Surrender at 20? Matchmaking in League of Legends

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***Abstract*—Online games rely upon matchmaking systems to group players into teams and to match teams against other teams for balanced, fun gameplay. Despite the importance of matchmaking, little has been published about the effectiveness of current matchmaking systems. This paper presents the results from a detailed user study analyzing the matchmaking system for League of Legends (LoL), a popular online game. Analysis of objective and subjective data from over 50 games shows LoL games are balanced based on player ranks, but are unbalanced based on player opinions. Despite this, unbalanced games are often the most fun for players, as long as they are on the winning team. This last result suggests new considerations for matchmaking system algorithms.**

I. Introduction

Since online players typically engage in cooperative and competitive matches against other opponents, it is critical for game systems to create balanced matches between teams of opponents in order for online game sessions to be fun.

Matchmaking is the process of matching players of similar skill together in competitive online games. In many online games, players join a virtual lobby where they are grouped into teams, and then teams are matched against each other and the game starts. Game systems try to group players of similar skill on the same team and also try to make sure opposing teams are evenly matched. Unbalanced teams mixing novices and experts or unbalanced games with strong teams versus weak teams can ruin the game experience for everyone. Matching players can take time, both time to compute the best team compositions but also time to wait for players with similar skills to arrive in the lobby to create a balanced game. In effect, there is a tradeoff between waiting time in the lobby queue and the match balance achieved. However, despite the importance of matchmaking, there is relatively little published research that analyzes matchmaking in practice.

Previous work has gathered and analyzed objective data about matchmaking [1], inferring player waiting times in queues and game balance based on ranks. However, while objective data may be an indicator of game fairness, it is only effective if the objective measures correspond to player experience. For example, a match that has perfectly evenly ranked teams will still only be fair if the ranking system itself accurately represents player skill. Work on improving matchmaking has recognized the need to gather player opinions about the match quality [2], but thus far, to the best of our knowledge, there has been no work explicitly gathering and analyzing player opinions on match balance. Such data can be used to better assess current matchmaking effectiveness and indicate areas of improvement.

Our work analyzes the perceived balance of matchmaking from the players' perspectives. Our study uses one the most popular online games, *League of Legends* (LoL) (Riot Games, 2009), a game in which matchmaking is used to form teams of 5 players and pit 2 teams against each other. LoL is played by more more than 27 million people each day [3], with professional leagues which compete year round. We conducted an extensive user study where participants played LoL in our computer lab and answered survey questions about the game. This setup allowed us to gather objective data on the game (e.g., player rank and queue times) as well as subjective opinions from the users (e.g., match balance and enjoyment). The mix of quantitative and qualitative data was analyzed for its implications to matchmaking.

Analysis of data from over 50 games shows queue times are generally short, with the median times under 60 seconds across all ranks. Most teams are balanced, with half of all players within 1 rank of the team mean, and most games are evenly matched, with over 80% of games having an average team rank within 1 of each other. However, players perceive matches as being unbalanced, even when matchmaking provides the exact same average team rank, suggesting balance is *not* met by having the same average team rank alone. When players win, they only slightly perceive the teams to be unbalanced, but when players lose, they mostly find the teams to be unbalanced. Not too surprisingly, players find games considerably more enjoyable when they win, but surprisingly, players find matches that are unbalanced in their favor the most enjoyable. This latter implication suggests fair matchmaking may not be needed for everyone to have fun and suggests matchmaking systems should take this into account when forming teams.

The rest of the paper is organized as follows: Section II describes the methodology of our user study; Section III analyzes the user study results; and Section IV summarizes our conclusions and possible future work.

II. Methodology

This section provides a brief background on the game selected, League of Legends, followed by our survey design and procedure.

League of Legends (LoL) is a multi-player online battle arena (MOBA) game where players are matched into two opposing teams of 5 players each.[1] Once matched to a team,

[1]There are other variants, but the 5-person team game is the most popular.

players choose one out of over 100 different characters to control during the game. Gameplay consists of controlling the character to fight opponents' characters as well as other lesser monsters on the game map. The objective is to destroy the opposing team's headquarters. Characters are enhanced by gaining skills and purchasing items using gold earned during the game. If a LoL game is extremely unbalanced, players sometimes surrender at the first chance, 20 minutes into the game. At the time of our study, LoL was at version 4.21.

The user study was held in a campus computer lab with about 20 computers divided into 3 smaller rooms. Each computer ran Windows 7 on an Intel Core i7-3770 3.4GHz processor, 12 GB DDR3 RAM, and an AMD Radeon graphics card. All computers had 24" Dell monitors and headsets. The entire lab was reserved for 3 separate study sessions. Each study session lasted about five hours and users could arrive and participate any time during the session. Users were solicited from the general student body to join in our study.

Before starting each game, users provided information about their League of Legends experience. Once the game started, information about the match, such as the rank of all players on both teams, was gathered from a third party Web site.[2] After the game finished, users provided their opinions on the game just played, including enjoyment and balance. The full user survey can be found online.[3] The League of Legends match history Web site was used to record objective game information such as kills by each team and player kill-death-assist ratios. Due to space constraints, analysis of this objective data is only available in our full report [4].

III. Results

A. Demographics

We collected 52 complete responses to our user study, from 23 unique users (some users played more than one game). Users mirrored the demographics of our University – predominantly white males (70%), ages 18-22, all gamers. All users were active LoL players. The most popular game mode among users was the normal 5v5 match, played by 80% of users at least once a week, and 50% of user every day. About 60% of users played Ranked Solo (match counts towards competitive ranking, entering virtual lobby alone) or Ranked Duo (match counts towards competitive ranking, entering virtual lobby with a teammate) a few times per week.

The distribution of player rankings for users in our study and on the LoL North American server,[4] where all our users played, is shown in Figure 1. The y-axis is the cumulative distribution and the x-axis is the player rank, where 0 is unranked. While our scale is numeric, LoL groups players into clusters of Bronze, Silver, Gold, Platinum and Diamond with 5 levels in each.[5] Overall, our distribution of users is somewhat more evenly distributed among ranks than the North American LoL population which has a larger group of players at the Silver and Gold categories.

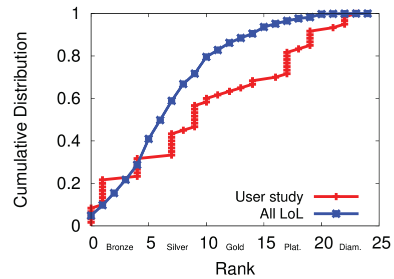

Fig. 1. Player Ranks. Cumulative distribution of player ranks in our user study and for all North American LoL players.

B. Queue Time

Rather than setting up a match with the players currently in the game queue, matchmaking systems can wait for more players to arrive to try for a better balanced match. Figure 2 depicts the time users spend waiting in queue versus their ranks. The y-axis is the queue time in seconds and the x-axis is the player rank as in Figure 1, but clustered into the major categories. The data is represented by boxes and whiskers which show the minimum and maximum with the lines (whiskers), the quartiles with the boxes, and the medians with black lines. Queue times generally range from 25 to 75 seconds and are higher for users at higher ranks. This latter fact is likely because LoL has fewer players at higher ranks, so the matchmaking system must wait longer in order to create a balanced game. In fact, there is a tradeoff from the player's perspective between the game balance and the time waiting in queue for a game to start.

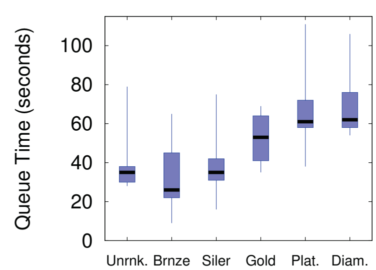

Fig. 2. Queue Times. Box and whiskers plot of time waiting in queue before match begins versus player ranking.

C. Balance

LoL matchmaking attempts to create balanced teams where players of similar skill are placed on the same team. An objective measure of team balance (or imbalance) is to compute the difference in rank for each player from the team mean rank. Figure 3 depicts the team imbalance for all the teams in our user study. The y-axis is the cumulative distribution and the

[2] http://na.op.gg/

[3] http://www.cs.wpi.edu/~claypool/iqp/lol-match/

[4] http://www.lolsummoners.com/stats/na

[5] Since there are no Master and Challenger ranked players in our study and very few in LoL in general, they are not included in the graph.

x-axis is the imbalance. Most teams are balanced, with half of all users within 1 rank of the team mean. However, some teams are somewhat imbalanced, with about 10% of users 3 or more ranks from the team mean.

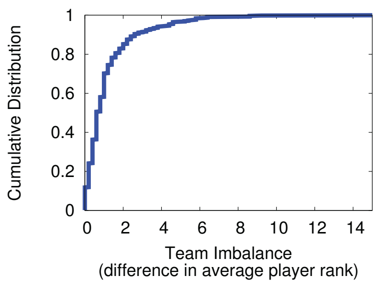

Fig. 3. Team Imbalance. Cumulative distribution of difference in user rank from team mean rank.

LoL matchmaking also attempts to pair teams against each other for a competitive match. An objective measure of game balance (or imbalance) is to compute the difference in mean rank for both teams. Figure 4 depicts the game imbalance for all games in our user study. The y-axis is the cumulative distribution and the x-axis is the imbalance. Most games are evenly matched, with over 80% of games having an mean team rank within 1 of each other. However, about 5% of games have an mean rank difference of more than 2.

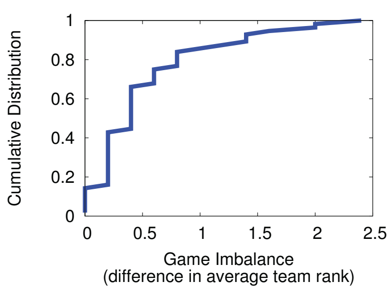

Fig. 4. Game Imbalance. Cumulative distribution of difference in mean team rank for each game.

While balance can be measured objectively, it is not clear that such measures correlate with balance as perceived by players. In our user study, after each game, users were surveyed as to their opinion of the game balance with the question "How even did you feel the game was?" Answers were on a 5-point scale, with 3 being a balanced game. A measure of user opinion of the imbalance of the game is the absolute difference from 3. Figure 5 depicts a scatter plot of the perceived imbalance (difference from 3) versus the game imbalance (difference in mean team rank). There is no visual correlation[6] between perceived imbalance and game imbalance. Since are data points at y values of 1 and 2 even for games that are have both teams with the same average rank, this suggests that the imbalance perceived by players is *not* met simply by equalizing the mean team ranks during matchmaking.

[6]The correlation coefficient is -0.02.

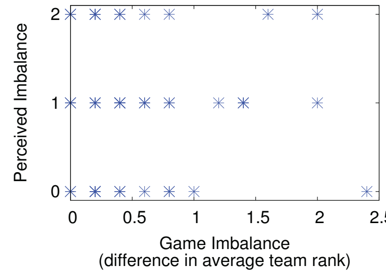

Fig. 5. Perceived Imbalance and Game Imbalance. Scatter plot of perceived imbalance (absolute difference in self-reported balance) of the game versus rank imbalance (difference in mean team rank) for each game.

Continuing with an analysis of balance, Figure 6 depicts a bar chart of the user-reported scores of the perceived balance after each game. The y-axis is the number of games for each reported score and the x-axis is the balance. The left side indicates users felt their team was much better, the middle was equally balanced, and the right the other team was much better. From the graph, there are more scores to the right, indicating generally users are more likely to see perceived imbalance in favor of opponents than of themselves.

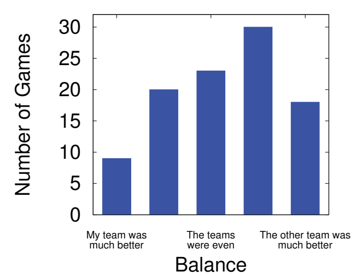

Fig. 6. Balance. Bar chart of self-reported perceived balance of the game.

Figure 7 depicts a cumulative distribution of the perceived balance grouped by wins and losses. The x-axis is the balance and the y-axis is the cumulative distribution. Generally, when users win, there is a mostly even distribution of perceived balance, with a slight shift (about 60%) of the distribution towards their team being better. However, when users lose, there is a noticeable shift in the distribution, with nearly 80% of the distribution indicating users thought the games imbalanced in the other teams' favor.

D. Enjoyment

After each game, users were asked "How enjoyable was the game you just played?" on a 5 point scale. Figure 8 shows the distribution of user responses. The x-axis is the users' responses and the y-axis is the cumulative distribution. The two trendlines are responses grouped by games won and games lost. There is a clear difference in user enjoyment

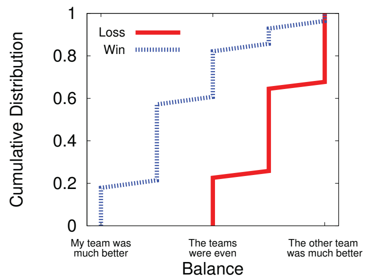

Fig. 7. Balance. Cumulative distribution of self-reported perceived balance of game where users won or lost.

from winning versus losing. About 70% of users found the game enjoyable after winning compared to less than 10% after losing. No users found the game very enjoyable (5) after losing and 30% found the game to be the least enjoyable (1) after losing. Contrast that to winning users that never found any games unenjoyable (1 or 2).

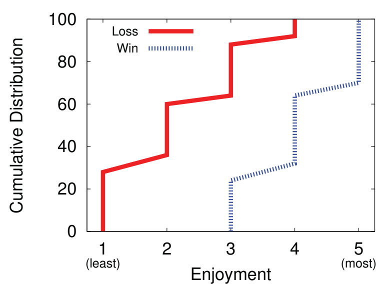

Fig. 8. Enjoyment. Cumulative distribution of self-reported enjoyment after games where players won or lost.

Combining analysis of enjoyment with balance, Figure 9 shows the distribution of self-reported enjoyment versus perceived balance. The y-axis is enjoyment, as in Figure 8, and the x-axis is balance, as in Figure 7. The data is represented by boxes and whiskers, as in Figure 2. From the graph, there is a clear trend towards games imbalanced in a user's favor being more enjoyable, with all games where users felt their team was much better scoring a 3+ on enjoyment. Contrast that to games where users felt their team was much worse having a median enjoyment of 1. This data is contrary to conventional wisdom that suggests balanced games are more fun for both players that win and players that lose – if such were the case, enjoyment would be highest in the middle, where games were perceived to be balanced.

IV. Conclusion

Matchmaking systems for online games are critical for combining individuals into compatible teams and matching teams for fair, competitive games. Despite their importance, there is little published work on matchmaking systems and even less on player opinions on their effectiveness.

This paper provides an in-depth analysis of the effectiveness of the matchmaking system for League of Legends (LoL), a popular online game, based on a detailed user study. Over 20 users competed in over 50 LoL games, providing subjective opinions on game balance and enjoyability that can be compared to objective measurements of game balance based on player and team ranks.

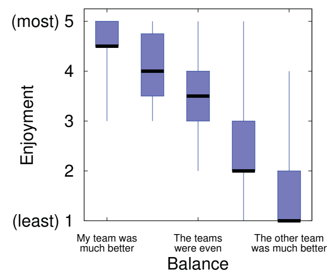

Fig. 9. Enjoyment and Balance. Box and whiskers of self-reported enjoyment versus self-reported balance of the game.

Analysis of the results shows that queue times are short (less than 60 seconds) relative to game lengths (games are a minimum of 20 minutes). From the objective data, most teams and games are balanced, but from the subjective data, players think most games are unbalanced, usually in the other teams' favor. Players' opinions of balance are heavily influenced by whether they win or lose, with losing players seeing significantly more imbalance. Enjoyment is even more heavily correlated with winning. Even more striking is that enjoyment is correlated with imbalance, with games that are imbalanced in a player's favor being the most enjoyable.

The results suggest that match balance cannot be met by player ranking alone. Moreover, contrary to popular opinion, since balanced games are not necessarily the most fun, matchmaking systems may not need to strive to have balanced games each time. Instead, a strategy could be to ensure a player does not have too many losing games in a row with an unbalanced team since that is clearly not enjoyable. The matchmaking system can consider recent wins/losses to intentionally place players on unbalanced teams in their favor, when appropriate.

Future work could include study of other game modes in LoL (e.g., Dominion) or other similar games (e.g., *Heroes of the Storm* (Blizzard, 2015)). Additional work could include analysis of other objective game data, and use both subjective and objective data in alternate matchmaking algorithms.

References

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