Analysing the Gacha Mechanism: The Truth behind the Rates

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ILA

Contents

Preface

It was nearing the deadline for submitting the title for your ILA and I had still not given the project much thought. Forcing myself to choose a topic on the final day of the extended deadline, I was deliberating going down one of two routes; the easy yet laborious, or the difficult but enjoyable. After taming down my ambitions I went with the former and submitted that in thinking the route would be less bumpy.

Fast forward a couple of days and I am at my desk looking at my blank screen titled, “How Immigration affects the Local Economy.” Finally I come to the realization that this is going to be a reading fest, examining 30 odd articles and picking out what is relevant for me, only to come up with a conclusion that mirrors someone else’s with data that has been sourced from some one else. What would be my input? Besides, the title itself was bland and monotonous, exactly not what I wanted to my ILA to encompass.

So, I had to start from scratch with Mr Bradford thinking I was some labour economist. This time I decided I would go down the other route titled: "Are in-app purchases a scam?" Being a frequent app gamer and statistics enthusiast, I thought this was the perfect idea until I became aware of its potential downfall: the countless different app genres and in-game purchase functions. For example, in one game “gems” might be spent trying to summon a character from a pool, in another “stones” may merely speed up time. Trying to make comparisons of the value of in-game currency between two distinct games (whose currency served different functions) would be very difficult, let alone quantifying the value of speeding up game time itself.

With the help of Mr Xuan I managed to narrow down my appetite to a more specific genre, gacha: the controversial Japanese lootbox[1] extraordinaire now common in western app stores and perhaps the biggest “socially approved” scam out there. Having played these games before and having previously meddled with statistics in the context of these games, I realized there was a much bigger section of this topic to be explored using more elements of statistics, I at the time did not know of.

I wanted my ILA to be truly independent, in other words, I wanted most of the research to be my own, using my own unique methods and coming up with my own conclusions about these games. That’s why choosing such a niche topic that had not been previously explored, bar the odd superficial statistical analysis by players in the games’ communities, was perfect for my goal.

However, there were two large problems that I immediately faced as I tried to change subject from in-app purchases as a whole to the specific genre of gacha. Firstly, gacha was too specific and foreign a genre that many people did not understand the complicated terminology associated with it. Being an avid gacha gamer myself did not help either, as it was difficult to gauge what a stranger to the game would not at first understand. In fact, after submitting my first draft for approval, those who had played such games prior to reading my draft had good things to say about it, as opposed to those who hadn’t who struggled to get past the first couple pages. To fix this, I decided to restructure my ILA so it was more easy to follow, add a definitions page for any foreign vocabulary, buff up the introductory explanation of gacha, and finally add footnotes to parts that may not be fully accessible to a lay reader. This came with a downside in that my essays’ word count ballooned to make up for the more detailed explanations.

[1] A loot box is a “consumable virtual item in video games which can be redeemed to receive a randomised selection of further virtual items, or loot, ranging from simply customization options for a player’s avatar or character, to game-changing equipment such as weapons and armour.” – Wikipedia https://en.wikipedia.org/wiki/Loot_box

The second problem was perhaps the bigger of the two. Having already written a large amount for my old topic of in-app purchases it was painful to cut out the now irrelevant sections. Changing topics immediately made the vast proportion of my then ILA redundant. My over attachment to what I had previously written made it difficult to cut stuff out on the basis of forcefully made reasons explaining their relevance. This resulted in an ILA which lacked a coherent structure and clearly looked as if someone had changed ideas halfway through writing it. In the end I managed to overcome this issue with the help of Mr Xuan (…again), by planning my new essay and only extracting the relevant parts from my old ILA, editing them slightly before inputting them into my new one.

The end product was an ILA dipped in statistical analysis, coated with behavioral analysis with a sprinkle of scorn on top. I understand some of this analysis does not apply to the whole gacha genre, indeed there are some games which are not so much of a scam but more a delight to play. This essay was mainly aimed at targeting the so-called gacha mechanism in popular gacha games that have, in some cases, been criticized as “scam-like” or close to “gambling” by many game critics.

Introduction

With "92% of mobile games on Google Play free"[2] as of December 2016, it is not new news that the free-to-download business model is dominating app stores. Rather ironically, its these "free games" that are commandeering the revenue charts with Minecraft, the top paid app, not making the top 100 in terms of gross revenue[3]. With high profit margins and no fear of piracy, these games meet market desire to pay in sequential small amounts rather than large lump sums from the start. The barrier to play these games is virtually non-existent, being free to download, and they appeal to the large competitive audience through intense multiplayer elements.

What distinguishes this model of games from the other model, (pay-to-download) is the barrier to entry (in the form of upfront costs). With a $5 price tag, consumers will be hesitant to try the game at all and be more demanding that the experience matches the price. It's a risk consumers don't wish to take unless knowing for certain, through reviews and gameplays, that the game is "worth it." On the other hand, free games are free, at least from the start anyway. It is unusual for "free games" to stay "free" as people play more and more. Using the absence of a barrier to amass a large player base, the competitive nature of the game begins pulling in money. Relying on the "freemium strategy," such games are the perfect encapsulation of tricks and devices to edge unsuspicious players to make their first purchase.

However, one branch of "free-to-download" games takes these tricks to another level, so much so that they have been frequently likened to that of gambling and scams. These "Gacha games," whose purchase-function (a so called "gacha-mechanism," similar to that of lootboxes) relies so heavily on chance, are breeding grounds for tricks to not only initiate a gambling-like process but to sustain it as players, particularly competitive ones, spend on a weekly basis to try acquiring a new hero which is always, suspiciously, better than the last.

With the old saying at heart: "nothing is free in this world," in this essay I will be exploring the gacha mechanism, shining a light on the true purposes hiding behind seemingly unsuspicious benefits, serving to lull you into paying the same, if not more for what had previously put you off from downloading another pay-to-download game.

In fact, the extent of the hidden and unsuspicious nature of these ploys, deliberate or a result of convenience, can be demonstrated by this one overlooked factor that already makes any in-app purchase very dangerous; the method of payment. Such a seamless and intangible transaction process (as exists in both Apple and Google Play stores) numbs the "pain of payment" and leads to unbalanced cost-benefit analyses. This in turn leads to overspending on items that the consumer would otherwise be reluctant to buy given a more upfront, physical and persistent payment system.

In a study by Drazen Prelec and Duncan Simester of MIT (2001)[4], it was found that shoppers spend up to 100% more when using credit cards instead of cash. Similarly in another study, the authors found that participants were willing to spend $175 to throw a Thanksgiving party when using a credit card to buy the food, but only $145 when using cash. Why is this the case, and what are the implications for in-app purchases?

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[2] Statista - 2016

[3] Sourced from https://dmarket.com/blog/free-vs-paid-games/, and validated by use of SensorTower

[4] Sourced from: https://www.forbes.com/sites/billhardekopf/2018/07/16/do-people-really-spend-more-with-credit-cards/#798a75c81c19

[4] Sourced from: The Journal of Consumer Research: Volume 38, Issue 1, (1st Juner 2011): How Credit Card Payments Increase Unhealthy Food Purchases: Visceral Regulation of Vices

As opposed to payments in cash, when purchasing virtual goods by card there is no physical element of exchange. As a result, the reality of the loss, commonly enforced by the handing over of physical money, is not fully realized, downplaying the cost of the item. On the other hand, such a seamless transaction highlights the benefits of the purchase to the consumer via the immediate transferal of the good. Allowing a consumer to benefit from a good immediately after purchase, whilst dampening the "pain of payment" causes a one-sided cost-benefit analysis to occur. Consequently, this unbalanced analysis leads to a greater willingness to purchase the virtual good or service with card than what would be the case for cash. There are numerous studies to support such a notion. In a paper documented by Priya Raghubir and Joydeep Srivastava in 2008 in the "Journal of Experimental Psychology: Applied", it was concluded that "the more transparent the payment outflow, the greater the aversion to spending or the higher the pain of paying…leading to less transparent payment modes such as credit cards being more easily spent." In other words, since counting coins is more painful than a simple tap on a screen the period of doubt and regret about such a purchase is prolonged, thereby leading to more considered decisions.

Furthermore, with virtual purchases edging closer towards one-button authentication systems as well as the stubborn existence of no-refund policies, the threat of impulse buying is growing. Comparing the purchase of in-app products to that of shopping in a grocers: "When consumers encounter vice products - such as cookies, cakes and pies – the emotive imagery and associated desire trigger impulsive purchase decisions. These visceral factors entice them to include such vice products in their shopping baskets, even though they consider such products to be unhealthy. Pain of payment can curb the impulsive responses, and thus reduce the purchase of such vice products."[5] By contextualising the phenomena to app markets, we see that the "vice products" are the virtual goods consumers desire although rationally view to be unnecessary (in the analogy "unhealthy"). The existence of such a prompt payment system, which lowers the "pain of purchase," can cause action out of the impulsive thoughts and wants leading to purchases the consumer would not rationally adhere to.

Finally, a common phenomenon associated with purchases by card, particularly for virtual goods, is "payment decoupling". Payment decoupling is the process of separating or decoupling a purchase from the consumption and in doing so reduces the perceived cost of the product. Decoupling is particularly present in purchases through credit cards as by postponing the payment by a few weeks and grouping it up with all the other purchases, the payment is separated from the original purchase. This effect has two main consequences. The first is a loss of track of payments as they are made less salient through decoupling. A study composed by Soman (1997) found that students leaving the campus bookstore were much more accurate in remembering the cost if they paid by cash rather than by card: "payment by credit card thus reduces the salience and vividness of the outflows, making them harder to recall than payments by cash or check which leave a stronger memory trace' (p. 9)."[6] This follows on to the other consequence of decoupling: overspending. With lower perceived costs and unfamiliarity with previous purchases it is not surprising that overconsumption or rather careless consumption is a large problem with seamless payment methods such as these. Putting this into context, the use of credit cards can lead to forgetful and underestimated purchases of virtual products which build up over time, as the consumer is removed from the cost and merely focuses on the utility it brings.

Consequently, the implication this has for our gacha games is rather significant. Being dominated by one-tap card transactions, such a payment medium could not be any simpler. This, therefore, can lead to a lower perception of costs especially when people are nearing the checkout for a purchase they are deliberating on whether or not should be bought. In essence buying in-app products is easy, so much so

[6] Sourced from "Advances in Behavioural Economics" – edited by Colin F. Camerer, George Loewenstein and Matthew Rabin

that it can lead to overconsumption and/or consumption of products that wouldn't be bought given a "harder" transaction system. It is fascinating how something as simple as the payment method, attributed to the final stage of a purchase, can contribute so much to the purchase itself, and begs the question what other overlooked and now deliberate factors heavily determine the final outcome of a purchase?

Background into "gacha"

The term "gacha," originating in Japan and now commonplace in the West, describes a toy machine into which a customer puts money in exchange for a plastic egg acquired through the twisting of a crank. Inside the egg is usually a collectible (often figurines) which is part of a completable set. Gacha games are apps that virtualize the gacha mechanic, using a virtual currency in place of real money.

***Figure 1**: A picture of a Japanese gacha vending machine housing many different collectible toys.*

"In these phone games, there are usually a variety of cards, characters, units or other items that players can collect (that often have functions in-game) most of which, if not all are only obtainable via the gacha mechanism. Hence players, "pull" or "spin" the gacha (analogous to the capsule-toy vending machine) using a specific amount of in-game currency to receive, from a pool, a randomized unit.[7]

The gacha mechanism itself is essentially the process of obtaining characters from the general pool in accordance with publicized rates and chances.

Why analyse this mechanism?

Well, the gacha mechanism is notoriously successful with the gacha industry generating $55 billion since 2007.[8]

Not only that, but this model has frequently been compared to that of collectible trading card games as well as gambling. In other words, splurging cash on a gacha game (via the mechanism) will not always result in gains, especially since the gacha mechanism operates purely on given rates and chances. Therefore, by taking apart the gacha-mechanism using the help of statistics and behavioral economic principles we will be able to truly see if the genre is, indeed, close to gambling and what lies at the heart of its success.

In order to simplify the situation we will use two in-demand games for reference and example during our analysis.

The first game we will be looking at is called "Naruto Blazing," (by Bandai) themed on the popular anime Naruto. With over 10 million downloads on the Google Play store and even more on the Apple store, it has amassed a large playerbase over its three years in service. The second game called "Grand Cross: 7DS" is a more recent addition to both markets (having been released on 3rd March 2020). It is again very popular with over 7 million downloads across its Global and Japanese releases. In these games the in-game currency is used, primarily, to summon characters from pools which are updated every week with the addition of a new character.

To smoothen descriptions of Gacha games further down the line, I will now define some vocabulary or terminology that will frequently appear in such descriptions.

The first use of such terminology in following sections will by highlighted in bold text.

Summon – A summon is the act of drawing a character from a banner-specific pool. It is this "summoning" of characters that lies at the heart of the gacha mechanism

[7] Gacha is both similar and different to lootboxes present in popular western games. Whilst both share the same aspect of summoning from a pool, the level of significance differs completely. In Gacha, the summoning aspect lies at the heart of the game with new characters coming every week in their own featured summoning banner. However with lootboxes the rewards from the pool tend not to be frequently updated and there is often many desired items rather than the specific one.

[8] Data is sourced according to industry association Mobile Content Forum (MCF) and an analysis of data compiled by Bloomberg.

Pulls/to Pull – refers to the acquiring of an item/character from a summon

Rank – is a class of characters. In the gacha genre there are three main ranks, R, SR and SSR as defined below. The concept of three summonable classes is the same in all gacha games, differing only by class-names.

Free-to-play player (F2P) – is a player who does not buy or buys very little in-game currency and plays the game simply because they enjoy it.

Pay-to-play player (P2P) – is one who pays on a consistent basis, either from a competitive viewpoint (to maintain a competitive advantage) or simply to unlock more features of a game they enjoy.

Rates – The term refers to the percent chance of a character appearing on a given pull (usually a single). Shortened version of "drop rate."

R – refers to "Rare," and is the lowest ranking of character. They are the body that takes up most of the summoning rates for the sole reason of minimizing the chances for players to get anyone valuable (SSRs). Basically a populous of characters whose presence signifies more of an absence, if anything.

SR – refers to "Super Rare" and is the middle ranking. Characters of SR rank are often useful in some games but in the majority of gacha games they are either fodder for SSR heroes or simply units added to largen the pool.

SSR – refers to "Super Super Rare" (believe me or not). These characters have the smallest rates of appearance. They are most desired because firstly they tend to be the best units and secondly, since the new weekly character is always an SSR, pulling an SSR potentially means that the new character has been acquired.

***Figure 2**: A typical summoning **banner**. The featured character is advertised at the top, underneath which there are two options to summon.*

Shaft – is a summon in which no SSR was obtained.

Unit – a character or item that is summoned via the gacha-mechanism and has in-game functions.

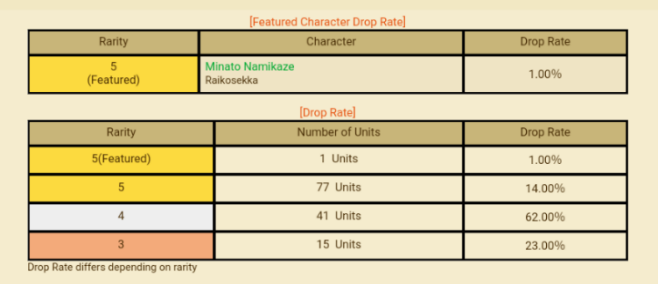
Banner – A banner is what players summon on. It is where players go to summon for characters. Each banner usually comes with its own new character that is included in a pool with other old characters.

Featured unit – a featured unit is the new character in a banner that has a heightened drop rate compared to other units of similar rank.

Diamonds – The name of the in-game currency for Grand Cross 7DS. It may also be used in this essay, for simplicity, to refer to in-game currency as a whole

Pearls – The name of the in-game currency for Naruto Blazing

Pity bar – The pity bar is part of the pity system in Grand Cross 7DS. After each shaft multi (defined later on) =the pity bar fills up. After 5 shafts the pity bar is full and guarantees the player an SSR in his next multi, (hence the name "pity," as the system is "taking pity" on players with bad luck.)



[Featured Character Drop Rate]

Rarity	Character	Drop Rate
5 (Featured)	Minato Namikaze Raikosekka	1.00%

[Drop Rate]

Rarity	Number of Units	Drop Rate
5(Featured)	1 Units	1.00%
5	77 Units	14.00%
4	41 Units	62.00%
3	15 Units	23.00%

Drop Rate differs depending on rarity

Figure 3: *The picture to the left, shows the publicised drop rates for a banner in Naruto Blazing, including the featured unit: "Minato Namikaze". In the picture, the number "5" refers to the rank SSR, "4" to SR, and "3" to R.*

We can see how the featured unit has a drop rate of 1% as opposed to the other SSR units which only have a 0.18% rate each. (Found by dividing 14% by 77)

[9]

Singles and Multis in the gacha mechanism

The gacha mechanism as explained previously is the summoning of characters from a general pool that have in-game uses.

When it comes to gacha games, summoning operates through two different options. The first, known as a "single", is where you summon for just one unit. The second, called a "multi", is where you summon for 10 units in one go. A multi costs the same as 10 singles.

As you see in the picture to the right, in Naruto Blazing, a "single" costs 5 pearls and a "multi" costs 50.

Figure 4*: The summoning options: "Multi" and "Single" as seen in Naruto Blazing*

In most games there is an incentive encouraging players to summon via the multi. This incentive is in the form of a **multi-summon promotion** that increases the chances of pulling an SSR and, in turn, the featured unit. This means that, with the multi-summon promotion in effect, a multi no longer has the same rates as the equivalently priced 10 singles. For example, in Naruto Blazing the multi-summon promotion is "An SR or higher guaranteed." Without this promotion a multi would be simply be an option of completing 10 'singles' in one go. However with this promotion in play, a multi has slightly better rates than the 10 singles for reasons explored later.[10]

In this essay we will analyse three aspects (or potential "scams") of this gacha mechanism that, while may look like benefits from the outside, have underlying purposes and costs to the consumer. They are:

- The low rates.
- The existence of "multis"
- A so called "pity-system,"

[9] The "single" distribution shown in Figure 3, is actually a more recent distribution that was implemented in Naruto Blazing on June 15th 2020. However the "single" distribution used in calculations in this essay (for Naruto Blazing) are based on the earlier distribution which is as follows: R(67%), SR(30%) and SSR(3%). I have used the older distribution as opposed to the more recent one on the basis that the more recent one came out during the writing of my ILA, and also because the older distribution has years of data which I refer to later on (in the Money or Sincerity section) as opposed to the very recent distribution for which data is scarce.

[10] In Grand Cross 7DS, a multi gives the player 11 characters not 10. This is because the game's multi-summon promotion is the inclusion of a free character. Therefore, because each 'single' costs three diamonds, a multi in this game costs 30 diamonds and gives 11 characters instead of 10.

Scam 1: The truth behind the rates

The first aspect of the gacha mechanism we will be analyzing is the low **rates** associated with these games. By referring to the rates on respective **banners** we will be able to ascertain how much the gacha-mechanism costs (by calculating the cost of **summons** needed until a particular banner-**featured unit** is pulled). We will then compare it with the benefits one receives after having acquired that **unit** and finally examine the implications this has on **F2P** players.

Evaluating the cost of the Gacha Mechanism

In this section, we will be using the help of statistics to attach a true cost to the gacha mechanism[11] by using the given rates to predict the expected amount of summons needed to pull a desired banner-featured unit. From then we derive the cost by converting the price of the summons into a pound value.

[Although multis, because of the added promotion, have a better chance at pulling a unit, we will be using 'singles' in our analysis as the added promotions for multis tend to vary between games. In some games there is no promotion at all, in others the promotion is minimal (will be explored later) and in a few the promotion is very good. Thus whilst multis often have better drop rates and thus give lower costs for our gacha-mechanism, 'singles' will be a better, more general representation of the genre.[12]]

Singles:

In every summoning banner, there is always a new character (the featured character) whose rates are higher than those of characters of the same rank (**SSR**). Therefore, the majority of people summoning on the banner are doing so with the hopes of "pulling" the new character. This allows us to assume that each summon has the purpose of acquiring the new character. Hence, once the new character has been acquired, the purpose is fulfilled, and no more summons take place. So we will model how many "singles" are needed to be expected to pull our first copy (of the new character).

The probability distribution used to quantify the probability of doing something for the first time on a particular trial is the geometric distribution

To calculate the probabilities described by the distribution we use the general formula:

$$X \sim Geo(p)$$

$$P(X = x) = (p)(1-p)^{x-1}$$

Furthermore, applying the characteristics of a geometric progression we see that:

$$P(X \leq 50) = \frac{p(1-(1-p)^{50})}{1-(1-p)} = 1-(1-p)^{50}$$

From this we can derive the equation for cumulative geometric probabilities for first-time successes on trials greater than a certain number x.

[11] Because gacha-mechanisms are game-specific, in that different games have different drop rates and different in-game currency prices, we will look at the cost of the gacha mechanism for a particular game. Since the prices and drop rates in gacha games are very similar this should also give us a general representation of costs for the genre as a whole, thus establishing a general cost for the gacha-mechanism.

[12] One may argue that there is still fluctuation between games anyway, given that character drop rates are game-specific. Therefore, because multis are, in most cases, better chance-wise for pulling a desired unit, analysing multis would be a better representation of player behaviour (as players would be summoning by multis). That said, "singles" will give us a ground cost illustrating the reality of the rates themselves, ignoring any promotion making such a "reality" seem less harsh. Furthermore "multis" themselves will be analysed separately later.

Since $P(X \leq x) + P(X > x) = 1$, you can deduce that $P(X > x) = (1-p)^x$, and from that $P(X \geq x) = (1-p)^{x-1}$.

With the geometric distribution covered to a sufficient degree, we can move onto applying it in an in-game scenario using the rates in **Grand Cross: 7DS** as an example:

From the picture to the right, we see that there is a 0.5% chance of pulling the new (featured) character on each single. In our case the new character is "*[Harlequin] King the Fairy King.*"

Therefore, we can model a geometric distribution of: $X \sim Geo(0.005)$

This allows us to make the following observations:

There is a 0.005 chance (or 0.5% chance) that a player manages to obtain the character on their first single, costing them merely 3 **diamonds**.

***Figure 5**: Illustrates the drop rates for a particular banner in **Grand Cross: 7DS.** We see that the featured unit for the banner has a 0.5% drop rate (a rate higher than the other equivalent SSRs in the pool)*

In the first 10 singles, the chance of a player obtaining his first copy of the new character is:

$$P(X \leq 10) = 1 - (0.995)^{10} = 1 - 0.95111 \ldots$$
$$= 0.0489 \text{ or less than a 5\% chance.}$$

In the first 20, the chance is:

$$P(X \leq 20) = 1 - (0.995)^{20} = 1 - 0.90461 \ldots$$
$$= 0.0954 \text{ or less than a 10\% chance}$$

In the first 50, the chance is:

$$P(X \leq 50) = 1 - (0.995)^{50} = 1 - 0.778313$$
$$= 0.222 \text{ or just over a 20\% chance}$$

In fact, we can find the number of trials needed to get a probability above 50%:

$$P(X \leq x) \geq 0.5$$

$$1 - (1-p)^x \geq 0.5$$

$$-(0.995)^x \geq -0.5$$ (Note that when we divide by -1 or any negative number, we flip the inequality sign)

$$x \log(0.995) \leq \log 0.5$$ (Since log(1-p) is a negative number we need to flip the inequality once more)

$$x \geq \log_{0.995} 0.5$$

$$x \geq 138.28 \ (2.d.p)$$

The above working tells us that you need to do 139 singles to at least have a 50% chance of pulling your first copy. In other words, in Grand Cross: 7DS, you are paying 417 diamonds (since each single is 3 diamonds), which costs £308, only to have a 50% chance to pull your desired unit once. Worse still, the mean of the geometric distribution, given by 1/p, tells us that on average one would expect to pull their first copy of a character after their 200th single (600 diamonds), or after having spent £450.

Therefore, we can say that the gacha-mechanism in Grand Cross 7DS has a cost of £450 as that is the amount players must spend (on average) in order to fulfill the purpose of acquiring the new banner featured character.

Evaluating the benefits:

The temporary nature:

Despite such a high price tag, the benefit or utility that comes from spending the £450 is only temporary. In all gacha games, as well as in other loot box games, units always get better as the game matures. Intuitively it makes sense; one needs better characters to have a better chance at completing the harder missions. People would not summon for more units if the units they had were already better. Since summoning lies at the heart of gacha games, such games must stimulate summoning to stimulate revenue, through the constant release of newer and better units, as well as harder missions to accompany them. This in turn results in a sustained deflation of the in-game currency. By realizing that the goods the in-game currency buys are the units themselves and by valuing the units in a certain measure, we see that the value that can be bought with a given amount of currency increases as the game gets older. In essence, the purchasing power of in-game currencies continuously increases as the game releases newer, better characters in banners with the same price and same rates.

To explain our point we will be referring to the character progression in Naruto Blazing over its 3-year lifetime. If we were to look at the first and most recent character side-by-side the obvious difference will be in their stats (i.e. strength, health, speed, e.t.c). Therefore, if we calculate the average strength of the three newest units and compare it with the average for the three oldest units we should have an estimate for the increase in character quality. However, strength varies between characters and is often traded for damage multipliers. This means a character may have low strength but to compensate for it, a very large damage multiplier. A more realistic comparison should be taken from the damage dealt by each unit in-game, although that too varies between missions and seasonal activities. Thus, a more representative evaluation of the appreciation in character quality can be found simply in the difference in length of the description of their abilities. I call it the Letter Oriented Label Length Operator, or LOLLO for short.

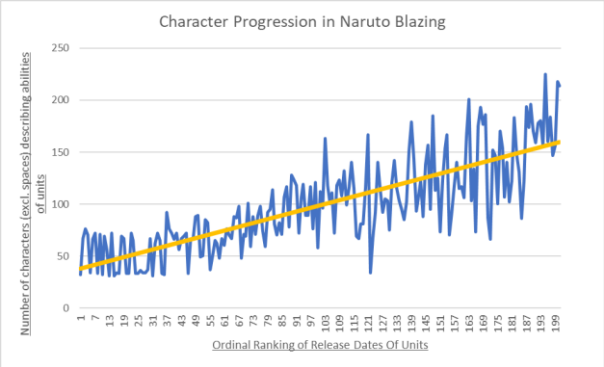


Figure 6: Illustrating the LOLLO measure for all 201 SSR units in the game. After measuring each description, I plotted them in a graph of characters (letters and spaces) against ordinal ranking with respect to release date. The orange line shows the trend line of appreciation.

If we take the word-for-word description of the ability of an old character and that of a new, by comparing the number of letters used to make up the respective descriptions, the percentage difference should shed some light on the appreciation of said characters. This use of measure is based on the fact that as the game progresses, character abilities become more complexed and innovative leading to longer descriptions. To remove any bias that will effect our appreciation measure, we have to choose characters of the same rank, in our case SSRs. The word-for-word description of the ability for our oldest unit is:"*3.2x attack toward 1 enemy(s) in range.*" This sentence-long description accounts to 32 letters. On the other hand, the word for word description of the ability of our newest character is: "*5x attack toward all enemies in range and knocks them back. 75% chance of speed reduction for 4 second(s), and reduces their Chakra Gauge by 2. Also nullifies damage you receive from Ninjutsu or Secret Techniques for 3 turn(s), and restores own Chakra Gauge by 3.*" This paragraph-like description numbers to 225 letters, or 7 times as much as the description for our much older character. Using the average letter count for the three oldest characters and the three newest characters, we see that the latter is 5 times longer than the former. This measure helps illustrate, therefore, a fast appreciation of

character quality present in these games and thus how much more value the in-game currency can buy as time develops.

Consequently, in gacha games, players pay hundreds of pounds just for **a chance** to pull a character which will only depreciate as new and better ones get released for the same effective cost. In fact, according to our LOLLO measure its only a matter of 5 weeks (on average) before the character, for which you payed hundreds for will be outclassed. (Based on how long it took for a character with a longer description to come out)

Competitive advantage:

The only significant benefit of spending to acquire a character, is the competitive advantage that getting that character sooner gives. When a new strong character comes out, immediately obtaining him and utilising him gives that player an advantage over others who have not got him yet and thus are now relatively weaker. Each addition of a new strong character to these game disturbs the previous power balance such that a player who does not have the new character, even if previously being one of the top players, no longer maintains that status. In fact, looking at the PvP (player vs player) tournaments for Naruto Blazing following the release of a new ground-breaking unit, the new unit is on average in 9 of the top ten teams. This illustrates how immediately acquiring the new character gives one a large competitive advantage in such intense multiplayer games.

Implications for free-to-play players:

What does this mean for free-to-play players? Accounting for all the possible ways a free-to-play player can farm diamonds (in Grand Cross 7DS), the maximum amount he can possibly muster in a week is a mere 60 diamonds. This is only 1/10 of the amount needed to be expected to pull the weekly character and requires a consistent gameplay of 3 hours/week. By deliberately employing low rates and simultaneously restricting weekly diamond outflow, new characters are intentionally placed out of the reach of free-to-play hands 9 times out of 10.

As a result, it is not surprising that the majority, if not all of the competing players in the games' respective tournaments are pay-to-play. It is not possible for free-to-play players to fund the summons needed to support a competitive place in multiplayer tournaments such as those common in gacha games.

If free-to-play players want to be truly successful in a gacha game the best option would be to delay their consumption, save up their in-game currency and spend them on special event banners where the majority of ground-breaking characters are released (with the same drop rate and price of summoning, and thus the same effective cost). The characters released in special event banners (such as anniversary banners) tend to remain useful for a much longer period (10 weeks according to LOLLO) than what would be the case for normal banner units. These special event characters have a head start (in terms of ability) over the others that helps delay the devaluative effects that arise over time as newer and stronger characters are released for the same cost.

Why do players not defer their consumption, but spend their free currency on a regular weekly basis?

That said many people continue to spend on regular banners with lower quality characters. This seemingly irrational behaviour can be explained in many different ways:

The first concerns the idea of information failure in that people are not fully aware of the implications of a 0.5% drop rate. In fact, after composing a survey in which 53 players of Grand Cross: 7DS were asked to

estimate the expected diamonds needed to pull one copy of the featured unit, the average estimate was 31% lower than the actual value[13]. Most people, when estimating the diamonds needed, experience cognitive biases specifically the Availability Heuristic. Because players, in the game's communities, see posts concentrated with people pulling "so-and-so," they are led to believe that the chances of pulling "so-and-so" are higher than they actually are. This effect is also compounded with the optimism bias which suggests that people tend to overestimate the likelihood of good things. Both these effects result in an overestimation of one's chances, despite the rates being advertised on each banner.

Another reason why people summon regularly on these very expensive banners is because they manage to buy the in-game currency cheaply. With such a high cost for the purchase function, it is rather unsurprising that a black market for discounted in-game currency exists on the major social platforms despite the harsh penalties that warrant them. People desire in-game currency to summon for a character they like but are unable to do so because the diamonds are expensive. As such people, turn to third parties selling the in-demand currency at a lower price. This allows players to maintain a competitive advantage at a lower cost.

The final reason why players tend not to save but consume is because some games prevent it. By making the weekly diamond outflow progress-dependant as is the case in many gacha games, players trying to save are cut off from the weekly diamond supply. In order to collect diamonds to save, players must complete the harder missions each week, which in turn, requires the better characters that are regularly released. However, in order to get the better characters, one needs to summon regularly and so use up all their savings. In addition, many weekly missions have associated units whose stats are ameliorated making the mission much harder for those without the mission-specific unit. Therefore, both unit-specific missions and a fast-paced character development make saving and acquiring of new diamonds strictly independent activities.

Conclusion:

In conclusion, it is this "luck"-based gacha mechanism that makes these games so dangerous and potent. Having a purchase function (the acquisition of a desired character) without a specific price tag, allows these games to get away with, in many cases, extortionate costs like the one demonstrated above. Due to the variance of these rates, on one side of the spectrum people may get their desired character for free (within the 60 free weekly diamonds) but on the other side, players may spend over £1000 and still come out empty handed. The use of rates, instead of a fixed price, allows these games to hide the real (average) costs involved in the summoning process. By having to get the desired character through the gacha mechanism funded by purchased in-game currency, this indirect transaction system does not actually guarantee the player the character they paid for. These games are avoiding a quid-pro-quo payment exchange, justifying it through their use of "rates" and in turn funding a gambling-like system for the character the player paid to get. It is this feature of coming out "empty-handed" and not guaranteeing players something to represent their purchase that makes games like these morally unjust and borderline scam-like. Instead they should be more revealing with respect to the implications of such a low drop rate to reduce the information failure and unawareness present in the majority of the games' communities.

It could be argued that such games do indeed, give players something to represent their purchase, through the other characters in the pool. Although not being what was originally desired, players may still benefit from the other SSR characters included in the banner, and thus benefit from spending money. That said, the majority of SSRs normally included in banners are often very old and therefore no longer as useful. Moreover, in some games there is no reward for obtaining the same character twice. This means for

[13] (The actual value used was 540. This is the amount expected when summoning by multi. We used 540 because it mimics player behaviour to summon via multi.)

experienced players, who have acquired the majority of characters in the pool, the external (outside of getting the desired character) benefit from summoning is smaller.

Despite the harsh purchase function associated with the genre, a vast amount of people still play these games for various reasons. The first is because they ultimately enjoy the game. The majority of gacha games are, at heart, very fun to play. Gacha games often include very good mechanics and a unique gaming style that makes playing the game rather addictive. In fact, by looking at the specific reviews for "gameplay" on the Google Play Store, 20 randomly chosen gacha games all had ratings above 4 stars (for "gameplay"). This goes to show that the majority of gacha games feature enjoyable playing experiences, even if limited by in-app purchases.

A further reason people play such games regularly is because they enjoy the concept of a gacha-mechanism. For some, summoning characters from a pool is an exciting concept. It allows players to try their luck, and in the odd case, get the unit they desire at a discounted price, while also appreciating that sometimes they may get unlucky and come out with nothing. It is comparable to "responsible gamblers" who find the suspense and hype associated with luck-based pooling exhilarating. We can also go on to argue that the instances where players spend loads of money on a unit and come out with nothing are compensated by the welfare benefits they may gain later, upon acquiring a character within their first few summons.

Furthermore, not all gacha games come under the label of "scam-like," and indeed many who previously had, have now changed the game so it is more giving to players. Naruto Blazing is an example of such a game that has adapted and updated its content in accordance with the demands and requests of its player-base. Having previously featured a poor weekly diamond outflow with no guarantee of pulling the unit combined with low rates, the game has significantly improved. It has now implemented a guaranteed multi which gives the player the character for free after having spent 450 pearls or £210.96 on one banner. (Note "pearls" are a different currency from the "diamonds" in Cross 7DS). They have also increased the rates on banners drastically so that, 50% of the time, you need only spend half the pearls needed to reach the guaranteed step to get at least one copy of the featured unit. Moreso players can now obtain 55 pearls a week, as opposed to what had previously only been 27.

Ultimately, people play these games despite, in some cases, the extortionate prices, because the enjoy the game. F2P players can have fun in these pay-to-win games if they accept that without paying they can not expect to get very far in the game's multiplayer element. Players only pay, typically from a competitive viewpoint, to gain the newest character which is often needed to maintain such a competitive foothold in the game.

‘Scam 2’: “Multis” and their underlying purpose

In this section we will see how “multis” are a more dangerous style of summoning compared to “singles” and how game developers often frame (and thus overexaggerate) the “multi-summon promotion” to get people to summon that way.

The existence of multis in Gacha Games as an option of summoning:

As explained previously, a ‘multi’ is, in most cases, where a player summons for 10 units in one go. Since each summon in a ‘multi’ is independent of one another, a multi can be modelled as 10 singles. The rates, if there was no incentive-system in play, would the same for 10 singles as for 1 multi. However, in all Gacha games there is always an added bonus for “multis” that encourages players to choose that option of summoning. The very existence of an incentive system is an example of a ploy in play to make players spend more diamonds. By encouraging players to summon via multis, they lose their diamonds much faster and more easily, indirectly influencing them to purchase more diamonds when a new banner comes out for which they have nothing to spend.

How “multis” are more dangerous than “singles”

When summoning a player is more likely to go overboard and spend more in-game currency, if summoning by multi’s than he/she is by singles. This is due to the following reasons:

Firstly, each individual ‘single’ has lower rates (for a desired unit) than each individual ‘multi’. Therefore, people have low expectations when entering a single. On the other hand, people expect much more from a ‘multi’, given that it is equivalent to (or because of the promotion, better than) 10 singles, and so their perceived gain from an incremental ‘multi’ is much higher than from an additional ‘single’. Crudely put, people will be more encouraged to try their luck on an additional multi than on an additional single.

Moreover, it takes barely any time to buy one multi as opposed to 10 singles and so the period of deliberation or “pain of purchase” is reduced when one buys a multi. Clicking the button to buy one multi has the same outcome as clicking the button 10 times to buy a single. In the same way, the shorter transaction period also reduces the reluctance to summon from bad pulls. One will be more put off from summoning if he receives 10 Rs (rares) from 10 consecutive singles, than he would be if he got 10 Rs from one multi, as the “pain” is prolonged and spread out. In addition, because the results of a multi are compiled together, an element of decoupling is introduced. For example, the significance of a R would be downplayed if it was received with an SSR in a multi, than if it was received separately via singles. Therefore, summoning by multis decreases the demotivation to summon from bad pulls.

Consequently, the likelihood of overspending is higher for multis than it is for singles. Not only that, but the cost of going overboard is much higher for multis too since they cost 10x as much as singles. If one were to buy one more single than they originally planned, the cost would only be 3 diamonds[14]. Yet, if one were to buy one more multi than they originally planned, the cost would be 30 diamonds (impulsively clicking to buy a multi costs ten times as much as impulsively clicking to buy a single). On the other hand, it is similarly easier to save diamonds on ‘singles’ than it is for ‘multis’, as multis are in denominations of 10 as opposed to ‘singles’ and thus, one has to spend 30 diamonds on what would be the determining trial, but only 3 if it were a single, (i.e. with singles you can stop directly after the unit has been acquired, but with multis you must follow through with, in the worst case, the 9 following units.) Combine both the added cost and likelihood of overspending and we see that multis are a much more dangerous style of summoning compared to singles. Therefore, having a system (in the first place) encouraging players to summon via

[14] This is in terms of Grand Cross 7DS’s currency.

multis would indirectly increase the amount of diamonds purchased as players find themselves without their free hard-earnt diamonds rather quickly.

Hence whilst the incentive-system (the added promotion) for multis does make the rates somewhat better than singles, it leads to overconsumption of diamonds (especially of free hard earnt diamonds) than what would have been the case if the player had summoned by "singles."

Framing of the promotion/incentive system:

In most cases, the incentive system itself is also a product of behavioral tricks causing players to overestimate by how much a multi is better than a single. Consider the multi-summon promotion in Naruto Blazing: "At least one SR or higher guaranteed." When players encounter this promotion they would be more inclined to summon via a multi due to the inclusion of the guaranteed unit, which could either be an SR or an SSR (the more desired option). However, such a promotion can be carried out in different ways, some of which fulfill the promotion yet have little added benefit to the players.

In order to compare the different possible promotions, we will be analyzing the effect each scenario/promotion has on the random variable: "expected number of SSRs per multi summon," using the distribution for "singles" present in the game: R(67%), SR(30%) and SSR(3%). (i.e. model the multi as 10 singles and factor in the promotion, which is, indeed, what a multi is).

Originally with no added promotion (our base case) the expected number of SSR's per multi summon is 10x0.03= 0.3 SSRs per multi. (This is the same as doing 10 'singles')

Now consider the first and most beneficial scenario (Scenario A): 1 character is pulled from an SR/SSR pool, and the rest are from the pool with the given distribution above. The chance of pulling an SSR from the one summon from the SSR/SR pool is 0.03/ (0.33) = 0.091, and the chance of pulling an SSR from the 9 summons in the larger pool is 0.03x9=0.27. By adding them together we see that the expected number of SSRs' per multi increases by 20.3% to 0.361 SSRs per multi. This gives the players a very large increase in rates (for an SSR), and relies on the assumption that the distribution of SSRs and SRs in the SSR/SR pool is proportional to that of the original pool which may not be the case. In fact the SR/SSR pool may have its own unique distribution for which the chance to pull an SSR is dampened.

Our second scenario (Scenario B) involves removing the possibility of getting all 10 units as rares from the sample space, by re-summoning if 10 Rs are generated. This will, in turn, ensure that the player gets at least one SR, or SSR. Since the chance of getting all Rares is $(0.67)^{10}$= 0.0182, by reducing our sample space we see that the expected number of SSR's per multi jumps to 0.3/(1-0.0182)=0.306, or grows by 1.86%. This fufills the promotion but results in a sharply lowered added benefit for the players compared to scenario 1. Even so, the developers could do better:

In our final scenario (Scenario C), 9 characters are pulled from a regular pool. If all 9 are R, the 10^{th} unit is pulled from an SR/SSR pool. The probability of getting 9 Rares from 9 consecutive summons is $(0.67)^9$= 0.0272. This means that the expected number of SSRs per multi, according to this scenario, is:

=P(Not getting 9 R's)x(Expected number of SSR's per 10 summons) + P(Getting 9 R's)x[(Expected number of SSRs per 9 summons) + P(Getting an SSR from the SR/SSR pool)].

=(1-0.0272)(0.3) + (0.0272)(0.17+(0.03/0.33)) = 0.302 (3 s.f.)

This is a mere 0.552% increase in the expected number of SSRs compared to our base, non-promotion case. Therefore, whilst the promotion may look very good, somewhat like scenario 1, in reality it could be very minimal, more like scenario 3. This is an example of framing, whereby framing a statement or offering

it in a different way generates a new response, by changing the comparison set it is viewed in. In our case, the promotion "get an SR or higher guaranteed," sounds better and is the positive form of "guaranteed to not get all Rares," which is essentially what the promotion is getting at. The latter statement is the same as the former but shows clearly that the only case in which a multi is better than a single, is when you get 10 consecutive singles as Rs which is quite rare.

Of course, with the aim of generating as much money as possible, the developers would chose the positive formulation of the statement and an algorithm (or scenario) which minimizes the rates of puling an SSR, lulling players into overestimating their chances when summoning via 'multis.' This would, in turn, encourage them to summon more dangerously (through 'multis' instead of 'singles') and buy more diamonds when they have churned through all the diamonds they had and still not pulled what they originally desired (as a result of the low rates).

However you may be thinking that there are a lot of uncertainties in this analysis, which I agree with. It may be that scenario 1 is the actual system adopted by the game as opposed to the third, rate-minimizing, option[15]. Since we are not the game developers it is not possible to see which scenario is in play or even whether it is one of the three demonstrated above at all. For example, the distribution used to make our base case (of 0.3 SSRs per multi) was based on the distribution for 'singles', and so 'multis' may have their own unique distribution (by distribution I am referring to the percentage drop rates for Rs, SRs, and SSRs). Similarly, as mentioned previously, we also assumed that the SR/SSR pool rates were proportional to the original distribution which may not be the case. Given that our analysis was solely based on assumptions, this begs the question, what can it possibly prove? Well, this analysis does serve to prove one point: that the promotion may not be as good as it seems from first impressions. Framing is a very powerful behavioural tool that can manipulate the outcome of our choices solely based on how the same information is presented. Indeed, although guaranteeing an SR or higher, Bandai may only have increased the rates by half a percent compared to 10 singles, falsely motivating players to quickly spend all their free hard-earnt diamonds in the process.

Having said that, there is a statistical tool that we could use to see which of our proposed scenarios the actual distribution of a 'multi' favors. This would allow us to get at Bandai's true motive: money or sincerity. This tool is called a "Goodness of Fit Test," and we will be using it hand-in-hand with a "Chi-Squared Test," to evaluate how closely our model fits the actual distribution. By examining multis from the game via online summoning videos posted by relevant content creators we will be able to compare the actual numbers of SSR's pulled to what would be expected given our model was true, or near the truth. There are several problems with such an approach, however. Firstly, content creators tend not to post the full story of their summons. They tend to summon off-camera and in some cases only post the highlights instead of the whole summoning process. This problem can be avoided by watching posted live streams where all summoning was done on camera. Furthermore on the edited videos we can choose to analyze only a handful of summons at random intervals throughout the video, which should reduce any bias. The second problem concerns updates and uncertain timing. The 'single' summon distribution used to make our base non-promotion case, was sourced from 2017 and the rates have since changed in proceeding updates (June 2020). Consequently, we will only be able to refer to videos in the year the rates were sourced from, (2017)

[15] (This is unlikely as it would mean that the game developers are framing their promotion quite badly as one may incorrectly assume from the promotion alone, like from our extrapolations, that the rates are actually worse than what they are trying to promote.)

After compiling enough data from appropriate summoning videos, I recorded 200 (20 multi) summons and listed whether they were SSRS, or not. Then underneath the observed pulls I calculated what would be expected given each of the scenarios were true:

	Number/Frequency of SSRs pulled	**Number/Frequency of non SSRs pulled**
Observed pulls (O_i)	54	146
Expected pulls given Scenario A was true (E_{iA})	72.2	127.8
Expected pulls given Scenario B was true (E_{iB})	61.2	138.8
Expected pulls given Scenario C was true (E_{iC})	60.4	139.6

To compare which model is closest to the actual distribution (the observed pulls) we need to conduct a Goodness of Fit test (GoF). A GoF test measures how well an observed frequency distribution fits to a known distribution.

To conduct a Goodness of Fit test we calculate X^2 from the following formula:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

where O_i is the observed frequency and E_i is the expected frequency asserted by the null hypothesis (which in our case is that the respective scenario is true)

After rearranging, a simpler equation for X^2 can be found:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i} = \sum \frac{O_i^2 - 2O_iE_i + E_i^2}{E_i}$$

$$X^2 = \sum \frac{O_i^2}{E_i} - \sum \frac{2O_iE_i}{E_i} + \sum \frac{E_i^2}{E_i}$$

$$X^2 = \sum \frac{O_i^2}{E_i} - \sum 2O_i + \sum E_i$$

$$X^2 = \sum \frac{O_i^2}{E_i} - \sum O_i$$

$$X^2 = \sum \frac{O_i^2}{E_i} - N$$

$\sum E$ and $\sum O$ are both equal to *N* as they represent the total number of trials and or observations

With this simpler equation for X^2 we can now find the Goodness of Fit results for our three scenarios.

Scenario A: $X_A^2 = \frac{54^2}{72.2} + \frac{146^2}{127.8} - 200 = 7.18\ (3.s.f)$

Scenario B: $X_B^2 = \frac{54^2}{61.2} + \frac{146^2}{138.8} - 200 = 1.22\ (3.s.f)$

Scenario C: $X_C^2 = \frac{54^2}{60.4} + \frac{146^2}{139.6} - 200 = 0.972\ (3.s.f)$

Given that the higher the value of X^2 the less similar the observed distribution is to the theoretical distribution, we can see from face value that Scenarios B and C are better models for the in-game multi rates than the more generous Scenario A.

However, since the sample is quite small at only 200 observations, natural variation has a larger effect on our Goodness of Fit test. In other words, we may have recorded unusually low data from our sample. Consequently, carrying out a hypothesis test (by means of a Chi-Squared Test) for scenario A will allow us to see how much the difference from the observed data can be justified by natural variation.

To complete a hypothesis test we have to formulate the null and the alternative hypotheses given by H_0 and H_1 respectively.

H_0: Scenario A matches the in-game model for multis in Naruto Blazing

H_1: Scenario A does not match the in-game model for multis in Naruto Blazing

Note that all hypothesis tests for GoF are always one-tailed as GoF tests are always positive. This means the critical region is always the set of values above the critical value.

The critical value for our test depends on both the number of degrees of freedom and the significance level at which we choose to conduct our hypothesis test. The number of degrees of freedom from our data is 1, because knowing the *amount of SSR's pulled* uniquely determines *the amount of SSR's not pulled* as we have a constraint of 200 total observations. (If we pull *x* SSRs, we know we have pulled *200-x* non SSRs. This data point is therefore no longer "free". It is dependant because we have a constraint.) Thus the constraint of 200 total observations takes up one of the two data points leaving only one data value not used up and free to vary (independent.)

For our hypothesis test we will choose a significance level of 1%.

This means the critical value for our test is thus $\chi_1^2(1\%) = 6.635$

The subscript "1" refers to the degrees of freedom, and the bracketed percentage references that this test is being measured at the 1% significance level.[16] Note how it is no longer X^2, but chi-squared because we are finding the critical value by referencing a member of the chi-squared family of distributions, with the same degrees of freedom and significance level as ours. (This is the chi-squared test)

Hence if the GoF test for Scenario A exceeds 6.635 we can conclude that it is in critical region and thus not a suitable model. Since $X_A^2 = 7.18$ which is greater than 6.635, it is indeed in the critical region and so there is sufficient evidence at the 1% significance level to reject H_0 in favour of H_1 and conclude that Scenario A is not a suitable model even with natural variation accounted for.

I chose a very low significance level because it minimised Type 1 error. Type 1 error is the percentage chance of incorrectly rejecting H_0. Since we want to be as accurate as possible when dismissing scenario A as the potential in-game model, choosing a 1% significance level means that there will only be a 1% chance that the GoF test is greater than 6.635 due to natural variation. This in turn, tells us that there is a 1% chance our conclusion is wrong and scenario A is indeed the in-game model. However, because this is very small we can be confident in rejecting Scenario A and concluding that Bandai (the developers of Naruto

[16] The critical value itself is found by referencing a table of "Percentage points of the Chi-Squared distribution" with the same degrees of freedom and significance level as our test. This table is found in "Edexcel AS and A level Further Mathematics Further Statistics 1 ActiveBook" – page 192

Blazing) have opted for a more hard-giving multi summon promotion, framing it in such a way that it seems better than it is, lulling players into spending their hard-earnt in-game currency quickly.

When carrying out the hypothesis test for both Scenarios B and C, the hypotheses would again be:

H_0: Scenario B/C matches the in-game model for multis in Naruto Blazing

H_1: Scenario B/C does not match the in-game model for multis in Naruto Blazing

(Depending on which scenario we are testing)

However, because their GoF tests are very close to 0, (1.22 and 0.972 respectively), we pretty much know already that we will accept H_0 as it is less than 6.635 and so not in the critical region (that is if we used the same significance level as done with scenario A)[17]. So instead we want to minimise Type 2 error. Type 2 error is the percent chance that you accept H_0 but H_0 is actually false. In our case, this means the percent chance that Scenario B/C is not the model in the game and that the GoF test chose not to fall in the critical region by natural variation (i.e. the data was unnaturally low enough to not satisfy the critical region for our test.) Since Scenarios B and C are very similar to the in-game distribution (according to the GoF tests) we want to choose a larger significance level. This means it is easier for our chi-squared test to fall in the critical region (as it is now larger) and thus easier to reject H_0. This reduces Type 2 error by making it easier for what may have been a different distribution or natural variation, that had falsely suggested a close relationship between the in-game model and B/C, to fall in the critical region and now be accounted for.

Whilst with Type 1 errors we can find the percent error as it was simply the significance level, Type 2 errors usually can't be quantified because to quantify them we need to know the actual distribution present in the game. From then, we calculate the probability of that distribution not falling in the critical region. Since we do not have that information, for the sake of simplicity,[18] we will choose a significance level of 10%, which should in theory, minimise Type 2 error drastically. Furthermore, due to the small size of our sample, it will be difficult to distinguish whether the in-game model favours Scenario B or C, because they only differ by 0.8 in expected number of SSRs pulled. This means both scenarios will have the same results for our chi-squared tests, and so for brevity we will only look at scenario B, because if scenario B succeeds, scenario C, which is closer to the observed pulls, will also succeed.

The hypothesis test for scenario B is as follows:

H_0: Scenario B matches the in-game model for multis in Naruto Blazing

H_1: Scenario B does not match the in-game model for multis in Naruto Blazing

Since we have 1 degree of freedom as we are referencing the same data used in the hypothesis test for Scenario A and we are using a significance level of 10%, the critical region is as follows:

$$\chi_1^2(10\%) = 2.705$$

Because $X_B^2 = 1.22$ which is less than 2.705, it does not fall in the critical region. Therefore there is insufficient evidence at the 10% significance level to reject H_0 and so we can conclude that $X_{B/C}$ is likely to be the in-game model.

[17] This is not how you normally determine whether to prioritise reducing Type 1 or Type 2 error. But for the sake of simplicity, particularly to the lay reader I have described it in this way.

[18] We could if we wanted to propose a distribution using the data from our tables, but to do that accurately we need a larger sample size, and it would make this section drag on even longer.

These hypothesis tests ultimately shed light on our original statement: that promotions, particularly good ones are not always as they seem. In Naruto Blazing, we can see that their main aim is Money not Sincerity, because although guaranteeing an SR/SSR they have chosen to increase the expected number of SSRs per multi by only 1.86 or 0.552% or similar, despite the easiest way to carry out their statement (Scenario A) involving a 20.3% increase in rates. By deploying a statement with ambiguity and a false sense of hope in their multi-summon promotions, many gacha games are lulling players into going down the dangerous route of summoning, indirectly nudging them to buy more diamonds/pearls.

Evaluation:

In evaluation, there are flaws in the argument for multis being a more dangerous route of summoning. Firstly this argument does not apply to gacha games for which the multi-summon promotion is good enough to warrant the more dangerous route. For example, in Grand Cross 7DS, whilst a multi costs the same as 10 'singles,' a multi gives the player 11 characters instead, effectively giving them one free. This already gives multis a 10% increase in the expected number of SSRs compared to the equivalently priced 10 singles. Such a large increase in rates outweighs the potential hazard of overspending that comes from summoning by multis. In addition, whilst argued previously that "singles" are a better way of saving over multis given that you can stop directly after the determining trial, (whereas with multis you have to, in the worst case, follow through with the 9 other summons), this point is made redundant if the multi-summon promotion is good enough to reduce the expected number of summons by 9 or more. In fact, in the case of Grand Cross 7DS, not summoning by multis poses a large opportunity cost to the consumer as they are not maximizing the value they could have bought when summoning through singles. For each multi, not bought the consumer effectively loses one summon.

This leads on to our second point, in that players should instead summon by multis but in doing so, budget their spending. If players adhere to a strict budget, then they can make fruit of the increased rates associated with multis whilst also not overspending, leaving more in-game currency to be spent on an upcoming banner. That said, as we will find in the consequent section; budgeting one's spending is much harder than it seems, especially in gacha games with "pity systems" incorporated in.

It this "pity-system" and reduced pain of purchase associated with multis combined that leads to heightened overspending.

‘Scam 3’: Pity Systems

In this section we will be looking at a so-called “Pity-system” common in the majority of Gacha games. Whilst often guised as a sympathetic reward system it, in most cases, acts as a carrot on a stick model incentivizing players to spend just that little bit more to a seemingly “golden” reward.

The effects of the Pity System:

Figure 7: Shows the pity bar, (under “Draw Bonus”) which fills up 20% after every shaft.

The majority of gacha games feature these pity systems in their multis, which can be seen as a method to lay people off of their original budgets. A pity-system is an in-game system that compensates players with bad-luck, who have spent a lot of in-game currency to no avail. In Grand Cross 7DS, for example, if you get 5 shaft multis (which needn’t be consecutive), your next multi will include a guaranteed SSR. These pity-systems, similar to the multi-summon promotions, have some benefits but tend to only be exclusive to pay-to-play players.

Before we digest the statistics behind pity-systems and to what effect they increase rates to pull desired characters, we need remember to account for the multi-summon promotion in Grand Cross 7DS

Since the promotion is the inclusion of a free unit, when we model the multis as binomial distributions with n trials and probability of success, p, we must remember that for multis the number of trials (n)=11, whereas for independent singles, n=10.

That covered, we can move on to analyzing the effect of the pity system in Grand Cross 7DS. We must remember that the pity system only comes into effect after 5 shaft multis, or 5 multis in which no SSR’s have appeared. After every summon a pity bar is shown which, after each shaft, fills up. Once full, after 5 shaft multis, an SSR is guaranteed on the next multi.

Hence, we can calculate after how many multis, on average, the pity system comes into use.

Because we are concerned with the amount of SSRs per multi and not the amount of desired units, our binomial distribution has changed to:

$$Let\ X\ be\ the\ number\ of\ SSRs\ per\ multi$$

$$such\ that\ X \sim B(11, 0.03)$$

Our probability parameter has changed to 3%, as that is the drop rate for SSRs. Thus the probability of being shafted is:

$$P(X = 0) = 0.97^{11} = 0.715\ (3.s.f)$$

Therefore, the number of trials needed to get 5 shafts is:

$$\frac{5}{0.7153\ldots} = 6.99006\ldots So\ by\ the\ 7th\ multi\ you\ are\ expected\ your\ 5th\ shaft$$[19]

As a result of the pity system the multi after it, expected to be your 8th, will feature a guaranteed SSR. We must treat this multi differently as the rates will be different from an ordinary 11-character summon. The probability of pulling at least one desired (banner featured) unit in this multi is the probability that we pull

[19] This formula, used to calculate the expected number of summons to get 5 shafts, is the mean of the negative-binomial distribution. Its significance is not large enough to warrant a whole section on it, in our case.

at least one copy in the 10-ordinary summons (called Event Y) plus the probability that we pull him from the one summon from the SSR pool, (which is essentially what the guaranteed SSR is) (called Event Z).

The probability of Event Y happening is:

$$Let\ X\ be\ the\ number\ of desired\ units\ per\ 10\ summons\ such\ that:$$

$$X \sim B(10, 0.005)$$

$$P(X \geq 1) = 1 - P(X = 0) = 0.0489\ (3.s.f)$$

And the probability of Event Z happening is:

$$\frac{P(pulling\ desired\ unit)}{P(pulling\ an\ SSR)} = \frac{0.5}{3} = \frac{1}{6}\ or\ 0.167\ (3.s.f)$$

Hence the total probability of pulling at least one copy of the desired unit on this multi is 0.167 + 0.0489 = 0.216 (3sf)

This is just over 4 times the rate for regular multis.

Therefore, if we imagine the 8 multis as a **cycle**, the probability of pulling at least one copy of the desired unit in this cycle is:

0.216 + P(Pulling at least one copy in each of the 7 multis) = 0.216 + 0.376 (3.s.f) = 0.591.

Therefore, using the mean of a geometric distribution with parameter 0.591, we see that on your 1.69^{th} cycle you are expected to pull at least one copy of your desired unit. Be that as it may, with both 1.69 not being a whole number and our cycle consisting of 8 multis, which is a large denomination, it is difficult to pinpoint on which specific summon you are expected to pull at least one copy of the desired unit. However, since we know that the expected multi lies 69.2% along our second cycle we can use linear interpolation to determine the expected value of multis needed. Seeing that the 8^{th} multi (or the pity-multi) in our cycle is on par with 4 ordinary 11-character multis we will have to adjust our interpolation proportionally. In other words, we cannot interpolate on a scale with 8 equal partitions, as the 8^{th} partition or multi has a much larger drop rate for our desired unit than the other 7. By using the probability value of 0.591 as being 100% along the cycle, each multi, should, with their respective probability values be proportionally represented. This means being 69.2% along our cycle is to be at the probability value of 0.692 x 0.591 = 0.409 (3sf). So, the multi in the cycle that gets our cumulative probability above 0.409 will be the determining multi (to be expected to get the desired unit.) The probability of pulling at least one copy of the desired unit in the first seven multis is $7x(1-0.995^{11}) = 0.3755$ (4.s.f). Since 0.409 is greater than 0.3755, the expected multi is the final one in our cycle. This means, on average, you need to complete 2 cycles or summon 16 times to be expected to pull the desired character at least once. Therefore, as a result of a pity system one only saves 3 multis or 16% of their diamonds as opposed to a scenario without the pity. As enticing as it may seem, the pity system is, however, yet another ploy in play to make players purchase diamonds. The explanation can be derived from the nature of the pity system itself:

The Pity System as yet another ploy:

Firstly, as mentioned previously the benefits of this system are strictly pay-to-play exclusive. In order to reap the rewards of the pity-system a player must have been shafted 5 times. This means one needs minimum 180 diamonds, (for 6 multis, assuming the first 5 were shafts), or the expected 240. That said, a free-to-play player can only amass 180 diamonds after 3 weeks given the restriction in diamond outflow. Therefore the pity system, being conveniently placed out of the reach of free-to-play hands, can encourage the purchasing of diamonds to close that gap and make fruit of the heightened drop rate for the desired

character that would otherwise be unattainable. The drop rates for the pity system are deliberately large in comparison to ordinary multis in order to motivate players to pay to reach it, yet simultaneously low in absolute terms such that it fails 4 out of 5 times, welcoming players to try their luck again.(i.e. by going another cycle)

Most importantly, the pity system serves as a quintessential example of the sunk cost fallacy in play. The sunk cost fallacy applies to the continuation of a behavior or endeavor only as a result of previously invested resources. Frankly put, it is a scenario in which a person follows through with an action in the hopes of recovering an already lost value. Perfectly contextualized by Shakespeare, Macbeth says “I am in blood, stepped in so far that should I wade no more, returning were as tedious as going o’er.” It occurs when deliberating on whether to continue and risk further losses or stop and forgo your losses. In our game, the sunk cost is invested diamonds on a banner which have not pulled the desired unit. Players, in accordance with the fallacy, and in attempts to make the most of the already lost diamonds choose to spend real money to summon more and fill the pity bar, which had been partially filled by the already spent diamonds. As such, people are motivated by the false thought of redeeming the value of the diamonds lost, to purchase more diamonds and summon on the pity which has a higher chance of fulfilling their original goal. Because each cycle ends with the pity multi, which is on par with 4 multis, people may view an already semi-full pity-bar and feel the need to fill it by summoning more, given it would be a waste of “invested resources” when the pity refreshes. To echo one’s internal reasoning: “I have gone this far, I may as well follow through.” Hence refreshing the pity every week for each new banner puts pressure on players not to let their progress to a reward go to waste. Hence, the pity gives players a reason to summon further when there would otherwise not be.

In addition, by pushing the pity-system far from reach and showing progress towards the pity system after each summon as shown in the picture below, players count their multis in terms of how close they are to the pity rather than in absolute terms. This can lead to players losing count of how many multis they have spent, as they focus solely on reaching the pity.

Consequently, the pity-system ultimately serves as a reason to continue summoning rather than a benefit whilst summoning. By having it only activate after 5 shafts and not after a specific amount of summons there is no knowing for certain when a player will achieve the pity. Such uncertainty can lead to players underestimating how many multis they need to commit to complete a cycle, leaving them to buy more diamonds when they come to the realization that the multis bought are not enough and will go to waste if more aren’t bought to fill the pity (This in turn, makes budgeting one’s spending very difficult). In conclusion, the pity system is merely a motivation to summon, playing on our inherent overweighting of sunken costs. It uses short time spans and constant reminders after every summon to further the irrational decisions telling us to continue. Therefore, the pity multi (with its large rates) acts an anchor or a carrot at the end of a stick, telling us to stop at the end of a cycle than in the middle of one, making us spend diamonds to complete the partial cycle we would have otherwise finished on.

Conclusion

In conclusion, from our above analysis we can see how the gacha mechanism, associated with extremely low rates and its respective pity system, is extremely costly and hence pay-to-play exclusive.

This ultimately begs the question, "is it really a scam, then?" According to the Cambridge English Dictionary a scam is "an illegal plan for making money, especially one that involves tricking people." We can safely say that "scam" is perhaps too strong a word as the gacha mechanism is not illegal. The latter part of the definition, however, could be argued to be applicable. One may claim gacha game developers are tricking people through the framing of their multi-summon promotion, their purposefully designed pity-systems and incredulously low rates. However, to trick someone implies to cheat someone and that is not what gacha games are doing. Gacha games are simply bending the truth, hiding away the ugly side of the facts under an appealing guise for the players. They are still advertising their rates, pity-system and multis but it is the players not fully realising the cost in their cost-benefit analyses, that is the problem. Gacha games do display the true chances for pulling specific units (for not doing so would be illegal) but they themselves along with external contribution influence the player to overestimate those chances. The individual, always has a choice when it comes to purchases, but Bandai and other gacha developers influence that choice by downplaying the cost of the item. This is often through how the game is presented which feeds subliminal messages to the consumer as they navigate through the games' menus (this is also aided by the seamless transaction system mentioned in the introduction).

This is not to say, however, that gacha is unlike gambling. Fundamentally the gacha mechanism has incorporated a sense of gambling into purchases. It has the potential to make purchases redundant (i.e losses) if the bought in-game currency fails to achieve what was first aimed for by it. Perhaps it is the sense of no or minimal compensatory benefits and uncertainty as to when a player will acquire the new unit (to acquire a unit) that is the most gambling-like aspect of the game. Despite the luck and unluckiness associated with these summons, players will still, on average, pay large sums for highly illiquid assets which can't be traded on and only depreciate as the game progresses. Indeed these purchases will bring utility to the consumer, but is this the maximum utility that could have been bought? One needs to distinguish whether paying this amount of money for a virtual in-game character is the result of maximising utility or an addiction or likewise obsession to collect all the characters/units that, in turn results in a lower indifference curve being selected and thus lower achieved utility.

Ultimately it is unfair to make generalisations to the genre. Indeed, some games do exhibit the "ploys" mentioned in this essay, whilst others don't. We can't forget, these games are providing a service in the form of their games which are generally of high quality, for free. Their payment system, therefore, being heavy in-app purchases allows these games to keep the barrier to download virtually non-existent. Being free-to-play does not mean the game is necessarily unplayable, but it just slows down or caps progress and you lose out on events/activites that pay-to-play players would otherwise receive. Such games need to satisfy the free-to-play playerbase as it makes up a large proportion of players playing these games. If free-to-play players did not play these games, then pay-to-play players would not pay to maintain a competitive advantage as there would not much competition left to gain a foothold on.

These games are very good at targeting or even exploiting consumer weaknesses at computation. Playing on the sunk cost fallacy, their use of framing and heuristics (due to external contribution and the presentation of these games) allows them to make a lot of money as people spend more money than they would rationally adhere to. Indeed, after asking many regular buyers about their first purchase, the majority of them said it ended in "regret", although that did not stop them buying more.

The best solution to this would be avoiding being overly attached to games like these, or to sunken costs. Being able to drop the game easily and substitute to other forms of entertainment will allow consumers to maximise utility especially when they realise that they no longer enjoy the game, and are solely playing, on the basis of their invested resources (to not let their account on which thousands of pounds was spent go to waste/depreciate). These games feed on the addiction of players with little self-control. Such players are caught in a weekly cycle, paying for a new character which is always going to be better than the last. Gacha games' exploitation of these consumer weaknesses, whilst legal, are morally unjust as it does not give the consumer the right frame of mind to make rigorous and accurate cost/benefit analyses when making a purchase. This leads to an inefficient allocation of resources in that other games which may provide a better service and better utility for a lower cost are not realised.

That said, such exploits of consumer weaknesses leading to irrational decisions in favour of the producer is common in our modern world. However, it is the fact that the gacha genre is taking advantage of addictions and even supplies them with the constant release of newer better units each week for the same absurd price is what distinguishes these games from the rest of the world.

Unfortunately, however, these "tricks" are unlikely to be changed. When brought up, gacha games will always argue their side of the story; that the pity-system sympathises with players, that the multis act as a convenience and that the multi-summon promotion is just stating the truth. In fact, in the future we can expect to see more instances of the "gacha-mechanism" as other companies take aboard this successful approach, and the existing companies grow larger and expand their operations testing the boundary even further into "scam-like" territory.

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