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Emotional Utility and Probability Misperception: Unpacking Irrational Spending in Mobile Game Gacha Systems

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Abstract. Despite its benefits in terms of revenue generation, the gacha system is now a key monetization feature in many mobile games today, which has led to over-consumption, an issue resulting in growing social and regulatory problems. Taking the Warp mechanism of Honkai: Star Rail, for instance, this paper delves into the factors that contribute to irrational spending from a behavioral economics perspective and a regulatory analysis, adopting a dual-path analytical approach. The case analysis suggests that there are two key drivers of biased consumption: probability-perception bias from low base drop rates and pity-counter feedback; and sunk-cost-fueled emotional entrapment from abstract virtual-currency transactions. Moreover, it is demonstrated that existing regulations fail to take sufficient account of the specific risks of adolescent players for such psychologically engineered monetization. Specific optimization proposals are advanced, such as visualized disclosure of probabilities, with cooling-off triggers; less abstraction of the virtual currency; and hierarchical shields for adolescents' consumption. This research adds to the application of behavior economics in digital game design and offers a theoretical foundation and practical insights for digital game industry regulation and for protecting the interests of end-users.

Keywords: Emotional Utility, Probability Misperception, Gacha Systems, Irrational Spending, Adolescent Protection

1. Introduction

1.1. Research background

In the past decade, the way of making money in games has changed rapidly. Random reward systems, such as loot boxes and card drawing, have become an important source of income for game developers. In 2025, 22 consumer protection agencies conducted a global review and surveyed 439 games. It was found that 46% of the games contained loot boxes, but only a few games informed players that they contained the function before purchase [1]. The same survey also shows that many games with story boxes do not inform consumers of the probability of obtaining items. This problem cannot be ignored, because these games often face children and minors as consumers [1]. These results show that there is an obvious conflict between the profit model of random rewards and the informed needs of players. In China, the conflict is even more serious: card-driven games such as Collapse: Stardome Railway have earned billions of yuan in revenue.

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In business, gacha is a pricing method that is also emotionally sensitive. Research provides real scenarios to study how people make choices when they don't know the odds. Most players regret their excessive consumption behavior and show a gambling-like reaction [2, 3]. This means that the psychological and emotional theories behind irrational consumption have become a serious social and regulatory problem. This study examines the reward mechanism and probability misjudgment in mobile game card drawing, and uses a typical case to discuss why players' expenditure exceeds the expectations of the economic model.

1.2. Literature review

The existing research is roughly divided into three parts. The first part is concerned with whether there is a relationship between random rewards and gambling behavior. Raneri and others analyzed the path of teenagers and found that the use of trooty boxes was related to game obstacles and gambling problems, and this association did not disappear during the epidemic lockdown [4]. Another player survey also saw a similar trend, but with a weaker intensity: lot box spending is associated with gambling risk factors, but most buyers do not develop serious problem behaviors.

Another research clue focuses on the clarity of the odds disclosure of game companies and the effectiveness of supervision. Xiao and others studied the British self-regulation rules, and most companies did not seriously abide by them. Even if they were disclosed, the information was deeply hidden and written vaguely [5]. On the contrary, Xiao and Park studied South Korean law and found that mandatory rules were more effective in prompting companies to disclose odds [6]. It can be seen that transparency is the key to protecting players, but in reality, it is not always achieved.

The third area focuses on how pricing and reward design affect the willingness to pay. A British experiment motivated hundreds of participants to play games and found that when people used virtual currency instead of real money, they were more likely to buy loot boxes [7]. Gan, on the other hand, uses the prospect theory model to regard card drawing as a pricing strategy. Its model shows that people do not always think rationally about probability, and the bottom guarantee mechanism, which guarantees rewards after a certain number of times, helps to explain how the system keeps running [8]. These studies jointly explain the psychological outline behind card consumption. This case study is based on this.

Prior work is wide-ranging. Three key gaps still exist. Most studies deal with loot boxes in general, and rarely disassemble a leading card-drawing product at the mechanism level. Existing research has also been used to separate the sides of gacha, like revenue and player value, from the bad sides, such as entrapment and excessive spending. There is a lack of a general perspective that brings both sides together. There is a lack of evidence linking the psychological process with specific design choices or policy changes. This study uses the Warp system in Honkai: Star Rail as an example to fill those gaps.

1.3. Research framework

The study follows four steps. First, the Case Description outlines the background, mechanics, and industry setting of the gacha system. Then the Analysis section focuses on the effects and points out three problems about emotional utility and how people perceive probability, which is linked to existing literature. The Suggestions section proposes interventions that match each problem. Finally, the Conclusion wraps up the findings, their importance, and the study's limits throughout the analysis based on economics and real-world case evidence.

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2. Case profile: the warp system in Honkai: Star Rail

Honkai: Star Rail is a game made by HoYoverse released in 2023. It is one of the most popular mobile games globally. Its income deeply depends on the Warp system—a mechanism for getting characters and light cones. They can earn in-game currency without spending money or buy it with real money. Characters and gear may be given by ten-pull warps with random probability. A featured five-star character has a base drop rate of less than one percent. A pity system has given that guarantees the featured item after a set number of pulls. The character promoted is determined by a fifty percent mechanic. The core design is composed of low-transparency odds with a worst-case outcome that is limited but expensive. This system is part of an industry and regulatory context. Back in 2025, the FTC settled allegations with HoYoverse regarding its game, Genshin Impact. The case had false odds, communication, and selling loot boxes to minors [9]. But that settlement is an indication that regulators are listening. In many instances, consumer protection measures globally have revealed that the modus operandi of systems and the probability of winning are not transparent [10, 11]. There are laws about probability disclosure in China and Hong Kong: Star Rail does disclose its odds. However, this has not stopped players from continuing to play despite numerous failures. Thus, in situations where risks are known, people do not always act rationally. One of the main cruxes of this analysis is the difference between what is revealed and what people do.

Table 1 shows what hard pity costs. For players who rely mainly on paid resources, reaching the threshold requires substantial financial input.

Table 1. Cost structure and hard-pity threshold of the Warp system

Pull type	Unit cost in game currency	Total currency for hard pity (90 pulls)	Appreciate the real money equivalent
Single pull	160 Stellar Jade	14400 Stellar Jade	1440 CNY
Ten-pull Warp	1600 Stellar Jade	14400 Stellar Jade	1440 CNY

3. Dual-path analysis: functional affordances and structural vulnerabilities

3.1. Functional affordances: sustaining the free-to-play ecosystem

The gacha model brings not only bad sides but real benefits. First, it supports a to-play business model that lowers entry barriers. The free-to-play effect encourages a lot of people to join. The fixed costs of development are spread across a number of users. Because the cost is paid by those who consume, the main content can be freely provided. This helps fund updates, art, music, and live service operations that would not be possible otherwise. This openness helps people to communicate from different cultures and places, which builds an active community. This benefit should not be ignored.

Furthermore, it is a good way of safeguarding players to have odds and a pricing system. It's a true consumer protection when compared with less-regulated games. Honkai: Star Rail displays its odds, unlike games that have concealed chances. Hard-pity guarantee reduces the costs associated with acquiring a character. If you are given odds and a pit system, it can help individuals not spend too much and gain trust when utilized correctly, according to research. The pit system also helps to maintain balance according to prospect theory. Without limits, there would be an increase in

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excitement, and it helps reduce this. These good parts indicate the design is not inherently dangerous. It creates a problem when the psychological tricks are not backed up with proper checks.

3.2. Structural vulnerabilities: cognitive biases and safeguard deficits

3.2.1. Probability misperception and the near-miss effect

First, an understanding of probability is caused by low chances and near-miss feedback. Even though the actual chance of getting a five-star character is less than 1%, when players fail, they can see a visible pity counter go up. It gives a sense of reward when getting close. This misinterpretation transfers the sense of failure to the idea that chance is higher than it is. Under prospect theory, people will already overestimate the small probability and change their judgment with the number of pulls. So the feeling of what might happen is higher than what happens. This mistake gets worse because of disclosure. Even when the odds are shared, they are not always easy to find, causing players to have no clear sense of opportunity. As a result, players think they are more likely to win and ignore the cost to keep trying. This mistake stimulates the spending that is not rational.

3.2.2. Emotional entrapment and sunk-cost fallacy

The second one is emotional, and the pitfall in thinking about investments. After players invest their time and money in the game, their investment becomes a motivation to continue playing the game. This is what the I-PACE framework refers to as entrapment. It causes them to continue when they no longer have fun. They continue spending because they do not wish to lose the money they have invested. After multiple unsuccessful pulls, it seems like a waste to end the gacha world. So players continue to play despite the odds. This isn't made better by using in-game currency. Experiments indicate that using money, people are more willing to spend than using real money. This is because virtual currency isn't quite as real. It can be a combination of not wanting to waste money and the fact that it's virtual, which can make it easier to spend more money than you need to, and feel bad about it later.

3.2.3. Regulatory vulnerability of adolescent players

The third issue is that young players are especially at risk, and current rules are not enough. Studies show that playing games with loot boxes and gacha machine-made links to gambling problems, gaming disorder, and risky behavior. Young people and young adults seem to be more sensitive to this. Rules are different in countries. The introduction of laws with odds in South Korea has led to better adherence to laws. In the UK, self-regulation didn't work. In Belgium, a ban wasn't enforced. That wasn't good enough either way. Actions by the FTC against HoYoverse show that even big companies have tricked consumers about odds and have not protected minors enough. In this situation, the emotional parts of the gacha system played on the youth can cause big money and mental problems that current rules cannot fully handle.

4. Intervention strategies

4.1. Dynamic probability transparency and mandatory cooling-off mechanisms

To reduce the bias caused by the miss effect, game operators should change their attention from simply following rules to helping players think more deeply. Putting probability numbers in small

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footnotes has limited effects. Developers can use dynamic visual indicators to show real-time chances of winning and how close the player is to getting a reward. This changes complicated math into pictures. A cooling-off period must happen when the system notices many losses in a row or when a player puts a lot of money out in a day. When this occurs, the player will see a notification showing their usual spending amount compared to that of other players. It will also tell them to stop playing for a while. Also, warning messages should be on payment pages to explain that each time a player tries, it's a chance, and previous losses don't help.

Through such modifications to the game interface, players will be able to make choices over time and enhance their thinking about what they derive from the game.

4.2. De-abstracting virtual currency and self-imposed spending constraints

To stop players from feeling they are not spending real money when using in-game currency. When players use coins like Stellar Jade, the real money value should be shown on the screen. This "currency retranslation" helps remind players that they are losing real money. Moreover, players should be able to set limits on how much they spend each day or for each event in advance. This setting needs a cool-down period to change, so players cannot change it in a short period. When the limit is reached, the game will stop for a while, and players will need a special sign-in to continue. This makes it harder to make impulsive purchases. For players who have spent a lot in the game, let them trade items for sure things, helping them stop spending on unattained virtual goods. This gives them a way out, which stops the cycle of spending just because they don't want to give up what they already have.

4.3. Multi-tier age verification and consumption-protection framework for adolescent players

Young people are more prone to being tempted to play gacha games, so the protection should be more than just checking their names. There should be a limit on how much a minor can spend per month for accounts that are verified by the minor. For younger players, the bright and exciting animation of ten-pull games should be less intense to help prevent too much excitement.

Payments require a face scan or phone check for parents/guardians to monitor their children's purchases. Also, there should be messages on the screen for youngsters explaining issues such as sunk-cost fallacy and opportunity squandered. These are just some of the messages that encourage young players to spend more money while playing the game. This system can safeguard players, maximize the money-making potential of the game, and ensure it remains fair.

5. Conclusion

5.1. Key findings

Using the Warp system in Honkai: Star Rail as an example, this study examines the behavioral-economic aspects of gacha mechanics as a driver of mobile-game irrational consumption. When winning odds are low and pity counters are visible, there is obviously a strong probability perception bias, which leads players to overestimate their chances of winning. Emotional utility and sunk-cost reasoning also lead to behavioral entrapment, which is amplified by the psychological opacity of virtual in-game currency. There are still obvious gaps in the current protective measures for adolescent cohorts that are vulnerable to emotionally-laden random-reward loops. The matching countermeasures include three aspects: visualization of the probability of disclosure with cooling-off

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reminders, demystification of the virtual currency with voluntary spending locks, and multi-level protective shields for minors. These are intended to reduce cognitive distortions and to balance commercial revenues with consumer welfare.

5.2. Research significance

This research yields practical, business, and social-level values. Gacha design transparency and player-centric operation offer benefits to game operators, such as mitigating regulatory risks and encouraging player trust and long-term game IP sustainability. This paper provides regulators in the industry with practical points of reference, such as compulsory consumption restrictions, mandatory visual presentation of probability, and more, to build a healthier digital-entertainment market governance. It demystifies the complex psychological pitfalls of gacha systems and raises awareness of how to better protect oneself in the digital world, particularly for young player groups who may not be familiar with behavioral-economic mechanisms. In sum, this case study contributes to the group of understandings of irrational consumption in digital economies and provides actionable governance inspiration for a myriad of stakeholders.

5.3. Limitations and future study

This study is primarily based on secondary sources as well as case study analysis. Internal logical relationships between the mechanism design and the consumption bias are interpreted thoroughly, but the player surveys/player interviews are not taken as original data, and quantitative evaluation on the exact number of emotional/cognitive drivers is limited. Future investigations could obtain subjective feedback and behavioral statistics directly from participants by means of questionnaires and semi-structured interviews, thereby quantifying the emotional utility and the misperception of the probability and its impact on the size of actual spending. Furthermore, this paper focuses solely on one representative Chinese-market gacha title. Future cross-cultural research on the East-Asian, European, and North-American games market can be carried out. A/B testing could also be used to test the effectiveness of the intervention strategies proposed in this paper in real-world environments.

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