Upon closer inspection: Most Popular iPhone games in Mainland China did not fully comply with loot box probability disclosure requirements

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Abstract

Loot boxes and gacha are gambling-like products inside video games that players buy with real-world money to obtain random rewards. Parents and policymakers are concerned about players, especially children, experiencing harm. Mainland China requires companies to disclose the probabilities of obtaining different rewards to promote consumer protection. Four years ago, research suggested that companies generally complied with the basic requirement to disclose; however, most companies failed to publish the disclosures prominently. The present study confirmed that loot boxes remained highly prevalent (97.0%) in mobile games and nearly all relevant games (96.9%) disclosed the probabilities for at least one loot box found within. However, upon closer inspection, 89.7% of relevant games contained other loot boxes whose probabilities have *not* been disclosed. The accessibility of disclosures has not improved. The prevalence and implementations of ID and age verification and other engagement and monetisation mechanics, such as daily login rewards, were also surveyed.

Keywords:

Loot boxes; Video games; Video gaming regulation; Interactive entertainment law; Information technology law; Consumer protection; Industry self-regulation; Social corporate responsibility

1. Introduction

Loot boxes are products inside video games that players buy with real-world money to obtain random rewards. Most of the time, the player will receive a reward that they do not want, but rarely, they will receive a desirable reward. Players are thereby encouraged to buy multiple loot boxes to obtain the rarer rewards. Some loot boxes can be obtained without payment (*e.g.*, by merely completing in-game tasks) (Nielsen and Grabarczyk, 2019; Larche et al., 2022); however, the present study focuses on paid loot boxes whose activation requires purchase using real-world money. References below to 'loot boxes' refer to 'paid loot boxes.' In addition, other games also offer mechanics similar to loot boxes that provide unknown random rewards in exchange for money, but these are not referred to as 'loot boxes' or portrayed as an in-game treasure chest that is opened to revealed random rewards, and may instead be called 'gacha' summoning mechanics, especially in Far East Asian-produced video games (Woods, 2022; Blom, 2023). References below to 'loot boxes' are inclusive of all in-game purchases that involve randomisation. These mechanics are widely implemented in video games in both Western and Asian countries (Zendle et al., 2020; Xiao et al., 2021; Xiao, Henderson and Newall, 2023; Xiao, 2023a), particularly on mobile platforms, and are available for purchase by many young children. Official surveys in the UK have consistently reported that over 20% of 11–16-year-olds purchased loot boxes with real-world money (UK Gambling Commission, 2019; Department for Communities (Northern Ireland), 2023). The Spanish Government reported that 23.7% of 15–17-year-olds bought them, as did 13.8% of 18–25-year-olds (Dirección General de Ordenación del Juego [Directorate General for the Regulation of Gambling] (DGOJ) (Spain), 2023). A non-representative online survey of Mainland Chinese video game players found that 51.4% of all players spent money on loot boxes, and 64.0% of players who played games with loot boxes and therefore had opportunities to purchase them bought them (Xiao et al., 2024).

These mechanics are conceptually and psychologically similar to gambling (Drummond and Sauer, 2018). However, most loot boxes cannot be regulated as gambling in nearly all countries (with Belgium as the exception (Xiao, 2023a)) because the mechanics do not satisfy the legal definitions of 'gambling' (which are arguably stricter than most common sense understandings) (Xiao, 2021a, 2022b; Leahy, 2022). Loot box spending has been linked to problem gambling (Zendle and

Cairns, 2018; Garea et al., 2021; Spicer et al., 2022), which suggests that a vulnerable group of consumer might be at risk of experiencing harm (Close et al., 2021). Earlier research expressed concern that this link might not be present in culturally different Asian regions where traditional gambling is far more heavily regulated (Xiao, Fraser and Newall, 2023); however, this positive correlation has since been robustly replicated in Mainland China (Xiao et al., 2024). Stakeholders, such as players, parents, gambling harm reduction charities, and policymakers, are concerned about the potential harms that loot boxes may cause, ranging from overspending and experiencing financial harm (Hodge et al., 2022) to normalising and promoting gambling behaviours in children who are generally prohibited from accessing traditional gambling, even in Western countries that have a legalised but regulated gambling market (Brooks and Clark, 2022; González-Cabrera et al., 2023).

Different regulatory approaches to loot boxes of varying degrees of restrictiveness are available (Moshirnia, 2018; Leahy, 2022; Xiao et al., 2022). Belgium has attempted to 'ban' loot boxes by applying the country's uniquely wide encompassing gambling law (Belgische Kansspelcommissie [Belgian Gaming Commission], 2018). However, the regulator has not enforced the law in practice by punishing non-compliant companies that continue to sell loot boxes. This meant that 82 of the 100 highest-grossing iPhone games in Belgium in mid-2022 still contained loot boxes (Xiao, 2023a). Other countries (such as the US) have not taken any dedicated action as yet, whilst others (such as the UK) are relying on the video game industry to regulate its own behaviours through platform rules and non-binding principles (Department for Digital, Culture, Media & Sport (UK), 2022; Department for Culture, Media and Sport (UK), 2023; Ukie (UK Interactive Entertainment), 2023). A comprehensive review of the regulatory actions and proposals around the world has been conducted elsewhere (Xiao, 2024a). Importantly, one middle-ground approach that has been adopted by a number of Asian regions (including Mainland China, Taiwan, and South Korea) to address the relevant consumer protection concerns in a non-restrictive manner, whilst also reasonably preserving the companies' commercial interests, is to require so-called probability disclosures.

1.1. Loot box probability disclosure requirements in Mainland China

The regulatory requirement that video game companies must publish loot box probability disclosures in Mainland China so as to inform players of their likelihood

of obtaining various potential items was first announced by the Ministry of Culture [文化部] (2016) (as it then was) in the 'Notice on Regulating the Operation of Online Games and Strengthening Concurrent and Ex-Post Supervisions' on 1 December 2016 (hereinafter, the '2016 Notice'). Besides the requirement to disclose probabilities (Article 6), it was also required that a record of loot box opening results be published and preserved for at least 90 days for potential auditing by regulators (Article 7) and that player should be provided with the opportunity to obtain in-game content that is functionally identical to loot box rewards through non-randomised means, such as direct purchase (Article 8, although broadly this did not appear to have been properly complied with). Per Article 21, non-compliance with Articles 6–8 was punishable under Article 31 of the 2010 Interim Measures for the Regulation of Online Games, and the sanctions were the confiscation of illegal gains and a fine of no less than ¥10,000 and no more than ¥30,000 Renminbi (≈US$1,500–4,500, using contemporaneous exchange rates) (文化部 [Ministry of Culture] (PRC), 2010). The provisions of the 2016 Notice came into effect on 1 May 2017. (Foreign media reporting (Yodo1, 2019; Straub, 2020) of how the number of loot boxes a player may purchase per day in Mainland China has been capped is baseless misinformation. Neither the 2016 Notice nor any other published regulatory documents have ever imposed such requirements.)

However, the 2010 Interim Measures for the Regulation of Online Games, upon which the enforcement powers were based, were repealed on 10 July 2019 (文化和旅游部 [Ministry of Culture and Tourism] (PRC), 2019). This meant that the explicit basis for punishing non-compliance with the 2016 Notice no longer existed, which may have affected how enforceable the regulatory requirements were from then on. Further, just over a month later on 19 August 2019, the 2016 Notice itself was repealed as part of a broader government process of reviewing whether various extant regulatory documents should be kept or not (文化和旅游部 [Ministry of Culture and Tourism] (PRC), 2019). This was done through the since combined Ministry of Culture and Tourism [文化和旅游部] (2019) publishing a list of regulatory documents that continue to have effect and another list of ones that are thereby repealed. The 2016 Notice was contained in the latter list of repealed regulatory documents. Both lists were appended to an official notice announcing the review results as attachments (文化和旅游部 [Ministry of Culture and Tourism]

(PRC), 2019), which might have caused the repealing of the 2016 Notice to be little noticed and reported. In short, by 19 August 2019, the requirement that video game companies must make probability disclosures could no longer be explicitly found in any effective regulatory documents.

Notwithstanding, the advice given to companies by law firms and the main trade association since then is to nonetheless disclose probabilities despite the 2016 Notice having been repealed, and the general industry practice has followed that guidance (诸 [Zhu], 2023; 朴 [Park] and 郭 [Guo], 2023). This was proven rightfully prudent when it was reported in February 2023 that the Shanghai Putuo District Administration for Market Regulation [上海市普陀区市场监督管理局], charged with enforcing consumer protection law, fined the company behind *Survivor.io* [弹壳特攻队] (Habby [上海乐钻科技有限公司], 2022), ¥10,000 Renminbi (≈US$1,500, using contemporaneous exchange rates) for not disclosing loot box probabilities from when the game was first released in August 2022 until an update in October 2022 after a complaint was submitted to the regulator by a player/consumer (佛陀 [Fotuo], 2023; 诸 [Zhu], 2023). The fine was due to the non-disclosure of loot box probabilities being deemed as the company imposing on players 'other provisions that are unfair and unreasonable to consumers' within the meaning of Article 12(7) of the 2015 Measures for Penalties for Infringing Upon the Rights and Interests of Consumers (国家工商行政管理总局 [State Administration for Industry and Commerce] (PRC), 2015). Notably, the repealed 2016 Notice could not, and was not, used as the basis for this enforcement action. Instead, broader consumer protection law was used. This shows the regulator's willingness and ability to apply more general laws to novel challenges posed by novel technologies, such as video game loot boxes if and as when required. (Consumer protection law in other regions, such as the EU, can likely also be similarly applied to address some of the most obvious concerns related to loot boxes (Xiao, 2022a, 2024b; Cartwright and Hyde, 2022; Leahy, 2022).)

Given that companies can be, and indeed have been, punished for non-compliance despite the 2016 Notice having been repealed, it cannot be said whether to make probability disclosure is voluntary. It is, in fact, compulsory. Accordingly, the most accurate legal position is to state that probability disclosures are currently required

in Mainland China as a matter of law on the basis of wider consumer protection law, rather than any dedicated video game and loot box regulation as before. Some of the provisions of the repealed 2016 Notice were included in the draft regulations for the video game industry published on 22 December 2023. Specifically, Clause 27 dealt explicitly with loot boxes (国家新闻出版署 [National Press and Publication Administration (PRC)], 2023). This included how loot box rewards or functionally identical items must also be directly purchasable. In the same clause, it was also said that the number of loot box openings required and the loot box probabilities involved should be 'set up reasonably.' However, interestingly, there was no explicit requirement to make probability disclosures. This omission may have been a drafting oversight and might be fixed in due course, given other more obvious propositions (such as that online video games must not threaten national security per Clause 16(3)) were nevertheless restated.

1.2. Loot box prevalence and probability disclosures

Five previous assessments of loot box prevalence amongst highest-grossing games have been conducted: in the UK (Zendle et al., 2020) and in Australia in 2019 (Rockloff et al., 2020), in Mainland China in 2020 (Xiao et al., 2021), in the UK in 2021 (Xiao, Henderson and Newall, 2023), and in Belgium in 2022 (Xiao, 2023a). These results are summarised in Table 1.

Table 1

Previous loot box prevalence studies (N = *5).*

Study	Data collection	Platform	Region	Prevalence rate	Probability disclosure rate
Zendle et al. (2020)	Feb 2019	iPhone	UK	59.0%	Unknown
~	~	Android	~	58.0%	Unknown
~	~	Steam	~	36.0%	Unknown
Rockloff et al. (2020)	Aug – Oct 2019	Various	Australia	62.0%	Unknown
Xiao et al. (2021)	Jun 2020	iPhone	Mainland China	91.0%	95.6%
Xiao et al. (2023)	Jun 2021	iPhone	UK	77.0%	64.0%
Xiao (2023)	Jun 2022	iPhone	Belgium	82.0%	Unknown

The prevalence rate of loot boxes is known to change over time: specifically, broadly increase as time has passed when the results of the two UK studies (Zendle et al., 2020; cf. Xiao, Henderson and Newall, 2023) were compared (Xiao, Henderson and

Newall, 2022), although individual cases of games removing loot boxes have also been well-reported (Batchelor, 2022; Dealessandri, 2022). The disclosure rate (which, depending on where the study was conducted and the regulations then in force there, may be the compliance rate with legal or industry self-regulatory probability disclosure requirements) is also subject to change as more companies might have decided to comply (and to comply more effectively by, *e.g.*, making more visually prominent disclosures) as time has passed and the self-regulatory requirement became more well-known. Tracking these shifting trends (if any) would help us to better understand how the loot box issue continues to develop.

A new study on loot box prevalence and probability disclosure requirements was therefore conducted in Mainland China in 2024, nearly four years after the original Xiao *et al.* (2021) study. The present results were compared to older data to identify potential structural changes in the industry and individual changes within specific games.

Research Question 1: Has the prevalence of loot boxes amongst the highest-grossing iPhone games in Mainland China changed from 2020 to 2024?

Hypothesis 1: The loot box prevalence rate in the present early 2024 sample will be significantly different from the mid-2020 rate of 91%.

Research Question 2: Has the loot box probability disclosure rate amongst the highest-grossing iPhone games in Mainland China changed from 2020 to 2024?

Hypothesis 2: The loot box probability disclosure rate in the present early 2024 sample will be significantly different from the mid-2020 rate of 95.6%.

The repealed 2016 Notice originally stated that probability disclosures made either in-game or on the game's website are compliant. Presumably, more general consumer protection law, on whose basis probability disclosures are now required, would also hold a similar position that companies are not in breach so long as the probabilities are disclosed somewhere. However, as previous studies argued(Xiao et al., 2021; Xiao, 2022a; Xiao, Henderson and Newall, 2023), making disclosures at both location is evidently better because players would have easier and more direct

access from within the game, whilst non-players (such as parents) would have access to searchable website information without having to play the game themselves. Have more companies disclosed probabilities at both locations following the previous recommendations?

Research Question 3: Are more games containing loot boxes making probability disclosures both in-game and on websites in 2024 as compared to in 2020?

Hypothesis 3: The percentage rate of games containing loot boxes making probability disclosure both in-game and on websites in the present early 2024 sample will be significantly higher than the mid-2020 rate of 34.1%.

The majority of probability disclosures observed in Mainland China in 2020 were not visually prominent or easily accessible by players (Xiao et al., 2021). For example, one game required the player to click multiple in-game buttons, follow multiple hyperlinks, and do a lot of scrolling before allowing them to see the disclosure. Only a minority of games made 'reasonably prominent' disclosures at either in-game or on websites. A 'reasonably prominent' in-game disclosure was defined by Xiao et al. (2021) as being 'either accessible by searching for the Chinese word '概率 [probabilities]' on the in-game loot box purchase page or automatically displayed)' (Xiao et al., 2021, p.603). On the other hand, a 'reasonably prominent' website disclosure was defined therein as being 'always accessible by using the internet browser's find command to search for the Chinese word '概率 [probabilities]' on the official website's homepage' (Xiao et al., 2021, p.603). Those definitions are adopted for present purposes in order to allow for fair comparison. Companies were encouraged by the previous study to adopt the better disclosure methods identified. Since the original study, have more companies made 'reasonably prominent' disclosures?

Research Question 4: Are loot box probability disclosures, either in-game or on websites, more often 'reasonably prominent' in 2024 as compared to in 2020?

Hypothesis 4: The percentage rate of in-game probability disclosures being 'reasonably prominent' in the present early 2024 sample will be significantly higher than the mid-2020 rate of 21.2%.

Hypothesis 5: The percentage rate of website probability disclosures being 'reasonably prominent' in the present early 2024 sample will be significantly higher than the mid-2020 rate of 10.6%.

1.3. Pity mechanics

So-called 'pity' mechanics are sub-mechanics related to loot boxes that have garnered attention because they change the player's probabilities of getting different rewards when the player spends more money (Xiao et al., 2021; Xiao, Fraser and Newall, 2023; Xiao, Henderson and Newall, 2023). For example, the player usually has only a 1% chance of getting a 'legendary' reward, but the player is guaranteed to obtain such a reward on the twentieth purchase attempt if all 19 previous attempts failed to result in such a reward. This might be implemented to mean that all attempts from the first to the nineteenth only have a 1% chance of providing the legendary reward and that the twentieth attempt has a 100% chance if the condition that all previous 19 attempts have failed to result in the legendary reward is satisfied. However, it could also be implemented through successively slightly increasing the probability for obtaining the legendary reward as more purchases are made that do not result in such a reward: for example, a 2% chance for the second attempt, a 5% chance for the third attempt, etc.

The prevalence of such mechanics (based on how many highest-grossing iPhone games publicly disclosed implementing them, which means that the rate is presumably in fact higher due to non-disclosure) was 65.9% in Mainland China (Xiao et al., 2021) and 34.7% in the UK (Xiao, Henderson and Newall, 2023). It is yet unclear how these mechanics affect player spending, besides that a vast majority (86.9%) of players are known to view them positively (Xiao, Fraser and Newall, 2023), likely because these mechanics mean that players are ultimately guaranteed the desired reward and that they can predict the maximum amount of money they might need to spend to secure that reward. Continued monitoring of the prevalence of such mechanics, which is incidentally possible when assessing loot box prevalence and examining probability disclosures, can affirm the importance of studying these sub-mechanics if they remain popular.

1.4. Other controversial monetisation and engagement mechanics

Besides loot boxes, the draft regulations for the Mainland Chinese video game industry published in December 2023 (国家新闻出版署 [National Press and Publication Administration (PRC)], 2023) also explicitly referred to other monetisation and engagement mechanics. Specifically, it was intended through Clause 18 that 'daily login,' 'first purchase,' 'continuous purchase,' and other mechanics that offer 'persuasive' rewards be prohibited. These terms were not further defined. However, it was presumed that daily login mechanics meant providing the player with rewards because they logged into the game on a specific day. First purchase mechanics presumably meant giving the player rewards for making their first purchase in the game. Continuous purchase mechanics was presumed to mean rewarding players as they cumulatively spend more and more money in-game.

Importantly, these mechanics could be associated with loot boxes but could also be either entirely unrelated and relate to all in-game purchases irrespective of any randomisation: *e.g.*, daily login rewards could be loot boxes or, in contrast, non-randomised items, and a continuous purchase could cumulatively count loot box spending, non-randomised in-game spending, or both. The prevalence rates of these mechanics are not known. The potential impact of the draft regulations on industry practice, in the event it is adopted without further amendments, could be better assessed with that information.

1.5. Real-life identity verification

Finally, Mainland China requires particularly strict real-life identity (ID) and age verification procedures to be conducted before online video game services are provided to users. This is to allow underage users to be identified and ensure that regulatory limits on when and how long under-18s can play online games and how much money they are permitted to spend can be effectively enforced (Xiao, 2022c; Zendle et al., 2023). Article 1 of the 'Notice on the Prevention of Online Gaming Addiction in Juveniles' required that all new user accounts for online video games be ID verified from November 2019 (hereinafter, the '2019 Notice') (国家新闻出版署 [National Press and Publication Administration (PRC)], 2019). This was reiterated in Article 2 of the 'Notice on Further Strictly Regulating and Effectively Preventing Online Video Gaming Addiction in Minors' effective from September 2021 (hereinafter, the '2021 Notice') (国家新闻出版署 [National Press and Publication

Administration (PRC)], 2021b). Therefore, incidental to answering the research questions concerning loot boxes, which would require the creation of new user accounts for the Mainland Chinese version of the games (thus triggering the required ID verification process), whether games conducted ID verification could be assessed.

2. Method

A list of the 100 highest-grossing games for the iPhone platform in Mainland China on 5 January 2024 was collated through data.ai, a leading analytics company. This list formed the sample as all games remained available for download from the Mainland Chinese Apple App Store and playable during the data collection period.

The following variables were measured:

Apple age rating

This was copied from the relevant age rating information displayed on the game's Mainland Chinese Apple App Store page.

CADPA age rating

Besides the international, platform-based Apple age rating system, the China Audio-video and Digital Publishing Association [中国音像与数字出版协会] (CADPA), a national industry body that represents, *inter alia*, the video game industry, has its own age rating system (国家新闻出版署 [National Press and Publication Administration (PRC)], 2021a). This information was copied from the relevant age rating information displayed on the game's login, initial loading, or equivalent page.

Presence of ID verification

Each game was downloaded from the Mainland Chinese Apple App Store. Upon start-up, it was checked whether and how the game conducted ID verification.

Presence of paid loot boxes

Each game was played for an hour to identify whether paid loot boxes were being implemented and sold in exchange for real-world money or premium in-game currency that could in turn be bought with real money. A 'paid loot box' is defined as any in-game purchase involving real-world money with any randomised

elements. This aligned with the UK Ukie (2023) self-regulation's definition, the Entertainment Software Rating Board's (ESRB's) definition (2020), and that set out in the Introduction section of a comparable, prospective study on loot box industry self-regulation in the UK (Xiao, 2023b). Following the method of the UK study, one hour of gameplay meant using best endeavours for 60 minutes to access as many in-game purchasing offers as possible (Xiao, 2023b). If multiple loot boxes were found within that hour, then they were each separately noted and assessed. Screenshots were taken of all found loot boxes.

In Xiao et al. (2021), which was the only previous study assessing loot box prevalence and probability disclosure compliance in Mainland China, loot box presence was determined through up to 40 minutes of gameplay (but in fact often required less) followed by up to two hours of internet browsing if required. However, no internet browsing was conducted for the present study to code loot box presence and other in-game aspects. The length of gameplay used has instead been extended from 40 minutes to one hour. This change in methodology aligned with more recent studies' methods (e.g., Xiao, 2023a) and better conserved research resources (*i.e.*, limited researcher's time). Importantly, internet browsing could not allow for the accurate assessment of certain variables, such as the *Method of in-game disclosure* (detailed below), because online resources of in-game content (*e.g.*, a video recording of a player opening loot boxes inside the game) would rarely, if ever, show the player accessing the probability disclosures, and even when this is shown, it would often be difficult to determine exactly which button was tapped, for example. It is arguably necessary for the researcher to interact with the loot box themself in order to properly code *Method of in-game disclosure*. The same applies for the *Presence of daily login mechanics*, etc.

Presence of probability disclosures

In relation to each type of loot box found in each game, a corresponding probability disclosure was searched for in-game. In addition, a website disclosure was searched for using Baidu and a manual search of the game's official website if needed. The search terms that were used were the game's Chinese title; and '概率' [probabilities]; and '公示' [publication]. This was deemed as expending reasonably sufficient efforts to attempt to find the probability disclosures (similar to what a reasonably circumspect player might use), thus if no disclosure could be found using the steps

above, then the game was deemed as not having made any probability disclosures. Any disclosures that nevertheless have been made but could not be found after the previous steps were taken were presumed to also be too unhelpfully hidden for the average consumer to identify and benefit from.

If a game had multiple types of loot boxes and made disclosures only for some of them but not all, that game was deemed as having disclosed when calculating the 'disclosure rate' that was used for Hypothesis 2, in accordance with the methodology of prior studies (Xiao et al., 2021; Xiao, Henderson and Newall, 2023); otherwise, the results would not be comparable. However, a separate 'compliance rate' was calculated that deemed such a game as not having complied because proper compliance would require a disclosure for each and every loot box type identified.

Method of in-game disclosure and Method of website disclosure

Different methods of disclosure were categorised using the updated framework of Xiao *et al.* (2023). The codebook was also permitted to be amended and adapted to reflect more recent implementations. For example, if a probability disclosure was found that would not fall within any of the previously established subcategories, then a new subcategory was defined and created. Similarly, the boundaries of previously defined subcategories could also be amended as needed to incorporate methods that technically could have been new subcategories but were merely subtly different and so were instead, more appropriately, combined and subsumed into an amended version of previously established subcategories.

If multiple loot boxes were found for a game, following Xiao *et al.* (2021) in order to allow the results to be comparable, these two variables were coded based on the loot box that made the most prominent disclosure for the purposes of Hypotheses 4 and 5. It would have been too resource intensive to code the disclosure method for each and every loot box type found.

Presence of pity mechanics

The loot box purchase screen and any probability disclosures were examined to identify whether the game implemented any mechanics that changed (either increased or decreased) the probabilities of obtaining various randomised rewards

as the player purchased more loot boxes. This included guaranteeing a reward of a certain rarity or a specific reward after a predetermined number of purchases have been made. These are broadly known as 'pity' mechanics, as defined by Xiao et al. (2021).

Presence of daily login, *first purchase*, and *continuous purchase mechanics*

During the one hour of gameplay spent on each game, the coder recorded any of these three specific monetisation and engagement mechanics that may have automatically appeared or became available for manual engagement. The presumed definition for each mechanic as set out in the Introduction section was used, although the coder also remained open to accept other potential implementations that may fall within or adjacent to the definitions. The different implementations found are detailed in the Discussion section.

Date and time of data collection

The date and time on and at which the game was examined were recorded.

In accordance with the *Danish Code of Conduct for Research Integrity* (Ministry of Higher Education and Science (Denmark), 2014), as adopted by the IT University of Copenhagen, the present study did not require research ethics assessment and approval because no human participants or personal data were involved and only publicly available information was examined and recorded.

The loot box-related aspects of this study were preregistered in the Open Science Framework at: https://doi.org/10.17605/OSF.IO/U4CAH.

3. Results

3.1. Age ratings and age-appropriate guidance information

Two age rating systems for video games on the Apple App Store are in force in Mainland China concurrently for iPhone games: the propriety one of the Apple App Store and that of the CADPA. The Apple age rating was copied from the App Store product listing page, whilst the CADPA age rating was copied from the information displayed inside each game. It is not known why the Apple App Store does not provide both age ratings on the product listing page, even though the non-Apple

CADPA one would in nearly all cases be inevitably shown inside the game. The age ratings of the 100 games studied are shown in Table 2.

Five games did not display a CADPA age rating. Two of these games, Games 067 (*重返帝国*) and 073 (*光与夜之恋*), stated in text on the login screen in a very small font that they were not suitable for players under 18, so no appropriate CADPA could be shown for them as the originally proposed CADPA 18 was not included as part of the system and the highest possible CADPA 16 would not be appropriate. The other three games, Games 092 (*皇家捕鱼电玩城*), 093 (*足球在线*), and 099 (*海王捕鱼*), did not give an explanation as to why no CADPA age rating or relevant information was provided. Notably, a CADPA 8 age rating was found to have been shown on Game 093's official website, which suggests it was an implementation error (specifically, an omission) in relation to this game's iPhone client. The remaining two games were social or simulated casino games that were likely deemed as requiring an age rating that is higher than the highest possible CADPA 16 (as they were both rated Apple 17) and so had no appropriate CADPA age rating information to display. (So-called simulated or social casino games allow players to spend real-world money to participate in traditional gambling, *e.g.*, playing on slot machines, without the possibility of converting any potential winnings back into real-world money.) However, many other social casino games simply displayed CADPA 16 (*inter alia*, Games 079 (*乐鸿捕鱼*) and 100 (*捕鱼炸翻天*)). One other social casino game (Game 025 (*途游休闲捕鱼*)) showed a non-existent CADPA 17 age rating, which is not part of the official age rating system but was shown by the video game company at its own volition possibly to adhere to the game's Apple App Store 17 rating, which is higher than the highest possible CADPA 16. Another game, Game 010 (*捕鱼大作战*), was observed as having initially shown a CADPA 17 age rating but then changed this to CADPA 16 at some point during the data collection period.

Table 2

*Age rating of games examined (*N = *100)*

Age Rating	# of games	%
Apple 4	7	7.0%
Apple 9	17	17.0%
Apple 12	36	36.0%
Apple 17	40	40.0%
CADPA 8	12	12.0%

CADPA 12	37	37.0%
CADPA 16	45	45.0%
CADPA 17[a]	1	1.0%
No CADPA rating shown	5	5.0%

[a] The CADPA 17 rating is not part of the official age rating system but was shown by one game.

The CADPA age rating icons when tapped would usually provide further details about the game through a '适龄提示 [age-appropriate guidance],' *e.g.*, providing a synopsis of the gameplay; justifying the age rating; and detailing what regulatory measures would be applied in relation to underage users of various age groups (such as limits on gameplay time and in-game spending to comply with relevant regulations (Xiao, 2021b, 2022c; Zendle et al., 2023)). For the 95 games that showed a CADPA age rating, 93 games (97.9%) provided this, whilst the other two games' age rating icon (2.1%) were not interactable and could not be prompted to show further information.

Inconsistencies between the two age ratings given for the same game by the two separate systems were identified in relation to some games. Firstly, there were obvious errors: for example, if a game was rated CADPA 12, the game's Apple Age Rating should also have been at least 12 (rather than either 4 or 9) to not falsely advertise the game as suitable for children aged between 4 and 11 and thus prevent them (or their parents) from downloading the game only to find out that the game is not actually suitable to them. In total, 12 games had a CADPA age rating of either 12 or 16, but displayed an Apple age rating of either 4 or 9, when at least Apple 12 should have been displayed. Game 008's (部落冲突) age ratings were thusly inconsistent, and its age-appropriate guidance stated that under-12s cannot spend money in-game, which implies that under-12s would still be permitted to access the game despite the CADPA 12 age rating. The law only requires that under-8s be not permitted to make in-game purchases (Xiao, 2020), so the company has adopted stricter child-protection measures than legally required by also prohibiting 8–11-year-olds from spending money. This demonstrates that the CADPA age ratings are indeed merely advisory at present even though companies could voluntarily (or be required in the future by regulations to) restrict access to the games and limit player's in-game spending based on them (because companies have access to

information about the user's age through the required ID verification process, as discussed below).

Secondly, because the two systems' age brackets do not correspond perfectly (4, 9, 12 and 17 for Apple as compared to 8, 12, and 16 for the CADPA), there were cases where it was arguably more appropriate to have given the game an Apple age rating that was one tier higher because the CADPA age rating was closer to that higher rating, even though the Apple age rating given was technically not wrong. For example, four games were rated CADPA 8 but only Apple 4 when, arguably, Apple 9 would have been more appropriate (as something deemed unsuitable for children under 8 by a more culturally sensitive national system is presumably not suitable for 4-year-olds on the lower end of the range for good reason), even though Apple 4 was not technically wrong (because eight is closer to nine than four, but technically still between four and nine). Nine games were rated CADPA 16 but only Apple 12 when Apple 17 likely would have been more suitable for the same aforementioned reason. Thus, a total of 13 games had arguably inappropriate Apple age ratings that were too low and did not reflect the Chinese cultural sensibilities incorporated into the CADPA age rating system.

3.2. Real-life ID verification

Amongst all 100 games, 95 games (95.0%) duly implemented an ID verification process to determine both the real-life identity of the player and, by implication, their age. Generally, this was done through the game asking the player to input their legal name and their Chinese national identity number (which plainly contains the person's date of birth). Some games that were operated by the same company recognised the coder's login information (either mobile phone number or WeChat account) as having been inputted into another game operated by the same company that was previously coded and so did not request for the ID information pair to be inputted again for verification. Thus, it was not possible to definitively state (or indeed provide screenshots showing) whether ID verification was properly conducted in relation to those games. However, in fairness to the video game companies involved, it was presumed that this was done correctly as evidence of the lack of ID verification could also not be produced (except in one case detailed below). Many potential issues arise from this implementation of an ID and age verification system: these are detailed in the Discussion section.

The other five games (5.0%) demonstrably did not conduct ID verification. Firstly, Games 022 (*指尖四川麻将*) and 023 (*开心消消乐*) provided a so-called '游客模式 [guest mode]' that allowed users to play the game without providing ID verification. These modes may also be referred to as a '快速游戏 [quick play]' mode. These were explicitly prohibited by Mainland Chinese regulations as detailed below under the Discussion section (Xiao, 2021b). A number of other games' UI (user interface) still contained remnants of guest modes (*e.g.*, the button still existed), but these either were disabled (*e.g.*, Game 001 (*王者荣耀*)) or nonetheless still required ID verification upon entry (*e.g.*, Game 042 (*倩女幽魂*)), both of which would be compliant with the law.

Secondly, Games 016 (*咸鱼之王*) and 040 (*星球：重启*) allowed the coder to begin playing the game by logging in with an Apple ID that, importantly, has *not* been ID verified. The iOS operating system frequently warned the coder that a Chinese Apple ID '必须 [must]' be verified with a Chinese phone number (as occurred when the coder was assessing Game 049 (*合金弹头：觉醒*) as shown in Figure 1), which would imply ID verification. (This is because Chinese phone numbers are required by law to always be linked to a real-life identity since September 2013 (工业和信息化部 [Ministry of Industry and Information Technology] (PRC), 2013), but, in practice, the person actually using the phone number may not necessarily be the person registered against said number, which is a major flaw in the verification process that is discussed below.) However, the coder was able to simply choose '以后再说 [Discuss later]' and decline the operating system's request. This meant that the coder was able to continue to possess and use an unverified Apple ID that was only linked to an email address and so was neither directly ID verified (which Apple could have required but did not) nor even indirectly ID verified through a Chinese phone number. In contrast, other games like Game 053 (*乐乐捕鱼*) allowed the user to login with their Apple ID but then sought ID verification before gameplay started, which would then be compliant with the law.

Figure 1. When coding Game 049 (*合金弹头：觉醒*), a pop-up window from the operating system stated that 'to continue using your Apple ID, please add a Chinese phone number' and that 'the phone number must be verified.' The player was given the options of either 'discuss later' or 'open [the] "settings" [menu to complete the verification process].' © 2024 Apple & Tencent

Thirdly, Game 89 (*斗罗大陆:魂师对决*) only asked for the coder's phone number and did not seek further ID verification. Usually, such a case would be deemed as having ID verified the user because the phone number implies ID verification and also the company might have already linked up the phone number with the user's ID when they played a previous game operated by the same company (specifically, Game 84 (*凡人修仙传：人界篇*), which was coded earlier). However, the customer support bot, when asked, said that it could not confirm whether or not ID verification took place and that this information could instead be found in the settings or account menu; if the information does not appear there, then the account has *not* been ID verified. This information was not present at the mentioned in-game locations; thus, reasonably assuming that the customer support bot provided correct and up-to-date information, there is conclusive evidence of the game not having conducted ID verification based on information the company itself provided, *i.e.*, a self-admission. It is possible that other games that only sought a phone number may also have not properly ID verified, but to err on the side of caution, those games were presumed to have been compliant as contrary evidence could not be produced, unlike for Game 89.

Finally, interestingly, the ID verification system of four games (Games 010 (*捕鱼大作战*), 025 (*途游休闲捕鱼*), 036 (*途游斗地主*), and 060 (*次神：光之觉醒*)), all operated by the same company, 途游 [Tuyoo], did not recognise the authentic ID information pair (legal name and Chinese national ID number) provided by the coder. That information pair was successfully used for all other games that demanded ID verification. The ID information pair of another person was successfully used to access these games for research, thus showing that the system did work as intended but has seemingly specifically been programmed to reject the ID information of the coder, who is a published researcher of video game regulation. The implications of this perplexing situation (presumably blacklisting) are discussed below.

3.3. Prevalence of loot boxes and probability disclosures

The prevalence of loot boxes in Mainland Chinese video games in early 2024 was 97.0%. A preregistered two-sample test of proportions (two-sided) found that the 2024 prevalence rate was not statistically significantly different from the mid-2020 rate of 91.0% ($z = -1.79$, $p = .074$). Table 2 also shows the prevalence rates amongst games with different age ratings.

Table 2

Age rating of games examined and loot box prevalence (cumulative; N = *100)*

Age Rating	Total games	Games with loot boxes	Prevalence of loot boxes
Apple 4+	7	6	85.7%
Apple 9+	24	21	87.5%
Apple 12+	60	57	95.0%
Apple 17+	100	97	97.0%
CADPA 8+	12	10	83.3%
CADPA 12+	49	46	93.9%
CADPA 16+	94	91	96.8%
CADPA 17+ [a]	95	92	96.8%
No CADPA rating shown	5	5	100.0%
All games	100	97	97.0%

[a] The CADPA 17 rating is not part of the official age rating system but was shown by one game.

Of 97 games with loot boxes, 94 games (96.9%) were found to have disclosed probabilities for at least one paid loot box identified during the one hour spent examining the game, whilst three games (3.1%) did not disclose for any loot box found. A preregistered two-sample test of proportions (two-sided) found that the

2024 disclosure rate was not statistically significantly different from the mid-2020 rate of 95.6% ($z = -0.47$, $p = .636$).

However, a game is only compliant with the requirement to disclose loot box probabilities if *all* loot boxes, rather than any *one* loot box, disclosed. Previous studies only assessed the latter issue: even when other loot boxes that did not disclose were found, the game was coded as compliant so long as at least one loot box that did disclose could be found. However, the present study invested significantly more time in data collection in order to examine all games for one hour and was often able to find multiple loot boxes in a single game that adopted varying degrees and methods of compliance.

Of 97 games with loot boxes, only 10 games (10.3%) disclosed the probabilities for all loot boxes found, whilst 87 rule-breaking games (89.7%) were found to have contained at least one loot box for which no probability disclosures were provided either in-game or on the game's official website. The present results ought not be interpreted as the 10 games having been entirely compliant with the law because they may still have contained non-compliant loot boxes that did not disclose, but the coder simply had no opportunity to observe that within the one hour of gameplay. The present study could only identify non-compliance with confidence (with the caveat that extremely obscurely published disclosures might not have been found).

3.4. Locations of probability disclosures

In-game probability disclosures were found for at least one loot box identified in 81 of 97 games (83.5%), but not in the 16 other games (16.5%). Website disclosures were found for at least one loot box identified in 55 of 97 games (56.7%), but not for the other 42 game (43.3%). The disclosure location availability rates shown in Table 3 do not reflect that every loot box identified in each game disclosed at said location: the disclosure location availability status may differ for each loot box in the same game (*e.g.*, one loot box in the game may have disclosed only in-game, whilst another disclosed only on the website). Two exploratory two-sample tests of proportions (two-sided) found that the in-game probability disclosure availability rate (for at least one loot box) was significantly *higher* than the 2020 Chinese rate of 57.1% ($z = -3.97$, $p < .001$), whilst the website disclosure availability rate (again for at least one

loot box) was significantly *lower* than the 2020 Chinese rate of 72.5% ($z = 2.26$, $p = .024$).

Disclosures were found at both locations for 42 of 97 games with loot boxes (43.3%). A preregistered two-sample test of proportions (one-sided) found that the rate of games making disclosures at both locations in 2024 was not statistically significantly higher than the mid-2020 rate of 34.1% ($z = -1.29$, $p = .098$).

Table 3

*Location(s) of at least one observed disclosure (*n = *97)*

Disclosure location(s)	Number of games (%)
In-game only	39 (40.2%)
On the official website only	13 (13.4%)
Both locations	42 (43.3%)
No disclosure found	3 (3.1%)

3.5. Most prominent method of in-game and website disclosures

The accessibility method of the most prominent in-game probability disclosure found in each game is shown in Table 4, whilst the same for website disclosures is shown in Table 5.

Table 4

*Categories of observed in-game disclosures (*n = *81)*

Number of games (%)	Summary of disclosure format
58 (71.6%)	Immediately after tapping a small generic symbol, such as a question mark button, an '(i)' button, or a 'rewards preview' button, that did NOT explicitly reference probabilities
11 (13.6%)	Automatically displayed on the loot box purchase page without requiring any additional input from the player
8 (9.9%)	Immediately after tapping a small button explicitly referencing 'probabilities' or a conceptually similar term, such as a 'detailed probabilities' or a 'probability disclosures' button
3 (3.7%)	After tapping a small generic symbol as described above and then following at least one additional step, such as tapping another button

1 (1.2%)	Interacting with a non-obvious element on the loot box purchase page, which specifically in relation to Game 88 (*崩坏3*) meant tapping on the blank areas of the gacha summoning banner (and specifically not tapping on any of the characters or buttons shown, which caused other information to be shown)

Table 5

Subcategories of observed website disclosures (n = *55)*

Number of games (%)	Summary of disclosure format
38 (69.1%)	Published as a regular 'news' or 'notices' post, which was then chronologically listed (with leeway for mistakes in the ordering) under all other posts under the relevant 'news' or 'notice' category tab
6 (10.9%)	Inaccessible from the homepage (*i.e.*, a web address existed for the disclosure, but the link could only be found through a search engine query or was only linked to from in-game, such that the disclosure on the official website was not hyperlinked from anywhere else on the website)
4 (7.3%)	Published on a page that was linked directly from the homepage
3 (5.5%)	Published as a regular 'news' or 'notices' post, but which was then pinned to the top of all other posts
2 (3.6%)	Published as a 'probabilities' or 'drop rates' post on relevant websites (*e.g.*, the company's website or the game's official wiki) and could be found using the website's search function
1 (1.8%)	Published as a 'probabilities' post and categorically separated out from other posts, such that the disclosure post was always shown on the homepage
1 (1.8%)	Published in a section of the website that could be accessed from another page that was not the homepage but could itself be accessed from any other page of the website under one of the pinned tabs (*i.e.*, requiring at least two hyperlinks to be followed)

A reasonably prominent in-game probability disclosure was defined by previous studies as one that was automatically shown on the loot box purchase page or could be accessed from which by interacting with a button that showed explicit text

referring to 'probabilities,' 'drop rates,' or such (Xiao et al., 2021; Xiao, Henderson and Newall, 2023; Xiao, 2024c). Accordingly, only 19 of 81 in-game disclosures (23.5%) were reasonably prominent. A preregistered two-sample test of proportions (one-sided) found that the rate of games making reasonably prominent in-game disclosures in 2024 was not statistically significantly higher than the mid-2020 rate of 21.2% ($z = -0.304$, $p = .381$).

A reasonably prominent website probability disclosure was defined as one that could be accessed from the homepage of the official website by using the internet browser's 'find' or equivalent function to search for 'probabilities,' 'drop rates,' or such (Xiao et al., 2021; Xiao, Henderson and Newall, 2023). Only five of 55 website disclosures (9.1%) were reasonably prominent. A preregistered two-sample test of proportions (one-sided) found that the rate of games making reasonably prominent website disclosures in 2024 was not statistically significantly higher than the mid-2020 rate of 10.6% ($z = 0.277$, $p = .609$).

None of the 42 games (0.0%) that disclosed at both locations made reasonably prominent disclosures at both locations.

Importantly, the categorisations above were based on the most prominent disclosure found at each location for each game; other loot boxes in these games may have disclosed using less prominent and accessible methods or may even have not disclosed at all.

3.6. Pity, Daily Login, First Purchase, and Continuous Purchase Mechanics

Pity mechanics were found in 87 of all 97 games containing loot boxes (89.7%). An exploratory two-sample test of proportions (two-sided) found that the pity mechanic implementation rate was significantly *higher* than the 2020 Chinese rate of 65.9% ($z = -3.95$, $p < .001$). Amongst all 100 games, daily login mechanics were observed in 98 games (98.0%); first purchase mechanics were found in 93 titles (93.0%); and continuous login mechanics were seen in 89 of them (89.0%). Given that this study could only ascertain the presence of a mechanic (within one hour of gameplay) but not its absence, more games than reported herein may have implemented these mechanics that only appeared after a lengthy period of gameplay (longer than one hour).

4. Discussion

4.1. An 18+ age rating should be introduced under both systems

Nearly all Mainland Chinese games displayed a CADPA age rating (95.0%) and provided age-appropriate guidance information (93.0%). The few games that did not provide CADPA age rating information presumably did not do so because the highest possible CADPA 16 rating (suitable for people aged 16+) was still deemed to be too low and not appropriate for the content found within the game (which might be suitable only for people aged 18+). There was no appropriate CADPA age rating for the companies operating these adult-only titles to display.

Instead of not providing a CADPA age rating at all, some companies chose to simply display CADPA 16 despite its potential inappropriateness. A total of 31 games were rated Apple 17, which is Apple's highest age rating, but were given only CADPA 16. These included simulated or social casino games that are deemed suitable only for adults (18+) in Europe by PEGI (Pan-European Game Information), the relevant age rating organisation (Robertson, 2021). Games with content that might be deemed suitable only for adults are being given Apple 17 and CADPA 16 instead of an adult only age rating, which would be more appropriate. The age-appropriate guidance of Game 100 (*捕鱼炸翻天*), a social casino game that was rated Apple 17 and CADPA 16, even stated that: 'This game … is suitable for users aged 16 and above, but this game provides services only to users aged 18 and above.' This meant that users under 18 could not actually play Game 100 even after downloading it and satisfying all of the age rating information shown. Companies are enforcing an 18+ age rating in practice, whilst misleadingly displaying lower age ratings.

There are three justifications for introducing an adult only 18+ rating under both the Apple system and the CADPA system: firstly, to allow games with content that is suitable only for adults to actually receive an appropriate adult only rating that is equivalent to, *i.e.*, a new Apple 18 (rather than a misleading CADPA 16 or Apple 17); secondly, to fix the inability of companies to label some games with content suitable only for adults with a CADPA age rating at all (CADPA 18 could be displayed, instead of no age rating or only some explanation text shown in a very small font being provided); and thirdly, to reduce the likelihood of misleading age rating information being given by some games that do not take effect in practice.

It was actually considered whether a CADPA 18 age rating should be included; however, the official press release stated that it was ultimately not included because 'it might be interpreted by people in divergent ways' without providing any further explanation (国家新闻出版署 [National Press and Publication Administration (PRC)], 2021a). Given the practical need for a CADPA 18 age rating that the present study has demonstrated (some games do need to display such a rating so as not to mislead consumers and parents), this decision should be reconsidered. Apple should add an Apple 18 age rating not just in Mainland China but also beyond, so that regional rules, such as how social casino games and online gambling apps should always get an adult-only 18+ rating in Europe, could be effectively implemented.

4.2. (In)accuracy of age ratings and age-appropriate guidance texts

Cases where the Apple and CADPA age ratings were inconsistent with each other as detailed in the Results section should be fixed. This would prevent players from being misled into downloading games that they thought would be suitable for them only to discover after entering into the game that it is in fact unsuitable or, even worse, that they are not in fact permitted to play it. The provision of both ratings and the age-appropriate guidance on the Apple App Store product listing would also be helpful for consumers by providing more information. In Brazil, an official national age rating system replaced Apple's own system on the country's store (Apple, 2019, 2024a), thus demonstrating that Apple could, of course, adapt a specific country's Apple App Store UI to accommodate a different age rating system. Further, as quoted above in relation to Game 100, for example, the age-appropriate guidance of some games provides information that is contrary to the CADPA age rating and should be corrected.

In addition, Game 100's age-appropriate guidance also says that 'this game is a casual and educational board game.' That was evidently untrue, because the game was in fact a 'fishing' social casino game wherein the player shoots cannons at various aquatic creatures that have a random chance of turning into the in-game currency that can be used to shoot more cannons. There was no educational or board game aspects. The present study did not conduct a close reading of all the age-appropriate guidance texts and compare them against actual gameplay to check their veracity. This is an important future direction of research: the age-appropriate

guidance should, of course, be accurate and informative and not false and misleading.

4.3. ID verification: non-compliance and loopholes

Five games (5.0%) demonstrably did not conduct ID verification before providing the coder with gameplay services in Mainland China as required and were in clear breach of regulations (国家新闻出版署 [National Press and Publication Administration (PRC)], 2019, 2021b). The so-called 'guest modes' that allowed users whose ID were unverified to play the game for up to one hour was permitted under Article 1 of the 2019 Notice (and before its publication) but were then explicitly prohibited by Article 2 of the 2021 Notice (国家新闻出版署 [National Press and Publication Administration (PRC)], 2021b). The newer Notice supersedes, so the two games that allowed the coder to play using guest modes was also in breach of that specific ban, in addition to failing to perform ID verification.

Two other games allowed the coder to log into and play by using his Apple ID, which should have been verified against a Mainland Chinese phone number; however, Apple allowed users to simply refuse to verify their Apple ID and continue to use its services as detailed in the Results section. This was a loophole that should be promptly patched. The relevant game companies likely assumed that the Apple ID used was already ID-verified and provided service on that basis (even though the company itself would have no access to the information pair that was used to verify the Apple ID unless Apple collected that information and was willing to pass it along). This shows that overreliance on a third-party to conduct ID verification may be unwise. Notwithstanding, using a trusted third-party to authenticate might be a more efficient industry-wide solution for both players and companies if it is properly implemented. For example, all game companies could place the burden of verifying IDs on Apple and rely on Apple to confirm that the Apple ID has been ID-verified. This means that ID verification would no longer need to be conducted on an individual company-by-company basis, which would save costs for companies and also make the player experience smoother (they can simply login with a verified Apple ID to all games that implement the unified system).

4.3.1. Flaws of the current verification system based on legal name and ID number

Insights about the implementation of age assurance more broadly that other countries may also benefit from also be drawn from the Chinese experience. ID verification was generally conducted by asking the user to provide their Chinese legal name and Chinese national ID card number. This pair of information was then presumably verified using a database that checks whether the pair matches the information in that system. It is not known whether this system is centralised or whether every video game company has been entrusted with a copy of the database. The coder encountered one game company that presumably blacklisted his information pair and rejected it from being verified (even though every other game accepted the pair), which suggests that some companies might be running the information pair through another filter, besides checking whether it matches the information in the database. This method of ID verification is treated as state-of-the-art by Mainland Chinese video game companies. However, it presents at least five flaws.

Firstly, the process does not actually verify the identity of the user. The process only verifies that the pair of information (name and ID number) exists in the database and is correct. However, there is no verification that the pair of information provided actually belongs to the player attempting to use it (which would require, *e.g.*, concurrent biometric verification).

Secondly, the process is easily circumventable. Because no ID verification was actually conducted, a player may easily use another person's ID information pair to gain access to the game either with permission (*e.g.*, by using their parent's information or buying someone else's information pair online) or without permission (*e.g.*, by pretending to be someone else through stealing an information pair, such as one that was leaked online).

Thirdly, the system does not work well when accounts are transferred between users. Because the ID verification is only ever done once when a user account is created when the game is played for the first time and never again, this means that the account will have been marked as verified and would continue to do so even if it has since been (temporarily) transferred to someone else (as the game company would not know that it has been transferred). This means that ID verified accounts could also be sold instead of the information pair to help underage users circumvent

relevant regulations. (Sellers might prefer to do this because their information pair, which is sensitive personal information, would not need to be shared with the buyer and potentially be used for other purposes.) Either exclusive access to the account or temporary access for a certain period of time could be sold. There could also be 'innocent' transfers between players: any phone numbers that are forfeited will be recirculated and given to another new phone user, who upon entering the game would gain access to an already ID-verified account if that phone number was previously registered with the game by the previous user. The mobile phone company would need to inform video game companies if and when a phone number's possession has been transferred to another user to ensure that the new user does not gain unpermitted access: this probably is not being done given the amount of work it would take to communicate between all relevant companies.

Fourthly, the system is difficult for non-residents to use. The database presumably only contains information on long-term Mainland Chinese residents. Many games (*e.g.*, Game 019 (*问道*)) only allowed a Chinese name and national ID number to be used, meaning that adults without those cannot verify their identity and play the game at all (*e.g.*, non-residents visiting China briefly). Other games (*e.g.*, Game 020 (*三国志·战略版*)) did provide an option for the ID verification process to be completed using other documents, such as passports. However, this would presumably require manual verification and would incur additional costs on the part of the company and take time to process. The player would likely need to wait a few hours, if not a couple of working days, before being granted access after their 'unusual' ID document has been verified.

Fifthly, there is potential for personal data to be compromised. The video game company has obtained a copy of the information pair and then used that information to verify the user in a database. Some companies explicitly state that they use this information only for the ID verification process, but they have obtained a copy of the data and must retain it so long as the user account remains undeleted, and so there is a risk for the data to be leaked. In contrast, companies could instead ask players to provide that pair only to a third-party (and receive a binary verified or not variable back from that third party) and so would never process nor retain this personal information.

4.3.2. Problems arising from the verification status being used across multiple games

The coder also encountered some games by companies with whom he has already verified his identity in another game of theirs. This resulted in the game company deciding that his account (usually meaning his WeChat account or mobile phone number used to login to the game) has already been verified and thus did not require re-verification. This leads to at least three further problems.

Firstly, it was unclear whether consent was asked and given for the ID verification-related personal information to be retained and reused in this manner (because even after verification was completed, the data pair still needs to be held permanently on record by the game company so long as the account continues to exist). This consent might have been obtained through the player's agreement to a provision in the extremely long terms and conditions that all players were required to agree to (even though most people, if not everyone, would not have read them at all), but it was certainly not prominently disclosed as it should have been.

Secondly, it was unclear whether verification has been completed. Sometimes, a quick pop-up would appear and quickly disappear stating that the ID verification information from another game has been found for this account so that it is not needed again. But other games just allowed the coder into the game without providing any relevant notifications about the reliance on prior ID verification, which made the coder suspect whether or not the game did conduct ID verification (until the coder was able to find his personal ID information displayed in the settings menu, for example, although this could not be done in all cases).

Thirdly, a system based on recognising phone numbers would malfunction when the numbers are transferred to other users. The ID verification status of an account is bound to the phone number. Logging in with a phone number is done not with a password but with an SMS (Short Message Service) verification code that would be received by the current user of the phone number. This means that if a phone number transfers from one person to another, the second person could possibly misuse the ID verification status of the first person. The second person may not be asked to verify again because the game company would not know about the phone number having been transferred. (There is another risk of personal data leakage here in that some games do display the ID verification information collected back to the

player if requested, meaning that the second person could potentially view and obtain the first person's sensitive personal information.)

4.3.3. Lessons learned from the Mainland Chinese implementation of age verification

Some of the concerns identified above can be resolved by changing how the ID verification process is conducted. Three lessons could be learned.

Firstly, it is a data privacy concern that game companies are getting a copy of the ID information pairs. To fix this, companies could be asked to use a trusted third-party service instead for the verification process. Rather than directly asking players for a copy of their information pair, the game company could redirect the player to a more secure, industry-standard third party (like *Roblox* has done in the UK). The player only gives their information pair to the third party and not the video game company. The third party verifies the information and sends to the game company only a binary yes/no as to whether the information pair has been correctly verified. Such a system would avoid needing each individual game company to hold copies of players' information pair. As described above, Apple and other app store platforms (such as Google) could perhaps perform the role of this third-party authenticator.

Secondly, a major problem with the current Chinese system is that there is no guarantee that the user who provides the information pair is the person to whom the information pair belongs. In addition, it cannot be known whether whoever continues to play with the account is that initially ID-verified person. These two issues likely could only be solved by combining the ID verification process with concurrent biometric verification that is conducted *regularly* during gameplay. Conducting concurrent biometric verification only once upon initial registration would be insufficient because the active user could still change to another person after the first user passes that verification process.

Tencent has, for example, implemented biometric verification in its games offered to Mainland Chinese players since at least 2018 (腾讯游戏 [Tencent Games], 2018). This was described as combining 'video verification' with 'comparisons with [data held in] the authoritative public security data platform' (腾讯游戏 [Tencent Games], 2018). This suggests that certain biometric data are being collected and then sent to a

centralised system to see whether there is a match between the person attempting to pass facial recognition and the data already held by the company on the person whose ID it is. This is unlike other biometric verification systems that do not attempt to match the newly collected data with a database but instead make certain estimations about a person based on the collected data only (likely because there is no public access to such an authoritative database in most other countries).

Tencent (2021) then reported: as of June 2021, on average, per day, 5,800,000 accounts triggered the facial recognition system during the login process, and 28,000 accounts triggered it during the payment process. (Presumably, all of these accounts have already been successfully ID-verified as supposedly belonging to an adult, so that further verification was required to check whether the restrictions should continue to be disapplied; the restrictions would have automatically applied to underage users' accounts, which do not need to be verified again.) As to impact, 91.4% of accounts either refused or failed the verification during the login process thus leading to the anti-addiction measures being applied, and 87% of accounts' payment attempts were stopped for the same reasons (Tencent, 2021). Implementing a combined ID and biometric verification system would be costly and possibly impractical in some countries. However, it is capable of identifying more non-compliant individuals and better protecting them from potential harms.

Thirdly, games should seek to have age verification conducted on a game-by-game basis, regardless of the login method (*e.g.*, Apple ID or WeChat account). The convenience provided by having an account be verified across multiple games from the same company is appreciated, but it also creates certain risks (described above) that should be avoided. The process is not cumbersome for most users even if it is required upon the initial startup of every game title.

The available evidence suggests that the only assured way of guaranteeing that the person playing the game is who they claim to be is to conduct both ID verification and biometric verification by comparing data obtained from the player with a centralised database of existing information about the person whose ID is being used. It would also be necessary for the biometric verification to be conducted regularly (*e.g.*, every 15 minutes) to ensure that whosoever successfully passed the initial verification process is indeed the person that has continued to play the game

using that account thereafter. Access to that centralised system containing the 'correct' ID and biometric information appears practically difficult for many countries to implement: such a system may not exist or cannot be made available to private companies. Regular biometric verifications are also extremely intrusive and would significantly negatively affect the gameplay experience. It is necessary for Chinese companies (namely, Tencent and possibly some of the other major companies, because the smaller companies are unlikely to have access to the required technology) to conduct such rigorous age and ID verification because Chinese law so requires.

In a country where the law does not require this to be done so robustly, stakeholders should consider deeming less intrusive age verification processes to be sufficiently robust: *e.g.*, biometric age estimation upon initial registration (a video of the user's face is examined by an algorithm to estimate the person's age without needing to verify their exact identity). For players whose age are very close to the limit (*e.g.*, just around 18), and only for those players, perhaps an ID verification could then be sought. It would then be wise to use behavioural monitoring to potentially flag accounts that are acting contrary to their age verification information and subject them to further scrutiny. Such a nuanced approach would support other principles of data protection and privacy, such as data minimisation and fairness.

4.4. Loot box prevalence

The prevalence rate of loot boxes in Mainland China in early 2024 was 97.0%, which meant that nearly every game contained in-game purchases that involved randomisation. This is higher than the approximately 80% prevalence rates that were usually observed in Western countries recently (Xiao, 2023a, 2024c; Xiao, Henderson and Newall, 2023). Cultural factors might affect how loot boxes are implemented by companies and how players interact with them. For example, Sato *et al.* (2023) argued that there is 'higher [social] acceptance of, or at least less resistance to [loot boxes] in Japan' due to how they were already widely implemented in that country more than a decade before they were popularised in Western countries, so that the public debate, which led to some regulations, has already occurred and therefore since died down (p.11). With very few exceptions (cf. Woods, 2022; Gentles et al., 2022; Xiao, Fraser and Newall, 2023; Xiao et al., 2024), most studies on loot boxes have focused on Western players. However, because the issue affects all players

across the world (possibly in different ways), it is important that the perspectives of players from non-Western countries are better considered in the future.

4.5. Probability disclosure compliance

4.5.1. Probability disclosure presence

Of the 97 games with loot boxes, probability disclosures were found for at least one loot box in 96.9% of games. This 'disclosure rate for at least one loot box' is comparable to the mid-2020 disclosure rate of 95.6% reported by Xiao et al. (2021) that was calculated on a similar basis. Nearly all companies appear to understand that they are obliged to disclose probabilities. However, more in-depth examination of the games (which Xiao et al. (2021) did not conduct) revealed that only 10.3% of games disclosed probabilities for all loot boxes found and that 89.7% did not. Disclosing the probabilities for *all* loot boxes is required by law and approximately 90% of games were therefore non-compliant. Taking the number one highest-grossing game (Game 001 (*王者荣耀*)) as an example, the most prominent loot boxes in the game duly disclosed probabilities; however, there were more minor loot boxes (such as one that was hidden away in a more obscure part of the in-game shop and must be purchased as part of a bigger bundle) that did not disclose. A number of loot boxes (*e.g.*, in Game 084 (*凡人修仙传：人界篇*)) were obtainable as part of the paid 'battle pass' system (see Petrovskaya and Zendle, 2020; Joseph, 2021), meaning that the player technically obtained the loot box through gameplay by completing in-game tasks, but ultimately they only had the opportunity to do so because they spent money to purchase access to that 'premium' part of the battle pass. Many other games similarly disclosed for the seemingly more important loot boxes but did not disclose for, presumably, less popular ones. One might argue that a more minor loot box not disclosing would be less harmful than a more prominent loot box failing to disclose due to fewer players being potentially affected. However, the relative prominence or popularity of a loot box is irrelevant for compliance: *all* in-game purchases involving randomisation must disclose; the failure to disclose for even one loot box is non-compliance and punishable by law.

Besides less important loot boxes not disclosing, four other types of in-game purchases involving randomisation that often did not disclose should also be detailed. Firstly, many games allowed players to purchase using real-world money a form of 'energy' (which was effectively a premium virtual currency) that could be

expended to participate in gameplay that ultimately rewarded the player with random rewards. These mechanics are no different to traditional loot boxes except that the player must also engage in some additional gameplay before the random rewards could be obtained (*e.g.*, defeat some enemies before the random rewards are granted). However, usually, even in games that did disclose for traditional loot boxes that were directly opened with a premium virtual currency (*e.g.*, Game 017 (*原神*)), no disclosures were given for these loot box mechanics that also involve some additional gameplay to be activated. Secondly, social casino games generally did not disclose probabilities for the simulated traditional gambling mechanics, such as card games and mahjong (with a few exceptions, such as Game 053 (*乐乐捕鱼*), which did disclose), even though sometimes they did disclose for classic loot boxes also found within. Thirdly, a number of games (*e.g.*, Game 080 (*万国觉醒*)) offered players the ability to spend real-world money to 'refresh' what is available for sale in the in-game shop: after money is spent, the shop will be randomly restocked with new items, possibly replacing previous offers that the player chose not to take up. No disclosures were given as to the probabilities for different items to be restocked. Fourthly, there were certain classic loot boxes that contained very few rewards (*e.g.*, only four or six different possible outcomes as in Game 085 (*梦幻新诛仙*))), and it was highly likely that the different rewards had equal probabilities of being obtained. However, no disclosure, which would have been required by law, was given to confirm that fact in some games. Other games, such as Game 037 (*魂斗罗:归来*), did confirm the equal probabilities with a message, which made them compliant.

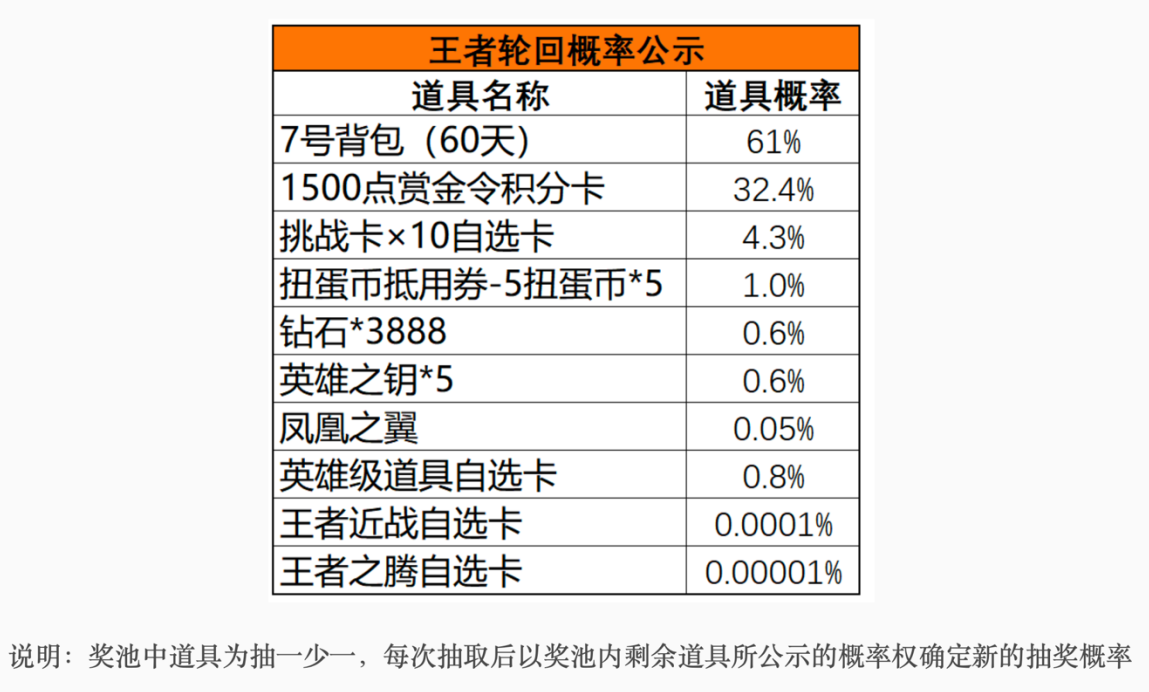
Companies may be under the misimpression that certain forms of monetisation mechanics involving randomisation do not require probability disclosures to be provided. However, presumably, the law applies consistently and uniformly to all such mechanics involving randomisation. Otherwise, traditional loot boxes could also be amended to, for example, require some gameplay elements to be completed before the rewards are given, and thus allowing them to escape regulations. In fact, the loot boxes that involve more complex opening procedures are arguably more potentially harmful because they obfuscate the purchasing and randomisation process more, even though random chance is inevitably involved. It is clear that purchasing a classic loot box means betting money on random results, whilst it is

less obvious that money has been risked on random outcomes with, for example, the energy-based system described above.

4.5.2. Probability disclosure location

As to whether the disclosures could be found in-game and/or on the game's official website, the in-game probability disclosure availability rate has increased from 57.1% in mid-2020 to 83.5% in early 2024, whilst the availability rate for website disclosures have *decreased* from 72.5% to 56.7% for the same time period. In mid-2020, 38.5% of games used to only disclose on the official website, whilst in early 2024, only 13.4% of games disclosed at that location only. A number of games also did not have a dedicated official website. Previous research comparing whether games disclosed probabilities on the game's official website has found that games popular in Mainland China used to do so far more frequently than UK games (75.9% as compared to 33.3%) (Xiao, Henderson and Newall, 2023, p.14). The present results suggest that Mainland Chinese games are more frequently disclosing in-game, but also less frequently disclosing on the game's official website. The former is a positive development, whilst the latter is a negative. Where video games make probability disclosures is also becoming more homogenous across national markets (and despite game companies' different countries of origin): an emphasis is placed on in-game disclosures, whilst website disclosures are given less attention. Making disclosures available at both locations is naturally better because in-game disclosures are more easily accessible for players, whilst website disclosures are more accessible for interested non-players (such as parents) and also allow players to more easily search through large amounts of data for useful information (*e.g.*, identify the probability for one specific desired prize by using the web browser's find command to search for certain text) (Xiao, Henderson and Newall, 2023, p.14). It should be noted some games (*e.g.*, Game 005 (*穿越火线:枪战王者*)) still culpably disclosed on websites using a screenshot of a table of data that was not text searchable, as shown in Figure 2, which is a screenshot of the image and accompanying explanatory text displayed on the relevant webpage (《穿越火线：枪战王者》官方运营团队 ["Crossfire: Gunfight King" Official Operation Team] and Tencent, 2023). This significantly reduced their useability and must be fixed: the information ought to be presented in searchable text so that players can more easily use it. Whilst it is encouraging to see more in-game disclosures, companies should not neglect also providing website disclosures. Importantly, the coding was based on whether at least one probability

disclosure could be found at a certain location, meaning that not every loot box necessarily disclosed at all locations coded. Companies should ensure that all loot boxes disclose at all locations.



王者轮回概率公示	
道具名称	道具概率
7号背包（60天）	61%
1500点赏金令积分卡	32.4%
挑战卡×10自选卡	4.3%
扭蛋币抵用券-5扭蛋币*5	1.0%
钻石*3888	0.6%
英雄之钥*5	0.6%
凤凰之翼	0.05%
英雄级道具自选卡	0.8%
王者近战自选卡	0.0001%
王者之腾自选卡	0.00001%

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Figure 2. Game 005 (*穿越火线:枪战王者*) disclosed probabilities using an image of a table containing the relevant data, rather than in a text-searchable format. Further, all the probabilities disclosed added up to 100.75011% and not 100%. An explanation at the bottom disclosed a pity mechanic by stating that once a reward has been obtained, it would be removed from the pool, and the probabilities for the remaining rewards will be redetermined. © 2023 Tencent

4.5.3. Probability disclosure method

As to the methods for accessing the disclosures, only 23.5% of the most prominent in-game disclosure and 9.1% of the most prominent website disclosure found for each game was reasonably prominent. This meant that the visual prominence and accessibility of disclosures has *not* improved from mid-2020 to early 2024, despite previous academic research calling for better disclosures that players can find and read more easily (Xiao et al., 2021; Xiao, Henderson and Newall, 2023). Improvements could actually be easily implemented: 71.6% of in-game disclosures were accessed by tapping a small generic button; it would be trivially simple to add the text 'probability disclosures' next to that button to better signify that it led to the relevant information. If all relevant games made this small change, then 95.1% of in-

game disclosures would be reasonably prominent. Similarly, with website disclosures, it would be very easy to implement one webpage that contains the disclosures for all loot boxes found within the game and provide a link to that page prominently on the homepage and every other page of the website. Companies are highly encouraged to immediately adopt these improvements that require little to no costs to be incurred. Importantly, the coding was based on the most prominent disclosure found at each location for each game. Companies should ensure that all loot boxes implemented disclose using the same prominent method at all locations.

4.5.4. Probability disclosure non-compliance

Because of the great number of individual loot boxes studied in total across all games (likely around a thousand, although this was not counted), certain implementation errors were also detected: these may have been either unintentional mistakes or more culpable intentional decisions to comply poorly in order to reduce the amount of information consumers are provided with. Certain noteworthy examples of non-compliance are described below. Companies should endeavour to avoid all of these situations in future implementations.

Firstly, there were problems with displaying the disclosure. For some loot boxes in Game 045 (*使命召唤手游*), the button that should have led to the probability disclosure in fact led to a pop-up window that merely stated the name of the relevant loot box or provided explanatory text without disclosing probabilities. That same button did lead to probability disclosures for similar loot boxes; therefore, these were likely human data entry errors made during the manual implementation process as the company is clearly aware of its disclosure obligations given its other acts of compliance. In Game 089 (*斗罗大陆:魂师对决*), the player were allowed to play (at least some parts of) the game and purchase loot boxes before all game files have been downloaded: this meant that when the button for accessing the probability disclosure was tapped before all the necessary files were downloaded, nothing happened. The button did work correctly after all the files were downloaded; however, there was a window of opportunity when players could potentially have purchased loot boxes without being able to access any probability disclosures. Game 063 (*天天爱消除*) had a loot box that made website disclosures, but the list of potential rewards on the disclosure did not completely match the potential rewards shown in game (*e.g.*, '40 diamonds' were marked as a 'rare'

reward and shown as obtainable in-game on the loot box purchase page; however, the website disclosure did not list '40 diamonds' as one of the potential rewards, and the percentage values for all the potential rewards that were shown added up to 100%). It is likely that the loot box's content had been updated in-game since the website disclosure was first published (in March 2020), but the website disclosure was not updated simultaneously, meaning that outdated and inaccurate information was being provided.

Secondly, there were obvious mistakes with certain probability disclosures. Game 058 (*鱼乐达人*) disclosed that the probability for one potential result was '1/(5000-10000)' (*i.e.*, −0.02%). A *negative* percentage value certainly would not have been correct and required further explanation. In Game 005 (*穿越火线:枪战王者*), all the probabilities disclosed for one loot box did not add up to 100% and instead added up to 100.75011%, as shown Figure 2. Perhaps certain values shown were rounded up, but that cannot explain all the inaccuracies, and the disclosure as shown was undoubtedly incorrect and non-compliant. Other games only made partial probability disclosures: for example, Game 084 (*凡人修仙传：人界篇*) only disclosed the probability for obtaining the presumably rarest and most desirable items and not for other potential results. Game 034 天龙八部手游 disclosed that there was a 'relatively low probability' of getting a different reward that is better than the usual reward without specifying what 'relatively low' means. Other games disclosed a range of potential values for the probability, rather than an exact value. For example, Game 099 (*海王捕鱼*) stated that the occurrence of one in-game event was within the range of '1/200-10000,' which presumably meant between 1/200 and 1/10,000 (or 0.5%–0.01%). This meant that the event could potentially be 50 times rarer or more common depending on whether the minimum or maximum value disclosed is more accurate and actually applied in practice. Game 027 (*FC 足球世界*) disclosed that the probabilities for certain events occurring were 'low,' 'good,' 'very good,' or 'top level' and then disclosed that, for example, 'low' was defined as between '1%–25%' and 'good' was '25%–50%.' Players could not actually know what their probabilities of obtaining certain results are from these purported 'disclosures' as the value is not precise and could potentially be very different even within the disclosed range. The current study could not assess whether the disclosures were accurate or not, but obvious errors and inaccuracies as mentioned above could be detected.

4.5.5. Unsatisfactory probability disclosures

The aforementioned cases were non-compliant and illegal. However, there were also other examples that were presumably permissible because they were technically compliant with the regulations but should nevertheless be denounced as unsatisfactory or even malicious compliance. For example, the website disclosures for Game 005 (*穿越火线:枪战王者*) were published on at least 84 separate web pages that had to be individually visited. These were also frequently (but not always) published as non-searchable images as shown in Figure 2, so the text is not easily useable through search engine queries or the internet browser's find command. Game 010 (*捕鱼大作战*) disclosed that the probability was '1/the number of items in the prize pool,' which required players to manually count how many items in total are available in the prize pool (so the player had to count up all 31 individual items and calculate the probability themselves), which placed extra burdens on players and forced them to potentially make multiple mistakes (*i.e.*, with the counting and/or the calculation, neither of which was trivial for an average consumer). The probability of 1/31 or approximately 3.2% should have just been plainly provided. Even worse, Game 056 (*三国杀*) disclosed probabilities by presenting a complex mathematical formula on its website that players must use to calculate the relevant values themselves as shown in Figure 3 (Yoka Games, 2023). Using this formula required extensive math knowledge (far beyond the abilities of the average 9- or 12-year-old that the two age rating systems have deemed the game to be suitable for and most certainly also beyond those of the average adult player). The player must also manually obtain certain numbers to be filled into the formula even if they managed to figure out how to calculate the probabilities: certain numbers could only be found and extracted from within the game, whilst other numbers had to be copied from a separate data table (that was not text-searchable).

武将分级	需求武将个数
1	0
2	36
3	39
4	43
5	46
6	50
7	60
8	65
9	69
10	74
11	88
12	91
13	97
16	100
17	100
18	101
19	101
20	102

令 x=你拥有武将个数达到需求武将个数的最大分级
y=对武将的分级
A=你的可招募武将集合
对任意在可招募总范围内的武将 a，如果 a 的 y<=x，则a ∈ A
W 为武将招募权重

单次招募武将 a 的概率$P_a = \frac{W_a}{\sum_{i \epsilon A} W_i}$

Figure 3. Game 056 (三国杀) disclosed probabilities only through the provision of the complicated mathematical formula required to calculate them. ©2019–2023 Yoka Games

Game 075 (*红警OL*) updated its website at some point, which results in older website disclosures being no longer accessible from the new website's homepage and only accessible if the player already knew the URL (Uniform Resource Locator) address for the webpage, *e.g.*, through search engine queries. The customer support

website of Game 079 (*乐鸿捕鱼*) stated that probability disclosures could be found in-game, but did not provide the method required for accessing them or, ideally, the relevant disclosures on the webpage also. The coder in fact failed to find the disclosures in game. Game 88 (*崩坏3*) was found to have disclosed probabilities in-game using a particularly poor method in 2020 (Xiao et al., 2021, fig.S7). The UI design for the loot box purchase screen for the exact same in-game purchase mechanic has since changed (perhaps even multiple times) in the intervening four years; however, the disclosure remained difficult to access (and was arguably even more difficult than before to access) because the player was still required to tap on an area of the loot box purchase screen that was not obviously interactable.

Finally, Game 078 (*小冰冰传奇*) and Game 081 (*跑跑卡丁车*) pretended that the player was buying something else (that is worth very little if anything at all) and only being 'gifted' the loot box or the currency used to open the loot box (which is what the player actually wanted to purchase and was in fact purchasing). This behaviour was also previously observed and was suspected to have been attempts to comply with a prohibition on selling loot boxes that some companies interpreted earlier regulations (specifically, Article 6 of the 2016 Notice that have since been disapplied (文化部 [Ministry of Culture] (PRC), 2016)) as having imposed (Xiao, 2022a, pp.359–363). Companies might attempt to rely on this sham to argue that loot box-related regulations do not apply to them. No one should be misled into thinking that they are supposedly purchasing something else and only being given loot boxes for free. Regulators should make clear that any loot box regulations would obviously apply to these implementations and that such purported 'gifting' of 'free' loot boxes in exchange for purchasing other in-game items that are evidently worth very little is misleading by itself.

4.5.6. Unsatisfactory probability disclosures

The previous sections have criticised both literal non-compliance and technically permissible but poor compliance. The overall results do not suggest that probability disclosure compliance has broadly improved over the past four years (besides the increased provision of in-game disclosures). However, it is also important to recognise good behaviours and improvements that have been observed.

Broadly speaking, there are two different degrees of detail that probability disclosures could be presented in. Firstly, a more succinct category-based disclosure only informs the player of a few percentage values for different categories of rewards that could be obtained (for example, a super rare reward has 1%; a rare reward has 19%; and a common reward has 80%). Secondly, a more difficult to read, but also more detailed, individual item-based disclosure that provides the probabilities for each individual item under each category (for example, a list of every individual super rare reward and corresponding probability, such as 'pink gun = 0.1%,' 'blue shield = 0.1%,' 'green sword = 0.1%,' etc.). Previous research has suggested that players be presented with the easy-to-read category-based disclosure first to avoid overloading them with too much information (whose access from the loot box purchase page should be through a prominent button clearly marked 'probabilities') but also be given the opportunity to access individual item-based disclosure if desired so that specific information could be obtained (Xiao, 2022a, pp.368–370). Game 013 (*冲呀！饼干人：王国*) has implemented such a prominent and easily accessible disclosure: on the loot box purchase page, players can tap a button explicitly stating 'detailed probabilities,' which led to a pop-up window that showed a category-based disclosure at the top and also allowed the player to scroll through a highly detailed individual item-based disclosure. It cannot be known whether game companies have read and accepted the recommendations of prior academic research; nonetheless, it is encouraging to see at least some companies implementing disclosures prominently and accessibly to ensure that the average player will have unimpeded access to them.

One direct improvement within the same game was also observed. When Xiao et al. (2021) examined Game 014 (*QQ 飞车*) four years ago, there was a list of all probability disclosures posts; the most relevant post was the most recent one, but the list was presented in chronological order meaning that the player had to scroll all the way to the bottom of the list and the webpage before they can access the most relevant individual post (Xiao et al., 2021, fig.S5). However, when the present study assessed Game 014 again, it was discovered that the list had been changed to a reverse chronological list meaning that the most recent post was now instead prominently displayed at the top and the player no longer needed to scroll through the entire list to find the most relevant information. This example demonstrates that

companies are able to change their loot box and probability disclosure implementations if required to or pressured into doing so.

4.5.7. Towards better regulation and compliance

To achieve better regulations and compliance, the headline advice remains as it was first stated in Xiao et al. (2021) previously: any regulation should specify and require a certain industry standard form of probability disclosure implementation. This includes where the probabilities should be disclosed. Ideally, disclosures should be required at least both in-game and on the game's official website. Other potential locations that a player might visit, such as the game's social media accounts and forums (*e.g.*, Reddit subreddits) should also be required to provide a link to the relevant webpage with the disclosures. How disclosures should be made accessible should also be detailed in the regulations. Ideally, for in-game disclosures, these should either be automatically shown or displayed immediately after a button explicitly stating 'probabilities' is tapped. For website disclosures, a hyperlink should be provided on every page of the website in a prominent position, such as in a banner in the header of the website that cannot be closed. What information the disclosure should provide *at a minimum* should also be specified. Ideally, as argued above, category-based disclosures initially and also the corresponding probabilities for obtaining every individual item (*i.e.*, individual item-based disclosures) upon request (Xiao, 2024c).

Rulemakers (whether legislators, regulators, or platform owners) should also consider addressing specific issues with dedicated regulations. Disclosures that are presented merely as the mathematical formula that can be used to calculate the probabilities could be specifically prohibited (even though they might well already breach existing consumer law for failing to provide the relevant information in a reasonably useable format). Another problem that has been observed was that some games disclosed that certain events had an extremely small probability of occurring, such as '0.00001%' or 1 in 10 million in Game 005 (*穿越火线:枪战王者*), as shown in Figure 2. This specific mechanic in question implemented a pity mechanic meaning that after ten purchases, the player was guaranteed to obtain that extremely rare reward. The probability of the player obtaining that rare prize in the nine non-guaranteed attempts is minimal and negligible. It is therefore arguably misleading to even suggest that the player has a chance at all of experiencing that highly unlikely

outcome. As observed in South Korea, games could also implement these extremely small probabilities without (disclosing) the implementation of a pity mechanic guaranteeing that a specific, desired reward will eventually be obtained: for example, '0.0000000000053126%' or 1 in 18,823,175,000,000 (Nexon, 2024), which is many magnitudes worse than the odds of winning the jackpot prizes of most lotteries around the world, which sit at around 1 in 50–100 million (Purkess, 2024), rather than 1 in 18 *trillion*. The loot box in question offered 1,687 different potential rewards. Merely advertising that such an event could potentially occur (that the rare reward *could* be obtained) is arguably misleading because the actual chance is effectively non-existent. Specific regulations could be brought in requiring that the lowest probability that a reward could be obtained should be at least 5% and that loot boxes may contain only up to 20 items at most to reduce the design complexity of loot boxes and make them easier for consumers to understand, for example (Xiao and Newall, 2022).

Individual implementation issues that have been identified (*e.g.*, probabilities that failed to add up to 100%) should be fixed when they are reported. Procedures should also be in place to prevent the same issues that were previously identified (possibly in relation to other games) to arise again. To that end, an online resource dedicating to teaching companies about how to effectively implement probability disclosures may prove useful.

4.6. Prevalence of pity and other monetisation and engagement mechanics

Amongst games offering loot boxes, 89.7% implemented pity mechanics, which is a significant increase from the 65.9% rate found in mid-2020 (Xiao et al., 2021). Taken at face value, this suggests increased implementation; however, it must be acknowledged that, when the present study is compared to the previous study, significantly more time was expended examining loot boxes, which allowed for more individual loot box types to be assessed in each game, meaning that there were more opportunities to find more pity mechanics. Games are known to implement pity mechanics in relation to only some, but not all, of their loot boxes. The previous study might have simply not had a chance to examine the other loot boxes that already implemented pity mechanics but could only be found elsewhere in the game at that time. Regardless, a high prevalence rate of pity mechanics has been observed. Loot boxes with pity mechanics are arguably better than those without because

players can calculate the maximum amount of money required to guarantee obtaining the most desired rewards. This potentially allows for better financial planning and also, in theory, makes loot boxes less gambling-like (because the desirable result is always eventually assured). The psychological effects of this highly popular loot box sub-mechanic should be further studied. More complex implementations of pity mechanics were also found: for example, in Game 045 (*使命召唤手游*), the player was guaranteed to get the rarest and most desirable reward after a predetermined number of attempts; however, the price for opening the loot box gradually increased after each purchase. The price for the final loot box opening that would guarantee the rare reward being obtained would be 40 times the price of the first loot box opening where that reward had only a 0.3% chance of being obtained. Similarly, the second-to-last loot box would have costed 24 times more than the first loot box. This particular implementation is more questionable and arguably predatory because it takes advantage of the sunk cost fallacy, whereby a person feels obliged to continue spending money to justify prior losses (*e.g.*, when money was spent on loot boxes that did not unlock the rare reward) (Rogers, 1998, p.120).

Daily login (98.0%), first purchase (93.0%), and continuous purchase (89.0%) mechanics were implemented in the vast majority of games. This means that if the draft regulations proposing to prohibit them is adopted in Mainland China without any changes (国家新闻出版署 [National Press and Publication Administration (PRC)], 2023), nearly all companies would need to make significant adjustments to their games' engagement and monetisation mechanics in order to comply.

4.6.1. Different implementations of daily login mechanics

Different implementations of each mechanic were identified. With daily login mechanics, the most basic implementation gave players a reward for logging into the game each day. Some games (*e.g.*, Game 025 (*途游休闲捕鱼*)) implemented multiple daily login mechanics simultaneously, meaning that players were given multiple, separate rewards for entering the game. More complex implementations were found in, *e.g.*, Game 012 (*蛋仔派对*). Daily login rewards might be linked to a weekly or monthly calendar of rewards, meaning that if the player does not login on a specific date, then they miss out on the daily login rewards for that day, although an option

might be provided for players to pay for or otherwise obtain the missed rewards. Other games' daily login rewards cannot be missed and work cumulatively by counting how many days in total the player has logged in: the player always obtains the next daily login reward, irrespective of how many days passed since they last logged in. One mechanic in Game 012 rewarded players for logging into the game at specific times of the day: *e.g.*, once between noon and 2 PM and another time between 7–9 PM. Such a mechanic presumably attracts more players to play at those times, which could allow for quicker matchmaking for multiplayer games (which Game 012 was). At the same time, such a mechanic could also be used in reverse to divert players by encouraging them to play at less popular times to reduce burdens on game servers at peak hours. Finally, certain daily rewards appeared as daily 'missions' or 'quests' and required players to perform certain tasks before the rewards are granted, such as playing the game a certain amount or staying online for at least a certain period of time (rather than simply logging in and potentially spending no time on gameplay). Game 090 (*龙迹之城*), quite concerningly, rewarded players for being online at least 480 minutes (or eight hours) each day. These mechanics are undoubtedly capable of encouraging players to engage with the game frequently and intensively.

4.6.2. Different implementations of first purchase mechanics

The most usual first purchase mechanics gave players an extra reward for spending any money in the game (buying anything at all) for the very first time. Players who spent an amount of money in the game (however small) are presumably far more likely to be 'retained' by the game because the player may feel that they have already 'invested' into the game and so are more likely to keep playing it and not quit. Other games gave players a discount or extra rewards for buying certain specific items for the first time (which might not be the absolute first purchase that the player has made in that game): for example, Game 017 (*原神*) gave players double the usual amount when they buy each premium currency bundle for the first time, and they can buy each currency bundle once to receive their respective first purchase bonus. Finally, there were in-game purchase offers that were technically referred to by the game as 'first purchase' mechanics but were merely an in-game purchase offer requiring payment that might be extremely discounted and only available for purchase once by new players, as compared to a mechanic that is triggered after buying something else. It is unclear whether these mechanics should

count as first purchase mechanics when they themselves are products to be bought and not merely a bonus. However, due to their highly discounted nature, they likely act as a similar way in terms of enticing players into spending money on the game for the very first time or early on in their experience playing the game. Other games also implemented these highly discounted offers but did not refer to them as 'first purchase' mechanics, which were thus not recognised as such. The line between a classic first purchase mechanic and a particularly good offer that is extremely attractive to new players is difficult to draw as they may perform the same role psychologically.

4.6.3. Different implementations of continuous purchase mechanics

Finally, as to continuous purchase mechanics, the most basic implementation cumulatively counted how much money the player has spent or how many loot boxes they have opened and provided an extra reward once a certain target has been reached. This is similar to the VIP schemes of traditional casinos that offer bonuses (such as free food) to gamblers who spent significant sums of money. In fact, many games did refer to their continuous purchase mechanic as a VIP programme and allowed players to achieve different levels of VIP status depending on how much they have spent. Another implementation (observed in, *e.g.*, Game 035 (*冒险岛：枫之传说*)) made certain products available for purchase only after other products have already been purchased by the player. Sometimes, the player can see what offers will be made available for purchase before the previous purchase offer has been bought, but other times, the player do not know what offers will later become available. When purchasing the first offer, the player is arguably buying not just what is contained therein but also the chance to purchase future offers. When the contents of future offers are unknown or randomised, the continuous purchase mechanic arguably contains gambling-like elements. The items found in the first offer might potentially be completely undesirable to the player, but they are obliged to purchase it anyway in order to access the second offer. This appears to be a form of product 'tying' (because the availability of the second offer is conditional on purchasing the first offer) that is questionable and potentially illegal under competition law.

Thirdly, a discount might be given if the player purchases multiple products together. In Game 095 (*肥鹅健身房*), there were two monthly subscription programmes costing CN¥60 and CN¥18, respectively. However, both could be purchased together for only CN¥68, which represented a discount of CN¥10 when

compared to buying both separately. The ultimate intended effect of all of the above implementations, despite their differences, is to encourage players to spend more money on the game.

4.6.4. Increased scrutiny of various mechanics is justified

These various monetisation and engagement mechanics could also be combined with each other. A daily mission (which would be a daily login mechanic) could task the player to spend at least a certain amount of money or buy enough loot boxes (which would therefore also be a continuous purchase mechanic). The reward for a first purchase mechanic might be loot boxes, which means those loot boxes are paid loot boxes because their access was preconditioned on the spending of real-world money. A first purchase mechanic and a continuous purchase mechanic could also overlap if the first amount of money required to activate the continuous purchase mechanic is the minimum amount of money that could be spent (*e.g.*, CN¥6). A pity mechanic in general is also arguably a continuous purchase mechanic, as the player is being rewarded with better probabilities for getting desired items for spending increasingly more money.

It is unclear whether the draft regulations published at the end of 2023 intended to prohibit all these implementations (国家新闻出版署 [National Press and Publication Administration (PRC)], 2023). For the better understanding of daily login, first purchase, and continuous purchase mechanics and for regulatory purposes, it would be wise for taxonomies or ontologies of each of these mechanics to be separately developed so that potential differences between implementations can be easily identified. Useful works of this kind on loot boxes have already been conducted (Ballou, Gbadamosi and Zendle, 2020; Sato et al., 2023).

Future research should also assess the prevalence of other controversial mechanics and commercial practices that ought to be scrutinised, including seasonal (*e.g.*, Halloween) and limited-time offers that may give rise to the fear of missing out (FOMO) and put pressure on players and parents to make immediate purchases (Mills, Ash and Gordon, 2024, pp.11–12); the sale of basic quality-of-life features improving the gameplay experience that arguably should have been provided to all players for free (Petrovskaya and Zendle, 2021); in-game advertising that may undertake illegal personal data collection and processing; announcing to all players

that another user had a lucky loot box opening result using a text banner that cannot be closed (thus peer pressuring players into also buying loot boxes); in-game player organisations (*e.g.*, guilds) that may cause users to peer pressure each other into spending more money; etc.

4.7. Good mechanics that should be more widely promoted

The present study has generally focused on the negatives. However, a number of positive developments (beyond those already discussed) were also observed. Game 024 (*交错战线*) allowed players to 'reroll' or open the initial large batch of loot boxes given to all new players for free again for potentially different results at no cost. This allowed for more rarer rewards to be received as players can choose to give up on poorer loot box openings to try again for free. Players are known to reroll when they begin to play a video game involving loot boxes (or rather, specifically, gacha mechanics) in order to begin the game with an account that has better loot box rewards (*i.e.*, a head start). Usually, this would require the player to make multiple new accounts and waste significant amounts of time to progress through the same beginning sections of the game again and again in order to unlock the loot box opening feature and access the large batch of free loot boxes that are gifted to all new player accounts (Woods, 2022, p.1086). Game 024's implementation of a reroll mechanic reduces the amount of time a player might waste 'rerolling' manually through creating multiple accounts and perhaps allow players to feel that the beginning sections of the game are fairer for every player. Notably, games might be incentivised to encourage manual rerolling because multiple accounts are being created per user, and this may reflect well (albeit misleadingly) on reports about the game's performance to investors.

Game 021 (率土之滨) implemented a mechanic that made it more expensive to perform in-game actions when the time in the real-world is between midnight and 6 AM thus discouraging players from playing during that period. This implementation required a subjective assessment that playing video games between midnight and 6 AM is unhealthy and undesirable. This is likely true in relation to most players who should probably better spend that period sleeping. This is therefore a good intervention for many. However, it does not account for how some players may benefit from playing during that period specifically or can only play during that period due to unique circumstances or personal commitments. Allowing

players more flexibility as to when to place that period of time and perhaps also rewarding players for playing at more desirable hours (rather than to punish players for playing at less desirable hours) are potential improvements that should be considered.

Finally, Game 052 (第五人格) provided a tutorial on what each part of the loot box purchase screen did the first time the player accessed the loot box purchase page: this included a segment specifically pointing out where and how the player can access the probability disclosures. This was a very effective way of informing players and ensuring that they will know how to access the probability disclosures: the information was actually actively *given* to, rather than passively *found* by the player, which was the case with nearly all other games. The player is required to actively look for the information, rather than the company proactively providing it. A potential improvement might be to allow players to access that tutorial again after the first time they saw it, if they so desired, to get reminded about what each part of the UI for the loot box purchase screen did.

Good practices like these should be highlighted, and other games should consider adopting them as well and innovating with other measures that can reduce potential harms and better empower players.

4.8. Stores in breach of the external sops

Finally, attention is turned from issues of compliance with rules that intend to protect the public (*i.e.*, consumers) to a rule that intends (at least primarily) to commercially benefit Apple as the platform owner. Apple's App Review Guidelines, which video games must abide by in order to be made available for download on the Apple App Store, state at Section 3.1.1. that developers are only allowed to 'unlock features or functionality' within the game for the player in exchange for payment of real-world money (*e.g.*, sell in-game currency that players use to purchase loot boxes) through 'in-app purchase,' which is Apple's own proprietary payment processing system (Apple, 2024b). An additional clause, which has since been removed due to litigation in the US and presumably also concurrent regulatory enforcement actions in the EU (as explained below), used to state: 'Apps and their metadata may not include buttons, external links, or other calls to action that direct customers to purchasing mechanisms other than in-app purchase.' This was Apple's

so-called 'anti-steering' rule that prohibited developers from encouraging players to bypass Apple's payment system (which charges a commission of up to 30% (Campbell and Alexander, 2021)) and instead pay using an alternative system that would charge a smaller commission, which would benefit both the developer and the consumer by cutting out Apple as the middleman: the commission amount would be split (in whatever proportions) between the developer and the consumer to both of their benefit.

Apple's anti-steering rule was successfully challenged in the US court, which required it to be removed (*Epic Games, Inc. v. Apple Inc.*, 559 F. Supp. 3d 898 (N.D. Cal. 2021); *Epic Games Inc. v. Apple Inc.*, 67 F.4th 946 (9th Cir. 2023), cert. denied, 144 S. Ct. 682 (2024)). At the same time, the European Commission (2024) found the anti-steering practices to be illegal in the European Economic Area (EEA), but only in relation to music streaming apps specifically, and fined Apple €1.8 billion. Consequently, a Section 3.1.1(a). has since been added to the App Review Guidelines allowing 'steering' to be done (*i.e.*, permit developers to link consumers to alternative payment options, rather than force them to use Apple's own system that charges a high commission), but only in very limited circumstances (Apple, 2024b). One subclause provided for the US and another for music streaming apps in the EEA (without specifying those jurisdictions and only opaquely referring to 'specific regions'). The anti-steering rule was intended to have been disapplied only in those limited circumstances (Apple, 2024c, 2024d). The rule otherwise remains applicable to other jurisdictions, including Mainland China, until it is disapplied through civil suits or enforcement actions from competition law and anti-monopoly authorities elsewhere.

Therefore, it was surprising to find that Game 094 (*妄想山海*) 'steered' players to purchase in-game items on 拼多多 (Pinduoduo), a major e-commerce platform and thereby bypass Apple's payment system and its commission. The player could benefit from an 8% discount from the usual price shown inside the game (meaning that the 30% commission has not been divided equally between the developer and the consumer). Directly linking to an alternative payment method from within the game and encouraging players to use it by advertising the lower price available through it are both clearly prohibited by Apple's policy. This game is liable to be

removed, and its developer banned from marketing on the Apple App Store for breaching its rules.

This issue is concerning considering that this was one of the highest-grossing games in Mainland China, rather than an obscure title no one played. Apple would be expected to know how these popular games are operating and actively punish breaches of the App Store's rules. There are two possible explanations, neither of which is encouraging from a consumer perspective, for this inaction. Firstly, Apple most likely was not aware (and possibly remains unaware) of this occurring. This then indicates Apple is not actively monitoring and enforcing its own rules that commercially benefit itself against companies. This casts doubt on whether Apple would then enforce rules that do not obviously benefit itself and only seek to help consumers (*e.g.*, the platform rule that loot box must disclose probabilities applicable to countries that do not already require this as a matter of law). In the UK, it was found that 64% of top-grossing iPhone games with loot boxes did not disclose probabilities (Xiao, Henderson and Newall, 2023). If Apple is not even actively enforcing rules that it is strongly incentivised to enforce, then consumers and policymakers cannot reasonably expect nor rely on Apple to enforce rules that it is not incentivised and is, on the contrary, disincentivised to enforce (because assuming loot box probability disclosure effectively reduce spending, then Apple will receive less commission if games implement them).

Secondly, and this is a far less likely explanation, Apple may have an agreement with the company in question permitting this steering. Game 094 is published by Tencent, which has an incredibly dominant position in the Mainland Chinese video game market (and also in the world, through ownership of and shareholding in foreign companies). At least a third of the highest-grossing games forming the sample were directly operated by Tencent. A unique agreement between Tencent and Apple permitting steering could be contemplated. However, this would raise questions as to whether two dominant companies are conspiring to stifle competition from other companies. Further, there is no justifiable reason why Apple would agree to this only in relation to one game (as the same behaviour was not observed in other games). If an (highly unlikely) agreement exists between Apple and Tencent, it should have applied to other games operated by the same company. It would be unproductive to speculate further. Apple does not provide for a public

complaint channel to report this potential breach of its own rules (or non-disclosure of loot box probabilities for that matter), so it is not possible to ask Apple to comment.

Besides breaches of the anti-steering rule, what is important here in relation to loot boxes is that these are now purchasable from outside of the game. This would thus arguably disapply Apple's platform rule requiring probability disclosures, for example (Xiao, Henderson and Newall, 2023). In fact, no probability disclosure was provided on the Pinduoduo product page. Presumably, this would remain a breach of Mainland Chinese consumer law because of its broader application to other contracts in addition to video game ones. But in a hypothetical jurisdiction whose loot box regulations only apply to in-game matters, this manoeuvre could allow companies to escape scrutiny. Anti-steering rules are increasingly being challenged and will potentially be struck down elsewhere in the world, so the purchase of loot boxes outside of the game itself might become more prevalent. These and other opportunities to purchase outside of the game should also be subject to regulation, which might present further practical difficulties on enforcement due to the increased costs required (in addition to the game itself, many product listings on various e-commerce platforms must also be reviewed for compliance). Policymakers and regulators should ensure that their drafting and enforcement of loot box regulations are also inclusive of specific circumstances that may circumvent existing rules and be prepared to adapt those rules to changes.

4.9 Limitations

The present study's methodology was more robust than that of previous similar studies (Xiao et al., 2021; Xiao, 2023a; Xiao, Henderson and Newall, 2023) because one hour of gameplay was spent on all games, which allowed for multiple loot boxes per game to be examined (if they were available to be found). This allowed for insights, such as how even though the most prominent loot boxes have generally disclosed probabilities, more minor and hidden implementations often did not. However, one hour of gameplay still did not permit for a comprehensive review of the games. In fact, it was obvious to the coder that only a very limited percentage of the gameplay has been observed in relation to some games. This lack of time and information (which could have been gleaned by spending more time) meant that certain mechanics could only be acknowledged as potential loot boxes (and did not

affect the coding besides being detailed in the coder's notes), for example. In fact, the present study could never prove that a game is compliant because it is always potentially possible for an obscure loot box that is only available after 100 hours of gameplay and did not disclose probabilities to exist. The present study could never have found that loot box. Games that have been deemed as 'compliant' may still have been non-compliant. Similarly, although instances of non-compliance are evidenced with screenshots in the data repository, it remained possible that the probability disclosures for certain loot boxes were so obscurely implemented that they could not be found during the coding process, which resulted in those loot boxes (and potentially the game) being deemed as not having disclosed, rather than having disclosed very poorly.

In a similar vein, due to a lack of time and sufficient engagement with each game (which might require up to a couple dozen hours), it could not be known which loot boxes were more popular and were actually being purchased by players. Practically, compliance in relation to those loot boxes would be more important (because more players benefit) than compliance in relation to unpopular loot boxes that are implemented but not bought in practice. The present study demonstrated that more time spent on examining each game will allow for far more information to be gained. However, resource constraints (*e.g.*, on coder time) and the principle of diminishing returns mean that it may not be advisable to recommend further research to simply increase the length of time spent on assessing each game. A more efficient methodology for future studies might be to speak directly with veteran players through, *e.g.*, surveys and interviews, about their experience. This may more efficiently reveal important information about the game in mere minutes that would otherwise require a coder who has no knowledge of the game many hours to obtain personally.

The present study examined each game only at a specific point in time meaning that the compliance situation may have been different beforehand and could have since changed. The coding merely reflected the situation as it was then observed. Importantly, the coding period encompassed the Chinese New Year period. This is the longest and most important festival in the Chinese calendar. Many loot boxes observed were themed around Chinese New Year, and games often held special events. It is highly unlikely that the compliance situation during this period of time

was different than what it would have been during regular times of the year as there is no potential reason for that to occur. In fact, conducting this research during this special period of time brought important benefits. Firstly, during this extended non-working and non-studying holiday period of rest, players likely played more often and for longer periods of time. Secondly, under-18s were allowed more gameplay time than usual on these official holidays because the regulations imposing limits on gameplay time (the 2021 Notice) so provided (Xiao, 2021b, 2022c). Thirdly, children and young people receive gifts and cash from their relatives during this period meaning that they would have had stronger spending power and may have spent more on loot boxes and video games in general than usual. The data repository hosts screenshots of how video game companies represented Chinese New Year that may be useful for studying, *e.g.*, how limited-time events that may pressure both child and adults players and parents into spending money are presented (Mills, Ash and Gordon, 2024). Certain loot boxes with special rewards that are themed around Chinese New Year were only available for purchase around that period. Relatedly, loot boxes that were purchasable only during specific (but less special) time periods were also discovered: for example, Game 097 (*超进化物语2*) offered loot boxes that were only on sale on Fridays, Saturdays, and Sundays. This again illustrates that the data collection time could have affected the results observed because different loot boxes would have been assessed. This difficulty arises not only for academic research but also for policy enforcement: regulators may need to work on holidays in order to monitor non-compliance that occurs only transiently.

Further, the examples that have been described herein (*e.g.*, of poor disclosure implementation) were selected from the coder's notes. This selection process was intended to highlight the worst and best practices but was admittedly not objective. All notes can be read in the data depository. Finally, the present study merely assessed compliance and cannot comment as to the efficacies of the measures (except in relative terms, *e.g.*, one method of probability disclosure that is obviously more visually prominent when compared to another would be better). We do not know whether probability disclosures can reduce loot box harms. Admittedly, perfect compliance with a measure that is practically ineffective (*e.g.*, a loot box harm reduction measure that does not in fact reduce the risk of overspending) would be useless. At the same time, a practically effective measure that is not widely implemented due to non-compliance would also be unhelpful to consumers.

Therefore, assessing compliance irrespective of the practical effectiveness of the underlying measure is still important because the evidence could help to inform the future implementation of measures that are demonstrably practically beneficial. However, other studies are required to assess the effectiveness of a measure at achieving its regulatory goals (*e.g.*, whether probability disclosures reduce 'irrational' loot box spending and whether prohibiting daily login mechanics would reduce excessive and harmful engagement with video games) (see Zendle et al., 2023).

Despite these limitations, the present results remain informative as to what a reasonable consumer (who, *e.g.*, only expends a justifiable length of time to search for probability disclosures) would experience at the beginning of each game. Stakeholders, including players, parents, regulators, and policymakers, are expected to nevertheless find this evidence useful.

5. Conclusion

Loot boxes were highly prevalent (97.0%) in mobile games popular in Mainland China in early 2024. Nearly all games with loot boxes (96.9%) disclosed probabilities for at least one loot box found within the game, thus demonstrating that companies were generally aware of this obligation. However, companies did not take their responsibility seriously. Upon closer inspection, despite each game having been assessed for only one hour, 89.7% of games with loot boxes failed to disclose probabilities for all relevant products found within them, meaning that they contained at least one illegal loot box that did not disclose probabilities. The Chinese companies operating the vast majority of video games with loot boxes knew that they must disclose probabilities (as demonstrated by them doing so in relation to certain loot boxes found within the same game). However, they failed to ensure that this was properly done in all cases with every loot box and are therefore liable for criminal prosecution for failing to disclose loot box probabilities. This is arguably more culpable than failing to disclose probabilities due to a lack of the knowledge that this is required at all. Companies having either knowingly chosen to not comply with regulations (perhaps thinking that the more hidden loot boxes are less likely to be subject to scrutiny) or negligently omitted to provide this information (which casts doubt on the adequacy of their internal compliance processes). Chinese regulations and the limited enforcement actions taken (*e.g.*, in Shanghai (佛陀

[Fotuo], 2023; 诸 [Zhu], 2023)) have not resulted in widespread compliance. Companies should, of course, endeavour to comply better. Regulators should do more to ensure that the rules are applied in practice, *e.g.*, through imposing heavier fines and opening up accessible channels for players to report non-compliance.

Compared to previous results from mid-2020, many more games with loot boxes (83.5%, compared to 57.1% in 2020) are disclosing probabilities in-game, which is a positive development as these are more accessible than website disclosures for players. However, this came at the cost of fewer website disclosures being implemented (56.7% of relevant games, compared to 72.5% in 2020). Website disclosures are also important because they can be text-searchable using an internet browser, which allows for the information to be more easily parsed, and because non-players who are interested in the probabilities, such as parents, can also access them without being required to play the game. Companies should make probability disclosures at both locations and also better sign-post players from other locations, such as a pinned post on their social media accounts containing the link. Compared to the 2020 results, games did not make more visually prominent and accessible disclosures. However, it should be trivial for companies to improve their in-game and website disclosure methods: in-game disclosures should be accessible from the loot box purchase page through at most one button explicitly stating that it leads to the 'probabilities,' whilst website disclosures should be accessible through a link on a pinned header that is displayed on every page of the website.

Nearly all video games conducted ID (and, by implication, age) verification on user accounts prior to providing any online video game services as required by Chinese regulations. However, importantly, 5% of games culpably provided services *without* conducting mandatory ID verification. It is highly concerning that a number of the most popular games in the country were in clear breach of the law intended to protect young people from video game-related harms (*i.e.*, both the 2019 and 2021 Notices). Further, the current, supposedly state-of-the-art method of merely asking users to provide a pair of information (their legal name and national ID number) to conduct ID verification needs to be improved upon before the process can be deemed as effective age assurance. The information pairs of other people who are adults can be easily used by children to circumvent any protective measures intended to be implemented against under-18s. Additional, regularly conducted

biometric verification following ID verification has already been implemented in some games by, *e.g.*, Tencent, and other companies should consider following suit to ensure true compliance with both the letter and the spirit of the law.

Two age rating systems are in place in Mainland China simultaneously. Many Apple age ratings should be increased to align with the game's more culturally aware, national CADPA age rating. Certain games were misleadingly advertised as suitable for young children on the Apple App Store by displaying a very low Apple age rating (e.g., suitable for those aged 4+) but in fact received a much higher CADPA age rating (suitable only for those aged 16+). Both age rating systems should additionally adopt an 18+ age rating to signify that certain games are not suitable for minors at all and only suitable for adults. Certain games displayed an Apple 17+ and/or CADPA 16+ age rating only to forbid all under-18s from playing the game once it has been downloaded and following age and ID verification: this was misleading advertising caused arguably by the lack of an appropriate 18+ rating that companies could display under both systems.

Games widely implemented pity mechanics (89.7%); daily login mechanics (98.0%); first purchase mechanics (93.0%); and continuous login mechanics (89.0%). A variety of different implementations of each mechanic were identified. Any regulation seeking to target them (such as the draft regulations for the Mainland Chinese video game industry published in 2023 (国家新闻出版署 [National Press and Publication Administration (PRC)], 2023)) will significantly impact industry practice and ought to account for all implementation differences to ensure that the imposed rules achieve their intended goal by encompassing all relevant implementations that may cause harm.

Mainland China is leading the world in terms of video game regulation by imposing and enforcing various regulations. Although compliance may have appeared satisfactory at face value, most companies were found to have not been fully compliant upon closer scrutiny and potentially subject to criminal prosecution. Additionally, even those companies who were following the rules often complied using methods that were suboptimal and questionable. Many companies did the bare minimum required and did not endeavour to consider whether they can be more socially responsible and do even better for their consumers by going above and

beyond. Only better compliance and stronger enforcement can ensure adequate consumer protection in relation to loot boxes.

Conflict of Interest

L.Y.X. was employed by LiveMe, then a subsidiary of Cheetah Mobile (NYSE:CMCM), as an in-house counsel intern from July to August 2019 in Beijing, People's Republic of China. L.Y.X. was not involved with the monetisation of video games by Cheetah Mobile or its subsidiaries. L.Y.X. undertook a brief period of voluntary work experience at Wiggin LLP (Solicitors Regulation Authority (SRA) number: 420659) in London, England in August 2022. L.Y.X. has contributed and continues to contribute to research projects that were enabled by data access provided by the video game industry, specifically Unity Technologies (NYSE:U) (October 2022 – Present). L.Y.X. has been invited to provide advice to the UK Department for Digital, Culture, Media and Sport and its successor (the Department for Culture, Media and Sport; DCMS) on the technical working group for loot boxes and the Video Games Research Framework. L.Y.X. was the recipient of two Academic Forum for the Study of Gambling (AFSG) Postgraduate Research Support Grants that were derived from 'regulatory settlements applied for socially responsible purposes' received by the UK Gambling Commission and administered by Gambling Research Exchange Ontario (GREO) and its successor (Greo Evidence Insights; Greo) (March 2022 & January 2023). L.Y.X. has accepted funding to publish academic papers open access from GREO and the AFSG that was received by the UK Gambling Commission as above (October, November, & December 2022, November 2023, & May 2024). L.Y.X. has accepted conference travel and attendance grants from the Socio-Legal Studies Association (February 2022 & February 2023); the Current Advances in Gambling Research Conference Organising Committee with support from GREO (February 2022); the International Relations Office of The Jagiellonian University (Uniwersytet Jagielloński), the Polish National Agency for Academic Exchange (NAWA; Narodowa Agencja Wymiany Akademickiej), and the Republic of Poland (Rzeczpospolita Polska) with co-financing from the European Social Fund of the European Commission of the European Union under the Knowledge Education Development Operational Programme (May 2022); the Society for the Study of Addiction (November 2022 & March 2023); the organisers of the 13th Nordic SNSUS (Stiftelsen Nordiska Sällskapet för Upplysning om Spelberoende; the Nordic Society Foundation for Information about Problem Gambling) Conference, which received gambling industry sponsorship (January 2023); the MiSK Foundation (Prince Mohammed bin Salman bin Abdulaziz Foundation) (November 2023); and the UK Gambling Commission (March 2024). L.Y.X. has received honoraria from the

Center for Ludomani for contributing parent guides about mobile games for Tjekspillet.dk, which is funded by the Danish Ministry of Health's gambling addiction pool (Sundhedsministeriets Ludomanipulje) (March & December 2023), and from the YMCA (Young Men's Christian Association) of Greater Toronto Youth Gambling Awareness Program for a presentation, which is funded by the Government of Ontario, Canada. A full gifts and hospitality register-equivalent for L.Y.X. is available via: https://sites.google.com/view/leon-xiao/about/gifts-and-hospitality-register. The up-to-date version of L.Y.X.'s conflict-of-interest statement is available via: https://sites.google.com/view/leon-xiao/about/conflict-of-interest.

Positionality Statement

In terms of L.Y.X.'s personal engagement with loot boxes, he has played and continues to play video games containing loot boxes (*e.g.*, *Hearthstone* (Blizzard Entertainment, 2014) until 2018 and *Genshin Impact* (miHoYo, 2020) from 2020), but he has never purchased any loot boxes with real-world money.

Data Availability Statement

The raw data and a full library of PDF printouts and screenshots showing, *inter alia*, the relevant Apple App Store webpage sections and in-game loot box purchase pages for each game will be publicly available in the Open Science Framework at https://doi.org/10.17605/OSF.IO/TZ27G.

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