Asymmetric Game Design and Player Location: An Empirical Study on Mobile Play Experiences

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***Abstract*—The emergence of new hardware and software tools for game design and play provides an important opportunity to study how players interact and what new modes of play experiences achieve the highest overall player experience. This study examines an asymmetric game design – wherein players choose different roles in a one-against-many scenario. We empirically validate asymmetric game design through a formal usability study that measures how location (co-location vs. distributed location) and role selection influence overall player satisfaction. Results demonstrate that players enjoy asymmetric games and appreciate the ability to select their desired role without being constrained by other players' selection. Additionally, this study finds that real-world placement/location significantly influences play style. This study contributes to the field by defining the viability of this emerging game design pattern and points to novel opportunities for future research.**

Keywords—Asymmetric game design; player placement; player interaction; game usability study

I. INTRODUCTION

Recent developments in new game consoles and mobile devices afford new interactions among game players. Increasingly, mobile and personal screens are available such that each player can view their own unique perspective into game systems. We observe this in the embedded display of the WiiU controller, Microsoft's SmartGlass (wherein players can utilize Surface tablets and the Xbox), and Sony's integration of the PS Vita with the PlayStation console. Multiple, per-player displays allow for new game designs. Additionally, cross-media/platform play is more readily possible given always-connected mobile devices.

This research focuses on leveraging these emerging trends in game hardware to examine new ways players can interact. Our research questions are:

1. If each player has their own display and view into the game space, can we design a play experience that allows players to select their own role in the game in an imbalanced/asymmetric design while still maintaining an enjoyable experience for all?
2. Additionally, since each player has their own display and connects to the game through a high-speed network, can we change the location of the players, and what effect does the difference in location have on the players' behavior?

To answer these questions, we implement a classic game (Missile Command) with a slight variation to achieve the asymmetric game design: one player initiates all attacks by launching missiles, and all other players defend their unique cities. One player takes the role of the antagonist by using the PlayStation Move to target the cities of the defending players, while the other players defend their skyline using their handheld device. We created a game that can be played across multiple devices with different hardware, both mobile and console/desktop. By implementing a modern, mobile, and multiplayer variant of the classic game Missile Command, we demonstrate how innovative uses of mobile computing can lend itself to asynchronous play in a simple manner.

Asymmetric Gameplay is the idea of two or more players playing a game but having separate experiences [9]. By leveraging new gaming platforms and mobile devices, game designers have ample opportunity to explore and create more asymmetric games. Will players enjoy new asymmetric games, and would they accept new challenges that this will bring? Since modern computing and gaming environments include per-player displays/screens and high-speed networks, we can examine asymmetric game design by allowing each player to have a customized experience while being in the same or different locations.

We use the motion sensing technology of the PlayStation Move, but it would certainly be possible to implement this game using the Microsoft Kinect or the Nintendo Wii remote (or any other motion-sensing hardware). On the mobile client-side, we implement the game on PlayStation Vita and Apple iPad/iPhone (iOS) devices, but this client game could be extended and implemented on any mobile device with a network connection and display. We intentionally varied the hardware in this study's environment to demonstrate that asymmetric game design and play does not have to be limited to one console or even be limited to the same location.

The ultimate goal of our research is to not only develop a system that focuses on asymmetric game play, but to also study the interactions and reactions of many players as they engage in asymmetric play.

II. BACKGROUND AND RELATED WORK

The concept of asymmetrical gameplay is not new. In 2003 Nintendo released a game titled "Pac-Man VS" where many

players take on the role of the antagonists (ghosts) while just one of the players played as the protagonist (Pac-Man) [9]. The idea that all but one player uses the same mechanics is mimicked in our version of Missile Command; one player is the attacker and launches missiles at cities across the globe while all other players defend on their separate devices. The core difference between most multiplayer (symmetric or asymmetric) games in the past is that in our asymmetric design, all players have their own screens and are not tethered or shared between each other. In doing this, we aim to give each player a more personal experience while being connected to different players playing the same game.

Nintendo, Microsoft, and Sony are all involved and motivated by per-player displays that enable asymmetric design. Nintendo's WiiU remote display (embedded within the controller), Microsoft's SmartGlass (using tablets connected to the Xbox), and Sony's combining PlayStation and mobile Vita gaming all support this type of experience. With its built-in controller screen and games such as New Super Mario Brothers U, Super Mario Galaxy, Raymond Legends, and Zombie U, Nintendo has embraced this new design. PlayStation is also exploring asymmetric gameplay by utilizing the Vita in tandem with the PlayStation Console with its patch to Little Big Planet 2 [4]. Microsoft's SmartGlass is still early in its development but shows similarities.

One interesting concept that comes into play in asymmetric game design is that of the different types of motivation. Intrinsic and extrinsic motivation can play a big part in how and why a player enjoys a game. Intrinsic motivation is when the motivation is driven solely on the enjoyment of playing the game itself, while extrinsic motivated players relies on a goal or achievable task [6]. We believe providing unique per-player interactions and allowing the player to choose their role and work on a team (or work against a team) is both intrinsically and extrinsically motivating.

Reward systems in the game also play an important role in balancing the gameplay. As Mikael Jakobsson states, "Rewarding systems have always, and always will be, an integral core component of games" [7]. By adjusting reward systems in either the client side or the server, we can achieve a more balanced and well designed experience for each player.

Beyond whether the asymmetric design will enhance player experience, we also seek to answer whether location (and co-location) is important to the play experience. [5] research indicates that location of usability studies is important within the field of gaming, and our experimental design allows us to examine this previous research. In "The Space of Play of Games" [10], the concepts of locative (location) and technological dimensions of gamespace are important in defining how players interact. Additionally, [10] discusses the notion of mobility as an influence on gameplay. This study relies upon these premises heavily. By varying the location of players (from within the same room to separating them into different rooms), we can determine if players indeed change their play patterns and behaviors.

III. ARCHITECTURE & DESIGN

This game study utilizes a game similar to the 1980's classic *Missile Command*. Our version pits players against each other by letting them choose from one of two roles: the attacker or the defender. The attacker uses the PS Move wand to target the defenders, while the defenders are left to defend themselves from falling missiles by utilizing the touch screen of the device they are on. Players defend their given city from the attack of missiles using their PS Vita, Android, or iOS device. As missiles hit the player's skyline, the missiles will explode and take one health bar from the defender. The player with the least amount of damage received after time is up is the round's winner.

This system is built around a client/server setup utilizing TCP and UDP. This conforms to the API standard for the PlayStation Move.me system. In building this system, there were three main aspects to consider:

1. Design and build a PC game server (attacker screen)
2. Interaction with the Move.Me server (via PlayStation)
3. Design and development of the client (defender screen)

The PC game server is built using XNA 4.0. This server handles communication between the PS Move server and each client utilizing the TCP/IP protocol. The PC game server first creates a TCP connection with the PS Move in order to listen to any messages that the PS Move controller may send. In our case, the controller sends the X and Y coordinates of the place being targeted by the player. The PC game server then broadcasts these coordinates to each client. See Fig 1.

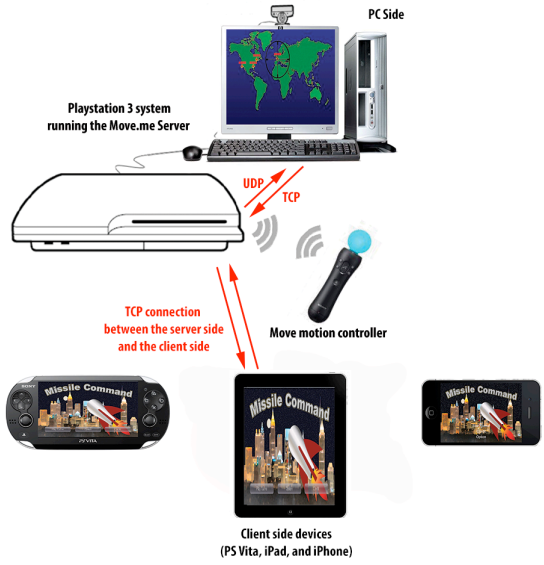

Fig. 1 System Overview – Many Mobile Clients & Single Server

The PC game server has two purposes: one is a data server, and the other is a game screen. At the start of the game, the PC server will generate a single world map that will serve as a map to other player locations for the attacker/antagonist.

As each client connects to the PC game server, they are issued a unique numeric ID number. This ID is used to organize communication between clients and the server as well as issuing a city for the client's player to defend. Once the PC game server recognizes a successful connection, it will draw an icon on the world map indicating the location and the amount of health for the connected city (as shown in Fig 2).

Fig. 2 PC game server screen

In using this kind of setup we attempt to show that this could be extended to many other platforms and technologies. All one would need to do is utilize networking protocols and threading to easily achieve and replicate our core implementation for asymmetric game design.

IV. Methodology & Experimental Design

This study examines player feedback when presented with a simple, asymmetric game and challenge. We repeated the study for a total of 8 rounds of play, with 3-4 different players in each round. Our study divided each round into 3 unique cases that were designed to mimic different play environments. During each case, players rotated so that each one played the part of the attacker and the part of the defender, and the location varied between:

1. All players being co-located (case 1),
2. The attacker in one space with all defenders in another space (case 2), and
3. All players in different spaces (case 3).

Case 1 simulates play environments in which all the players are present in the same physical location. In doing this we expose all players to potential interactions with each other during gameplay, and expose different dynamics as an outcome.

In case 2, all of the defenders were in a separate room away from tha attacker. This represents when all the defenders might be in the same physical location, but the attacker would be located at another physical location in the world. This exposes players to dynamics of not being able to see the attackers target, but the play is concentrated on their own screen; additionally, defenders enjoy fellowship with the other defending players (among their team).

Case 3 represents the scenario when all players are located in different physical locations. This exposes the players to a more isolated play experience while still being connected through assymmetric game play.

In each case, we measured the number of times the defenders attempted to defend their cities with the touchscreen interaction (click counts) and the amount of times the attacker pulled the trigger on the PS Move controller.

V. Experimental Results

The attacker trigger counts were divided into catagories based on the city that the attacker successfully hit. Fig 3 and Fig 4 show the number of defensive and attack interactions among all eight rounds. Each round consists of three location variations (cases 1, 2, and 3 as defined earlier), and each experimental run involved 3 or 4 players (each as an attacker or defender). As a result, there were 72 experiments conducted while varying the location and rotating users/players among the roles (attacker and defender).

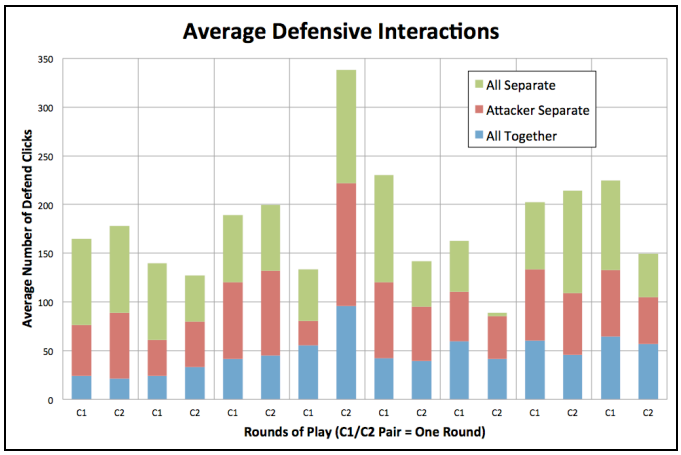

Fig. 3 Average Client Clicks

When examining results from Fig 3, we can compare how each city was defended across each round (eight rounds total) and across each location variation (the stacked/color bars). It becomes clear that, overall, the number of defensive interactions increased from case 1 (all together) to case 3 (all separated); this is as expected since players were gaining proficiency as they increased exposure in playing the game. In general, the number of defensive interactions was comparable between cities (C1 and C2) across all rounds except in rounds 4, 6, and 8; in these rounds, there is a wider variation in the number of defensive interactions (with a 2:1, 10:1, and 2:1 disparity respectively). We believe this is a result of the need to defend (and maps directly to the play style of the attacker shown in figure 4 below).

Fig 4 below shows that, in general, the number of attack interactions was comparable between cities (C1 and C2) across all rounds except in rounds 4, 6, and 8 (with a 6:1, 2:1, and 3:2 disparity respectively). In these rounds, one city was attacked more often that another. This is particularly pronounced in location variation case 3 (where all players are in separate locations) whereas in location variations 1 and 2 (wherein there is some co-locations of players), the number of attacks is more evenly distributed among the defending

cities/players. This indicates that when players are in different locations (non co-located), attacker behavior becomes more imbalanced.

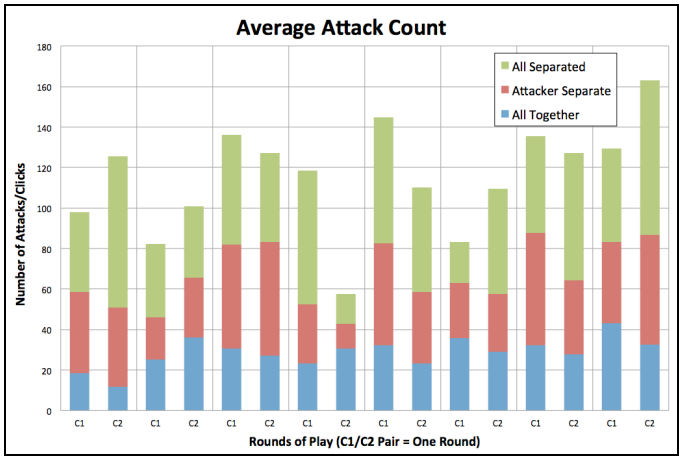

Fig. 4 Average Number of Attacks/Clicks (on Server)

VI. Post-Play Survey Results

Once the location and role variations of play testing were finished (after having played the game nine times in various locations and roles), players were asked to complete a post-play survey to provide their opinions about their play experience. The survey was completed in a separate room without the presense of the researchers. The following questions were asked:

A. How much did you enjoy playing the attacker/protagonist?
B. How much did you enjoy playing the defender?
C. Do you think this imbalanced play experience was fun?
D. Would you play games like this in the future?
E. How innovative/fresh is the concept of asymmetric play?
F. Would you be more or less likely to play games if they had this design?

The range of possible responses was 1 (most negative/disagree completely) to 5 (most positive/agree completely); a response of 3 would indicate a neutral response. Since all participants rotated among attacker and defender and all also participated in all location cases (cases 1, 2, and 3), the survey results apply to all varitions of play examined in this study. The following table shows the results of the survey; the number in the table indicates how many respondants selected this choice.

Table 1: Post-Play Survey Results

	Response					
Question	**1**	**2**	**3**	**4**	**5**	**Average**
A: Enjoy Attacker	0	1	4	8	12	4.40
B: Enjoy Defender	0	4	3	11	6	3.79
C: Fun	0	0	5	16	4	3.96
D:Play in Future	1	0	3	13	8	4.60
E: Innovative	0	13	5	9	8	3.34
F:Likely to Play	1	0	4	17	3	3.84

The responses to the survey indicate that players had a strong positive experience with the asymmetric game design. Even though the game system was not refined and, though functionally complete, lacked polish and better graphics, the players overall experience was better than average.

When asked to independendtly rate on a scale from 1 to 5 (did not like at all to loved it completly) how much they enjoyed playing as the attacker/protagonist, 80% gave it a score of 4 or better.

Players were asked how much they enjoyed playing as the defender on the same scale. 72% of the players gave this a score of 4 or better, while only 16% gave it a score of 2.

Participants were asked if they thought the imbalanced play experience was fun, and 80% responded with a rating of 4 or better.

When asked on a scale from 1 to 5 (would not play at all to would definitly play again respectively) if they would play games like this in the future, 84% rated this as a 4 ot better, while one player said they would not play at all.

When asked how inovative/fresh this concept of asymmetric play was, on a scale from 1 to 5 (not new at all to very inovative and creative), 68% gave it a rating of 4 or better. 20% and 12% gave it a score of 3 and 2 respectivly.

The final question asked if the players would be more or less likely to play games if they had this design. 80% gave this a score of 4 or better.

Overall, the players provided very positive qualitative feedback on the post-play survey. A sample of qualitative responses are below:

- The game was fun overall because roles were changed during the exercise. I particularly enjoyed the role of the shooter.
- The setup using the PS remote and another tablet was enjoyable and challenging
- Client UI was easy to use. Server side was much more difficult. Asymmetrical aspect seems more realistic because many things in the world are imbalanced
- I enjoyed being the shooter but being the defender was extremly hard. If the shooter was concentrating on you, it was pretty much game over.

Fig. 5 One attacker (with Move) and three mobile defenders (on iPads)

VII. Discussion and Conclusions

Although asymmetric gameplay is a relative new concept for most players, it is slowly starting to gain the attention of game developers and gamers. In the case of this study, almost all users enjoyed the game and left positive feedback. In one case, a user gave a lower score when answering the questions, but left good feedback informally to the researchers. A majority stated that they woud like to play other asymmetric games.

This study shows that different types of players like different play styles. This is evidenced by the comments that the players provided. Throughout the study, players expressed their satisfaction or disatisfaction of being either the defender or the atacker. For instance, one user really liked being the shooter and thought it was fun, but they also thought that being a defender was too hard. On the other hand, another player stated that shooting was too hard, while being a defender was more fun. This leads to an an observation that asymmetric design can allow people to choose the role that they want most in a game and have a better time than if they were assigned a specified role. Additionally, since players can choose their role in the game, everyone can enjoy the same game with other players who enjoy different roles.

Designing an asymmetric game can be a challenge, and this research demonstrates that care must be taken to implement an asymmetric design that is both playable/enjoyable while at the same time ensuring fairness among all players and roles. Future research into asymmetric gameplay should include more challenges and engagement for each player involved. Our study included multiple clients playing simultaneously, but if one client was not being attacked, then they were idle (i.e., for brief moments in the gameplay, a player had no required actions). While this isn't measured as a research question in this study, our study reveals this as an open research question: how can such 'idle' players be engaged and how can the game ensure that all players are in an optimal 'flow' state appropriate to their level of skill and experience with the game [3, 4].

One solution is to use DDA, or Dynamic Difficulty Adjustment. Like the suggestions Ernest Adams mentioned in *The Designer's Notebook: Difficulty Modes and Dynamic Difficulty Adjustment* [2], we could make more options in the game either by providing settable difficulty levels or DDA.

Another factor to be considered in the future is the architecture of the system. Since how efficient and effectivley the data passes betweeen client and server can affect the player's experience, one should look at ways to improve the performance of data passing. Since the message delivering in our game utilized TCP/IP and UDP protocols, we are able to design the game architecture using the idea provide by Dugki Min [8] so that in the future, if we need to handle dozens of simultaneously-connected clients, we could use this game architecture to maximize throughput and minimize response time. Researching different algorithms are necessary if we want to provide high performance in asymmetric gameplay.

Additionally, it is important to note that the location of the players in the game influences their play style. This is evident when examining the difference in the number of attacks and how the attackers played the game between cases 1, 2, and 3 (all together/co-located, all defenders co-located, all separated). Notice the results in figures 3 and 4 show that when separated, the attackers exhibited a more aggressive style of play to the point that one could conclude being co-located induces a more friendly style of play whereas being separated induces a 'bullying' style of play. When separated, the attackers tended to focus on a single defender and didn't spread the attacks among the different defenders as equally.

Overall, we haveadvanced the viability of asymmetric game design through the development of a cross-platform and mobile-based system. We have determined that players have a positive play experience with asymmetric design; further, there are noticable changes in aggression levels when players are distributed/separated in mobile play space. We envision exploring this novel design space and plan to extend this work to further advance asymmetric game design.

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