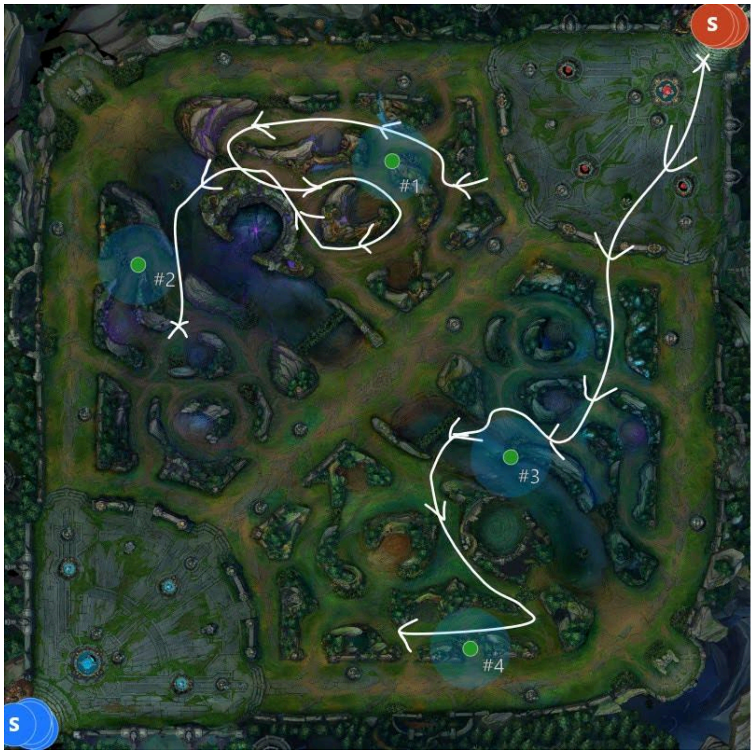

Figure 4: Each of the vision setups are shown and labeled, and the path the enemy champion takes is shown in white arrows. Where the path ends in an X, the enemy champion uses an in-game feature to teleport back to its base.

Analysis

In order to track the effectiveness of each minimap size, we calculated the time span at which each participant was able to spot each event occurring. Because most of this analysis of the eye tracker data had to be calculated manually, we devised a method to ensure consistent measurement of participants' results. We settled on the following: For each event, we went through the recording frame-by-frame and located the first frame in which the enemy champion appeared on the participant's minimap. We started our measurement at that point in time. Looking at both the participant's eye tracker data as well as their cursor movements, we found the first frame in which the eye tracker tracked the participant's gaze on the minimap, as well as when the participant's cursor made an obvious move with intent to ping the minimap. This frame was the end of the time measurement for this event. As such, we ensured that the participant not only saw the enemy champion, but also internally recognized it as an enemy to ping. An example of this method is shown in Figures 5.1, 5.2, 5.3, and 5.4.

Figure 5.1: First frame enemy champion appears on minimap (bottom center, event 6). Start time measurement. Participant eye tracker (orange line and circle) and cursor (red cursor, blue line, and gold circles) hovering around minions while performing task 1 of farming.

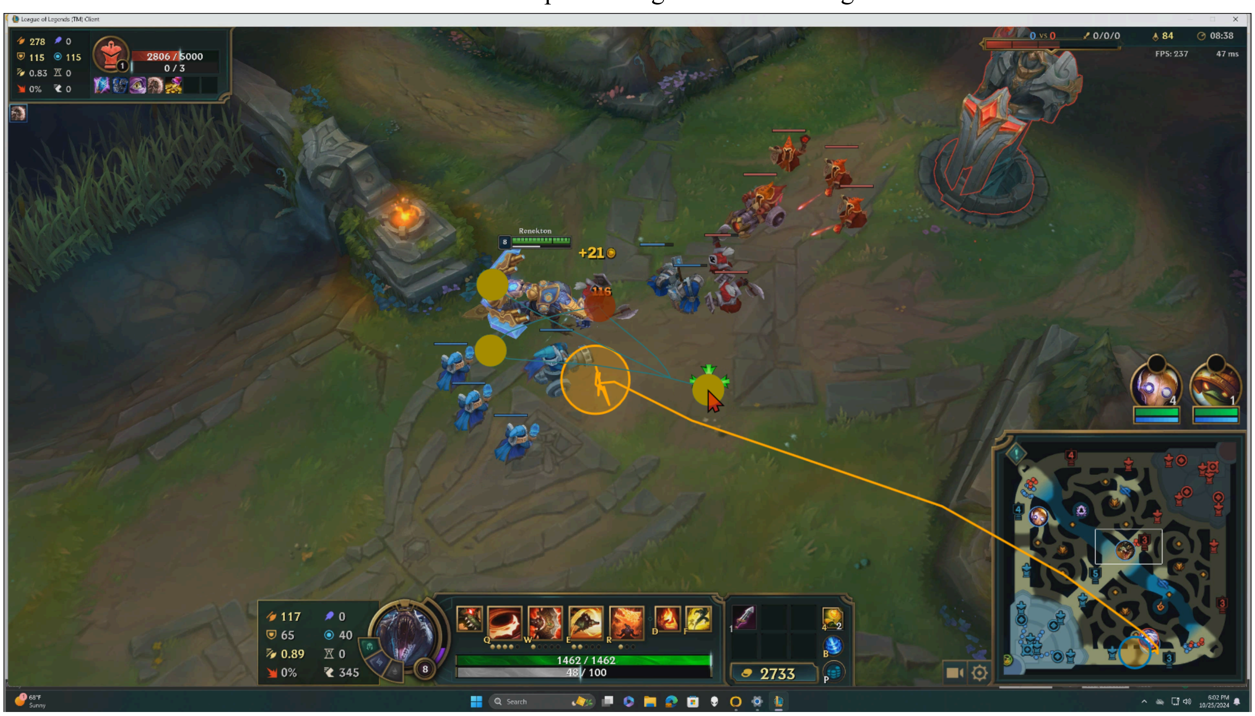

Figure 5.2: First frame that the participant eye tracker moves to minimap after the enemy champion appears, but the cursor is still inputting movement around minions. Continue time measurement.

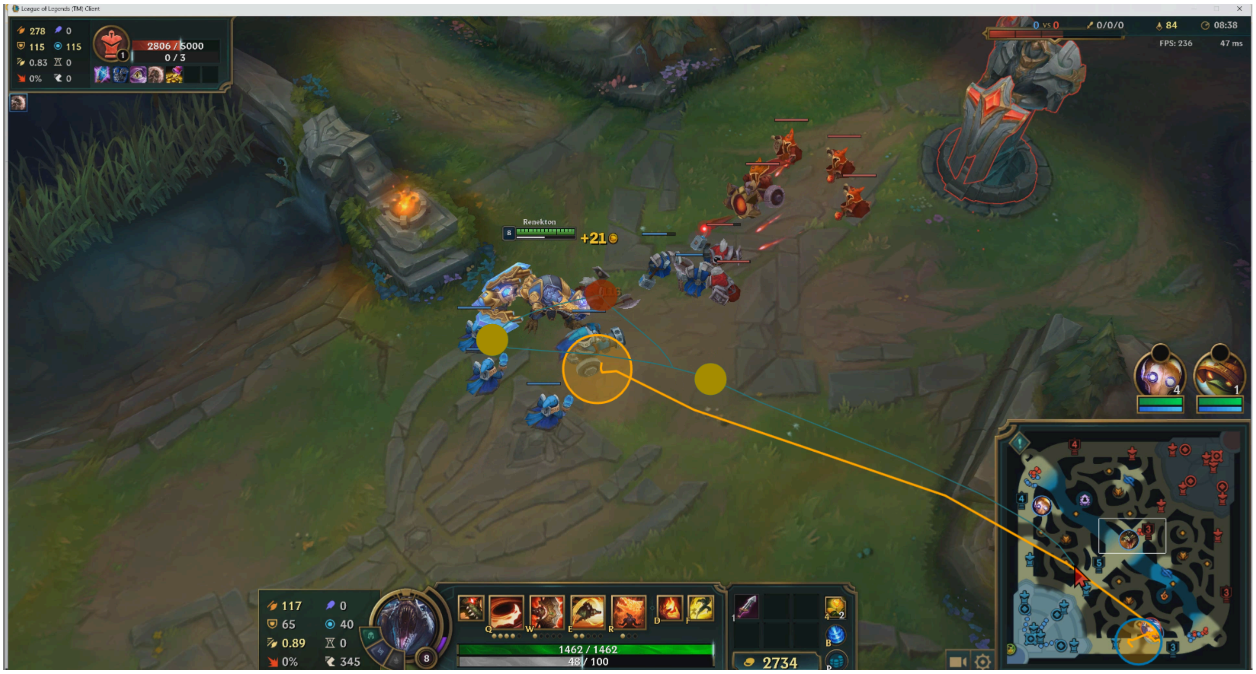

Figure 5.3: First frame participant's cursor makes an obvious movement towards minimap with intent to ping. End time measurement here.

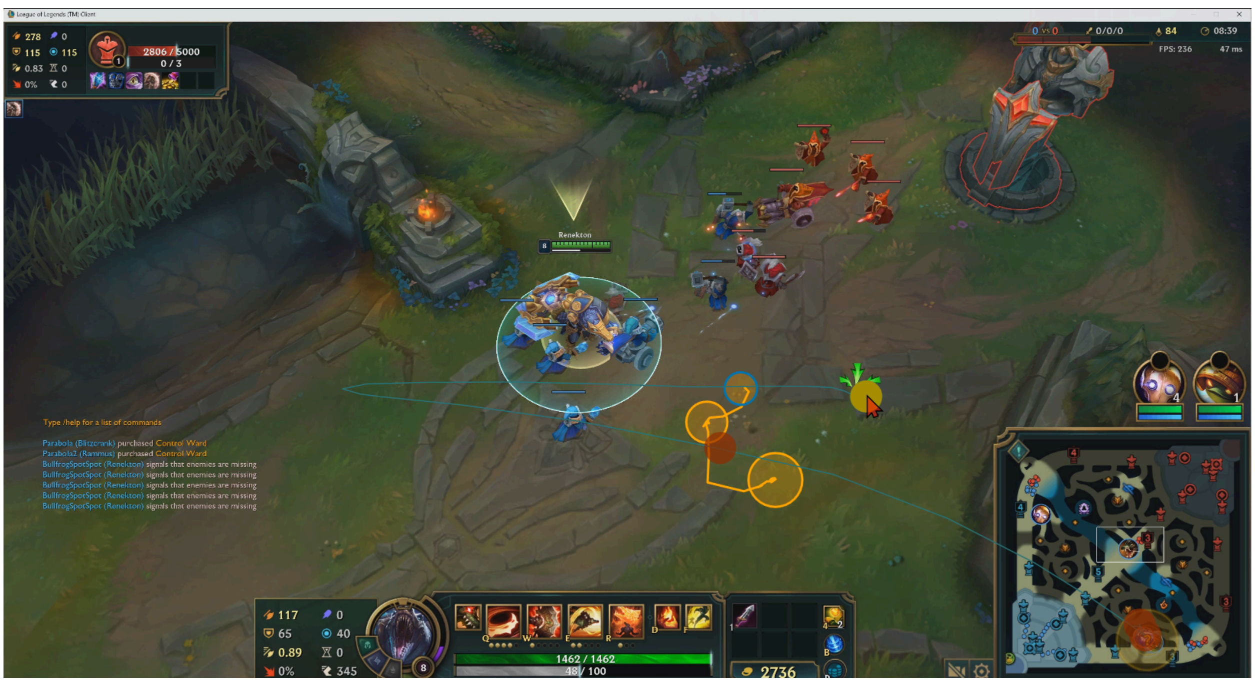

Figure 5.4: Participant performs in-game ping and resumes 'farming' task.

The iMotions software also allows for the designation of 'Areas of Interest' which we set up on the minimap in-game. By doing this, the software automatically tracked the dwell time, revisit count, and fixation count of the minimap for each participant.

Results

We have presented our collected data in Figure 6.1. Due to some complications, such as a severe outlier and unrecorded observations, we have omitted 2 participants from our results section. We calculated each participants' mean time to detect the enemy threat, as well as their CS (how well the player performed the 'farming' task at hand), dwell time (what percent of the player's gameplay was spent looking on the minimap), revisit count (how many times the player's gaze moved back onto the minimap), and fixation count (how many times the player's gaze focused on different things within the minimap).

	P1	P2	P3	P4	P5	P6	
Treatment	Large	Default	Large	Default	Large	Default	
Rank	Diamond	Emerald	Diamond	Emerald	Emerald	Diamond	
Champion	Galio	Irelia	Renekton	Zeri	Jax	Jax	
E1	1.503	0.899	0.9	0.761	0.522	0.607	
E2	0.873	0.902	0.774	1.982	0.747	1.746	
E3	0.763	0.638	1.301	0.881	2.015	1.643	
E4	Missed	0.645	0.518	1.373	0.601	1.106	
E5	1.487	1.666	Missed	0.493	1.387	0.806	
E6	1.197	0.774	0.892	0.642	2.143	1.811	
Mean Detection	**1.165**	**0.921**	**0.877**	**1.022**	**1.236**	**1.287**	
CS	77	88	88	87	85	84	98 Total Possible
Dwell Time (%)	11.90%	12.20%	14.70%	27.40%	12.90%	22.90%	
Revisit Count	148	191	208	258	103	215	
Fixation Count	274	319	338	725	324	349	

Figure 6.1: Data showing metrics for each participant- "Large" denotes a large minimap size while "Default" denotes the default minimap size

	Group 1: Default	Group 2: Large			
Mean Rank:	Diamond	Diamond			
E1 Mean:	0.7556666667	0.975	Encounter St Dev:	0.3476933515	
E2 Mean:	1.543333333	0.798		0.5453247351	
E3 Mean:	1.054	1.359666667		0.5438692551	
E4 Mean:	1.041333333	0.5595		0.3719224382	
E5 Mean:	0.9883333333	1.437		0.4960833599	
E6 Mean:	1.075666667	1.410666667		0.6064821239	
Mean Detect:	1.076	1.090	p-value: 0.94	Mean Diff: .0136	SE: .183
Mean Dwell:	15.63%	13.17%	p-value: .17	Mean Diff: 7.667	SE: 4.582
Mean CS:	86.33333333	83.33333333	p-value: .439	Mean Diff: 3	SE: 3.496
Mean Revisit:	221.3333333	153	p-value: .132	Mean Diff: 68.33	SE: 36.182
Mean Fixation:	464.3333333	312	p-value: .313	Mean Diff: 152.33	SE: 132.057

Figure 6.2: Quantitative Analysis on Difference of Means between the 2 treatments

In Figure 6.2, we calculated basic statistical data analysis for the difference in means for all the metrics between the 2 treatment groups. Overall, we found no statistically significant difference between the 2 means for all the metrics. However, it is important to note that the Mean Detection Time was higher for the large minimap treatment group, while the Mean Dwell Time, Mean CS, Mean Revisit Count, and Mean Fixation Count were lower for the large minimap treatment group. Also, 2 participants in the large treatment group failed to detect the enemy champion for 1 event each (P1 for Event 4 and P3 for Event 5 in Figure 6.1, denoted with "Missed")

Discussion

Although we did not find statistically significant results from our quantitative analysis, the combination of our results is able to provide some framework for possible inference. Due to the lower detection time for the default minimap group, and the lower dwell time, revisit count, and fixation count for the large minimap group, we believe there is some evidence that supports that players in the large minimap group focus more on peripheral vision to detect incoming enemy threats. This means that while the players in the default minimap group have to actively pay attention to the minimap to detect incoming threats, players in the large minimap group can focus more on the task at hand and react passively to incoming threats. Although the active group may detect enemies more quickly as they are constantly checking the minimap, the passive group can afford to pay more attention to their gameplay and check the minimap reactively when they detect an incoming enemy. Additionally, participants in the large treatment group were more prone to failing to detect an incoming threat as they were more passive in minimap monitoring.

These results may allow us to infer reasons as to why Riot Games has set their default minimap to a much smaller size. We speculate that Riot Games wants to make players actively look at the minimap as players may observe more information about the game state by actively monitoring the minimap. For example, players that check the minimap more are able to observe where allies and enemies are on other parts of the map and not just focusing on immediate threats to themselves. As such, we believe Riot Games has purposely set the default minimap size to incentivize players to look at the minimap more frequently. As such, we have learned more about the intention of minimaps in games. Not only are they used for detecting immediate threats to the player, the minimap is also essential for observing the full state of the game. As game designers, we should design minimaps to be a useful tool for players to gain information about the whole game state while not being distracting.

Limitations and Future Work

There were a handful of limitations and considerations we had after this research project, the largest one being a lack of an enemy lane partner. When playing a regular game of League of Legends, there is a member of the enemy team in the same lane as you applying pressure. Because we did not replicate this a couple of our participants actually mentioned casually after the fact that this lack of pressure most likely changed their performance from how it normally might be. If we were to do this research again, that would definitely be something to include. Precautions should be taken to try to make this aspect as consistent as possible as it will likely be extremely variable due to the nature of how the game is played and would have a large impact on the outcome.

Another limitation is the quite limited number of participants that we were able to bring in. Other than the one outlier whose results we excluded from our analysis, our participants were luckily pretty close in rank. In order to improve this research, a larger number of participants covering a larger spread of ranks would be better. Covering a larger swathe of ranks could also lead to more findings as there is the potential that much higher rank players use the minimap completely differently than a lower rank player.

Although its impact is likely quite minute, another variable that we weren't able to fully control was that the participants all played different champions. This could have had a slight effect on the CS measurement, as each champion in League of Legends has different abilities which have different capabilities to perform the 'farming' task with different levels of ease.

One other thing to include in a future version of this research would be to include more treatment groups instead of just the default minimap size and the maximum. More granularity between those two extremes could lead to more findings about what size is actually optimal.

Conclusion

This study examined the impact of minimap size on players' ability to detect incoming threats in the MOBA game League of Legends. By comparing performance and situational awareness between groups with default and enlarged minimaps, we sought to understand if an increased minimap size enhances threat detection without compromising gameplay focus. Our results indicate that increasing the minimap size enabled players to rely on automatic detection of enemy threats, resulting in players actively looking at the minimap less frequently than those with the default minimap. These findings show that a good minimap design should seek to find the balance between ease of detecting enemies and incentivizing the player to actively look at the minimap.

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Additional:

1. Some of the text in the Abstract, Introduction and Related work was translated from Chinese to English by ChatGPT. The instruction we gave to ChatGPT was “You are a linguist who is fluent in both Simplified Chinese and American English, so I'd like to ask you to help me translate the Chinese content into English.”
2. Figures 1, 2, and 3 are screenshots of League of Legends by Riot Games. Figure 4 is a screenshot from the website LoL Planner - RiftKit. Figure 5 are screenshots of the recording from iMotions of gameplay of League of Legends by Riot Games.