What are the odds?
Lower compliance with Western loot box probability disclosure industry self-regulation than Chinese legal regulation

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Abstract

Loot boxes are purchased to obtain randomised rewards in video games. These mechanics are frequently implemented, including in children's games, and are psychologically akin to gambling. Emulating gambling harm reduction measures, disclosing the probabilities of obtaining loot box rewards is a consumer protection measure that may reduce overspending. Presently, this has been adopted as law only in China, where a 95.6% disclosure rate was previously observed. In other countries, the industry has generally adopted this measure as self-regulation. This study assessed the compliance rate of self-regulation amongst the 100 highest-grossing UK iPhone games to be 64.0%, significantly lower than that of Chinese legal regulation. Additionally, only 6.7% of games containing first-party implemented loot boxes made reasonably prominent disclosures. Non-enforced Western self-regulation needs substantial improvements before it can be as effective as legal regulation: until then, uniform and prominent disclosures should be required by law to maximise their consumer protection benefits.

Keywords:

Consumer protection; Industry self-regulation; Interactive entertainment law; Loot boxes; Video gaming regulation

1. Introduction

Paid loot boxes are randomised monetisation methods in video games that are purchased by players to obtain randomised rewards of varying value. Some loot boxes may be obtained through gameplay without paying real-world money. However, the present study focuses on paid loot boxes which are, hereinafter, referred to simply as 'loot boxes.' Loot boxes are prevalent in video games internationally and across different hardware platforms: approximately 60% of the highest-grossing mobile games in 'Western' countries (specifically, Australia and the UK) contain loot boxes (1,2), as do approximately 90% in the People's Republic of China (PRC) (3).¹ Loot boxes represent an important revenue stream for the video game industry, which, in the UK, is now larger than the music and movie industries combined (4): indeed, the sale of loot boxes in one single game can generate more than US\$528,000 per day from just one country alone (5). Global loot box spending was estimated to have been US\$15 billion in 2020, and is estimated to rise and exceed US\$20 billion by 2025 (6).

The loot box purchasing process hides and *randomises* what rewards the player will actually receive (and, by implication, the rewards' value) until after both the purchase decision and payment have already been made. Most of the time, the player will receive a reward that does not have an official monetary value but is perceived to be worth less than the price of the loot box, but, rarely, the player will receive a valuable reward (7). Some games also allow players to buy and sell loot box rewards between each other for real-world money, thus allowing these rewards to gain monetary value (8). Certain rare rewards have a probability of as low as '0.0008%' (or 1 in 125,000) chance of being won from a loot box costing £2.50 (as implemented in Game S14 (*Art of Conquest*) and shown in Figure 1): the low entry cost and the astronomically low chance of winning, present in some loot boxes, are characteristics shared by traditional prize raffles and lotteries. Players often purchase multiple loot boxes in order to attempt to obtain the valuable rare rewards (9). This is why loot boxes have been considered conceptually and structurally akin to gambling (10–12).

¹ In this paper, the PRC refers to Mainland China and excludes the Special Administrative Regions of Hong Kong and Macau, and Taiwan, as the applicable laws in these areas are different.

Loot box purchasing has been found to be positively correlated with problem gambling severity in 16 published studies using Western samples: generally, the higher a player's problem gambling severity was, the more that player spent on loot boxes (e.g., 13). This finding has been replicated internationally (14–16), including in Denmark (17), Germany (18), Spain (19), New Zealand (20), Australia (21), and the USA (22,23). Loot boxes may present a gateway to gambling for vulnerable consumers, e.g., children (24,25): 58.9% of games deemed suitable for children aged 12+ contain loot boxes in the UK (2), as do 90.5% in the PRC (3). Indeed, 22.9% of 11–16-year olds in the UK have reported paying real-world money to buy loot boxes (26). Many countries across the world are considering whether to regulate loot boxes because of their potentially harmful link to problem gambling, and because of general consumer protection concerns (e.g., lack of transparency as to how the randomisation process determines loot box results), particularly in relation to vulnerable groups, such as children and people with problem gambling issues (27–34).

Figure 1. Game S14's (*Art of Conquest*) in-game loot box probability disclosure was accessed by tapping the (?) symbol on the loot box purchase screen (top; annotated with arrow) and shows a percentage probability of '0.00080%' of obtaining '5 Hour Building Rush' (bottom).

1.1. How Best to Regulate Loot Boxes?

Countries, such as Belgium and the Netherlands, have proactively 'banned' the sale of certain implementations of loot boxes by actively enforcing existing gambling law (35,36): for example, by fining Electronic Arts (EA) for contravening Dutch gambling law when the company implemented certain loot boxes in the *FIFA* game series (37). Such a restrictive approach provides immediate consumer protection; however, it also limits players' consumer freedom to purchase loot boxes, and harms video game companies' commercial interests, and therefore may not be the ideal regulatory solution for all jurisdictions (32,34). Not all players will be harmed by loot boxes and at least some players benefit from having the freedom to choose when, and how much, to pay video game companies; however, a 'ban' prevents *all* players

from purchasing loot boxes. In addition, most games monetised through loot boxes can be played for free, so this monetisation model opens up video gaming opportunities (and thereby providing entertainment and social interactions) to people who may not otherwise have been able to afford them (34). Companies also had to change how they implement loot boxes (including removing certain games from the Belgian market because it was no longer commercially viable to operate there (38)) following changes in the Dutch and Belgian regulatory environments (39,40), thus causing them to either lose revenue entirely or incur additional compliance costs. A ban therefore arguably fails to balance the interests of all stakeholders.

A less restrictive approach that attempts to balance consumer freedom with consumer protection is requiring video game companies to disclose the probabilities of obtaining randomised rewards from loot boxes, which is easy to implement and therefore incurs minimal compliance costs (3). Such a measure seeks to provide consumers with information to help them make more informed purchasing decisions, but does not limit the consumers' ability to purchase loot boxes. Researchers have recommended adopting this measure to provide transparency and reduce the potential financial harms of overspending on loot boxes (34,41,42).

1.2. Probability Disclosures as Legal Regulation or Industry Self-Regulation?

This probability disclosure measure has been adopted as law in the PRC, presently the only country to do so (3,43). In all other countries, ranging from the USA to Japan, the video game industry has generally adopted this measure as voluntary self-regulation (e.g., 44–48): for example, all video games published on Apple's App Store in all countries 'offering "loot boxes" or other mechanisms that provide randomized virtual items for purchase must disclose the odds of receiving each type of item to customers prior to purchase' (49). The industry has argued that it can self-regulate loot boxes without legal intervention, similarly to how the industry has moderated violent and sexual content in video games through self-regulatory age content ratings (44), e.g., the ESRB (Entertainment Software Rating Board) age rating system in North America (50). However, it is not known whether self-regulation acting alone, which does not have the same enforcement powers as the law (e.g., being able to impose financial penalties and injunctions against non-compliant companies), would be as effective at ensuring a high compliance rate.

If probability disclosures can be found for PRC versions of the game but *not* for another version of the game published in a different country (*e.g.*, the UK where only the industry self-regulation applies), then legal intervention appears necessary in this context to *force* companies to enhance consumer protection. The PRC regulatory approach should then be recommended for adoption in other countries as law, rather than merely as industry self-regulation, in order to improve consumer protection. Conversely, if the same or similar probability disclosures made in the PRC version of the game can already be found in a version made available in a non-PRC country (*e.g.*, the UK), then this would either mean (a) that the PRC regulations have had a ‘spillover’ effect (specifically, that companies have simply chosen to make and publish one PRC law-compliant version of the game, and thereby incidentally disclosed probabilities in all countries, rather than making multiple versions of the same game for different countries which would incur additional costs), or (b) that industry self-regulation acting alone has been effective at ensuring compliance, which means that further legal regulation would be unnecessary and should be avoided to save costs and prevent overregulation.

In the PRC, amongst the 100 highest-grossing iPhone games, probability disclosures were found for 95.6% of 91 games containing loot boxes (3). However, because the PRC law requiring probability disclosures and Apple’s self-regulation were in force simultaneously, it could not be determined whether the PRC legal requirement was necessary *in addition* to Apple’s self-regulation to ensure the identified high level of compliance. A replication in another country (where the relevant legal requirement does not apply, such as the UK) would shed light on the effectiveness of self-regulation acting alone.

1.3. Varying Prominence and Accessibility of Disclosures

A previous study of the loot box features of PRC games identified a variety of different methods of probability disclosures of varying prominence and accessibility, because the relevant PRC law did not require specific methods of disclosure (3). This is reflected in two aspects: firstly, the location(s) where the disclosure is published, and secondly, the method of disclosure at any given location. There are three possibilities as to location: (i) disclosure made in-game only; (ii) disclosure made on the official website only; and (iii) disclosure made at both locations. Only 34.1% of games were identified as having disclosed at both locations even though doing so

would have provided a higher degree of consumer protection than disclosing only at one of either location. As to the second aspect, six subcategories of in-game disclosures and five subcategories of official website disclosures of varying levels of prominence and accessibility were identified (3). For example, the most prominent and accessible disclosure format was automatically displaying the probabilities on the in-game page where loot boxes may be purchased; however, only 5.5% of games containing loot boxes disclosed probabilities in this manner. On the other end of the spectrum, probability disclosures that were difficult to access and arguably actively hidden away by video game companies include those that, for example, required the player to interact with an in-game customer service bot in a different language or were completely inaccessible from the game's official website's homepage through web browsing. Probability disclosure self-regulation in Western countries is similarly worded in general terms and do not require specific, uniform and prominent methods of disclosure (51), *e.g.*, Apple's self-regulatory requirement quoted above (which should be contrasted with more detailed industry self-regulation in Japan and South Korea discussed further below (47,48)). Patricia E. Vance, the president of the ESRB, has suggested that loot box probability disclosures are, and should be, implemented differently in various games, rather than uniformly:

'[Video game companies] have ... made a commitment to make disclosures easy to access and be understandable. ...[L]oot boxes vary game-to-game, loot box-to-loot box. There is no one silver bullet for disclosures. There's no one standard. I think we have to leave it to individual game developers to develop the right type of disclosures for their game and their customers' (52).

Lack of uniformity and consistency, and giving companies discretion as to how to comply, are contrary to improving transparency and consumer protection because players would not know what they need to do to access the disclosure (*e.g.*, which button to tap) and instead must endeavour to find it afresh for each new game that they play. Presently, there is no industry standard requiring a specific format of loot box probability disclosure in the PRC (3) and Western video game industry bodies, such as the ESRB, actively support and encourage non-uniformity, as quoted above. This should be contrasted with mandated disclosures in other more established

industries, for example, legally-required standardised food nutrition labels in the USA require specific information to be emphasised and leave almost no discretion to food producers as to how they should comply (53). Indeed, disclosure of information to customers by more established industries selling products that are known to be addictive (*e.g.*, alcohol and tobacco) in Western countries have been identified as suboptimal and failing to provide the highest standard of consumer protection (54–59). Such corporate actions which seek to inhibit consumers from making more informed choices and potentially encourage them to make worse choices, rather than to ‘nudge’ them towards making better choices (60,61), have been termed ‘sludge’ in behavioural science (62–65). Most loot box probability disclosures observed in the PRC were arguably sludge rather than nudge because they were not uniform, not prominent, and not easily accessible, such that consumers could not derive maximum potential benefits from them (3). Only 21.2% of in-game disclosures and 10.6% of website disclosures in the PRC could be considered ‘reasonably prominent’ because they were either automatically shown or the player was able to access them by searching for the Chinese word for ‘probabilities’ (‘概率’) on the loot box purchase page or the official website’s homepage. Indeed, only 18.7% of PRC games containing loot boxes made reasonably prominent disclosures at either location and only one game (1.1%) did at both locations (3). Whether games would make reasonably prominent loot box probability disclosures in other jurisdictions governed by industry self-regulation has not been investigated.

1.4. Pity-Timer Submechanics

Additionally, 65.9% of PRC games containing loot boxes also disclosed the implementation of submechanics known as ‘pity-timers’ (3). Pity-timers *change* the probabilities of obtaining randomised rewards as the player purchases more loot boxes: generally, the probabilities for obtaining the rarer and more valuable rewards are increased until the player eventually obtains such a reward, at which time the probabilities are reset, although one implementation of a ‘detrimental’ pity-timer that decreased the probabilities of obtaining rarer rewards has also been identified (3). Pity-timers are known to be implemented by video game companies in Western countries: however, some implementations have not been transparently disclosed to players and how they work had to be figured out by players through trial and error, *e.g.*, in *Hearthstone* (66,67). Because pity-timers change the probabilities of obtaining randomised rewards, a comprehensive probability disclosure should disclose their

implementation, as was done by many video game companies in the PRC, where 65.9% of games containing loot boxes disclosed pity-timer implementations (3). In fact, a failure to disclose a pity timer renders a probability disclosure inaccurate (whenever the pity-timer is operative) and therefore technically non-compliant with disclosure obligations (both legal and self-regulatory). The prevalence of pity-timer implementation in Western video game markets is not known. An assessment is required because such submechanics complicate the loot box purchasing environment and render probabilities of obtaining specific items particularly difficult for the player to calculate correctly (51,68). If such submechanics are prevalently implemented, then policymakers and regulators should pay specific attention to them and potentially make dedicated regulatory provisions prohibiting or limiting their implementation.

1.5. A Reportedly Increasing Industry-Wide Aversion to Loot Boxes?

Finally, the only previous survey of UK loot box prevalence (which did not assess probability disclosure compliance) used a highest-grossing iPhone game list captured on 28 February 2019 (2). It has been suggested that, since then, video game companies have begun to stop implementing loot boxes and instead adopt other (non-randomised) monetisation methods, such as battle passes (6,69), either to avoid bad press or to act more ethically towards their customers (34), as demonstrated by commercial decisions taken by companies such as Epic Games to stop implementing loot boxes in games within its portfolio (70–72). A further survey in the UK would shed light on whether loot box prevalence has indeed decreased two years after the previous UK survey.

1.6. Research Questions

Therefore, a survey replicating Xiao *et al.* (2021) was conducted in the UK to assess: (i) the effectiveness of self-regulation alone in the absence of legal intervention; (ii) the methods of compliance (*i.e.*, prominence and accessibility of probability disclosures) in Western countries; and (iii) any industry changes in the prevalence of loot box implementation.

The following hypotheses were preregistered at <<https://osf.io/fjnmj/>>.

Hypothesis 1: The percentage of the 100 highest-grossing iPhone games containing loot boxes in the UK that discloses loot box probabilities will be significantly lower than the 95.6% found in the highest-grossing iPhone games in the PRC by Xiao *et al.* (2021).

Hypothesis 2: The percentage of the 100 highest-grossing iPhone games containing loot boxes in the UK that will be found by the present study will be significantly lower than the 59.0% found in the highest-grossing iPhone games in the UK in February 2019 by Zendle *et al.* (2020).

Further, the present study was preregistered to describe:

1. the percentages of the 100 highest-grossing UK iPhone games containing loot boxes disclosing probabilities at the following three locations: (i) in-game only; (ii) on the official website only; and (iii) at both locations;
2. the percentages of the 100 highest-grossing UK iPhone games containing loot boxes using various methods of disclosure subcategories developed by Xiao *et al.* (2021), and using various then yet unidentified methods of disclosure subcategories that were subsequently defined by the present study;
3. the percentage of games containing loot boxes, which were both included in Xiao *et al.* (2021)'s sample and available on the UK Apple App Store with an English version when data is being collected by the present study, that disclosed loot box probabilities.

Finally, the percentage of the 100 highest-grossing UK iPhone games containing loot boxes that disclosed the implementation of pity-timer submechanics is described and their prevalence rates in the UK and the PRC are compared through exploratory analysis.

2. Method

Replicating Xiao *et al.* (2021) and as preregistered, the 100 highest-grossing iPhone games on the UK Apple App Store on 21 June 2021 as reported by App Annie, an authoritative independent analytics company, were selected to form the sample. In addition, as preregistered, 31 games that were both included in Xiao *et al.* (2021)'s

sample and available on the UK Apple App Store with an English version (but were not within the UK 100 highest-grossing list on 21 June 2021) when data was being collected by the present study were added to the sample. The aforementioned 31 games, in addition to eight games that were within both the 100 highest-grossing PRC list in Xiao *et al.* (2021) and the UK list used by this present study, constitutes the 'Overlap Sample' of 39 games. Thus, a total of 131 games were coded.

The raw data, a full library of screenshots showing, *inter alia*, loot box purchase pages and the process for accessing in-game disclosures, and printouts and archived links to website disclosures are available via <<https://osf.io/cx5rv/>>.

The following variables were measured:

Apple age rating

This variable was coded using the relevant age rating information displayed on the game's UK Apple App Store page.

Presence of paid loot boxes

A 'paid loot box' was defined as being either an Embedded-Isolated random reward mechanism or an Embedded-Embedded random reward mechanism, as defined by Nielsen & Grabarczyk (2019) (11). This variable was coded based firstly on 40 minutes of gameplay. If no such mechanic was found within that time, this variable was coded based on up to 2 hours of internet browsing of video streams and screenshots. In total, 125 games (95.4%) were coded through gameplay and 6 games (4.6%) were coded through internet browsing. In contrast to Zendle *et al.* (2020), but replicating Xiao *et al.* (2021), games were assessed based on gameplay first, which was only then followed by internet browsing if required, because this more accurately reflected a player's experience of encountering loot boxes when they start to play a new game (3). Additionally, this also allowed for free exploration of the game's various menus and therefore more accurate assessment of the other variables relating to probability disclosures as virtually no videos of players interacting with probability disclosures are available: videos generally only show (relatively experienced) players purchasing and opening loot boxes, without consulting the relevant probability disclosure.

Presence of probability disclosure

Games were coded as having disclosed probabilities if the likelihood of obtaining potential rewards from loot boxes was found either in-game or on the official website. Considerable efforts were expended when attempting to find disclosures but the risk of false negatives could not be entirely removed: however, any disclosures that were not found by the present study were also unlikely to have been observed by and helpful to the average, or indeed even the determined, consumer.

Location of observed disclosure

Games were coded as having disclosed probabilities (i) in-game only, (ii) on the official website only, or (iii) at both locations. If multiple loot boxes were found for a game, this variable was coded based on all loot boxes found: *e.g.*, if a game contains loot box A and loot box B, and loot box A's probability disclosure was made in-game only and loot box B's probability disclosure was made on the official website only, this game would be coded as having made disclosures at both locations, so as to be as fair as possible to companies by giving them maximum recognition for their compliance efforts. This approach was also adopted because such potential within-game variation between multiple loot box types could not be exhaustively recorded as some games contained at least 75 different loot boxes (73).

Method of in-game disclosure

This variable was coded in accordance with the six subcategories of in-game disclosures developed in Xiao *et al.* (2021), which included, for example, an in-game probability disclosure that is 'Automatically displayed on the loot box purchase page without requiring any additional input from the player.' When an in-game probability disclosure was found that did not fall within any of the six subcategories developed in Xiao *et al.* (2021), a new subcategory was defined and created. If multiple loot boxes were found for a game, this variable was coded based on the loot box that made the most prominent in-game disclosure, so as to be fair to companies by allowing them to gain maximum credit for their compliance efforts and highlighting their most consumer-friendly examples.

Method of official website disclosure

This variable was coded in accordance with the five subcategories of official website disclosures developed in Xiao *et al.* (2021), which included, for example, an official

website probability disclosure that is ‘Linked directly from the homepage.’ When an official website probability disclosure was found that did not fall within any of the five subcategories developed in Xiao *et al.* (2021), a new subcategory was defined and created. If multiple loot boxes were found for a game, this variable was coded based on the loot box that made the most prominent official website disclosure.

Was a pity-timer disclosed?

A ‘pity-timer’ was defined as a submechanic that changes (either increases or decreases) the probabilities of obtaining randomised rewards from loot boxes as the player purchases more loot boxes, as defined by Xiao *et al.* (2021) (3).

Inter-rater reliability analysis

As preregistered, 20 games (15% of the sample of 131 games, rounded up) were dual-coded to test the inter-rater reliability of the coding, which is summarised in Table 1. L.Y.X. and L.L.H. first coded the *Apple age rating*, *Presence of loot boxes*, *Presence of probability disclosure* and *Location of observed disclosure*. The two coders were in perfect agreement, except that there were two disagreements for the *Location of observed disclosure* (90.0% agreement, Cohen’s kappa = 0.85). Discussions revealed that these related to particularly inaccessible disclosures made by Games 14 (*8 Ball Pool*) and S20 (*BanG Dream! Girls Band Party*). For Game 14, which made particularly hidden disclosures at *both* locations, L.Y.X. failed to find the in-game disclosure which could only be accessed through a button not on the loot box’s purchase page (specifically, a button hidden in the settings menu, as shown in Figure 2) and L.L.H. failed to find the official website disclosure which was inaccessible from the official website’s homepage. In addition, L.Y.X. failed to find the official website disclosure for Game S20 because it could only be found on the FAQ (Frequently Asked Questions) page of the website, which, although it was linked from the homepage, did not state or imply that it would show the disclosure: the 85th question in a long list of 117 different questions on various topics on the FAQ page reveals how the probabilities can be accessed in-game by ‘tapping the “i” on the Gacha [loot box] screen’ (see 74). Disclosing at one location how to access the disclosure at the other location was deemed to be a disclosure at both locations (if the disclosure at the other location could in fact be found as described), so as to give companies credit for at least providing these instructions to the player. The two coders then exchanged screenshots of found loot boxes, disclosures and pity-timers to ensure that both were

coding based on the same loot box that made the most prominent disclosure following the methodology of Xiao *et al.* (2021) (3). There was one disagreement as to *Method of official website disclosure* (95.0% agreement, Cohen's kappa = 0.93), which was caused by L.L.H. creating a new subcategory to define a relatively inaccessible method of official website disclosure that was made by Game 100 (*Hero Wars – Fantasy World*) on the customer support website as a 'drop rates' post but which could not otherwise be accessed except through a direct link (75), unlike other customer support website disclosures which could all be found using the website's embedded search function. Following discussions, it was agreed that this proposed subcategory was redundant, and the situation was already covered by the pre-existing subcategory that the website disclosure was inaccessible from the homepage (which corresponded to L.Y.X.'s coding). The coding was adjusted after the inter-rater reliability discussions.

Table 1

Inter-rater reliability (n = 20)

Variable	Percentage agreement (Cohen's kappa)
<i>Apple age rating</i>	100% (1.00)
<i>Presence of paid loot boxes</i>	100% (1.00)
<i>Presence of probability disclosure</i>	100% (1.00)
<i>Location of observed disclosure</i>	90.0% (0.85)
<i>Method of in-game disclosure</i>	100% (1.00)
<i>Method of official website disclosure</i>	95.0% (0.93)
<i>Disclosure of a pity-timer</i>	100% (1.00)

Figure 2. The four screenshots on the left half should be read from top to bottom (respectively numbered left 1–4) before those on the right half should be read from top to bottom (respectively numbered right 1–4). Game 14's (*8 Ball Pool*) in-game disclosure was accessed by entering the settings menu by tapping the gear icon at the bottom left-hand corner of the game's home screen (left 1; annotated), scrolling down to the very bottom (the annotation arrows in left 2–4 highlighting the scroll bar demonstrate that a significant amount of scrolling was required to arrive at the end of the setting menu), tapping the 'View' button (left 4), and then tapping the 'Show Me' button (right 1), which opens an in-game internet browser (right 2) that redirects to the official website disclosure (which itself was inaccessible from the website's homepage) that requires players to scroll further in order to view the disclosure for specific loot boxes (right 3–4).

3. Results

3.1. Descriptive Statistics: Presence of Loot Boxes and Apple Age Ratings

Of the 100 highest-grossing UK iPhone games on 21 June 2021, 77.0% (77 games) contained loot boxes. Their Apple App Store age ratings are summarised in Table 2. Notably, Games 1 (*Roblox*) and 26 (*Minecraft*) were duly coded as containing loot boxes because, although loot boxes were not officially implemented by the developer and publisher of these two games (*i.e.*, no ‘first-party’ implementation), these ‘sandbox’ games allow for user-generated content (UGC (76)) to be implemented and sold by third parties (which could be designed to cost real-world money and provide randomised rewards, *i.e.*, loot boxes), as officially recognised and permitted by Roblox Corporation, the developer and publisher of Game 1 (*Roblox*), which explicitly requires probability disclosures for such UGC loot boxes (77). These two games were included in the sample when reporting *Presence of paid loot boxes* and *Apple age rating* because their existence needs to be highlighted as they present a unique compliance risk (specifically, that the subject of self-regulation may itself need to impose and enforce subsidiary self-regulation on others to ensure that it is compliant with its own self-regulation obligations, as Game 1 did (77)); however, these two games were excluded from the sample when reporting presence, location and accessibility of probability disclosures and disclosure of pity-timers because the present study sought to report whether, and if so how, the game *officially* (or first-party) implemented loot box probability disclosures. The array of UGC loot boxes is too diverse and too frequently changed for these latter aspects to be assessed with confidence in these two games: doubtlessly, some UGC loot boxes do not disclose probabilities despite being required to do so, and how UGC loot boxes disclose probabilities will vary significantly between various third-party implementations.

Table 2

Apple App Store age rating of games containing loot boxes (cumulative; n = 100)

Apple App Store Age Rating	Total number of games (cumulative)	Number of games that contain loot boxes (cumulative)	Percentage containing loot boxes
4+	30	17	56.7%
9+	48	33	68.8%
12+	80	61	76.3%
17+	100	77	77.0%

3.2. Descriptive Statistics: Locations of Found UK Disclosures

Of the 75 games containing first-party implemented loot boxes, 64.0% (48 games) disclosed probabilities as required by Apple's self-regulation, whilst 36.0% (27 games) did not. Locations at which disclosures were observed are displayed in Table 3. An exploratory binomial test revealed that the UK website disclosure availability rate of 21.3% was significantly lower ($p < .001$) than the 72.5% PRC rate (3).

Table 3

Locations of Observed Disclosures (n = 75)

Location of Disclosure	Number of games
In-game only	32 (42.7%)
On the official website only	0 (0.0%)
Both locations	16 (21.3%)
No disclosure found	27 (36.0%)

3.3. Confirmatory Analyses

Hypothesis 1 was supported using a binomial test (one-tailed test, $p = .05$) which revealed that the UK disclosure rate of 64.0% was significantly lower ($p < .001$) than the 95.6% PRC disclosure rate (3).

Hypothesis 2 was rejected using a binomial test (one-tailed test, $p = .05$) which revealed that the UK loot box prevalence rate in mid-2021 of 77.0% was not significantly lower ($p > .999$) than the 59.0% early 2019 UK prevalence rate (2). On the contrary, it was significantly higher ($p < .001$).

3.4. Descriptive Statistics: Accessibility of UK In-Game and Website Disclosures

Eight subcategories of in-game disclosures were identified, as summarised in Table 4. The UK situation was similar to the PRC's (3): more than half of games' probability disclosures in both jurisdictions were accessed through tapping a small generic button. Three new subcategories, not identified in the PRC (3), were defined: although they were each only subtly different from pre-existing subcategories, certain aspects of their implementation nonetheless render them distinct and noteworthy. For example, two games disclosed probabilities when symbols that conceptually implied randomness and chance (*e.g.*, a dice symbol, as shown in Figure 3) were interacted with: this subcategory therefore should be recognised as

being different from the subcategory that showed probabilities after a small generic symbol, such as an ‘i’ or ‘(?)’ button (which do not in any way allude to probabilities, as shown in Figure 1) was tapped (26 games), and both aforementioned subcategories should be deemed less prominent than the subcategory that displayed probabilities after a button explicitly stating ‘probabilities’ or a conceptually similar word (e.g., ‘rates’, as shown in Figure 4) was tapped (3 games). One egregiously hidden in-game disclosure subcategory (that was initially missed by a coder as described in the Method section) was used by one game: players were required to enter the settings menu, scroll down to the bottom and then interact with a button to ‘View’ ‘Mini Games Information’ in order to be redirected to the website disclosure, as shown in Figure 2. This arguably actively concealed implementation draws some allusions to the one PRC game that required players to chat, in a foreign language, with the in-game customer support bot found in the settings menu in order to access the disclosure (3). In contrast, only one game adopted the most prominent disclosure method of automatically showing the probabilities on the loot box purchase page without requiring any additional input from the player, as shown in Figure 5.

Table 4

Subcategories of observed in-game disclosures (n = 48)

Number of games	Adoption rate	Summary of disclosure format	Further details
26 (54.2%)	34.7%	Immediately after tapping a small generic symbol	e.g., a question mark sign ‘(?)’ (Game S14: <i>Art of Conquest</i>), as shown in Figure 1; an ‘i’ or ‘i’ sign, which stands for ‘information’ (Game 31: <i>RAID: Shadow Legends</i>); an exclamation mark sign [‘!’] (Game S23: <i>Ullala: Idle Adventure</i>); or a ‘details’ button (Game 27: <i>Genshin Impact</i>)
13 (27.1%)	17.3%	After tapping a small generic symbol and following additional steps	Same types of generic symbol as above. Additional steps include, e.g., tapping on another button (Game 77: <i>The Sims FreePlay</i>), as shown in Figure 7; or tapping on another button and following a hyperlink to the game’s official website’s disclosures (Game 6: <i>Clash Royale</i>)

3 (6.3%)	4.0%	Immediately after tapping a small button explicitly referencing 'probabilities' or a conceptually similar term	<i>e.g.</i> , a button stating 'Character Summoning Rates' (Game 33: <i>DRAGON BALL Z DOKKAN BATTLE</i>), as shown in Figure 4; 'Appearance Rates' (Game 52: <i>Fire Emblem Heroes</i>); or 'Drop Rate' (Game S22: <i>Mr Love: Queen's Choice</i>)
2 (4.2%)	2.7%	Interacting with a graphic symbol that conceptually referenced 'probabilities' and 'chance'	<i>e.g.</i> , a dice symbol (Game 87: <i>Last Day on Earth: Survival</i>), as shown in Figure 2
1 (2.1%)	1.3%	Automatically displayed on the loot box purchase page without requiring any additional input from the player	Specifically, as implemented in Game 98: <i>Dragon City Mobile</i> , as shown in Figure 5
1 (2.1%)	1.3%	After tapping a small button explicitly referencing 'probabilities' and following additional steps	Specifically, tapping a 'Pack Probabilities' hyperlink button and then tapping a 'Continue' button that takes the player to the official website disclosure (Game 37: <i>Star Wars: Galaxy of Heroes</i>)
1 (2.1%)	1.3%	By tapping a graphic element on the loot box purchase page that was not seemingly interactable and then following additional steps	Specifically, tapping the picture depicting the loot box above the payment/price button (colloquially known to players as the loot box 'banner') and then tapping an [<i>i</i>] button and an 'OK' button to confirm being redirected to the official website disclosure (Game 69: <i>Monster Legends</i>)
1 (2.1%)	1.3%	By interacting with certain buttons not on the loot box purchase page	<i>e.g.</i> , a button hidden within the game's settings menu (Game 14: <i>8 Ball Pool</i>), as shown in Figure 2

Note. Adoption rate refers to the percentage of the 75 games implementing first-party loot boxes that adopted each subcategory. Example games used to illustrate each subcategory were not necessarily included in the subsample.

Figure 5. Game 98's (*Dragon City Mobile*) in-game loot box probability disclosure was automatically shown on the purchase screen without requiring the player to perform any action (annotated).

Four subcategories of website disclosures were identified, as summarised in Table 5. The much smaller subsample size of 16 games, when compared to the PRC's of 66 games (3), caused by companies not disclosing probabilities on official websites in the UK must be noted. The results therefore need to be interpreted with some caution. Unlike with in-game disclosures, the UK website disclosure situation is very different from the PRC situation (3): the vast majority of PRC website disclosures (78.8% in the PRC) were published as 'news' or 'notice' posts and then chronologically listed alongside other posts; in contrast, only two UK games (12.5%) disclosed probabilities on their websites in this manner. Two new subcategories, not previously identified in the PRC (3), were defined. Firstly, two games' website disclosures were technically linked from their respective homepages; however, the interactable link on the homepages did not explicitly reference 'probabilities' or in any way allude to the disclosure being available on the other page that will be

opened (see 74). Secondly, nearly half of UK website disclosures (7 games) were published as ‘probabilities’ or ‘drop rates’ posts on the customer support website and could be found using the website’s embedded search function but required players to perform this additional step. Finally, nearly a third of UK website disclosures (5 games) were not accessible from the website’s homepage and could only be accessed either through typing in and visiting the correct URL, or through being redirected from in-game: these were technically official website disclosures, but were effectively inaccessible by people who are unfamiliar with, or do not play, the game (*e.g.*, parents of child players).

Table 5

Subcategories of observed website disclosures (n = 16)

Number of games	Adoption rate	Summary of disclosure format, including link to example implementation
7 (43.8%)	9.3%	Published as a ‘probabilities’ or ‘drop rates’ post on the customer support website and could be found using the website’s search function, <i>e.g.</i> , Game 15: <i>Brawl Stars</i> (78)
5 (31.3%)	6.7%	Inaccessible from the homepage (<i>i.e.</i> , a web address exists for the disclosure, but the link can only be found through a search engine or is only linked to from in-game, such that the disclosure on the official website is not hyperlinked from anywhere else on the website), <i>e.g.</i> , Game 37: <i>Star Wars: Galaxy of Heroes</i> (73)
2 (12.5%)	2.7%	Published under the ‘news’ or ‘notice’ tab and which were then chronologically listed alongside other posts, <i>e.g.</i> , Game 6: <i>Clash Royale</i> (79)
2 (12.5%)	2.7%	Published on a page that is linked directly from the homepage; however, the link does not reference ‘probabilities’ or ‘drop rates’ and therefore it is unclear that the link leads to the disclosure, <i>e.g.</i> , for Game S20: <i>BanG Dream! Girls Band Party</i> , on the FAQ page of the website as described in the Method section (74)

Note. Adoption rate refers to the percentage of the 75 games implementing first-party loot boxes that adopted each subcategory. Example games used to illustrate each subcategory were not necessarily included in the subsample.

3.5. Descriptive Statistics: Overlap Sample

Of the Overlap Sample of 39 games whose disclosure status were assessed in both the PRC by Xiao *et al.* (2021) and the UK by the present study, 13 games (33.3%) had

different Apple age ratings: of which four games (30.8%) had higher age ratings in the UK and nine games (69.2%) had higher ratings in the PRC.

Loot boxes were found in the same 35 games (89.7%) in both jurisdictions. The disclosure rate was identical in both jurisdictions at 94.3% (33 of 35 games). However, there were four inconsistencies (11.4%) as to whether a game disclosed probabilities: two games' disclosures were found only in the PRC (3), whilst two other games' disclosure were found only in the UK by the present study. These inconsistencies were not further investigated because they may have been caused simply by the passage of time.

A binomial test revealed that the disclosure rate of 94.3% in the Overlap Sample is significantly higher ($p < .001$) than the 64.3% found in the overall sample when overlapping games were excluded ($n = 70$).

3.6. Exploratory Analyses

3.6.1. Comparisons with PRC Loot Box Prevalence Rates

A binomial test revealed that the UK loot box prevalence rate in mid-2021 of 77.0% found by the present study remained significantly lower ($p < .001$) than the 91.0% mid-2020 PRC prevalence rate (3). Of games deemed suitable for children aged 12+, binomial tests revealed that the loot box prevalence rate of 76.3% found by the present study was significantly higher ($p < .001$) than the 58.9% early 2019 UK prevalence rate (2), and significantly lower ($p < .001$) than the 90.5% mid-2020 PRC prevalence rate (3).

3.6.2. Disclosures are Less Likely to be Found for UK-Only Games

Of the 100 highest-grossing UK iPhone games on 21 June 2021, 73% (73 games) were not available in the PRC Apple App Store when a search was conducted on 11 September 2021.² Of these 73 games, 76.7% (56 games) contained loot boxes, of which, 60.7% (34 games) disclosed probabilities. Amongst the 105 games containing

² This search was conducted using best endeavours; however, it may potentially have incorrectly categorised certain games as being available in the UK only because, for example, certain games might have initially been made available on the PRC store but were removed from the PRC store by 11 September 2021. The results under this subheading should therefore be interpreted with due caution; however, note that such one direction errors could only render the probability disclosure compliance rate in the UK only subsample to be higher than the true value, meaning that the interpretations made by the present study hold even if errors along these lines were made.

first-party implemented loot boxes in all 131 games sampled, a two-sample z-test revealed that probability disclosures were significantly less likely to have been found for games available in the UK only (of which 60.7% made disclosures) when compared to games available in both jurisdictions (of which 89.8% made disclosures), $z = 3.40$, $p < .001$.

3.6.3. Pity-Timers

Of 75 games containing first-party implemented loot boxes within the UK 100 highest-grossing list, 34.7% (26 games) disclosed the implementation of a pity-timer mechanic. A binomial test revealed that this disclosed UK pity-timer prevalence rate was significantly lower ($p < .001$) than the 65.9% mid-2020 PRC pity-timer prevalence rate (3).

4. Discussion

4.1. Loot Box Prevalence and Accessibility to Children

The present study reaffirmed the results found by Zendle *et al.* (2020) and Xiao *et al.* (2021). Loot boxes were prevalently implemented in 77.0% of the highest-grossing iPhones games available on the UK Apple App Store. Hypothesis 2 that loot box prevalence in the UK has reduced in the two years following the previous UK study due to industry developments (*e.g.*, abandonment of loot box implementation for ethical reasons (34,67)) was rejected. It would appear that corporate actions by particular game companies, for example, Epic Games deciding to stop implementing loot boxes (70–72), are special cases that have been (over-)highlighted and do not reflect a broader trend within the industry, at least on the mobile games market.

On the contrary, the present study found a significantly higher UK loot box prevalence rate than Zendle *et al.*'s (2020), which suggests that loot boxes are being implemented in increasingly more games in the UK. An alternative explanation is one major difference in methodology: Zendle *et al.* (2020) assessed presence of loot boxes through watching video recordings of others playing the games first and only when gameplay videos were unavailable or unclear were games assessed through personal gameplay by the coders. This may have prevented certain more minor and hidden loot box implementations from being identified. Indeed, the true prevalence rate of loot boxes could only be higher than the 77.0% reported by the present study because it is possible for loot box implementations to have been missed by both

coders (although this is unlikely given that the coders were in perfect agreement), but it is *not* possible for any game to have been mistakenly identified as containing loot boxes when it did not (because screenshots of all identified loot boxes are available for public scrutiny at the data deposit link: <<https://osf.io/cx5rv/>>).

In addition to finding a significantly higher loot box prevalence rate in all UK iPhone games than Zendle *et al.* (2020), the present study also found that loot boxes were more prevalent within each level of age rating than the results of Zendle *et al.* (2020) had suggested: for example, 76.3% of games deemed suitable for children aged 12+ contained loot boxes, compared to the 58.9% found Zendle *et al.* (2020). Loot boxes are more widely available and easily accessible to children and young people in the UK than was previously apparent, possibly due to more games starting to implement them recently. In addition, 33.3% of games in the Overlap Sample having different age ratings in the PRC and the UK is worth highlighting: these ratings were determined through companies' self-declaration of the presence of certain content (*e.g.*, 'Infrequent/Mild Sexual Content and Nudity') (49). Therefore, it is anomalous for the same game to have received different age ratings in different countries because the Apple age rating system in different countries uses the same standard and the game's content was unlikely to have undergone major changes (if any) through the localisation process that would affect its age rating. This phenomenon is worth further investigation.

Finally, despite the UK iPhone loot box prevalence rates having been identified as higher than Zendle *et al.*'s (2020) results, the present study still found significantly lower prevalence rates than those found in the PRC (3). This and the lower prevalence of pity-timer mechanics in the UK may have been caused by the highest-grossing lists in the two countries having consisted of games from different 'genres' (80,81). From the coders' subjective experience, amongst the PRC highest-grossing list, there were more 'gacha' games (82) (in which engaging with loot boxes, *i.e.*, performing in-game actions or making real-money purchases in order to open more, arguably forms the 'core game loop' (83)), such as Game 6 (*Clash Royale*). In contrast, amongst the UK highest-grossing list, there were more 'tile-matching' or 'match-three' games that generally do not contain loot boxes (84,85), such as Game 3 (*Candy Crush Saga*). Therefore, the relative popularity of game genres in different countries may affect loot box prevalence: product availability and market structure in various

countries can be vastly different: national surveys should be conducted in other countries to assess national loot box prevalence before any regulations are imposed. However, the present results are highly likely to be translatable internationally to other Western countries in North America, Europe and Australasia, where the highest-grossing game lists are similar and where the positive correlation between loot box expenditure and problem gambling severity has also been consistently replicated (15,16).

4.2. Ineffectiveness of Industry Self-Regulation

The present study found probability disclosures, as required by Apple's self-regulation, for only 64.0% of the 75 games within the UK 100 highest-grossing list containing first-party implemented loot boxes. Considerable efforts (above and beyond what a regular consumer would have used) were expended by the present study to try to find the probability disclosures: any disclosures not found by the present study are also unlikely to be found by the average, or indeed even the determined, player. Indeed, games whose disclosures could not be found highly likely failed to disclose probabilities as required (3). The following discussion proceeds on that assumption.

Players of 36.0% of games containing first-party implemented loot boxes presumably would have no access to probability disclosures, despite this consumer protection measure having been promised to them by both Apple and the relevant game companies. Apple is the owner and operator of the software marketplace, and therefore it financially benefits from every loot box sale because it always deducts a commission of up to 30% and at least 15%. Apple is also the self-regulator that sets out the relevant loot box probability disclosure requirement. However, Apple has not sought to actively enforce its self-regulation and police compliance; on the contrary, Apple is arguably financially benefiting from the lack of probability disclosures in more than a third of games containing loot boxes when players potentially overspend: there is a conflict of interest in that the self-regulator benefits from non-compliance. The games analysed by the present study were the most popular and highest-grossing UK iPhone games (the compliance rate amongst worse-performing games is likely even lower), and therefore Apple's inaction could not be excused for practical reasons, such as being unable to assess every single one of more than one million games, reportedly presently available for download from

the Apple App Store (86). Indeed, Apple is arguably obliged to audit compliance amongst all available games, in accordance with the promise it made to consumers when it instituted the self-regulation. Regardless, Apple can afford to, and is obliged to, monitor compliance and rectify non-compliance amongst at least the highest-grossing games, but Apple has *failed* to do so.

The relevant game companies that did not make loot box probability disclosures are failing to be transparent and honest not only with players but also with Apple, because companies intending to market games on the App Store must purport to have complied with the App Store Review Guidelines, which includes the loot box probability disclosure self-regulation (49), during the submission review process (87). Players of a substantial proportion of games are not being given the consumer protection that was promised to them. Crucially, such non-compliance with self-regulation that deceptively purported to have been compliant has given consumers, and also policymakers and regulators, the *false* impression that industry-wide compliance (and a certain degree of consumer protection) has been achieved in Western countries, despite loot box probability disclosures not being required by law when this is evidently untrue. Failing to provide disclosures after promising to provide them is arguably worse than not promising and not providing disclosures in the first place because, in the latter case, consumers would know that they are not being provided with any consumer protection and therefore may act in a more risk-averse manner, whilst in the former case, consumers were misled into believing that consumer protection is being provided to them (when it is not) and therefore they may have been induced to act in a more risk-tolerant manner by this misrepresentation.

European consumer protection law certainly recognises that the former is *worse* and more culpable than the latter: for example, ‘claiming to be the signatory to a code of conduct [*i.e.*, self-regulation] when the trader is not,’ or ‘claiming that a trader (including his commercial practices [*i.e.*, whether or not to disclose loot box probabilities]) or a product has been approved, endorsed or authorised by ... a private body [*i.e.*, an industry self-regulator such as Apple] when the trader, the commercial practices or the product have not or making such a claim without complying with the terms of the approval, endorsement or authorisation’ are both viewed as ‘commercial practices which are in all circumstances considered unfair’

that are liable for criminal prosecution (88, Annex I, paras 1 and 4). An example to illustrate this may be that parents would be more willing to allow their children to play games containing loot boxes if the parents know that the game makes probability disclosures: thus, a game which purports to, but does not, disclose probabilities is potentially more harmful because it creates a false impression of being 'safer' and enforcement action against it is more imminently necessary.

The results of the present study are conclusive as to legal regulation being more effective than industry self-regulation, at least in the current Western loot box probability disclosure self-regulation context. Companies were statistically significantly more likely to disclose probabilities in the PRC where legal requirements applied than they were to disclose in the UK where only advisory-level industry self-regulation applied. This proposition is further supported by the finding that games available in the UK only were statistically significantly less likely to have made disclosures (only 60.7% did so) than games available in both the UK and the PRC (89.8% did so), and the particularly high disclosure rate in the Overlap Sample (which consisted of well-performing and highly scrutinised PRC games that were also available in the UK) of 94.3%. The so-called spillover effect, proposed in the Introduction, that companies intending to release games in both the UK and the PRC markets simply made a PRC-law compliant version of the game and released said version in all markets (regardless of the absence of local legal requirements and/or industry self-regulation) appears plausible: the PRC legal regulation may have improved the degree of consumer protection in other countries beyond its formal jurisdiction.

Western loot box industry self-regulation (64.0% compliance rate in the UK) is statistically significantly weaker than legal regulation at guaranteeing a near-perfect level of compliance (95.6% disclosure rate in the PRC (3)). Indeed, 31.6% more highest-grossing games disclosed probabilities in the PRC than did in the UK. Therefore, policymakers and regulators in countries such as the UK, where practically voluntary and non-enforced industry self-regulation similar to Apple's is already in force, should nonetheless consider imposing loot box probability disclosure requirements as law to increase the rate of compliance and better protect consumers from potential loot box harms, *e.g.*, overspending.

4.2.1. Minor Factors Potentially Affecting the Compliance Rate

The passage of time (approximately one year's difference between the data collections of Xiao *et al.* (2021) and the present study) may have slightly contributed to the compliance rate variation between the two countries, although it is far more likely that more video games in the UK decided to add disclosures during the additional time they had to take compliance actions (rather than to remove them during this time) and so the UK compliance rate likely would have been even lower had it been assessed at Xiao *et al.* (2021)'s data collection time. Temporal differences, if any, were far more likely to have weakened, rather than strengthened, the statistical significance of the observed difference and therefore the interpretations of the present study hold.

In addition, the prevalence of certain video game genres, which differs between the UK and the PRC highest-grossing lists, may also have affected the results. From the coders' subjective experience, gacha games (in which loot boxes form part of the core game loop, as discussed above, and are the principal monetisation method), *e.g.*, Games S4 (*Arknights*) and S5 (*Onmyoji*), were more prevalent in the PRC sample than in the UK sample. In contrast, the UK sample included more games in which the loot boxes arguably did not form part of the core game loop and were minor or peripheral to gameplay, such as in Games 53 (*Mafia City: War of Underworld*) and 61 (*Hay Day*). In these latter games, not only were the loot boxes tangential to the main gameplay, they also did not appear to be the principal monetisation method. For example, in Game 53, a loot box mechanic was identified but it was only as part of a larger bundle consisting of multiple items: in that bundle, the majority of items (including what appeared to be the most valuable items, as they were more prominently advertised) were guaranteed and non-randomised, and only a minority of items were randomised, as shown in Figure 6. When players buy this particular in-game microtransaction, their purchasing decision might have only been motivated by the non-randomised, non-loot box elements of the bundle, whilst the loot boxes were merely perceived as complimentary bonuses. Subjectively (because the following observation was not coded as it was difficult, if not impossible, to assess this objectively), the coders also expressed that the games in which loot boxes were minor aspects were less likely to make probability disclosures, than games in which loot boxes formed part of the core game loop and were seemingly the principal monetisation method of the game. The player communities of different

genres of video games may have different expectations as to whether probability disclosures need to be provided: for example, players likely expect disclosures to be made in relation to the loot boxes that are the principal monetisation method in gacha games, but may be less concerned about the absence of probability disclosures for loot boxes that are only peripheral in other games. Varying levels of social pressure and potential backlash from the player communities may have ensured a higher compliance rate amongst, for example, gacha games. Although game genre and the relative importance of loot boxes as a monetisation method when compared to other in-game microtransactions in a particular game (both financially and in relation to the core game loop) were not coded, the differing popularity of game genres within the two samples may have contributed to the differing level of compliance between the PRC and the UK. Further research should examine these more technical and nuanced game design aspects (89).

Finally, note, that when viewed with a more cynical perspective that assumes game companies will always act to maximise their self-interests (specifically, that they will always choose to be non-compliant by not disclosing probabilities in order to maximise revenue, unless the negative consequences of being non-compliant outweighs the potential gains), the 64.0% compliance rate with UK self-regulation is actually quite high given that Apple's measure appears to be a practically voluntary measure that companies can ignore, given that no negative consequences for non-compliance (*e.g.*, delisting from the App Store) have been suggested, let alone enforced, by Apple (3).

Figure 6. Game 53's (*Mafia City: War of Underworld*) loot box (annotated) is sold as a minor part of a larger bundle of multiple items: most items in the bundle, including the most valuable, are guaranteed and non-randomised.

4.3. Inaccurate Disclosures

The present study was unable to verify the accuracies of disclosures made due to lack of access to previous opening results held by game companies (3). However, examples of evidently unclear, inaccurate, or incomplete probability disclosures were identified (similar to in the PRC (3)): for example, Game 77 (*The Sims FreePlay*) disclosed percentages that did not sum to 100%, as shown in Figure 7. Game S31 (*Contra Returns*) disclosed the probability of obtaining many specific loot box rewards not as a percentage but instead as a range, *e.g.*, '0.5%–2%' and '45%–70%', without any further explanation as to how the percentage value for any specific loot box opening will be determined from within the stated range, as shown in Figure 8 (see 90). A potential difference of 25% for the range '45%–70%' appears quite significant visually; however, the difference between the range '0.5%–2%' is actually more significant: the probability of obtaining the rare reward is potentially four times as unlikely if the lower value is used. Such differences considerably increase how many loot box purchases are needed, on average, to obtain certain rare rewards and may well change whether a player will decide to purchase the loot box and try their luck.

Figure 7. Game 77's (*The Sims FreePlay*) in-game loot box probability disclosure (bottom) was accessed by tapping the (i) button on the loot box purchase screen (top; annotated), then tapping another (i) button on the subsequent screen that is displayed (centre; annotated). Notably, the disclosed percentage values do not add up to 100% ($96\% + 1.8\% + 1.8\% = 99.6\%$).

CONTRA RETURNS DROP RATES

2021.07.08

Dear Contra warriors

Here is the drop rates of the top prize in game:

Lucky Draw	Prize	Chance
Ultimate Weapon-Basic Training Ground	Purple Weapon Fragment	0.5%-2%
	Blue Weapon Fragment	30%-40%
	Green Weapon	3%-10%
	Other Materials (Weapon Advance Materials, Super Weapon Upgrade Materials, etc.)	45%-70%
Ultimate Weapon-Advanced Training Ground	Orange/Gold Weapon Fragment	0.5%-2%
	Purple Weapon/Fragment	5-10%
	Hero Fragment	5-10%
	Other Materials (Weapon Advance Materials, Super Weapon Upgrade Materials, etc.)	75%-90%

Figure 8. Game S31's (*Contra Returns*) website loot box probability disclosure disclosed ranges (e.g., '0.5%-2%' and '45-70%'), rather than specific percentage values, and did not explain what value within the disclosed range will actually apply to each particular opening.

4.4. Locations and Methods of Disclosure

Similar to the pattern identified in the PRC (3), companies preferred to make disclosures at only one location (66.7%), rather than at both locations (33.3%). This means that, in relation to most games, players do not have two alternative channels of accessing probability disclosures, thereby reducing the number of players seeing the disclosures and therefore providing a lower degree of consumer protection. Notably, unlike in the PRC where companies prefer making website disclosures, companies in the UK prefer making in-game disclosures. No game in the UK disclosed on the official website *only* (0.0%), whilst 40.2% did so in the PRC (3). Indeed, in total, 75.9% of games containing loot boxes (66 of 87) made disclosures on the official website in the PRC, but only 33.3% did in the UK (16 of 48 games). This is a statistically significant difference between the UK and the PRC. Survey results have shown that in-game disclosures are more likely to be seen by players than website disclosures, even in the PRC where website disclosures are implemented more frequently than in-game disclosures (91). The preference for in-game disclosures in UK games therefore likely increases consumer protection. Nonetheless, making disclosures at both locations is evidently superior: on one hand, making disclosures internally within the game ensures that the disclosures are

more proximate to the loot box purchase decision itself, which likely maximises their effect at providing a ‘cooling off’ period and potentially halting purchase (92,93); on the other hand, making disclosures externally on the official website ensures that non-players who have an interest in learning about the disclosures (e.g., parents of child players) can also easily access them without needing to expend time to play the game themselves (51). However, two-thirds of UK games *failed* to make disclosures at both locations.

Xiao *et al.* (2020) defined a disclosure as being ‘reasonably prominent’ if the player can access it by interacting with an element either on the loot box purchase page or the website’s homepage that referenced ‘probabilities’ or a conceptually similar term (e.g., ‘rates’) (3). Of all UK in-game disclosures, only five games’ (10.4% of in-game disclosures) could be deemed reasonably prominent because they were either shown automatically (one game), or were accessed through initially interacting with a button on the loot box purchase page that explicitly referenced ‘probabilities’ or ‘rates’ so as to clearly indicate that the button led to the disclosure (three games showed the disclosure immediately upon the button being tapped, whilst one other game required performing additional steps after tapping said button). Importantly, when compared, UK games made fewer reasonably prominent in-game disclosures (10.4%) than in the PRC (21.2%).

None of the UK website disclosures (0.0%) could be deemed reasonably prominent because the player could not access any of them by simply interacting with an automatically displayed element on the website’s home page that referenced ‘probabilities’ or a conceptually similar term, unlike, for example, one PRC website disclosure that could be accessed by clicking a hyperlink entitled ‘probability disclosure’ which appeared in the footer of every page of the website, including the homepage (3). One UK website disclosure subcategory representing 43.8% of website disclosures was comparatively more accessible than the other subcategories because players could access the disclosures by using the customer support website’s homepage’s embedded search function to look up terms such as ‘probability’ (Game 2: *Coin Master* (94)), ‘chances’ (Game 56: *CSR 2 Multiplayer Racing Game* (95)), or ‘drop rates’ (Game 15: *Brawl Stars* (78)). Notably, the terms generally were not interchangeable, meaning that, for example, if a player searched for ‘probability’ on Game 15’s (*Brawl Stars*) official website, there would have been

no result and the player would not have been able to access the disclosure. Companies could have inputted all these synonyms as keywords on the probability disclosure page to ensure that it would be found when any one of the synonyms was searched for by the player. This subcategory could not be deemed reasonably prominent because it required the player to perform multiple additional steps: opening up the embedded search function; typing in the correct keyword search phrase; and then following the hyperlink that is shown amongst the search results. When compared, fewer official website disclosures were reasonably prominent in the UK (0.0%) than in the PRC (10.6%). Closer scrutiny reveals that substantially more UK website disclosures were also entirely inaccessible from the homepage (31.3%) than in the PRC (7.6%).

Overall, of all 75 highest-grossing UK iPhone games containing first-party implemented loot boxes, only one game (1.3%) adopted the most prominent disclosure format of automatically displaying the probabilities on the in-game loot box purchase page (compared to 4 of 91 PRC games (4.4%)); only five UK games (6.7%) made reasonably prominent in-game disclosure (compared to 11 of 91 PRC games (12.1%)); and no UK games (0.0%) made reasonably prominent official website disclosures (compared to 7 of 91 PRC games (7.7%)). Overall, only 5 UK games (6.7%) made reasonably prominent disclosures at either location (compared to 17 of 91 PRC games (18.7%)) and no game (0.0%) made reasonably prominent disclosures at both locations (compared to 1 of 91 PRC games (1.1%)). When compared to PRC games, UK games generally made less prominent and less accessible disclosures both in-game and on the official website, and significantly fewer UK games disclosed probabilities on their official websites at all. In terms of the method of disclosure, the UK and the PRC loot box probability disclosure compliance situation appears similarly suboptimal: nearly *all* companies in both countries failed to adopt the most prominent disclosure format of automatically displaying probabilities in-game and failed to make reasonably prominent disclosures at both locations.

4.5. Examples of Sludge

In terms of sludge (*i.e.*, ways that information is obscured or complicated by companies to inhibit informed consumer choice) being deployed by video game companies in the UK loot box probability disclosure context, the most obvious

demonstration is that 89.6% of in-game disclosures and 100.0% of website disclosures were *not* reasonably prominent. Sludge is also demonstrated by the differing methods of disclosure: for example, with in-game disclosures, there was great variability in what button on the purchase page the player must first engage with to access the disclosure or at least to begin the process of eventually accessing the disclosure (compare the ‘(?)’ button shown in Figure 1, the dice symbol shown in Figure 3, the ‘Character Summon Rates’ button shown in Figure 4, and the ‘(i)’ button shown in Figure 7). The symbols chosen for these buttons potentially imply different meanings. Symbols such as ‘(?)’ and ‘(i)’ express that information will be conveyed, but do not indicate what information this will be: probability disclosure or otherwise. Indeed, certain games chose to use such symbols, which would have led to disclosures in other games, for other purposes unrelated to probability disclosures: for example, in Game 8 (*State of Survival*), the ‘(i)’ button on the loot box purchase screen, when tapped, displayed a reward preview screen, which easily could have, but importantly did *not*, display probability disclosures, as shown in Figure 9. In contrast, the ‘(!)’ symbol suggests a warning or disclaimer; again, the player would not know that this was a probability disclosure unless they interacted with it, but this does imply that the player should pay heed to the information when making a purchasing decision. Finally, dice symbols express an element of chance, but would not usually be associated with obtaining further information, so it may not be immediately obvious that these buttons were interactable and would lead to a disclosure, and instead simply be perceived as a cosmetic element, especially for players who do not generally associate loot boxes with gambling. In most cases, players would not know which button they should interact with to access the disclosure because there is no uniform industry standard requiring a specific format, unlike standardised food nutrition labels, for example (96). This is further exacerbated by games using these same symbols for other, non-probability disclosure purposes, *e.g.*, Game 8, as discussed above. Indeed, players from different cultural and linguistic backgrounds may also perceive these symbols to have varying meanings: the (i) symbol is shorthand for ‘information,’ which speakers of many languages would not understand. Future research should assess what players perceive each different symbol to mean and identify which would be the most widely accepted as appropriate for denoting probability disclosure, although it is likely that a button explicitly stating ‘probability disclosures’ would be the most easily recognisable in all circumstances.

Figure 9. Game 8's (*State of Survival*) in-game loot box purchase screen's (i) button (top; annotated) did not display a probability disclosure page when interacted with, and instead displayed a reward preview screen that did not disclose probabilities (bottom).

Many other specific examples of sludge were encountered as detailed below, thus illustrating the prevalence of sludge that players encounter when trying to access probability disclosures.

Figure 1 shows that Game S14 (*Art of Conquest*) discloses probabilities going down to five decimal places (e.g., "2.10553%"). This makes the probabilities appear unnecessarily complex and likely more difficult for players to understand. This is further exacerbated by the fact that Game S14 discloses that its loot box 'Mithril Chest' contains 61 different potential rewards, including one reward ('5 Hour

Building Rush') with an extremely low probability of 0.0008% of being obtained. Instead of simplifying disclosure information, which would have been a nudge, Game S14 chose to complicate disclosure information and thereby adopted sludge.

In Game 87 (*Last Day on Earth: Survival*), the probability disclosure can be accessed through interacting with a dice symbol (which is one of the more prominent disclosure methods), as shown in Figure 3: however, *tapping* on the symbol does not cause the disclosure to be shown; instead, the player must press down and *hold* onto the symbol for the disclosure to be shown, and the disclosure disappears whenever the player releases their hold on the screen. Many players may never even discover this and simply assume that the dice symbol is not interactable after trying to tap it to no avail.

An example of official website disclosures employing sludge is the website disclosure of Game S31 (*Contra Returns*), which disclosed probabilities not using text that is searchable using an internet browser's find command but instead using text on a JPEG image file that is not searchable (see 90), thus rendering players unable to easily look up a specific loot box's disclosure and instead forcing them to scroll through the entire image to scan for the specific loot box manually: some players might miss the disclosure when searching through the list, or give up from undertaking this dreary task, and therefore not derive any consumer protection benefits from the self-regulation.

Official website disclosures often allow for more detailed information to be provided than in-game disclosures (which tend to be more concise) thus revealing more of the innerworkings of how loot box probabilities are determined: Game 100 (*Hero Wars – Fantasy World*) revealed that mathematical formulae are used when determining probabilities, as shown in Figure 10: specifically, the result of '1,000,000 divided by the "amount of soul stones" to the power 1.5' needs to be used to calculate the correct probabilities. Game 100 places the burden of calculating this value (which would not be the correct percentage chance and would only be an intermediary value that is then needed to conduct further calculation to arrive at the actual percentage probability) on the players themselves (75).

THERE IS A 50% CHANCE ONE OF THE 5 HEROES WITH THE MOST FRAGMENTS THE USER HAS WILL BE DROPPED. THIS CHANCE IS CALCULATED AS FOLLOWS:

- 5 heroes with the most fragments (no matter evolved or not) are weighed as

$$\frac{1000000}{\text{AMOUNT OF SOUL STONES}^{1.5}}$$

- the calculated weights are used to receive a probability
- this probability is used to determine which hero's fragment is to be dropped next
- the exact amount of fragments to be dropped is calculated with the following chances

Hero's name	Amount of fragments	Chance %	Amount of fragments	Chance %	Amount of fragments	Chance %
Aurora	1	32.52%	3	32.52%	7	34.96%
Galahad	1	32.52%	3	32.52%	7	34.96%
Keira	1	32.52%	3	32.52%	7	34.96%
Astaroth	1	44.54%	3	44.54%	18	10.91%
Kai	1	44.54%	3	46.84%	30	6.32%
Phobos	1	32.52%	3	32.52%	7	34.96%
Thea	1	32.52%	3	32.52%	7	34.96%
Daredevil	1	44.54%	3	44.54%	18	10.91%
Heidi	1	32.52%	3	32.52%	7	34.96%
Faceless	1	32.52%	3	32.52%	7	34.96%
Chabba	1	46.84%	3	46.84%	30	6.32%
Arachne	1	44.54%	3	44.54%	18	10.91%
Orion	1	32.52%	3	32.52%	7	34.96%
Fox	1	44.54%	3	44.54%	18	10.91%

Figure 10. Game 100's (*Hero Wars – Fantasy World*) website loot box probability disclosure reveals that mathematical formulae are used to calculate the probabilities for each opening. Note that the list of different potential rewards (many with different probabilities) at the bottom of the screenshot is incomplete because the image was cropped: the list is even longer (75).

Finally, Game 69 (*Monster Legends*) disclosed probabilities in-game through a button that launched an in-game internet browser and redirected the player to the official website disclosure; however, of the two different loot boxes that were encountered, one loot box's in-game button leading to the official website disclosure was incorrectly implemented such that an error message asking the player to 'check [their] network connection and try again' would be displayed instead of the disclosure. This error message was itself an error because the coder's internet connection was working correctly at the relevant time given that the in-game button

for the other loot box did correctly redirect to the official website disclosure. The in-game button for the prior loot box was almost certainly incorrectly programmed; however, the wording of the misleading error message may cause some players to stop trying to access the disclosure and mistakenly blame themselves, rather than the company, for their inability to see this information.³

Sludge can come in many forms, both intentional and unintentional, and these examples are not an exhaustive list. Companies should endeavour to avoid creating sludge of any kind to ensure that players can easily access and derive maximum benefits from probability disclosures.

4.6. How Can Companies Do Better?

The methods of disclosure, both in-game and on the official websites, and the examples of sludge presented by this study echo the suboptimal compliance situation identified in relation to loot box probability disclosure law in the PRC (3). Companies chose to comply with loot box probability disclosure self-regulation imposed by Apple in 64.0% of games containing loot boxes; however, most companies that have disclosed probabilities used methods of disclosure that are difficult for players to access, and some companies have adopted corporate actions that obfuscate and complicate the decision-making environment and further discourage players from seeing the disclosure and benefiting from their consumer protection effects. Companies should make disclosures both in-game on the loot box purchase page and on the game's official website to maximise players' and non-players' opportunities to access and benefit from the probabilities. Companies can easily improve the prominence and ease of access of their disclosures by automatically showing them on the in-game loot box purchase page or, if that is not possible, by adopting the other reasonably prominent disclosure methods recognised above. Companies should also refrain from using sludge to weaken the effectiveness of probability disclosures and instead seek to design more 'ethical' loot boxes that instead nudge players to make more informed purchasing decisions: for example, by implementing fewer different loot box types in each game and fewer potential rewards in each loot box to reduce the length and enhance the readability of the probability disclosure (68).

³ Screenshots documenting this series of events relating to Game 69 can be accessed via the game's screenshot folder at the data deposit link: <<https://osf.io/cx5rv/>>.

4.7. Pity-Timer Submechanics

'Pity-timer' is a phrase coined by the video gaming community (3,66) to describe a mechanic that increases their probabilities of 'winning' and obtaining rare rewards as they purchase more loot boxes without 'winning.' Game 88 (*My Hero Academia: The Strongest Hero*) referred to its pity-timer mechanic as 'bad luck protection,' whilst Game 31 (*RAID: Shadow Legends*) named it 'The Mercy System.' Presently, there is no industry standard as to what such a mechanic should be called. Developing or adopting an easily understandable and widely accepted term would help players to recognise and account for such mechanics when purchasing loot boxes.

Of UK games containing loot boxes, 34.7% disclosed implementing pity-timers, significantly lower than the 65.9% mid-2020 PRC pity-timer disclosure rate (3). Pity-timers may be less prevalently implemented in the UK. Alternatively, the implementation rate could actually be identical in both jurisdictions, but UK games chose not to disclose their implementation, potentially due to the lack of any obvious negative consequences for them failing to do so, given that Apple's self-regulation imposed none. In contrast, in the PRC where loot box probability disclosure requirements have legal force, failure to disclose pity-timers and thereby breaching the regulations could have potential legal or quasi-legal consequences, such as enforcement actions being taken by the quasi-governmental China Consumers Association, as reportedly happened in relation to the probability disclosures made by Game S7 (*Shining Nikki*) in the PRC (97).

Every pity-timer identified increased the player's probability of obtaining rare rewards as the player bought more loot boxes, except one, which reduced the relevant probability and then increased it: Game 69 (*Monster Legends: Collect all*) disclosed that in its 'Epic Monster Chest,' the player had a '0.71%' chance of obtaining '1 Legendary Monster' (the rarest and most valuable potential reward from said loot box) on the 1st and 2nd loot box openings, *i.e.*, purchases, but no chance (0.00%) on the 3rd and 4th opening of obtaining said reward. The player then had a '14.13%' chance of obtaining it on the 5th opening and a '29.92%' chance on the 6th purchase. The difference between the probability for the 1st and 2nd openings and the probability for the 3rd and 4th openings did not go towards increasing the probabilities of obtaining rarer or better rewards and instead contributed towards

increasing the probability of obtaining more common or worse rewards, such as '15 Epic Cells' (which is evidently worse than '1 Legendary Monster' because many 'Cells' are required to create a 'Monster,' in addition to a 'Monster' belonging to the Epic rarity being generally worse than one from the Legendary rarity). Therefore, the probability of obtaining rare rewards actually decreased (albeit temporarily) as the player purchased more loot boxes in Game 69: this reflects that the underlying probabilities of each individual loot box opening can be, and are being, easily manipulated by companies.

Microsoft, which owns the Xbox hardware platform, has claimed that:

'We will not use a player's personal or gameplay information to negatively impact the odds or results of receiving a valuable loot box item. This information, if used, would only be used to enhance the opportunity of a player, e.g., the possible items received may be geared toward what a player needs at a given time in the game or to prevent duplicates where the duplicate item has no added value' (98).

This statement confirms that pity-timers are being implemented by video game companies not only on the mobile platforms as evidenced by the present study, but also more broadly on console (*e.g.*, Xbox) and PC platforms. Additionally, companies have at least realised the possibility of reducing the player's probabilities of obtaining rare items (for example, reducing the probabilities for known heavy spenders (*i.e.*, 'whales' (14)) to maximise revenue). Game 69 and a previously identified PRC game containing a detrimental pity-timer that reduced the player's probabilities of obtaining rare rewards as more loot boxes are bought (3), are evidence that such manipulative actions may be ongoing, particularly considering that the video game industry owns patents that explicitly enable loot box probabilities to be 'adjusted' based on the player's 'past spending behavior' (99,100). Given that disclosing such a detrimental pity-timer is likely harmful to the trust that players may have towards a company (and therefore it is within the company's interest to keep the implementation confidential), detrimental pity-timers may be more widespread than apparent.

In games such as Game 45 (*Mobile Legends: Bang Bang*), the player had an exceptionally low probability of 1 in 100,000 or 0.001% chance of obtaining the desired rare reward from the loot box. However, there was a more prominently disclosed pity-timer mechanic that guaranteed that the player would, at worst, obtain the reward after 100 purchases and, at best, obtain it after 20 purchases. This pity-timer mechanic effectively means that the astronomically low probability for obtaining the reward directly of 0.001% is irrelevant to the loot box purchasing decision: the player should calculate their expected cost using the pity-timer mechanic, rather than the percentage-based probability disclosure. This echoes one PRC player's comment that they were deciding whether to buy loot boxes based on the pity-timer mechanic rather than the probability disclosure (91). How players feel about and interact with such mechanics should be studied further using qualitative methods, such as semi-structured interviews with loot box purchasers (9).

4.8. Self-Regulation is Worse Than Legal Regulation?

Finally, more broadly, beyond the loot box probability disclosure context, the present study presents empirical evidence that industry self-regulation (at least without additional external oversight) was worse than legal regulation at ensuring compliance. Compliance with legal and self-regulatory requirements in other domains are often difficult to assess due to practical reasons (*inter alia*, costs, lack of access and lack of effective comparators) and cannot readily be quantified as was possible with loot box probability disclosure through content analysis of publicly available information that can be accessed remotely. Self-regulation has been suggested for adoption, and has in fact been adopted, in many other domains given its potential benefits, such as lower information and enforcement costs (due to self-regulators possessing industry expertise and technical knowledge), and greater flexibility and speed when dealing with cases of non-compliance (101) and new industry developments (102). However, unlike legal regulation, self-regulation is not a singular concept; each self-regulatory regime sits on a spectrum of enforceability (103): on one end, some quasi-legal self-regulations (*e.g.*, codes of practice) may be formally binding and breach of which raises a rebuttable presumption of non-compliance in law, whilst other self-regulations are entirely voluntary and have no legal force (101).

The level of compliance under UK loot box probability disclosure self-regulation being statistically significantly lower than that of PRC legal regulation can be simply interpreted as legal regulation being more effective at ensuring compliance and therefore being the preferable approach. However, the issue is more multifaceted and nuanced: industry self-regulation should not be entirely dismissed, given its many potential benefits. UK self-regulation failed in this context because it was badly designed and enforced. Specifically, Apple's self-regulatory requirement (and by extension Google's (104) for the Android mobile platform; the Entertainment Software Association's (44) for the major console platforms; and TIGA's for the UK video gaming industry (105)) was drafted in an abstract manner without specifications as to, *inter alia*, where the disclosure should be located; how it should be accessed by the player; and what level of detail is required (whether percentages for each individual potential reward or only percentages for categories of rewards, such as rarities, as required by Microsoft (98), need to be disclosed) (51). This should be contrasted with how the Japanese and South Korean loot box probability disclosure self-regulations are more detailed: the Japanese self-regulation requires the disclosure to be placed at a location that is 'easily recognisable' by the player (47), and the South Korean self-regulation requires disclosure on the loot box purchase page and illustrates its requirements with screenshots of example implementations (48). Additionally, Apple's self-regulation does not provide for any enforcement powers: no negative consequences apparently flow from non-compliance, thus rendering the measure practically entirely voluntary. In contrast, the Japanese self-regulation requires platform providers to actively audit, identify and rectify non-compliance (47), whilst the South Korean self-regulation provides for an enforcement regime that actively monitors compliance and adopts a 'name and shame' system (34): a list of repeatedly non-compliant games is published monthly (see 106), which might discourage players from playing those games, or at least damage the companies' reputation, and thus disincentivise companies from breaching the self-regulations by failing to disclose probabilities. Note, however, that research in other regulatory contexts has found evidence that reputational sanctions and social pressures may be ineffective at increasing compliance (107), because some companies, such as smaller companies in highly competitive markets (and the video game industry is one), are unlikely to experience reputational damage at all (108), and because the market does not necessarily react to adverse publicity (109).

Apple's self-regulation (and by extension the various loot box self-regulations present in Western countries) occupies the purely voluntary and non-binding end of the self-regulation spectrum. Indeed, such self-regulation arguably should be more accurately referred to as mere advisory guidance, rather than as 'self-regulation,' as there is no active regulating. In contrast, the Japanese and South Korean self-regulations trend towards the more consequential and enforceable side of the self-regulation spectrum. The South Korean loot box probability disclosure self-regulator reported a compliance rate of 90.8% in August 2021 (106):⁴ this is much closer to the 95.6% PRC disclosure rate than the 64.0% UK compliance rate. In short, loot box probability disclosure self-regulation should not be abandoned as a potential solution; however, those self-regulations currently in force in Western countries, *e.g.*, Apple's self-regulation, need significant improvements (perhaps by emulating the positive features of the Japanese and South Korean self-regulations) before they outvalue more costly but more effective legal regulation.

4.9. How Can Industry Self-Regulators Do Better?

The present study found that companies' compliance with loot box probability disclosure industry self-regulation in the UK was suboptimal, just as companies' compliance with loot box probability disclosure law in the PRC was (3). How loot box probability disclosures are made can be substantially improved upon.

Companies can themselves implement more prominent disclosures as detailed above; in addition, industry self-regulators can also *force* companies to improve by better designing and drafting self-regulation requirements. Rather than abstractly requiring loot box probability disclosures in principle, as Apple presently does (see 49), industry self-regulators can explicitly require uniform disclosures using prominent methods at specific locations to ensure that all players can easily access loot box probability disclosures no matter which game they are playing.

Additionally, the main weakness of industry self-regulation at present when compared to legal regulation is that lack of enforcement powers, for example, the

⁴ The South Korean 'disclosure rate' would have been even higher than the 'compliance rate' published by the self-regulator because compliance with the South Korean self-regulation requires the disclosure to have been made using specific methods, rather than simply made, thus certain games likely were deemed by the self-regulator to have been non-compliant even though they did disclose probabilities because the disclosures were made using incorrect methods. Indeed, many of the games on the August 2021 'name and shame' list of non-compliant games (106), such as Games 15 (*Brawl Stars*) and S4 (*Arknights*), are known to have made disclosures in other countries (specifically, the PRC and the UK) when they were assessed by Xiao *et al.* (2021) and the present study: these games were likely deemed non-compliant despite having made disclosures in South Korea because they used incorrect methods when doing so.

inability to impose any fines on non-compliant companies (34,51). Industry self-regulators, such as Apple, should also, when requiring loot box probability disclosures, design and enforce potential private law ‘punishments’ for non-compliance that can serve as more effective deterrence than the South Korean ‘name and shame’ system that many major non-South Korean game companies (that potentially face less social pressure (108,110,111)) simply decide to ignore (106): for example, disabling in-app purchase features; freezing funds and not transferring payments generated by the game’s previous month’s sales; or delisting games containing loot boxes that do not disclose probabilities from the App Store until disclosures are appropriately implemented. These non-public law punishments can be enforced through contractual means: self-regulators that are software marketplaces or hardware providers can require companies seeking to market their games to sign specific agreements outlining the consequences of not implementing probability disclosures for loot boxes. Further, self-regulators should also open and maintain a support channel that can allow players (and other interested parties, such as competing video game companies) to report non-compliant companies to better police compliance. Self-regulation can be improved to more effectively deter non-compliance and incentivise compliance: once the effectiveness of self-regulation is at a comparable level to that of legal regulation, then the balance tips in favour of self-regulation, given its benefits, *e.g.*, costs-saving and flexibility. Until then and unless industry self-regulation improves, legal regulation should be imposed to ensure consumer protection.

4.10. Limitations

The present study focused on the highest-grossing iPhone games operated by reputable companies that were the most scrutinised by the public: this likely means that the compliance rate would have been lower amongst financially worse-performing games that received less public oversight. This study design decision was made to ensure that the present results would be directly comparable to the previous PRC study, which only assessed the iPhone platform and not the Android and Steam platforms due to market differences between the two countries, specifically the unavailability and questionable legality of the two latter platforms in the PRC (3). The present results are likely translatable to other mobile platforms in Western countries where the highest-grossing lists are similar (such as Android) given that the previous UK study found nearly identical prevalence rates for iPhone

(59.0%) and Android (58.0%) platforms. However, the compliance situation for console and PC games is not known and remains to be specifically assessed by future research: the previous UK study found that the then loot box prevalence rate for PC games (36.0%) was lower than for mobile games (iPhone (59.0%) and Android (58.0%)) (2); therefore, the compliance rates on different hardware platforms potentially vary.

The relevant features of only one loot box were recorded per game. Most games contained multiple loot box types: for example, Game 37's (*Star Wars: Galaxy of Heroes*) website disclosure revealed that it contained at least 75 different loot box types (73). Exhaustively recording the relevant features of each loot box type in each game was not practicable. Indeed, variations in loot box implementation within the same game could not be recorded: each game was coded according to the loot box that used the most prominent disclosure method, even though in some games different loot box types disclosed probabilities using different methods, for example, in Game 33 (*DRAGON BALL Z DOKKAN BATTLE*), one loot box's in-game disclosure was accessed by tapping a button stating 'Character Summon Rates,' as shown in Figure 4, whilst another loot box's in-game disclosure was accessed by tapping an identical button stating 'Character Summon Rates' but then tapping another button on a new screen that opens up: this within-game variation demonstrates that individual players may experience loot box probability disclosures differently even within the same game.

Finally, whether probability disclosures are effective at reducing loot box spending or preventing overspending remains to be assessed through further research. Survey results from PRC players indicate that only 16.4% spent less money on loot boxes after seeing probability disclosures (91). Individual players' loot box spending data from before and after probability disclosures were implemented would reveal the measure's effectiveness: video game companies are in possession of such data and should share them publicly to ensure that players are provided with adequate consumer protection measures, rather than an ineffective measure that is merely performative.

5. Conclusion

Loot boxes are more prevalent in UK video games and more accessible to UK children than previously suggested (cf 2). Industry self-regulation requiring probability disclosures has resulted in a reasonably high 64.0% compliance rate, at least amongst the highest-grossing UK iPhone games; however, this rate remains statistically significantly lower than the 95.6% disclosure rate in the PRC where loot box probability disclosures are required by law. Policymakers and regulators around the world should consider imposing loot box probability disclosure requirements by law, even in countries such as the UK where industry self-regulation is already in force, to ensure a higher compliance rate and provide better protection to consumers. Results from the Overlap Sample and from games available in the UK only suggest that the overall UK compliance rate may have been indirectly increased as a result of companies acting to comply with PRC law. In the now globalised world where the same product is often available in many countries, one jurisdiction's regulation against that product may have spillover effects into other jurisdictions and bring consumer protection benefits to people beyond its geographical and legal boundaries. At present, loot box probability disclosure industry self-regulation works to an extent; however, the law would be more effective. Improved regimes of industry self-regulation, such as the current South Korean self-regulation (48), may be nearly as effective as legal regulation but also, importantly, be more cost effective due to the known benefits of self-regulation (101), and therefore industry loot box self-regulation should not be ruled out as a potential solution; however, the present results evidence that existing self-regulations in Western countries are inadequate and need improvements. When given discretion as to how prominently and accessibly probability disclosures should be implemented, the vast majority of companies chose methods that are suboptimal: for example, by failing to disclose probabilities at multiple locations; by requiring players to perform complex series of actions before showing them the disclosures; and by disclosing probabilities using technical language and mathematical formulae (see Figure 10) that are difficult to understand. The video game industry, both companies and self-regulators (*e.g.*, software marketplaces and hardware providers), can do much better when it comes to making and requiring uniform, prominent and accessible loot box probability disclosures. To put it bluntly:

in relation to loot box probability disclosures, the video game industry, particularly in ‘self-regulated’ Western countries, needs to ‘git gud.’⁵

Data Availability Statement

The data presented in this paper is available via <<https://osf.io/cx5rv/>>.

Screenshots of in-game disclosures, and printouts and archived links to website disclosures are also available at this location.

Copyright Notice

The Authors acknowledge that the copyright of all screenshots of video games and websites used in this paper are retained by their respective copyright holders. The Authors use these copyrighted materials for the purposes of research, criticism or review under the fair dealing provisions of copyright law in accordance with Sections 29(1) and 30(1) of the UK Copyright, Designs and Patents Act 1988.

Conflict of Interest Statement

L.Y.X. was employed by LiveMe, 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. communicated with Playrix, the developer and publisher of sample games 9 (*Gardenscapes*), 10 (*Homescapes*), 18 (*Fishdom*), 65 (*Manor Matters*), and 75 (*Township*) in a legal capacity unrelated to the games’ monetisation, including the presence/absence of the implementation of loot boxes and probability disclosures in these games, during his internship at LiveMe, a subsidiary of Cheetah Mobile (NYSE:CMCM). L.L.H. declares no conflict of interest. P.W.S.N. is a member of the Advisory Board for Safer Gambling – an advisory group of the Gambling Commission in Great Britain, and was a special advisor to the House of Lords Select Committee Enquiry on the Social and Economic Impact of the Gambling Industry. In the last 3 years, P.W.S.N. has received research funding from Clean Up Gambling and has contributed to research projects funded by GambleAware, Gambling Research Australia, NSW Responsible Gambling Fund, and the Victorian Responsible Gambling Foundation. In 2019, P.W.S.N. received travel and

⁵ ‘Git gud’ is a popular intentional misspelling of the phrase ‘get good’ that is used by video gaming communities to heckle and encourage newer players to do better than they are currently doing (112).

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CRedit Authors' Contribution Statement

L.Y.X.: Conceptualisation; Data Curation; Formal Analysis; Investigation (lead); Methodology; Project Administration; Resources; Software; Validation (supporting); Visualization; Writing – Original Draft Preparation (lead); Writing – Review & Editing

L.L.H.: Conceptualisation; Investigation (supporting); Methodology; Validation (lead); Writing – Original Draft Preparation (supporting); Writing – Review & Editing

P.W.S.N.: Conceptualisation; Supervision; Writing – Original Draft Preparation (supporting); Writing – Review & Editing.

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