Exerwalls – an Exercise Alternative to Paywalls in Mobile Games

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Many mobile games implement paywalls, a monetization strategy whereby players are periodically forced to stop playing the game for a short period of time unless payments are made. While potentially effective at generating revenue, our survey results of over 50 people found that paywalls can frustrate players, reducing player retention and overall game ratings. As an alternative to the classic paywall, we propose an *exerwall* where players have the additional option of exercising to continue playing. The goal is to encourage physical activity, which is often reduced by playing games, while mitigating player frustration with paywalls. We designed and developed a mobile game called *Laser Planets* to evaluate the viability of exerwalls, incorporating walking as an alternative to waiting to continue play. Our week-long evaluation with over 20 players shows that exerwalls can be successful at both reducing frustration and increasing physical activity, and could potentially be used to integrate exercising into games that currently use paywalls.

Keywords: Exerwall, Paywall, Mobile Game, Exergame

Introduction

Physical inactivity increases the risk of many ailments including diabetes, cardiovascular disease, metabolic syndrome and some cancers [CDC, 2015]. In fact, physical inactivity is one of the leading causes of death in the United States [Mokdad, Marks, Stroup, and Gerberding, 2000] and obesity is the leading preventable cause of health problems afflicting young people. Current physical activity guidelines recommend that youth perform at least 150 minutes of moderate to vigorous physical activity weekly. Unfortunately, many children and adolescents have sedentary, "online" lifestyles (including social media, video games, smartphone and Internet usage) and do not get adequate exercise [Rideout, Foehr, and Roberts, 2010]. We believe that innovative ways to integrate exercise into electronic media that youth already enjoy (e.g., exergames) could encourage more exercise. For instance, bitwalking – a program in which people earn bitcoins (a digital currency) by walking – and *Pokémon Go* (The Pokémon Company, 2016) have already had a promising positive impact on walking [Arnett, 2016; Simmons, 2015].

In 2015, the estimated market for mobile games was approximately $30 billion [Pearson, 2014]. Surprisingly, 79% of this revenue was generated by "free to play" games [Grubb, 2014] which can be downloaded and played without requiring players to spend money on the game. Free to play games become profitable for the developer by incorporating small, in-game purchases ("micro-transactions") that lure players into spending small amounts of money on game items (e.g., lives or levels). These micro-transactions are often facilitated by *paywalls* whereby game content is "walled off" from players until they pay, typically by spending real money linked to electronic payment methods. However, more recently a variant of paywalls has emerged whereby players are allowed access to content after waiting for a certain amount of time. Figure 1 is a screenshot of such a paywall, in this case from the game *Dungeon Keeper* (Mythic Entertainment, 2013). In this example, the player can proceed through the game immediately by paying (the green "1 Rush" option) or s/he can wait a pre-determined amount of time (the "timer" indicated in the text) to continue playing.

While effective at generating revenue, paywalls are largely disliked by gamers and may hinder the growth rate and revenue of games that include them. While a relatively small group of enthusiastic players can sustain a game by consistently spending money on paywalls, more beneficial may be for developers to focus on growing a game's player base by expanding paywall options. In the long term, the larger user may also increase overall revenue.

Motivated by ventures such as bitwalking mentioned above, we propose *exerwalls* as a new kind of paywall where, in addition to choices of paying or waiting, a player also has the choice of exercising to shorten his/her wait time. Exerwalls are intended to promote physical activity while giving the player more control since a player can complete the exercises required to navigate the wall at his/her own pace. More-

Figure 1. Paywall example (*Dungeon Keeper*, Mythic Entertainment, 2013). Player can either pay or wait predetermined amount of time to continue play.

over, the added physical activity may keep players invested in the game by eliciting feelings of self-accomplishment via exercise and may also result in more habitual exercise outside the game. Compared to traditional paywalls, the exercise option does not replace the option for paying or waiting, thus allowing developers to continue to use paywall revenue models, but with added benefits to players who choose to exercise instead of waiting. In fact, the benefits of exerwalls may also help to retain more players by reducing the current frustration with traditional paywalls, growing a game's player base and generating more revenue overall.

In this paper, in order to better understand gamer dispositions towards paywalls, we conducted a survey of 50 students. Survey results show that all forms of paywalls can be frustrating, but that exerwalls may be a viable option to retain player interest in a game. To facilitate a comprehensive evaluation, we developed an original mobile game, called *Laser Planets*, that we instrumented with exerwalls. Game development included completely original art, design and programming with focus group testing to iteratively refine the game to make it enjoyable and to determine the best points in the game to place exerwalls.

We tested our game in a one-week user study, recording indicators of engagement including each player's daily step count, the times s/he opened or closed the game, and choices made[1] (wait or walk) when presented with exerwalls. Over 20 students participated in the study, playing Laser Planets daily over the course of a week. Analysis of the data shows that when given a choice, players chose to walk and wait equally often, suggesting that walking and waiting are both viable paywall options. Additionally, when players encountered a "walk" wall (with no choice to wait), they walked significantly more than when they experienced a "wait" wall (with no choice to walk). Players also showed a slight increase in their average daily step counts over the course of the week-long study.

The rest of this paper is organized as follows: Section 2 provides some background on paywalls, particularly for mobile games; Section 3 itemizes our methodology; Section 4 presents our survey and survey results; Section 5 describes the *Laser Planets* mobile game we developed in order to evaluate exerwalls; Section 6 details our user study and analysis of the results; and Section 7 summarizes our conclusions and presents possible future work.

Paywalls

This section defines paywalls and provides examples from commercial games.

Paywall Definition

Paywalls are an in-game mechanism to restrict content from players until they have paid for it with money, time, or effort. Originally used in Websites to restrict certain pages to paid subscribers, paywalls have become common in mobile gaming as a way to generate revenue. While traditional computer games require players purchase the entire game content before playing, paywalls use the rationale that players are more likely to pay multiple, small amounts in the middle of a game than they are to pay large amounts before playing. Modern paywalls can be broken down into four categories [Doe, 2015]:

1. **Classic paywall.** The classic paywall, sometimes called downloadable content, requires players to make purchases in order to acquire some form of content such as extra characters, new quests, or additional game maps. The only way players can access the new content behind a classic paywall is to make the purchase.

2. **Patience-wall.** The patience-wall forces players to wait a fixed amount of time before being allowed to complete an action or in order to obtain a reward. These actions could range from completing the building of an item to gaining another life. Patience walls typically have waiting timers that can be bypassed by making a small purchase. Compared to the classic paywall, if a player is patient enough s/he can simply wait, accessing all of the game content for free.

3. **Pressure-wall.** The pressure-wall integrates a social aspect whereby players can easily observe how friends playing the same game are progressing, facilitating competitive pressure. Pressure walls often notify players when their friends are close to beating their scores, pressuring players that want to be better than their friends to pay. Pressure-walls thus target both impatient players and competitive players, increasing the number of players who potentially pay for progress.

[1] We did not incorporate a payment option in our study.

4. **Ad-wall.** The ad-wall makes players watch an advertisement before allowing further progress in the game. Ad-walls can promote game titles made by the developers to increase the interest in the developer's other games, or generate revenue indirectly by showing a 3rd party's paid advertisement.

Paywall Examples in Mobile Games

Paywalls are a widely utilized monetization strategy, encompassing many varieties of mobile games. Paywalls are used in collectible card games such as *Hearthstone* and *Heroes of Warcraft* (Blizzard, 2014), puzzle games such as *Candy Crush* (King, 2012), strategy games such as *Game of War – Fire Age* (Machine Zone, 2013), and even mobile adaptations of classic games such as *Monopoly* (Hasbro, 2015). Most of these games are considered "free to play" meaning that players are not required to spend money on the game in order to start playing it. In fact, only 1.35% of players spend any money on mobile games and 62% of all mobile game revenue comes from only 0.13% of players [Takahashi, 2014].

Game of War is one of the most successful "free to play" games in the app-store. In 2015, the game made $1.5 million per day through the use of paywalls [Watson, n.d.]. In Game of War, players build a stronghold and an army in order to compete with other players. The building and upgrading of the stronghold and army units takes time, ranging from a few minutes to over a month. These patience-walls can be bypassed through the use of in-game currency purchased with real money. Almost everything in the game can be done without paying, but doing so requires waiting with the progress of other players (that may pay) being readily visible.

Candy Crush is a popular puzzle game that made approximately $900,000 daily in 2015 [Watson, n.d.]. Candy Crush utilizes pressure-walls, comparing a player's score on each level with the scores of his/her friends. Every time a player fails a level, a life is lost. In order to get additional lives, players have to either wait or pay – a patience-wall.

Hearthstone: Heroes of Warcraft is a collectible card game that made over $10 million between 2014 and 2015 [Watson, n.d.]. Hearthstone utilizes paywalls where players need to purchase digital cards to add to their collections. Given enough time, players can eventually earn enough in-game currency to purchase cards without real money, but this happens quite slowly – a patience-wall. In order to build a deck that can compete with other players, "booster packs" of additional random cards must be purchased – a pressure-wall.

Methodology

In order to evaluate exerwalls as a possible alternative to patience-walls, we deployed the following methodology:

1. Assess user opinions on exerwalls and patience-walls
2. Develop *Laser Planets*, a mobile game with exerwalls, suitable for a user study
3. Conduct a user study to evaluate the efficacy of exerwalls in *Laser Planets*
4. Analyze the results of the user study

Survey

In order to assess current opinions on paywalls and explore opinions on the viability of our proposed exerwalls alternative, we conducted an online survey. In addition to basic demographic information, our survey gathered exercise, mobile gaming habits and opinions on paywalls. Paywall-related questions included:[2]

- How likely are you to spend money on a mobile game?
- Have you played games that include paywalls?
- If you encountered a paywall preventing play that costs *X* dollars, how long would you be willing to wait instead to continue without paying?
- If you encountered a paywall preventing play that costs *X* dollars, how long would you be willing to *walk* instead to continue without paying?

The survey questions were coded into an online format using the Qualtrics survey tool[3] and distributed to Worcester Polytechnic Institute (WPI) campus mailing lists, primarily targeting students.

Results

Valid survey responses were received from 56 subjects – 93% college students and 7% WPI staff. For gender, 68% were male, 28% female, and 4% unspecified. Subjects' ages ranged from 18 to 51 years with a median age of 20 years. Fifty-one percent reported being in Computer Science with most of the rest in Engineering.

Respondents reported a fairly inactive lifestyle, with 31% exercising fewer than 4 hours per week, far less than the recommended amount of 450 minutes per week [Association, 2015]. For many students, their only exercise is walking to and from classes. Only 25% of students paid attention to the amount they exercise.

Seventy percent of respondents use mobile phones for gaming. Twenty percent try to avoid paywalls and 68% are extremely unlikely to spend money on mobile games. Sixty-eight percent of the gamers said that they play games at least once per day and 82% of the gamers stated that they had

[2]The full list of survey questions can be found at: http://www.cs.wpi.edu/~claypool/mqp/paywall/

[3]https://www.qualtrics.com/

Table 1
Summary of Survey Results

OVERALL	
Use phones for gaming	70%
Unlikely to spend money on mobile games	68%
GAMERS	
Play once or more per day	68%
Have experienced paywalls	82%
Felt paywalls negatively impacted game	84%
Would exercise instead of waiting	75%
Exercise time as percentage of waiting time	33%

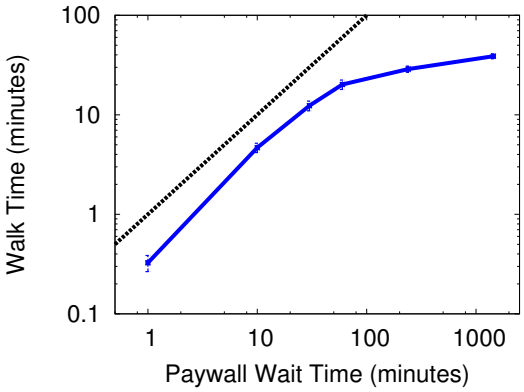

Figure 2. Amount of time player is willing to walk to continue playing instead of waiting to continue playing.

played games with paywalls. Of the gamers that had experienced paywalls, 84% felt paywalls negatively impacted their opinions of mobile games. When asked about an option to exercise instead of waiting, responses were generally positive. Most players who would not spend money on mobile games would exercise to get around paywalls, suggesting exercise times of up to an hour to avoid paying money, and exercise times of about 1/3 of the waiting time to avoid waiting.

Table 1 summarizes the survey results.

Figure 2 depicts in more detail the length of time players would walk to continue playing a game rather than wait through a paywall. The horizontal axis is the time a paywall would require the player to wait to continue playing and the vertical axis is the time the player could choose to walk, instead. Note both axes are shown in logscale for readability. Each point is the mean response of all subjects with the bars showing the standard error of the mean. The dashed diagonal line shows the point where walking time would equal waiting time. In general, the walk values are positive in that players are more willing to exercise by walking rather than waiting. For up to about an hour, players are willing to walk on average about one-third the waiting time.

Figure 3 depicts the amount of time players would walk

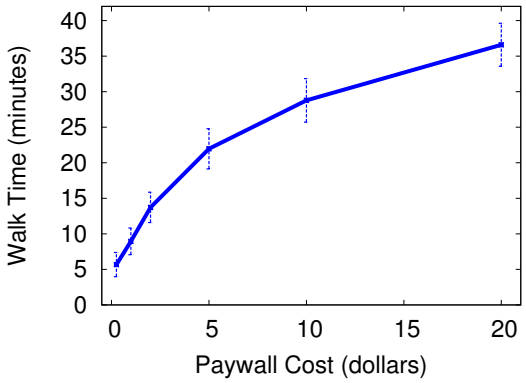

Figure 3. Amount of time player is willing to walk to continue playing instead of paying to continue playing.

to avoid paying for a paywall. The horizontal axis is the cost to bypass a paywall to continue playing and the vertical axis is the time the player would choose to walk, instead. Each point is the mean response with the bars showing the standard error of the mean. In general, there is a logarithmic progression with the time players are willing to walk with the increase in paywall cost. Game vendors seeking to deploy exerwalls in place of traditional paywalls may use this information to determine levels of exercise that are equivalent to various amounts of monetary gain.

Mobile Game

In order to assess user interactions with exerwalls and the overall player experience in an actual game, we developed *Laser Planets*, an original mobile game to allow full control over its implementation. We specifically needed the ability to insert exerwalls and patience-walls at various points in the game, as well as to control exerwall parameters such as steps and wait-time required to get past these walls. In addition, we needed to gather game play and exercise statistics in order to completely assess efficacy and player engagement. Last but not least, we needed a game that was engaging enough so as not to skew a paywall user study due to boring or difficult gameplay.

Based on our prior development expertise, we developed on the Android operating system using Libgdx,[4] a Java game development framework. Libgdx allowed for focus on the game programming by abstracting away the low-level OpenGL graphics commands. Procedural content generation was used to algorithmically generate the art assets. A minimalist 2D art style was selected to go along with the procedural generation, specifically a space exploration (solar systems and planets) theme, which also presented a useful, broad set of game options.

[4]https://libgdx.badlogicgames.com/

Focus Group

After an initial prototype implementation, final development was informed by focus group testing with game enthusiasts. Participants were sought out from friends and colleagues with a known interest in mobile games. Attendance was encouraged by providing refreshments (pizza).

At the start of the focus group session, the preliminary game design and implementation was presented, followed by a discussion guided by a list of topics. Questions on each topic were designed to get feedback on current game ideas and implementation and to foster discussion on new ideas.

1. Graphics: Is the current artwork appealing?
2. Storyline: how critical is a storyline for an engaging game? How should a storyline be integrated into the game (e.g., cut scenes or text)?
3. Currency: should the in-game currency be removed or expanded? If used, what for?
4. Planet Options: are the early game options equally balanced, interesting and useful in the game?
5. Character Customization: how interesting are customized characters versus purely procedurally generated characters?
6. Inventory Items: what are interesting items to add to enhance game strategy and tactics options?
7. Login Bonus: what is a good in-game reward for playing the game every day?
8. Rare Events: what extra content should be provided to keep time-invested players interested in the game?
9. Player versus Player: how much does playing versus friends versus the computer help with game interest?
10. Star Map Screen: Would different star types add meaning for player exploration?
11. Graphic Map: How much would a visual map of planets increase interest in the game?
12. Paywalls: Where in the game should patience-walls and exerwalls be placed?
13. Sound: how critical is sound for an engaging game? What is the relative importance of sound effects versus music?

The focus group lasted one hour. During the session, the audio was recorded for transcription and detailed analysis offline. The transcription can be found in our full report [Baumann and Gallo, 2016].

Table 2
Focus Group Feedback

Topic	Feedback	Imp.	Ease
Currency	Needs specific purpose	M	L
Collectibles	Hats, badges, etc.	H	M
Character	Modular	H	M
Rare events	Stars, black holes, etc.	H	M
Star map	Visual for planets owned	M	M
Story	Cut scene	M	M
Daily bonus	Login bonus, step bonus	M	M
Environment	Boss battles, end-game	H	M
Upgrades	Planet, ship, character	H	H
PvP	Leaderboards, combat	H	M
Ship	Skins, colors	M	H
Sound	Yes, most sound effects	H	L

In analyzing the transcript, we ascertained the importance of clusters of items based on focus group feedback, which we coupled with the projected difficulty in implementation. Rating scales are Low, Medium, High where "L" means low importance to players and high difficulty in implementation, and a "H" means high importance to players and relatively easy to implement. Table 2 shows the results, where the "Imp." column refers to the importance to players and the "Ease" column refers to the ease of implementation.

Generally, items that were high in at least one of the columns were targeted for our final game implementation, including collectibles, upgrades, and special/rare events, with the exception of sound effects. Also included in the final implementation were an in-game currency and a brief story.

Game Design

The final game is called *Laser Planets*. The player seeks to build a team with the strongest planets for galactic domination. In the game, planets are alive and can shoot laser beams to battle other planets.

Home planet. Each player starts the game by selecting a home planet. Planets vary in appearance by their procedurally generated continents and clouds in both color and size, along with their eye designs. Each planet has attributes of size, energy output, base color, and rank. The planet's size and energy output are used during a laser battle. The base color is used for bonuses against enemy planets. The rank represents a planet's overall strength. Figure 4 depicts the start screen where a player can randomize the pictured planet, using the "Randomize" button, varying color, eyes, size and energy output. When satisfied, the player selects his/her home planet using the "Select" button.

Exploration. Players explore by flying to different stars selected on the explore screen, shown in Figure 5. Flying to a star requires a fuel unit. Once out of fuel units, a player must

Figure 4. Choose home planet.

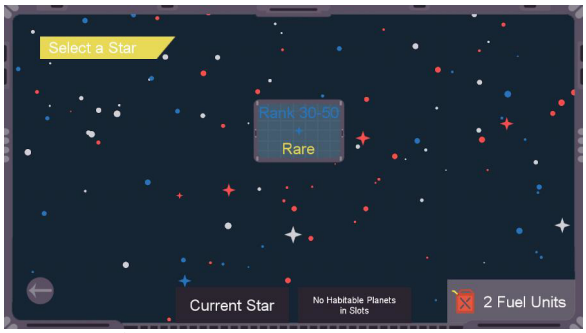

Figure 5. Explore stars.

refuel before being allowed to travel again. Players select stars to travel to as they float by, with the fuel units required for travel shown in the bottom right. Each star is a specific color: red stars (red dwarfs) have a solar system with planets ranked 1-15, white stars (white dwarfs) ranked 15-30, and blue stars (blue giants) ranked 30-50. Each star also has the potential to be rare which means its planets are more likely to have rare eyes or wear a power-up hat.

Figure 6 depicts a screen shot of a star's solar system. Each star's solar system is randomly generated with 1–6 planets, displayed with rank and base color. Players can select and then fly to an individual planet to begin a laser battle.

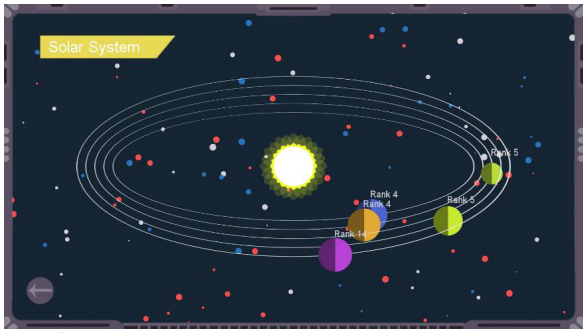

Figure 6. Select planet to commence laser battle.

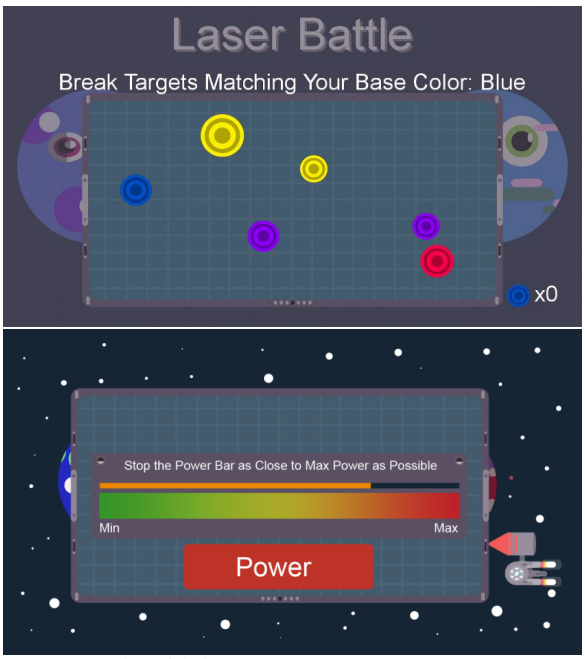

Figure 7. Battle with lasers.

Laser Battle. In a laser battle, the player first tries to click on pop-up targets that match the planet's base color and then attempts to stop an elastic power bar at its peak. Both mini-games are shown in Figure 7. In the top screen, each matching target tapped adds to the final energy output, while tapping non-matching targets deducts from the final output. In the bottom screen, the bar moves more quickly the closer it gets to the maximum, with the closer the player comes to stopping the bar at the maximum, the more the contribution to the final energy output.

The laser battle commences based on the final energy output from the mini-games. If the player wins, s/he can: a) absorb the planet to gain experience and rank, b) take the planet's resources to gain crystals (currency), or c) keep the planet to expand his/her roster.

Shop. In the shop, shown in Figure 8, players use crystals to purchase unique hats with power up abilities to give a planet a small advantage in future laser battles against enemy planets. Some power ups increase a planet's strength for a certain base color or provide a chance for a one hit knock out during a battle.

Manage planets. Players can manage planets with the interface in Figure 9. Here, players view acquired planets, change the order of the planets during battle, release a planet, and swap hats for the planets, shown in Figure 8. A defeated planet can also be healed.

Boss battle. In a boss battle, shown in Figure 10, a player does a laser battle against Boss Jim's planets, which have a higher percentage of being rare and having hats. If defeated,

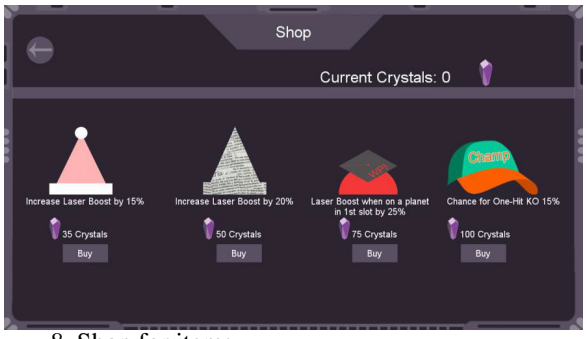

Figure 8. Shop for items.

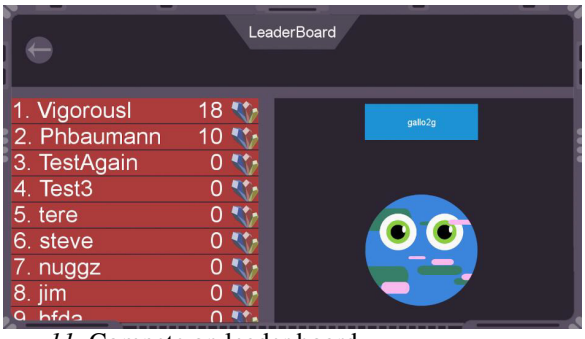

Figure 11. Compete on leader board.

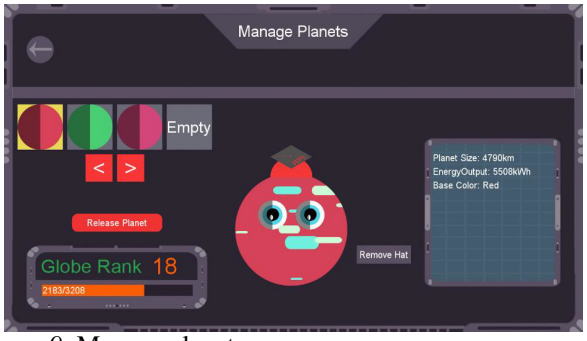

Figure 9. Manage planets.

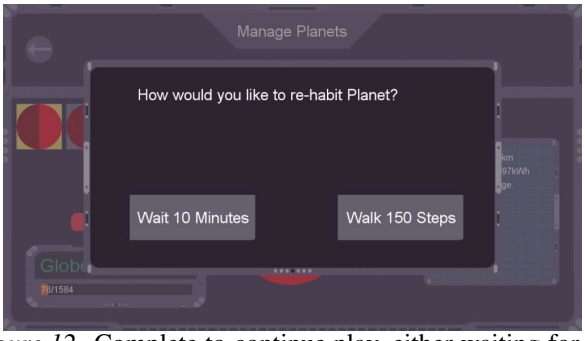

Figure 12. Complete to continue play, either waiting for 10 minutes or walking 150 steps.

Boss JimâĂŹs planets also yield mega crystals that are used to determine a player's rank, shown in the leaderboard in Figure 11. Each victory also increases the subsequent difficulty of defeating Boss Jim.

User Study

Paywall Implementation

Exerwalls and patience-walls were placed in Laser Planets. We did not allow a player to actually pay through any wall, instead focusing specifically on exercise and/or wait options. The exercise was walking, measured as steps taken and obtained through the smartphone's built-in pedometer.

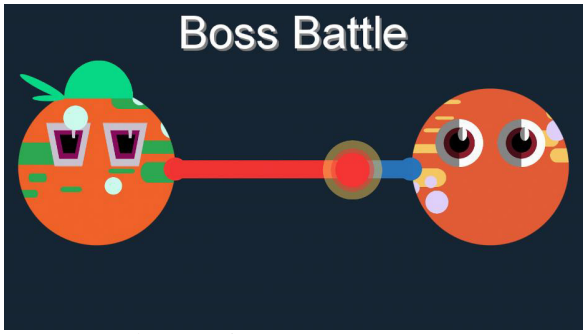

Figure 10. Battle Boss Jim.

In Laser Planets, there are two different places where a paywall appears. The first place is in the explore screen (Figure 5). When out of fuel, a new button appears on the screen that, when pressed, opens a paywall popup before the player can continue. The second place is when a planet is defeated in battle and must be healed before it can be re-inhabited – pressing the heal button opens a paywall popup, such as the example shown in Figure 12. Pilot studies were used to tune the paywalls to 300 steps and 20 minutes for fuel and 150 steps or 10 minutes for re-habitation. For the user study, when presented with a paywall, users were randomly given one of three outcomes: wait, walk or a choice between wait or walk.

User game session statistics were gathered via a centralized database. Data gathered included each time Laser Planets was open and closed as well as wall options – walk, wait or choice between walk or wait. Google Fit was used to record step count, which was retrieved by the History API to provide a step count every 2 minutes.

Procedure

The user study lasted for a little over one week in April, 2016. Potential users were solicited through WPI email aliases. Incentives included a raffle for two $25 Amazon gift

cards and a $50 Best Buy gift card for the user ranked first on the leader board at the end of the week.

Users first filled out a pre-survey on demographics, exercise habits, Android phone use and an Institute Review Board (IRB) consent. Then, participants downloaded the game as an Android application package (APK) and followed installation instructions. A brief tutorial provided instructions on the game itself.

Each user was asked to play the game at least once per day for a week. At the end of the week, users filled out a post-survey with closing questions about the game and paywalls.

The full set of pre- and post-survey questions and the installation and game instructions can be found in the full report [Baumann and Gallo, 2016], also available online.[5]

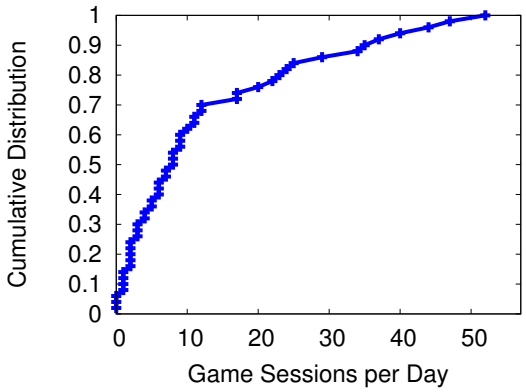

Figure 13. Cumulative distribution function (CDF) of mean game sessions per day for all users.

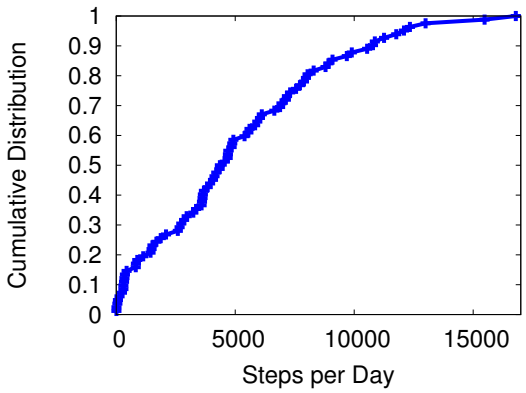

Figure 14. Cumulative distribution function (CDF) of mean steps per day for all users.

Results

Aggregate Data. Twenty-one students from WPI participated in the user study. Five were female and sixteen were male. Ages ranged from 18 to 31 years with a median age of 21 years, all studying Engineering or Computer Science.

The users played a total of 1289 game sessions during the week with a total of 78 hours, 38 minutes, and 5 seconds spent playing the game. The median number of game sessions per day was 8. The mean game session length was 3 minutes and 38 seconds. Users walked a total of 374,772 steps, for a mean of 4997 steps per person per day and a median of 5391, about half of the recommended 10,000 steps per day [Rettner, 2014]. From the pre-survey, 31% of the users participated in only 0-4 hours of physical activity per week and 40% participated in only 5-10 hours of physical activity per week.

Figure 13 depicts a cumulative distribution function (CDF) of the mean number of game sessions users played Laser Planets per day. From the graph, the median user was engaged, playing about 9 sessions per day (the mean is 12.9). Only about 5% of the users played less than once a day, while about a quarter played over 15 times per day.

Figure 14 depicts a CDF of the mean number of steps users took per day. From the graph, the median user took an average of about 5000 steps per day (the mean is 5102) and 10% of the users averaged over 10,000 steps per day. However, about 10% of users took an average of fewer than 500 steps per day.

Paywall Choices

When users encountered a paywall, about one-third of the time they had a choice – either waiting for the required amount of time or walking for the required number of steps – before being able to continue playing. Figure 15 depicts the percentage of time (the y-axis) users made the choice (the x-axis). From the graph, the percentages for each choice are similar. This suggests that the new exercise option (in our case, walking) may sometimes be utilized by users in favor of waiting.

To examine individual user choices, Figure 16 depicts a CDF of the user choices when presented with the choice option. The x-axis is the number of times users made a particular choice (walk or wait) and the y-axis is the cumulative distribution. There are two trendlines shown, one for each choice. From the graph, there is an equal distribution of choices across users, with the exception of the wait option favored quite heavily for 3 users. This reinforces the efficacy of an exercise option for a paywall for most users, suggested by Figure 15, but does indicate some users may still overwhelmingly choose a wait option.

Effects on Walking

Figure 17 shows the trend in the mean number of steps taken over the course of the user study. The x-axis is the day

[5] http://www.cs.wpi.edu/~claypool/mqp/paywall/

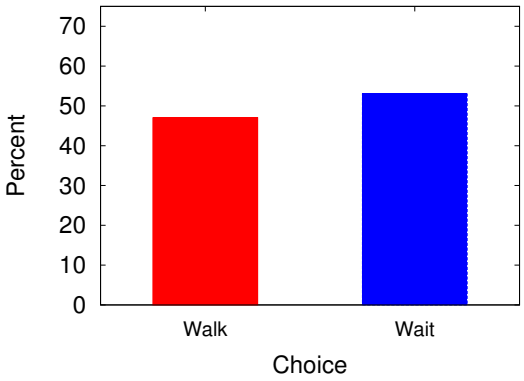

Figure 15. User paywall choice selection.

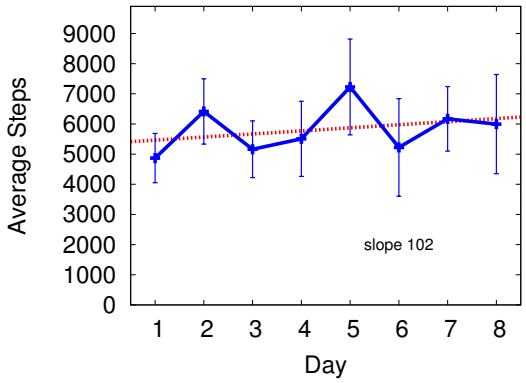

Figure 17. Average steps per day averaged over all users.

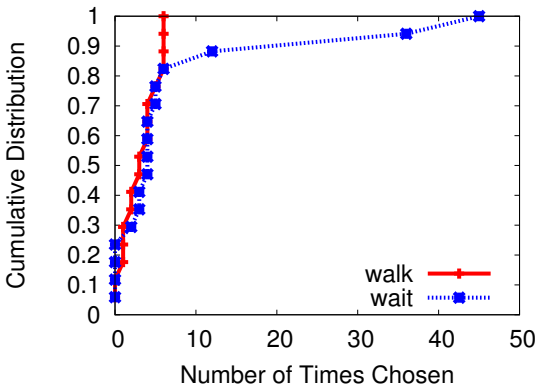

Figure 16. User paywall choice selection.

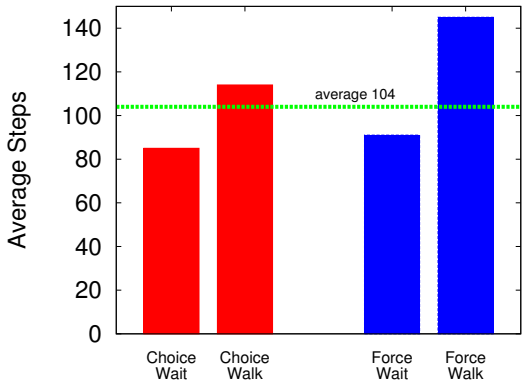

Figure 18. Average steps taken by all users given wall options.

of the user study (the study lasted a little over a week) and the y-axis is the mean number of steps. Each point is the mean number of steps across all users for that day with the bars showing the standard error of the mean. The dashed line is a trend line, the least squares line fit of the mean values. From the graph, there is considerable variation in the mean values, but a noticeable upward trend – the slope is +102 steps/day – suggesting slightly more steps per day at the end of the study than at the beginning.

Figure 18 shows the combined analysis of the paywall presented and/or chosen (walk or wait) with the average number of steps taken. This analysis examines the average number of steps taken by each user for 20 minutes after presented with a paywall. The time window of 20 minutes is used since that is the longest patience-wall waiting time. The horizontal axis shows four cases, the two on the left when there is a choice (walk or wait) and the two on the right when there is no choice. The y-axis is the average number of steps taken. The horizontal dashed line shows the overall average number of steps over 20 minutes for reference. From the figure, when the exerwall has the user walk, whether through choice or not, the user takes more steps than a patience-wall option of wait. Although not definitive, this suggests the exerwall may have encouraged users to exercise more.

Conclusions

Mobile gaming is a multi-billion dollar industry [Pearson, 2014]. Most of this revenue is generated from paywalls in free to play games [Grubb, 2014]. Unfortunately, paywalls are generally frustrating to players and games with them are often avoided by potential players. Moreover, classic paywalls do nothing to encourage players to exercise, merely having players pay or wait to continue playing. We propose exerwalls as an alternative to traditional paywalls. Exerwalls keep payments as a form of revenue for mobile developers but replace the wait timers of traditional paywalls with modest exercise (e.g., walking).

We conducted a survey to assess players' opinions of classic paywalls and receptiveness to our exerwall idea. Survey results show most people use their mobile phones for gaming but are unlikely to spend money on mobile games, instead

waiting through any paywalls. About 3/4ths of people surveyed would choose to exercise instead of waiting for any paywall time limit, exercising up to 1/3 the amount of the waiting time.

We developed *Laser Planets*, a custom mobile game with an exerwall implementation to evaluate exerwalls in comparison to typical paywalls, allowing exploration of whether or not exerwalls can be effective in increasing player exercise. We conducted a one-week user study with over 20 players, most playing our game daily, and gathered data on game sessions and walking steps.

Analysis of the data shows exerwalls have the potential to increase player exercise. Players who either chose to walk or were forced to walk tended to increase their step count immediately after encountering the wall. We also saw an modest overall increase in the average daily step count among all users in our study. In addition, players chose to wait almost as often as they chose to walk, which suggests the walk and wait options could be interchangeable for developers as alternative paywall options. The difference between the exerwall versus the classic paywall is that with an exerwall, players that do choose to complete the task have the added health benefit of being active.

Future Work

While our research shows that exerwalls have potential to be replacements for waiting done with typical paywalls, there is room for future research.

Additional studies with larger numbers of users across a broader set of demographics and longer periods of time can help better understand the impact of exerwalls. Individual analysis of exercise (e.g., daily steps) before being introduced to a new game with exerwalls and after can help determine potential benefits to individuals.

Future research could explore the number and variety of exerwalls to assess the impact of placement and duration of exercise. Gathering user satisfaction / quality of experience may help with exerwall placement.

Developers will want to explore the effects of exerwalls on in-app purchases. Given that most players choose not to pay when confronted with a paywall, exerwalls may result in a similar amount of paying players, but potentially show an increase in total players since allowing exercise to continue play may be more rewarding for some players.

Finally, while we have evaluated exerwalls within *Laser Planets*, our original mobile game, investigation of the utility of exerwalls in a wide range of other games would be instructive. Specifically, it would be useful to ascertain exerwalls acceptability within various genres of exergames.

References

Arnett, D. (2016, July). Grip of the Great Pokemon Quest. *The Boston Globe*.

Association, A. H. (2015, August). Recommendations for Physical Activity in Adults. Online at http://goo.gl/LBb5pD.

Baumann, P. & Gallo, A. (2016, May). Exploring Exer-Walls as a Healthy Alternative to Paywalls in Mobile Games. *Major Qualifying Project MQP-EOA-0030*, *Computer Science, Worcester Polytechnic Institute*. Advisors E. Agu and M. Claypool.

CDC. (2015, June). The Benefits of Physical Activity. Online at: http://www.cdc.gov/physicalactivity/basics/pa-health/index.htm. Centers for Disease Control.

Doe, J. (2015, August). You Shall Not Pass! The 4 Types of Paywall in Mobile Games. *Which Button is Jump*. Online at http://www.whichbuttonisjump.com/you-shall-not-pass-the-4-types-of-paywall-in-mobile-games/.

Grubb, J. (2014, February). Report Finds Free-play-microtransactions Make Up 79% of U.S. App Store Revenues. *venturebeat.com*. Online at: http://goo.gl/tE5OlO.

Mokdad, A., Marks, J., Stroup, D., & Gerberding, J. (2000). Actual Causes of Death in the United States. *Journal of the American Medical Association (JAMA)*, *291*(10).

Pearson, D. (2014, October). Report: Mobile to Become Gaming's Biggest Market by 2015. *gamesindustry.biz*. Online at: http://www.gamesindustry.biz/articles/2014-10-22-report-mobile-to-become-gamings-biggest-market-by-2015.

Rettner, R. (2014, March). Truth about 10,000 Steps a Day. *Live Science*. Online at http://www.livescience.com/43956-walking-10000-steps-healthy.html.

Rideout, V., Foehr, U., & Roberts, D. (2010). Generation M2: Media in the Lives of 8- to 18-year-olds. *Kaiser Family Foundation*. Online at: http://www.kff.org/entmedia/upload/8010.pdf.

Simmons, D. (2015, November). Bitwalking - Digital Currency Pays People to Walk. *BBC News - Technology*. http://www.bbc.com/news/technology-34872563.

Takahashi, D. (2014, September). Swrve Finds that Only 1.35% of Players Spend Money in Mobile Games. *venturebeat.com*. Online at http://goo.gl/YUNzTC.

Watson, J. (n.d.). The 10 Highest Earning Mobile Games. Online at https://www.hottopics.ht/stories/consumer/the-top-10-games-of-the-mobile-gaming-revolution/. Last accessed April 4, 2016.