OXFORD JOURNAL
OF STUDENT
SCHOLARSHIP

Gacha Games, Reward System, and Player Retention

Zhaoyang Zheng
alessiozheng2008@gmail.com

ABSTRACT

This literary review explores how the reward system in gacha games influence players motivation and retention. The reward system employed is a random reward mechanism – modeled after the japanese "gachapon" machines – in order to promote dopamine production, stimulating players' anticipation and engagement. The core loops and gacha pull for the characters, supported by the complex currency system and progression-based leveling incentivize players a daily habit through the stamina system and daily missions. Moreover, the parasocial relationship between the player and the in-game character form a strong emotional investment that transcends mere gameplay. Furthermore, the game's design actively exploits cognitive biases like sunk cost fallacy, FOMO, and loss aversion; motivating players' retention towards the game. The culmination of these design strategies can lead to a physical alteration of the brain. While there is existing research that confirms the effectiveness of the game's design on players retention and motivation, the limitations suggest a deeper investigation of the effects between free-to-play players and pay-to-win players.

INTRODUCTION

Since 2011, gacha games have been introduced into the Japanese mobile games industry, soon becoming a widespread feature of the gaming industry (Lakić et al., 2023). In recent years, the growing community started to dominate the gaming market, becoming one of the highest profitable gaming industries and generating a couple of billions of revenues (Dang, 2023). Some of the most renowned gacha games include: Fate/Grand Order, released in 2015 with an estimated revenue of $4 billion; Genshin Impact, one of the most known gacha game, soon became a global sensation, released in 2020 and generated $1 billion in 6 months; Granblue Fantasy, released in 2014; and Honor of Kings, with an estimated revenue of $2.5 billion in 2020 (Dang, 2023).

This literature review examines how the reward systems in gacha games influence player motivation and player retention. Specifically, the design elements of random reward systems in gacha games, the brains' reward system, and the cognitive biases the reward systems induce on the players.

REWARD SYSTEMS

An integral element of gacha games is its random reward system (Dang, 2023), a random reward system includes a range of game mechanisms that can reward players with items, for instance: keys to unlock new locations, armour, weapons, characters, upgrades for the equipment; but, in exchange for something (Alegria, 2022). According to Wang & Sun (2012), they stated that "Reward mechanisms provide a sense of fun by fostering intrinsically rewarding experiences and are equally or more important than the extrinsic rewards that are distributed" (Wang & Sun, 2012, p. 1). This statement suggests that the reward system is effective not exclusively due to its extrinsic reward, but because of the players' intrinsically fun experience, meaning an internal feeling of satisfaction players undergo once obtained the reward (Alegria, 2022).

The random reward system is the core element which grants the title of "gacha" games. The term "gacha" derives from a famous japanese vending machine, called "gachapon", which distributes random toys, and the same concept is used in video games under the name of gacha boxes (Dang, 2023). One of the many ways this random reward system is applied is through loot boxes, or as the Eastern gaming market calls it, gacha boxes. They can be purchased using either the in-game currency or with real-world currency, and once the gacha box has been opened the player can receive a random reward (Dang, 2023).

Gacha boxes are designed to be more appealing and eye-catching for the players, employing different color patterns, visually stunning special effects, such as glowing borders or particle animations (Dang, 2023). For example, in Arknights, once the player obtains a super rare item from a gacha box, the screen shows an animation of a bag opening up, a golden glowing light with golden particles surrounding the bag starts to appear on the screen and the item appears (Dang, 2023). Special animation and background music while opening the box are other elements included to capture players attention and imbue a feeling of excitement (Cabrera et al., 2023). These design elements used in gacha boxes encourage players to be more active in the videogame.

Additionally, these types of video games may enforce cognitive biases to encourage players to purchase the gacha boxes. Limited time discount, bonus rewards are some examples that can be found in many gacha games. A pity counter is another possible characteristic added in these gacha games, displaying the remaining purchases required to obtain a guaranteed reward, and there are many examples in which the pity counter is present, for instance, Genshin Impact or Zenless Zone Zero. This design can induce a feeling of urgency or FOMO in players, encouraging them to purchase the rewards by either spending real-life currency or play the game and obtain the in-game currency (Cabrera et al., 2023),

These gacha boxes are the main method to obtain limited rare characters and weapons in gacha games, and they are also the players' main source of motivation. There are a large quantity of researchers surveys that recorded similar results. Lakić et al. (2023) recorded the results of a survey of participants choosing their favourite aspect of gacha game, and out of 654 responses: 248 (37.9%) choose characters, 175 (26.7%) choose story, 88 (13.4%) choose gameplay, and 82 (12.5%) choose collecting. Ismail et al.

(2021) measured the total frequency of agreed responses the participants recognise as a motivational factor, and the following is the list of motivation factors organized from most to the least agreed among the participants: To get the target character (items), I want new character (item), if limited-time character (item) are provided, if there is a probability UP event, I think some rare character (item) will hit someday, to advance the game, if there are sale events such as price reduction, to clear games, to rank up. Despite these surveys being from different people from different years, they both have a common component. In both surveys, the main factor motivating players to be engaged toward the game are character related factors.

The reason behind this connection towards a character is due to the game providing emotional but also narrative value in a character through character interactions within the game, with their visually stunning aesthetics, their unique personality, and their immersive character arc (Woods, 2021). The exposure to these characters can lead players to foster a parasocial relationship towards the character, similar to having deep connection with celebrities or fictional characters (Horton & Wohl, 1956). Yet, the one-sided emotional bond players have towards a character is not the only reason players pull for a certain character. Gacha games, such as, Genshin Impact or Fate/Grand Order tie characters to game progression, forcing players to pull for a character to access exclusive content (Rentia & Karaseva 2022; Woods 2021).

GACHA GAMES CURRENCY SYSTEM

As I previously mentioned, the gacha boxes can be bought using in-game currency, but the currency system behind it is very complex. There are 2 categories of currency we can divide them into: free currency and event currency. The free currency is a type of in-game currency obtainable by playing the game, eliminating enemies, progressing through the game, completing the quest, etc. Moreover, the currency freely obtained can be either gacha box currency or in-game currency. The gacha box currency is exclusively used to buy gacha boxes, while the in-game currency can be used for gameplay progression: upgrading weapons, buying tools… Whereas, event currency is temporary currency obtainable exclusively from in-game events, and they can be exchanged for more rewards (Andrea, 2023). This complex design of the games' currency can motivate players' engagement towards the game. Leading them to log in daily to claim the temporary event currency and exchange it for limited time rewards. This can even induce a sense of scarcity and exclusivity, leading players to crave for the currency and rewards (Koeder, Tanaka, 2017).

GACHA GAMES PSYCHOLOGICAL DESIGN

The Gameplay Design

Developers focus on player retention and motivation as one of their main goals during the development of a videogame, to keep players engaged in the game. In order to reach this objective they employ the core loops to obtain players attention (Puertas, 2023).

The core loops can be broken down into 3 elements: action, reward, and progress. This is defined as the main method players interact with the game, a sequence of actions, followed up by a reward for the correct action sequence, leading to the game's progression (Puertas, 2023). The repetitive nature of the loop can promote player motivation to play the game, due to the pay off for their grokking, which means learning and comprehending a concept they did not understand, receiving pleasure from the pay off (Rentia & Karaseva, 2022). Miranda (2021) suggests there are 4 different types of core loops: main loop, dual loop, nested loop, and compulsion loop. The main loop is the general game actions, premise and rules. The fame directs the players what path they should take and how they should take it to achieve the main objective and progressing through the game (Miranda, 2021). Meanwhile, the dual loop employs 2 main loops, each one with a different objective, allowing the player to pursue either of them (Miranda, 2021). While the nested loop is a loop within a loop. Consisting of a set of actions inside a loop that does not necessarily complete the loop, allowing players to start another loop without completing the main loop (Miranda, 2021). Compulsion loop is the last type of the core loop. This loop is structured into action, rewards, and anticipation (Miranda, 2021). It is designed in this way to activate a biological response (Kim, 2014), constantly supplying the brain with a neurochemical reward, dopamine (Puertas, 2023), caused by the expectation of a reward, leading the players to be more engaged in video games by repeatedly performing the same actions (Alegria, 2022).

An example of a loop design in gacha games are the large amount of collectible items players can obtain, each item with different stat, ability, appearance, incentivizing players to collect all of them (Dang, 2023). Moreover, there is also a random drop system employed in the game that has a similar function to the gacha boxes. This system can grant players a possibility to obtain a rare item or a common item. For instance, in Arknights, when a player completes stage 3-4, a drop tablet will be rolled to determine the rewards for the players, including the Orirock (a common drop) and the Orirock Cluster (a rare drop). Yet, even if the player is targeting the Orirock Cluster there is no guarantee that is the reward the player receives. The sense of excitement and anticipation the players have been exposed to motivate players to be more engaged toward the game, leading them to consume more time to obtain their desired item, normally being the highest rarity item (Dang, 2023). The anticipation players experience while waiting for the reward causes the human body to release dopamine within the nervous system (Alegria, 2022).

The gacha games leveling system is another important gameplay loop design in gacha games employed in videogames. Collecting rare items, weapons, or characters is not sufficient for players to progress through the game, and in order to become more powerful and improve the stats and utility of the items/characters players are required to increase its level. Imbuing a sense of progression through the game, as the players

see their items/units increasing in both strength and value (Dang, 2023; Alegria, 2022). This can influence players retention and motivation to continue engaging with the game due to sunk cost fallacy (Arkes & Blumer, 1985; Jhang et al., 2022). This cognitive bias reinforces players' motivation to play the game as a mechanism to prevent the players' past commitment and investments perceived as a loss (Arkes & Blumer, 1985; Jhang et al., 2022). A suitable example of a gacha game that employs the leveling system is Genshin Impact. In this game, a character requires at least 2 million mora (the in-game currency), without taking into consideration other leveling materials required, to reach the max level at 90 level. The large amount of resources the game requests to max level a character lead players to grind in these types of games, spending a large quantity of time in gacha games to obtain the upgrading materials (Dang, 2023).

The grinding element is a very common gameplay loop feature included not exclusively only in gacha games, but even in RPGs (role-playing games), MMOs (massive multiplayer online games), sports or fighting games. The grinding feature leads players to consume a large amount of time in the game. Research conducted by Zagal et al. (2013) suggest that the majority of gacha games apply a stamina system, recognised as "play by appointed" system. The stamina system limits player liberty of playing by their preferences, but rather requires players to play at a specific time for a specific amount of time (Zagal et al. 2013). An example of a stamina system is the "resin" in genshin impact, the resin in genshin impact has a maximum capacity of 200, and every 8 minutes one resin is produced, thus, taking 26 hours and 40 minutes to fully cap the resin. Therefore, the player must log in every day to prevent the resin from capping to fully use the stamina. Moreover, there are daily missions players are required to complete every single day to maximize the grinding output, as the daily missions also resets daily. Such as the 4 daily commissions in genshin impact (Alegria, 2022). This repetitive daily pattern and the motivation to increase a characters' level can raise a daily habit, lasting for an undefined amount of time (Zagal, 2013).

Dopamine Production

Dopamine is a hormone present in our human body, and this hormone plays a crucial role in players' addiction to gacha games (Alegria, 2022). Once the brain perceives a positive stimulus from a certain action, interpreting it as a beneficial experience, the human body will discharge the hormones in the nervous system. Causing the desire, the craving players experienced, working as a motivation to keep on pushing players to engage into the game (Alegria, 2022).

Among the immense game mechanisms in gacha games, the reward system is highly likely the main source of dopamine production (Alegria, 2022). As suggested by psychologist B.F Skinners' discovery, an animal may repeat a certain action if it received a reward for previously performing that action. According to Robert Sapolsky, there is a correlation between this phenomenon in animals with dopamine production within the nervous system. Suggesting that the expectation for a reward after performing a specific action will lead the individuals to be more engaged in the action (Alegria, 2022).

THE FEAR OF MISSING OUT AND LOSS AVERSION INDUCED BY GACHA GAMES

The games are designed in a way to induce the Fear of Missing Out (FOMO) to the players to retain their attention towards the game (Dang, 2023). The rotating shop in gacha games allow players to exchange useless materials for useful ones, including characters, weapons, upgrading materials, etc. Yet, these shops are only daily, weekly, or monthly limited before the store refreshes and the leveling materials are resupplied (Dang, 2023). While the characters and weapons work differently from the leveling materials, as they are not resupplied but are exchanged with another character/weapon, and thus become unavailable in the shop for an undetermined period of time. Since the schedule for the rerun of the characters in the shop are not disclosed to the public, players may feel pressured to purchase the character before the character or weapon had been taken down, thus purposely inducing FOMO in the players. (Dang, 2023).
From the evidence I provided, it shows how gacha games forcefully induce FOMO into their players, and there have been studies that suggest a positive relationship between FOMO and player gaming addiction (Utama & Utami, 2024). However, the rotating shop is not the only catalyst for FOMO in the players, as a matter of fact, social media is another efficient source of FOMO in players (Astuti, 2021). Communities are built in social media where individuals with the same interest gather together to aid each other and share information about the new game mechanisms, characters, events, etc. Yet, players can be constantly exposed to this information and seeing the community discuss it, there is a possibility to trigger FOMO in the individual. Aligning with what Wegmann (2017) suggested, that FOMO is an effort to stay informed on events occurring around the individual and in order to not miss out on any valuable experiences, thus, it encourages the players to grind and farm in the game (do a repetitive task over a prolonged period of time).

An important information to note down is that those who are more likely to develop FOMO are students. Since a study conducted by Utama and Utami (2024) indicated that over a year, with an average of 6 hours per day players played gacha games, 53.6% of these players were students. Due to the difference in the amount of free time between a student and an adult, they will be more exposed to these types of games, thus, they are more likely to develop FOMO and gaming addiction.

Loss Aversion Induced By Gacha Games

Loss aversion is a cognitive bias that an individual may experience, and along with FOMO, the game designs' purpose is to purposely induce the feeling of loss aversion in the players (Lee et al., 2025). Loss aversion may encourage negative emotions in individuals when they are faced with a potential loss that is the equivalent of positive emotions from a perceived gain (Lee et al., 2025). One of the most popular game designs to elicit the loss aversion in players, used by 95% of video games, is the daily login rewards system. By regularly logging into the game, players can receive rewards, building up a routine. In case the player misses a day, they may perceive that the accumulated process has been wasted, thus, motivating the players to keep playing the game and logging in daily (Lee et al., 2025).

Consequences of Video Game Addiction on the Human Brain

The list of the elements in video games that had been previously stated can all lead to video game addiction, which can influence the many regions of the brains' reward processing system (Liu et al., 2010 ; Hou et al., 2012 ; Hahn et al., 2014). Volkow et al. (2010) proposed a model to explain the complexity of the participants' craving response when exposed to gaming cues, which had been mentioned in various studies.

The precuneus, an area of the brain that plays a role to retrieve memories, visual processes and attention to link the visual information (gaming cues) to integral information, demonstrated an increase in their activity in addicted individuals (Ko et al. 2013). Furthermore, there are other regions in the brain that manifested an increased response (O'Brein et al., 1998) which provides emotional memories and contextual information for the gaming cues , including: parahippocampus, amygdala and the hippocampus (Ding et al., 2013).

In the meantime, the limbic system and the posterior cingulate, the central key regions of the brains' reward system, integrates the motivational information, providing an expectation and reward significance for gaming behaviours (O'Doherty, 2004). The craving for gaming and the motivation value from the cue-inducing stimuli are caused by the orbitofrontal cortex and anterior cingulate cortex (Heinz et al., 2009), strengthening the intensity and the activation of the reward-seeking behaviour (Kalivas & Volkow, 2005; Brody et al., 2007; Feng et al., 2013). Moreover, Han et al. 2010 and Ko et al. 2013 showed the prefrontal executive areas, for instance, dorsolateral prefrontal cortex, associated with the deliberate anticipation of playing video games through the development of behavioral plans, suggested a participation in the individuals craving response. There was also a reduction of the grey matter volume in the whole frontal regions of the brain in the participants, as a result of video game addiction (Jin et al., 2016).

A reduction in ventral striatum, in charge of reward prediction plays a fundamental role in reward prediction was shown in individuals with excessive gaming addictions (Hou et al., 2012), and in the insula (Naqvi & Bechara, 2009). Overall, these traits are typical of reward deficiencies that involve dopaminergic system dysfunctions, a neurobiological anomaly that is shared by other addictive disorders (Ko et al., 2009, 2013 ; Cilia et al., 2010; Park et al., 2010; Kim et al., 2011).

A crucial node in the reward system and the default mode network (Kim et al., 2015), the posterior cingulate cortex with its unique connectivity and activation patterns (Liu et al., 2010) may serve as a biomarker to severe the addiction in behavioural dependence. A shift from prefrontal to striatal control, from voluntary to compulsive substance use, and from ventral to dorsal striatal control over behaviour can be seen as the addiction become more severe (Everitt & Robbins, 2005), corresponding evidence had been shown in the form of reduced functional connectivity involving the dorsal-caudal putamen in addicted individuals (Hong et al., 2015).

It is significant to understand that professional gamers exhibit very different neural patterns from individuals addicted to video games, despite controlling the time spent playing video games. There is a neural difference in the grey matter volumes in the left cingulate gyrus (increased in pro-gamers) and thalamus (decreased in pro-gamers) may be a sign of an imbalanced reward system. Additionally, gamers who fall into the addiction category normally exhibit an increased impulsiveness and perseverative errors that are absent in professional gamers (Sánchez-González et al., 2005; Han et al., 2012).

DISCUSSIONS AND LIMITATIONS

Gacha games are designed in a way to utilize a variety of methods in order to maintain player retention and motivation to engage with the game by exploiting the brains' reward system and using psychological tricks on players' brains. The core loops formula is the foundation of the gacha games and how they are structured. A repetitive habit the persuade players to engage the game daily, by enforcing a large quantity of collectible items for the players to level up their characters, or the grinding feature, forcing players to engage the game when the game wants for as long as the game wants with the daily missions and the stamina system to maximize the value of these limited materials essential for the grinding sessions that refreshes daily. Furthermore, a psychological trick they apply is the sunk cost fallacy, defined as the tendency to continue the game due to the large quantity of time and resource already invested into the game.

The gacha box is probably the most important element in gacha games, as this paper suggests many individuals' motivation to keep on playing the game are the characters, which can be obtained solely from these gacha boxes. On top of that, the gacha boxes exploits our brains' reward system, as the pity system shows the odds of obtaining the desired character, the expectation of winning the character rises, thus, resulting in the production of dopamine within the nervous system, enhancing the experience generating a good sensation for the player.

Whereas, the intricate currency system is not only an essential resource of character upgrades or gacha boxes. But limited-time reward currency are another additional factor that encourages players to log into the game daily to claim the limited rewards with limited-time currency.

Moreover, sunk cost fallacy is not the only psychological trick developers use to promote the games retention and motivation, but it also includes FOMO and loss aversion. FOMO, or Fear Of Missing Out, is used through the rotating shop and social media. As the rotating shop changes the items sold without the information of when they are sold the next time, pressure the players to buy the item or wait for an undefined return of the item in the shop. While social media, where the community gathers to share the same interest in the gacha game, exposure to players discussing the new updates can pressure players to catch up to the others to not miss out on any irreplaceable experience.

All of these gacha game features can have major consequences on an individual's brain system, damaging or influencing the function of precuneus, hippocampus, amygdala, parahippocampus, the limbic system, and many other brain regions.

The limitations of this study must also be acknowledged to understand what is still lacking in this paper. The survey (Lakić et al., 2023; Ismail et al., 2021) did give me enough data to determine that characters are one of the main motivations for players to keep engaging with gacha games. Yet, the data sample cannot be generalized to represent the whole population of gacha gamers since there are only a couple of hundred responses. Additionally, the survey (Lakić et al., 2023; Ismail et al., 2021) did not divide the participants as F2P and P2W players, as they might have different points of view on what are the main motivations to play the game since they experience the game differently. Therefore, I suggest for future research to expand the number of participants, increasing their target demographic to be more generalizable for the broader population. Additionally, a division of F2P and P2W while performing the experiment and comparing the data between the 2 groups can also grant interesting insights on how different experiences of different players view the same game.

REFERENCES

Andrea, K. (2023). Types of mobile game currencies you need to know. Udonis Mobile Marketing Agency.

Almodovar Alegria, N. (2022). Analysis on reward systems in video games: Strategies in game design and their relation with addiction.

Arkes, H., & Blumer, C. (1985). The psychology of sunk cost. Organizational Behavior and Human Decision Processes, 35(1), 124–140.

Astuti, C. N. (2021). Hubungan kepribadian neurotisme dengan fear of missing out pada remaja pengguna aktif media sosial [The relationship between neurotic personality and fear of missing out in active teenage social media users]. Jurnal Ilmiah Bimbingan Konseling Undiksha, 12(2), 159–166.

Brody, A. L., Mandelkern, M. A., Olmstead, R. E., Jou, J., Tiongson, E., Allen, V., Scheibal, D., London, E. D., Monterosso, J. R., & Ling, W. (2007). Neural substrates of resisting craving during cigarette cue exposure. Biological Psychiatry, 62(6), 642–651.

Cilia, R., Ko, J. H., Cho, S. S., van Eimeren, T., Marotta, G., Pellecchia, G., Pezzoli, G., Antonini, A., & Strafella, A. P. (2010). Reduced dopamine transporter density in the ventral striatum of patients with Parkinson's disease and pathological gambling. Neurobiology of Disease, 39(1), 98–104.

Dang, T. (2023). The addictive design of mobile gacha games.

Ding, W., Sun, J., Sun, Y., Zhou, Y., Li, L., Xu, J., & Du, Y. (2013). Altered default network resting-state functional connectivity in adolescents with Internet gaming addiction. PLOS ONE, 8(9), e59902.

Everitt, B. J., & Robbins, T. W. (2005). Neural systems of reinforcement for drug addiction: from actions to habits to compulsion. Nature Neuroscience, 8(11), 1481–1489.

Feng, Q., Chen, X., Sun, J., Zhou, Y., Sun, Y., Ding, W., & Du, Y. (2013). Voxel-level comparison of arterial spin-labeled perfusion magnetic resonance imaging in adolescents with internet gaming addiction. Behavioral and Brain Functions, 9(1), 33.

González-Cabrera, J., Basterra-González, A., Ortega-Barón, J., Caba-Machado, V., Díaz-López, A., Pontes, H. M., & Machimbarrena, J. M. (2023). Loot box purchases and their relationship with internet gaming disorder and online gambling disorder in adolescents: A prospective study. Computers in Human Behavior, 143, 107685.

Hahn, T., Notebaert, K. H., Dresler, T., Kowarsch, L., Reif, A., & Fallgatter, A. J. (2014). Linking online gaming and addictive behavior: converging evidence for a general reward deficiency in frequent online gamers. Frontiers in Behavioral Neuroscience, 8, 385.

Han, D. H., Hwang, J. W., & Renshaw, P. F. (2010). Bupropion sustained release treatment decreases craving for video games and cue-induced brain activity in patients with Internet video game addiction. Experimental and Clinical Psychopharmacology, 18(4), 297–304.

Han, D. H., Lyoo, I. K., & Renshaw, P. F. (2012). Differential regional gray matter volumes in patients with on-line game addiction and professional gamers. Journal of Psychiatric Research, 46(4), 507–515.

Heinz, A., Beck, A., Grüsser, S. M., Grace, A. A., & Wrase, J. (2009). Identifying the neural circuitry of alcohol craving and relapse vulnerability. Addiction Biology, 14(1), 108–118.

Hong, S.-B., Harrison, B. J., Dandash, O., Choi, E.-J., Kim, S.-C., Kim, H.-H., Kim, C.-D., Kim, J.-W., & Yi, S.-H. (2015). A selective involvement of putamen functional connectivity in youth with internet gaming disorder. Brain Research, 1602, 85–95.

Hou, H., Jia, S., Hu, S., Fan, R., Sun, W., Sun, T., & Zhang, H. (2012). Reduced striatal dopamine transporters in people with internet addiction disorder. Journal of Biomedicine and Biotechnology, 2012, 854524.

Horton, D., & Wohl, R. R. (1956). Mass communication and para-social interaction: Observations on intimacy at a distance. Psychiatry, 19(3), 215–229.

Ismail, I. F., Fitriana, M., & Chuin, C. L. (2021). The relationship between loneliness personality differences motivation and video game addiction in the context of gacha games in F2P mobile games: A global setting. Journal of Behavioral Addictions, 10(3), 456–472.

Jhang, J., Chaein, D., Park, J., Lee, J., & Kim, J. (2022). The impact of childhood environments on the sunk cost fallacy. Decision, 9(4), 343–361.

Jin, C., Zhang, T., Cai, C., Bi, Y., Li, Y., Yu, D., Zhang, M., & Yuan, K. (2016). Abnormal prefrontal cortex resting state functional connectivity and severity of internet gaming disorder. Brain Imaging and Behavior, 10(3), 719–729.

Kalivas, P. W., & Volkow, N. D. (2005). The neural basis of addiction: A pathology of motivation and choice. American Journal of Psychiatry, 162(8), 1403–1413.

Kim, J. (2014). What is the compulsion loop? Game Analytics.Kim, S. H., Baik, S.-H., Park, C. S., Kim, S. J., Choi, S. W., & Kim, S. E. (2011). Reduced striatal dopamine D2 receptors in people with Internet addiction. NeuroReport, 22(8), 407–411.

Kim, Y.-H., Kang, D.-W., Kim, D., Kim, H.-J., Sasaki, Y., & Watanabe, T. (2015). Real-time strategy video game experience and visual perceptual learning. Journal of Neuroscience, 35(29), 10485–10492.

Ko, C. H., Liu, G. C., Hsiao, S., Yen, J. Y., Yang, M. J., Lin, W. C., Yen, C. F., & Chen, C. S. (2009). Brain activities associated with gaming urge of online gaming addiction. Journal of Psychiatric Research, 43(7), 739–747.

Ko, C. H., Liu, G. C., Yen, J. Y., Chen, C. Y., Yen, C. F., & Chen, C. S. (2013). Brain correlates of craving for online gaming under cue exposure in subjects with Internet gaming addiction and in remitted subjects. Addiction Biology, 18(3), 559–569.

Koeder, M. J., & Tanaka, E. (2017). Game of chance elements in free-to-play mobile games. A freemium business model monetization tool in need of self-regulation? [Paper presentation]. TPRC 45: The 45th Research Conference on Communication, Information and Internet Policy.

Lakić, N., Bernik, A., & Čep, A. (2023). Addiction and spending in gacha games. Information, 14(7), 399.

Lee, H., Imteyaz, K., & Savage, S. (2025). Playing to pay: Interplay of monetization and retention strategies in Korean mobile gaming. arXiv.

Liu, J., Gao, X.-P., Osunde, I., Li, X., Zhou, S.-K., Zheng, H.-R., & Li, L.-J. (2010). Increased regional homogeneity in internet addiction disorder: A resting state functional magnetic resonance imaging study. Chinese Medical Journal, 123(14), 1904–1908.

Miranda, A. M. (2021). Alternative techniques to avoid abusive compulsion loops in mobile games.

Naqvi, N. H., & Bechara, A. (2009). The hidden island of addiction: The insula. Trends in Neurosciences, 32(1), 56–67.

O'Brien, C. P., Childress, A. R., Ehrman, R., & Robbins, S. J. (1998). Conditioning factors in drug abuse: Can they explain compulsion? Journal of Psychopharmacology, 12(1), 15–22.

O'Doherty, J. P. (2004). Reward representations and reward-related learning in the human brain: Insights from neuroimaging. Current Opinion in Neurobiology, 14(6), 769–776.

Palaus, M., Marron, E. M., Viejo-Sobera, R., & Redolar-Ripoll, D. (2017). Neural basis of video gaming: A systematic review. Frontiers in Human Neuroscience, 11, 248.

Park, H. S., Kim, S. H., Bang, S. A., Yoon, E. J., Cho, S. S., & Kim, S. E. (2010). Altered regional cerebral glucose metabolism in internet game overusers: A 18F-fluorodeoxyglucose positron emission tomography study. CNS Spectrums, 15(3), 159–166.

Pou Puertas, A. (2023). Decoding random virtual rewards: A guide to identify hazard game design techniques in video games [Bachelor's thesis, Universitat Politècnica de Catalunya].

Rentia, G. G., & Karaseva, A. (2022). What aspects of gacha games keep the players engaged?

Sánchez-González, M. A., García-Cabezas, M. A., Rico, B., & Cavada, C. (2005). The primate thalamus is a key target for brain dopamine. Journal of Neuroscience, 25(26), 6076–6083.

Utama, B., & Utami, R. H. (2024). The relationship between fear of missing out and internet gaming disorder in gacha game players. In Trend: International Journal of Trends in Global Psychological Science and Education, 2(1), 61–66.

Volkow, N. D., Wang, G.-J., Fowler, J. S., Tomasi, D., Telang, F., & Baler, R. (2010). Addiction: decreased reward sensitivity and increased expectation sensitivity conspire to overwhelm the brain's control circuit. BioEssays, 32(9), 748–755.

Wang, H., & Sun, C.-T. (2012). Game reward systems: Gaming experiences and social meanings [Conference paper]. DiGRA: Digital Games Research Association International Conference.

Wegmann, E., Oberst, U., Stodt, B., & Brand, M. (2017). Online-specific fear of missing out and Internet-use expectancies contribute to symptoms of Internet-communication disorder. Addictive Behaviors Reports, 5, 33–42.

Zagal, J. P., Björk, S., & Lewis, C. (2013). Dark patterns in the design of games. In Foundations of Digital Games 2013.
Zhang, K. (2025). Balancing engagement and addiction in gacha games: An experience design approach [Master's thesis, Northeastern University].