Streaks and Coping: Decoding Player Performance in League of Legends Using Big Data from Top Players' Matches

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Abstract

Among athletes and sports fans, it is common to believe that one victory leads to another. Such an effect is known as the hot-hand effect or, simply, a winning streak. This effect was most often associated with traditional sports, however, people participating in electronic sports also tend to believe in it. To explore this venue, we collected 597,680 matches from top players in League of Legends, one of the largest esports games in the world, and analyzed the match data. The findings showed significant but small correlations: winning streaks were associated with improved performance while losing streaks correlated with decreased performance. Players also typically maintained the same champion and lane during winning streaks and tended to switch during losing streaks. Consistency in champion and lane selection was associated with better performance overall. Players also took longer breaks after both winning and losing streaks, which slightly improved performance following losses but had no significant effect after wins. This paper is one of the first ones to test the hot-hand effect with big data in the esports context. Future studies should include players of varying skill levels and regions, incorporate additional performance metrics, and utilize qualitative methods to capture a more comprehensive understanding of player behavior and psychology.

CCS Concepts

• **Applied computing**; • **Computers in other domains**; • **Personal computers and PC applications**; • **Computer games**; • **Human-centered computing**;

Keywords

winning streak, hot hand effect, esports, Multiplayer online battle arena (MOBA)

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1 Introduction

Contemporary culture, entertainment, and media have been significantly influenced by the advent of esports, also known as competitive video gaming, where people engage in competitive gameplay using electronic or digital systems [7]. Unlike their traditional sporting counterparts, these digital athletic endeavors place a heightened focus on strategic and cognitive skills rather than physical prowess. However, in various aspects such as career development, social functioning, and psychological well-being parallels have been observed between esports athletes and their traditional sports counterparts. For example, esports athletes can experience an enhanced sense of self-worth and an upsurge in performance due to a series of wins, or conversely, feel extreme stress following a sequence of losses [21] or excessive stress resulting from repeated losses [20]. In traditional sports, these sequences are known as winning and losing streaks, concepts that remain understudied in esports.

Our current research delves into the "hot hands" phenomenon and its influence on performance using data from League of Legends (LoL), a Multiplayer Online Battle Arena (MOBA) video game developed by Riot Games in 2009. LoL is one of the most popular MOBA games, where players team up with five teammates to fight against opponents [14].

Based on the extant literature, our study hypothesizes that successful performance in LoL may induce psychological momentum that influences subsequent gameplay. Therefore, we aim to explore how winning and losing streaks affect player performance, strategic

decisions, and game engagement. This research strives to offer empirical evidence of the impact of streaks on player behavior and performance within the context of video gaming and esports.

1.1 Streaks and Momentum

Köppen & Raab [17] wrote that belief in streaks is commonly spread among humans. They seem to influence decision-making and are identified to occur in many areas of daily life, from game or exam outcomes, through births, to sports and even esports [17], [18], [26]. For instance, people often commit cognitive fallacies, believing that one lucky or unlucky occurrence increases the chance of another such event occurring, thus deciding to abstain from a behavior or engage in it more strongly, with gambling being a prime example (gambler's fallacy). In sports literature, usually, two types of streaks are distinguished: winning and losing streaks.

Winning streaks, or the "hot hands" phenomenon, refer to a "belief that the performance of a player during a particular period is significantly better than could be expected based on the player's overall record" [2]. To put it simply, it is a belief that success breeds more success, and it is propagated by athletes of many sports (e.g., Basketball, Baseball, Football, Hockey [29, 31, 34]. Similarly, a "cold hands" phenomenon, otherwise known as losing streaks, is posed to exist [17]. The actual existence of those effects, however, remains controversial within academic circles, with some studies asserting its veracity while others write it off as a cognitive illusion or a fallacy [2][1].

In esports or MOBA games specifically, winning and losing streaks have garnered only limited attention. A notable qualitative study by Kou et al. [18], investigates players' perceptions of streaks. Most often the streaks in LoL are perceived either as a number of consecutive won matches, constant rank changes, an overall time when losses or success are experienced, or a win rate. As factors perceived to be potentially influencing winning streaks by the players, the authors indicate individual and teammates' in-game performance, mentality, system randomness, or matchmaking. Interestingly, players seem to notice losing streaks more often than winning ones. Another study by White and Romano [36] suggests that it is possible to model psychological momentum and tilt using existing match data to predict game outcomes, essentially showing that psychological momentum might indeed influence wins or losses in esports.

In esports, this performance can be measured by numerous indicators, including Kill-Death Ratio (KDR) or Kill-Death/Assists (KDA; [4, 22, 25], which shows how many times the players have eliminated others about how often they were eliminated. These performance indicators have been correlated with various factors like motivation, win rates, and in-game economy. Thus, considering the existing literature, we suggest the following hypotheses:

H1a: There is a positive correlation between winning streaks and subsequent match performance (KDA) in League of Legends players.

H1b: There is a negative correlation between losing streaks and subsequent match performance (KDA) in League of Legends players.

1.2 Motivation and Coping

Winning can enhance one's motivation, making the person, believe that with each successful performance, success becomes more attainable than before [9]. This can be attributed to the fact that maintaining the streak can be perceived as a reward in itself, being a strong external motivator. The desire to continue a winning streak cannot only drive individuals to put in more effort and practice but can, for instance, lead to an increase in self-efficacy [32]. Essentially, as the streak becomes a tangible goal, the fear of ending it can push individuals to strive harder than they might under normal circumstances.

From a different perspective, a winning streak can boost one's intrinsic motivation by tapping into the psychological principle known as psychological momentum. This concept is understood as gaining a "psychological power" that can transform an individual's self-perception, enhance their motivation, their perception of others, and even how others perceive them [12], [11]. This momentum can impact both the individual's performance and that of their opponents, thereby creating a zero-sum game in competitive scenarios. That is, the psychological advantage is gained in an intersection of one's own successful performance and the unsuccessful performance of the other. Of course, this definition relates to situations where competition exists. However, momentum might be experienced in situations where performance success is not socially embedded. For instance, video game players might play single-player games, where there is no competition (most Role-Playing Games are such games), or momentum might be gained while learning. An interesting example of that was recently provided by Huynh and Iida [10] who explored the effects of winning streaks in Duolingo, a gamified language learning application. Thus, this also brings an important aspect of psychological momentum – it is not only applicable in sports contexts. Regardless, Iso-Ahola and Dotson [11] assert that psychological momentum functions as a bridge between consecutive performances, whether successful or unsuccessful.

Losing, on the other hand, can lead to an increase in stress, unpleasant emotions, or a reduced belief in self-efficacy. It can also undermine an individual's confidence and motivation [28]. However, losing a game or a failure does not necessarily hold an inherently destructive influence over a person. It is how one copes with a loss, in our case a losing streak, that will have long-term effects. Coping strategies, that is ways to manage stressful situations or deal with emotional distress [8], can be roughly split into those that are adaptive and those that are not [3, 30]. They include different cognitive (e.g., positive reappraisal) and behavioral (e.g., seeking support) approaches that can be focused on avoiding the issue or confronting it [8]. Adaptive coping strategies involve constructive actions, that are supposed to help find new perspectives on the experienced failure and build upon it. Maladaptive coping strategies in turn usually exacerbate the negative impact of failure. Such strategies can include, for instance, self-blaming, avoidance, or resorting to unhealthy or even dangerous behaviors, such as drinking alcohol or self-harm.

In traditional sports, coping is shown to be associated with athletic performance [19]. Among athletes, adaptive coping strategies are rather common. They include increasing practice, focusing

on goals, time management or venting unpleasant emotions, and remaining confident [24]. Maladaptive coping, however, is also common, like avoiding stressful stimuli. If coping is adaptive and well-adjusted to the current situation it is shown to increase performance, reduce anxiety, and induce positive emotions [24].

A parallel can be found in esports and video gaming research. Smith et al. [33] show that esports players may use coping strategies ranging from increasing practice or retraining, through building a rapport with their own teammates, to changing strategies or complete re-evaluation of possibilities. Such a change of strategy could include changing the weapon used in FPS games, changing build order in RTS games, or changing items bought, lanes or champions used in MOBA games. In the case of our study, lane change, and champion change were the only factors discernible through big data analysis as possible indicators of adaptive coping in response to a losing streak.

A change in strategy, such as switching to a different lane or champion, may provide a new perspective or, if a player utilized the same strategy repeatedly, a perception of breaking a streak, thus, in a way, resetting their failures. Therefore, esports players are likely to change their strategies in the face of experiencing a losing streak. Similarly, as the momentum theory shows, if a streak or success is experienced, such a lane or character switch is an unwelcome change, which could lead to a failure. Therefore, in this case, esports players should be less likely to change their strategies. Considering the above, we suggest the following hypotheses:

H2a: Players are more likely to stick with the same champion during winning streaks.

H2b: Players are less likely to stick with the same champion during losing streaks.

H2c: Players are more likely to stick with the same lane during winning streaks.

H2d: Players are less likely to stick with the same lane during losing streaks.

H2e: Maintaining the same champion during winning streaks leads to improved performance (KDA).

H2f: Maintaining the same champion during losing streaks leads to decreased performance (KDA).

H2g: Maintaining the same lane during winning streaks leads to improved performance (KDA).

H2h: Maintaining the same lane during losing streaks leads to decreased performance (KDA).

Smith et al. [33] further indicate that not every player utilizes adaptive coping strategies. Many players tend to avoid situations that make them uncomfortable. For example, they might start playing passively to avoid making mistakes or simply refrain from discussing matters that are stressful for them if they consider playing in a team. The easiest method, it would seem, is to simply disengage from a stressful situation. In MOBA games such disengagement might include avoiding further competition by quitting the game, muting own in-game teammates, or even uninstalling the game [18]. By doing this, the players can either get rested or avoid the stimuli that made them tilted. Thus, we expect that if a player experiences a losing streak, they are more likely to take longer breaks between games, in order to try to reset their streak. In turn, when a player experiences a winning streak, they would probably avoid taking longer breaks between games, to not lose the momentum. Therefore, we suggest the following hypotheses:

H3a: Players will take longer breaks between games as their winning streaks increase.

H3b: Players will take longer breaks between games as their losing streaks increase.

H3c: A longer time interval following a winning streak is associated with decreased performance (KDA).

H3d: A longer time interval following a losing streak is associated with improved performance (KDA).

2 Method

2.1 Data collection

Players' match histories were collected using the Riot Games developer API. When a match was determined to be legitimate, participant profile summaries from op.gg were loaded [16]. These summaries included information on champion proficiency statistics, season totals, and performances for the past 20 games.

We designed a scraping application with Python and collected the most recent 20 matches' data from the top 3% (29,898) players (Korean server) on op.gg. We focused on the Korean server because it is widely regarded as having the highest level of competitive play in League of Legends, which ensures a high standard of gameplay and strategic diversity for our analysis [5]. We collected only the top 3% of players to decrease the risks of overloading and damaging the website [13] and to control the effect of ranking on the results. In total, 597,680 matches from August 12, 2023 (beginning date of the season) to January 10, 2024 (data collection date) were collected. All the matches were from the Solo/Duo rank queue.

The original data contained detailed information about the matches, including result, KDA, champion, lane, match beginning time, and match duration. Only the 10 most recent games were utilized to evaluate player performance and strategy. The 10 older matches were used exclusively for calculating our variables such as streak numbers, ensuring that our analysis was based on recent and relevant gameplay data. During our initial data inspection, we identified and removed 4,341 matches that were classified as "remakes." In LOL, a "remake" allows players to end a game early without affecting their records if certain conditions are met, such as a player being disconnected at the start. These matches do not reflect standard gameplay or player performance and were therefore excluded to maintain the integrity of our data analysis.

2.2 Data cleaning

Based on the original data, we coded the following variables:

1. **Streak number** (min = -13, max = 17, mean = .59, SD = 2.53) represented streaks occurring before each match, with positive numbers indicating winning streaks and negative numbers indicating losing streaks.

2. **Performance** (min = 0, max = 43, mean = 4.05, SD = 4.10) was quantified using the standard KDA ratio commonly used in MOBA games. The KDA ratio was calculated as (Kills + Assists) / Deaths. In cases where deaths were zero, we used 1 as the divisor to avoid division by zero, aligning with common practices in performance metrics in MOBA games [23].

3. **The time interval** (seconds) between matches (min = 179, max = 11544225, mean = 78193, SD = 248450) represented the time interval between matches was computed by subtracting the start time of the last match and its duration from the start time of the current match.

4. **Champion** (mean = .37, SD = .48) and **lane** (mean = .80, SD = .40) **changes** were the comparison between the champion and lane used in the current match to those used in the previous match. If the player used the same champion and lane, it was coded as 1; otherwise, it was coded as 0.

3 Results

To test H1, we investigated the relationships between players' number of winning and losing streaks and their subsequent match KDA. The correlations were very small for both winning streaks ($r = .006$, $p = .009$, $N = 171373$) and losing streaks ($r = -.019$, $p < .001$, $N = 125326$). Given these minimal effect sizes, both **H1a and H1b are not supported**.

To test H2, we examined the relationships between players' winning and losing streaks and their likelihood to play the same champion or the same lane in the subsequent match. The correlations were very small for both winning streaks with playing the same champion ($r = .018$, $p < .001$, $N = 171373$) and lane ($r = .008$, $p = .001$, $N = 171373$), suggesting that players on a winning streak are only slightly more likely to stick with the same champion and lane. For losing streaks, the correlations with playing the same champion ($r = -.030$, $p < .001$, $N = 125326$) and lane ($r = -.047$, $p < .001$, $N = 125326$) were also small, indicating that players are slightly less likely to play the same champion and lane as their losing streak extends. Given these minimal effect sizes, the hypotheses **H2a through H2d are not strongly supported**.

When investigating the influence of playing the same champion during winning streaks on KDA, players who did not change champions ($N = 70{,}590$, $M = 4.331$, $SD = 4.254$) had a higher mean KDA than those who did ($N = 100{,}783$, $M = 4.003$, $SD = 4.041$) with a mean difference of -.328 ($t(171371) = -16.169$). Similarly, during losing streaks, players who did not change champions ($N = 39{,}408$, $M = 4.089$, $SD = 4.163$) performed better than those who switched ($N = 85{,}918$, $M = 3.858$, $SD = 3.998$) with a mean difference of -0.231 ($t(125324) = -9.388$).

For lane consistency during winning streaks, players who did not change lanes ($N = 141{,}238$, $M = 4.235$, $SD = 4.195$) outperformed those who switched ($N = 30{,}135$, $M = 3.684$, $SD = 3.794$) with a mean difference of -.551 ($t(171371) = -21.053$). During losing streaks, maintaining the same lane ($N = 95{,}986$, $M = 4.028$, $SD = 4.120$) resulted in better performance compared to changing lanes ($N = 29{,}340$, $M = 3.609$, $SD = 3.803$) with a mean difference of -.419 ($t(125324) = -15.532$).

In conclusion, sticking to the same champion and lane during both winning and losing streaks is associated with improved performance. Thus, **H2e and H2g are supported, and H2f and H2h are not supported and show the opposite effect**.

The study also examined how winning and losing streaks correlate with the time interval before the next game. The correlations were small for both winning streaks ($r = .080$, $p < .001$, $N = 171373$) and losing streaks ($r = .038$, $p < .001$, $N = 125326$). This suggests that players tend to take slightly longer breaks before their next match as their number of consecutive wins or loses increases. Given these minimal effect sizes, the practical significance of these correlations is limited, indicating weak relationships. Thus, **H3a and H3b are not strongly supported**.

The analysis sought to determine if the time interval between games is related to performance, as measured by KDA, after players have experienced a losing streak. The correlation was very small for the relationship between time interval and KDA following a losing streak ($r = .017$, $p < .001$, $N = 125326$). This suggests that taking a longer break between games is very slightly associated with improved performance after losses. Similarly, the study investigated the relationship between time interval and KDA following a winning streak. The results showed a nonsignificant correlation ($r = .001$, $p = .598$, $N = 171373$), suggesting no significant association between the time interval before the next game and performance after a series of wins. Thus, **these findings do not support H3c and H3d**.

4 Discussion

4.1 How do streaks affect players' next match's performance?

Online games are complex systems with numerous hidden mechanisms that are critical to the player's experience [18]. This complexity arises not only from the interplay of various character roles and team strategies but also from the dynamic nature of in-game decision-making that directly influences outcomes. Each match outcome is influenced by multiple factors including team composition, in-game itemization, and moment-to-moment tactical decisions, which collectively contribute to the KDA ratios of individual players [6]. Therefore, the minimal correlation between streaks and KDA likely reflects the complex nature of performance determinants in esports, where no single factor such as a win or loss streak is solely decisive.

4.2 Changing Champion/Lane as a Strategy to Cope with Streaks

Persisting with the same champion during winning streaks exemplifies how players in LOL capitalize on their recent successes to enhance future performance. This strategic choice is supported by our findings that show slight improvements in KDA for players who stick with a familiar champion, suggesting that familiarity and refined tactical execution can offer incremental performance benefits. Maintaining consistency not only bolsters a player's confidence but also reduces the cognitive load involved in adapting to new characters, enabling deeper strategic focus and tactical precision [27]. This phenomenon is supported by broader esports research, which links strategic continuity with sustained performance and reduced decision-making errors under pressure [35].

Our study also highlights that maintaining the same champion during losing streaks results in better performance compared to those who switch. This indicates that the benefits of strategic consistency extend beyond winning streaks and play a crucial role in helping players cope with and recover from losses. Switching champions or lanes, often seen as a way to disrupt negative outcomes,

does not necessarily translate into improved performance. This finding underscores the importance of psychological adjustment and suggests that maintaining a consistent strategy might help manage stress and regain control more effectively than previously believed. The tendency for strategic shifts, although common, may not be as beneficial as sticking with known and comfortable gameplay dynamics, even during losing streaks. This behavior aligns with theories of psychological flexibility, which emphasize adapting strategies in response to new information or failures as a way to manage stress and regain a sense of control [15].

4.3 Disengagement as a Strategy to Cope with Streaks

Our findings of H3 weakly support that disengagement is used as a coping mechanism to deal with the psychological impacts of intense gaming sessions, such as anxiety and mental fatigue. In the case of winning streaks, players may take breaks to enjoy victories or simply to avoid the potential stress of losing a subsequent match, which could break their streak. For losing streaks, longer breaks might help players reset emotionally and cognitively, providing them a chance to return to the game with a clearer mind and reduced frustration.

The relationship between time interval and subsequent performance was not found from our results based on the very small or no effect size. This might be because we did not consider the effect of outliers (the maximum time interval in our data was 133.6 days). While slight disengagement might help players recover from fatigue, a few months' disengagement can lead to decreased familiarity with game mechanics and lag in understanding new updates. Future research should take these factors into account and aim to determine the optimal length of break time for maintaining or improving performance.

5 Limitations and Future Research

1. **Sample Specificity**: Our research was limited to the top 3% of players on the Korean server. To broaden the applicability of our findings, future studies should consider including players of varying skill levels and from different geographic regions. This would enhance the generalizability of the results and provide insights into how cultural and regional differences may influence gameplay and player psychology.
2. **Measurement Constraints**: We used KDA as the primary measure of performance, which does not capture all aspects of a player's contribution during matches. Future research could incorporate additional performance metrics such as damage per minute, vision scores, or objective control. These metrics would provide a more comprehensive view of player performance and could reveal new correlations between winning and losing streaks.
3. **Reliance on Secondary Data**: Using data from game APIs and op.gg allowed for efficient data collection but lacked the nuanced insights that might be gained from direct interaction with players. Future research might include qualitative methods such as interviews or player diaries to capture the subjective experiences and emotional responses of players to winning and losing streaks. This mixed-methods approach could enrich the quantitative findings and provide a deeper understanding of the strategies players use to cope with competitive pressures.

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